

PC-HELPER

Digital I/O Board
for PCI Express
Low Profile

DIO-1616T-LPE

User's Guide

CONTEC CO.,LTD.

Check Your Package

Thank you for purchasing the CONTEC product.

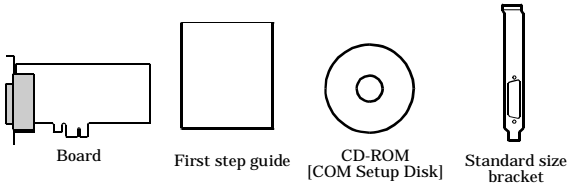
The product consists of the items listed below.

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

Product Configuration List

- Board [DIO-1616T-LPE]...1
- First step guide... 1
- CD-ROM *1 [API-PAC(W32)]...1
- Standard-sized bracket...1

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



Copyright

Copyright 2006 CONTEC CO., LTD. ALL RIGHTS RESERVED.

No part of this document may be copied or reproduced in any form by any means without prior written consent of CONTEC CO., LTD.

CONTEC CO., LTD. makes no commitment to update or keep current the information contained in this document. The information in this document is subject to change without notice.

All relevant issues have been considered in the preparation of this document. Should you notice an omission or any questionable item in this document, please feel free to notify CONTEC CO., LTD.

Regardless of the foregoing statement, CONTEC assumes no responsibility for any errors that may appear in this document or for results obtained by the user as a result of using this product.

Trademarks

MS, Microsoft, Windows are trademarks of Microsoft Corporation. Other brand and product names are trademarks of their respective holder.

Table of Contents

Check Your Package.....	i
Copyright	ii
Trademarks	ii
Table of Contents.....	iii

1. BEFORE USING THE PRODUCT	1
------------------------------------	----------

About the Board.....	1
Features	1
Support Software	2
Cable & Connector (Option)	3
Accessories (Option)	3
Customer Support	4
Web Site.....	4
Limited Three-Years Warranty	4
How to Obtain Service	4
Liability.....	4
Safety Precautions	5
Safety Information.....	5
Handling Precautions.....	6
Environment.....	7
Inspection.....	7
Storage	7
Disposal	7

2. SETUP	9
-----------------	----------

What is Setup?	9
Using the Board under Windows Using the Driver Library API-PAC(W32)	9
Using the Board under Windows Using Software Other than the Driver Library API-PAC(W32).....	9
Using the Board under an OS Other than Windows	10
Step 1 Installing the Software	11
Starting the Install Program.....	11
Selecting the Digital I/O Driver	12
Executing the Installation	13
Step 2 Setting the Hardware	14
Replacing the Bracket.....	14
Parts of the Board and Factory Defaults	15
Setting the Board ID	15
Plugging the Board	16

Step 3 Installing the Hardware	17
Turning on the PC.....	17
Setting with the Found New Hardware Wizard.....	17
Step4 Initializing the Software	20
Invoking API-TOOL Configuration	20
Updating the Settings.....	20
Step 5 Checking Operations with the Diagnosis Program	21
What is the Diagnosis Program?.....	21
Check Method.....	21
Using the Diagnosis Program	22
Setup Troubleshooting.....	25
If your problem cannot be resolved.....	25

3.	EXTERNAL CONNECTION	27
-----------	----------------------------	-----------

How to connect the connectors.....	27
Connector shape.....	27
Connector Pin Assignment	28
Relationships between API-PAC(W32) Logical Ports/Bits and Connector Signal Pins	29
Connecting Input Signals.....	30
Input Circuit.....	30
Connecting a Switch	30
Output Circuit	31
Output Circuit	31
Connection to the LED	31

4.	FUNCTION	33
-----------	-----------------	-----------

Data I/O Function	33
Data Input.....	33
Data Output.....	33
Monitoring Output Data.....	33
Digital Filter.....	34
Digital Filter Function Principle.....	34
Set Digital Filter Time	34
Interrupt Control Function.....	35
Disabling/enabling Interrupts	35
Selecting the Interrupt Edge	35
Clearing the Interrupt Status and Interrupt Signal	35

5.	ABOUT SOFTWARE	37
	CD-ROM Directory Structure	37
	About Software for Windows.....	38
	Accessing the Help File.....	38
	Using Sample Programs	39
	Uninstalling the Driver Libraries	41
	About Software for Linux.....	42
	Driver Software Install Procedure.....	42
	Accessing the Help File.....	43
	Using Sample Programs	43
	Uninstalling the driver.....	43
6.	ABOUT HARDWARE	45
	For detailed technical information	45
	Hardware specification.....	45
	Block Diagram.....	47

1. Before Using the Product

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

About the Board

This product is a PCI Express bus-compliant interface board for input/output of unisolated TTL-level digital signals.

This product can input and output up to 16 channels. You can use all of the input signals as interrupt inputs.

This product supports a Low Profile size slot and, if replaced with the supplied bracket, supports a standard size slot, too.

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

- Unisolated TTL-level input x 16 channels,
Unisolated open collector output x 16 channels
- Unisolated TTL-level (positive logic) input/output enabling fast response (within 200nsec)
- You can use all of the input signals as interrupt inputs.
You can also disable or enable the interrupt in bit units and select the interrupt edge.
- This product has a digital filter to prevent input signals from carrying noise or a chattering.
- The rated output signal is up to 30VDC, 40mA per one signal.
- Support for both of low-profile and standard size slots (interchangeable with a bundled bracket)
- Equipped with the same function as the PCI board PIO-16/16T(LPCI)H
- The connector shape and the signal assignment for the connector is compatible with the PIO-16/16T(LPCI)H.

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

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

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

This driver is used to control CONTEC digital 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)

Shield Cable with Two 50-Pin Mini-Ribbon Connector	: PCB50PS-0.5P(0.5m)
	: PCB50PS-1.5P(1.5m)
Shield Cable with One 50-Pin Mini-Ribbon Connector	: PCA50PS-0.5P(0.5m)
	: PCA50PS-1.5P(1.5m)
Connection Conversion 0.5m Shield Cable (50-Pin Ribbon→37-Pin D-SUB)	: PCE50/37PS-0.5P(0.5m)

Accessories (Option)

Screw Terminal Unit(M3 terminal block, 50 points)	: EPD-50A *1
Screw Terminal Unit(M3 terminal block, 37 points)	: EPD-37A *2
Screw Terminal Unit(M3.5 terminal block, 37 points)	: EPD-37 *2
General Purpose Terminal	: DTP-3A *3
Termination Panel (M3)	: DTP-3(PC) *3
Screw Terminal	: DTP-4A *3
Termination Panel	: DTP-4(PC) *3
Signal Monitor for Digital I/O	: CM-32(PC)E *2

*1 PCB50PS-*P optional cable is required separately.

