PC-HELPER

Digital to Analog Output Board for PCI
DAI16-4C(PCI)
User’s Guide

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Product Configuration List
- Board [DAI16-4C(PCI)] …1
- First step guide …1
- CD-ROM *1 [API-PAC(W32)]…1

*1 The CD-ROM contains the driver software and User’s Guide (this guide)
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1. Before Using the Product

About the Board

These boards are PCI bus-compliant interface boards that performs digital-to-analog conversion.
The DA16-4C(PCI) performs D-A conversion using 4 output channels at a conversion speed of 20 μsec [50KSPS] and a resolution of 16 bits.
Using the bundled driver library [API-PAC(W32)], 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++.

Features

Compatible with voltage and current output.
The board is compatible not only with voltage output (-10V - +10V and 0V - +10V) but also with current output (0mA - 20mA).

Installed with voltage output control relays.
All channel voltages are output via relays. These relays prevent unnecessary voltage output from occurring during power-up.

Installed with voltage output control relays.
All channel voltages are output via relays. These relays prevent unnecessary voltage output from occurring during power-up.

Optional units
Using optional units facilitates connections.
For more details on the option, please refer to this chapter “Cable & Connector” or “Accessories (Option)”.

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)/API-AIO(98/PC)**
[Stored on the bundled CD-ROM driver library API-PAC(W32)]

These drivers are 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 Vista, XP, Server 2003, 2000
Adaptation language  Visual Basic, Visual C++, Visual C#, Delphi, C++ Builder

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

Linux version of analog I/O driver  **API-AIO(LNX)**
[Stored on the bundled CD-ROM driver library API-PAC(W32)]

The API-AIO(LNX) is the Linux version driver software which provides device drivers (modules) by shared library and kernel version. Various sample programs of gcc are provided.

< Operating environment >
OS  RedHatLinux, TurboLinux
    (For details on supported distributions, refer to Help available after installation.)
Adaptation language  gcc

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

Data acquisition VI library for LabVIEW  **VI-DAQ** (Available for downloading (free of charge) from the CONTEC web site.)

This is a VI library to use in National Instruments LabVIEW.

VI-DAQ is created with a function form similar to that of LabVIEW's Data Acquisition VI, allowing you to use various devices without complicated settings.

See http://www.contec.com/vidaq/ for details and download of VI-DAQ.
Cable & Connector  (Option)

Flat Cable with 37-Pin D-SUB Connector at One End : PCA37P-1.5 (1.5m)
Shield Cable with 37-Pin D-SUB Connector at One End : PCA37PS-0.5P (0.5m)
: PCA37PS-1.5P (1.5m)

Flat Cable with 37-Pin D-SUB Connectors at either Ends : PCB37P-1.5 (1.5m)
Shielded Cable with 37-pin D-SUB connectors at either ends: PCB37PS-0.5P (0.5m)
: PCB37PS-1.5P (1.5m)

37-pin D-SUB (Male) Connector Set (5 Pieces) : CN5-D37M

Accessories  (Option)

General Purpose Terminal (M3 x 37P) : DTP-3A *1
Screw Terminal (M2.6 x 37P) : DTP-4A *1
Screw Terminal Unit (M3 x 37P) : EPD-37A *1 *2
Screw Terminal Unit (M3.5 x 37P) : EPD-37 *1

*1 PCB37P-* or PCB37PS-* optional cable is required separately.
*2 "Spring-up" type terminal is used to prevent terminal screws from falling off.

* Check the CONTEC’s Web site for more information on these options.
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 Three-Years Warranty

CONTEC products are warranted by CONTEC CO., LTD. to be free from defects in material and workmanship for up to three years 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.

| ⚠ DANGER | DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. |
| ⚠ WARNING | WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. |
| ⚠ CAUTION | CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage. |
1. Before Using the Product

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

- There are switches and jumpers on this product that need to be set in advance. Be sure to check these before installing to the expansion slot.
- Only set the switches and jumpers on this product to the specified settings. Otherwise, this product may malfunction, overheat, or cause a failure.
- Do not strike or bend this product. Otherwise, this product may malfunction, overheat, cause a failure or breakage.
- Do not touch this product's metal plated terminals (edge connector) with your hands. Otherwise, this product may malfunction, overheat, or cause a failure. If the terminals are touched by someone's hands, clean the terminals with industrial alcohol.
- Do not install this product to the expansion slot and do not plug or unplug the cables which are connected to this product while the PC or expansion unit is still turned on. Otherwise, this product may malfunction, overheat, or cause a failure. Be sure that the personal computer power is turned off.
- Make sure that your PC or expansion unit can supply ample power to all the product installed. Insufficiently energized products could malfunction, overheat, or cause a failure.
- The specifications of this product are subject to change without notice for enhancement and quality improvement. Even when using the product continuously, be sure to read the user’s guide and understand the contents.
- Do not modify the 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.
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 bus connector of the board and its cable have been plugged correctly.
- Check that the board has no dust or foreign matter adhering.
- The gold-plated leads of the bus connector have no stain or corrosion.

Storage

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

(1) Put the product in the storage bag.
(2) Wrap it in the packing material, 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 board.

What is Setup?

Setup means a series of steps to take before the product can be used.
Different steps are required for software and hardware.
The setup procedure varies with the OS and software used.

Using the Board under Windows

Using the Driver Library API-PAC(W32)

This section describes the setup procedure to be performed before you can start developing application programs for the board using the bundled CD-ROM “Driver Library API-PAC(W32)”.

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 Installing the Software
- Step 2 Setting the Hardware
- Step 3 Installing the Hardware
- Step 4 Initializing the Software
- Step 5 Checking Operations with the Diagnosis Program

If Setup fails to be performed normally, see the “Setup Troubleshooting” section at the end of this chapter.

Using the Board under Windows

Using Software Other than the Driver Library API-PAC(W32)

For setting up software other than API-PAC(W32), refer to the user’s guide for that software. See also the following parts of this user’s guide as required.

- This chapter Step 2 Setting the Hardware
- This chapter Step 3 Installing the Hardware
- Chapter 3 External Connection
- Chapter 6 About Hardware
Using the Board under an OS Other than Windows

For using the board under an OS other than Windows, see the following parts of this user’s guide.

