

PC-HELPER

Digital I/O Card with Opto-Isolation
for CardBus

PIO-16/16L(CB)H

User's Guide

CONTEC CO.,LTD.

Check Your Package

Thank you for purchasing the CONTEC product.

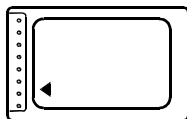
The product consists of the items listed below.

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

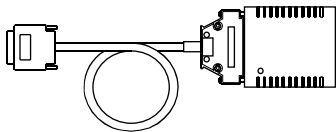
Product Configuration List

- PC Card [PIO-16/16L(CB)H] ...1
- Cable with isolation unit [PIO-16/16L(CB)H-BOX and CB-PM68/37] ...1
- First step guide ...1
- CD-ROM [API-PAC(W32) *1] ...1

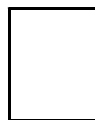
*1 The CD-ROM contains the driver software and User's Guide (this guide)



PC card



Cable with isolation unit



First step guide



CD-ROM
[API-PAC(W32)]

Copyright

Copyright 2004 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 and Windows NT 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 PC Card | 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 PC card under Windows Using the Driver Library API-PAC(W32) | 9 |
| Using the PC card under Windows Using Software other than the Driver Library API-PAC(W32)..... | 9 |
| Using the PC card 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 |
| Part Names | 14 |
| Connecting the PC Card to the Connector Cable..... | 15 |
| Insert the PC Card..... | 16 |
| Cautions When Using Two or More PIO-16/16L(CB)H Cards..... | 17 |

| | |
|---|----|
| Step 3 Installing the Hardware | 18 |
| Turning on the PC..... | 18 |
| Setting with the Add New Hardware Wizard..... | 18 |
| Step 4 Initializing the Software | 21 |
| Invoking API-TOOL Configuration | 21 |
| Updating the Settings..... | 21 |
| Step 5 Checking Operations with the Diagnosis Program | 22 |
| What is the Diagnosis Program?..... | 22 |
| Check Method..... | 22 |
| Using the Diagnosis Program | 23 |
| Setup Troubleshooting..... | 26 |
| Symptoms and Actions | 26 |
| If your problem cannot be resolved..... | 26 |

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

| | |
|---|----|
| Using the On-board Connectors | 27 |
| Connecting a Device to a Connector | 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 | 32 |
| Example of Connection to TTL Level Input | 32 |
| Connecting the Sink Type Output and Sink Output Support Input | 33 |

| | |
|-------------------------|-----------|
| 4. FUNCTION | 35 |
|-------------------------|-----------|

| | |
|--|----|
| Data I/O Function | 35 |
| Data Input..... | 35 |
| Data Output..... | 35 |
| Monitoring Output Data..... | 35 |
| Digital Filter..... | 36 |
| Digital Filter Function Principle..... | 36 |
| Set Digital Filter Time | 36 |
| Interrupt Control Function..... | 37 |
| Disabling/Enabling Interrupts..... | 37 |
| Selecting the Interrupt Edge | 37 |
| Clearing the Interrupt Status and Interrupt Signal | 37 |

| | | |
|-----------|---|-----------|
| 5. | ABOUT SOFTWARE | 39 |
| | CD-ROM Directory Structure | 39 |
| | About Software for Windows..... | 40 |
| | Accessing the Help File..... | 40 |
| | Using Sample Programs | 41 |
| | Uninstalling the Driver Libraries | 43 |
| | About Software for Linux..... | 44 |
| | Driver Software Install Procedure..... | 44 |
| | Accessing the Help File..... | 45 |
| | Using Sample Programs | 45 |
| | Uninstalling the driver..... | 45 |
| 6. | ABOUT HARDWARE | 47 |
| | Hardware specification..... | 47 |
| | Block Diagram..... | 49 |

1. Before Using the Product

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

About the PC Card

PIO-16/16L(CB)H is a PC Card Standard compliant CardBus TYPE II size PC Card for input/output of digital signals.

PIO-16/16L(CB)H can input and output digital signals at 12 to 24 VDC and can input and output up to 16 channels.

Using the bundled Driver library [API-PAC(W32)], you can create Windows application software for this PC card in your favorite programming language supporting Win32 API functions, such as Visual Basic or Visual C/C++.

Features

- The signal assignment for the connector is compatible with the PIO-16/16L(PCI)H, PIO-16/16L(PCI), and PIO-16/16L(PM).
- The response time has been improved to 200μsec or better.
- Individual external power supplies can be used for each common pin as it is shared by 16 signal points.
- The PC card slot side (PC) and the I/O interface are isolated from each other by an opto-coupler, offering good noise immunity.
- You can use all of the input signals as interrupt inputs.
You can also select the interrupt trigger edge of the input signal.
- The PC card has a digital filter feature to prevent noise or chatter from causing erroneous inputs.
- Up to 35 VDC, 100 mA per signal, max. output.
- The output transistor has a zener diode connected to protect the PC card from surge voltages.
Overcurrent protective device provided for every eight channels of output transistors.

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/C++.

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

CONTEC provides download services 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, 2000, Me, 98, etc..

Adaptation language Visual C/C++, Visual Basic, Delphi, Builder, etc..

Others Each piece of library software requires 50 megabytes of free hard disk space.

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 (PC cards) from within Linux.

You can control CONTEC I/O boards easily using the shared library used by gcc and Kylix, the device driver (module) for each kernel version, and the board (PC card) configuration program (config).

CONTEC provides download services 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, Kylix, etc..

Others Requires 3 megabytes of free hard disk space.

Base package of ActiveX components for measurement system development

ACX-PAC(W32)BP (Option)

This is a set of useful Windows development tools for measurement systems and consists of a software component library with ready-to-use samples which you can combine for easy programming.

The package contains components for controlling CONTEC I/O boards (PC cards). Features include interface control for analog I/O, digital I/O, GPIB communications, and counter inputs, as well as X-Y plotting and file storage support.

Check the CONTEC's Web site for more information on this soft.

Advanced package of ActiveX components for measurement system development

ACX-PAC(W32)AP (Option)

Complements the ACX-PAC(W32)BP functions with additional components including graphics (plotting, switches, and lamps, etc.) and mathematical and analysis tools.

Check the CONTEC's Web site for more information on this soft.

Data acquisition VI library for LabVIEW **VI-DAQ** (Free download)

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.co.jp/vidaq/> for details and download of VI-DAQ.