*2 PCE50/37PS-0.5P and PCB37P or PCB37PS optional cable is required separately.

*3 PCE50/37PS-0.5P optional cable is required separately.

* 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 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 extension slot while the computer's power is turned on. And also do not connect the board and external device while the power is turned on. Otherwise, the board may malfunction, overheat, or cause a failure. Be sure that the personal computer or the I/O extension unit power is turned off.
 - Make sure that your PC or extension 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

Humidity

10 - 90%RH (No condensation)

Corrosive gases

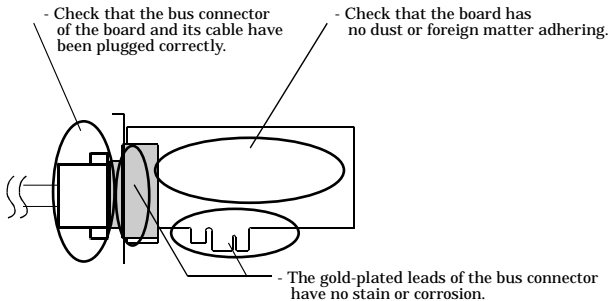
None

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, and then put it in the box.
- (3) Store the package at room temperature at a place free from direct sunlight, moisture, shock, vibration, magnetism, and static electricity.

Disposal

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

2. Setup

This chapter explains how to set up the 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 Linux, see the following parts of this manual.

This chapter Step 2 Setting the Hardware

Chapter 3 External Connection

Chapter 5 About Software

Chapter 6 About Hardware

For using the board under an OS other than Windows and Linux, 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

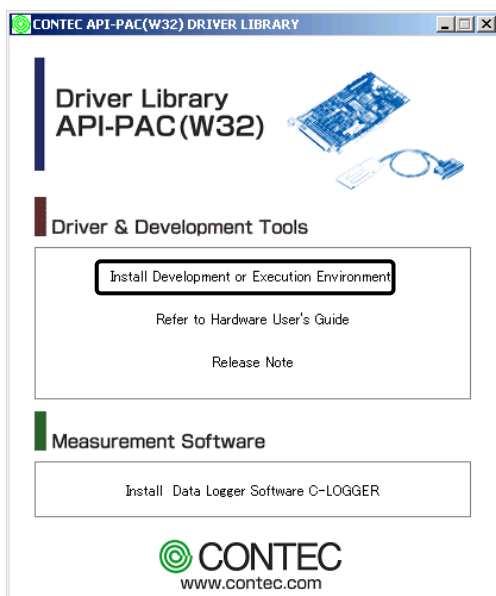
This section describes how to install the Driver libraries.

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.

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.

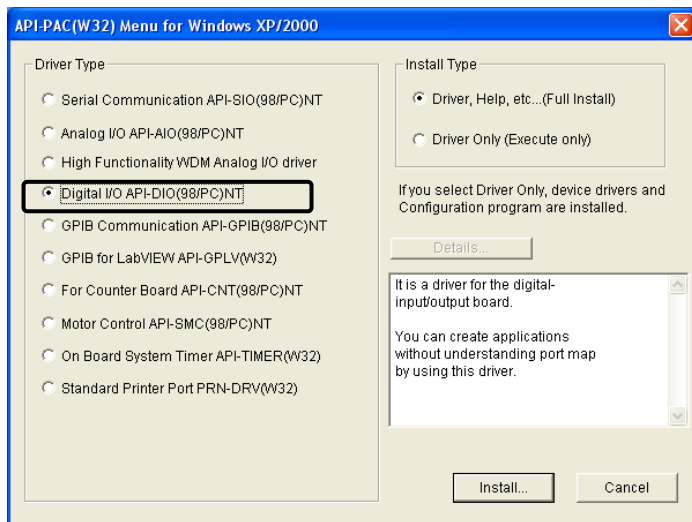


⚠ CAUTION

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

Selecting the Digital I/O Driver

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



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” and “Show readme file” check boxes are displayed.

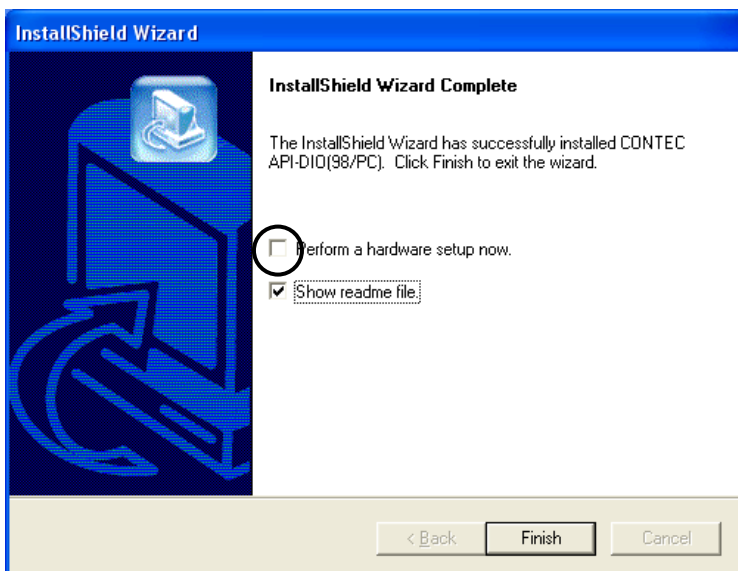
When you are installing the software or hardware for the first time:

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”, 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 to be preset.

Check the on-board switches before plugging the board into an extension slot.

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

Replacing the Bracket

This board is shipped with a Low Profile size bracket mounted. To plug the board into a standard size slot, replace the bracket with the bundled standard size bracket. The replacing method is as follows :

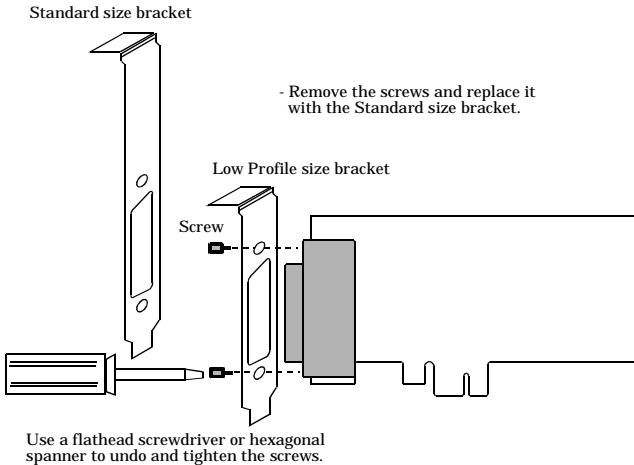


Figure 2.1. Replacing the Bracket

Parts of the Board and Factory Defaults

Figure 2.2. shows the names of major parts on the board.