- This chapter Step 2 Setting the Hardware
- Chapter 3 External Connection
- Chapter 6 About Hardware
2. Setup

Step 1 Installing the Software

This section describes how to install the Driver libraries.

**Before installing the hardware on your PC, install the Driver libraries from the bundled API-PAC(W32) CD-ROM.**

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.

**About the driver to be used**

Two Analog I/O drivers are available: API-AIO(WDM) and API-AIO(98/PC).

API-AIO(WDM) is a new driver to perform analog I/O under Windows.

API-AIO(WDM) was developed to improve the conventional product version of API-AIO(98/PC) in the ease of use and functionality.

It is advisable to use API-AIO(WDM) for you to use an analog I/O device. API-AIO(WDM) will support new OS and devices in the future but will not support Windows NT 4.0, Windows 95, ISA bus. Use API-AIO(98/PC) if your operating environment contains such an unsupported piece of software or hardware.

Check the following selection guide to easily select the driver to be used.

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<td></td>
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<tr>
<td>Windows XP/Windows 2000</td>
<td>Windows NT 4.0</td>
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<td>VC4, VC2, VB4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows Me/98</td>
<td>ISA Bus</td>
<td></td>
<td></td>
<td></td>
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```
Starting the Install Program

1. Load the CD-ROM [API-PAC(W32)] on your PC.
2. The API-PAC(W32) Installer window appears automatically. If the panel does not appear, run (CD-ROM drive letter):\AUTORUN.exe.
3. Click on the [Install Development or Execution Environment] button.

* When using the Windows Vista, driver is automatically installed.

⚠️ CAUTION

Before installing the software in Windows Vista, XP, Server 2003, 2000, log in as a user with administrator privileges.
When Using API-AIO(WDM)

Selecting API-AIO(WDM)

(1) The following dialog box appears to select “Driver to install” and “Install option”, “Usage of driver library”.

(2) Select the "Advanced Analog I/O driver".

(3) Click on the [Install] button.

* Clicking the [API-AIO] button under the “Detail” displays detailed information about API-AIO(WDM) and API-AIO(98/PC).

Run the installation

(1) Complete the installation by following the instructions on the screen.

(2) The Readme file appears when the installation is complete.
When Using API-AIO(98/PC)

Selecting API-AIO(98/PC)

1. The following dialog box appears to select “Driver to install” and “Install option”, “Usage of driver library”.
2. Select “Classic Analog I/O driver”.
3. Click on the [Install] button.

* Clicking the [API-AIO] button under the “Detail” displays detailed information about API-AIO(WDM) and API-AIO(98/PC).
Executing the Installation

(1) **Follow the on-screen instructions to proceed to install.**

(2) When the required files have been copied, the “Perform a hardware setup now(API-TOOL Configuration)” and “Show readme file” check boxes are displayed.

*When you are installing the software or hardware for the first time:*
1) Uncheck “Perform a hardware setup now”.
2) Click on the [Finish] button.
   Go to Step 2 to set and plug the hardware.

* When the hardware has already been installed:
  Check “Perform a hardware setup now(API-TOOL Configuration)”, then go to Step 4 “Initializing the Software”.

You have now finished installing the software.
Step 2 Setting the Hardware

This section describes how to set this product and plug it on your PC.

This product has some switches and jumpers to be preset.
Check the on-board switches and jumpers before plugging this product into an expansion slot.

This product can be set up even with the factory defaults untouched. You can change board settings later.

Parts of the Board and Factory Defaults

Figure 2.1. Part Names
Note that the switch setting shown below is the factory default.
Setting the Board ID

If you install two or more boards on one personal computer, assign a different ID value to each of the boards to distinguish them.

The board IDs can be set from 0 - Fh to identify up to sixteen boards.

If only one board is used, the original factory setting (Board ID = 0) should be used.

Setting Procedure

To set the board ID, use the rotary switch on the board. Turn the SW1 knob to set the board ID as shown below.

Figure 2.2. Board ID Settings (SW1)
Setting the Analog Output

Setting the Analog Output includes setting output ranges. Preset digital signals are converted to voltage and current in the output range dependent on resolution. A different output range can be set channel by channel.

### ch0 settings
- **Voltage output**: Bipolar -10V - +10V
- **JP1, JP2, JP3**: 1 3 1 3 1 3

### ch1 settings
- **Voltage output**: Bipolar -10V - +10V
- **JP1, JP2, JP3**: 1 3 1 3 1 3
- **Voltage output**: Unipolar 0V - +10V
- **JP1, JP2, JP3**: 1 3 1 3 1 3
- **Voltage output**: 0mA - 20mA
- **JP1, JP2, JP3**: 1 3 1 3 1 3

### ch2 settings
- **Voltage output**: Bipolar -10V - +10V
- **JP1, JP2, JP3**: 1 3 1 3 1 3
- **Voltage output**: Unipolar 0V - +10V
- **JP1, JP2, JP3**: 1 3 1 3 1 3
- **Voltage output**: 0mA - 20mA
- **JP1, JP2, JP3**: 1 3 1 3 1 3

### ch3 settings
- **Voltage output**: Bipolar -10V - +10V
- **JP1, JP2, JP3**: 1 3 1 3 1 3
- **Voltage output**: Unipolar 0V - +10V
- **JP1, JP2, JP3**: 1 3 1 3 1 3
- **Voltage output**: 0mA - 20mA
- **JP1, JP2, JP3**: 1 3 1 3 1 3

---

Figure 2.3. Analog Output Settings

⚠️ CAUTION

Only set the jumpers on the board to the specified settings. Otherwise, the board may cause a failure.
Plugging the Board

(1) Before plugging the board, shut down the system, unplug the power code of your PC.
(2) Remove the cover from the PC so that the board can be mounted.
(3) Plug the board into an expansion slot.
(4) Attach the board bracket to the PC with a screw.
(5) Put the cover back into place.

Applicable PCI bus slots

PCI bus slots used in PCs have keys to prevent 5V and 3.3V PCI bus boards from being accidentally plugged into wrong bus slots. This board can be plugged into both of the 5V and 3.3V PCI bus slots.

