

PC-HELPER

Unisolated Analog Input Board
for PCI

AI-1216B-RB1-PCI

AI-1216B-RU1-PCI

User's Guide

CONTEC CO.,LTD.

Check Your Package

Thank you for purchasing the CONTEC product.

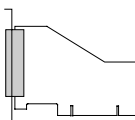
The product consists of the items listed below.

Check, with the following list, that your package is complete. If you discover damaged or missing items, contact your retailer.

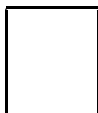
Product Configuration List

- Board (One of the following) ...1
[AI-1216B-RB1-PCI or AI-1216B-RU1-PCI]
- 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 Product

This product is a non-isolated, PCI-bus-compatible analog input board with a limited input range of bipolar $\pm 10\text{V}$ (AI-1216B-RB1-PCI) or unipolar 0-10V (AI-1216B-RU1-PCI). With a sole focus on the basic analog input function, the product offers high cost-effectiveness.

AI-1216B-RB1-PCI has an input range of bipolar $\pm 10\text{V}$, 12-bit resolution, 16 channels of single-end input as well as analog input at a conversion speed of $20\mu\text{sec/ch}$. In addition, it comes with digital input/output (non-isolated TTL level: 8 each).

AI-1216B-RU1-PCI has an input range of unipolar 0-10V, 12-bit resolution, 16 channels of single-end input as well as analog input at a conversion speed of $20\mu\text{sec/ch}$. In addition, it comes with digital input/output (non-isolated TTL level: 8 each).

Using the bundled API function library package [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

- Equipped with analog inputs in a range of $\pm 10\text{V}$ or 0-10V, 12-bit single-end input x 16ch, conversion speed: $20\mu\text{sec/ch}$
AI-1216B-RB1-PCI is a non-isolated analog input board equipped with functions such as bipolar $\pm 10\text{V}$, 12-bit resolution, single-end input x 16ch and a conversion speed of $20\mu\text{sec/ch}$.
AI-1216B-RU1-PCI is a non-isolated analog input board equipped with functions such as unipolar 0-10V, 12-bit resolution, single-end input x 16ch and a conversion speed of $20\mu\text{sec/ch}$.
- Unisolated TTL level digital input / output 8ch for each
- Windows compatible driver libraries are attached.
Using the attached driver library API-PAC(W32) makes it possible to create applications of Windows. In addition, a diagnostic program by which the operations of hardware can be checked is provided.
- A/D conversion enabled for a specified channel or multiple channels by software command
Setting a channel by software enables analog input for the specified channel or multiple channels (consecutive channels starting from channel 0). A/D conversion is performed for each software command.

Support Software

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

Windows version of analog I/O driver **API-AIO(WDM)**

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

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

< Operating environment >

OS Windows Vista, XP, 2000

Adaptation language Visual C++ .NET, Visual C# .NET, Visual Basic .NET, Visual C++, Visual Basic, Delphi, C++Builder, etc..

You can download the updated version from the CONTEC's Web site (<http://www.contec.com/apipac/>). For more details on the supported OS, applicable language and new information, please visit the CONTEC's Web site.

Cable & Connector (Option)

Flat Cable with Two 37-pin D- SUB Connectors	: PCB37P-1.5 (1.5m)
Shielded Cable with Two 37-pin D- SUB Connectors	: PCB37PS-0.5P (0.5m)
	: PCB37PS-1.5P (1.5m)
Flat Cable with One 37-pin D- SUB Connector	: PCA37P-1.5 (1.5m)
Shielded Cable with One 37-pin D- SUB Connector	: PCA37PS-0.5P (0.5m)
	: PCA37PS-1.5P (1.5m)
D-SUB37P Male Connector Set (5pieces)	: CN5-D37M

Accessories (Option)

Screw Terminal (M3 x 37P)	: EPD-37A *1*2
Screw Terminal (M3.5 x 37P)	: EPD-37 *1
General Purpose Terminal	: DTP-3A *1
Screw Terminal	: DTP-4A *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 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 and jumpers on this product that need to be set in advance.
Be sure to check these before installing this product.
 - 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 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.
 - Do not install or remove this product to or from the expansion slot while the computer's power or expansion unit is 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 products 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 this product continuously, be sure to read the manual and understand the contents.
 - Do not modify this product. CONTEC will bear no responsibility for any problems, etc., resulting from modifying this product.
 - Regardless of the foregoing statements, CONTEC is not liable for any damages whatsoever (including damages for loss of business profits) arising out of the use or inability to use this CONTEC product or the information contained herein.
-

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

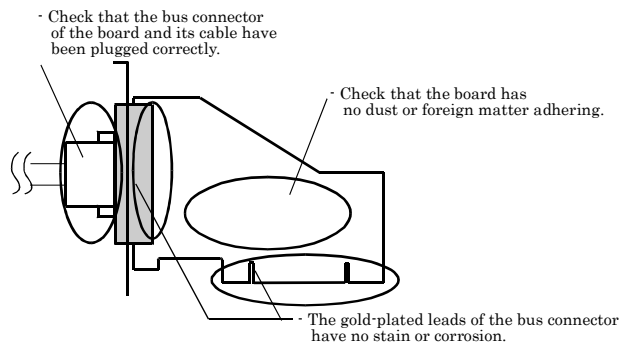
None

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.

