

PC-HELPER

Isolated High-Resolute Analog Input Module
for USB2.0

ADI16-4(USB)

User's Guide

CONTEC CO.,LTD.

Check Your Package

Thank you for purchasing the CONTEC product.

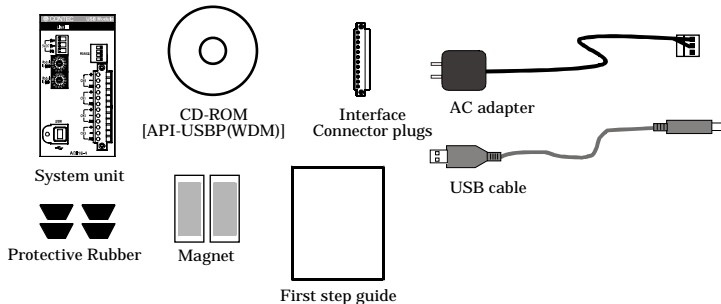
The product consists of the items listed below.

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

Product Configuration List

- USB module
[ADI16-4(USB)] ...1
- First step guide ...1
- CD-ROM *1 [API-USBP(WDM)] ...1
- Interface connector (plugs) FRONT-MC1,5/12-ST-3,81 ...1
- AC adapter (1.4m)...1
- USB cable (1.8m)...1
- Protective Rubber...4
- Magnet...2

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



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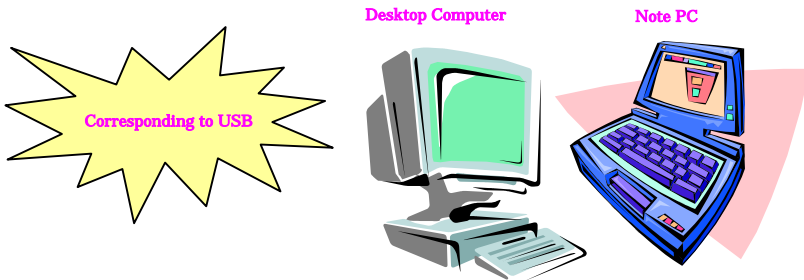


1. Introduction

Summary

Before, the measurement and control was realized by way of inserting PCI interface boards into expansion slots of a desktop computer in case of configuring system using computers. However, because of the limit on number of expansion slots, it is difficult to configure system sometimes, or it is difficult to perform the same measure and control as PCI interface boards for a note PC. The USB module can be used to resolve that kind of problems.

ADI16-4(USB) is compact analog input module which is applied to USB and can be used easily. ADI16-4(USB) converts external analog voltage signals into digital data.



Now serviceable with USB-compatible PCs, this module is best suited for use with notebook PCs with no PCI bus expansion slot.

When using it on a desktop computer, you can perform simple connection without the need for opening the host cover.



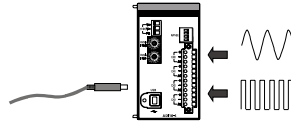
Being connected with USB port, the USB module can be setup simply. In addition, it can be used immediately owing to the supplied Windows development environment and Utility.

The communication in Full Speed (12Mbps) is added to this USB module, and which is compatible with High Speed (480Mbps). High Speed is namely High-Speed data communication which is additional definition in the specification of USB2.0. The host controller performs communication in 480Mbps when corresponding to High Speed of USB2.0. Comparing with communication in Full Speed, the response for module access as communication in High Speed improves.

Features

Storing 256K data

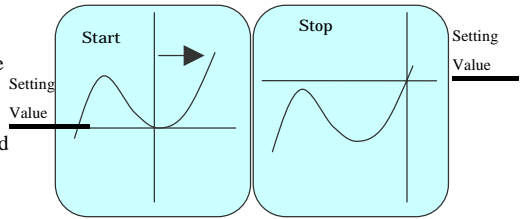
AD116-4(USB) can store up to 256K sampled data. Because CPU is incorporated in the module, USB communication processing will not result in data-losing, the data in every sampling period can be obtained. The minimum sampling period depends on how long it takes the module to process each sample and varies between approximately 200 μ s (when using one channel only) and 1msec (when using 16 channels). (Measured values: The minimum sampling period may be longer due to factors such as the load on the USB link.)



Analog trigger function

The AD116-4(USB) sampling start and stop can be controlled by the signal change from a specified channel.

Because you can select either upward or downward stop again set value, sampling can be performed without missing the measured event.



Isolated from external device

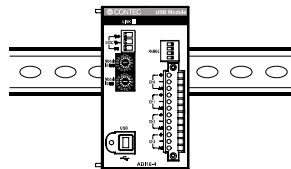
There is not external electric effect on the host computer by way of USB ports because of the isolation between the CPU of the module and A/D converter by opto-coupler.

Voltage or current input

The input range can be selected from among ± 10 and $0 - 20$ mA. Each analog input pin can withstand up to ± 20 V as it integrates an overvoltage protection circuit.

Easy-to-install design

The system, in the module itself, incorporates a 35mm DIN rail mounting mechanism as a standard item, so it can be attached and detached easily.



Easy to extend input channel

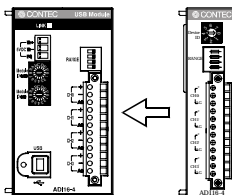
By adding expansion modules Option, the number of input channels can be increased.

It adopts the unique configuration of stack connecting which permits a simple, compact system configuration.

ADI16-4(USB) +

ADI16-4(FIT)GY x 3

(Up to 16 input channels can be extended)



Easy-to-develop-application Sample Program

Visual Basic, Visual C++, Delphi and C++ Builder sample programs have been prepared.

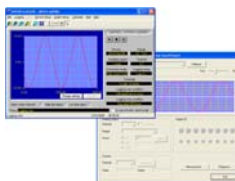
Functions convenient for developing generic applications, such as the functions that acquire the list of the current available USB modules, are prepared.



Easy-to-collect data utility

- Hyper Logger

Without programming, You can easily operate the USB module. Collecting data, displaying graph and saving file can be done by the various settings.



- Diagnostic Program

When the problem occurred, it will be helpful to solving the problem.

Support Software

It is suggested that support software produced by our company should be used according to the goal and development environment.

Driver Library **API-USBP(WDM)** (Bundled)

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 Win32API 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.

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

Further details may be found in the help within supplied CD-ROM or the homepage of our company.

< Operating Environment >

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

Accessories (Option)

Isolated analog input module (Expansion module for ADI16-4(USB))	: ADI16-4(FIT)GY
AC adapter (input: 90 - 264VAC, output: 5VDC 2.0A)	: POA-AD22
AC-DC power supply unit (input: 85 - 132VAC, output: 5VDC 3.0A)	: POW-AC13GY
AC-DC power supply unit (input: 85 - 264VAC, output: 5VDC 2.0A)	: POW-AD22GY
AC-DC power supply unit (input: 85 - 264VAC, output: 5VDC 4.6A(230VAC), 4.2A(115VAC))	: POW-AD25GY
DC-DC power supply unit (input: 10 - 30VDC, output: 5VDC 3.0A)	: POW-DD10GY
DC-DC power supply unit (input: 30 - 50VDC, output: 5VDC 3.0A)	: POW-DD43GY

* 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 Interface boards 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 boards. The warranty is not applicable if the device has been tampered with or damaged through abuse, mistreatment, neglect, or unreasonable use, or if the original invoice is not included, in which case repairs will be considered beyond the warranty policy.

How to Obtain Service

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

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

Liability




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

Safety Precautions

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

Safety Information

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

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

Handling Precautions

DANGER

Please do not use the product in environments subject to flammable and corrosive gas. Otherwise, it can bring on exploding, fire, electric shock and trouble.

CAUTION

- There are switches on the module that need to be set in advance.
Be sure to check its switch settings before using the module.
 - Please do not change the module switch settings in an unauthorized manner.
Otherwise, it can bring about malfunction, heating and trouble.
 - Please do not subject the module to impact or bend it.
Otherwise, it can bring about malfunction, heating, trouble and damage.
 - Please do not touch the metallic pins on the external module connector.
Otherwise, it can bring about malfunction, heating and trouble.
 - Please do not connect expansion module when the power for the module is turned on. Otherwise, it can bring about malfunction, heating and trouble.
Be sure to turn off the power for the USB module.
 - Please do not touch the module with a wet hand when the power for the module is turned on.
It is danger of electric shock.
Be sure to turn off the power for the USB module.
 - If you notice any strange odor or overheating, please unplug the power cord and USB cable immediately.
Otherwise, it can bring about malfunction, heating and trouble.
In the event of an abnormal condition or malfunction, please consult the dealer from whom the product was purchased.
 - In order to add functions to the product and perform quality improvement, the product specification is subject to change without notice.
Even if you use the product again, please be sure to read the manual to confirm the content.
 - Please do not modify the product.
CONTEC will bear no responsibility for any problems, etc., resulting from modifying the product.
 - Please do not open the product casing.
CONTEC will disclaim any responsibility for products whose casing has been opened.
 - Regardless of the foregoing statement, CONTEC assumes no responsibility for any errors that may appear in this document nor for results obtained by the user as a result of using this product.
-

2. Module Nomenclature

Figure 2.1 shows the names of module components.

In the figures, the indicated switch settings represent factory settings.

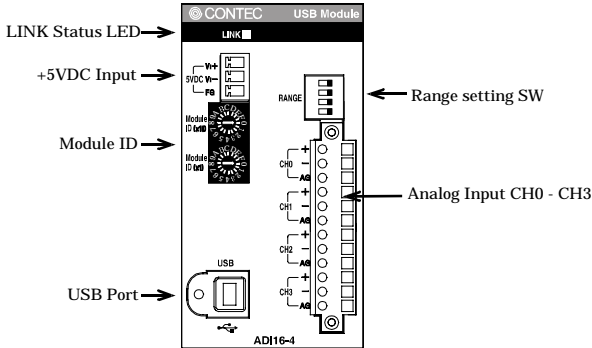


Figure 2.1. Nomenclature of Module Components < ADI16-4(USB) >

Table 2.1. List of Status LED Functions

Name	Function	Indicator color	LED indicator
LINK status	USB communication states	GREEN	ON : Communication established
			OFF : Communication unestablished

3. Setup

Connection-Overall Diagram

This is connection-overall diagram. Please reference to this page for actual

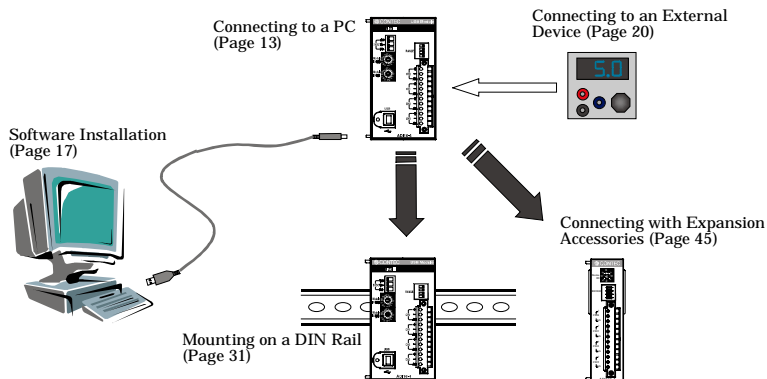


Figure 3.1. Connection-Overall Diagram

Setting a Module ID

The host computer distinguishes and keeps track of the modules of same model by assigning Module IDs to them. Factory settings “00” can be used when only one module per model is connected to one computer.