⚠️ CAUTION
- Do not touch the board's metal plated terminals (edge connector) with your hands. Otherwise, the board may malfunction, overheat, or cause a failure.
  If the terminals are touched by someone's hands, clean the terminals with industrial alcohol.
- Do not install or remove the board to or from the slot while the computer's power is turned on. Otherwise, the board may malfunction, overheat, or cause a failure.
  Be sure that the personal computer power is turned off.
- Make sure that your PC or expansion unit can supply ample power to all the boards installed. Insufficiently energized boards could malfunction, overheat, or cause a failure.
- Power supply from the PCI bus slot at +5V is required.
2. Setup

Step 3 Installing the Hardware

Windows needs to detect the I/O address and interrupt used by the board. This is called hardware installation.

When using more than one board, install the boards one at a time and do not install the next board until setup is complete for the previous board.

Turning on the PC

Turn on the power to your PC.

⚠️ CAUTION
- The board cannot be properly installed unless the resources (I/O addresses and interrupt level) for the board can be allocated. Before attempting to install the board, first determine what PC resources are free to use.
- The resources used by each board do not depend on the location of the PCI bus slot or the board itself. If you remove two or more boards that have already been installed and then remount one of them on the computer, it is unknown which one of the sets of resources previously assigned to the two boards is assigned to the remounted board. In this case, you must check the resource settings.

When Using API-AIO(WDM)

(1) The “Found New Hardware Wizard” will be started.
Select “Install from a list or specific location[Advanced]”, then click on the [Next] button.

![Found New Hardware Wizard](image)
(2) Specify that folder on the CD-ROM which contains the setup information (INF) file to register the board.

Source folder

The setup information (INF) file is contained in the following folder on the bundled CD-ROM.

\INF\WDM\AIO

You have now finished installing the hardware.
When Using API-AIO(98/PC)

(1) The “Found New Hardware Wizard” will be started. Select “Install from a list or specific location[Advanced]”, then click on the [Next] button. **If you are using Windows NT 4.0, the “Found New Hardware Wizard” is not started. Go to Step 4 “Initializing the Software”**.

![Found New Hardware Wizard](image)
(2) Specify that folder on the CD-ROM which contains the setup information (INF) file to register the board.

Source folder

The setup information (INF) file is contained in the following folder on the bundled CD-ROM.

- **Windows Vista**   
  \INF\WinVista\Aio\PCI

- **Windows XP, Server 2003, 2000**   
  \INF\Win2000\Aio\PCI

- **Windows Me, 98, 95**   
  \INF\Win95\Aio\PCI

**Example of specifying the folder for use under Windows XP**

- `\INF\Win2000\Aio\PCI`
CAUTION

In Windows XP, the Hardware Wizard displays the following alert dialog box when you have located the INF file. This dialog box appears, only indicating that the relevant driver has not passed Windows Logo testing, and it can be ignored without developing any problem with the operation of the board.

In this case, click on the [Continue Anyway] button.

You have now finished installing the hardware.
Step 4 Initializing the Software

The driver library requires the initial setting to recognize the execution environment. It is called the initialization of the driver library.

When Using API-AIO(WDM)

Setting the device name

1. Run Device Manager. From [My Computer] - [Control Panel], select [System] and then select the [Device Manager] tab. (You can also open Device Manager by right clicking on My Computer and selecting Properties.)

2. The installed hardware appears under the CONTEC Devices node. Open the CONTEC Devices node and select the device you want to setup (the device name should appear highlighted). Click [Properties].

* The name of the board you have just added is displayed. - DAI16-4C(PCI)
(3) The property page for the device opens. Enter the device name in the common settings tab page and then click [OK]. The device name you set here is used later when programming.

* The initial device name that appears is a default value. You can use this default name if you wish.
* Make sure that you do not use the same name for more than one device.

You have now finished installing the initial setting of Software.
2. Setup

When Using API-AIO(98/PC)

Invoking API-TOOL Configuration

(1) Open the Start Menu, then select “Programs” – “CONTEC API-PAC(W32)” – “API-TOOL Configuration”.

(2) API-TOOL Configuration detects boards automatically. The detected boards are listed.

Updating the Settings

(1) Select “Save setting to registry…” from the “File” menu.

You have now finished installing the initial setting of Software.
**Step 5 Checking Operations with the Diagnosis Program**

Use the diagnosis program to check that the board 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 board 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 board, I/O status, and interrupt status.

**Check Method**

To check analog I/O data, connect the signal. The diagrams below show examples of using channel 0 on the DAI16-4C(PCI). For details on the connections, see Chapter 3 “External Connection”. Check the board with the factory defaults untouched.

**Wiring Diagram**

- **Voltage output**
  - Board
    - Voltage output CH0 (CN1)1pin
    - Analog ground (CN1)20pin
    - e.g. Tester

- **Current output**
  - Board
    - Current output CH0+ (CN1)2pin
    - Analog ground (CN1)20pin
    - Load register 250Ω
    - e.g. Tester

The value of load resister RL is an example. The load connected to the current output must be within 500Ω including the wiring resistance.

**Figure 2.4. Wiring Diagram**

⚠️ **CAUTION**

Change the setting of the output range with the jumper when you confirm the current output. Please refer to "Analog Output Setup" on this chapter for details.
Using the Diagnosis Program for Use of API-AIO(WDM)

Starting the Diagnosis Program

Click the [Diagnosis] button on the device property page to start the diagnosis program.

* The name of the board you have just added is displayed.
  - DAI16-4C(PCI)
Analog output

You can select the desired output channel, output range from the lists.

You can also select the type of output data from among DC (constant voltage), SIN (sine wave), and Rect (rectangular wave).
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.

* The name of the board you have just added is displayed.
  - DAI16-4C(PCI)

* The contents of the diagnosis report is different due to the added board.
2. Setup

(2) The diagnosis report contains the following data.

- Version of OS
- Device Information
- File Information
- Diagnosis results for each I/O 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 5.

Using the Diagnosis Program for Use of API-AIO(98/PC)

Starting the Diagnosis Program

After selecting the board in [API-TOOL Configuration], run the diagnosis program. Follow the on-screen instructions.

* The name of the board you have just added is displayed.
  - DAI16-4C(PCI)
Checking the Analog Output

Analog output
You can select the output channel and output range from the lists.
2. Setup

Diagnosis Report

(1) Clicking on the [Report] button displays detailed data such as a board, channel settings and the diagnosis results while saving them in text format.