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 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 Windows

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 the PC, install the driver library from the API-PAC(W32) CD-ROM provided with the board.

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.

Which Driver to Use

CONTEC has two analog I/O drivers: API-AIO(WDM) and API-AIO(98/PC).

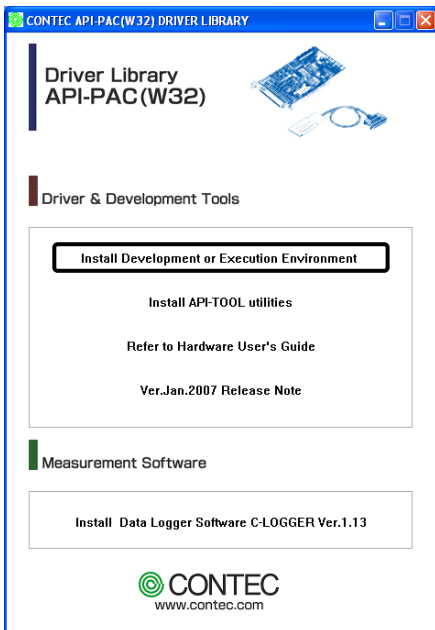
API-AIO(WDM) is a new driver for analog I/O under Windows.

This driver was developed to be easier to use and to provide additional functions above those provided by the previous API-AIO(98/PC) driver.

Please use the API-AIO(WDM) with this board. API-AIO(98/PC) is not supported.

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.



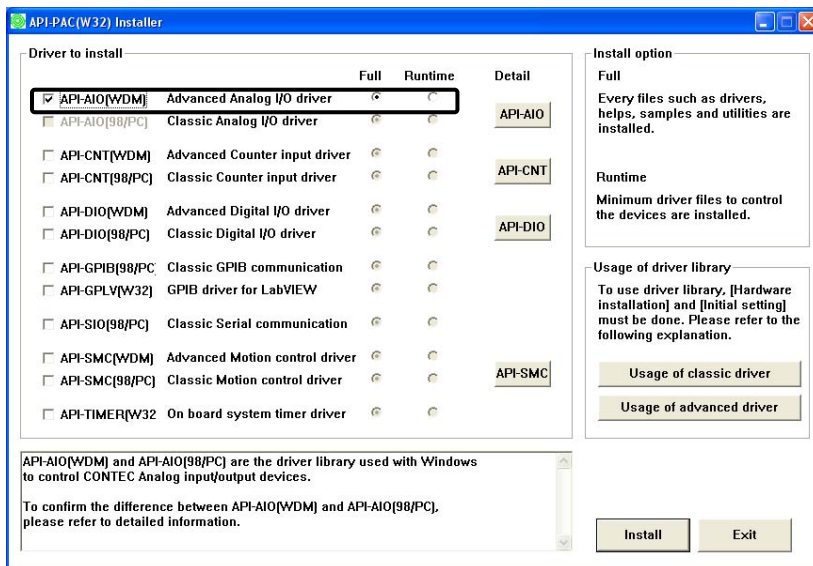
CAUTION

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

When Using the 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 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.

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 jumper 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. shows the names of major parts on the board.

Note that the switch setting shown below is the factory default.

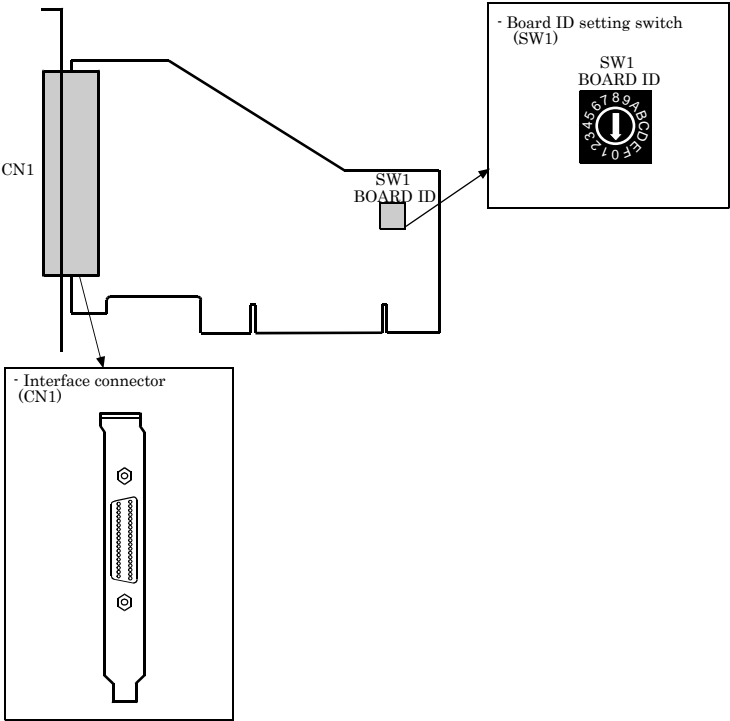


Figure 2.1. Part Names

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.

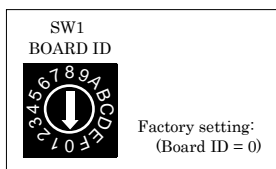


Figure 2.2. Board ID Settings (SW1)

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) Attach the board bracket to the PC with a screw.
- (5) Put the cover back into place.

