PC-HELPER

Digital I/O Unit with Opto-Isolation for USB (On-board Power Supply)

DIO-1616BX-USB

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
- Unit [DIO-1616BX-USB] …1
- AC adapter …1
- AC Cable (for 125VAC) …1
- Ferrite core (small size) …1
- USB cable (1.8m) …1
- USB cable attachment on the main unit’s side (For Mini B connector side) …1
- Clamps for prevention of cable on the main unit’s side …1

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

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1. Before Using the Product

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

About the Unit

This product is an USB2.0-compliant digital I/O unit used to provide a digital signal I/O function on a PC.

This product can input and output digital signals at 12VDC. This product features 16 channels of Optocoupler isolated inputs (compatible with current sink output) and 16 channels of Optocoupler isolated open-collector outputs (current sink type). You can use 16 input signals as interrupt inputs. Equipped with the digital filter function to prevent wrong recognition of input signals and output transistor protection circuit (surge voltage protection and over current protection).

As there is compatible with PCI bus-compatible board PIO-16/16B(PCI)H and PCI Express bus-compatible board DIO-1616B-PE in terms of connector shape and pin assignments, it is easy to migrate from the existing system.

Windows driver is bundled with this product. Possible to be used as a data recording device for LabVIEW, with dedicated libraries.

Features

- 16 channels of Optocoupler isolated inputs (compatible with current sink output) and 64 channels of Optocoupler isolated open-collector outputs (current sink type)

This product has the 16 channels of Optocoupler isolated inputs (compatible with current sink output) and the 16 channels of Optocoupler isolated open-collector outputs (current sink type) whose response speed is 200μsec. Supporting driver voltages of 12 VDC for I/O.

- Power for opto-coupler operation (12VDC 240mA) supplied internally

As the power to run the opto-couplers is supplied internally, no external power supply is required.

- Compatible to USB1.1/USB2.0

Compatible to USB1.1/USB2.0 and capable to achieve high speed transfer at HighSpeed (480 Mbps).

- USB HUB function

This product has the USB HUB function. Max. 4 DIO-1616BX-USB can be used in 1 USB port of PC.*3 When you use 4 or more DIO-1616BX-USB, you can do by connecting DIO-1616BX-USB to the another USB port of PC side.

Also, you can connect the CONTEC’s USB device other than DIO-1616BX-USB to the USB port of DIO-1616BX-USB. *1*2
1. Before Using the Product

- Optocoupler bus isolation

As the USB (PC) is isolated from the input and output interfaces by Optocouplers, this product has excellent noise performance.

- You can use 16 input signals as interrupt request signals.

You can use 16 input signals as interrupt request signals and also disable or enable the interrupt in bit units and select the edge of the input signals, at which to generate an interrupt.

- This product has a digital filter to prevent wrong recognition of input signals from carrying noise or a chattering.

This product has a digital filter to prevent wrong recognition of input signals from carrying noise or a chattering. All input terminals can be added a digital filter, and the setting can be performed by software.

- Output circuits include zener diodes for surge voltage protection and poly-switches for overcurrent protection.

Zener diodes are connected to the output circuits to protect against surge voltages. Similarly, polyswitches are fitted to each group of 8channels outputs for over-current protection. The output rating is max. 35VDC, 100mA per channel.

- Connectors are compatible with PCI/PCI Express bus-compatible board

As there is compatible with PIO-16/16B(PCI)H and DIO-1616B-PE in terms of connector shape and pin assignments, it is easy to migrate from the existing system. If the system of this product is created by the digital I/O driver API-DIO(98/PC), it is required to replace it with API-DIO(WDM).

- Windows compatible driver libraries are attached.

Using the attached digital I/O driver API-DIO(WDM) makes it possible to create applications of Windows. In addition, a diagnostic program by which the operations of hardware can be checked is provided.

- LabVIEW is supported by a plug-in of dedicated library VI-DAQ.

Using the dedicated library VI-DAQ makes it possible to make a LabVIEW application.