Cable & Connector (Option)

| | |
|--|-----------------------|
| Flat Cable with a 37-Pin D-SUB Connectors on 2Ends | : PCB37P-1.5 (1.5m) |
| | : PCB37P-3 (3m) |
| | : PCB37P-5 (5m) |
| Shielded cable with a 37-pin D-SUB connectors on 2 Ends: | PCB37PS-0.5P (0.5m) |
| | : PCB37PS-1.5P (1.5m) |
| | : PCB37PS-3P (3m) |
| | : PCB37PS-5P (5m) |
| Flat Cable with a 37-pin D-SUB Connector | : PCA37P-1.5 (1.5m) |
| | : PCA37P-3 (3m) |
| | : PCA37P-5 (5m) |
| Shielded Cable with a 37-pin D-SUB Connectors | : PCA37PS-0.5P (0.5m) |
| | : PCA37PS-1.5P (1.5m) |
| | : PCA37PS-3P (3m) |
| | : PCA37PS-5P (5m) |
| D-SUB37P Male Connector Set (5 Pieces) | : CN5-D37M |

Accessories (Option)

| | |
|----------------------------------|-----------------|
| Relay Terminal Unit for Crimping | : EPD-37 *1 |
| Relay Terminal Unit for Crimping | : EPD-37A *1 |
| Termination Panel (M3) | : DTP-3(PC) |
| Terminal Unit for Cables | : DTP-4(PC) |
| Signal Monitor for Digital I/O | : CM-32(PC)E *1 |

*1 PCB37P or PCB37PS 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 Interface products are warranted by CONTEC CO., LTD. to be free from defects in material and workmanship for up to three years from the date of purchase by the original purchaser.

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

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

How to Obtain Service

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

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

Liability




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

Safety Precautions

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

Safety Information

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

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

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

- Mount the PC card in a PC card Standard CardBus compatible PC card slot.
 - Power saving mode (standby mode) is not supported.
 - Do not strike or bend the PC card.
Otherwise, the PC card may malfunction, overheat, cause a failure or breakage.
 - Do not subject the socket used to connect the cable to the PC card to knocks or other excessive force.
Otherwise, the PC card may malfunction, overheat, cause a failure or breakage.
 - Do not plug or unplug any PC card into or from the PC card slot with the PC powered.
 - Do not plug or unplug the connection cable with the PC powered.
 - Connect the cable to the PC card before inserting the PC card into the PC.
Otherwise, the PC card may malfunction, overheat, or cause a failure.
 - Do not try to remove the cable from the connector on the PC card without pressing the locking spring as this may prevent the cable from being securely connected.
 - When you use the PC card in a noisy environment or are nervous about noise, attach ferrite cores to the connection cable.
 - When inserting the PC card, check that you are inserting the PC card with the correct orientation and that the PC card is inserted firmly.
Inserting the PC card incorrectly may damage the PC card or connector or result in a bad connection.
 - Ensure that the PC power supply has sufficient capacity for all mounted PC cards.
An inadequate power supply may 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 PC card may overheat, malfunction, or cause a failure.

Operating temperature

0 to 50°C

Operating humidity

10 to 90%RH (No condensation)

Corrosive gases

None

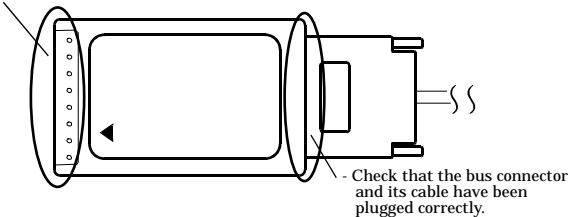
Floating dust particles

Not to be excessive

Inspection

Inspect the product periodically as follows to use it safely.

- The bus connector have no stain or corrosion.



Storage

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

- (1) Put the PC card 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 PC card.

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 PC card 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 PC card 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 PC card 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 PC card under an OS other than Windows

For using the PC card under 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 PC card 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

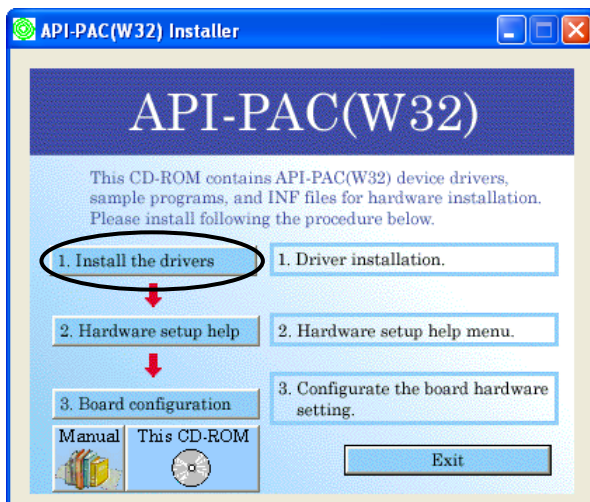
This section describes how to install the Driver libraries.

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 the drivers] button.

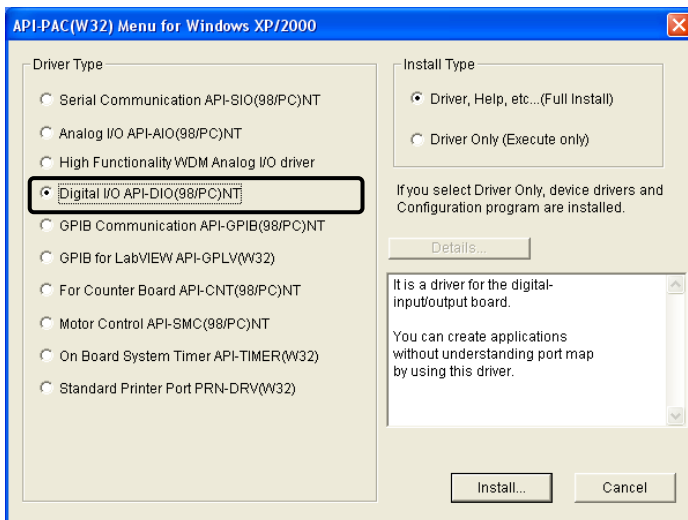


CAUTION

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”.
- (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:

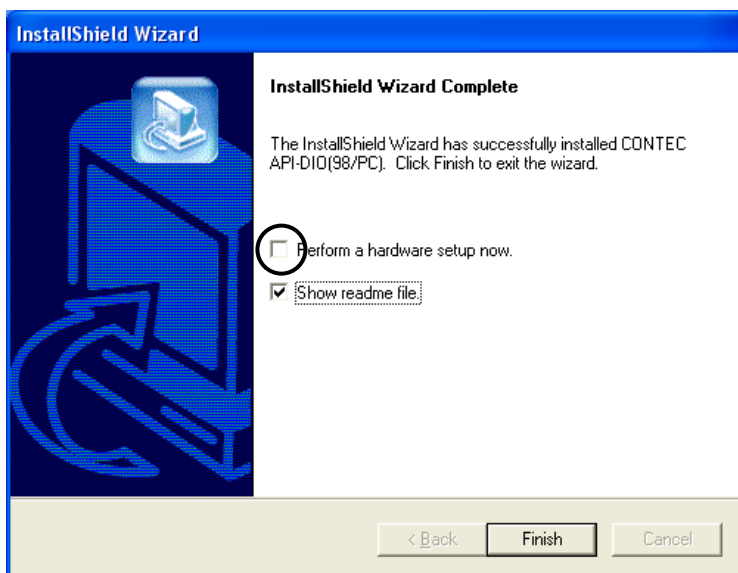
1) Uncheck the “Perform a hardware setup now”.