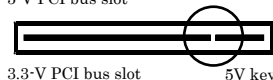


Applicable PCI bus slots

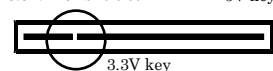
PCI bus slots used in PCs have keys to prevent 5V and 3.3V PCI bus boards from being accidentally plugged into wrong bus slots. This board can be plugged into both of the 5V and 3.3V PCI bus slots.

<PCI bus slot>

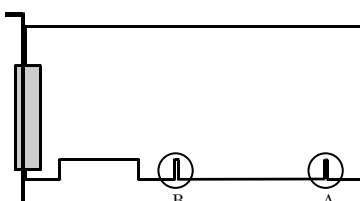
5-V PCI bus slot



3.3-V PCI bus slot



<PCI bus board>



A : Slit for 5-V PCI bus slot
B : Slit for 3.3-V PCI bus slot

⚠ 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.
- Power supply from the PCI bus slot at +5V is required.

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.



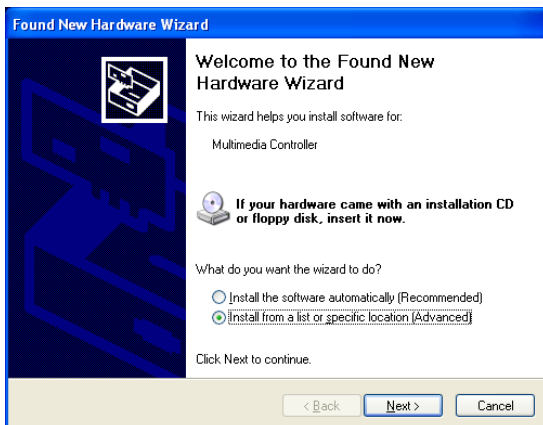
CAUTION

- 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 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.

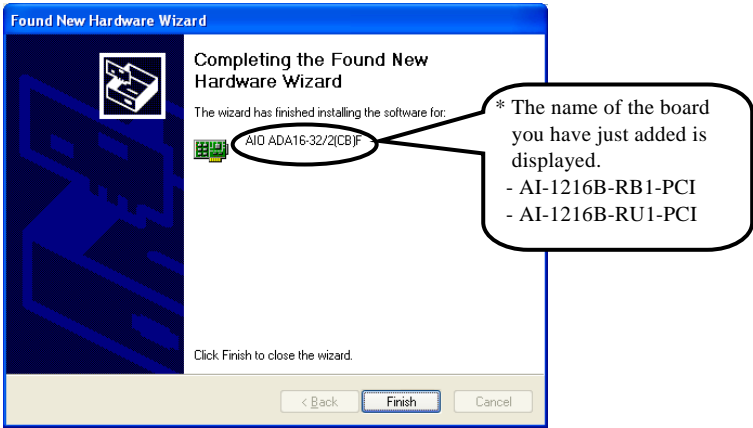
Using the API-AIO(WDM)

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

Select “Install from a list or specific location[Advanced]”, then click on the [Next] button.



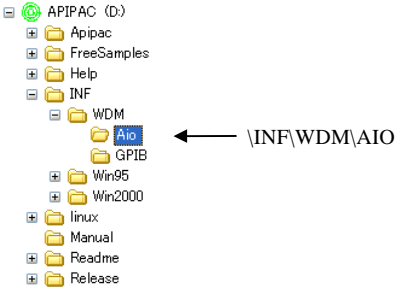
- (2) Specify that folder on the CD-ROM which contains the setup information file (INF) to register the board.



Source folder

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

\INF\WDM\AIO



You have now finished installing the software.

Step4 Initializing the Software

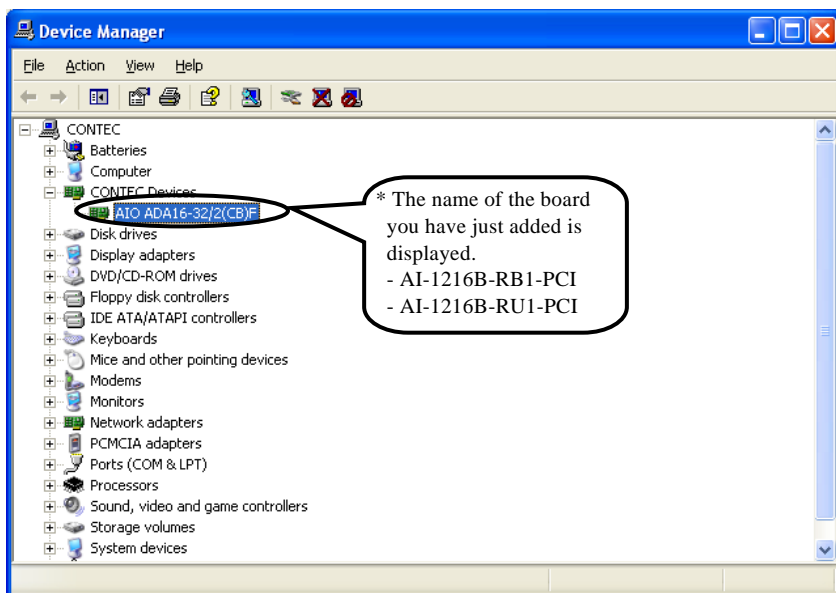
The driver library requires the initial setting to recognize the execution environment. It is called the initialization of the Driver library.

