

PC-HELPER

High-Resolution Analog Input Board for PCI

ADI16-4L(PCI)

User's Guide

CONTEC CO.,LTD.

Check Your Package

Thank you for purchasing the CONTEC product.

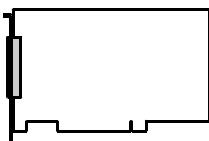
The product consists of the items listed below.

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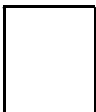
Product Configuration List

- Board[ADI16-4L(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)



Board



First step guide



CD-ROM
[API-PAC(W32)]

Copyright

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1. Before Using the Product

About the Board

ADI16-4L(PCI) are PCI-compliant interface boards that convert analog input signals to digital equivalents (performing analog-to-digital conversion).

The ADI16-4L(PCI) is that performs A-D conversion at a conversion speed of 10 millisecond per channel and a resolution of 16-bit.

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

Capable of low level Voltage Measurement

The board can low level voltages in the input ranges of $\pm 1.25V$, $\pm 0.125V$, $0 - +2.5V$, and of $0 - 0.25V$ at a resolution of 16-bit. The board is provided with a discontinuity detection circuit for thermocouple input in the range of $\pm 0.125V$ or of $0 - +0.25V$.

Inter-channel Insulation

The input channel for each channel is insulated by an opto-coupler, allowing different ground-level signals to be input to individual channels.

On-board Temperature Sensor

The board has a board temperature sensor that can be used for cold junction reference during thermocouple measurement.

Sampling Control Function

The board can perform sampling at any software-controlled timings or periodical sampling in synchronization with a sampling clock. The board offers a choice of sampling clocks selectable to determine the sampling speed: the internal sampling clock using the on-board clock generator and the external sampling clock using the digital signal input from an external device.

Optional Units

Using optional units facilitates connections.

For these options, see the "Cables & Connectors" and "Accessories" section of this chapter.

Support Software

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

Driver Library **API-PAC(W32)** (Bundled)

API-PAC(W32) is the library software that provides the commands for CONTEC hardware products in the form of Windows standard Win32 API functions (DLL). It makes it easy to create high-speed application software taking advantage of the CONTEC hardware using various programming languages that support Win32 API functions, such as Visual Basic and Visual C++.

It can also be used by the installed diagnosis program to check hardware operations.

CONTEC provides download services (at <http://www.contec.com/apipac/>) to supply the updated drivers and differential files.

For details, read Help on the bundled CD-ROM or visit the CONTEC's Web site.

< Operating environment >

| | |
|---------------------|---|
| OS | Windows XP, Server 2003, 2000, Me, 98, etc.. |
| Adaptation language | Visual C++ .NET, Visual C# .NET, Visual Basic .NET, Visual C++, Visual Basic, Delphi, C++Builder, etc.. |

Linux version of analog I/O driver **API-AIO(LNX)** (Supplied: Stored on the API-PAC(W32) CD-ROM)

This driver is used to control CONTEC analog I/O boards (cards) from within Linux.

You can control CONTEC I/O boards easily using the shared library called from the user application, the device driver (module) for kernel version, and the board (card) configuration program (config).

CONTEC provides download services (at <http://www.contec.com/apipac/>) to supply the updated drivers and differential files.

For details, read Help on the bundled CD-ROM or visit the CONTEC's Web site.

< Operating environment >

| | |
|---------------------|---|
| OS | RedHatLinux, TurboLinux, etc.. (For details on supported distributions, refer to Help available after installation.) |
| Adaptation language | gcc, etc.. |

Data 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 One 37-pin D-Type Connector : PCA37P-1.5 (1.5m)
- Shielded Cable with One 37-pin D-Type Connector : PCA37PS-0.5P (0.5m)
: PCA37PS-1.5P (1.5m)
- Shielded Cable with Two 37-pin D-Type Connectors : PCB37PS-0.5P (0.5m)
: PCB37PS-1.5P (1.5m)
- D-SUB37P Male Connector Set (5pieces) : CN5-D37M

Accessories (Option)

- Termination Panel (M3) : DTP-3(PC)
- Termination Panel : DTP-4(PC)
- Screw Terminal : EPD-37A*1
- Screw Terminal : EPD-37 *1

*1 A PCB37PS -*P optional cable is required separately. (0.5m is recommended.)

* 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-Year Warranty

CONTEC Interface boards 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 boards. 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. |

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 on the board that need to be set in advance. Be sure to check these before installing the board.
 - Only set the switches and jumpers on the board to the specified settings. Otherwise, the board may malfunction, overheat, or cause a failure.
 - Do not strike or bend the board. Doing so could damage the board. Otherwise, the board may malfunction, overheat, cause a failure or breakage.
 - 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. Doing so could cause trouble. Be sure that the personal computer or the I/O expansion unit 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.
 - 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 manual 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 board may overheat, malfunction, or cause a failure.

Operating temperature

0 - 50°C

Operating humidity

10 - 90%RH (No condensation)

Corrosive gases

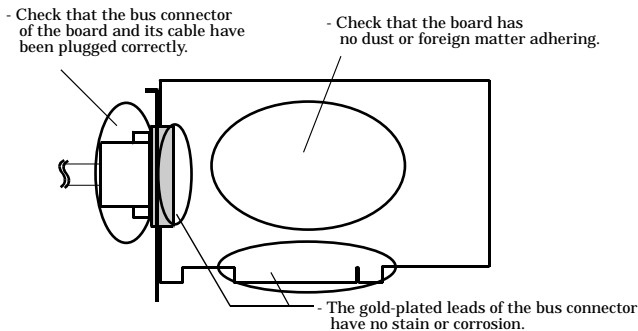
None

Floating dust particles

Not to be excessive

Inspection

Inspect the product periodically as follows to use it safely.



Storage

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

- (1) Put the board 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.

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 applications 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 Window

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

For setting up software other than API-PAC(W32), refer to the manual for that software. See also the following parts of this manual 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 manual.

This chapter Step 2 Setting the Hardware

Chapter 3 External Connection

Chapter 6 About Hardware

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)W95/NT.

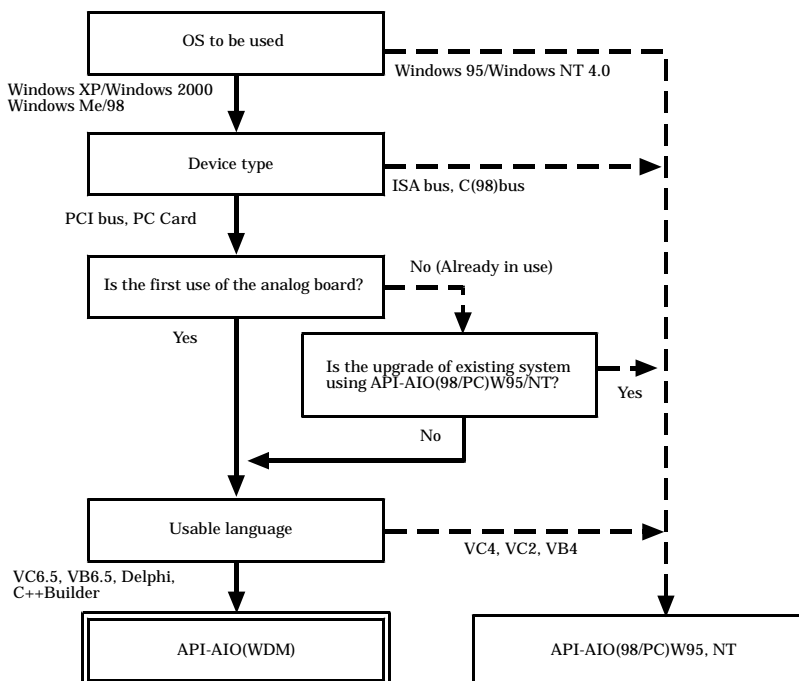
API-AIO(WDM) is a new driver to perform analog input/output under Windows.

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 OSs and devices in the future but will not support Windows NT 4.0, Windows 95, ISA bus.

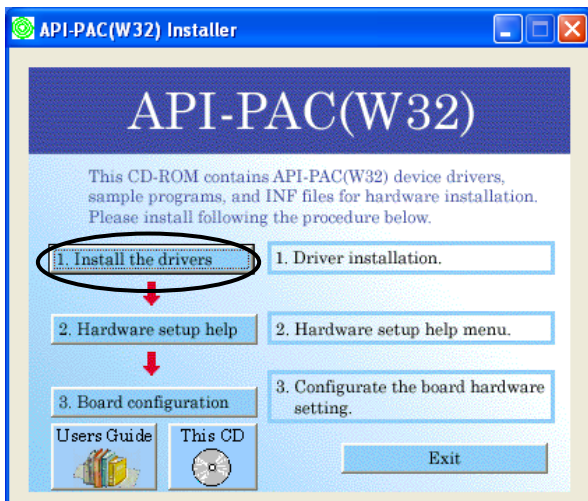
Use API-AIO(98/PC) if your operating environment contains such an unsupported piece of software or hardware.

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



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 the drivers] button.



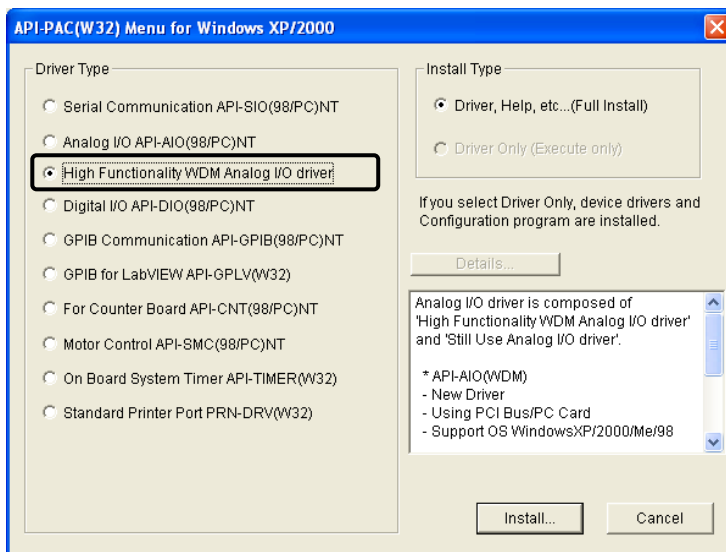
CAUTION

Before installing the software in Windows XP, or 2000, log in as a user with administrator privileges.