Each module should be assigned a unique Module ID in the range of 00 - 7Fh when several modules with the same model are being connected.

There are two rotary switches, moreover, “x16” and “x1” represent high bits and low bits of Module ID respectively.

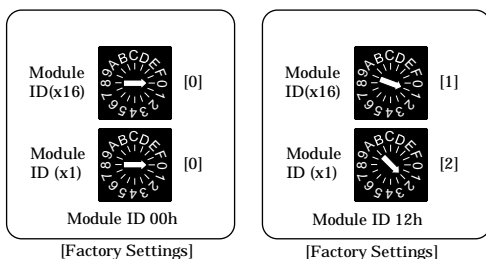


Figure 3.2 Setting a Module ID

Range Setting Switches

Inputs can be set as voltage or current inputs to suit your requirements. A single input range applies for all channels and separate ranges cannot be set for each channel. Do not set other the specified settings.

Setup method

The voltage/current input setting is set using a DIP switch on the module's panel.

Set as shown below.

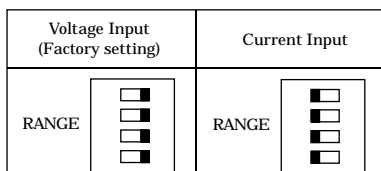
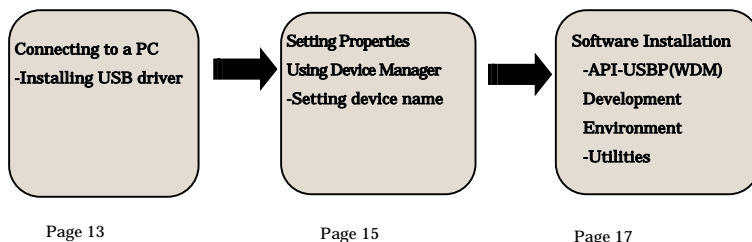


Figure 3.3 Input Range Setting

Setup Flow

The following shows the basic flow for installing USB module.



Connecting to a PC

Connect the USB device to a PC and install the driver.

It is illustrated by taking example for Windows XP. Displaying screen may be different according to different OS, but basic settings are the same.

Points

- You must be logged on as an administrator or a member of the Administrators group to work on Windows 2000 or Windows XP.

Step1 Setting supplied CD-ROM “API-USBP(WDM)”

The menu screen is displayed. The menu will be used in “Software Installation” on page 17 (If the menu screen is not displayed for PC settings, please jump to Step2.)

Step2 Connecting USB port with a PC

Use the bundled USB cable to connect the USB port of the USB module to the USB port on the PC.

Check the orientation of the connector and plug it deep into the port.

Note!

Always use the supplied AC adapter or power supply unit (option).

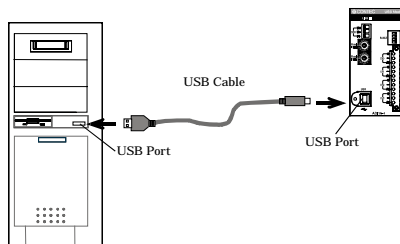
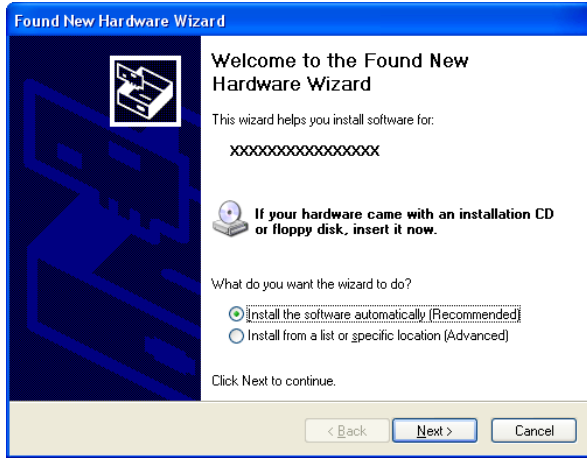


Figure 3.4 Connecting to a PC

Step3 Starting “Found New Hardware Wizard”

Start “Found New Hardware Wizard”, then select “Install from a list or specific location[Advanced]” item and finally click on “Next” button. Detect setup information from supplied CD automatically for installing USB driver.

XXXXXX: device name being searched out

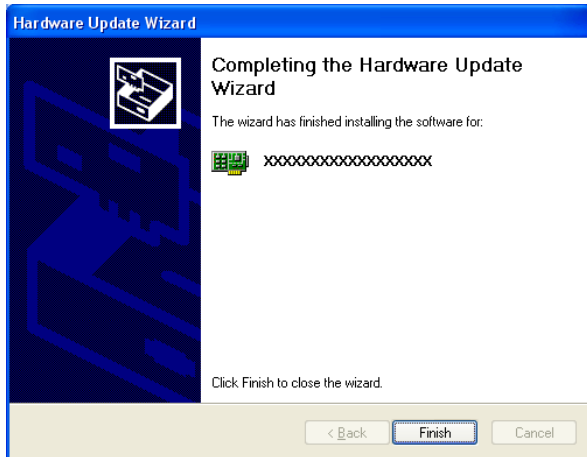


Point

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

Step4 Clicking on [Finish] button

Step4 Clicking on [Finish] button



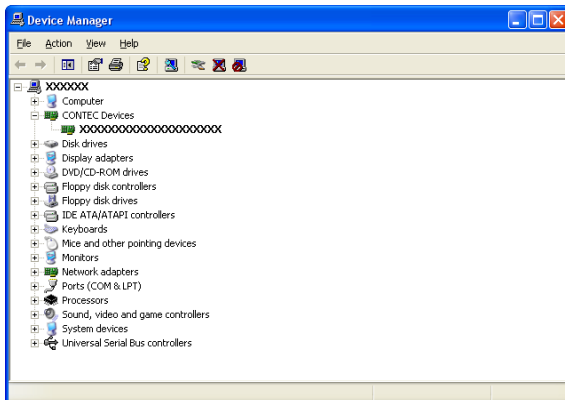
Setting Properties Using Device Manager

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

Step1 Starting Device Manager

Right-click on [My Computer] and select [Properties] to start device manager.

* The model number of the USB module appears under CONTEC Devices [XXXXXX].

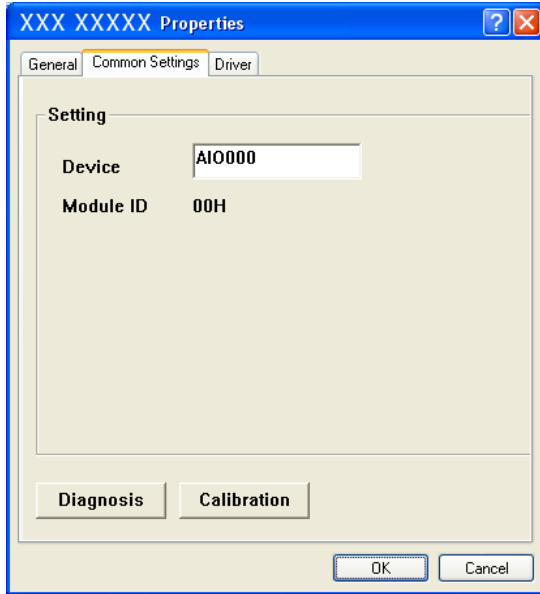


- In the case of Windows XP/2000

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

Step2 Setting the Device Name

Right-clicking on USB module name and selecting [Properties] displays [USB Module Properties]. Open [Common Settings] tab and enter arbitrary name in the editing box for device name. (Default name also can be used.)



CAUTION

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

Step3 Clicking on [OK] button

Device name is set by clicking [OK] button.

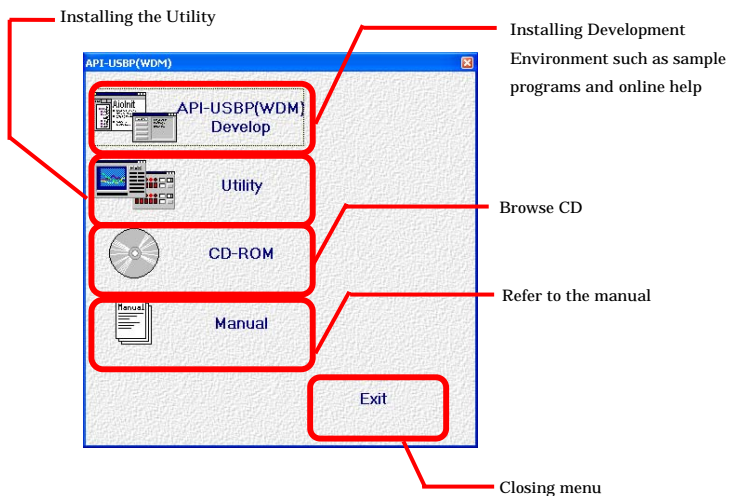
Points

- 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.

Software Installation

Connect with USB module, and install following software if USB driver has been installed.

Illustration of Menu Screen



Points

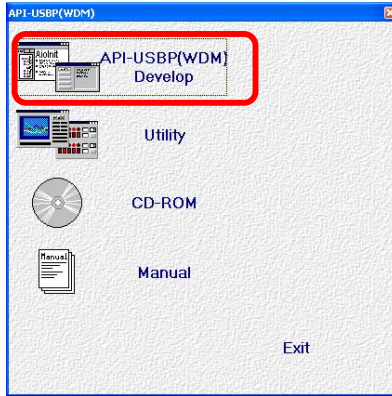
- Please set up the supplied CD-ROM if it has not been set up. The menu starts automatically.
- If the menu do not start, launch X:AUTORUN.EXE(X:CD-ROM drive) from [Run...] in Start menu.
- The screen design may be different.