When Using the 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.)

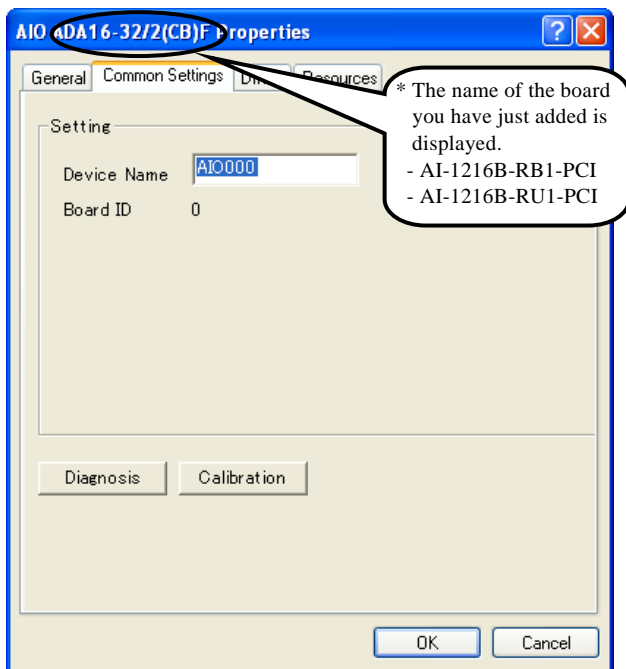


- (2) The installed hardware appears under the CONTEC Devices node. Open the CONTEC Devices node and select the device you want to setup (the device name should appear highlighted). Click [Properties].

(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.

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 the analog I/O data, connect to an external signal source.

The figure below shows an example of checking by connecting to an external signal.

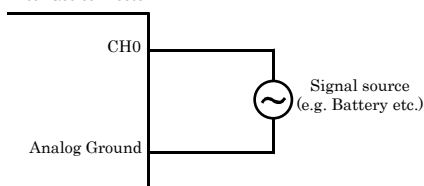
The analog input example illustrated below is an example of using analog input channel 0 on the AI-1216B-RB1-PCI or AI-1216B-RU1-PCI.

Connection diagram

< Analog Input >

· Single-Ended Input

Interface connector



CAUTION

Input data remains indeterminate when no input pin is connected. The input pin for the channel not connected to the signal source must be connected to the analog ground.

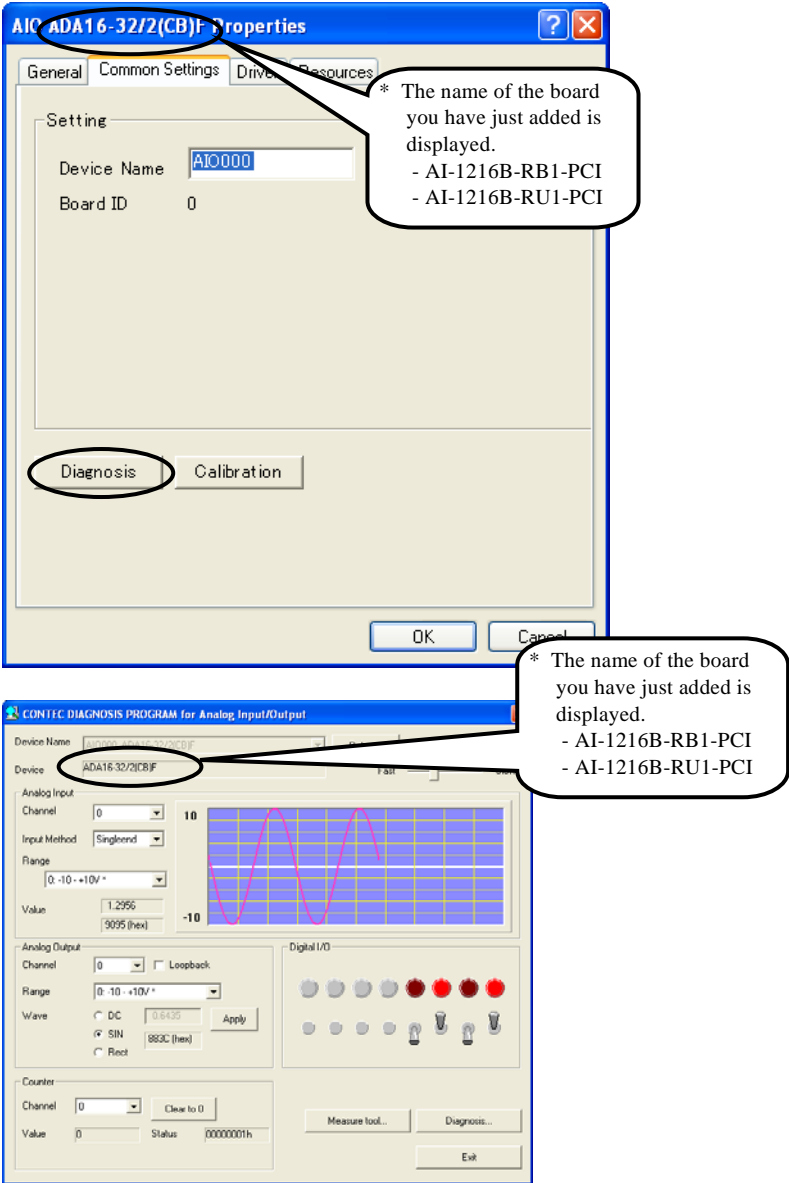
For details, see “Chapter 3 External Connection”.