Select API-AIO(WDM)

Selecting API-AIO(WDM)

- (1) The following dialog box appears to select “Driver Type” and “Install Type”.
- (2) Select the "High Functionality WDM Analog I/O driver".
- (3) Click on the [Install] button.



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

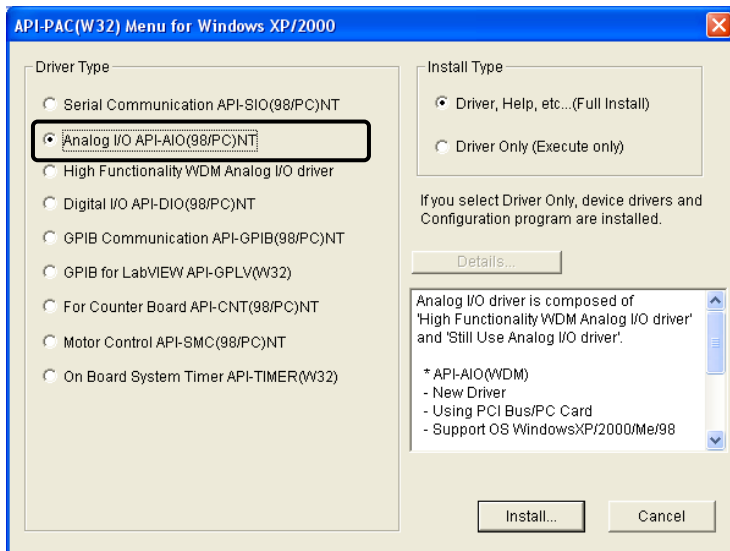
Run the installation

- (1) Complete the installation by following the instructions on the screen.
- (2) The Readme file appears when the installation is complete.

Select API-AIO(98/PC)

Selecting API-AIO(98/PC)

- (1) The following dialog box appears to select “Driver Type” and “Install Type”.
- (2) Select “Analog I/O API-AIO(98/PC)W95”.
- (3) Select “Driver, Help, etc..(Full Install)”.
- (4) Click on the [Install] button.



- * Clicking on the [Details ...] button displays detailed information on API-AIO(WDM), 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:

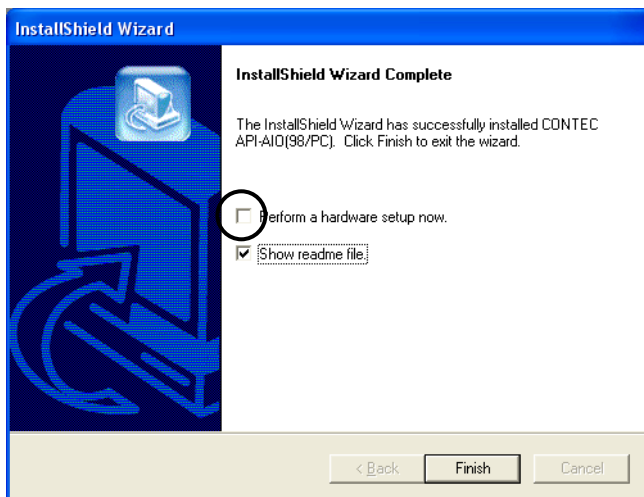
1) Uncheck “Perform a hardware setup now”.

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 the board and plug it on your PC.

The board has some switches and jumpers to be preset.

Check the on-board switches and jumpers before plugging the board into an expansion slot.

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

Parts of the Board and Factory Defaults

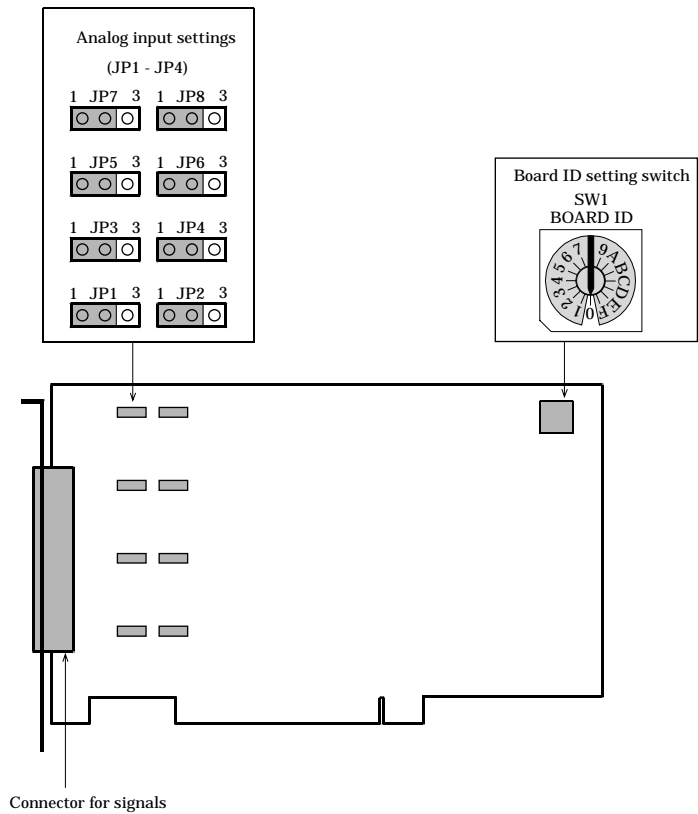


Figure 2.1. Part Names

Note that the switch and jumper 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.

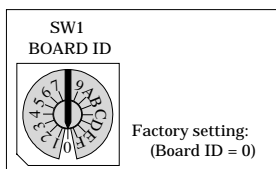


Figure 2.2. Board ID Settings (SW1)

Setting the Analog Input

This board allows an input range to be selected for each channel. The input ranges can be set with on-board jumpers.

Set JP1 - JP8 on the board as shown below. All of the jumpers are factory-set to the range of -1.25 - $+1.25$ V.

Bipolar -1.25 V - $+1.25$ V

| | | |
|-----|-----|-----|
| ch0 | JP1 | JP2 |
| ch1 | JP3 | JP4 |
| ch2 | JP5 | JP6 |
| ch3 | JP7 | JP8 |

Unipolar 0V - $+2.5$ V

| | | |
|-----|-----|-----|
| ch0 | JP1 | JP2 |
| ch1 | JP3 | JP4 |
| ch2 | JP5 | JP6 |
| ch3 | JP7 | JP8 |

Bipolar -0.125 V - $+0.125$ V

| | | |
|-----|-----|-----|
| ch0 | JP1 | JP2 |
| ch1 | JP3 | JP4 |
| ch2 | JP5 | JP6 |
| ch3 | JP7 | JP8 |

Unipolar 0V - $+0.25$ V

| | | |
|-----|-----|-----|
| ch0 | JP1 | JP2 |
| ch1 | JP3 | JP4 |
| ch2 | JP5 | JP6 |
| ch3 | JP7 | JP8 |

Figure 2.3. Setting the Input Range

Plugging the Board

- (1) Before plugging the board, shut down the system, unplug the power cord 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) Put the cover back into place.



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.
Doing so could cause trouble. Be sure that the personal computer or the I/O expansion unit 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.
-

Step 3 Installing the Hardware

For using an expansion board under Windows, you have to let the OS detect the I/O addresses and IRQ to be used by the board. The process is referred to as installing the hardware.

In the case of using two or more boards, make sure you install one by one with the Add New Hardware Wizard.

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 that 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.



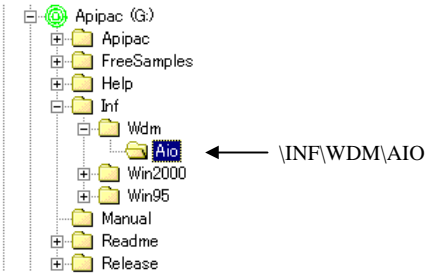
- (2) Specify that folder on the CD-ROM which contains the setup information (INF) file to register the board.



Source folder

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

\INF\WDM\AIO



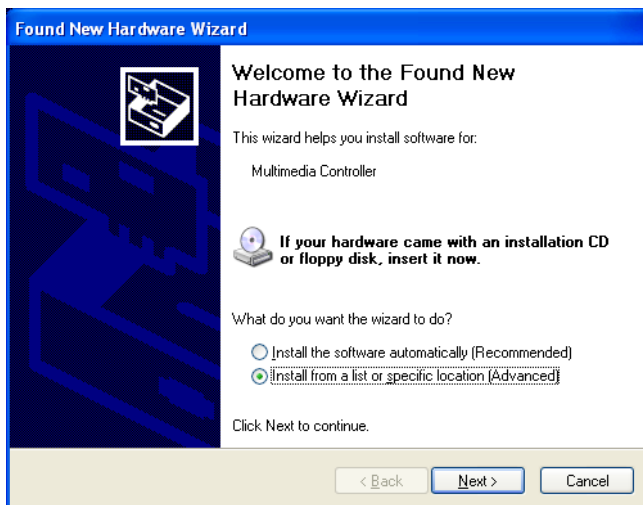
You have now finished installing the hardware.

When Using API-AIO(98/PC)

- (1) The “Add New Hardware Wizard” will be started.

Select “Specify the location of the driver (Advanced)”, then click on the [Next] button.

If you are using Windows NT 4.0, the “Add New Hardware Wizard” is not started. Go to Step 4 “Initializing the Software”.



- (2) Specify that folder on the CD-ROM which contains the setup information (INF) file to register the board.