*1 Do not connect the device other than that of CONTEC’s USB to the USB port included on the DIO-1616B-USB. Otherwise, this may cause a failure or malfunction.

*2 When connecting multiple units with USB HUB function and set up them, do one at a time and complete setup for the previous unit before starting to do the next unit.

*3 This product cannot be stacked up for installation.
Support Software

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

Windows version of digital I/O driver  **API-DIO(WDM)**
[Stored on the bundled CD-ROM driver library API-USBP(WDM)]

It is the library software, and which supplies command of hardware produced by our company in the form of standard Win32 API function (DLL). Using programming languages supporting Win32 API functions, such as Visual Basic and Visual C++ etc., you can develop high-speed application software with feature of hardware produced by our company.

In addition, you can verify the operation of hardware using Diagnostic programs.

< Operating environment >

OS  Windows 7, Vista, XP, Server 2003, 2000, Me, 98
Adaptation language  Visual Basic, Visual C++, Visual C#, Delphi, C++ Builder

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

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)

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat Cable with 37-Pin D-SUB Connectors at either Ends</td>
<td>PCB37P-1.5</td>
<td>1.5m</td>
</tr>
<tr>
<td></td>
<td>PCB37P-3</td>
<td>3m</td>
</tr>
<tr>
<td></td>
<td>PCB37P-5</td>
<td>5m</td>
</tr>
<tr>
<td>Shielded Cable with 37-pin D-SUB connectors at either ends</td>
<td>PCB37PS-0.5P</td>
<td>0.5m</td>
</tr>
<tr>
<td></td>
<td>PCB37PS-1.5P</td>
<td>1.5m</td>
</tr>
<tr>
<td></td>
<td>PCB37PS-3P</td>
<td>3m</td>
</tr>
<tr>
<td></td>
<td>PCB37PS-5P</td>
<td>5m</td>
</tr>
<tr>
<td>Flat Cable with 37-Pin D-SUB Connector at One End</td>
<td>PCA37P-1.5</td>
<td>1.5m</td>
</tr>
<tr>
<td></td>
<td>PCA37P-3</td>
<td>3m</td>
</tr>
<tr>
<td></td>
<td>PCA37P-5</td>
<td>5m</td>
</tr>
<tr>
<td>Shield Cable with 37-Pin D-SUB Connector at One End</td>
<td>PCA37PS-0.5P</td>
<td>0.5m</td>
</tr>
<tr>
<td></td>
<td>PCA37PS-1.5P</td>
<td>1.5m</td>
</tr>
<tr>
<td></td>
<td>PCA37PS-3P</td>
<td>3m</td>
</tr>
<tr>
<td></td>
<td>PCA37PS-5P</td>
<td>5m</td>
</tr>
<tr>
<td>37-pin D-SUB (Male) Connector Set (5 Pieces)</td>
<td>CN5-D37M</td>
<td></td>
</tr>
</tbody>
</table>

## Accessories (Option)

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw Terminal Unit (M3 x 37P)</td>
<td>EPD-37A</td>
</tr>
<tr>
<td>Screw Terminal Unit (M3.5 x 37P)</td>
<td>EPD-37</td>
</tr>
<tr>
<td>General Purpose Terminal (M3 x 37P)</td>
<td>DTP-3A</td>
</tr>
<tr>
<td>Screw Terminal (M2.6 x 37P)</td>
<td>DTP-4A</td>
</tr>
<tr>
<td>Signal Monitor / Output Accessory for Digital I/O (32P)</td>
<td>CM-32(PC)E</td>
</tr>
<tr>
<td>USB I/O Unit Bracket for X Series</td>
<td>BRK-USB-X</td>
</tr>
<tr>
<td>AC adapter (input: 90 - 264VAC, output: 5VDC 2.0A)</td>
<td>POA200-20</td>
</tr>
<tr>
<td>AC-DC power supply unit (input: 85 - 132VAC, output: 5VDC 3.0A)</td>
<td>POW-AC13GY</td>
</tr>
<tr>
<td>AC-DC power supply unit (input: 85 - 264VAC, output: 5VDC 2.0A)</td>
<td>POW-AD22GY</td>
</tr>
<tr>
<td>DC-DC power supply unit (input: 10 - 30VDC, output: 5VDC 3.0A)</td>
<td>POW-DD10GY</td>
</tr>
<tr>
<td>DC-DC power supply unit (input: 30 - 50VDC, output: 5VDC 3.0A)</td>
<td>POW-DD43GY</td>
</tr>
</tbody>
</table>