Figure 2.3. Connection diagram

Using the Diagnosis Program

Starting the Diagnosis Program

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



Analog input

Select the input channel, input type, and input range from the lists.

Input data is plotted on a graph.

Digital I/O

The upper row of circular lamps indicates the digital input states. Red indicates the bit is ON and brown indicates OFF.

Clicking the lower row of switches turns the digital output bits ON or OFF.

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:2004/05/08 07:08:09
OS :Microsoft Windows XP 5.1.2600 Service Pack 1

[Device information]
Device Name  AI0000
Device       ADA16-32/2(CB)F

[File information]
G:\WINDOWS\SYSTEM32\CAIO.DLL           1, 3, 0, 0 2003/10/31 01:30
G:\WINDOWS\SYSTEM32\CMESSENGER.COCX   1, 0, 0, 1 2001/10/25 01:15
G:\WINDOWS\SYSTEM32\CAIODEL.EXE       1, 1, 3, 0 2003/05/29 01:13
G:\WINDOWS\SYSTEM32\CAIOPF32.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 (8209hex) 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 (7908hex) 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 (7D50hex) 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
- Initialization, interrupts, current input or output state for each channel

Setup Troubleshooting

Symptoms and Actions

Data input or output does not operate correctly

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

The 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 the API functions.
- Refer to the source code for the sample programs.

The OS won't normally get started or detect the device.

Refer to the "Troubleshooting" section of API-AIO(WDM) HELP.

If your problem cannot be resolved

Contact your retailer.

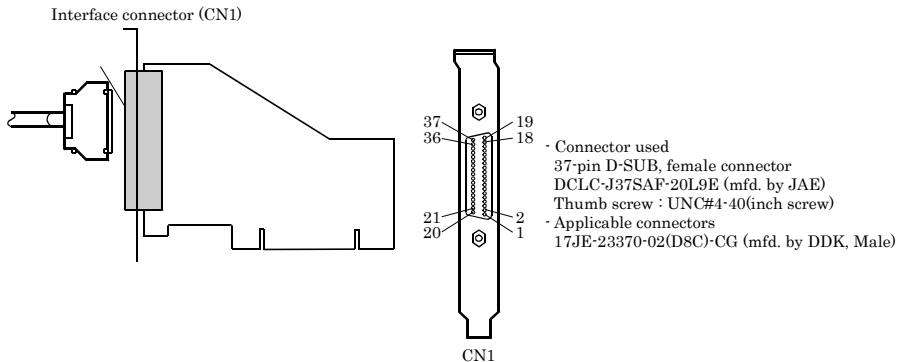
3. External Connection

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

How to connect the connectors

Connector shape

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

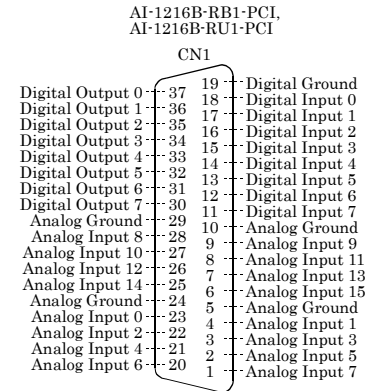


* Please refer to chapter 1 for more information on the supported cable and accessories.

Figure 3.1. Interface Connector Shape

Connector Pin Assignment

Pin Assignments of Interface Connector



Analog Input 0 · Analog Input 15	Analog input signals in single-ended input mode. The numbers correspond to channel numbers.
Analog Ground	Analog ground common to analog input signals.
Digital Input 0 · Digital Input 7	Digital input signal. The numbers correspond to input bit numbers.
Digital Output 0 · Digital Output 7	Digital output signal. The numbers correspond to output bit numbers.
Digital Ground	Digital ground common to digital I/O signals

Figure 3.2. Pin Assignments of Interface Connector 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.

Analog Input Signal Connection

Analog signal input types are divided into single-ended input and differential input. This board uses single-ended input fixed. The following examples show how to connect analog input signals using a flat cable and a shielded cable.

Single-ended Input

The following figure shows an example of flat cable connection.

Connect separate signal and ground wires for each analog input channel on CN1.

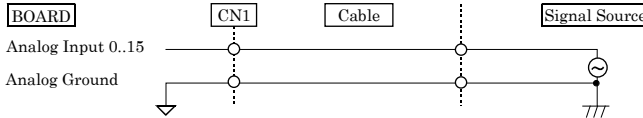


Figure 3.3. Single-ended Input Connection (Flat Cable)

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

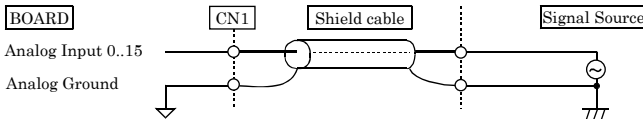


Figure 3.4. Single-ended Input Connection (Shield Cable)



CAUTION

- If the signal source contains over 50 kHz signals, the signal may effect the cross-talk noise between channels.
- If the board and the signal source receive noise or the distance between the board and the signal source is too long, data may not be input properly.
- An input analog signal should not exceed the maximum input voltage (relate to the board analog ground). If it exceeds the maximum voltage, the board may be damaged.
- Connect all the unused analog input channels to analog ground.