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

The following explains how to insert the PC card into the PC.

Part Names

Figure 2.1 shows the names of each part of the PC card.

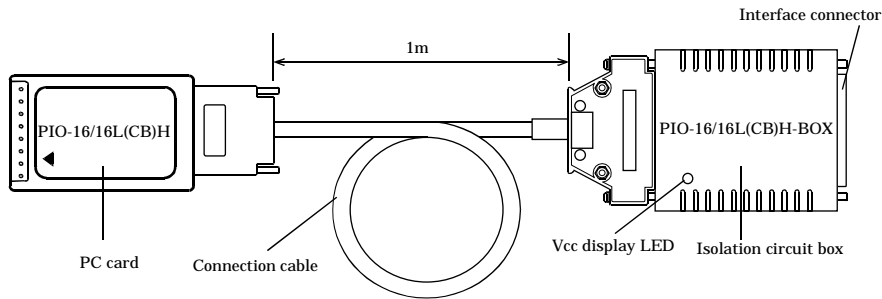


Figure 2.1. Part Names

Connecting the PC Card to the Connection Cable

Plug the PC card connector of the isolation circuit box PIO-16/16L(CB)H-BOX into the PIO-16/16L(CB)H PC card. Plug the cable with its connector' front surface (flat face) aligned with the top face of the PC card as shown in Figure 2.2.



CAUTION

- When plugging in the cable, align the cable connector with the PC card socket and push firmly into place. Do not apply any excessive force to the socket on the PC card as this may damage the socket or result in a bad connection.
- Never insert or unplug the connector while the PC power is turned on.

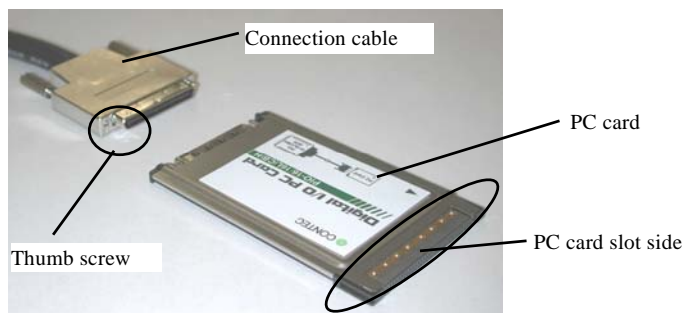


Figure 2.2. Connecting the PC Card to the Connection Cable

Insert the PC Card

Check that the power to the PC is turned off and insert the PC card into the PC card slot on the PC.

Firmly insert the PC card into the slot with the orientation indicated by the arrow symbol on the PC card, as shown in Figure 2.3.

The PC card has a key to prevent it from being inserted incorrectly. Do not try to force the PC card into the slot the wrong way around as this may damage the PC card or the slot on the PC. Also, check the PC card slot on your PC as the slots on some PCs are oriented so that PC cards is inserted with the topside facing down.

Refer to the manual for your PC for instructions on how to remove the PC card.



Figure 2.3. Insert the PC Card



CAUTION

Take note of the following points as inappropriate handling of the PC card may damage the PC card or connector socket and may result in a bad connection.

- Always insert the PC card with the correct orientation and in accordance with the instructions.
 - Do not hold the PC card by the cable or connector when inserting the PC card into the slot
 - Do not move the PC with the cable still plugged in.
 - Do not apply any excessive force to the cable socket on the PC card such as by pulling on the cable connector.
 - Do not place any objects on top of the cable connector.
-

Cautions When Using Two or More PIO-16/16L(CB)H PC Cards

If your PC has two TYPE II size PC card slots one on top of the other, you cannot use PIO-16/16L(CB)H PC cards in both slots at the same time. This is because of the shape of the cable connector.

However, you can use the PIO-16/16L(CB)H together with another PC card that does not require an external connector such as a memory PC card.

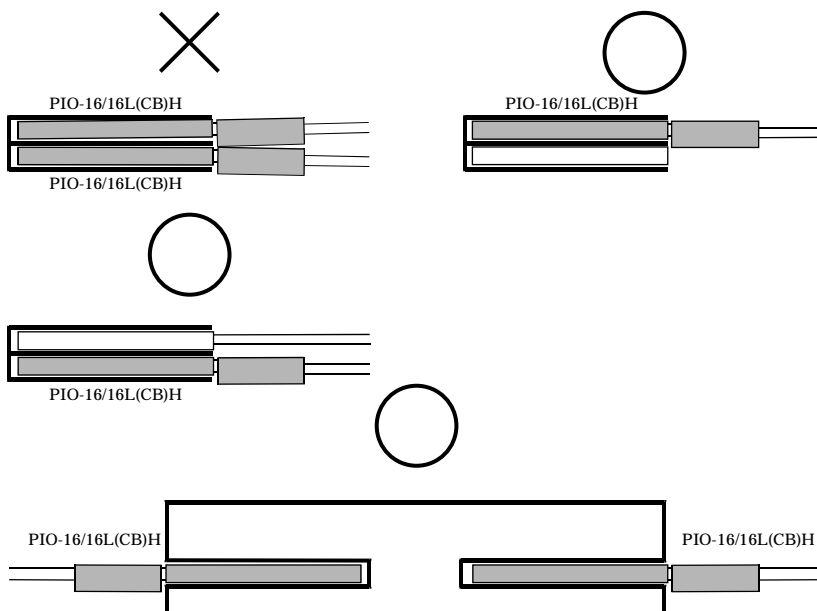


Figure 2.4. Cautions When Using Two or More PIO-16/16L(CB)H PC Cards

Step 3 Installing the Hardware

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

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

Turning on the PC

Turn on the power to your PC.

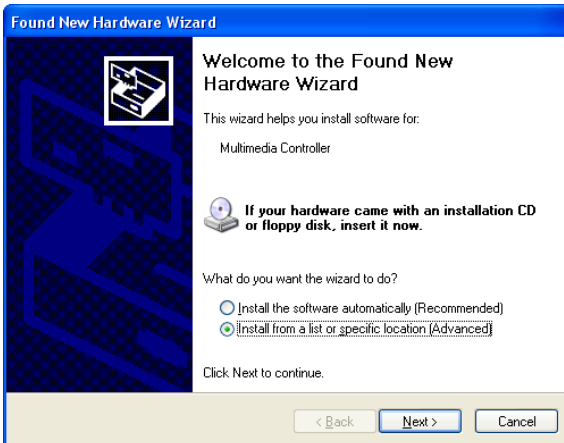
CAUTION

- The PC card cannot be properly installed unless the resources (I/O addresses and interrupt level) for the PC card can be allocated. Before attempting to install the PC card, first determine what PC resources are free to use.
 - The resources used by each PC card do not depend on the location of the PC cards slot or the PC card itself. If you remove two or more PC cards 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 PC cards are assigned to the remounted PC card. In this case, you must check the resource settings.
-