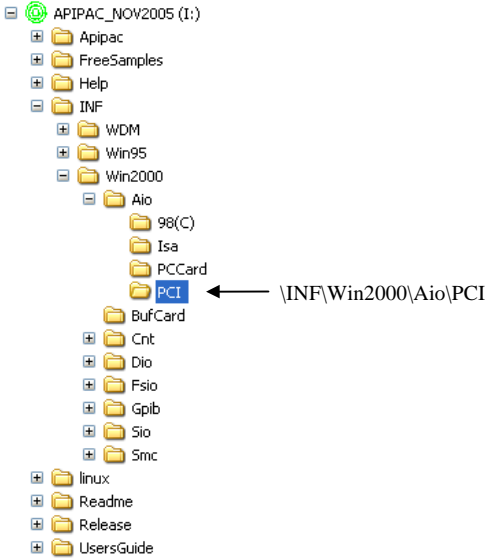


Source folder

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

| | |
|--------------------|----------------------|
| Windows XP, 2000 | \INF\Win2000\Aio\PCI |
| Windows Me, 98, 95 | \INF\Win95\Aio\PCI |

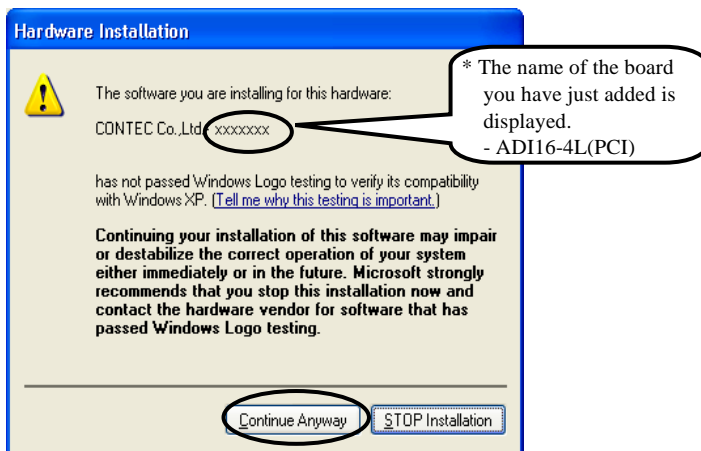
Example of specifying the folder for use under Windows XP



⚠ 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

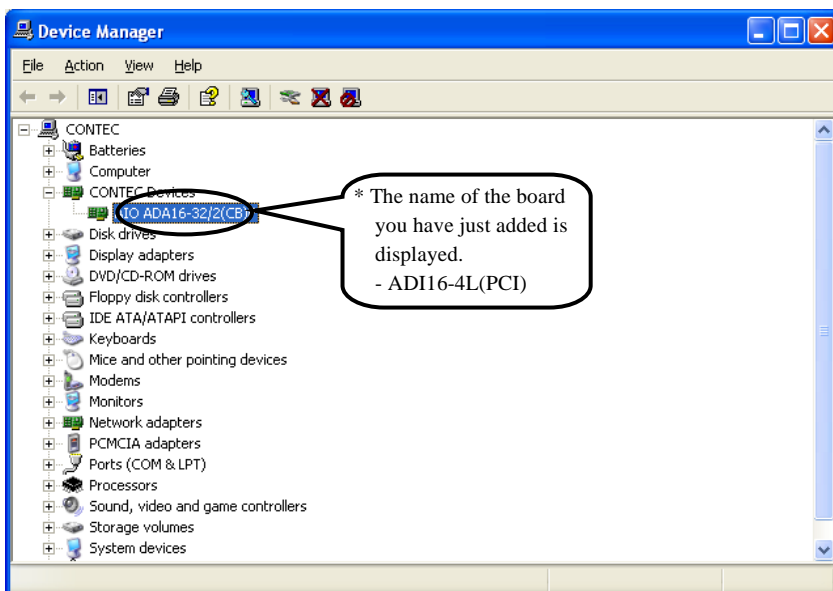
The driver library requires the initial setting to recognize the execution environment. It is called the initialization of the driver library.

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.)

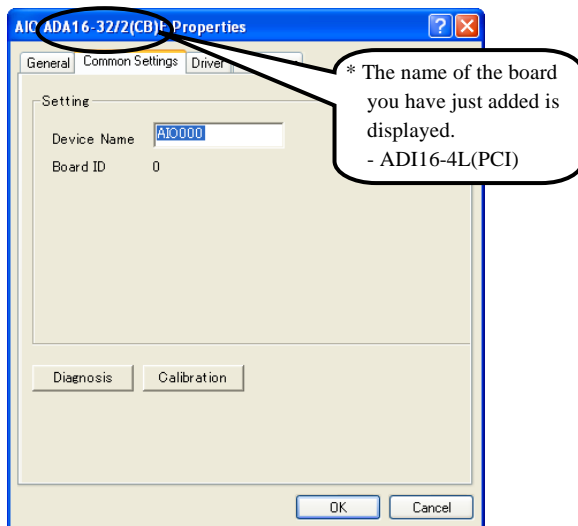


- (2) The installed hardware appears under the CONTEC Devices node. Open the CONTEC Devices node and select the device you want to setup (the device name should appear highlighted). Click [Properties].

(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.



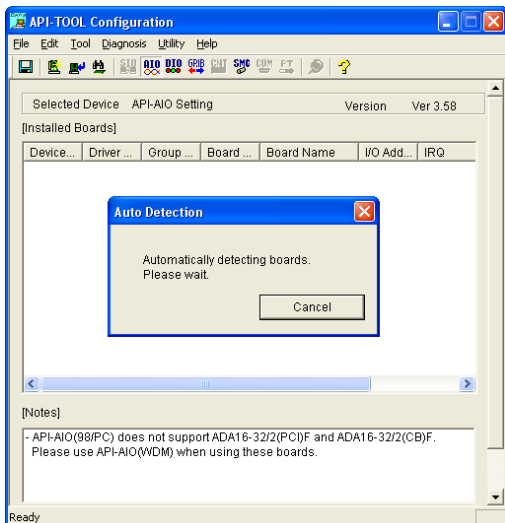
- * The initial device name that appears is a default value. You can use this default name if you wish.
- * Make sure that you do not use the same name for more than one device.

You have now finished installing the initial setting of Software.

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. For details on the connections, see Chapter 3 “External Connection”.

Check the board with the factor defaults untouched.

Wiring Diagram

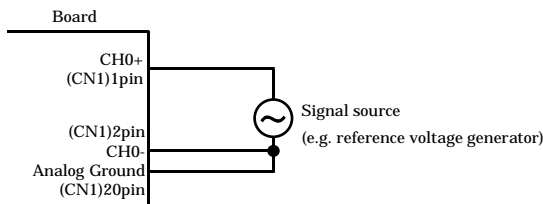


Figure 2.4. Wiring Diagram



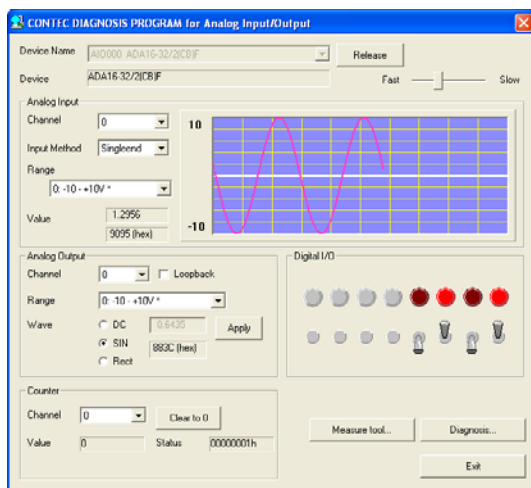
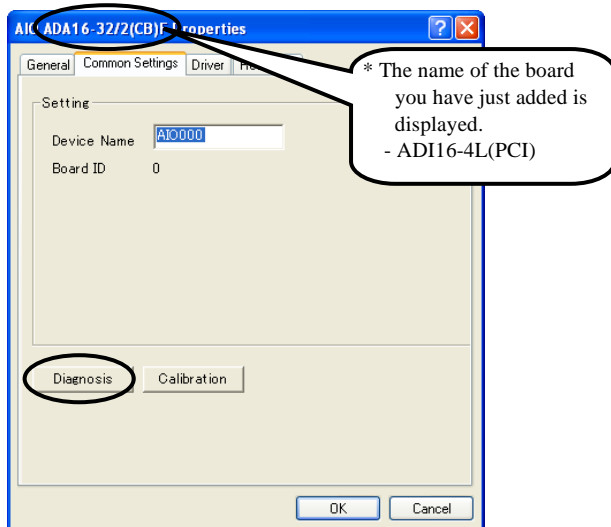
CAUTION

- When connecting a signal source, make sure that its output voltage falls within the input range.
- 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 Analog Signal Connection”.

Using the Diagnosis Program

Starting the Diagnosis Program

Select the board in the API-TOOL Configuration windows, then run the Diagnosis Program.



Analog input

You can select the desired input channel, input mode and input range from the lists.

Input data is plotted on a graph.