The results are saved and displayed as a text file (AioRep.txt) in the install folder (CONTEC/CONTECW95).

The Diagnosis Program performs “board presence/absence check”, “interrupt test”, “driver file test”, “board setting test”, and so on.

(2) A diagnosis report is displayed as shown below.
2. Setup

Setup Troubleshooting

Symptoms and Actions

The board cannot be initialized. [Windows NT 4.0]

The driver may not yet be activated. When your PC is running under Windows NT 4.0, set the PnP OS option in the BIOS Setup menu to “NO”.

For details on BIOS settings, refer to the user’s guide for your PC.

The board cannot output data normally
- Run the Diagnosis Program to check whether the board has been registered correctly and whether any initialization error has occurred.
- Check the settings and connections of the board. Also check the output ranges.

The board works with the Diagnosis Program but not with an application.

The Diagnosis Program is coded with API-TOOL functions. As long as the board operates with the Diagnosis Program, it is to operate with other applications as well. In such cases, review your program while paying attention to the following points:
- Check the return values of functions.
- Check the Driver No. and Board No.

The OS won't normally get started or detect the board.
[Windows Vista, XP, Server 2003, 2000]

Turn off the power to your PC, then unplug the board. Restart the OS and delete the board settings of API-TOOL Configuration. Turn off the PC again, plug the board, and restart the OS. Let the OS detect the board and use API-TOOL Configuration to register board settings.

If your problem cannot be resolved

Contact your retailer.
3. **External Connection**

This chapter describes the interface connectors on the product and the external I/O circuits. 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) shown below.

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

**Figure 3.1. Interface Connectors and Mating Connectors**

**Figure 3.2. Examples of Connecting Options**
## Connector Pin Assignment

Pin Assignments of Interface Connector (CN1)

<table>
<thead>
<tr>
<th>CN1 Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Plus Common</td>
</tr>
<tr>
<td>18</td>
<td>External Trigger Input</td>
</tr>
<tr>
<td>17</td>
<td>External Sampling Clock Input</td>
</tr>
<tr>
<td>16</td>
<td>N.C.</td>
</tr>
<tr>
<td>15</td>
<td>N.C.</td>
</tr>
<tr>
<td>14</td>
<td>Current Output 3</td>
</tr>
<tr>
<td>13</td>
<td>Voltage Output 3</td>
</tr>
<tr>
<td>12</td>
<td>N.C.</td>
</tr>
<tr>
<td>11</td>
<td>N.C.</td>
</tr>
<tr>
<td>10</td>
<td>Current Output 2</td>
</tr>
<tr>
<td>9</td>
<td>Voltage Output 2</td>
</tr>
<tr>
<td>8</td>
<td>N.C.</td>
</tr>
<tr>
<td>7</td>
<td>N.C.</td>
</tr>
<tr>
<td>6</td>
<td>Current Output 1</td>
</tr>
<tr>
<td>5</td>
<td>Voltage Output 1</td>
</tr>
<tr>
<td>4</td>
<td>N.C.</td>
</tr>
<tr>
<td>3</td>
<td>N.C.</td>
</tr>
<tr>
<td>2</td>
<td>Current Output 0</td>
</tr>
<tr>
<td>1</td>
<td>Voltage Output 0</td>
</tr>
</tbody>
</table>

**Figure 3.3. Pin Assignment of CN1**

⚠️ **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.
Connecting the Analog Output Signal

The sections below describe how to connect the signals using flat cable and shielded cable.

Connecting Example of Voltage Output

The following figure shows an example of optional flat cable (PCA37P) connection.

Connect the CN1 analog output channels and ground to the external device's input and ground.

**Figure 3.4. Connecting the Voltage Output (Flat Cable)**

The following example connects a signal source to this product using a shielded cable. Use shielded cable if the distance between this product and loading is long or if you want to provide better protection from noise. Use the core of the shielded cable to connect the analog output of CN1 to the input of the external device and use the shield braid to connect the CN1's analog ground to the external device's ground.

**Figure 3.5. Connecting the Voltage Output (Shield Cable)**

⚠️ CAUTION
- If this product and the target receive noise or the distance between this product and the signal source is too long, data may not be input properly.
- The maximum output current-carrying capacity of the analog output signal is ±5 mA. Check the specifications of the target before connecting this product to it.
- Do not connect any of the outputs and power outputs to the analog or digital ground.
- Do not connect the analog output signal to the other analog output signal and output signal of external device. Doing so may malfunction.
- Do not plug or unplug the interface connector to or from while the PC or external device power is turned on. Doing so may malfunction.
- The DA converter may cause glitches as it contains no deglitcher.
3. External Connection

**Connection Example of Current Output**

The figure below shows an example connection using a flat cable as the optional one (PCA37P).

The load register is connected. Please adjust the register load $R_L$ connected with the current output of each channel to 500Ω or less including the resistance of wiring.

Each current output of CN1 and analog ground is connected to the register load $R_L$.

![Figure 3.6. Connecting the Current Output (Flat cable)](image)

**Figure 3.6. Connecting the Current Output (Flat cable)**

The following figure shows an example of shielded cable connection. Use shielded cable if the distance between the loading and this product is long or if you want to provide better protection from noise. Connect the each current output of CN1 to the register load in the core wire of shielded cable and connect the each analog ground of CN1 to the register load in the shielding of shielded cable.

![Figure 3.7. Connecting the Current Output (Shielded cable)](image)

**Figure 3.7. Connecting the Current Output (Shielded cable)**

⚠️ **CAUTION**

- When the power supply is turned on, output (0mA) of data 0000h is output as for the output signal.
- Do not short circuit any of the output signals to analog ground. Doing either can cause a malfunction.
- Do not connect the output signal to that of other channel and of external device. Doing either can cause a malfunction.
- Do not detach the interface connector (CN1) with the power supply of a PC or an external device turned on. Doing either can cause a malfunction.
- If the connection cable is affected by noise, it may fail to output the accurate current data. Route the connection cable as far apart from noise sources as possible.
Connecting the Control Signal

Connecting the Input Signal

To the “External Sampling Clock Input” and “External Trigger Input”, connect current driven devices such as a switch and a transistor output device. Input circuit is as follows. An external power supply is required to drive the input circuit. The power capacity required at this time is about 11 mA per input channel at 24 VDC (or about 5.5 mA at 12 VDC).