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*1 A PCB37P or PCB37PS optional cable is required.

*2 “Spring-up” type terminal is used to prevent terminal screws from falling off.

*3 It is the same as the one appended to the product. Please buy it necessary for maintenance.

* 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 One-Year Warranty

CONTEC products are warranted by CONTEC CO., LTD. to be free from defects in material and workmanship for up to one year 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.
1. Before Using the Product

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.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="DANGER" /></td>
<td>DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.</td>
</tr>
<tr>
<td><img src="image" alt="WARNING" /></td>
<td>WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.</td>
</tr>
<tr>
<td><img src="image" alt="CAUTION" /></td>
<td>CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.</td>
</tr>
</tbody>
</table>

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**
  - Do not strike or bend this product. Otherwise, this may malfunction, overheat, cause a failure or breakage.
  - Do not touch this product's terminals (edge connector) with your hands. Otherwise, this may malfunction, overheat, or cause a failure.
  - If the terminals are touched by someone's hands, clean the terminals with industrial alcohol.
  - Do not close the ventilation hole(s) of this product by, for example, placing an object. This may cause overheating, malfunction, and/or failure of the product.
  - Do not touch the external connector when the power is on. Otherwise this may malfunction, overheat, cause a failure due to static electricity.
  - Make sure that your PC can supply ample power to all this product installed. Insufficiently energized products could malfunction, overheat, or cause a failure.
  - Do not connect the device other than that of CONTEC’s USB to the USB port included on the DIO-1616BX-USB. Otherwise, this may cause a failure or malfunction.
  - When connecting multiple units with USB HUB function and set up them, do one at a time and complete setup for the previous unit before starting to do the next unit.
  - The specifications of this product are subject to change without notice for enhancement and quality improvement.
  - Even when using this product continuously, be sure to read the manual and understand the contents.
  - Do not modify this product. CONTEC will bear no responsibility for any problems, etc., resulting from modifying this product.
1. Before Using the 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.

- If you use this product in a noisy environment, attach the bundled ferrite core to stabilize the operation.
  When attaching a ferrite core to the USB cable, coil it around once near the connector while leaving it open, and then close it.

- Regarding “VCCI Class A Notice”, “FCC PART 15 Class A Notice”
  The ferrite core of the product attachment must be installed in the following images to suit the above-mentioned standard.


FCC PART 15 Class A Notice

NOTE
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference at his own expense.

WARNING TO USER
Change or modifications not expressly approved the manufacturer can void the user's authority to operate this equipment.
1. Before Using the Product

**Environment**

Use this product in the following environment. If used in an unauthorized environment, this product 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.

- Check that the connector has no dust or foreign matter adhering.

**Storage**

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

1. Put this product 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 this product.

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.

Installing the driver

This section enables you to prepare the software and hardware by operating in accordance with each step in this chapter using the bundled CD-ROM. 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 Setting the Hardware
   Step 2 Installing the Software
   Step 3 Installing the Hardware
   Step 4 Checking Operations with the Diagnosis Program

Uninstall the driver and then set it up again if it cannot be set up properly.
Step 1 Setting the Hardware

This section describes how to set up the product and how to connect it to a PC.

Name of each parts

LED indicator

Internal power supply

This unit equips an on unit isolated power supply (12VDC, 240mA) for driving opto-isolation circuits. Do not connect the external source because it is a design that uses the internal power supply.