Installation of API-USBP(WDM) Development Environment

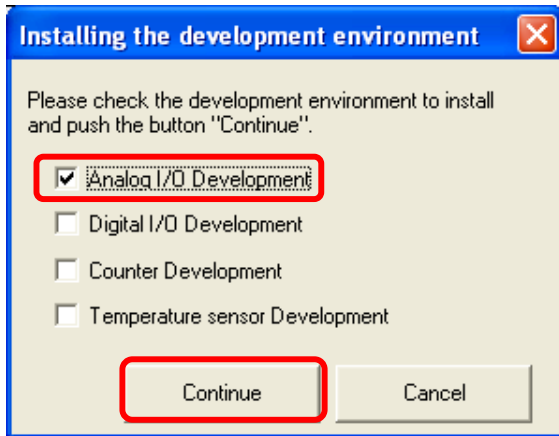
Installation of development environment is namely installing supplied online help and sample program in all language in order to use API function.

Step1 Clicking on “API-USBP(WDM) Develop”

[Installing the development environment] dialog box displays.



Step2 Selecting “Analog I/O”



Step3 Clicking on “Continue” Button

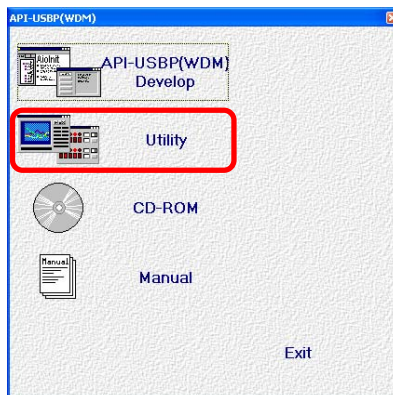
Please perform installation following the directions on the screen. And thus the installation is completed.

*The screen design may be different.

Installing the Utility

The utility is application with which you can verify device operation easily.

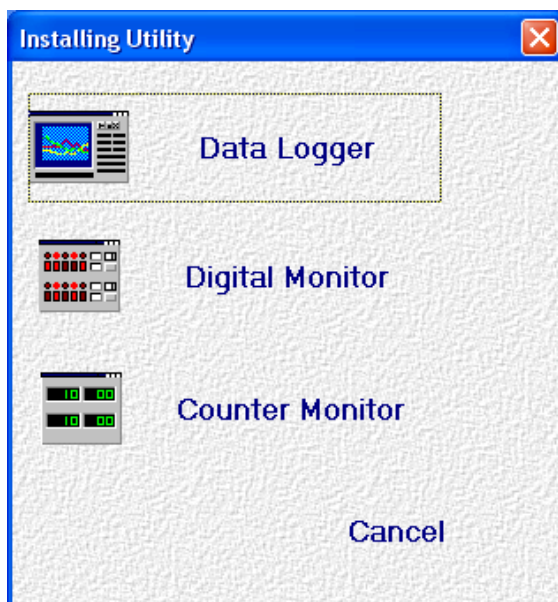
Step1 Clicking on “Utility”



Step2 Clicking on “Data Logger”

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

*The screen design may be different.



Connecting to an External Device

Signal Layout

The Module can be connected to an external device using a 12-pin (1 group) connector that is provided on the Module face.

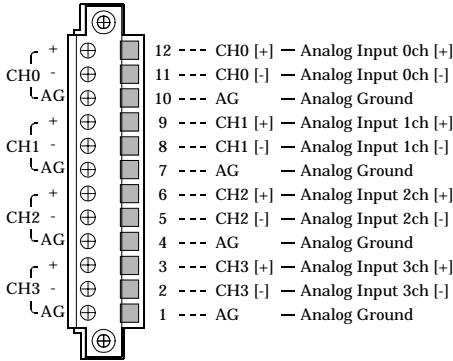


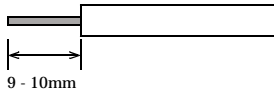
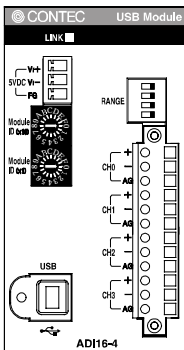
Figure 3.5. Signal Layout on the Interface Connector < ADI16-4(USB) >

Connection Method

When connecting the Module to an external device, you can use the supplied connector plug. When wiring the Module, strip off approximately 9 - 10 mm of the covering for the cable, and insert the bare wire by pressing the orange button on the connector plug. Releasing the orange button after the wire is inserted fixes the cable. Compatible wires are AWG 28 - 16.

⚠ CAUTION

Removing the connector plug by grasping the cable can break the wire.



- Connector used:
3.81mm pitch 12 pin type of rated current 8A
MC-1,5/12-GF-3,81 (made by Phoenix Contact Corp.)
- Compatible plug :
Front-operable spring gauge type
FRONT-MC1,5/12-ST-3,81 (made by Phoenix Contact Corp.)
Compatible wires : AWG 28 - 16

Figure 3.6. Connecting an Interface Connector and Connectors That Can Be Used

Making a connection using the differential input format

This is a method of measuring the voltage of signal source by connecting the 3 wires(2 signal wires- plus input pin[+] and minus input pin[-], analog ground[AG]) of the module.

How to connect:

- (1) Connect the analog ground to the signal source ground.
- (2) Connect [+] input to signal source plus pin (Point A).
- (3) Connect [-] input to signal source minus pin (Point B).

Minus pin and ground are both connected to a same point for the signal source. In this case, connect both module's minus input and analog ground to signal ground. You must connect 3-wires to take an accurate measurement.

Even when the module ground and the signal source have a potential difference in between, using a 3-wire connection eliminates its effect from the measurement results. In addition, the 3-wire input offers better noise immunity than the 2-wire input (single-end input).

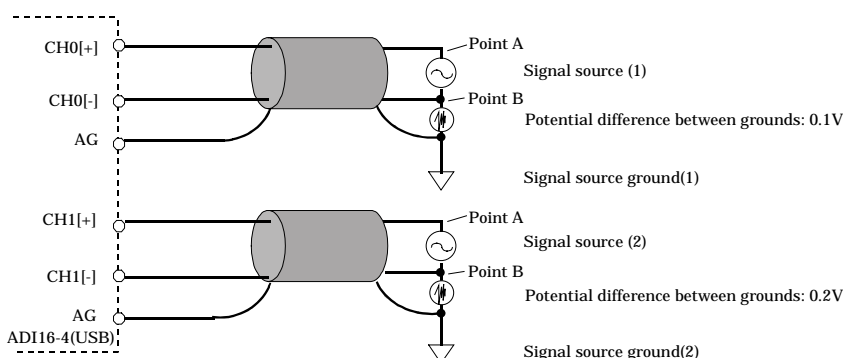


Figure 3.7. Connecting an Interface Connector and Connectors That Can Be Used

As shown in Figure 3.7, when several signal sources are measured, the potential differences between the module's ground and signal source's ground may be different, such as 0.1V or 0.2V. 0.1V offset voltage higher than the voltage of the signal source is added on CH0[+] and 0.2V on CH1[+]. Similarly, the offset voltage of the potential difference between grounds is added on CH0[-] and CH1[-] individually. However, with the connecting of 3-wires differential input, the value of voltage to be converted is the value between point A and point B, the potential difference between grounds can be canceled, so the measuring without error can be performed.

Although the maximum value of voltage on each input pin is $\pm 20V$, you should use the module with the potential difference of $\pm 2V$ between grounds.

Measuring voltage

Set the range setting switch and software setting to voltage input.

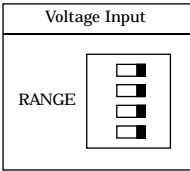
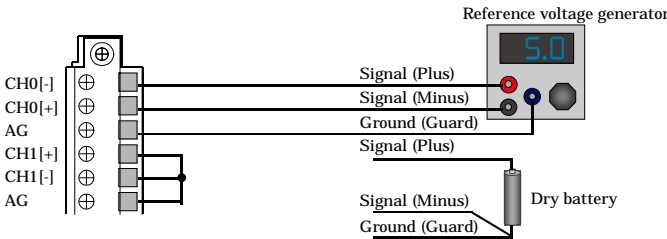
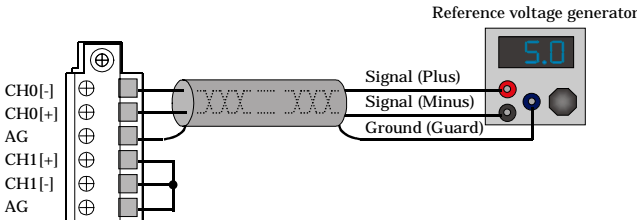


Figure 3.8. Setting the voltage input

The figure below shows an example of using flat cable to connect a reference voltage generator. As a two-wire connection is used when measuring a device such as a battery that only has positive and negative terminals, connect the negative terminal to CH0 (-) and AG. Also connect unused channel inputs to analog ground.



Moreover, you should connect the module by using a 2-core shielded cable in situations where the signal source is at a considerable distance from the module or the noise immunity must be increased.



⚠ CAUTION

- When an analog ground is not connected, the conversion data can be unpredictable.
- In situations where the connecting cable is subject to noise, accurate analog input can fail to occur. To avoid this problem, the connecting cable should be installed away from any sources of noise.
- An excessively long connecting cable can fail to ensure accurate analog input. The connecting cable should be as short as possible.
- The analog signals that are input into the [+] input or [-] input should not exceed the maximum input voltage relative to the module analog ground. A voltage greater than the input voltage can damage the equipment.
- If either the [+] or [-] input pin is not connected, the resulting conversion data can be unpredictable. If a channel is not connected to a signal source, both its [+] input and [-] input pins must be connected to the analog ground.

Measuring current

Set the range setting switch and software setting to current input.

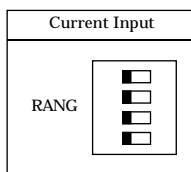


Figure 3.9. Setting the voltage input

The following figure shows an example of flat or shielded cable connection.