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

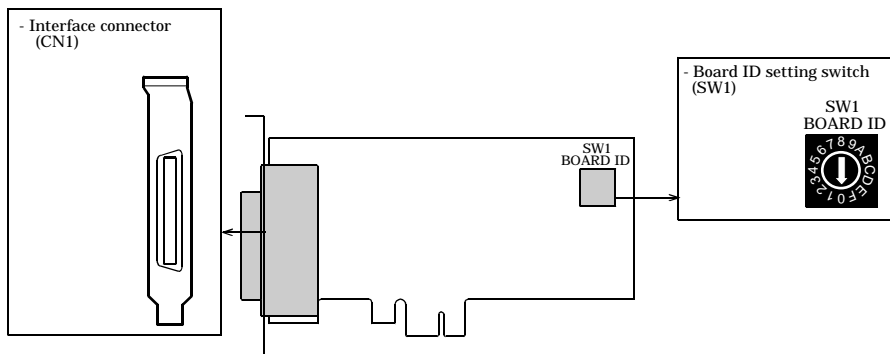


Figure 2.2. Component Locations

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 to 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.

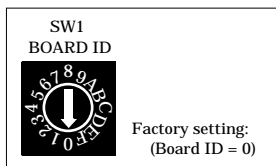
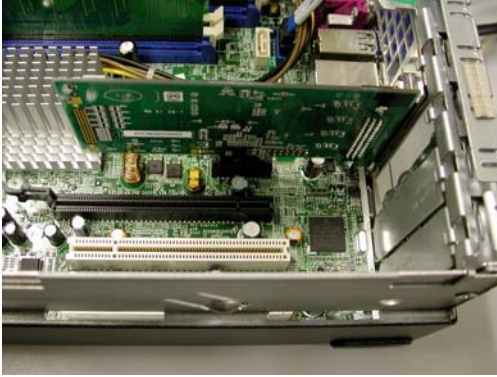


Figure 2.3. Board ID Settings (SW1)

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 extension slot.
- (4) Attach the board bracket to the PC.
- (5) 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 or extension unit's power is turned on. Otherwise, the board may malfunction, overheat, or cause a failure. Be sure that the personal computer or the I/O extension unit power is turned off.
 - Make sure that your PC or extension 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 extension 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 Found New Hardware Wizard.

Turning on the PC

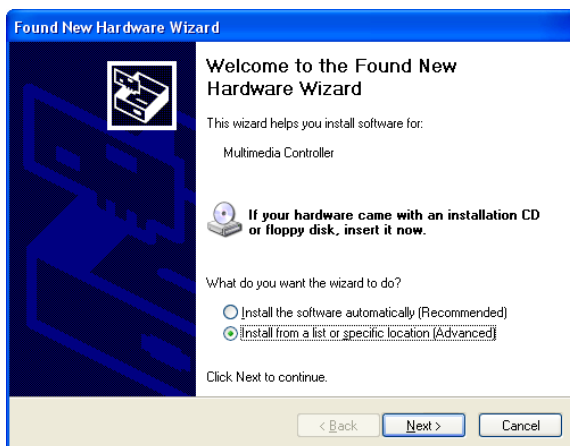
Turn on the power to your PC.

CAUTION

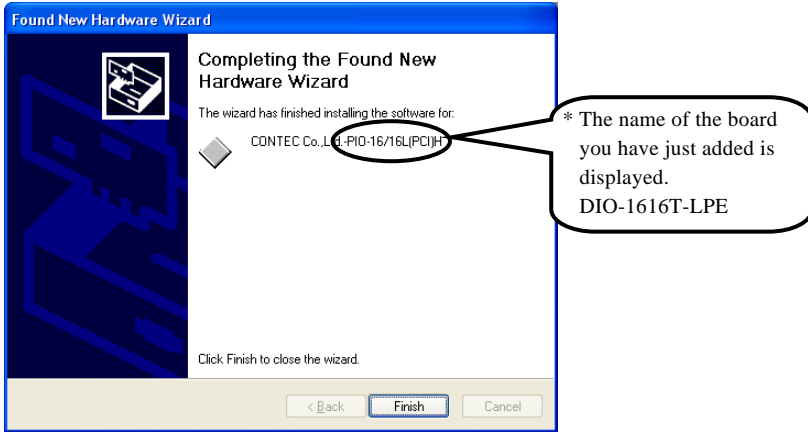
- The board cannot be properly installed unless the resources (I/O addresses and interrupt level) for the board can be allocated. Before attempting to install the board, first determine what PC resources are free to use.
- The resources used by each board do not depend on the location of the PCI Express 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.

Setting with the Found New Hardware Wizard

- (1) First, “PCI Standard PCI to PCI Bridge” will be checked and end automatically.
- (2) The “Found New Hardware Wizard” will be started.
Select “Install from a list or specific location[Advanced]”, then click on the [Next] button.



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

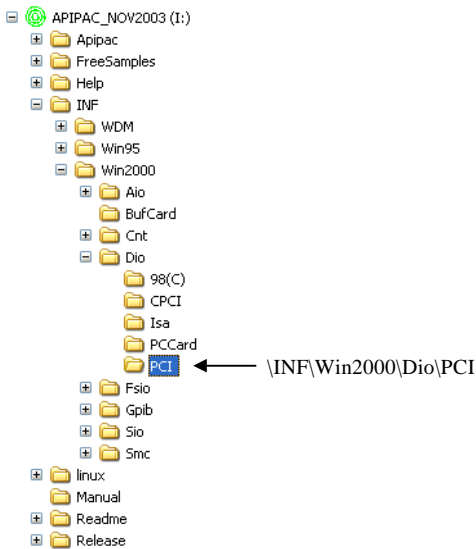


Source folder

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

Windows XP, 2000 \INF\Win2000\Dio\PCI

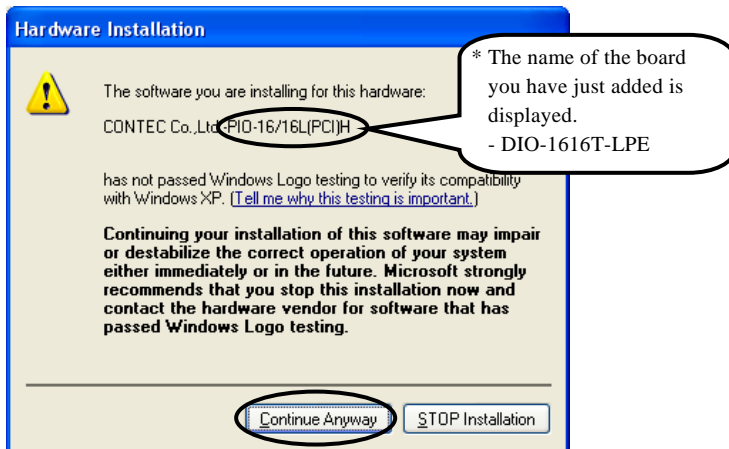
Example of specifying the folder for use under Windows XP



⚠ 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.