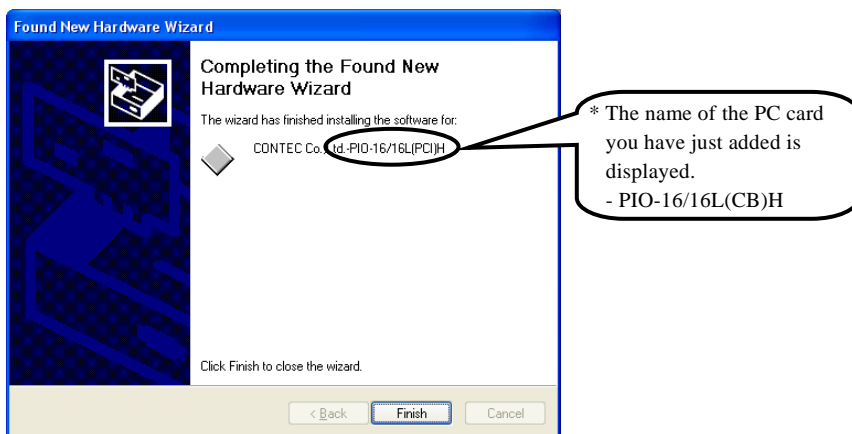
Setting with the Found New Hardware Wizard

(1) The "Found New Hardware Wizard" appears.

Select "Install from a list or specific location [Advanced]" and click the "Next" button.



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

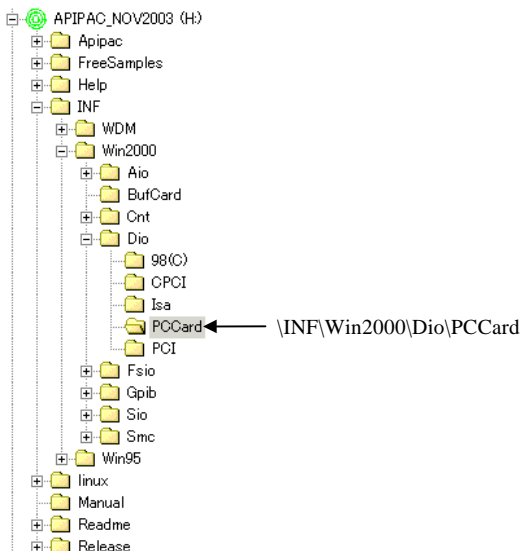


Source folder

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

| | |
|------------------|-------------------------|
| Windows XP, 2000 | \INF\Win2000\Dio\PCCard |
| Windows Me, 98 | \INF\Win95\Dio\PCCard |

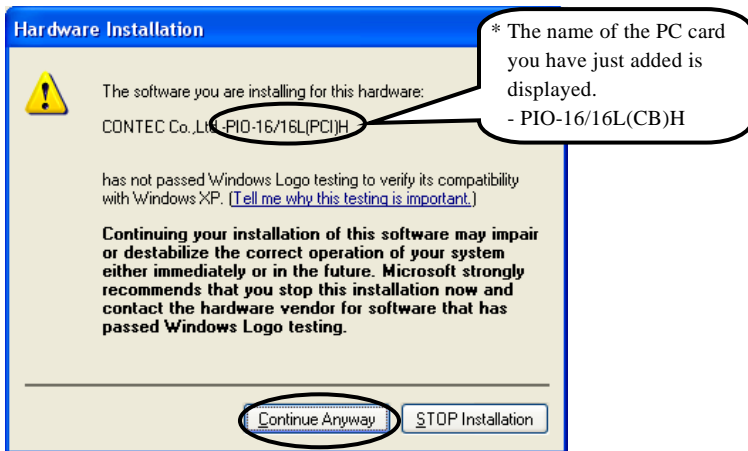
Example of specifying the folder for use under Windows XP



⚠ 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 PC card.

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



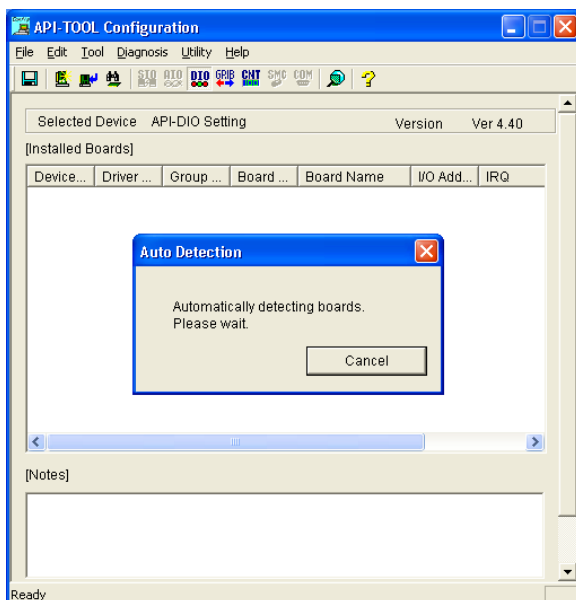
You have now finished installing the software.

Step 4 Initializing the Software

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

Invoking API-TOOL Configuration

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



- (2) API-TOOL Configuration detects the hardware automatically.
The detected the PC cards 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 PC card 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 PC card 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 PC card, I/O status, and interrupt status.

Check Method

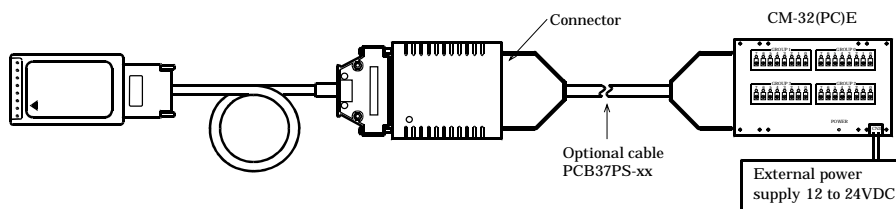
Connect the PC card to a remote device to test the input/output and check the execution environment.

For this PC card, prepare an external power supply (12 to 24 VDC).

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

Check the PC card with the factor defaults untouched.