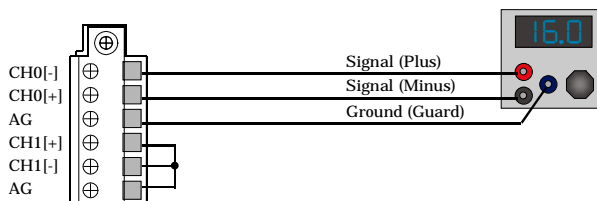
The figure below shows an example connection using a flat cable.

Connect the positive terminal of the current source to the channel's [+] input and the negative terminal to the [-] input. Also connect the module's analog ground to ground on the signal source.

If using more than one current source, you need to connect GND on each current source so that no potential difference is generated.

Although the CPU in the ADI16-4(USB) module is isolated from external devices, there is no isolation between analog input channels and a common analog ground is used.

If the measurement is affected by the potential difference between channels, use an isolating transformer or similar to provide inter-channel isolation.



⚠ CAUTION

- When an analog ground is not connected, the conversion data can be unpredictable.
- In situations where the connecting cable is subject to noise, accurate analog input can fail to occur. To avoid this problem, the connecting cable should be installed away from any sources of noise.
- The analog signals that are input into the [+] input or [-] input should not exceed the maximum input voltage relative to the module analog ground. A voltage greater than the input voltage can damage the equipment.
- If either the [+] or [-] input pin is not connected, the resulting conversion data can be unpredictable. If a channel is not connected to a signal source, both its [+] input and [-] input pins must be connected to the analog ground.

Sampling

Input Range and Conversion Data

On ADI16-4(USB), the range of input can be selected from $\pm 10V \cdot 0 - 20\text{ mA}$ by using software. The analog signals are converted into digital signals with a 16-bit resolution based on the range setting.

Current Input

As for this module, $0 - 20\text{ mA}$ is converted.

The right figure shows the relation between converted data and voltage value within the range of $0 - 20\text{ mA}$. Because the converted data is based on the value of dividing 20 mA current width(current span) by 65536, the converted data increase every 1, the current value increase $0.305\mu\text{ A}$. The converted data will be FFFFh for a current its converted data exceed FFFFh.

	(Decimal)	(Hexadecimal)	
20mA	65535	FFFFh	19.999 69 mA
	65535	FFFFh	19.999 69 mA
	65534	FFFFh	19.999 39 mA
	65533	FFFDh	19.999 08 mA
	:	:	
	32769	8001h	10.000 31 mA
	32768	8000h	10.000 00 mA
	32767	7FFFh	9.999 69 mA
	:	:	
	2	002h	0.000 61 mA
1	001h	0.000 31 mA	
0mA	0	000h	0.000 00 mA

Current value = (Current span of input range) / 65536 x (converted data) = $20 / 65536 \times$ (converted data)

Bipolar range

Indicates that the range of voltage measurable is bi-polar range, for this module, it is $\pm 10V$.

The right figure shows the relation between converted data and voltage value within the range of $\pm 10V$. Because the converted data is based on the value of dividing $20V$ voltage width(voltage span) by 65536, the converted data increase every 1, the voltage value increase 0.306mV . The converted data will be FFFFh for a voltage its converted data exceed FFFFh.

	Decimal	Hexadecimal	
10V	65535	FFFFh	9.999 69 V
	65535	FFFFh	9.999 69 V
	65534	FFFEh	9.999 39 V
	65533	FFFDh	9.999 08 V
	:	:	
	32769	8001h	0.000 31 V
	32768	8000h	0.000 00 V
	32767	7FFFh	-0.000 31 V
	:	:	
	2	002h	-9.999 39 V
1	001h	-9.999 69 V	
-10V	0	000h	-10.000 00 V

Voltage value = (Voltage span of input range) / 65536 x (converted data) + offset voltage
 = $20 / 65536 \times$ (converted data) - 10

Offset voltage : -10V for range of $\pm 10V$.

Sampling Rate

A/D Conversion Timing

The conversion time for the A/D converter in the ADI16-4(USB) is 10 μ sec for voltage measurement and 40 μ sec for current measurement, and the total time required to convert each analog input signal to digital data is (number of channels) x 10 μ sec + 20 μ sec for voltage input and (number of channels) x 40 μ sec + 20 μ sec for current input. There is a delay of 10 μ sec per channel for voltage input and 40 μ sec per channel for current input between the conversion data for ch0 and the conversion data for ch1 and subsequent channels.

Sampling process time with internal CPU

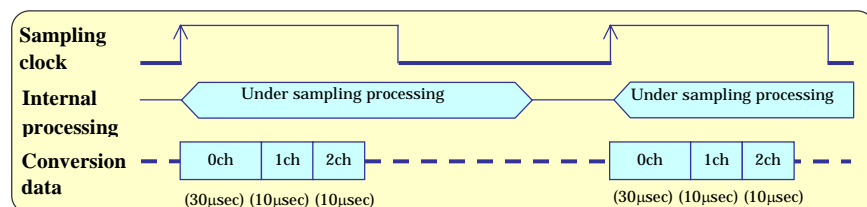
ADI16-4(USB) samples analog signals with CPU which is inside of module.

The practicable minimum sampling period is about 200 μ sec at single channel mode through 1msec at multi-channel mode up to 16 channels, which is depends on the sampling processing time inside a module.

Measured values: The periods may be longer due to factors such as the load on the USB link.

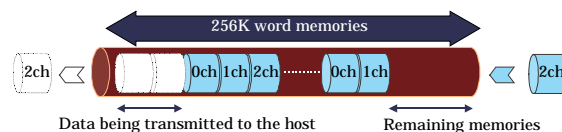
If the set of sampling clock time is shorter than internal sampling processing time, sampling error will occur. Please refer to explanation of AioSetAiSamplingClock in online-help of an API function library.

Converting channel 0 - channel 2



256K-word memory

A/D conversion data what internal CPU process with cycle of sampling clock is able to store up to 256k-word to internal memory. The stored data is transferred in block to host computer via USB. The share of memory is available, and the memory size per channel is up to 64k-word at multi-channel mode with 4 channels. It is able to be A/D sampling over 256k-word if transferring A/D conversion data to host computer before the memory is full.



⚠ CAUTION

Even if the ADI16-4(FIT)GY is used, the size of memory used for storing the conversion data has no change.

Trigger

The condition making ADI16-4(USB) start or stop the converting.

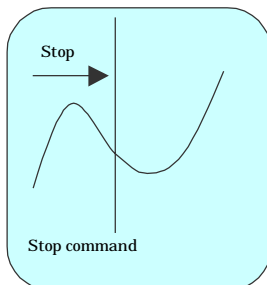
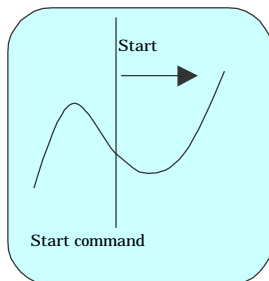
The converting can be controlled by software and the data of analog input.

⚠ CAUTION

When using multiple ADI16-4(USB), the modules don't synchronize.

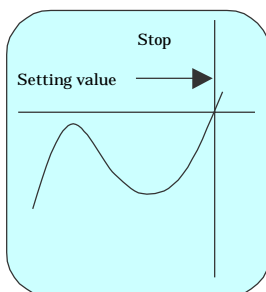
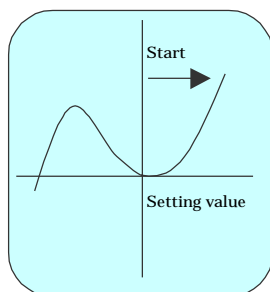
Software trigger

The converting can be started or be stopped by software.



Level trigger

The converting can be started or be stopped by the signal change from a specified channel.



Connecting an External Power Supply

This module must be connected with an external power supply (in a self-powered state).

Connect the external power supply to the +5 VDC input terminal.

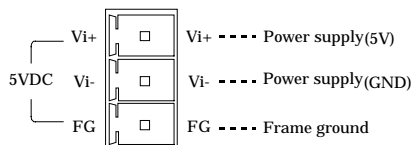


Figure 3.10. +5 VDC Input Terminal Pinouts

The bundled AC adapter POA-AD22 can be connected as it is because its connector is pin-compatible with the input terminal.

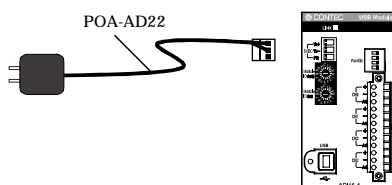


Figure 3.11. Connecting the AC Adapter POA-AD22

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.

Table 3.1. Optional power supply

Type	Model	Input	Output	External dimension (mm)	DIN rail
AC adapter	POA-AD22 (Bundled)	90 - 264VAC	5.0VDC±5% 2.0A(Max.)	44.0(W) x 55.0(D) x 26.5(H) (No protrusion)	-
AC-DC power supply	POW-AD13GY	85 - 132VAC	5.0VDC±5% 3.0A(Max.)	52.4(W) x 64.7(D) x 94.0(H) (No protrusion)	Corresponding
AC-DC power supply	POW-AD22GY	85 - 265VAC	5.0VDC±5% 2.0A(Max.)	52.4(W) x 64.7(D) x 94.0(H) (No protrusion)	Corresponding
AC-DC power supply	POW-AD25GY	85 - 264VAC	5.0VDC±5% 230VAC : 4.6A(Max.), 115VAC : 4.2A(Max.)	52.4(W) x 64.7(D) x 94.0(H) (No protrusion)	Corresponding
DC-DC power supply	POW-DD10GY	10 - 30VDC	5.0VDC±5% 3.0A(Max.)	25.2(W) x 64.7(D) x 94.0(H) (No protrusion)	Corresponding
DC-DC power supply	POW-DD43GY	30 - 50VDC	5.0VDC±5% 3.0A(Max.)	25.2(W) x 64.7(D) x 94.0(H) (No protrusion)	Corresponding

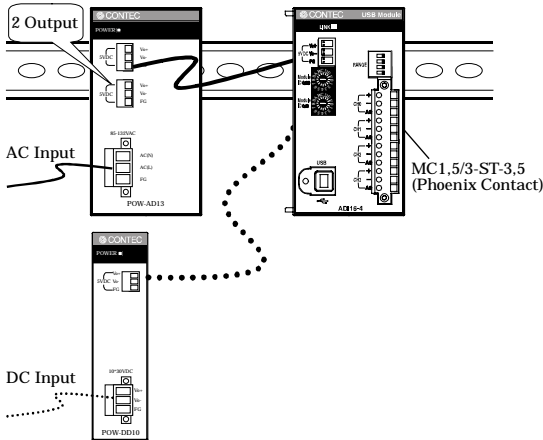


Figure 3.12. Optional power supply

For the power supply for installation on a DIN rail, use the connector MC1,5/3-ST-3,5 (Phoenix Contact).