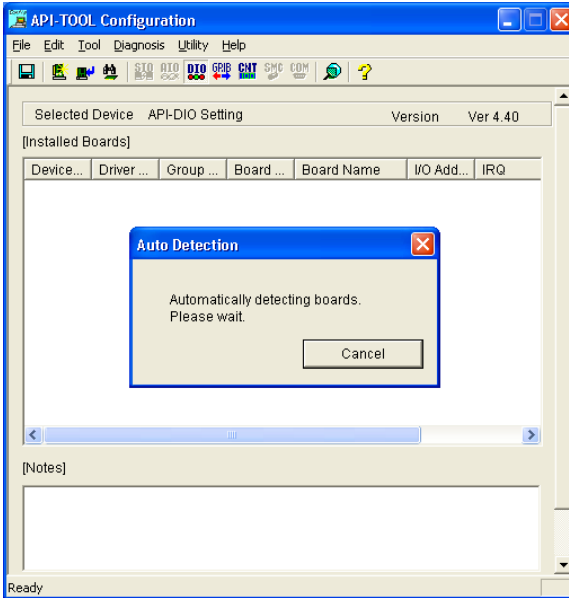
You have now finished installing the software.

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.

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 settings 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

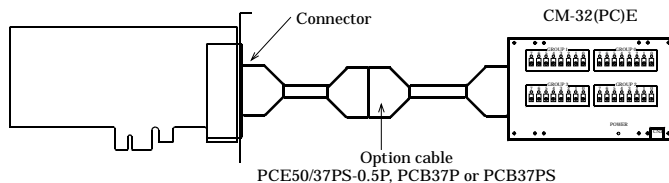
Connect the board to a remote device to test the input/output and check the execution environment.

For this board, an external power supply is not needed.

The Check Mate (CM-32(PC)E) comes in handy when you check digital I/O boards.

Check the board with the factor defaults untouched.

Connection diagram



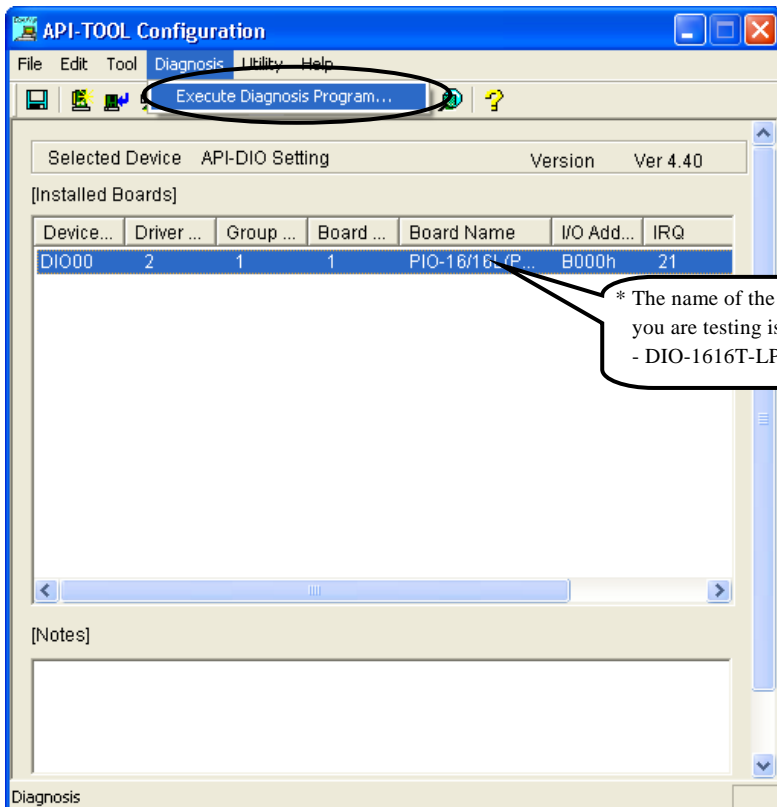
To connect a device other than the Check Mate, see Chapter 3 “External Connection”.

Using the Diagnosis Program

Starting the Diagnosis Program

Select the board in the API-TOOL Configuration windows, then run the Diagnosis Program. Follow the instructions on screen.

* The name of the board you have just added is displayed.



Checking Digital Inputs and Outputs

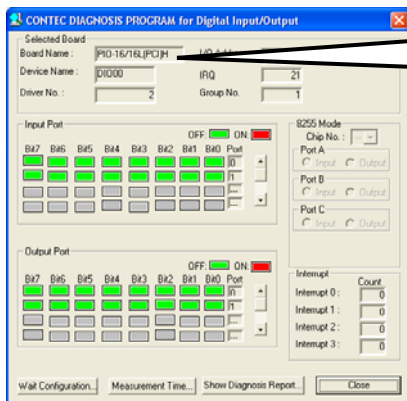
The main panel of the Diagnosis Program appears.

You can check the current operation states of the board in the following boxes:

“Input Port” : Displays input values bit by bit at fixed time intervals.

“Output Port” : Mouse operation allows the data to output or display.

“Interrupt” : Displays the number of interrupts detected bit by bit.



* The name of the board you have just added is displayed.
- DIO-1616T-LPE

To use the wait time control feature, click on the [Wait Configuration] button. Use the feature when the wait time based on the DioWait or DioWaitEx function is not normal.

To use the function execution time measurement feature, click on the [Measurement Time] button. Enter the I/O start port and the number of ports, then press the measurement button. The time for each execution of a function will be measured.

Diagnosis Report

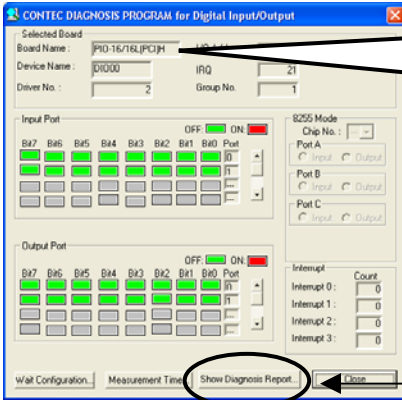
- (1) Clicking on the [Show Diagnosis Report] button displays detailed data such as board settings and the diagnosis results while saving them in text format.