Connection diagram



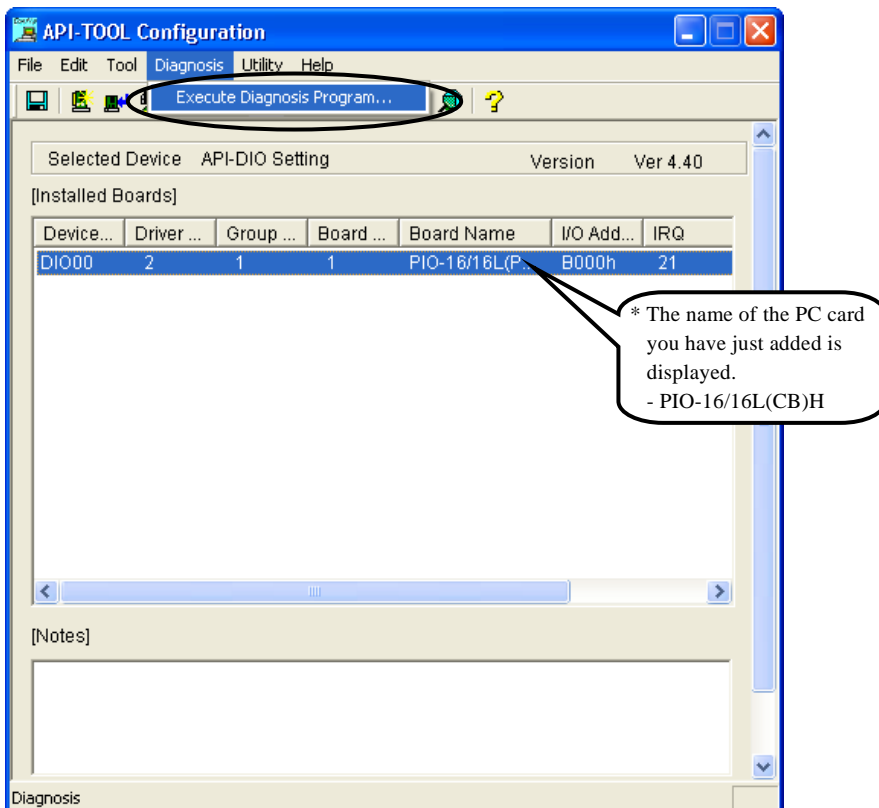
To connect a device other than the Check Mate, see Chapter 3 “External Connection”.

Using the Diagnosis Program

Starting the Diagnosis Program

Select the PC card in the API-TOOL Configuration windows, then run the Diagnosis Program. Run as the following screen.

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



Checking Digital Inputs and Outputs

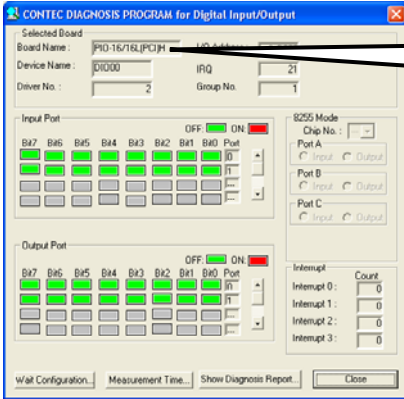
The main panel of the Diagnosis Program appears.

You can check the current operation states of the PC card 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 PC card
you have just added is
displayed.
- PIO-16/16L(CB)H

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 PC card settings and the diagnosis results while saving them in text format.

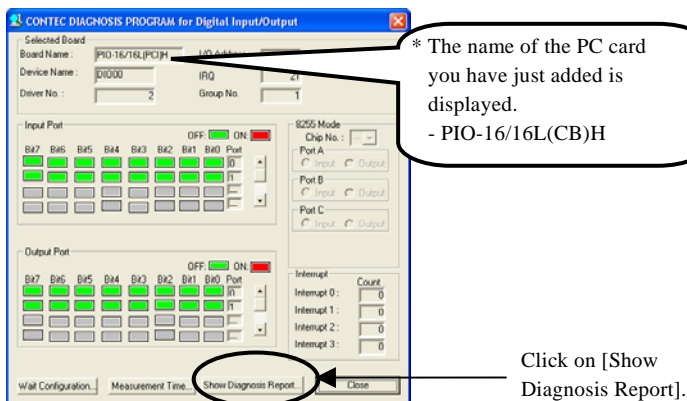
The results are saved and displayed as a text file (DioRep.txt) in the install folder (Program Files\CONTEC\API-PAC(W32)).

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

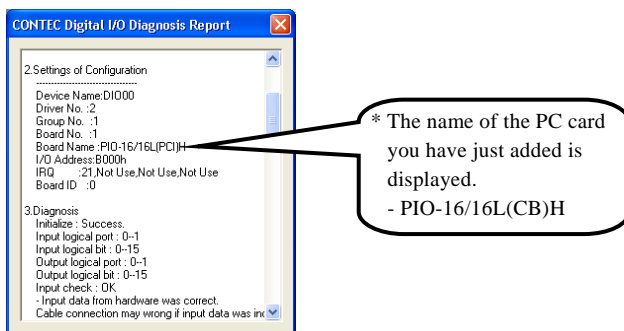


CAUTION

Before executing diagnosis report output, unplug the cable from the PC card.



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



Setup Troubleshooting

Symptoms and Actions

No output can be obtained.

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

The PC card works with the Diagnosis Program but not with an application.

The Diagnosis Program is coded with API-TOOL functions. As long as the PC card 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 PC card 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 PC card. [Windows XP, 2000]

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

If your problem cannot be resolved

Contact your retailer.

3. External Connection

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

Using the On-board Connectors

Connecting a Device to a Connector

To connect an external device to this PC card, plug the cable from the device into the interface connector [37pin D-SUB(female)]shown below.

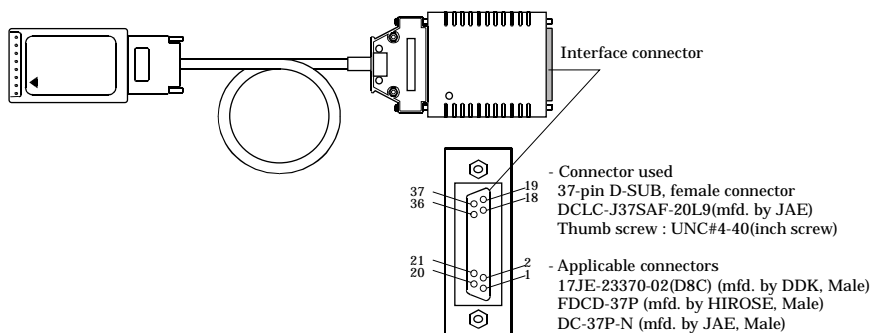
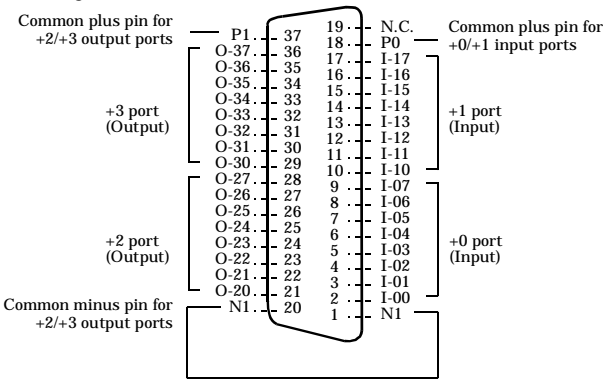


Figure 3.1. Interface Connector and Applicable Cable Connector

Connector Pin Assignment

Pin Assignments of Interface Connector



| | |
|--------------|--|
| I-00 to I-17 | 16 input signal pins. Connect output signals from the external device to these pins. |
| O20 to O37 | 16 output signal pins. Connect these pins to the input signal pins of the external device. |
| P0 | Connect the positive side of the external power supply. (Input) |
| P1 | Connect the positive side of the external power supply. (Output) |
| N1 | Connect the negative side of the external power supply. (Output) |
| N.C. | This pin is left unconnected. |