Connecting method

- To connect the external power supply and USB cable to the unit, take the steps below:
 - (1) Connect the external power supply connector to supply power to the USB module.
 - (2) Use the USB cable to connect the USB module to the PC.
- To remove the external power supply and USB cable from the unit, take the steps below:
 - (1) Unplug the USB cable.
 - (2) Remove the external power supply connector to stop power supply to the USB module.

⚠ CAUTION

- To use the AC adapter, connect it to the USB module first, then plug the AC adapter's connector into a wall outlet.
- 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. The AC adapter heats up itself when loaded heavily. If the AC adapter is exposed to high temperature or used continuously, you should keep the load at about 80% of the maximum load (at 1.6 A for the POA-AD22).

How to install the module

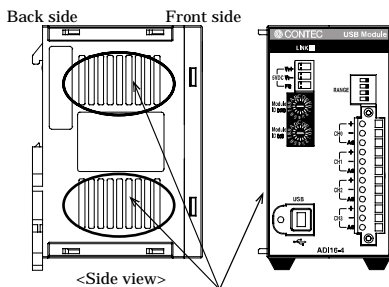
Installation orientation

Please use the module following orientation illustrated in the graph when the module is mounting on a DIN rail and being used on a desk. It should be noted that lateral slit of the module being covered brings about malfunction.

In addition, please use the supplied two rubber feet when setting on a desk or others as figure 3.13(A).

Correct Installation Orientation

(A) Vertical, Front



(B) Horizontal, Front

Do not cover the ventilation holes.

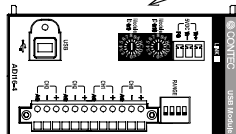


Figure 3.13. Installation direction

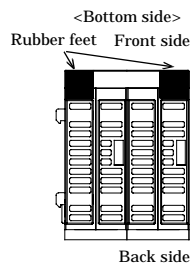


Figure 3.14. Example Rubber Foot Attachment

Mounting with magnets

Two magnets are appended to this product. It is easy of attachment and removal of the module to metal sides, such as a desk, partition panel and so on.

Initial adhesion strength of seal is high, but adhesion strength decreases an ability of peeling strength if once removing a magnet from the enclosure of USB module.

The example of magneto-attachment

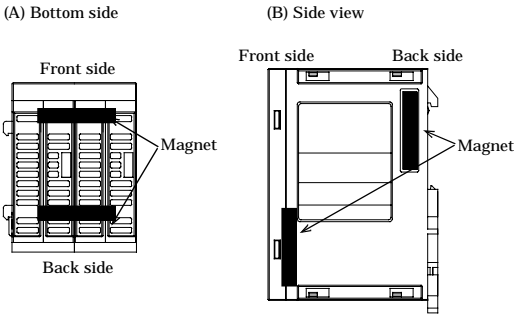


Figure 3.15. The example of magneto-attachment

CAUTION

- Please attach in a DIN rail on the wall and use USB Module, if connecting expansion modules.
 - Please do not close ventilation holes due to prevention of the temperature rise inside a product. Otherwise, it can bring about malfunction, heating and trouble.
-

Mounting on a DIN Rail

Installation Method

The following illustrates the installation with expansion module. Please reference to page 45, “6. Connecting with Expansion Accessories”.

- (1) Pushing the fixing hook with a flat-head screwdriver renders it into a lock-enabled condition (this should be done on all connected modules).

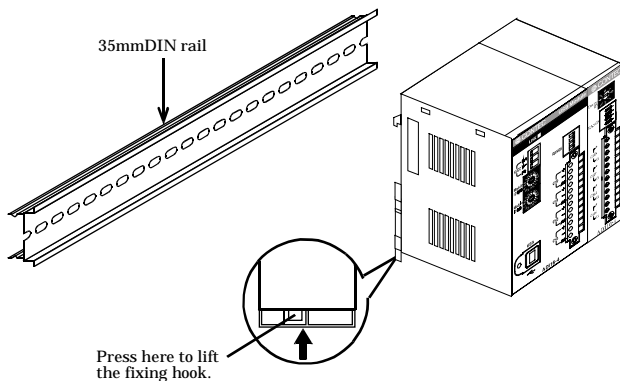


Figure 3.16. Mounting on a DIN Rail < 1 / 3 >

- (2) Hook the unit (an object consisting of a controller and a module) from the upper part of the DIN rail, and press the lower part of the unit onto the DIN rail.

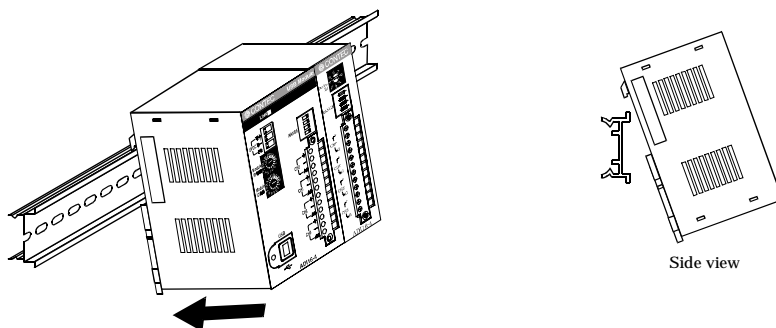


Figure 3.16. Mounting on a DIN Rail < 2 / 3 >

(3) The fixing hook is automatically locked, and the module can be mounted in one-touch.

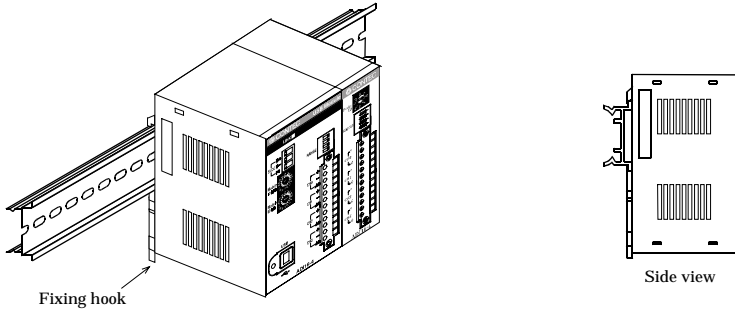


Figure 3.16. Mounting on a DIN Rail < 3 / 3 >

Removal method



CAUTION

Any operation involving the disconnection of modules in a unit (in which multiple modules are connected) that is attached to a DIN rail should be performed after the unit is removed from the DIN rail.

(1) Lower the fixing hook for the unit to unlock it (this operation should be performed on all connected modules).

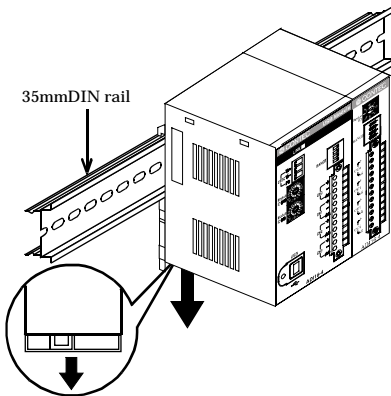


Figure 3.17. Removing the Module from the DIN Rail < 1 / 3 >

- (2) With the fixing hook unlocked, pull the lower part of the unit toward you.

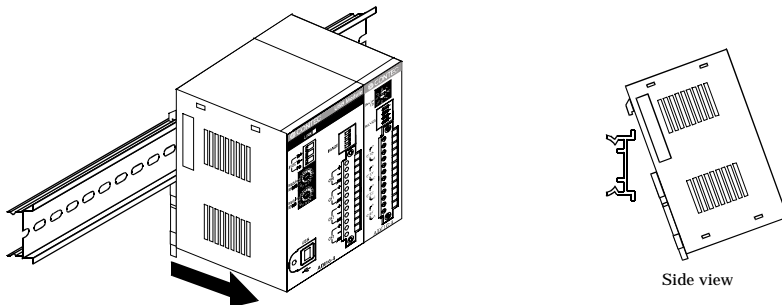


Figure 3.17. Removing the Module from the DIN Rail < 2 / 3 >

- (3) By lifting the unit, you can easily remove it from the DIN rail.

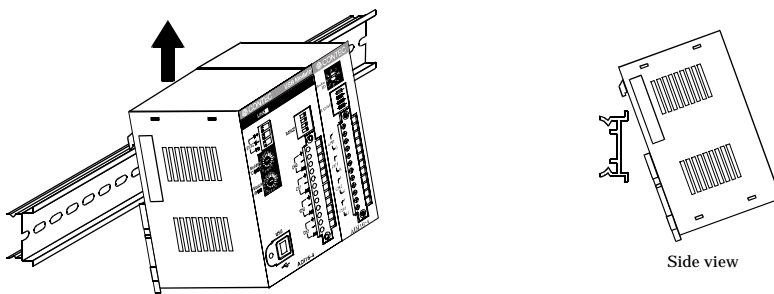


Figure 3.17. Removing the Module from the DIN Rail < 3 / 3 >

Using Several Modules with the same Model

Each module should be assigned a unique Module ID in order to let USB driver recognize them when several modules of the same model are being used.

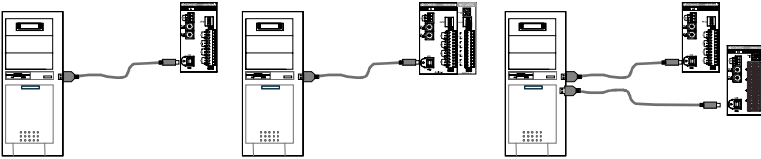
Factory settings (=00) can be used when only one module is connected to one computer.

Unnecessary to set Module ID

Stand alone

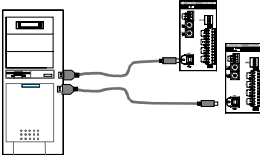
Expansion module being used.

Multiple modules with differential model being used.



Necessary to set Module ID

Multiple modules with same model being used.



Setting a Module ID

CONTEC USB Module

LINK

5VDC W+ W- PS

Module ID dial

RANGE

CH0 + AM

CH1 + AM

CH2 - AM

CH3 + AM

CH4 - AM

USB

AD116-4

One module being used, factory setting(is 00).