The results are saved and displayed as a text file (DioRep.txt) in the install folder (Program Files\CONTEC\API-PAC(W32)).

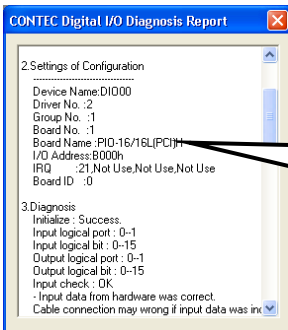
The Diagnosis Program performs “board presence/absence check”, “driver file test”, “board setting test”, and so on.

⚠ CAUTION

Before executing diagnosis report output, unplug the cable from the board.



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



Setup Troubleshooting

No output can be obtained.

Use API-TOOL Configuration to check whether the board name setting is wrong.

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 arguments to functions and their return values.
- When the board is an isolated type, it has a time lag for its response between the output by a function and the actual output. Consider the execution intervals between functions.

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

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

If your problem cannot be resolved

Contact your retailer.

3. External Connection

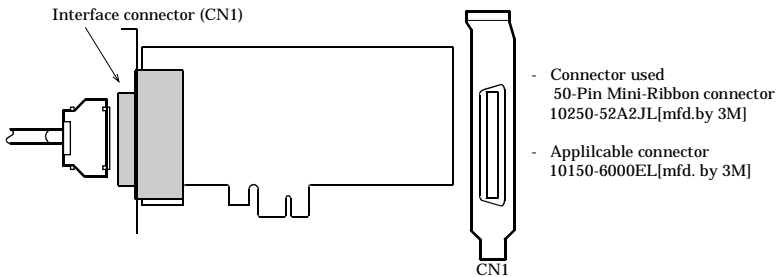
This chapter describes the interface connectors on the board and the external I/O circuits.

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.

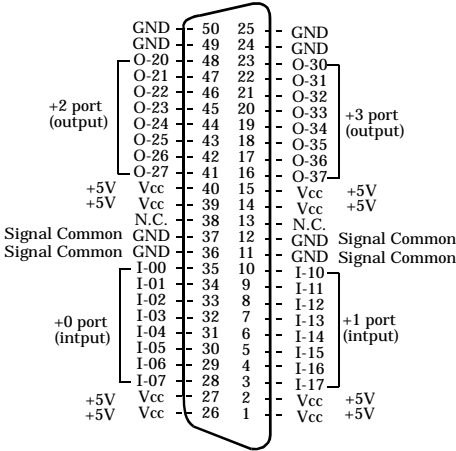


* Please refer to chapter 1 for more information on the supported cable and accessories.

Figure 3.1. Interface Connector (CN1) Shape

Connector Pin Assignment

Pin Assignments of Interface Connector (CN1)



I-00 - I-17	16 input signal pins. Connect output signals from the external device to these pins.
O20 - O37	16 output signal pins. Connect these pins to the input signal pins of the external device.
Vcc	This pin outputs power at +5 V.
GND	This pin is connected to the slot's GND.
N.C.	This pin is left unconnected.

Figure 3.2. Pin Assignments of Interface Connector (CN1)

Relationships between API-PAC(W32) Logical Ports/Bits and Connector Signal Pins

The following table lists the relationships between the connector signal pins and the logical port/bit numbers used for I/O functions when applications are written with API-PAC(W32).

Table 3.1. Logical Ports, Logical Bits, and Connector Signal Pins

	D7	D6	D5	D4	D3	D2	D1	D0
Input logical port 0	I-07	I-06	I-05	I-04	I-03	I-02	I-01	I-00
	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]
Input logical port 1	I-17	I-16	I-15	I-14	I-13	I-12	I-11	I-10
	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]
	D7	D6	D5	D4	D3	D2	D1	D0
Output logical port 0	O-27	O-26	O-25	O-24	O-23	O-22	O-21	O-20
	[7]	[6]	[5]	[4]	[3]	[2]	[1]	[0]
Output logical port 1	O-37	O-36	O-35	O-34	O-33	O-32	O-31	O-30
	[15]	[14]	[13]	[12]	[11]	[10]	[9]	[8]

Note: I-xx and O-xx represent input and output signals, respectively, where [xx] indicates a logical bit.



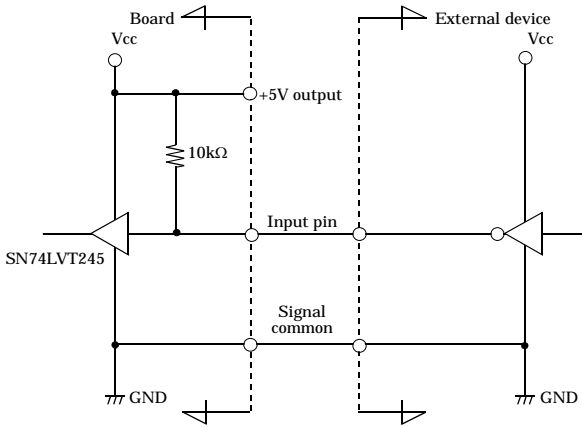
CAUTION

The logical port and logical bit numbers are virtual port and bit numbers that enable programming independent of board I/O addresses or board types.

For details, refer to API-DIO HELP available after installing API-PAC(W32).

Connecting Input Signals

Input Circuit



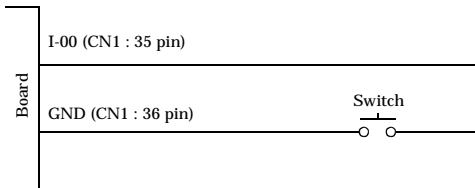
* Input pin represent input signals.

Figure 3.3. Input Circuit

The input circuit of interface is illustrated in Figure 3.3.

External digital signals given to signal inputs are TTL levels. The individual input signals are passed to the personal computer as active low signals. As each of the signal inputs is pulled up internally, the output of a relay contact or semiconductor switch can be connected directly between the signal input and the signal common pin.

Connecting a Switch

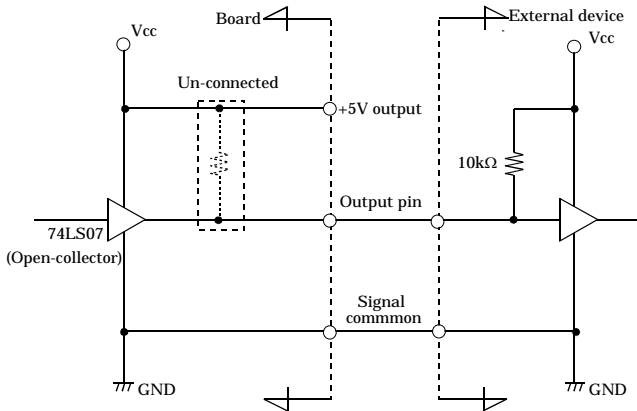


When the switch is ON, the corresponding bit contains 1.
 When the switch is OFF, by contrast, the bit contains 0.