Digital I/O signals Connection

The following sections show examples of how to connect digital I/O signals.
All the digital I/O signals and control signals are TTL level signals.

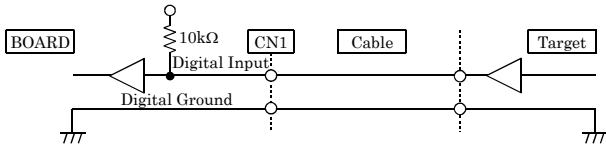


Figure 3.5. Digital Input Connection

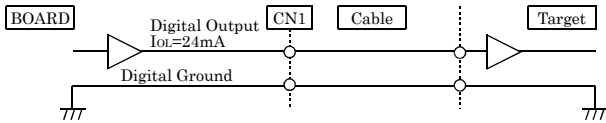


Figure 3.6. Digital Output Connection

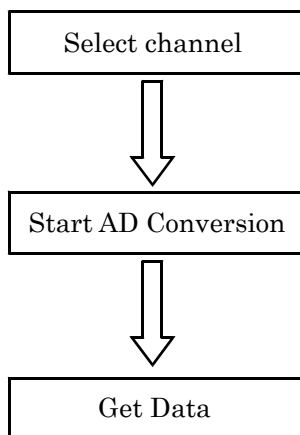
4. Functions

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 Input Function

The board converts analog signals to digital data according to the resolution and stores it in memory. API function performs one AD conversion on a specified channel or multiple channels.

Analog input processes are classified as follows:



Select Channel

"Channel" represents each channel number of analog input signals.

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

When selecting a channel, specify its channel No. or the number of channels on which you wish to perform AD conversion (consecutive channels starting from channel 0).

Start AD Conversion

AD conversion is started for each channel by a software command.

Get data

The following formula expresses the relationship between the acquired AD conversion data (binary data) and the voltage.

$$\text{Voltage} = \text{Input data} \times (\text{Max. range value} - \text{Min. range value}) / \text{Resolution} + \text{Min. range value}$$

The value of resolution for the 12-bit device is 4096.

<For AI-1216B-RB1-PCI ($\pm 10\text{V}$ range)>

The table below shows the relationship between input data and voltage in the $\pm 10\text{V}$ range.

Voltage	Conversion data (12-bit)
+9.995V	4095
:	:
0.005V	2049
0V	2048
-0.005V	2047
:	:
-10.000V	0

Ex.: When input data 3072 is input at a resolution of 12-bit in the $\pm 10\text{V}$ range
Voltage = $3072 \times (10 - (-10)) \div 4096 + (-10)$
 = 5.0

<For AI-1216B-RU1-PCI (0 - 10V range)>

The table below shows the relationship between input data and voltage in the 0 - 10V range.

Voltage	Conversion data (12-bit)
+9.998V	4095
:	:
5.002V	2049
5V	2048
4.998V	2047
:	:
-0V	0

Ex.: When input data 3072 is input at a resolution of 12-bit in the 0 - 10V range
Voltage = $3072 \times (10 - 0) \div 4096 + 0$
 = 7.5

Digital Input Function

- Input bit

Individual digital input points are called input bits.
For individual input bit numbers, see “How to connect the connectors” to “Connector Pin Assignment” in Chapter 3 "External Connection".

- Input in Bits

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

- Input in Bytes

Individual input bits can be input in byte units.
The byte data to be input is a value between 0 and 255 depending on the states of the bits.
Ex. Byte data = 85(55H)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0(OFF)	1(ON)	0(OFF)	1(ON)	0(OFF)	1(ON)	0(OFF)	1(ON)

Digital Output Function

- Output bit

Individual digital output points are called output bits.
For individual output bit numbers, see “How to connect the connectors” to “Connector Pin Assignment” in Chapter 3 "External Connection".

- Output in Bits

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

- Output in Bytes

Individual output bits can be output in byte units.
The byte data to be output is a value between 0 and 255.

Ex. Byte data = 170(AAH)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1(ON)	0(OFF)	1(ON)	0(OFF)	1(ON)	0(OFF)	1(ON)	0(OFF)