Figure 3.2. Pin Assignments of Interface Connector

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 [7] | I-06 [6] | I-05 [5] | I-04 [4] | I-03 [3] | I-02 [2] | I-01 [1] | I-00 [0] |
| Input logical port 1 | I-17 [15] | I-16 [14] | I-15 [13] | I-14 [12] | I-13 [11] | I-12 [10] | I-11 [9] | I-10 [8] |

| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-----------------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------|-------------|
| Output logical port 0 | O-27 [7] | O-26 [6] | O-25 [5] | O-24 [4] | O-23 [3] | O-22 [2] | O-21 [1] | O-20 [0] |
| Output logical port 1 | O-37 [15] | O-36 [14] | O-35 [13] | O-34 [12] | O-33 [11] | O-32 [10] | O-31 [9] | O-30 [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 PC card I/O addresses or PC card types.
For details, refer to API-DIO HELP available after installing API-PAC(W32).

Connecting Input Signals

Connect the input signals to a device which can be current-driven, such as a switch or transistor output device.

The connection requires an external power supply to feed currents.

The PC card inputs the ON/OFF state of the current-driven device as a digital value.

Input Circuit

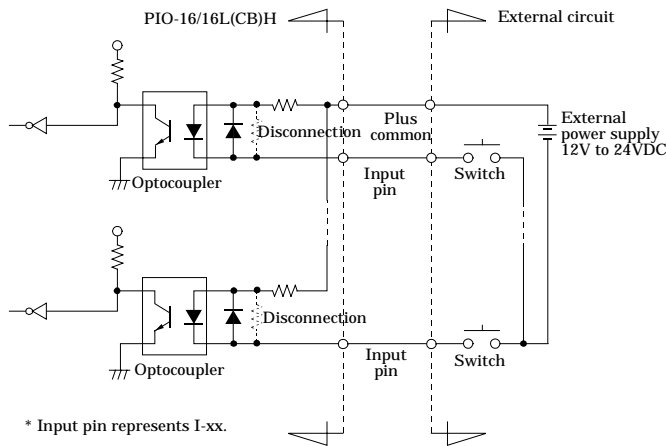
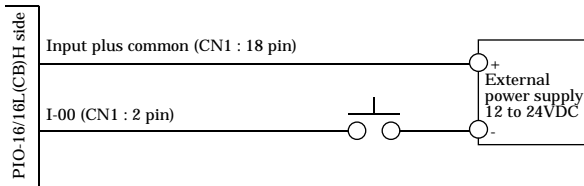


Figure 3.3. Input Circuit

The input circuits of interface blocks of the PIO-16/16L(CB)H is illustrated in Figure 3.3.

The signal inputs are isolated by opto-couplers (ready to accept current sinking output signals). The PC card therefore requires an external power supply to drive the inputs. The power requirement for each input pin is about 5.1 mA at 24 VDC (about 2.6 mA at 12 VDC).

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

Connect the output signals to a current-driven controlled device such as a relay or LED.

The connection requires an external power supply to feed currents.

The PC card controls turning on/off the current-driven controlled device using a digital value.

Output Circuit

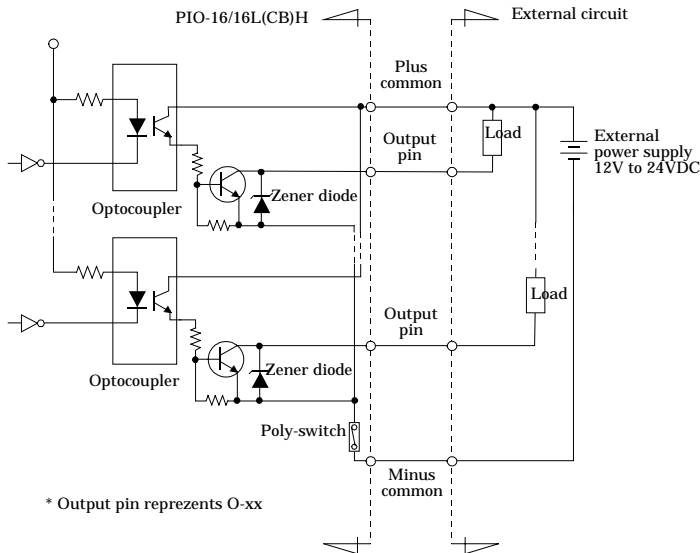


Figure 3.5. Output Circuit

The output circuits of interface blocks of the PIO-16/16L(CB)H is illustrated in Figure 3.5. The signal output section is an opto-coupler isolated, open-collector output (current sink type). Driving the output section requires an external power supply.

The rated output current per channel is 100 mA at maximum.

The output section can also be connected to a TTL level input as it uses a low-saturated transistor for output. The residual voltage (low-level voltage) between the collector and emitter with the output on is 0.5V or less at an output current within 50 mA or at most 1.0V at an output current within 100 mA.

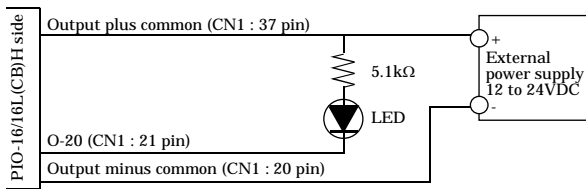
A zener diode is connected to the output transistor for protection from surge voltages. A PolySwitch-based overcurrent protector is provided for every eight output transistors. When the overcurrent protector works, the output section of the PC card is temporarily disabled. If this is the case, turn off the power to the PC and the external power supply and wait for a few minutes, then turn them on back.



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-20

Example of Connection to TTL Level Input

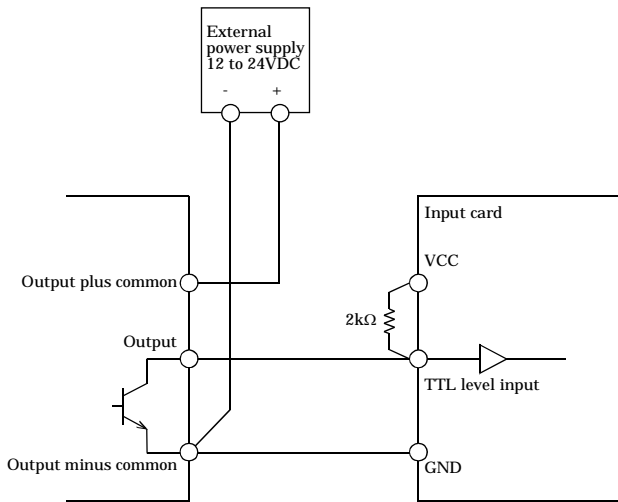


Figure 3.7. Connection Example of Output and TTL level Input Signal

Connecting the Sink Type Output and Sink Output Support Input

The following example shows a connection between a sink type output (output PC card) and a sink output support input (input PC card). Refer to this connection example when you connect such PC cards to each other.