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.

```

CAIoRep.txt - Notepad
File Edit Format View Help
-----
CONTEC Analog I/O diagnostic report
-----
** CAIoDiag.exe program **
Date:2004/05/06 07:08:09
OS :Microsoft Windows XP 5.1.2600 Service Pack 1

[device information]
Device Name AIO000
Device      ADA16-32/2(CB)

[File Information]
G:\WINDOWS\SYSTEM32\CAIO.DLL      1, 3, 0, 0 2003/10/31 01:30
G:\WINDOWS\SYSTEM32\CMESSENG.COX 1, 0, 0, 1 2001/10/26 01:15
G:\WINDOWS\SYSTEM32\CAIODEL.EXE   1, 1, 3, 0 2003/05/29 01:13
G:\WINDOWS\SYSTEM32\CAIOPP32.DLL  1, 1, 2, 0 2003/08/27 01:12
G:\WINDOWS\SYSTEM32\DRIVERS\CAIO.SYS 1, 1, 2, 0 2003/10/31 01:30
G:\WINDOWS\SYSTEM32\CAIODIAG.EXE  1, 1, 4, 0 2003/10/31 01:14

[diagnosis]
Initial result [0] Normality completion
Interrupt [0] Normality completion

Analog input 32CH
Input method:Singleend
CH00 [0] Normality completion DATA: 3.74(AFE4hex) RANGE:-10 - +10V
CH01 [0] Normality completion DATA: 0.16(8200hex) RANGE:-10 - +10V
CH02 [0] Normality completion DATA: -0.70(7701hex) RANGE:-10 - +10V
CH03 [0] Normality completion DATA: -0.53(793Dhex) RANGE:-10 - +10V
CH04 [0] Normality completion DATA: -0.93(7416hex) RANGE:-10 - +10V
CH05 [0] Normality completion DATA: -0.75(7659hex) RANGE:-10 - +10V
CH06 [0] Normality completion DATA: -0.63(77FChex) RANGE:-10 - +10V
CH07 [0] Normality completion DATA: -0.28(7C6Dhex) RANGE:-10 - +10V
CH08 [0] Normality completion DATA: -0.86(7506hex) RANGE:-10 - +10V
CH09 [0] Normality completion DATA: -0.77(7623hex) RANGE:-10 - +10V
CH10 [0] Normality completion DATA: -0.43(7A84hex) RANGE:-10 - +10V
CH11 [0] Normality completion DATA: -0.21(7050hex) RANGE:-10 - +10V
CH12 [0] Normality completion DATA: -0.38(7B32hex) RANGE:-10 - +10V
CH13 [0] Normality completion DATA: -0.16(7DF6hex) RANGE:-10 - +10V
CH14 [0] Normality completion DATA: -0.12(7E77hex) RANGE:-10 - +10V
CH15 [0] Normality completion DATA: -0.34(7BA1hex) RANGE:-10 - +10V
CH16 [0] Normality completion DATA: -0.54(7914hex) RANGE:-10 - +10V
CH17 [0] Normality completion DATA: -0.44(7A52hex) RANGE:-10 - +10V
CH18 [0] Normality completion DATA: -0.52(794Chex) RANGE:-10 - +10V
CH19 [0] Normality completion DATA: -0.41(7ACAhex) RANGE:-10 - +10V
CH20 [0] Normality completion DATA: -0.68(7747hex) RANGE:-10 - +10V
CH21 [0] Normality completion DATA: -0.39(7AF6hex) RANGE:-10 - +10V
  
```

- (2) The diagnosis report contains the following data.

- Version of OS
- Device Information
- File Information
- Diagnosis results for each input channel

Execution time measurement

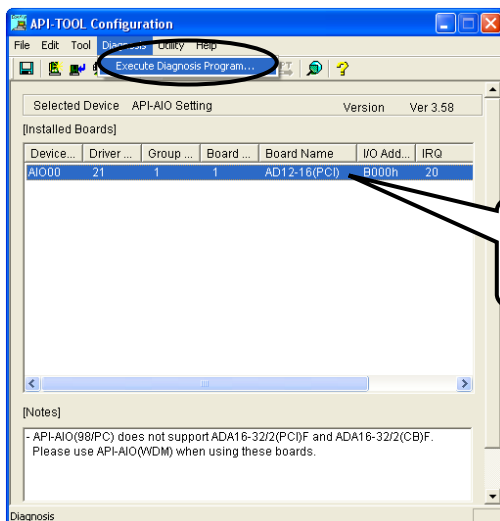
Clicking [Execution Time Measurement] runs the program to measure API function execution speed.

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)

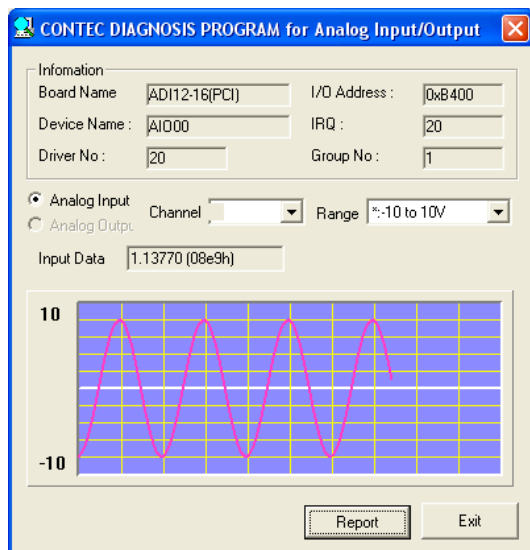
Starting the Diagnosis Program

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.
- ADI16-4L(PCI)

Checking the Analog Input



Analog input

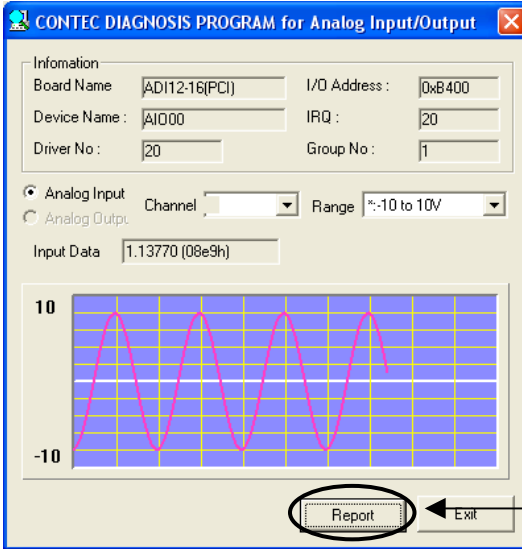
You can select the input channel and input range from the lists.
Input data is plotted on a graph.

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.

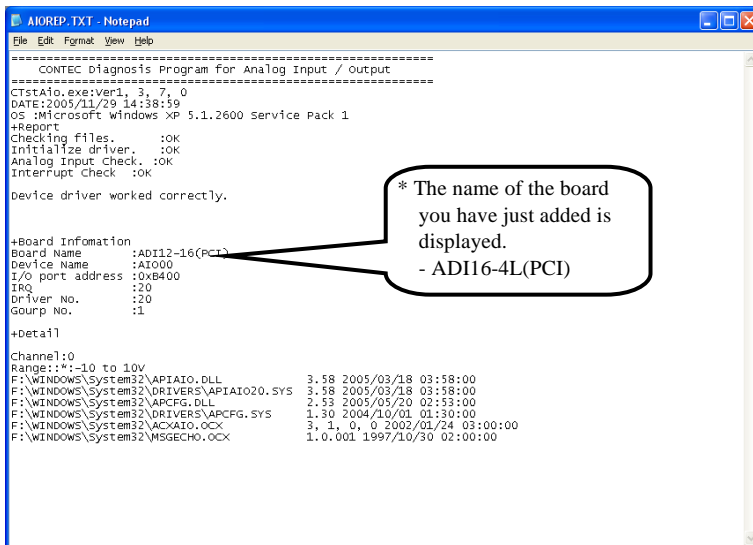
The results are saved and displayed as a text file (AioRep.txt) in the install folder (CONTEC/CONTECW95).

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



Click on [Report].

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



```

=====
CONTEC diagnosis Program for Analog Input / output
=====
CTstAI0.exe: Ver1. 3. 7. 0
DATE:2005/11/29 14:38:59
OS :Microsoft windows XP 5.1.2600 Service Pack 1
+Report
Checking files.      :OK
Initialize driver.   :OK
Analog input check.  :OK
Interrupt Check      :OK

Device driver worked correctly.

+Board Information
Board Name      :ADI16-4L(PCI)
Device Name     :AI000
I/O port address :0xB400
IRQ             :20
Driver No.      :20
Group No.       :1

+Detail
Channel:0
Range: *-10 to 10V
F:\WINDOWS\System32\APIAIO.DLL      3.58 2005/03/18 03:58:00
F:\WINDOWS\System32\DRIVERS\APIAIO20.SYS 3.58 2005/03/18 03:58:00
F:\WINDOWS\System32\APCFG.DLL       2.53 2005/05/20 02:53:00
F:\WINDOWS\System32\DRIVERS\APCFG.SYS 1.30 2004/10/01 01:30:00
F:\WINDOWS\System32\ACXAI0.OCX      3. 1. 0. 0 2002/01/24 03:00:00
F:\WINDOWS\System32\MSGEOCHO.OCX    1.0.001 1997/10/30 02:00:00
  
```

* The name of the board you have just added is displayed.
- ADI16-4L(PCI)

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 input or 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 input and output ranges. When your board uses jumpers to set the input/output ranges, correct data cannot be obtained unless the ranges have been adjusted. When no connection has been made, input data remains indeterminate. The channel to be used must be wired. The channels not to be used must be connected to the analog ground.
- If there is no appropriate signal source available at voltage input, either connect a cell or connect the channel to the analog ground to check for 0V.

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 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

Refer to the troubleshooting section of API-AIO HELP. If there is no answer in it, please contact your retailer.

3. External Connection

This chapter describes the interface connectors on the board and the external I/O circuits.
Check the information available here when connecting an external device.