⚠️ CAUTION ⚠️

- When the internal power supply is used, the input section of this board consumes up to 40mA current maximum and the output channel switching section consumes up to 30mA current maximum. The output current that can be supplied outside is 170mA. Please note it.
- Do not use the external supply. Or the supply will be broken down.
Step 2 Initializing the Software

Install software.
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.

Points
- If you are using Windows XP or Windows 2000, please log on as Administrator (authorized account) before proceeding to the following steps.

The following shows the basic flow for installing product.

Illustration of Menu Screen

Points
- Please set up the supplied CD-ROM if it has not been set up. The menu starts automatically.
- If the menu do not start, launch X:AUTORUN.EXE(X:CD-ROM drive) from [Run...] in Start menu.
- The screen design may be different.
2. Setup

Installation of API-USBP(WDM) Development Environment

Installation of development environment is namely installing supplied online help and sample program in all language in order to use API function.

(1) Clicking on “Install Development or Execution Environment”.
[API-USBP(WDM) Installer] dialog box displays.

(2) Selecting “Advanced Digital I/O driver”.

(3) Clicking on “Continue” Button.

Please perform installation following the directions on the screen. And thus the installation is completed.

* The screen design may be different.
Step 3 Installing the Hardware

Under Windows, information about the converter needs to be detected by the OS. This is called hardware installation.

To use more than one of this product, make sure to install them one by one, setting each unit after completing the previous one.

Connection with 5VDC Power Supply for Self-power

This product must be connected with 5VDC power supply (in a self-powered state).

Connect with 5VDC power supply by using +5VDC input pin.

**5VDC**

<table>
<thead>
<tr>
<th>FG</th>
<th>Vi-</th>
<th>Vi+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Power supply (5V)</td>
<td>Power supply (GND)</td>
</tr>
</tbody>
</table>

Figure 2.2. +5 VDC Input Terminal Pinouts

When using the attached AC adapter [POA200-20], please connect directly to the input terminals. When the accompanying power connector (MC1,5/3-ST-3,5, suitable cable: AWG28 - 16) is used to supply power to this unit, strip the end of the suitable cable and insert it to the power connector before firmly securing it using a screw.

Figure 2.3. Connecting the AC Adapter POA200-20

Beside the AC adapter, a power supply for installation on a DIN rail is also available (as an option). Use the appropriate power supply depending on the operating environment and application. When a power supply for installation on a DIN rail is used, connect the unit using the accompanying power connector MC1,5/-ST-3,5.

⚠️ CAUTION

- Connect 5VDC power supply to the main unit. Next, connect the USB cable to the PC. Do not turn it on or off when using. If you remove, USB cable is first and then 5VDC power supply.
- When the USB module is not used, leave the AC adapter unplugged.
- Continuously using the AC adapter heated affects its life.
- Use the AC adapter not in a closed place but in a well-ventilated place not to be heated.
- Do not remove the power connector [MC1,5/3-ST-3,5] attached to the AC adapter.
2. Setup

**Connecting the Product**

1. Turn on the power to the PC before connecting this product.

2. When the PC has been up and running, plug the USB interface connector to a USB port in the PC. The converter can also be connected to the PC via a USB hub of this product.

![Figure 2.4. Connecting the PC](image)

(3) USB cable can be attached firmly to the main unit by using a USB cable attachment.

![Figure 2.5. Attaching a USB Attachment](image)

⚠️ **CAUTION**

- The USB cable attachment cannot be used excluding an attached cable.
- When the USB cable attachment is being used, do not perform removing and connecting the USB cable on the unit side repeatedly. This may damage the USB cable attachment or yourself.
(4) When connecting the USB cable through the USB hub of this product, it can be made easily not to come off by using clamps for prevention of cable on the main unit's side (Appended goods).

Figure 2.6. Usage of clamps for prevention of cable on the main unit's side
2. Setup

Setting with the Found New Hardware Wizard

(1) The “Found New Hardware Wizard” will be started.
* In Windows Vista, Because the driver's installation is completed by "Installing the Software", it is not necessary to operate it about the Hardware Wizard.