Multiple modules being used setting different value.

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].

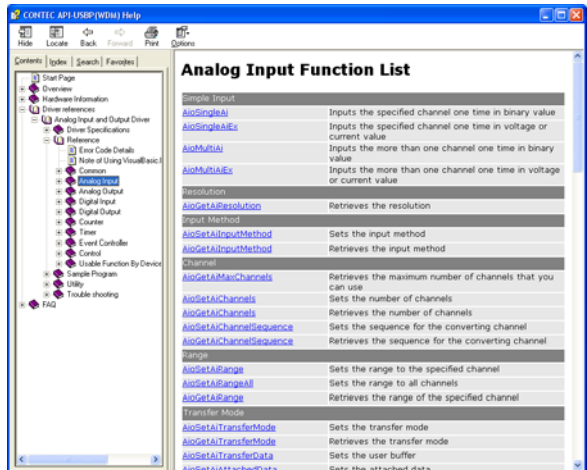
Detailed introduction to search method for help should be found from [How to navigate Help] in the help.

For basic usage, please reference to “Tutorial” for help.

Printing Function Reference

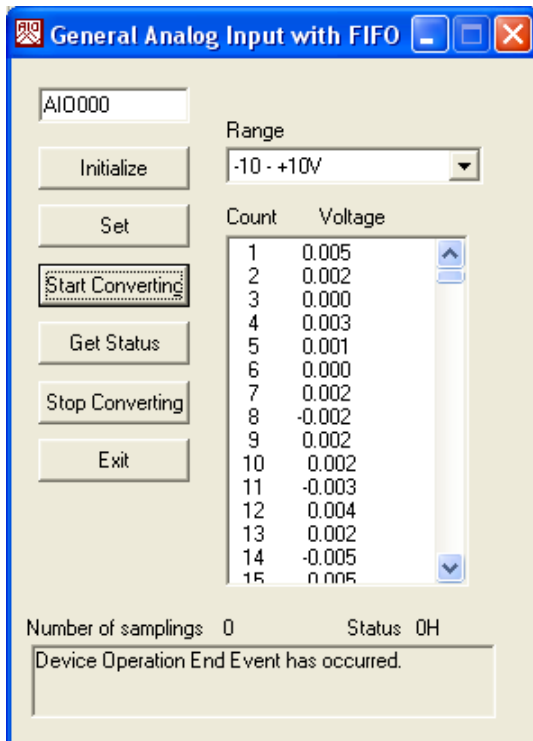
Clicking on Print button from online help prints the page being displayed. It can be printed entirely as follows in the case of referencing to printing function.

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

Sample programs are copied in installation path. (The default path is Program Files\CONTEC~) Sample programs in all language are provided here. To run a sample program, click on [Programs]-[CONTEC API-USBP(WDM)]-[AIO]-[Sample Name] from [Start] menu.



Distributing Developed Application

Please distribute the developed application with USB driver in supplied CD.

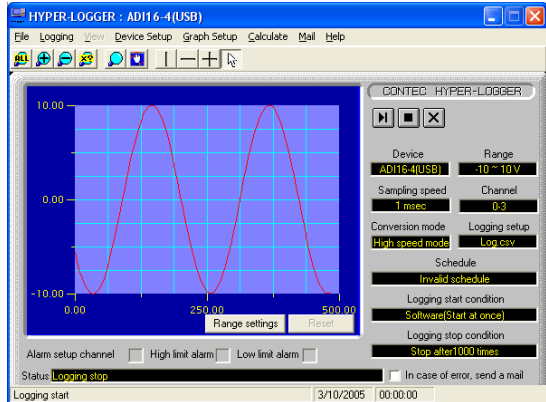
USB driver for analog I/O

X:\INF\WDM\AIO (X:CD-ROM drive)

Utility

You can verify the operation of USB device simply by using utility programs.

Please run the help from menu for usage.



5. Troubleshooting

When encountering trouble or question, you should reference to this section first.

For the usage of [API Function Library], please reference to online help or the sample program.

If you cannot find any piece of applicable information here or taking a suggested action does not solve the problem, contact your retailer.

Troubleshooting

Condition	Cause and measure
USB port of a PC is unusable.	<p>There is no [Universal Serial Bus Controllers] in the category of [Control Panel]-[System]-[Device Manager].</p> <p>It may be unusable for USB port without BIOS settings.</p> <p>BIOS settings is different according to different PC and so that you should reference to the manual of the PC being used.</p>
"Unknown Device" is registered with device manager (Win98/Me).	<p>The cause is incorrect operation such as canceling the wizard by mistake when connecting with a USB module.</p> <p>Follow the following procedure to delete unknown device.</p> <p>Start device manager, select [Unknown Device] and then click on [Delete] button.</p>
"USB Device" is registered with device manager (Windows 2000).	<p>The cause is incorrect operation such as canceling the wizard by mistake when connecting with a USB module.</p> <p>Follow the following procedure to delete unknown device.</p> <p>Start device manager, select [USB Device] and then right-click [Delete].</p>
The menu can not be displayed when a PC CD-ROM is being set.	<p>Select "Run..." form Start menu, and then type</p> <p>X: AUTORUN.EXE (X: CD ROM drive), finally, click on OK button.</p>
The message of "HI-SPEED USB Device Plugged into non-HI-SPEED USB Hub" is displayed on Windows XP.	<p>This USB module corresponds to communication with HighSpeed (480Mbps), and Full Speed (12Mbps) is used to communicate when host controller and HUT device do not correspond to HighSpeed.</p> <p>Warning message will be displayed on Windows XP and it does not disturb the operation.</p>
Fail to iutput(output) accurate data.	<p>Please verify whether the output of each channel is correct by using diagnostic program. Please short-circuit channels and check whether or not a voltage value exists.</p>
Unknown reason for abnormal operation.	<p>Please verify the content of error code in the help as error occurs from function. When program in developing is in no-operation, you should at first confirm whether the action of diagnostic program and sample program is normal. Contact with your retailer if the problem has not been resolved. In this instance, please send back the result of diagnostic program and the result of sample program.</p>

Q&A

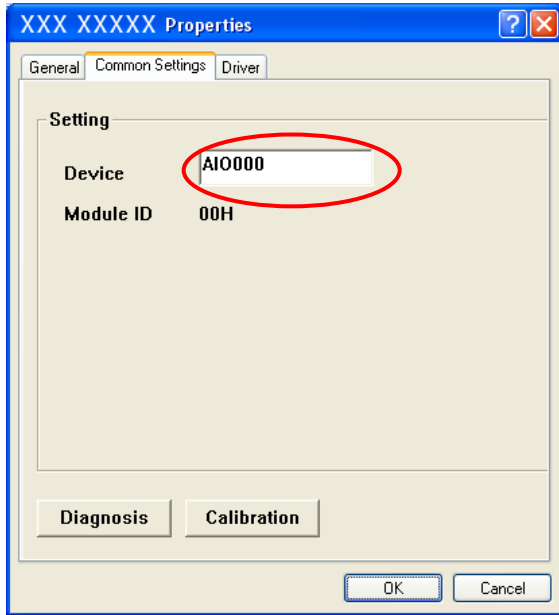
Question	Answer
Can it run on Windows NT4.0 or Windows 95?	No. In addition, it can not run on Windows 3.1, Windows NT3.51 and so on.
Can it run on OS different from Windows?	It can not run on non-Windows OS such as Linux, MS-DOS etc.
Can you make an USB connection with PC-9821 series?	Not support.
How many USB modules can be connected to one PC?	The number for connection is namely the number of USB ports available on a PC. Please supply the power by AC adapter when expanding ports by USB HUT.
Can the developed applications run on other PC?	Please install USB driver and set device name for developed applications with which the files necessary to distribute are supplied. USB driver is in the INF folder on CD-ROM drive.
Does it have license in distributing developed applications?	It is free to distribute developed applications.
Can applications be developed in language different from corresponding language?	The languages in which the supplied sample programs are written are the supported languages. USB driver is supplied in the form of Win32API DLL and so that it can be used by language and applications supporting this form (It can not be used by language which do not support corresponding argument type). The integrity of the operation cannot be guaranteed because we do not verify the operation.
Can it be used without programming knowledge?	There are supplied softwares (Development Environment) for application development on the CD-ROM. Applications are basically developed in corresponding language, and utility programs can be used to check status if you only want to monitor I/O status.
Can run with other applications together simultaneously?	It is possible because of multiple-thread processing in Windows. Reply from an application may be very slow because of the high load.
Can expansion modules with different type be connected?	No. In the case of using ADI16-4(USB), ADI16-4(FIT)GY is the only module to be connected.
What about the maximum length of USB cable?	The maximum length is less than 5m according to USB specification. But it can expand to 6 tiers with 30m long when using USB HUT.

Question	Answer
How to get the version of USB driver?	Run diagnostic program and [Diagnosis ...] to get the version of the driver.
How to upgrade USB driver to latest edition?	You can download it from following homepage when there is latest edition. http://www.contec.com/download
How to start the device manager?	Windows 2000/XP: Start Start->Settings->Control Panel->System.Select Hardware and click on Device Manager.
Does it feature suspend/resume function?	No. Please set power management for a PC in order to avoid suspension in operation.
Want to perform the channels more than the points being appended by expansion modules.	The number of expansion modules is 3(4 including the USB module). when channels more than this number are wanted, please purchase the necessary USB module(s) and expansion accessories.
Is adding points by expansion modules different form adding USB modules?	Using expansion modules - Only one USB port is used. - When a function is used, it is executed for one device with the number of channels increased. Adding main units - As many USB ports as the number of main units added are used. - When a function is used, it is executed for the separate devices.
In what order should the USB cable and power cable be unplugged?	When the module is externally powered, for example, via the AC adapter, unplug the USB cable first, then unplug the power cable.