![Input circuit diagram](image)

**Figure 3.8. Input circuit**
3. External Connection

Figure 3.9. Connection Example to Open Collector Output (Current Sink Type)

Figure 3.10. Connection Example to Mechanical Contact

The relation of the data (internal logic) seen from the input signal and the PC side as an example of the above figure is shown below.

Table 3.1. Relation between the input signal and the data (internal logic) seen from the PC side

<table>
<thead>
<tr>
<th>Internal logic</th>
<th>Contact point</th>
<th>Input pin voltage level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>OFF</td>
<td>High</td>
</tr>
<tr>
<td>1</td>
<td>ON</td>
<td>Low</td>
</tr>
</tbody>
</table>

Reference

For the operation timings for control signal input, see “Timing of External Control Signals” in Chapter 6 “Hardware”. 
Connecting the Output Signal

To the “Timer Output” and “Settling Busy Output”, connect a relay controller or a current driven control device such as a LED. Output circuit is as follows. An external power supply is required to drive the output circuit. The rated output current is up to 50 mA per channel. The output transistor is not associated with a surge voltage protection circuit. When the output signal is used to drive the inductive load to a relay or lamp, apply surge protection to the load side.

Figure 3.11. Output circuit

⚠️ CAUTION
When the power supply is turned on, all the outputs are turned off.
3. External Connection

**Figure 3.12. Connection example with current sink corresponding input**

**Figure 3.13. Connection Example to TTL level Input (with Pull-up Resistor)**
Surge Voltage Countermeasures

When connecting a load that generates surge voltages and inrush currents, such as an induction load (relay coil) or an incandescent light bulb, to the control output signals, appropriate protection must be provided in order to prevent damage to the output stage or a malfunction due to noise. The rapid shutoff of a coil, such as a relay, generates a sudden high-voltage pulse. If this voltage exceeds the voltage tolerance level of the output transistor, it can cause the transistor to gradually deteriorate, or even completely damage the transistor. Therefore, when driving an induction load, such as a relay coil, you should always connect a surge-absorbing device. The following illustrates a surge voltage countermeasure that can be employed:

- Examples of use of relay coil

![Diagram of relay coil surge voltage countermeasure]

- Examples of use of lump

![Diagram of lump surge current prevention resistor]

Figure 3.14. Surge Voltage Countermeasure

⚠️ CAUTION

In order for a protection circuit to operate effectively, it must be connected within 50cm of a load and a contact point.
3. External Connection
4. 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).

Analog Output Function

Analog output processes are classified as follows:
- Simple Analog Output
- High-functional analog output

Simple Analog Output

When an analog output start command is executed by software, output data is set for one or more channels, DA conversion is performed, and then the analog output operation is terminated.

* The analog output is finalized after the settling time after conversion is started. The conversion speed is determined by the settling time per channel.*
Simple analog output assumes the following conditions and settings.

**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 to analog value more precisely.

A device with a resolution of 12bit divides the range width into 4096 segments.

When the device covers the range of 0 to 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.

![Low-resolution board](image1)

![High-resolution board](image2)

DAI16-4C(PCI): The resolution is 16bit.

**Range**

“Range” means the range of voltages (current) at which analog output can be performed. The output range can be selected by setting the output signal type (voltage and current) and the upper and lower output signals.

DAI16-4C(PCI): Range is set by the jumper setting.
Output data

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

\[
\text{Output data} = \frac{(\text{voltage} - \text{Min. range value}) \times \text{Resolution}}{(\text{Max. range value} - \text{Min. range value})}
\]

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 ±10-V range.

<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 3V is output at a resolution of 12bit in the ±10-V range

\[
\text{Output data} = \frac{(3 - (-10)) \times 4096}{(10 - (-10))}
\]

\[= 2662.4 \ast\]

\* The value that can be set as output data at this time is an integer. Select "2662" or "2663" as the output data.

The analog signal corresponding to the output data contains an error as follows:
- Output data "2662" converted to: 2.9980 V
- Output data "2663" converted to: 3.0029 V

This error is a consequential error occurring when output data is obtained from an expected analog value.

Channel

"Channel" represents each point of analog output.

For individual channel numbers, see “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.

\* The above conditions and settings are also required for "high-functional analog output" described on the next page.
High-functional analog output

When an analog output start command is executed by software, DA conversion is performed in synchronization with the sampling clock from when the sampling start condition is met to when the sampling stop condition is met.

The analog output operation stops when the sampling stop condition is met.

Sampling is defined as a series of operations performed from when the sampling start condition is met to when the sampling stop condition is met.

The number of times DA conversion is executed during sampling is counted as a sampling count. The sampling count can be used as the sampling stop condition (as described later).

The following settings are required for high-functional analog output:

Sampling clock

The internal or external sampling clock can be selected as the sampling clock that determines the DA conversion period. The sampling clock is selected by means of software.

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

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

Memory

Output data can be stored in driver's memory in advance so that DA conversion can be executed repeatedly. You can select the memory type between FIFO and RING depending on the application of analog output. The memory type is selected with 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]

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]

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.

**Sampling Start Condition**

The condition for controlling the start of sampling can be selected from both software and an external trigger. The conditions for controlling the start and stop of sampling are completely independent of each other; they can be set separately.

- **Software**
  
  The analog output start command executed by software is set as the sampling start condition.

  This product starts sampling upon execution of the analog output start command.

- **External trigger**

  This product starts waiting for an external control signal as soon as the analog output start command is output. Sampling starts when the external control signal (falling edge) is input.

**Sampling Stop Condition**

The condition for controlling the stop of sampling can be selected from both the last setting count, and an external trigger. This product stops sampling whenever an error occurs irrespective of the stop condition setting.

- **Last setting count**

  When the memory type is FIFO, this product stops sampling the moment the sample count reaches the specified value.

  For RING memory, specify the sampling count equivalent to one period of an arbitrary waveform.