(2) Select “Install from a list or specific location”, then click on the [Next] button.
Detect setup information from supplied CD automatically for installing USB driver.

Point
Please specify the path for supplied CD as follows in the case of failure in detecting automatically.
X:¥INF¥WDM¥DIO  (X: CD-ROM drive)

(3) Click on [Finish] button to complete the installation of USB driver.
Setting Properties Using Device Manager

After connecting product with a PC and completing driver installation, open Device Manager and set properties.

(1) Starting Device Manager.
   From [Start] menu, click on [Settings]-[Control Panel]-[System] and then click on [Device Manager] button in [Hardware] tab.

- In the case of Windows 98/Me
   Right-click on [My Computer] and select [Properties] to start device manager.

* The name of the connected product will be displayed. DIO-1616BX-USB
2. Setup

(2) Setting the Device Name.
Right-clicking on the product name and selecting [Properties] displays [Product Properties].
Open [Common Settings] tab and enter arbitrary name in the editing box for device name.
(Default name also can be used.)

![Image of product properties window showing DIO-1616BX-USB]

* The product-specific number will be displayed as the serial number.

⚠️ CAUTION

USB driver can not be used without settings. Settings must be performed.

(3) Clicking on [OK] button.
Device name is set by clicking [OK] button.

Points
- When the application developed by users is running on another PC, please perform foregoing operation on the target computer. (No need to install software introduced on next page)
- Please use the device name specified in last step for initialization function when initialization is performed using API function. When running on other PC, it can run without changing the application for the same device name being specified.
Step 4 Checking Operations with the Diagnosis Program

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

Using the Diagnosis Program

Starting the Diagnosis Program
Click [Diagnosis] on the Properties page to start the diagnosis program.
2. Setup

Checking Digital Inputs and Outputs
The main panel of the Diagnosis Program appears.
You can check the current operation states of the product 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.

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 product settings and the diagnosis results while saving them in text format. The Diagnosis Program performs “product presence/absence check”, “driver file test”, “board setting test”, and so on.

⚠️ CAUTION ⚠️

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

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

* The name of the connected product will be displayed. DIO-1616BX-USB

Input port : 16Bit
Output port : 16Bit will be displayed.

Click on [Show Diagnosis Report].
3. External Connection

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

Using the Connectors

Connecting to a Connector

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

- Connector used
  37-pin D-SUB connector [F(female)type]
  DCLC-J37SAF-20L9E [mfd by JAE]+ equivalence to it
  Lock nut UNC #4-40 (inch screw threads)

- Compatible connector
  17JE-23370-02(D8C) [mfd by DDK, M(male)type]
  FDCD-37P [mfd by HIROSE, M(male)type]
  DC-37P-N [mfd by JAE, M(male)type]