5. About Software

CD-ROM Directory Structure

```

\
|— Autorun.exe           Installer Main Window
|
| Readmej.html           Version information on each API-TOOL (Japanese)
| Readmeu.html           Version information on each API-TOOL (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:

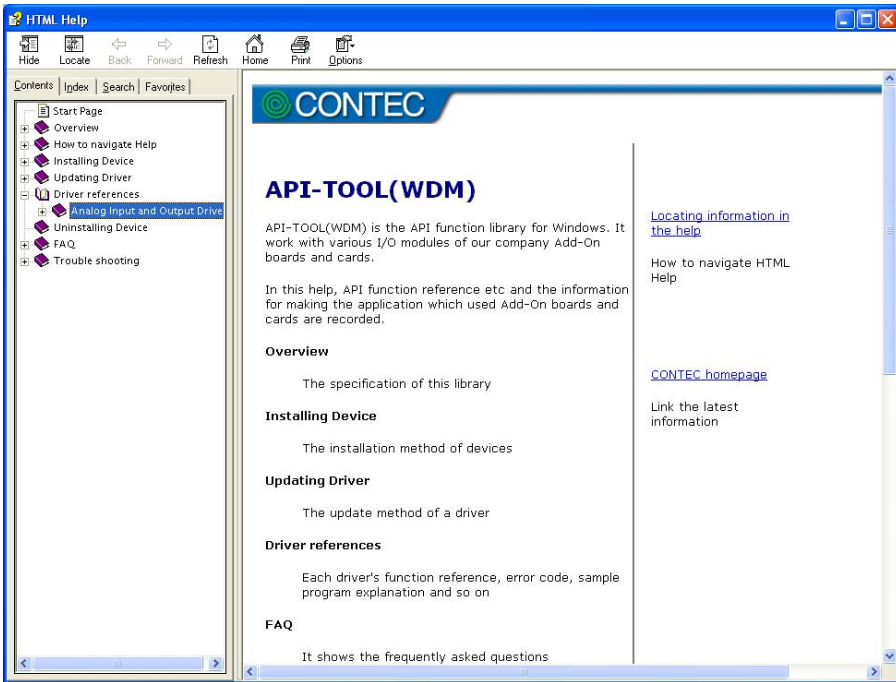
- Analog input or output through arbitrary channels
- Driver option check using a demo driver even without the board installed

For details, refer to the help file. The help file provides various items of information such as “Function Reference”, “Sample Programs”, “Tutorial”, “FAQs”and “Troubleshooting”. 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.

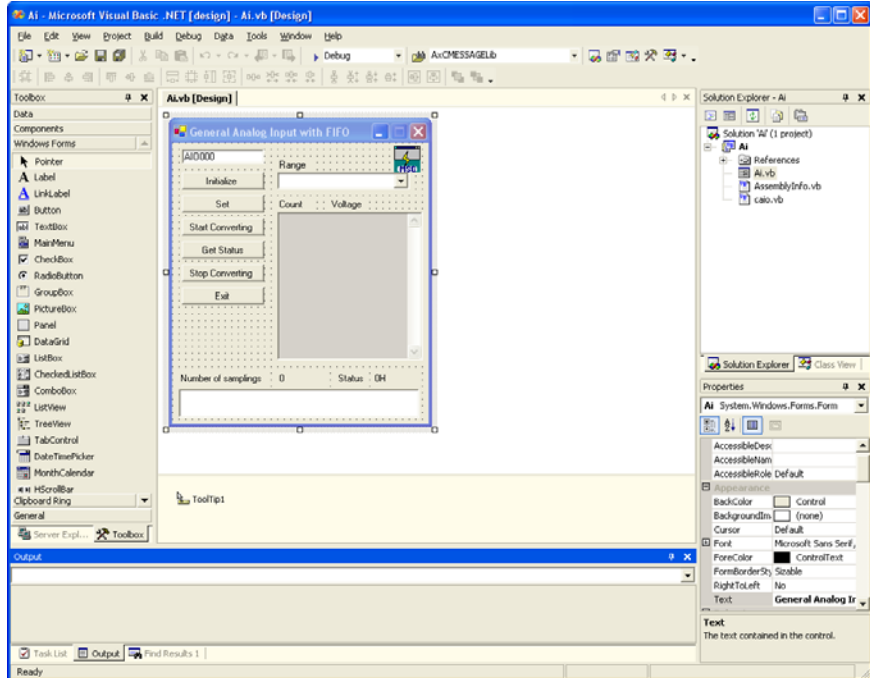


Using Sample Programs

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

Simple sample program

- SingleAi Perform single analog input from specified channel
- MultiAi Perform single analog input from multiple channels

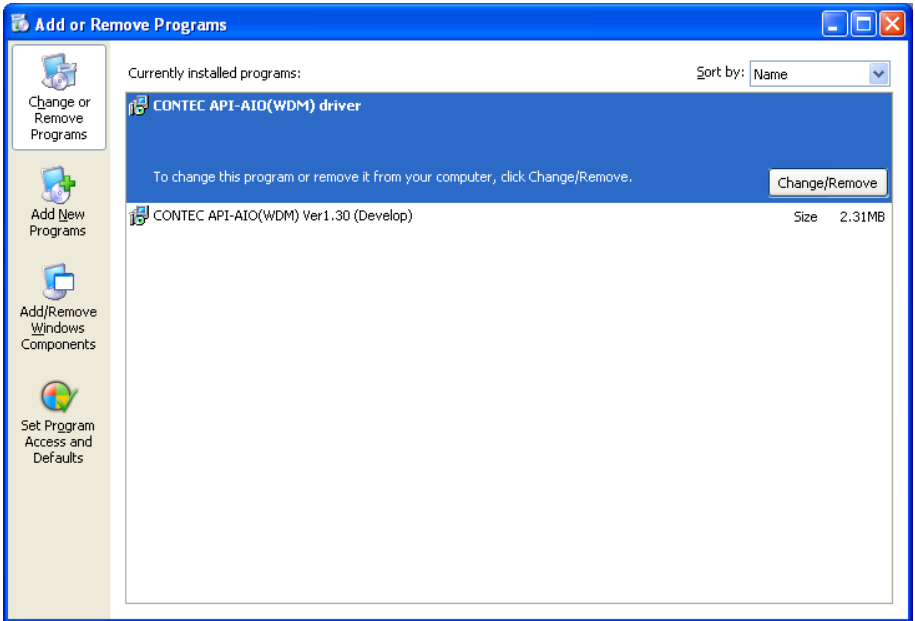
Digital input/output

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

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 or Remove Programs” in the Control Panel.
- (3) Select "CONTEC API-AIO(WDM) driver" and "CONTEC API-AIO(WDM) VerX.XX (Development environment)" from the list of applications.
Click the [Change or Remove Programs] button. Proceed with uninstalling by following the instructions that appear on the screen.



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

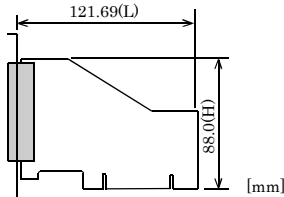
AI-1216B-RB1-PCI

Table 6.1. Specification < AI-1216B-RB1-PCI >

Item	Specification
Analog input	
Isolated specification	Un-Isolated
Type	Single-Ended Input
Number of input channels	16 channels
Input range	Bipolar ±10V
Absolute max. input voltage	±12V
Input impedance	1MΩ or more
Resolution	12-bit
Non-Linearity error *1*2	±3LSB
Conversion speed	20μ sec/ch (Max.)
Buffer memory	No buffer memory
Conversion start trigger	Software
Conversion stop trigger	Software