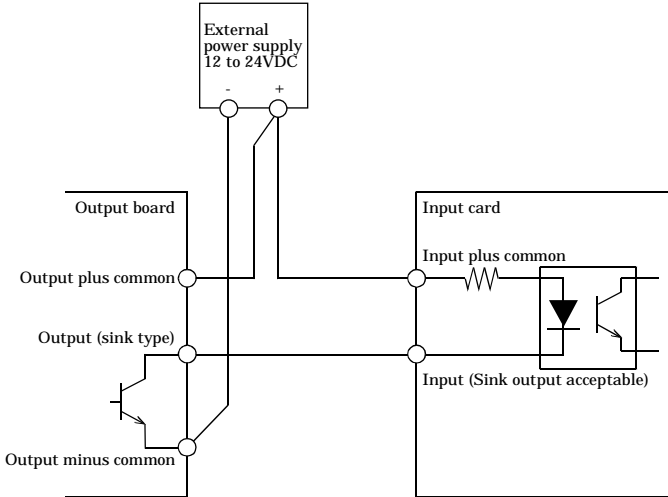


Figure 3.8. Example of Connecting the Sink Type Output and Sink Output Support Input

4. Function

This section describes the features of the PC card.

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

Data I/O Function

Data Input

When the 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

The PIO-16/16L(CB)H can read the state of the data currently being output without affecting the output data.

Digital Filter

Using this feature, the PIO-16/16L(CB)H 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.

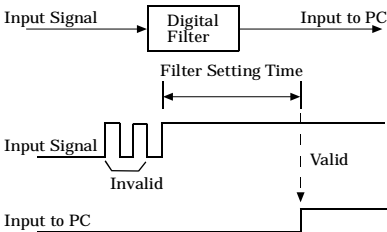


Figure 4.1. Digital Filter Function Principle

Set Digital Filter Time

Set the digital filter time to 0 to 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.

Digital Filter Time[sec.] = 2ⁿ / (8 x 10⁶)

n: = setting data(0 to 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 PC card to malfunction.

Interrupt Control Function

The PIO-16/16L(CB)H can use all of the input signals as interrupt request signals.