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

Figure 3.1. Interface Connector Shape
### Connector Pin Assignment

**Figure 3.2. Pin Assignments of Interface Connector (CN1)**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin No.</th>
<th>Signal name</th>
<th>Meaning</th>
<th>Pin No.</th>
<th>Signal name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>19</td>
<td>P1</td>
<td>Common plus pin for +2/+3 output port</td>
<td>18</td>
<td>P0</td>
<td>Common plus pin for +0/+1 input port</td>
</tr>
<tr>
<td>36</td>
<td>17</td>
<td>O-37</td>
<td>+3 port (output)</td>
<td>16</td>
<td>I-16</td>
<td>+1 port (input)</td>
</tr>
<tr>
<td>35</td>
<td>15</td>
<td>O-36</td>
<td></td>
<td>15</td>
<td>I-15</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>14</td>
<td>O-35</td>
<td></td>
<td>14</td>
<td>I-14</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>13</td>
<td>O-34</td>
<td></td>
<td>13</td>
<td>I-13</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>12</td>
<td>O-33</td>
<td></td>
<td>12</td>
<td>I-12</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>11</td>
<td>O-32</td>
<td></td>
<td>11</td>
<td>I-11</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>10</td>
<td>O-31</td>
<td></td>
<td>10</td>
<td>I-10</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>9</td>
<td>O-30</td>
<td></td>
<td>9</td>
<td>I-07</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>8</td>
<td>O-27</td>
<td>+2 port (output)</td>
<td>8</td>
<td>I-06</td>
<td>+0 port (input)</td>
</tr>
<tr>
<td>27</td>
<td>7</td>
<td>O-26</td>
<td></td>
<td>7</td>
<td>I-05</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>6</td>
<td>O-25</td>
<td></td>
<td>6</td>
<td>I-04</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>5</td>
<td>O-24</td>
<td></td>
<td>5</td>
<td>I-03</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>4</td>
<td>O-23</td>
<td></td>
<td>4</td>
<td>I-02</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>3</td>
<td>O-22</td>
<td></td>
<td>3</td>
<td>I-01</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>2</td>
<td>O-21</td>
<td></td>
<td>2</td>
<td>I-00</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>1</td>
<td>O-20</td>
<td>Common minus pin for +2/+3 output port</td>
<td>1</td>
<td>N0</td>
<td>Common minus pin for +0/+1 input port</td>
</tr>
</tbody>
</table>

**I-00 · I-17**  
16 input signal pins. Connect output signals from the external device to these pins.

**O-20 · O-37**  
16 output signal pins. Connect these pins to the input signal pins of the external device.

**P0**  
The output of this pin is +12V. These pins are common to 16 input signal pins.

**P1**  
The output of this pin is +12V. These pins are common to 16 output signal pins.

**N0**  
This pin is GND. These pins are common to 16 input signal pins.

**N1**  
This pin is GND. These pins are common to 16 output signal pins.

**N.C.**  
This pin is left unconnected.
Relationships between Logical Ports/Bits and Connector Signal Pins

The following table lists the relationships between the connector signal pins and the logical port / bit numbers.

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

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

Notes: I-xx represents the input signal. O-xx represents the output signal. [xx] represents the logical bit.

⚠️ CAUTION

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

Connect the input signals to a device which can be current-driven, such as a switch or transistor output device. This product inputs the ON/OFF state of the current-driven device as a digital value.

Input Circuit

![Input Circuit Diagram]

*I-xx represents the input pin.

**Figure 3.3. Input Circuit**

The input circuits of interface blocks of this product is illustrated in Figure 3.3. The signal inputs are isolated by Optocouplers (compatible with current sink output).

Connecting a Switch

![Connecting a Switch Diagram]

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**
Connecting Output Signals

Connect the output signals to a current-driven controlled device such as a relay or LED. This product controls turning on/off the current-driven controlled device using a digital value.

Output Circuit

![Output Circuit Diagram]

* O.xx represents the output pin.

**Figure 3.5. Output Circuit**

The output circuits of interface blocks of this product is illustrated in Figure 3.5. The signal output section is an optocoupler isolated, open-collector output (current sink type). This product therefore requires the on-board internal power supply to drive the output section of this product.

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 0.5 V or less at an output current within 50 mA or at most 1.0 V 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 8 output transistors.

When the overcurrent protector works, the output section of this product 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.
3. External Connection

Connection to the LED

![Diagram showing connection to the LED.](image)

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

![Diagram showing connection example to TTL level input.](image)

**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 side) and a sink output support input (input side). Refer to this connection example when you connect such this product to each other.

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

Please reference to online help and sample program when developing applications.

Reference to Online Help

Click on [Programs]-[CONTEC API-USBP(WDM)]-[API-USBP(WDM) Help] from [Start] menu.

The information for application development, such as function reference is provided in [API-USBP(WDM) Help].

Detailed introduction to search method for help should be found from [How to navigate Help] in the help.

Printing Function Reference

Clicking on Print button from online help prints the page being displayed. It can be printed entirely as follows in the case of referencing to printing function.