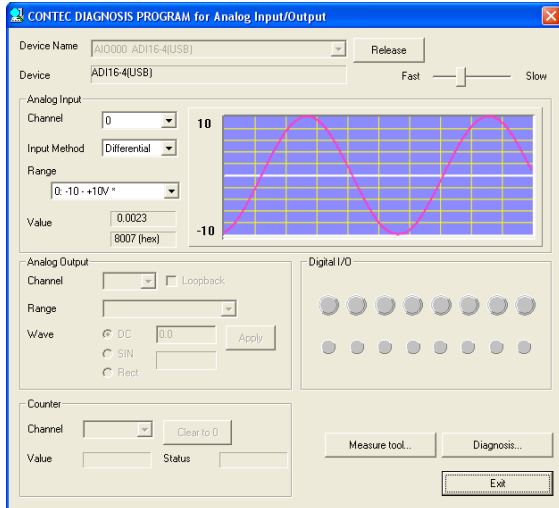
Diagnostic Program

Running diagnostic program may identify that if abnormality exists in hardware or software.

Run diagnostic program, open Properties for USB module of device manager and then click on [Diagnosis] button in [Common Settings] tab.



Using Diagnostic program, you can not only verify the status of current input but also perform further diagnosis by clicking on [Diagnosis...] button.



Version Upgrade

How to Upgrade the Firmware

Firmware is namely software which is embedded in USB module. Up-to-date firmware(update file) will be supplied in the homepage of our company in the case of function upgrade and so on. The following presents how to update the update file downloaded from homepage to USB module.

Step1 Removing USB module

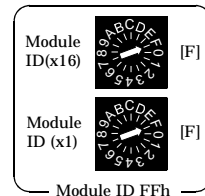
Please make disconnection when USB port is being connected. When using self power, remove AC adapter in order to reset status.

Step2 Set Module ID to FFh

Set Module ID to FFh.
It is special setting for firmware upgrade.

Point

- Modules should be performed firmware version upgrade one by one.
- Upgrade for multiple modules can not be performed at the same time.



Step3 Connecting USB Module with USB Port

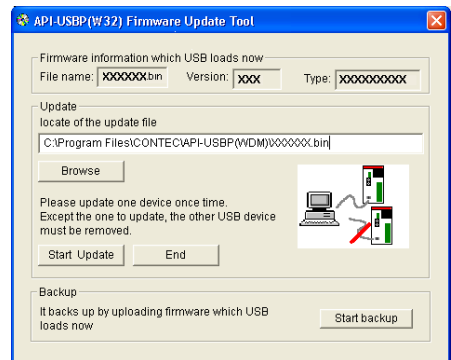
Please connect USB port after AC adapter has been connected when using self power.

Step4 Starting Firmware Upgrade Tools

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

Step5 Specifying Upgrade File

Clicking on [Browse] button specifies the file which has been downloaded.



Step6 Clicking [Start Upgrade] Button

Upgrade is completed automatically.

Step7 Setting Properties by Device Manager once more

After completing upgrade, perform settings again by referencing to “Setting Properties Using Device Manager” on page 15.

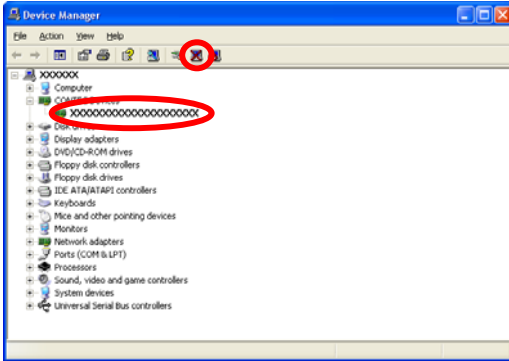
Driver Upgrade

If there is up-to-date driver, it is supplied in the homepage of our company.
<http://www.contec.com/download>

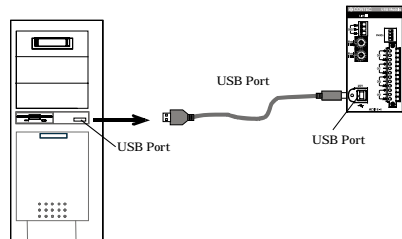
Returning to Initial State

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.

Step1 Deleting Device form Device Manager



Step2 Drawing USB cable from a PC



Step3 Uninstalling Driver

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

Step4 Restarting

6. Connecting with Expansion Accessories

When lacking of analog input channel used to connecting external device, you have to purchase a new same module, and thus it not only increases cost but also doubles installation space. At the same time, adding channels is considered when designing this module, and additional module can be connected by the connector on module side, so that not only the cost but also the installation space are controlled.

Up to 3 modules ADI16-4(FIT)GY can be connected when adding channels.

In the case of combination of the USB module “ADI16-4(USB)” and three expansion modules “ADI16-4(FIT)GY”, it is possible to control 16 channels input by way of one USB port.

Table 6.1. Expansion Modules

Type	Input channel	Current consumption	Function
ADI16-4(FIT)GY	4	+5VDC 300mA(Max.)	Expansion module for ADI16-4(USB)

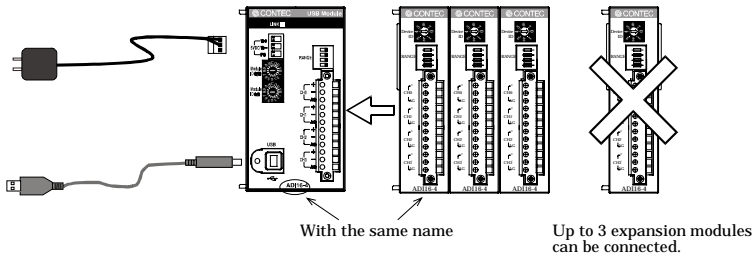


Figure 6.1. Expansion Modules

Points

- Up to 3 modules can be connected.
- Please use the supplied AC adapter when adding modules.
- Modules with different function from the USB module can not be connected.
- The analog grounds of both USB module and expansion module are isolated from each other.

Setting a Device ID

Set Device ID by rotary switch on the front when adding modules.

The ID for the first module being added must be 1 and values 2 and 3 are for the following two modules respectively. Furthermore, the factory setting for the Device ID is “0”.



CAUTION

To avoid malfunction, please do not set the Device ID to one other than 1, 2 and 3.

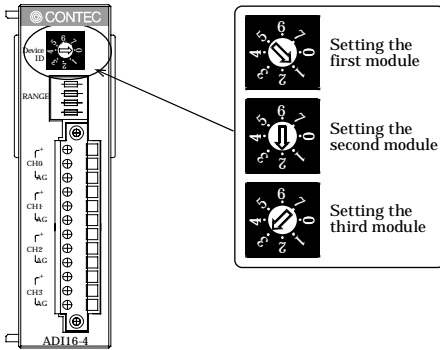


Figure 6.2. Setting a Device ID

Connection between Modules

Stack Connection Locking Devices

The module contains connecting locking devices (▲ mark, two units at the top and bottom).

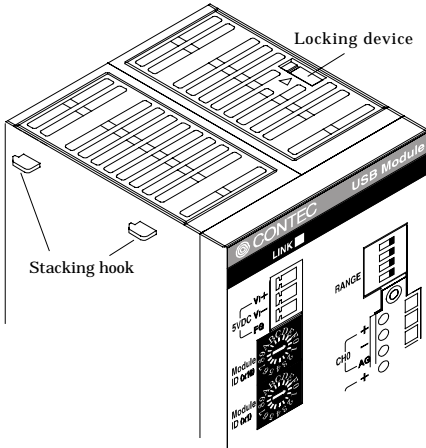
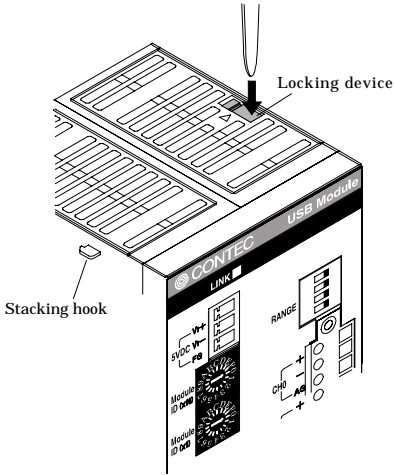


Figure 6.3. Stack Connection Locking Devices

How the Stack Connection Locking Device Works

Locking

Push the pawl of the locking device with a tool that has a slender tip downward from above to open the spring for the locking device (the groove moves toward you).



Unlocking

Push the groove of the locking device with a tool that has a slender tip in the direction of the arrow until the device is locked.

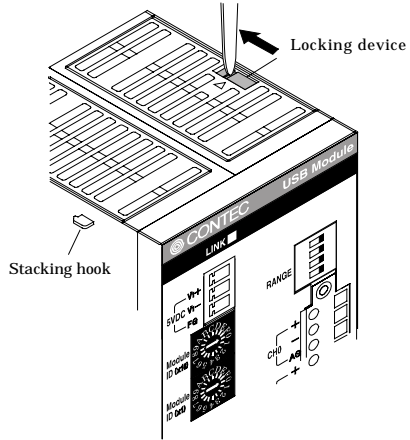


Figure 6.4. How the stack connection locking device works

Connecting the Module

Inserting the stack hook by aligning it with the hook insertion inlet for the other device automatically locks the module. (If a stack connector protective cover is attached, the connection operation should be performed after the cover is removed.)

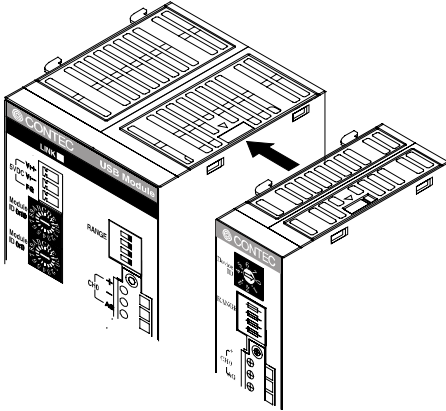


Figure 6.5. Connecting the Module

Removing the Module

Unlock the locking device at the top and the bottom. Remove the connected module from the hook.

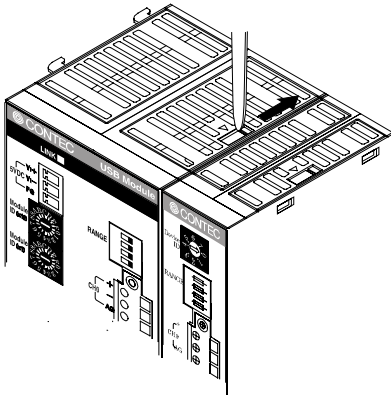


Figure 6.6. Removing the Module

7. Product Specification

Hardware Specification

Table 7.1 lists the hardware specification of ADI16-4(USB).