Figure 3.4. An Example to use Input I-00

Output Circuit

Output Circuit



* Output pin represent output signals.

Figure 3.5. Output Circuit

The output circuit of interface is illustrated in Figure 3.5.

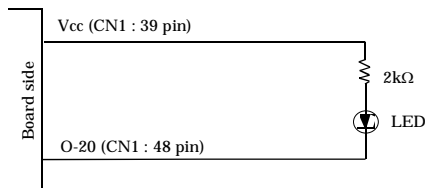
Signal outputs are open-collector outputs; individual output signals are sent to the external device as active low signals. Note that each signal output must be pulled up at the external device as it is not pulled up internally.



CAUTION

When the PC is turned on, all output are reset to OFF.

Connection to the LED



When "1" is output to a relevant bit, the corresponding LED comes on.

When "0" is output to the bit, in contrast, the LED goes out.

Figure 3.6. An Example to use Output O-00

4. Function

This section describes the features of the board.

Each function described here can be easily set and executed by using the bundled API function library. For details, refer to API-DIO HELP available after installation.

Data I/O Function

Data Input

When input data is “ON”, “1” is input to the relevant bit.

When the input data is “OFF”, in contrast, “0” is input to the relevant bit

Data Output

When “1” is output to the relevant bit, the corresponding transistor is set to “ON”.

When “0” is output to the relevant bit, in contrast, the corresponding transistor is set to “OFF”.



CAUTION

When the PC is turned on, all output are reset to 0 (OFF).

Monitoring Output Data

This product can read the state of the data currently being output without affecting the output data.

Digital Filter

Using this feature, this product can apply a digital filter to every input pin, thereby preventing the input signal from being affected by noise or chattering.

Digital Filter Function Principle

The digital filter checks the input signal level during the sampling time of the clock signal. When the signal level remains the same for the digital filter set time, the digital filter recognizes that signal as the input signal and changes the signal level of the PC.

If the signal level changes at a frequency shorter than the set time, therefore, the level change is ignored.

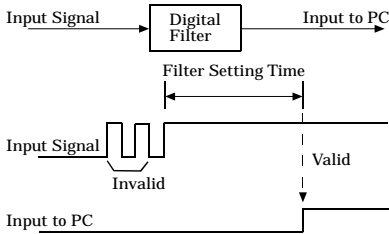


Figure 4.1. Digital Filter Function Principle

Set Digital Filter Time

Set the digital filter time to 0 - 20 (14h).

Setting the digital filter time to 0 disables digital filtering. It is set to 0 when the power is turned on.

Figure 4.2 shows the relationships between digital filter time settings and the actual digital filter times.

$$\text{Digital Filter Time[sec.]} = 2^n / (8 \times 10^6)$$

$$n: = \text{setting data}(0 - 20)$$

Setting Data (n)	Digital Filter Time	Setting Data (n)	Digital Filter Time	Setting Data (n)	Digital Filter Time
0 (00h)	The filter function is not used.	7 (07h)	16μsec	14 (0Eh)	2.048msec
1 (01h)	0.25μsec	8 (08h)	32μsec	15 (0Fh)	4.096msec
2 (02h)	0.5μsec	9 (09h)	64μsec	16 (10h)	8.192msec
3 (03h)	1μsec	10 (0Ah)	128μsec	17 (11h)	16.384msec
4 (04h)	2μsec	11 (0Bh)	256μsec	18 (12h)	32.768msec
5 (05h)	4μsec	12 (0Ch)	512μsec	19 (13h)	65.536msec
6 (06h)	8μsec	13 (0Dh)	1.024msec	20 (14h)	131.072msec

Figure 4.2. Digital Filter Time and Setting Data

⚠ CAUTION

- If you set the digital filter time, the filter applies to all input pins. You cannot apply the filter only to a specific filter.
- Do not set Setting Data to a value outside the above range as doing so can cause the board to malfunction.

Interrupt Control Function

This product can use all of the input signals as interrupt request signals.

This product can generate an interrupt request signal to the PC when the input signal change from High to Low or from Low to High.

When the digital filter (described above) is used, interrupt requests are generated by input signals that have passed through the filter.

Disabling/enabling Interrupts

Interrupt mask bits can be used to disable or enable the individual bits for interruptions.

Once a certain bit has been interrupt-disabled, no interrupt occurs even when the corresponding input signal changes its level.

To let interrupts occur, enable the corresponding interrupt mask bit for interruptions.



CAUTION

All of the interrupt mask bits are interrupt-disabled when the power is turned on.

Selecting the Interrupt Edge

Interrupt edge select bits can be used to set the input logic for interruption bit by bit.

If you set an interrupt edge select bit to 0, an interrupt occurs when the input value to the corresponding bit changes from 0 to 1 (at the fall of the input signal from High to Low).

If you set an interrupt edge select bit to 1, an interrupt occurs when the input value to the corresponding bit changes from 1 to 0 (at the rise of the input signal from Low to High).



CAUTION

When the power is turned on, all of the interrupt edge select bits are set to 0 so that an interrupt occurs when the input value changes from 0 to 1 (at the fall of the input signal from High to Low).

Clearing the Interrupt Status and Interrupt Signal

Interrupt status bits are used to identify the input signal bit being used for requesting an interrupt. When an interrupt status is input, the interrupt request signal and the interrupt status are cleared automatically.