- **External trigger**

  This product starts waiting for an external control signal after the sampling have been started. Sampling stops when the external control signal (falling edge) is input.
**4. Functions**

**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.

**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.

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

- "Sampling stop condition satisfied" event
  This event occurs whenever the sampling stop condition is met if the number of repetitions has been set.

- "End of device operation" event
  This event occurs when the analog output operation is terminated.

- "Specified number of output samples complete" event
  This event occurs when DA conversion is executed for the specified number of times. When the memory type is FIFO, the event occurs only once during sampling. When the memory type is RING, the event occurs as many times as the number of repetitions.

- 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 the analog output operation stops upon detection of a device malfunction by the driver.

**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).
4. Functions

**Monitoring the Status**

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:

- **Analog output operating**
  This status remains ON, after this product performs the analog output start command until the analog output operation is stopped.

- **Waiting for start trigger**
  This status remains ON, after this product performs the analog output start command until the sampling start condition is satisfied, if the sampling start condition is an external trigger. The status is set to OFF when the external trigger is input to start sampling.
  This status is set to ON whenever this product enters the conversion start wait status even when repeated operation has been set.

- **Specified number of data items already output**

- **Sampling clock error**
  This error occurs when the analog output operation stops as the sampling clock cycle is too short.

- **DA conversion error**
  This status is turned on when the analog output operation stops upon detection of a device malfunction by the driver.

**Sampling count**

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

**Repeat**

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

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

**All reset**
This command resets the entire device, thereby initializing the device.

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

**Memory**
This command resets the following memory related states.
- Resets the conversion data in memory.
- Resets the output sampling count.
- Resets the repeat count to 0.
- Resets the status information for the specified data save count.
5. About Software

CD-ROM Directory Structure

\|
| Autorun.exe Installer Main Window
| Readmej.html Version information on each driver (Japanese)
| Readmeu.html Version information on each driver (English)

|——APIPAC Each installer
| |——AIO
| | |——DISK1
| | |——DISK2
| | |——……
| | |——DISKN
| |——AioWdm
| |——CNT
| |——DIO
| |——……

|——HELP HELP file
| |——Aio
| |——Cnt
| |——……

|——INF Each INF file for OS
| |——WDM
| | |——WinVista
| | |——Win2000
| | |——Win95

|——linux Linux driver file
| |——cnt
| |——dio
| |——……

|——Readme Readme file for each driver

|——Release Driver file on each API-TOOL
| |——API_NT (For creation of a user-specific install program)
| |——API_W95

|——UsersGuide Hardware User's Guide(PDF files)
About Software for Windows

The bundled CD-ROM “Driver library API-PAC(W32)” contains the functions that provide the following features:

- Analog input or output through arbitrary channels
- Analog input at arbitrary intervals using the internal or external sampling clock
- Simultaneous monitoring of the termination of analog input sampling, buffer memory usage, and interrupt events such as occurrences of errors
- Driver option check using a demo driver even without the board installed

For details, refer to the help file. The help file provides various items of information such as “Function Reference”, “Sample Programs” and “Q&A”. Use them for program development and troubleshooting.
When using the API-AIO(WDM)

Accessing the Help File

1. Click on the [Start] button on the Windows taskbar.
2. From the Start Menu, select “Programs” – “CONTEC API-PAC(W32)” – “AIOWDM” – “API-AIO(WDM) HELP” to display help information.
Using Sample Programs

Sample programs are provided for each of the basic operations. You can use these to check the operation of the board and as a reference when writing your own programs.

To use the sample programs, specify the device name in the property page for the program.

The sample programs are stored in \Program Files\CONTEC\API-PAC(W32)\AIOWDM\Samples.

Running a Sample Program

1. Click on the [Start] button on the Windows taskbar.
2. From the Start Menu, select “Programs” – “CONTEC API-PAC(W32)” – “AIOWDM” – “SAMPLE…”.
3. A sample program is invoked.
Sample Programs - Examples

Analog input
- SingleAi  Perform single analog input from specified channel
- MultiAi  Perform single analog input from multiple channels
- Ai  Perform standard analog input using a FIFO buffer
- AiPoll  Perform standard analog input by polling
- AiEx  Perform analog input for multiple channels using a FIFO buffer
- AiLong  Perform long-duration analog input using a FIFO buffer
- AiExt  Perform analog input using an external clock
- AiTrg  Perform analog input using an external trigger to start and stop operation
- AiLevel1  Use a level trigger to start analog input
- AiLevel2  Use a level trigger to stop analog input
- Ai2  Perform standard analog input using more than one board

Analog output
- SingleAo  Perform single analog output from specified channel
- MultiAo  Perform single analog output from multiple channels
- Ao  Perform standard analog output using a FIFO buffer
- AoPoll  Perform standard analog output by polling
- AoEx  Perform analog output for multiple channels using a FIFO buffer
- AoLong  Perform long-duration analog output using a FIFO buffer
- AoExt  Perform analog output using an external clock
- AoRing  Perform continuous analog output using a ring buffer
- AoTrg  Perform analog output using an external trigger to start and stop operation
- Ao2  Perform standard analog output using more than one board

Digital input/output
- DioBit  Perform digital I/O using bit values
- DioByte  Perform digital I/O using port values

* Sample programs executable vary with the functions of boards in use.
When using the API-AIO(98/PC)

Accessing the Help File

1. Click on the [Start] button on the Windows taskbar.
Using Sample Programs

Sample programs have been prepared for specific basic applications. To use each sample program, enter its device name set by API-TOOL Configuration. Use these sample programs as references for program development and operation check. The sample programs are stored in Program Files\CONTEC\API-PAC(W32)\Aio\Samples.

Running a Sample Program

1. Click on the [Start] button on the Windows taskbar.
2. From the Start Menu, select “Programs” – “CONTEC API-PAC(W32)” – “Aio” – “SAMPLE…”.
3. A sample program is invoked.
Sample Programs - Examples

Analog input
- **AI** : Uses AioInp to convert an analog signal only once and display the data.
- **AIBack** : Uses AioInpBack to perform memory-less board analog input.
- **AIMemory** : Uses AioInpBdMem to perform continuous conversion and AioReadBuf to acquire data from board memory (an example of using an external clock).
- **AIIInt** : Infinite sampling example that uses AioInpBdMem for half/full interrupts and AioReadBuf to acquire data at interrupt events.
- **AITimer** : Infinite sampling example that uses AioInpBdMem to perform continuous conversion and AioReadBuf to acquire data at system timer events.
- **AISync** : Sample that uses AioInpBdMem and AioDO to perform simultaneous sampling of two memory-mounted boards.
- **AioInp** : Sample console application that uses AioOpenEx and AioInp.