Table 7.1. Hardware Specification < 1 / 2 >

Item	Specification
Analog input	
Input format	Bus-isolated voltage / current input
Input range	Voltage: Bipolar $\pm 10\text{V}$ Current: 0 - 20mA
Maximum input rating	Voltage: $\pm 20\text{V}$ Current: 30mA
Input impedance	Voltage: $1\text{M}\Omega$ (Min.) Current: 250Ω (Typ.)
Input channel	Different input 4 channels
Resolution	16 bits
Non-linear error	Voltage: $\pm 8\text{LSB}(\pm 0.012\%$ of FSR) Current: $\pm 20\text{LSB}(\pm 0.030\%$ of FSR)
Conversion rate	Voltage: $10\mu\text{sec}/\text{ch} + 20\mu\text{sec} * 1$ Current: $40\mu\text{sec}/\text{ch} + 20\mu\text{sec} * 1$
Data buffer	256K data (262,144 data)
Internal sampling timer	$10\mu\text{sec} - 1,073,741,824\mu\text{sec} * 2$
Communication	
USB transmission speed	12Mbps(full speed), 480Mbps(high speed) *3
Current consumption	+5VDC 600mA(Max.) *4

Table 7.1. Hardware Specification < 2 / 2 >

Item	Specification
Others	
Number of modules used at the same time	127 modules (Max.) *5
Use condition	0 - 50°C, 10 - 90%RH(No condensation)
External dimensions (mm)	50.4(W) x 64.7(D) x 94.0(H) (exclusive of protrusions)
Weight of the module itself	100g
Module installation method	One-touch connection to 35mm DIN rails (standard connection mechanism provided in the system)
Expansion module	ADI16-4(FIT)GY : 3 modules (Max.), Current consumption per one module : +5VDC 300mA(Max.)
Connectors	FRONT-MC1,5/12-ST-3,81(made by PHOENIX CONTACT) 3.81mm-pitch nominal current: 4A(Max.)
Applicable wire	AWG28 - 16
Bundled AC adapter (POA-AD22)	90 - 264VAC 5.0VDC±5% 2.0A(Max.) Cable length is about 1.4m

*1 Converting speed of A/D converter. The minimum executable sampling period is depending on internal processing time and is about 200msec (using one channel) - 1msec (using 16 channels).

(Measured values: The period may be longer due to factors such as the load on the USB link.)

*2 It takes the unit of 1000msec (1000msec, 2000msec, 3000msec, ...) when expansion module being used.

*3 USB module executes API function by USB communication. The executing time of API function by USB communication is about several msec in practice (Depending on the contents handled by API function, it may be longer than that). The responding speed of USB module is based on the environment of the host PC being used.

*4 Always use the supplied AC adapter or power supply unit (option).

*5 The USB interface can accommodate up to 127 devices on the bus. As a USB hub itself is counted as one device, however, 127 USB modules cannot be connected together.

Software Specification

Table 7.2. Windows Driver Specification

Item	Specification
Support OS	Microsoft Windows 98 or Second Edition Microsoft Windows Me Microsoft Windows 2000 Professional Microsoft Windows XP Professional, Home Edition
Support language	Microsoft Visual C++ Ver 5.0, Ver 6.0 Microsoft Visual C++ .NET 2002, 2003 Microsoft Visual Basic Ver 5.0, Ver 6.0 Microsoft Visual Basic .NET 2002, 2003 Microsoft Visual C# .NET 2002, 2003 Borland Delphi Ver 5.0, Ver 6.0 Borland C++ Builder Ver 5.0, Ver 6.0
System requirement	-PC (IBM PC/AT compatibility, DOS/V) with USB port -CD-ROM drive -Recommend the environment on which the using language can run smoothly

Circuit Block Diagram

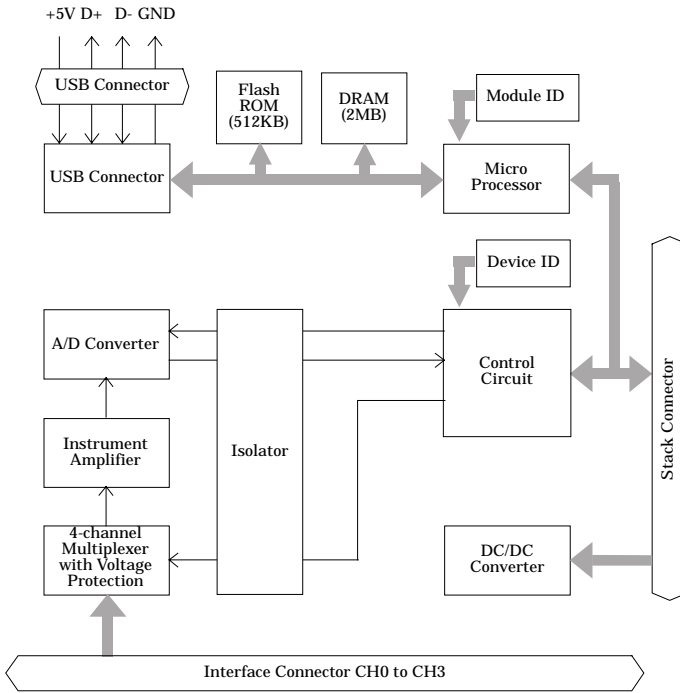
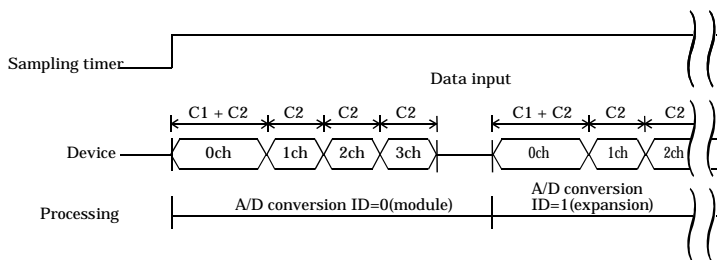


Figure 7.1. Circuit Block Diagram

Point

The Device ID of the USB module ADI16-4(USB) is fixed at “0”.

Timing Chart



[C1]: 20 μ sec

[C2]: Voltage input 10 μ sec / Current input 40 μ sec

Figure 7.2. Timing Chart

Setting

Sampling timer value: 1000 μ sec

Modules used: ADI16-4(USB) [ID=0] conversion channel 0ch - 3ch
 ADI16-4(FIT)GY [ID=1] conversion channel 0ch - 3ch

Operation

1. Start timer with the sampling timer set in ADI16-4(USB)
2. At rise edge of internal sampling clock, output conversion start command to ADI16-4(USB) and at the end of data input, output A/D conversion start command to ADI16-4(FIT)GY.

External Dimensions

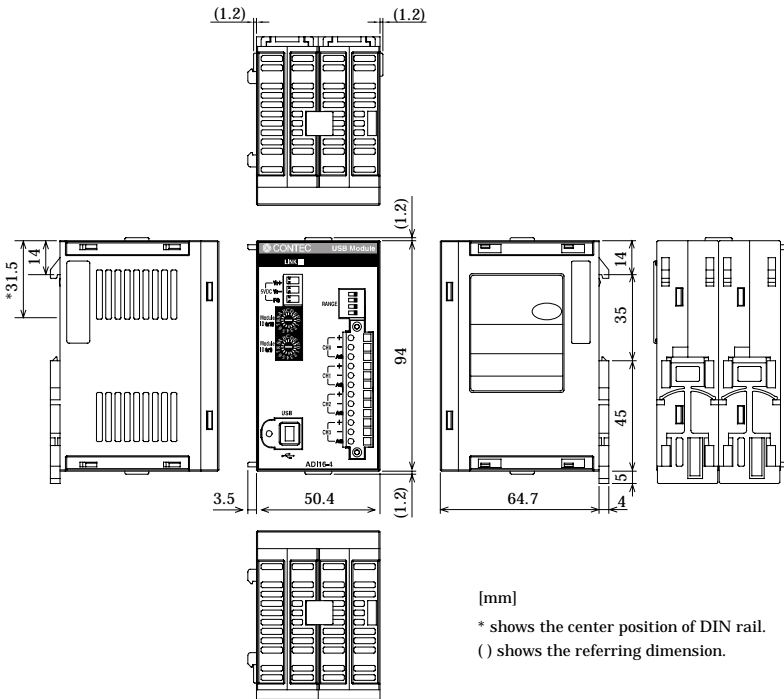


Figure 7.3. External Dimensions of the USB module

8. Appendix

Glossary

The glossary contains a brief description of terms used in this manual.

Terms	Explanation
API [Application Program Interface]	It is abbreviation for Application Program Interface. It is the open program interface for OS corresponding to applications, and all application processing are basically performed through the API. The API provided by our company can control hardwares by calling device driver.
PDF file	It is abbreviation for Portable Document Format. It is the document format developed in order to display files not depending on specified platform. It is developed by Adobe CO.
USB [Universal Serial Bus]	It is abbreviation for Universal Serial Bus. It is not only a specification for the connection between a PC and a peripheral equipment but also a kind of terminal. It can connect a wide range of devices and can be plugged/unplugged with the power being
USB 2.0 [Universal Serial Bus 2.0]	The latest USB specification that keeps up the low-compatibility with previous USB and promotes the data transfer speed to 480Mbps (60MB/sec).
Device ID [Device Identifier]	It is the ID being set when connecting expansion modules and specifying connection order. It is only for expansion modules. The channel number is decided by the setting.
Self power	Supplying power by using AC adapter is called Self-Power. Please make use of AC adapter when using expansion modules.
Device driver	It is softwares to operate and set peripheral equipment by a PC, and the peripheral equipment is installed on the PC. It is simply called Driver.
Device manager	It is a Windows tool which can confirm the behavior of the peripheral equipment installed on a PC, and the state being identified by Windows and so on.
Device name	The name is set by USB driver to specify modules. It is set in Properties of Device Manager and specified in the course of API function initialization and so on.
Hardware wizard	It is support program for user without technical knowledge to add peripheral equipment to a PC. It runs automatically after the device such as USB device has
Bus power	Power is supplied by a host when USB cable is being connected without connecting a AC adapter.
Firmware	It is the software incorporated into a equipment to perform basic control on hardware.
Properties	Select USB Modules from Device Manager, right-click and select [Properties] dialog box from pop-up menu to set the device name.
Module ID	About the ID of the USB module. Set unique ID value individually for the modules in order to distinguish the driver when using multiple modules. Use the factory setting(=0) when using one module.

ADI16-4(USB) User's Guide

CONTEC CO.,LTD.

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