CAUTION

- All of the interrupt status bits are set to 0 when the power is turned on.
 - If an interrupt mask bit has been set to disable interrupts, the interrupt status bit is not set even when the input signal changes its level.
-

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

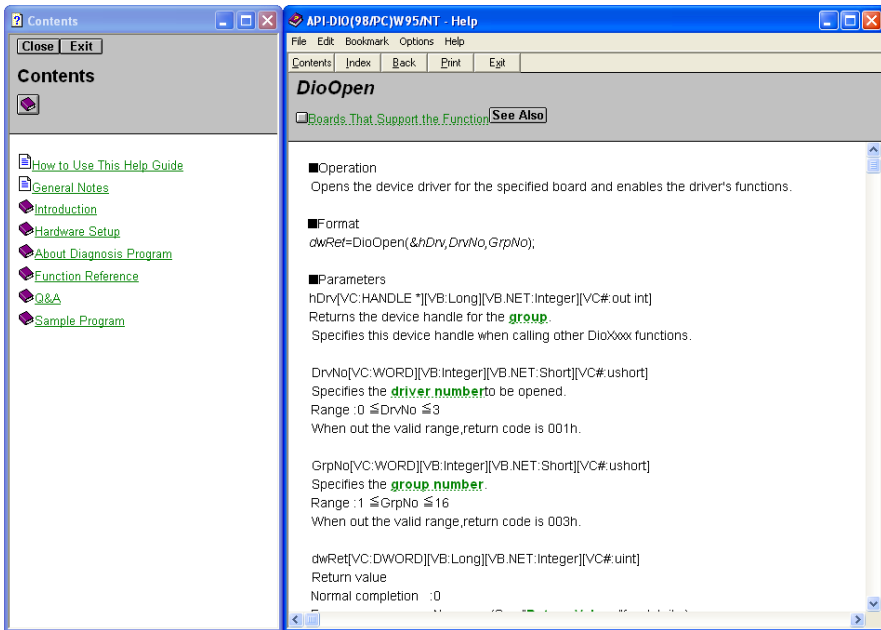
The bundled CD-ROM “Driver Library Package API-PAC(W32)” contains the functions that provide the following features:

- Digital input/output of specified ports
- Hardware digital input/output of specified bits
- Hardware digital filtering that prevents chattering

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.

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)” - “Dio” - “API-DIO HELP” to display help information.



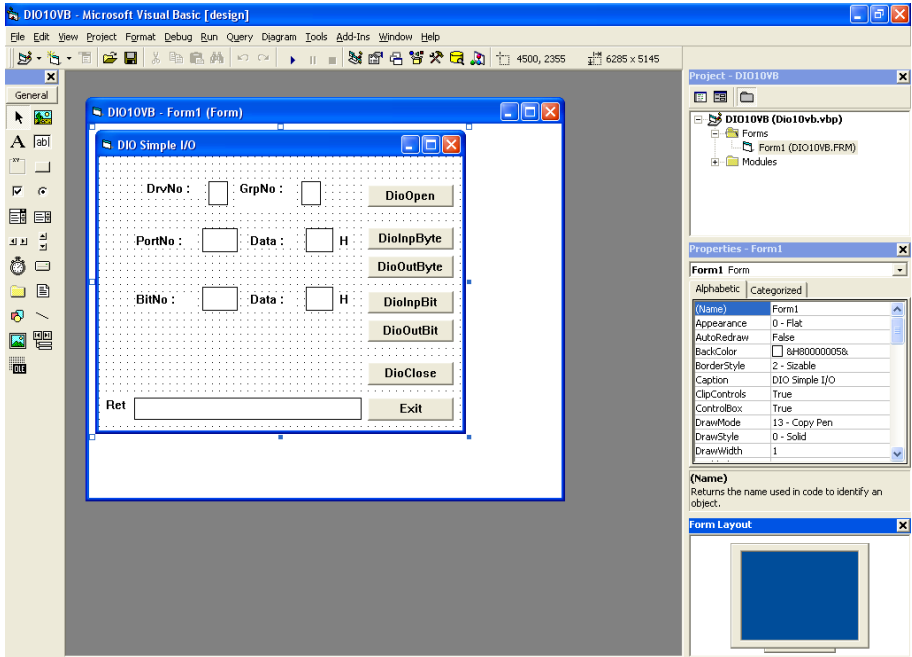
Using Sample Programs

Sample programs have been prepared for specific basic applications.

To use each sample program, enter its driver number and group number set by API-TOOL Configuration in the DrvNo and GrpNo fields.

Use these sample programs as references for program development and operation check.

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



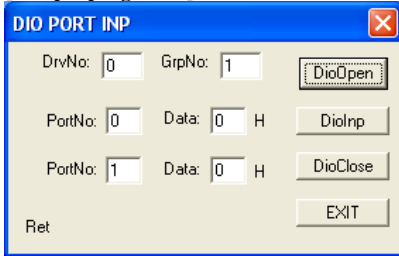
Running a Sample Program

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

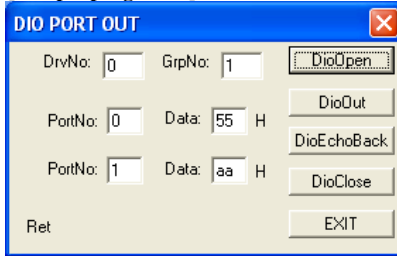
Sample Programs - Examples

- Sample program 1 : Inputs digital data through a specified port.
- Sample program 2 : Outputs digital data through a specified port.
- Sample program 3 : Inputs/outputs digital data from/to a programmable board.
- Sample program 4 : Inputs digital data from a specified port in the background.
- Sample program 5 : Inputs/outputs digital data from/to a specified bit.
- Sample program 6 : Services interrupts of a specified board.
- Sample program 7 : Provides process control of a specified board.
- Sample program 8 : Performs trigger monitoring of a specified board.
- Sample program 9 : Inputs digital data through a specified port using BCD data.
- Sample program 10 : Executes digital input (simple functions) at specified bits through a specified port.
- Sample program 11 : Services interrupts of a specified board (using an extended function).
- Sample program (Console): Inputs/outputs digital data through a specified port.

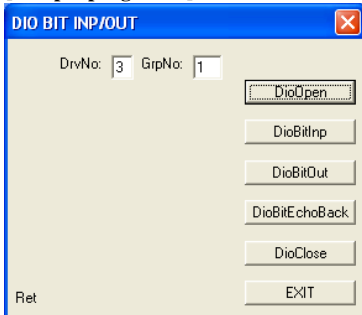
[Sample program 1]



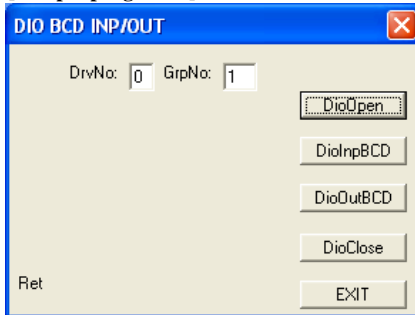
[Sample program 2]



[Sample program 5]