Using the On-board Connectors

Connecting a Device to a Connector

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

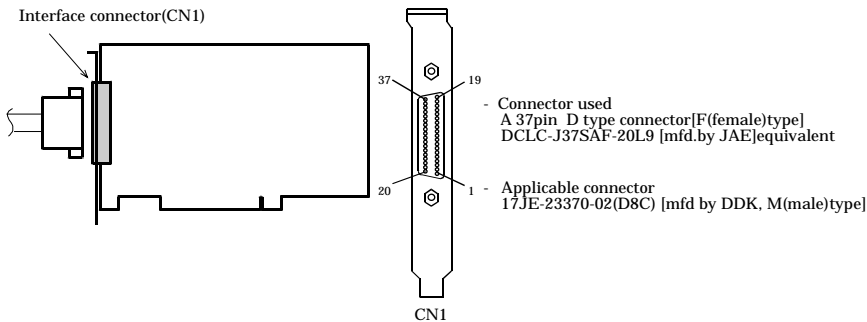


Figure 3.1. Interface Connectors and Mating Connectors

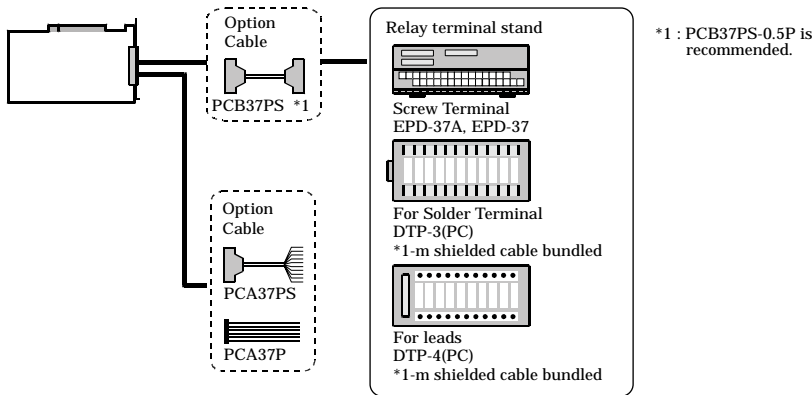
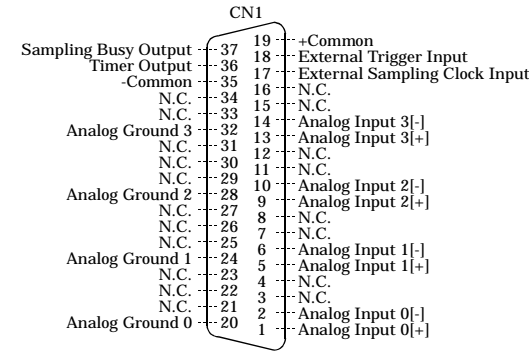


Figure 3.2. Examples of Connecting Options

Connector Pin Assignment

Pin Assignment of CN1



| | |
|-------------------------------|--|
| Analog Input 0 | Analog Input signal. |
| - Analog Input 3 | The numbers correspond to channel numbers. |
| Analog Input 0[-] | Analog Input signal. |
| - Analog Input 3[-] | The numbers correspond to channel numbers. |
| Analog Input 0 | Analog grounds corresponding to the identically numbered analog input signals |
| - Analog Input 3 | |
| External Trigger Input | External trigger Input signal. |
| External Sampling Clock Input | External sampling clock Input signal. |
| Time Out | Programmable timer output signal |
| Sampling Busy Output | Output signal indicating that the board is performing AD conversion |
| +Common | Connect the positive side of the external power supply to this pin. It is common to the "External Trigger Input", "External Sampling Clock Input", "Timer Out", and "Sampling Busy Out" signals. |
| +Common | Connect the negative side of the power supply to this pin. It is common to the "Timer Out" and "Sampling Busy Output" signals. |
| N.C. | No connection to this pin |

Figure 3.3. Pin Assignment of CN1

Analog Signal Connection

The following figure shows an example of flat cable connection. Connect the [+] input of each analog input channel in CN1 to the signal source and connect the [-] input to the ground of the signal source. In addition, connect the analog ground of the same channel to the ground of the signal source.

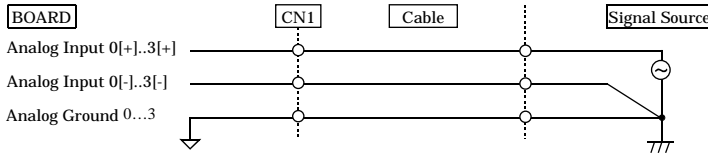


Figure 3.4. Single-ended Input Connection (Flat Cable)

The following sketch shows an example of connection using a two-conductor shielded cable. A shielded cable should be used when the signal source is rather away from the board or when the connection requires better noise immunity. Connect the [+] input of each analog input channel in CN1 to the signal source and connect the [-] input to the ground of the signal source. In addition, connect the analog ground of the same channel to the ground of the signal source using a shield braid.

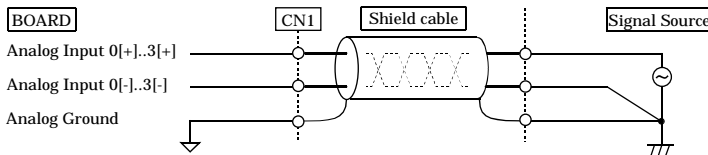


Figure 3.5. Single-ended Input Connection (Shield Cable)



CAUTION

- Input data remains indeterminate with the analog ground unconnected.
- The analog signals input to the [+] and [-] inputs must not exceed the maximum input voltage with respect to the corresponding analog ground. Otherwise, the board may break.
- Input data remains indeterminate with either the [+] or [-] input pin unconnected. Connect both of the [+] and [-] input pins of a channel not connected to the signal source to the corresponding analog ground.
- A long connection cable may prevent the board from performing accurate analog input. The connection cable should be as short as possible.
- A connection cable affected by noise may prevent the board from performing accurate analog input. Route the connection cable away from the noise source.

Connecting Control Signals

Connecting Input Signals

To “External Sampling Clock Input” or “External Start Trigger Input”, connect a device which can be current-driven, such as a switch or transistor output device. The input circuit is given below.

An external power supply is required to drive the input circuit. The power requirement for each input channel is about 11 mA at 24 VDC (about 5.5 mA at 12 VDC).

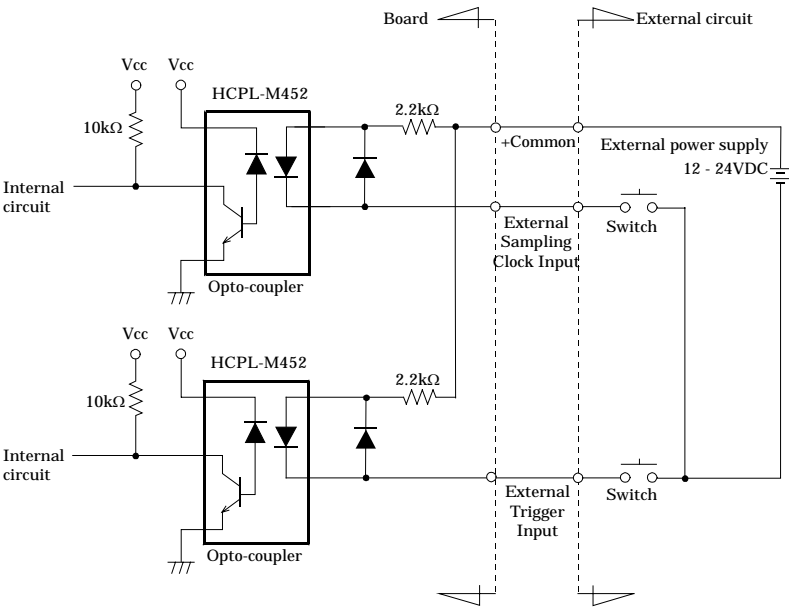


Figure 3.6. Input circuit

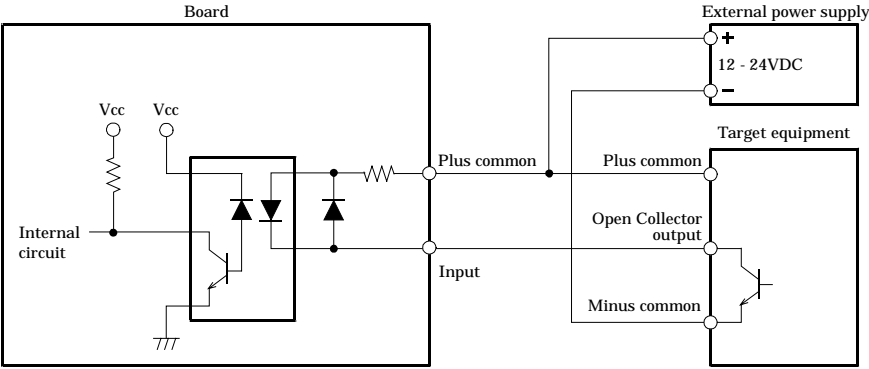


Figure 3.7. Example Connection with an Open Collector Output(Current Sink Type)

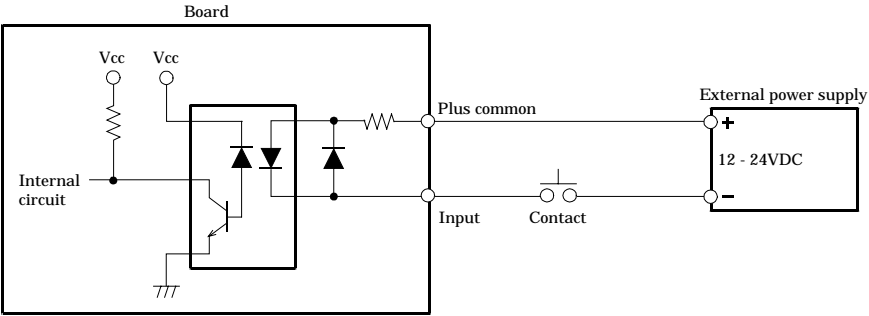


Figure 3.8. Example Connection with a Mechanical Contact

The table below shows the relationship between input signal and PC-sided data (internal logic), with the above schematic as a connection example.

Table 3.1. Input Signal and PC-sided Data (Internal Logic)

| Internal Logic | Contact | Input pin voltage level |
|----------------|---------|-------------------------|
| 0 | OFF | High |
| 1 | ON | Low |

Reference

For the operation timings for control signal input, see "Timing of External Control Signals" in Chapter 6.

Connecting Output Signals

To "Timer Output" or "Sampling Busy Output", connect a device for relay control or for current-driven control such as LED control. The output circuit is given below.

An external power supply is required to drive the output circuit. The rated output current is a maximum of 50 mA per channel.