As figure shown on the right, selecting 📖 mark and clicking on Print button prints all the topics under the mark selected at a time.
Sample Program

To run a sample program, click on [Programs] - [CONTEC API-USBP(WDM)] - [DIO] - [Sample Name] from [Start] menu.

Distributing Developed Application

Please distribute the developed application with USB driver in supplied CD-ROM. Created application (including driver) can be freely distributed.
Returning to Initial State

This is the method of returning to initial state. It is suggested that you should return to initial state and perform installation again when the operation is losing stabilization.

1. Deleting Device form Device Manager.

   ![Device Manager screenshot]
   * The name of the connected product will be displayed. DIO-1616BX-USB

2. Drawing USB cable from a PC *1

3. Uninstalling Driver
   Select [CONTEC API-DIO(WDM) driver] from [My Computer]-[Control Panel]-[Add/Remove Programs].

4. Restarting

*1 If 5VDC power supply is used, unplug it too.
   (It may not be normally initialized in the state of 5VDC power supply connection.)
5. Function

This section describes the features of this product.

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 wrong recognition of input signals 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 5.1. 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 5.2 shows the relationships between digital filter time settings and the actual digital filter times.

Digital Filter Time[sec.] = 2^n / (8 x 10^6)

n: = setting data(0 - 20)

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

Figure 5.2. 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 this product to malfunction.
Interrupt Control Function

This product can use 16 channels 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 Edge of input signals, at which to generate an interrupt

The input signal edge selection bit can be used to set the input logic for interruption bit by bit. If you set an input signal edge selection 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 input signal edge selection 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

All of the input signal edge selection bits are set to 0 when the power is turned on.

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. Function
6. About Hardware

**Hardware specification**

Table 6.1. Specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input section</strong></td>
<td></td>
</tr>
<tr>
<td>Number of input signal channels</td>
<td>16 channels (all available for interrupts) (1 common in 16 channels unit)</td>
</tr>
<tr>
<td>Input format</td>
<td>Optocoupler isolated input (Compatible with current sink output) (Negative logic *1)</td>
</tr>
<tr>
<td>Input resistance</td>
<td>4.7kΩ</td>
</tr>
<tr>
<td>Input ON current</td>
<td>2.0mA or more</td>
</tr>
<tr>
<td>Input OFF current</td>
<td>0.16mA or less</td>
</tr>
<tr>
<td>Interrupt</td>
<td>16 interrupt input signals are arranged into a single output of interrupt request signal INTA. An interrupt is generated at the rising edge (HIGH-to-LOW transition) or falling edge (LOW-to-HIGH transition) (set by software).</td>
</tr>
<tr>
<td>Response time</td>
<td>200μsec within *2</td>
</tr>
<tr>
<td><strong>Output section</strong></td>
<td></td>
</tr>
<tr>
<td>Number of output signal channels</td>
<td>16 channels (1 common in 16 channels unit)</td>
</tr>
<tr>
<td>Output format</td>
<td>Optocoupler isolated open collector output (current sink type) (Negative logic*1)</td>
</tr>
<tr>
<td>Output rating</td>
<td></td>
</tr>
<tr>
<td>Output voltage</td>
<td>35VDC (Max.)</td>
</tr>
<tr>
<td>Output current</td>
<td>100mA (per channel) (Max.)</td>
</tr>
<tr>
<td>Residual voltage with output on</td>
<td>0.5V or less (Output current≤50mA), 1.0V or less (Output current≤100mA)</td>
</tr>
<tr>
<td>Surge protector</td>
<td>Zener diode RD47FM(NEC) or equivalent</td>
</tr>
<tr>
<td>Response time</td>
<td>200μsec within *2</td>
</tr>
<tr>
<td><strong>USB section</strong></td>
<td></td>
</tr>
<tr>
<td>Bus specification</td>
<td>USB Specification 2.0/1.1 standard</td>
</tr>
<tr>
<td>USB transfer rate</td>
<td>12Mbps (Full-speed), 480Mbps (High-speed) *3</td>
</tr>
<tr>
<td>Power supply</td>
<td>Self-power</td>
</tr>
<tr>
<td><strong>Common section</strong></td>
<td></td>
</tr>
<tr>
<td>Number of terminals used at the same time</td>
<td>127 terminals (Max.) *4</td>
</tr>
<tr>
<td>Dielectric strength</td>
<td>500Vrms</td>
</tr>
<tr>
<td>Internal power supply</td>
<td>12VDC 240mA *5</td>
</tr>
<tr>
<td>Current consumption (Max.)</td>
<td>5VDC 830mA</td>
</tr>
<tr>
<td>Operating conditions *6</td>
<td>0°C to 50°C, 10% to 90%RH (No condensation)</td>
</tr>
<tr>
<td>Allowable distance of signal extension</td>
<td>Approx. 50m (depending on wiring environment)</td>
</tr>
<tr>
<td>Physical dimensions (mm)</td>
<td>180(W) x 140(D) x 34(H) (No protrusions)</td>
</tr>
<tr>
<td>Weight</td>
<td>300g (Not including the USB cable, attachment)</td>
</tr>
<tr>
<td>Connector</td>
<td>37 pin D-SUB connector [F (female) type] DCLC-J37SAP-20L9E [mfd. by JAE] equivalent to it</td>
</tr>
<tr>
<td>Attached cable</td>
<td>USB cable 1.8m</td>
</tr>
</tbody>
</table>