Analog output
- **AO** : Uses AioOut to perform analog output once.
- **AOBack** : Uses AioOutBack to perform analog output at fixed intervals.
- **AioOut** : Sample console application that uses AioOpenEx and AioOut.

Digital input and output
- **DIO** : Uses AioDO and AioDI to perform digital input/output.

Counter
- **Timer** : Sample program using a timer. It uses the counter function to measure the lapse of time.
- **Counter** : Sample program using a counter. It uses the counter function to count external pulses.

The following sample program in Visual Basic is available.

* Sample programs executable vary with the functions of boards in use.
Using the Utility Program

Operation Check Tool

This program is a comprehensive operation check tool that can use all the features of the AioOpen, AioClose, AioSetRangeAioInp, AioInpBack, AioInpBdMem, AioOut, AioOutBack, AioDo, and AioDi functions.

Invoke the tool by selecting the Start Menu – “CONTEC API-PAC(W32)” – “AIO” – “SAMPLE Analog”.

[Main screen]

AioInp : Simple analog input
AioInpBack : Analog input for non Memory-Board
AioInpBdMem: Analog input for Memory-Board
AioOut : Simple analog output
AioOutBack : Analog output in background
AioDi/AioDo : Digital input and output

[Analog input]
5. About Software

[Analog output]

[Digital input and output]
Uninstalling the Driver Libraries

The method used to uninstall API-PAC(W32) differs depending on which OS you are using. Follow the procedure given below.

Uninstall procedure for Windows Vista

< Uninstalling the device driver >

1. Run Device Manager. From [My Computer] - [Control Panel], select [System] and then select the [Device Manager] tab.
   (You can also open Device Manager by right clicking on My Computer and selecting Properties.)

2. All of the hardware that uses the API-TOOL(WDM) driver is registered under the CONTEC Devices tree.
   Open the device tree, select the hardware to uninstall, and then right-click the hardware.
   From the popup menu, select [Uninstall].

3. A dialog box opens asking you to confirm whether to uninstall. Select the [Delete the driver software for this device] checkbox, and then click [OK].
5. About Software

< Uninstall the development environment >
Use [My Computer] - [Control Panel] - [Add and Remove Programs] to uninstall the development environment.
Select [CONTEC API-***(WDM) VerX.XX (development environment)] and then click [Uninstall].
* "***" contains the driver category name (AIO, CNT, DIO, SMC, etc.).

Uninstall procedure for Windows XP and Windows 2003 Server

< Uninstall the device driver >
Use [My Computer] - [Control Panel] - [Add and Remove Programs] to uninstall the device driver.
Select [Windows driver package - CONTEC (****)] and then click [Change/Remove].
* "****" contains the driver category name (caio, ccnt, cdio, csmc, etc.).

< Uninstall the development environment >
Use [My Computer] - [Control Panel] - [Add and Remove Programs] to uninstall the development environment.
Select [CONTEC API-***(WDM) VerX.XX (development environment)] and then click [Change/Remove].
* "***" contains the driver category name (AIO, CNT, DIO, SMC, etc.).
Uninstall procedure for Windows Me

< Uninstalling the device driver >
Use [My Computer] - [Control Panel] - [Add or Remove Programs] to uninstall the device driver.
Select [CONTEC API-***(WDM) driver] and then click [Change/Remove].
* "***" contains the driver category name (caio, ccnt, cdio, csme, etc.).

< Uninstall the development environment >
Use [My Computer] - [Control Panel] - [Add or Remove Programs] to uninstall the development environment.
Select [CONTEC API-***(WDM) VerX.XX (development environment)] and then click [Change/Remove].
* "***" contains the driver category name (AIO, CNT, DIO, SMC, etc.).

Uninstall procedure for Windows 98, 98SecondEdition

< Uninstalling the device driver >
Use [My Computer] - [Control Panel] - [Add or Remove Programs] to uninstall the device driver.
Select [CONTEC API-***(WDM) driver] and then click [Change/Remove].
* "***" contains the driver category name (caio, ccnt, cdio, csme, etc.).

< Uninstall the development environment >
Use [My Computer] - [Control Panel] - [Add or Remove Programs] to uninstall the development environment.
Select [CONTEC API-***(WDM) VerX.XX (development environment)] and then click [Change/Remove].
* "***" contains the driver category name (AIO, CNT, DIO, SMC, etc.).
About Software for Linux

The Linux version of analog I/O function driver, API-AIO(LNX), provides functions that execute the following features:
- The analog input/output of a specified channel can be done.
- It is possible to operate as a set parameter to the analog input/output board is preserved by the default value, and the setting of the parameter doesn't exist.

For details, refer to the help file. The help file provides various items of information such as “Function Reference”, “Sample Programs”, and “FAQs”. Use them for program development and troubleshooting.

Driver Software Install Procedure

The Linux version for digital I/O driver, API-AIO(LNX), is supplied as a compressed file /linux/aio/caioXXX.tgz on the bundled API-PAC(W32)CD-ROM. (Note: XXX represents the driver version.)

Mount the CD-ROM as shown below, copy the file to an arbitrary directory, and decompress the file to install the driver.

For details on using the driver, refer to readme.txt and the help file in HTML format extracted by installation.

To install the driver, log in as a superuser.

Decompression and setup procedure

```
# cd
# mount /dev/cdrom /mnt/cdrom Mount the CD-ROM.
# cp /mnt/cdrom/linux/aio/caioXXX.tgz ./ Copy the compressed file.
# tar xvfz caioXXX.tgz Decompress the compressed file.

# cd contec/caio
# make Compile the file.

# make install Install.

# cd config
# ./config Set up the board to be used.

# ./contec_aio_start.sh Start the driver.
# cd
```
Accessing the Help File

(1) Invoke a web browser in your X-Window environment.
(2) In the browser, open diohelp.htm in the contec/caio/help directory.