The output transistor of this board has no surge voltage protector. To drive an inductive load such as a relay or lamp using this board, apply surge voltage protection to the load side.

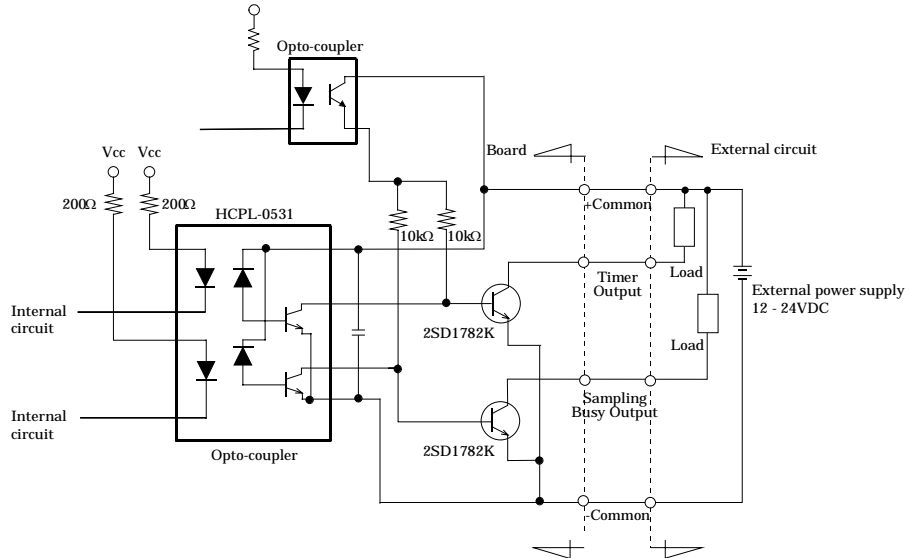


Figure 3.9. Output Signals



CAUTION

All outputs are set to OFF when the power is turned on.

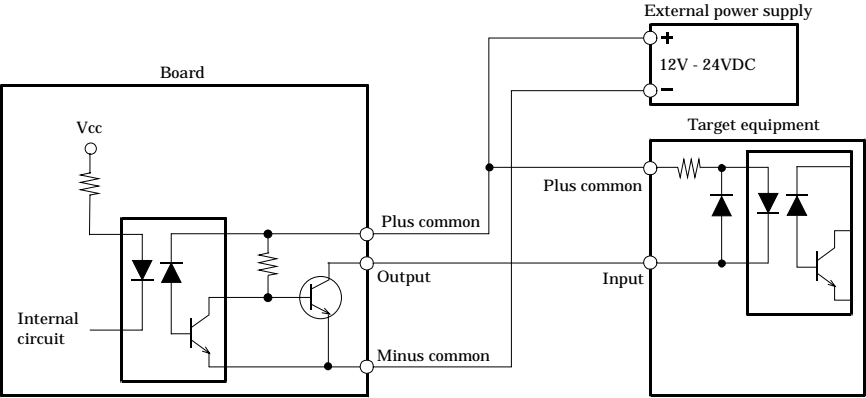


Figure 3.10. Connection with Current Sink Compatible Input

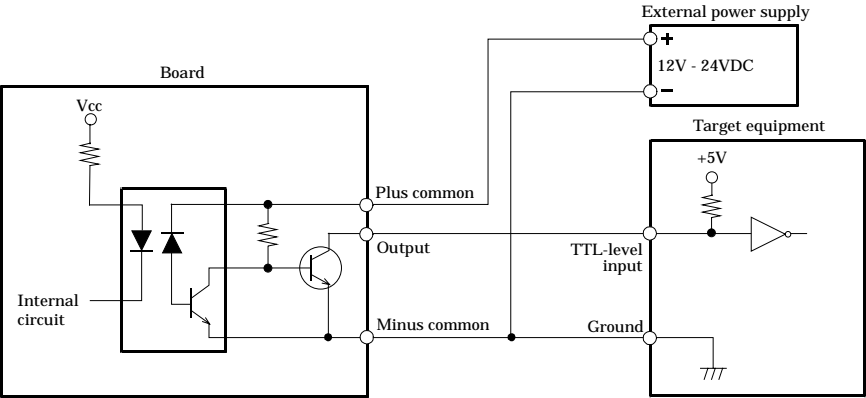
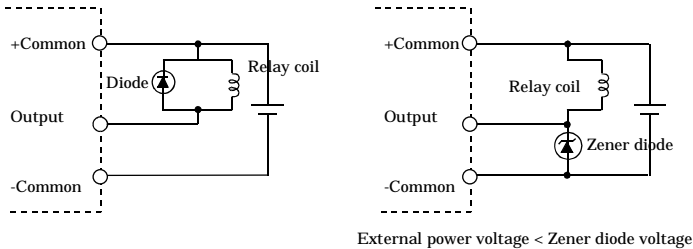


Figure 3.11. Example Connection with TTL-level Input(Attached with Pull-up Resistor)

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 signal, 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



Examples of use of lump

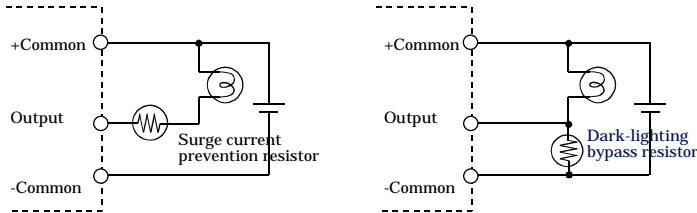


Figure 3.12. Surge Voltage Countermeasure

⚠ CAUTION

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

4. 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
│   │   ──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:

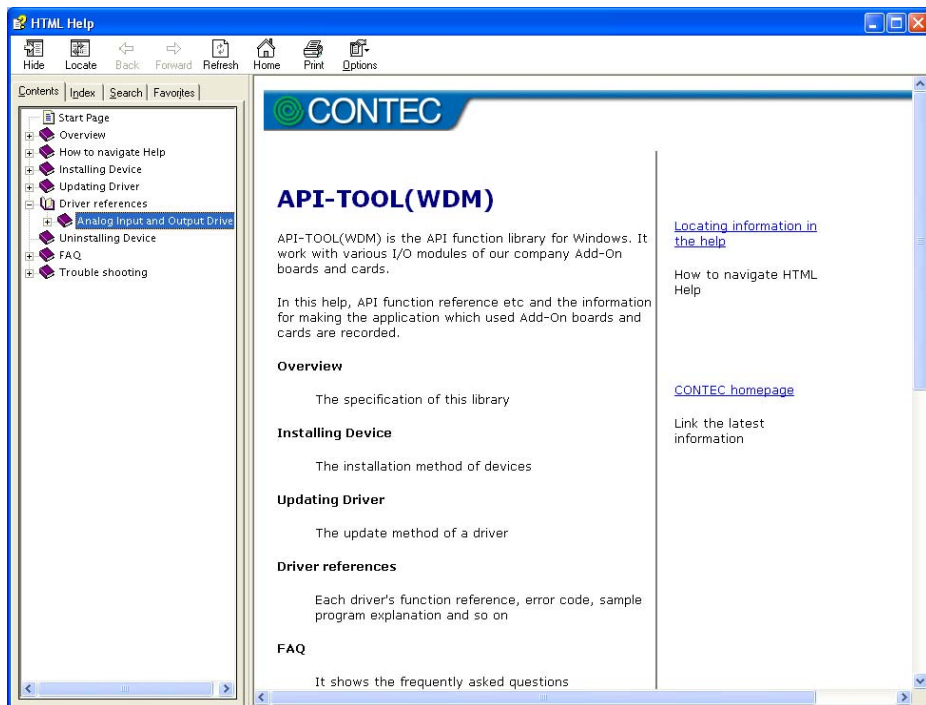
- Analog input or output through arbitrary channels
- Analog input at arbitrary intervals using the internal or external sampling clock
- Simultaneous monitoring of the termination of analog input sampling, buffer memory usage, and interrupt events such as occurrences of errors
- Driver option check 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)” – “AIO(WDM)” – “API-AIO(WDM) HELP” to display help information.