Digital I/O	
Number of output channels	Un-Isolated output 8ch (TTL level positive logic)
Number of input channels	Un-Isolated input 8ch (TTL level positive logic)
I/O address	Any 32-byte boundary
Interrupt level	1 level use
Power consumption	+5V 200 mA (Max.)
Operating condition	0 - 50°C, 10 - 90%RH (No condensation)
Bus specification	PCI(32-bit, 33MHz, Universal key shapes supported *3)
Dimension (mm)	121.69mm(L) x 88.00mm(H)
Interface connectors	
CN1	D-SUB 37-Pin female connector #4-40UNC
Weight	80g

- *1: When the environment temperature is near 0°C or 50°C, the non-linearity error may become larger.
- *2: At the time of the source use of a signal which built in the high-speed operational amplifier.
- *3: This board requires +5V power supply from expansion slots (it does not operate in the environment of only +3.3V power supply).

Board Dimensions



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

AI-1216B-RU1-PCI

Table 6.2. Specification < AI-1216B-RU1-PCI >

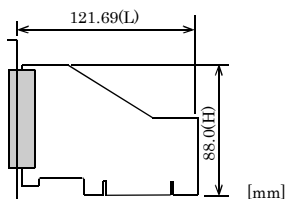
Item	Specification
Analog input	
Isolated specification	Un-Isolated
Type	Single-Ended Input
Number of input channels	16 channels
Input range	Unipolar 0-10V
Absolute max. input voltage	±12V
Input impedance	1MΩ or more
Resolution	12-bit
Non-Linearity error *1*2	±3LSB
Conversion speed	20μ sec/ch (Max.)
Buffer memory	No buffer memory
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Number of output channels	Un-Isolated output 8ch (TTL level positive logic)
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I/O address	Any 32-byte boundary
Interrupt level	1 level use
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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 6.1 is a circuit block diagram of this board.

AI-1216B-RB1-PCI, AI-1216B-RU1-PCI

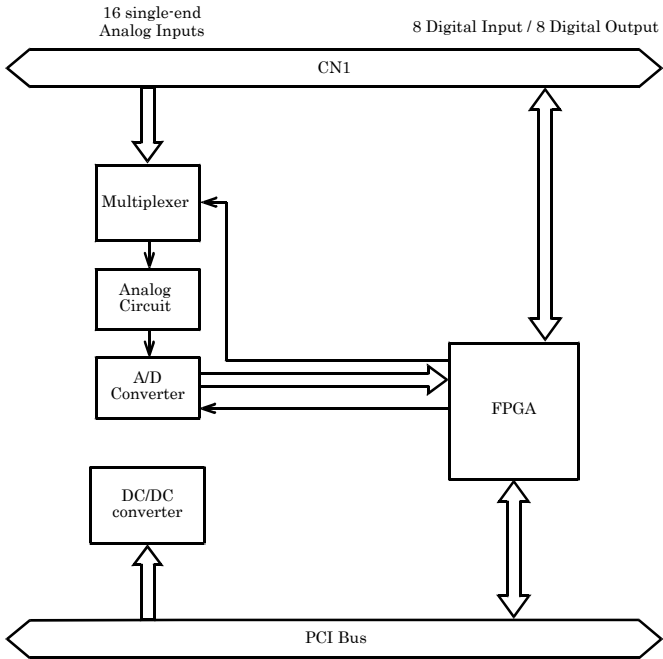


Figure 6.1. Block Diagram < AI-1216B-RB1-PCI, AI-1216B-RU1-PCI >

AI-1216B-RB1-PCI, AI-1216B-RU1-PCI User's Guide

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