Using Sample Programs

Sample programs have been prepared for specific basic applications.
Sample programs for each language are contained in the contec/caio/samples directory. For compiling them, refer to the manual for the desired language.

Uninstalling the driver

To uninstall the driver, use the uninstall shell script contained in the contec/caio directory. For details, check the contents of the script.
5. About Software
6. About Hardware

This chapter provides hardware specifications and hardware-related supplementary information.

For detailed technical information

For further detailed technical information ("Technical Reference" including the information such as an I/O map, configuration register, etc.), visit the Contec's web site (http://www.contec.com/support/) to call for it.
# Hardware specification

## Table 6.1. Common specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analog Output</strong></td>
<td></td>
</tr>
<tr>
<td>Isolated specification</td>
<td>Isolated independently</td>
</tr>
<tr>
<td>Number of output channels</td>
<td>4 channel</td>
</tr>
<tr>
<td>Output range</td>
<td>Bipolar ±10V, Unipolar 0 · +10V, 0 · 20mA (Jumper setting by channel)</td>
</tr>
<tr>
<td>Absolute max. output current</td>
<td>±5mA (Voltage output) ±10V, 0 · +10V</td>
</tr>
<tr>
<td>Load resistance (Max.)</td>
<td>500Ω (Current output)</td>
</tr>
<tr>
<td>Output impedance</td>
<td>10Ω or less (Voltage output)</td>
</tr>
<tr>
<td>Resolution</td>
<td>16bit</td>
</tr>
<tr>
<td>Non-Linearity error *1</td>
<td>±5LSB(±10V, 0 · +10V), ±15LSB(0 · 20mA)</td>
</tr>
<tr>
<td>Conversion speed</td>
<td>20μsec [50KSPS] (Max.)</td>
</tr>
<tr>
<td>Voltage output control relay</td>
<td>AQY221N28X (Matsushita Electric Works, Ltd.) or equivalence to it</td>
</tr>
<tr>
<td>Sampling clock</td>
<td>Internal sampling clock : 20,000 · 1,073,741,824,000nsec (Can be set in 250n sec units)</td>
</tr>
<tr>
<td>External sampling clock : Optocoupler isolated input (corresponding to current sink output)</td>
<td></td>
</tr>
<tr>
<td><strong>Programmable timer</strong></td>
<td></td>
</tr>
<tr>
<td>Setting frequency</td>
<td>500 · 1,073,741,824,000nsec (Can be set in 250n sec units)</td>
</tr>
<tr>
<td>Timer output signal</td>
<td>Optocoupler isolated open collector output (current sink type)</td>
</tr>
<tr>
<td><strong>External trigger input</strong></td>
<td></td>
</tr>
<tr>
<td>External trigger input signal</td>
<td>Optocoupler isolated input (corresponding to sink output)</td>
</tr>
<tr>
<td>Status</td>
<td>Trigger input, trigger input overrun</td>
</tr>
<tr>
<td>I/O address</td>
<td>32 ports boundary</td>
</tr>
<tr>
<td>Interrupt level</td>
<td>1 level use</td>
</tr>
<tr>
<td>Operating condition</td>
<td>0 · 50°C, 10 · 90%RH (No condensation)</td>
</tr>
<tr>
<td>Power consumption</td>
<td>+5VDC 2200mA (Max.)</td>
</tr>
<tr>
<td><strong>Bus specification</strong></td>
<td>32bit, 33MHz, Universal key shapes supported *2 *3</td>
</tr>
<tr>
<td>Connector</td>
<td>37pin D-SUB connector[F(female)type]</td>
</tr>
<tr>
<td>DCLC-J37SAF-20L9 [mfd.by JAE] or equivalence to it</td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>160g</td>
</tr>
</tbody>
</table>

---

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

*2 This product requires +5V power supply from the expansion slot (it does not work in a +3.3V environment).

*3 DAI16-4C(PCI): If the board No. is 7168B, PCI bus specification is 32bit, 33MHz, 5V.
Board dimension

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

**Block Diagram**

Figure 6.1 is a circuit block diagram of this product.

---

Figure 6.1. Block Diagram
Timing for Control Signal

Timing for External Sampling Clock and External Trigger Input Signal

Figures 6.2 and Table 6.2 shows the timing for external sampling clock and external trigger input signal.

![Figure 6.2. Timing for External Sampling Clock and External Trigger Input Signal](image)

<table>
<thead>
<tr>
<th>Table 6.2. Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
</tr>
<tr>
<td>Input circuit OFF→ Setup time of ON</td>
</tr>
<tr>
<td>Input circuit OFF→ Hold time of ON</td>
</tr>
</tbody>
</table>

Timing for External Trigger Input and Input Status

Figures 6.3 and Table 6.3 shows the timing for external trigger input and input status.

![Figure 6.3. Timing for External Trigger Input and Input Status](image)

<table>
<thead>
<tr>
<th>Table 6.3. Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
</tr>
<tr>
<td>Delay time</td>
</tr>
</tbody>
</table>
Timing for External Sampling Clock Input Signal and “Settling Busy Output”

Figures 6.4 and Table 6.4 shows the timing for external sampling clock input signal and “Settling Busy Output”.

![Diagram of timing for external sampling clock input signal and settling busy output]

Figure 6.4. Timing for External Sampling Clock Input Signal and “Settling Busy Output”

<table>
<thead>
<tr>
<th>Table 6.4. Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
</tr>
<tr>
<td>Input delay time</td>
</tr>
<tr>
<td>Settling time</td>
</tr>
<tr>
<td>Output delay time</td>
</tr>
</tbody>
</table>

Timing for Timer Output

Figures 6.5 and Table 6.5 shows the timing for timer output.

![Diagram of timing for timer output]

Figure 6.5. Timing for “Timer Output”

<table>
<thead>
<tr>
<th>Table 6.5. Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
</tr>
<tr>
<td>Pulse width when Count up occurs</td>
</tr>
<tr>
<td>Output delay time 1</td>
</tr>
<tr>
<td>Output delay time 2</td>
</tr>
<tr>
<td>Output pulse width</td>
</tr>
</tbody>
</table>

* External power supply : 24V, Loading : 25°C when connecting the 510Ω
About Calibration

This product is calibrated before shipment.

Contact your retailer if the board does not provide its prescribed performance.