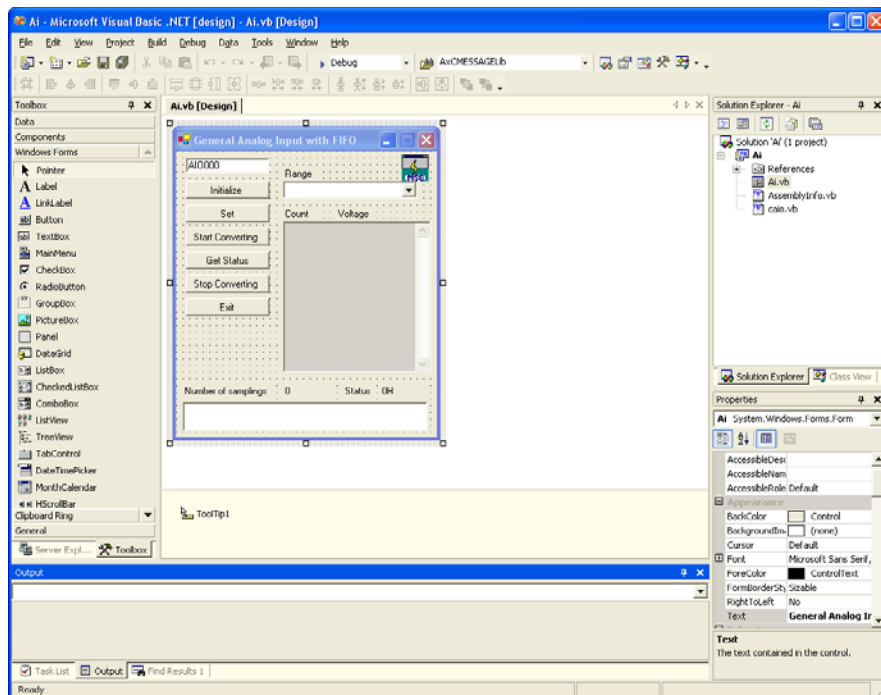


Using Sample Programs

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

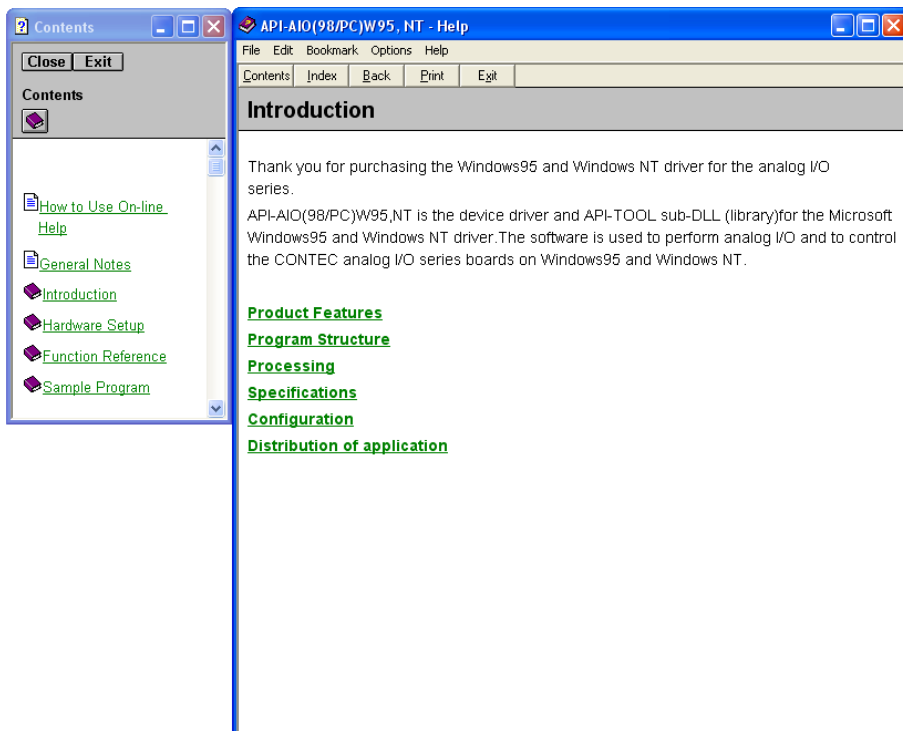
- DioBit Perform digital I/O using bit values
- DioByte Perform digital I/O using port values

* 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.
- (2) From the Start Menu, select “Programs” – “CONTEC API-PAC(W32)” – “Aio” – “API-AIO HELP” to display help information.



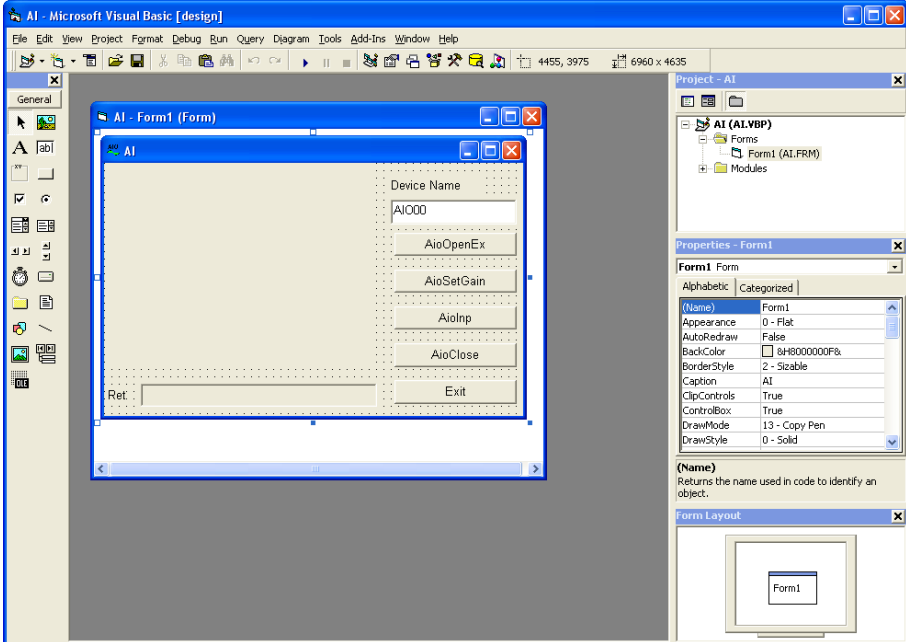
Using Sample Programs

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).
- AIInt : 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.
- AOBBack : 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.

- ANALOG : Versatile sample program using AioInp, AioInpBack, AioInpBdMem, AioOut, AioOutBack, AioDO, and AioDI

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

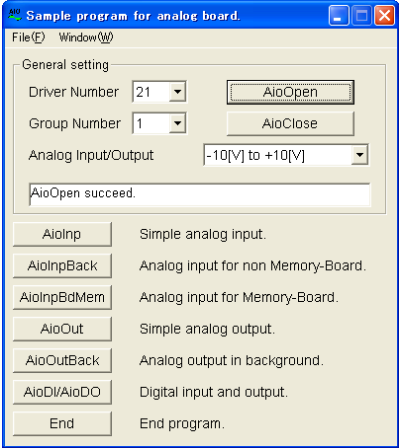
Using the Utility Program

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.

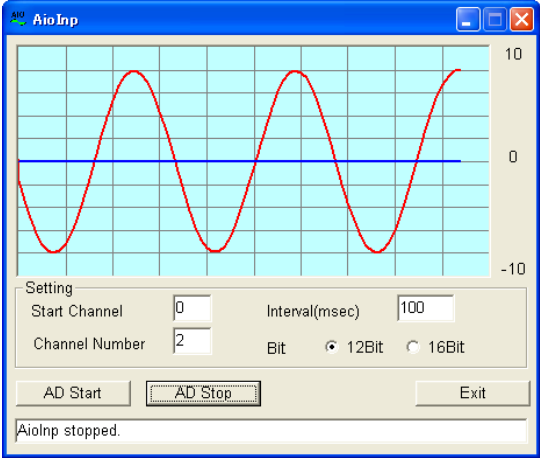
Invoke the tool by selecting the Start Menu – “CONTEC API-PAC(W32)” – “AIO” – “SAMPLE Analog”.

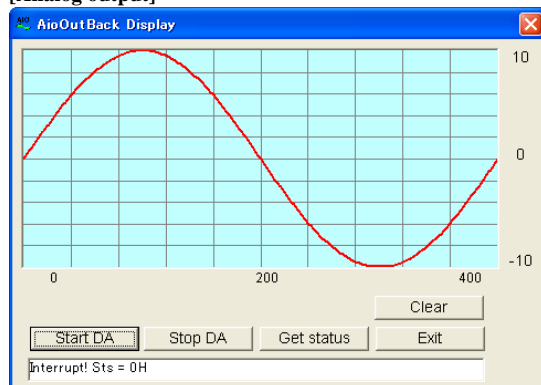
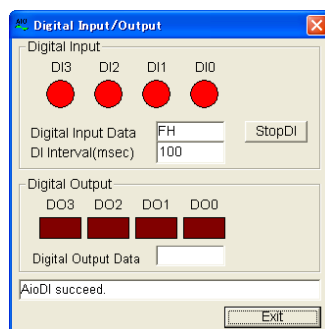
[Main screen]



- 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]

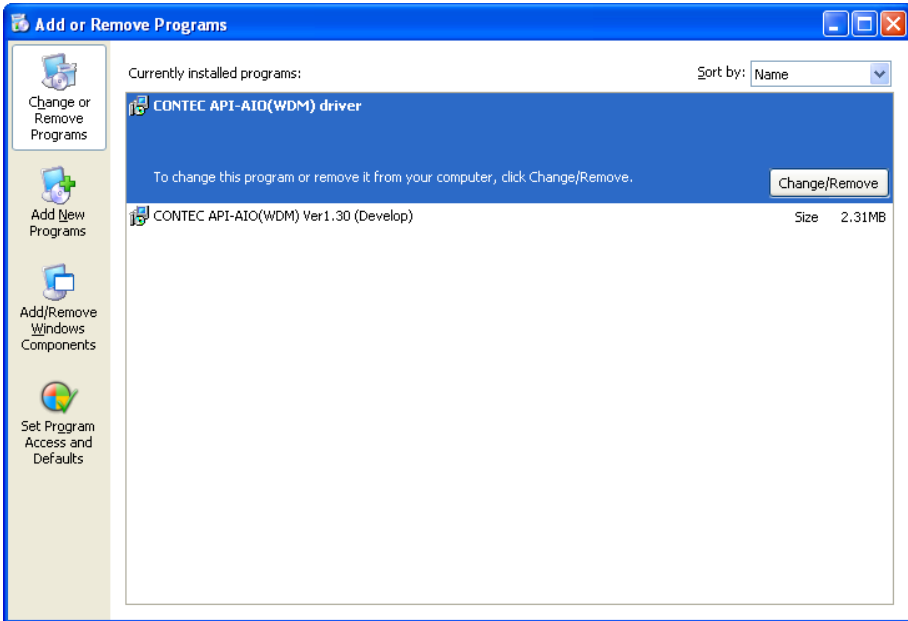


[Analog output]**[Digital input and output]**

Uninstalling the Driver Libraries

To uninstall API-PAC(W32), follow the procedure below.

- (1) Click on the [Start] button on the Windows taskbar. From the Start Menu, select “Settings” – “Control Panel”.
- (2) Double-click on “Add/Remove Programs” in the Control Panel.
- (3) If the API-AIO(WDM), select “CONTEC API-AIO(WDM) driver” and “CONTEC API-AIO(WDM) VerX.XX (Development)” from the displayed application. If the API-AIO(98/PC), select “CONTEC API-AIO(98/PC)xx VerX.XX (Development) and “CONTEC API-AIO(98/PC)xx VerX.XX (Runtime)”
Click on the [Add/Remove] button. Follow the on-screen instructions to uninstall the function libraries.