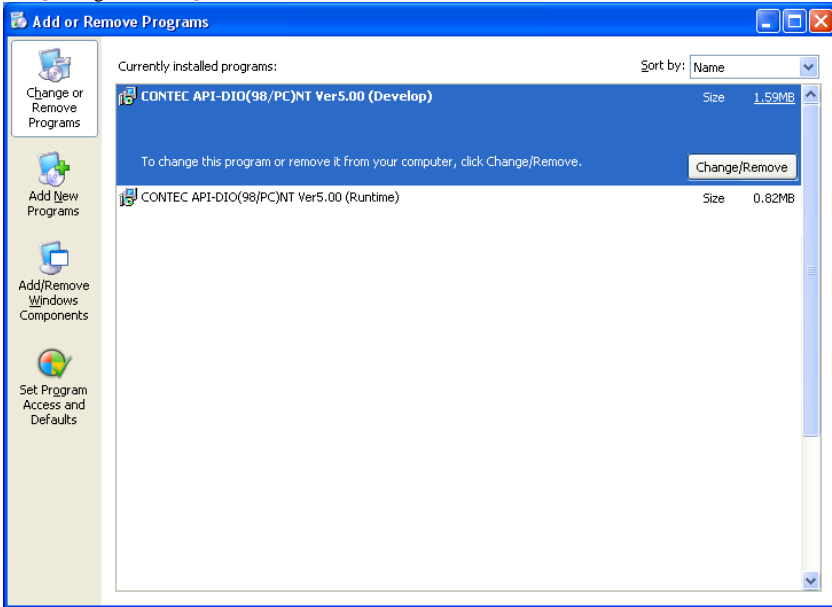
[Sample program 9]



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 “Control Panel”.
- (2) Double-click on “Install or Remove Programs and Windows components” in the Control Panel.
- (3) Select “CONTEC API-DIO(98/PC)xx” from the application list displayed, then click on the [Change/Remove] button. Follow the on-screen instructions to uninstall the function libraries.



About Software for Linux

The Linux version of digital I/O function driver, API-DIO(LNX), provides functions that execute the following features:

- Digital input/output of specified ports
- Digital input/output of specified bits
- Hardware digital filtering that prevents chattering

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-DIO(LNX), is supplied as a compressed file /linux/dio/cdioXXX.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/dio/cdioXXX.tgz ./ Copy the compressed file.
# tar xvfz cdioXXX.tgz                 Decompress the compressed file.
.....
# cd contec/cdio
# make                                  Compile the file.
.....
# make install                          Install.
.....
# cd config
# ./config                               Set up the board to be used.
..... Set as follows.....
# ./contec_dio_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 the contec/cdio/help directory.

Using Sample Programs

Sample programs have been prepared for specific basic applications.

Sample programs for each language are contained in the contec/cdio/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/cdio directory. For details, check the contents of the script.

6. About Hardware

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

For detailed technical information

For further detailed technical information (“Technical Reference” including the information such as an I/O map, configuration register, etc.), visit the Contec’s web site (<http://www.contec.com/support/>) to call for it.

Hardware specification

Table 6.1. Specification (1/2)

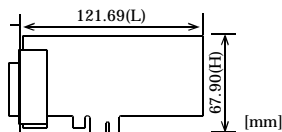
Item	Specification	
Input		
Input format	TTL-level input (Negative logic *1)	
Number of input signal channels	16 channels (all available for interrupts) (1 common)	
Input resistance	10kΩ (1 TTL load)	
Interrupt	16 interrupt input signals are arranged into a single output of interrupt signal INTA. An interrupt is generated at the rising edge (HIGH-to-LOW transition) or falling edge (LOW-to-HIGH transition).	
Response time	Within 200nsec	
Output		
Output format	Open-collector output (Negative logic *1)	
Number of output signal channels	16 channels (1 common)	
Output rating	Output voltage	30VDC (Max.)
	Output current	40mA (par channel) (Max.)
Response time	200nsec within (Variable with pull-up resistance)	

*1 Data “0” and “1” correspond to the High and Low levels, respectively.

Table 6.1. Specification (2/2)

Item	Specification
Common	
Built-in power	None
Allowable distance of signal extension	Approx. 1.5m (depending on wiring environment)
I/O address	Any 32-byte boundary
Interruption level	1 level use
Max. board count for connection	16 boards including the master board
Power consumption (Max.)	3.3VDC 300mA
Operating condition	0 - 50°C, 10 - 90%RH (No condensation)
Bus specification	PCI Express Base Specification Rev. 1.0a x1
Dimension (mm)	121.69(L) × 67.90(H)
Connector	50-Pin Mini-Ribbon connector 10250-52A2JL[mfd.by 3M]
Weight	60g

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

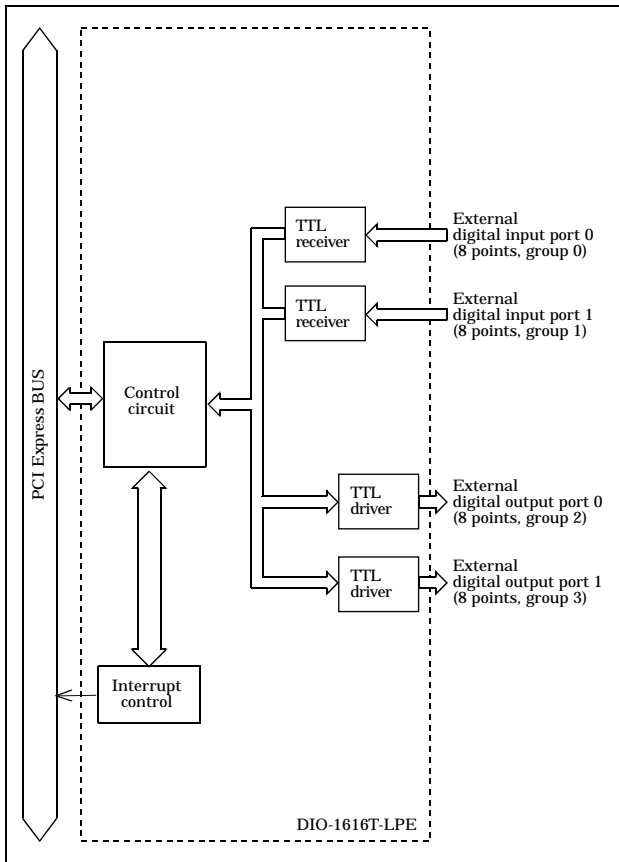


Figure 6.1. Block Diagram

DIO-1616T-LPE

User's Guide

CONTEC CO., LTD.

May 2006 Edition

3-9-31, Himesato, Nishiyodogawa-ku, Osaka 555-0025, Japan

Japanese <http://www.contec.co.jp/>

English <http://www.contec.com/>

Chinese <http://www.contec.com.cn/>

No part of this document may be copied or reproduced in any form by any means without prior written consent of CONTEC CO., LTD. [05252006]

[03172006]

Management No. A-51-213

[05252006_rev2]

Parts No. LYFY721