*1 Data “0” and “1” correspond to the High and Low levels, respectively.
*2 The Optocoupler’s response time comes.
*3 This depends on the PC environment used (OS and USB host controller).
*4 As a USB hub is also counted as one device, you cannot just connect 127 USB unit.
*5 The input section consumes up to 40mA and the SW section of output channel consumes up to 30mA, so the output current that can be supplied to the external device is 170mA.
*6 To suppress the heating, ensure that there are spaces for ventilation (about 5cm) around this product.
Physical dimensions

![Physical dimensions](image)

**Figure 6.1. Physical dimensions**

![Physical dimensions of attached AC adapter](image)

**Figure 6.2. Physical dimensions of attached AC adapter (POA200-20)**
6. About Hardware

Block Diagram

![Block Diagram](image)

Figure 6.2. Block Diagram

Difference from DIO-1616B-PE and PIO-16/16B(PCI)H

Table 6.2. Difference from DIO-1616B-PE and PIO-16/16B(PCI)H

<table>
<thead>
<tr>
<th>Item</th>
<th>DIO-1616BX-USB</th>
<th>DIO-1616B-PE</th>
<th>PIO-16/16B(PC)H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selecting Power Supply</td>
<td>It is impossible. (Only using the internal power supply)</td>
<td>It selects it with the jumper.</td>
<td></td>
</tr>
<tr>
<td>Current consumption (Max.)</td>
<td>5VDC 830mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>When using the internal power supply:</td>
<td>When using the internal power supply:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.3VDC 350mA,</td>
<td>5VDC 1200mA,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12VDC 350mA</td>
<td>5VDC 300mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>When using the external power supply:</td>
<td>When using the external power supply:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.3VDC 350mA</td>
<td>5VDC 300mA</td>
<td></td>
</tr>
<tr>
<td>Bus specification</td>
<td>USB Specification 2.0/1.1 standard</td>
<td>PCI Express Base Specification Rev. 1.0a x1</td>
<td>PCI(32bit, 33MHz, Universal key shapes supported)</td>
</tr>
<tr>
<td>Physical dimensions (mm)</td>
<td>180(L) x 140(D) x 34(H) (No protrusions)</td>
<td>169.33(L) x 110.18(H)</td>
<td>176.41(L) x 106.68(H)</td>
</tr>
<tr>
<td>Weight</td>
<td>300g (Not including the USB cable, attachment)</td>
<td>140g</td>
<td>150g</td>
</tr>
</tbody>
</table>