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. |
| Set as follows..... | |
| # ./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 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.

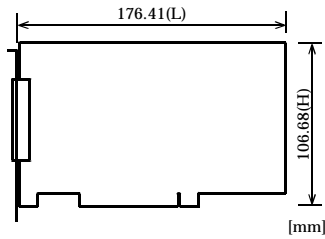
Hardware specification

Table 5.1. Specification

| Item | Specification |
|-----------------------------|--|
| Analog Input | |
| Isolated specification | Independent, isolated voltage input |
| Type | Differential input |
| Number of channels | 4 channels |
| Input range | Bipolar: $\pm 1.25\text{V}$, $\pm 0.125\text{V}$ Unipolar: $0 - +2.5\text{V}$, $0 - 0.25\text{V}$ (Jumper-setting for every channel) |
| Absolute max. input voltage | $\pm 3.0\text{V}$ (with respect to the analog ground of each channel) |
| Input impedance | $1\text{M}\Omega$ or more |
| Resolution | 16-bit |
| Non-Linearity error *1 | $\pm 15\text{LSB}$ |
| Conversion speed | 10msec/ch (Max.) |
| Sampling clock | Internal sampling clock: 10,000,000 - 1,073,741,824,000 nsec (Settable in 250 nsec) External sampling clock: Opto-Isolated Input (for current sinking output) |
| Board temperature input | |
| Input range | $0 - +50^{\circ}\text{C}$ |
| Measurement unit | 0.0625°C |
| Tolerance | $\pm 3.0^{\circ}\text{C}$ |
| Programmable timer | |
| Cycle setting | 500 - 1,073,741,824,000nsec (Settable in 250 nsec) |
| Status | Count up, Count up over-run |
| Timer output signal | Opto-Isolated Open Collector Output (current sinking type) |
| External trigger input | |
| External trigger input | Opto-Isolated Input (for current sinking output)1 level |
| Status | Trigger input, Trigger input overrun |
| Interface connector | |
| CN1 | 37pin D-SUB female connector #4-40UNC |
| I/O Address | Any 32-byte boundary |
| Interrupt | 1 level use |
| Operating condition | $0 - 50^{\circ}\text{C}$, 10 - 90%RH (No condensation) |
| Power consumption (Max.) | +5VDC 1200mA |
| PCI bus specification | 32-bit, 33MHz, 5V |
| Dimension (mm) | 176.41(L) \times 106.68(H) |
| Weight | 150g |

*1: A nonlinearity error of approximately 0.5% of the maximum range may occur at an ambient temperature of 0°C or 50°C .

Board Dimensions



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 5.1 is a circuit block diagram of this board.

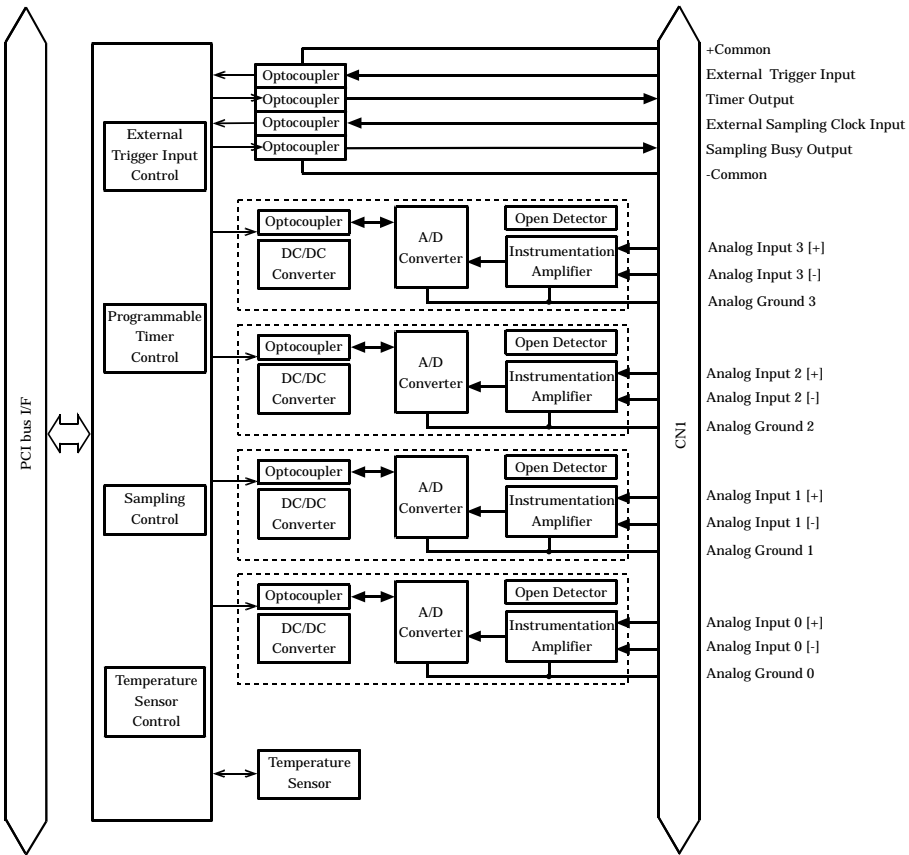


Figure 5.1. Block Diagram

Timing of Sampling Control Signals

Specifications of External Sampling Clock and External Trigger Input Signals

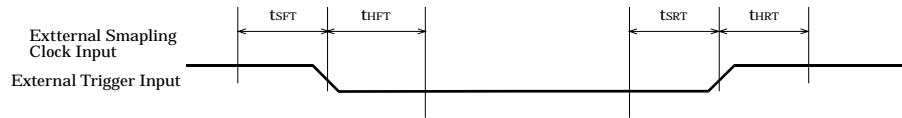


Figure 5.2. Specifications of External Sampling Clock and External Trigger Input Signals

Table 5.2. Details

| | Symbol | Min. |
|------------------------------------|-----------|---------------|
| Input circuit OFF-to-ON setup time | t_{SFT} | 2.5 μ sec |
| Input circuit OFF-to-ON Hold time | t_{HFT} | 2.5 μ sec |
| Input circuit ON-to-OFF setup time | t_{SRT} | 2.5 μ sec |
| Input circuit ON-to-OFF Hold time | t_{HRT} | 2.5 μ sec |

Timing of an external trigger Input and Input Status

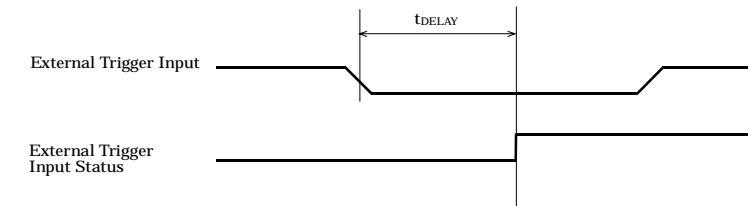


Figure 5.3. Timing of an external trigger Input and Input Status

Table 5.3. Details

| | Symbol | Min. |
|------------|-------------|-------------|
| Delay time | t_{DELAY} | 5 μ sec |

Timing of an external Sampling Clock Input and “Sampling Busy Output”

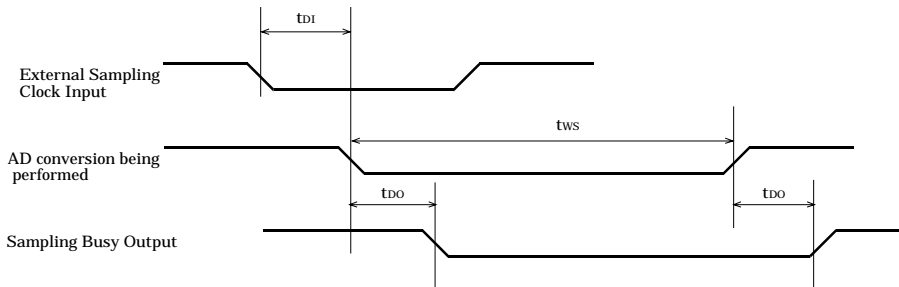


Figure 5.4. Timing of an external Sampling Clock Input and “Sampling Busy Output”

Table 5.4. Details

| | Symbol | Min. | Max. |
|--------------------|----------|---------|------------------|
| Input delay time | t_{DI} | 5μsec | --- |
| Sampling busy time | t_{ws} | --- | 10msec × Channel |
| Output delay time | t_{DO} | 2.5μsec | --- |

Timing of “Timer Output”

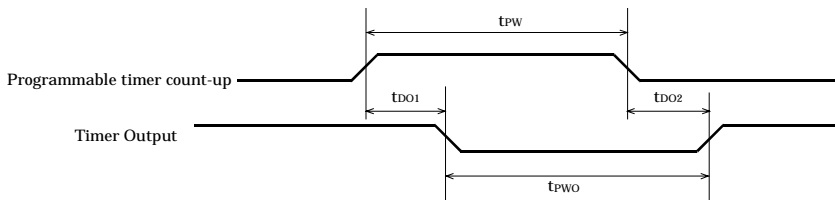


Figure 5.5. Timing of “Timer Output”

Table 5.5. Details

| | Symbol | Min. | Typ. | Reference Value |
|--------------------------------------|-----------|---------|---------|-----------------|
| Increment-time generated pulse width | t_{pw} | --- | 2.5μsec | --- |
| Output delay time 1 | t_{DO1} | 2.5μsec | --- | --- |
| Output delay time 2 | t_{DO2} | 2.5μsec | --- | --- |
| Output pulse width | t_{pwo} | --- | --- | 3μsec |

* External power supply 24V, Load 510Ω: 25°C

About Calibration

This board is calibrated before shipment.

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

ADI16-4L(PCI)

User's Guide

CONTEC CO., LTD.

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