The PC card can generate an interrupt request signal to the PC when the input signal changes 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

```

About Software for Windows

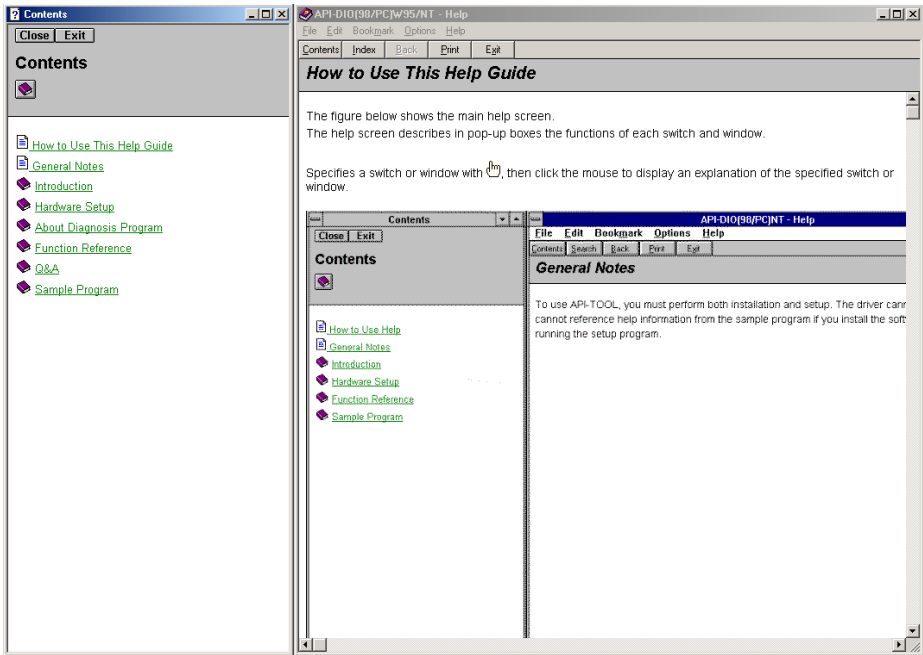
The bundled CD-ROM “Driver Library API-PAC(W32)” contains the functions that provide the following features:

- 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.



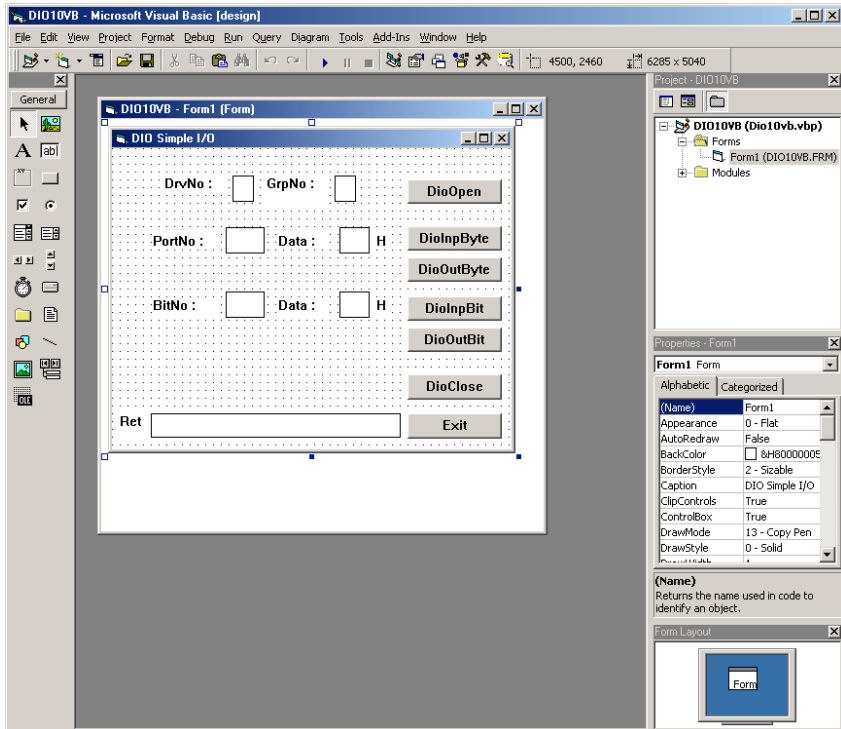
Using Sample Programs

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 PC card.
- 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 PC card.
- Sample program 7 : Provides process control of a specified PC card.
- Sample program 8 : Performs trigger monitoring of a specified PC card.
- 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 PC card (using an extended function).
- Sample program (Console): Inputs/outputs digital data through a specified port.

[Sample program 1]

DIO PORT INP

DrvNo: 0 GrpNo: 1 DioOpen

PortNo: 0 Data: 0 H DioInp

PortNo: 1 Data: 0 H DioClose

Ret EXIT

[Sample program 2]

DIO PORT OUT

DrvNo: 0 GrpNo: 1 DioOpen

PortNo: 0 Data: 55 H DioOut

PortNo: 1 Data: aa H DioEchoBack

PortNo: 1 Data: aa H DioClose

Ret EXIT

[Sample program 5]

DIO BIT INP/OUT

DrvNo: 3 GrpNo: 1 DioOpen

DioBitInp

DioBitOut

DioBitEchoBack

DioClose

Ret EXIT

[Sample program 9]

DIO BCD INP/OUT

DrvNo: 0 GrpNo: 1 DioOpen

DioInpBCD

DioOutBCD

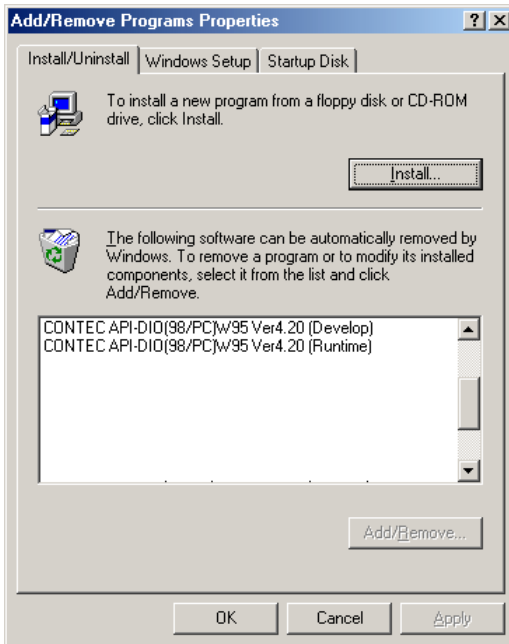
DioClose

Ret EXIT

Uninstalling the Driver Libraries

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

- (1) Click on the [Start] button on the Windows taskbar. From the Start Menu, select “Settings” – “Control Panel”.
- (2) Double-click on “Add/Remove Programs” in the Control Panel.
- (3) Select “CONTEC API-DIO(98/PC)xx” from the application list displayed, then click on the [Add/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 PC card 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 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.

Hardware specification

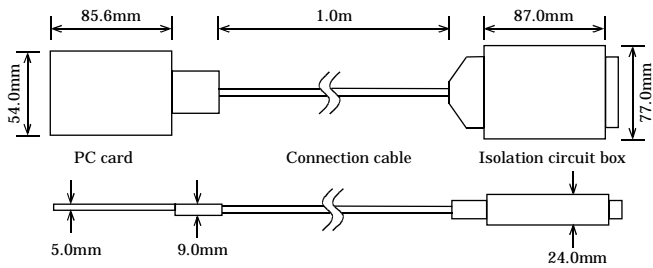
Table 6.1. Specification

| Item | | Specification |
|--|----------------|---|
| Input | | |
| Input format | | Opto-isolated input (Compatible with current sink output)(Negative logic *1) |
| Number of input signal channels | | 16 channels (all available for interrupts) (1 common pin) |
| Input resistance | | 4.7kΩ |
| Input ON current | | 2.0 mA or more |
| Input OFF current | | 0.16 mA or less |
| Interrupt | | 16 interrupt input signals are arranged into a single output of interrupt signal INTA. An interrupt is generated at the falling edge (HIGH-to-LOW transition) or rising edge (LOW-to-HIGH transition). |
| Response time | | 200μsec within |
| Output | | |
| Output format | | Opto-isolated open collector output (current sink type) (Negative logic *1) |
| Number of output signal channels | | 16 channels (1 common) |
| Output rating | Output voltage | 35 VDC (Max.) |
| | Output current | 100 mA (par channel) (Max.) |
| Residual voltage with output on | | 0.5V or less (Output current≤50 mA), 1.0V or less (Output current≤100 mA) |
| Surge protector | | Zener diode RD47FM(NEC) or equivalent |
| Response time | | 200μsec within |
| Common | | |
| I/O address | | 8 bit x 32 port boundary |
| Interruption level | | 1 level use |
| Dielectric strength | | 1000Vrms |
| External circuit power supply | | 12 to 24 VDC(±10%) |
| Power consumption | | 3.3 VDC 200 mA (Max.) |
| Operating condition | | 0 to 50°C, 10 to 90%RH (No condensation) |
| Allowable distance of signal extension | | Approx. 50m (depending on wiring environment) |
| Cable length | | 1m |
| Compatible PC card slot | | PC card Standard compliant CardBus |
| Dimension (mm) | | 85.6(w) x 54.0(D) x 5.0(H) TYPE II *2 |
| Weight | | 440g(Total weight of PC card, connection cable, isolation circuit box) |

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

*2 On PCs with two TYPE II size PC card slots arranged vertically, two PIO-16/16L(CB)H cards cannot be used in the two slots at the same time. This is due to the shape of the cable connectors.

PC card Dimensions



Block Diagram

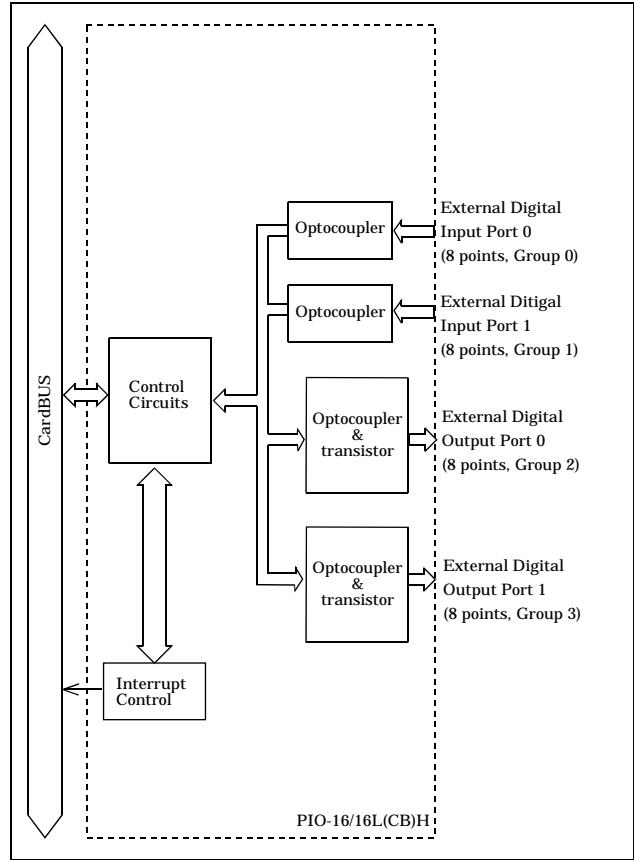


Figure 6.1. Block Diagram

PIO-16/16L(CB)H

User's Guide

CONTEC CO.,LTD.

August 2004 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. [08062004]

[08062004]

Management No. A-46-900

Parts No. LYDY411