PCI-AIO01

User Manual

Version 1.0

DAQ SYSTEM
Measurement & Automation

Contents

UPDATE HISTORY

2010-10-12

Add API function

ADC_StartBufferedRead()

ADC_StopBufferedRead()

ADC_GetBufferedData()

ADC_GetBufferedDataEx()

ADC_SetAvgCounter()

API function description supplement

ADC_GetData()

2010-11-05

Add API function

GetBoardVersion() - Effective since board version 2

2011-07-04

6. Add installation

7. Add sample program description

1. Introduction

PCI-AIO01 is an analog input/output PCI board that supports 2 channels of 12-bit DAC (Digital to Analog Converter) and 8 channels of 12/14/16-bit ADC (Analog to Digital Converter). All control of this board is designed with FPGA (Field Programmable Gate Array), so function enhancement or modification is free, and it can be easily upgraded according to the user's needs. In addition, it is a board with various ADC input range support (+5V, +10V, ±5V, ±10V) and DAC output range (0 ~ +10V, ±10V).

1-1 Product Features

Items	Description	Remark
Hardware		
PC Interface	PCI 32bit/33Mhz	
Operation Power	+5VDC/ Max 1A	
I/O Port	D-Sub9 / D-Sub25	
Feature	12/14/16 bit ADC 8 Channel In 12 bit DAC 2 Channel Out	
Analog Input	12/14/16bit resolution 8 Single ended or 4 Differential	0 to +5V, 0 to 10V, ±5. ±10V Software-Programmable input range
Analog Output	12bit resolution 2 Channel	0 to +10V, -10V to 10V range MAX 500K (2uSEC) update rate
Simultaneous use of boards	Max. 4	
Operating temperature range	0 ~ 70℃	
Storage temperature range	-20 ~ 80℃	
Humidity range	20 ~ 80%	Non-condensing
Board size	175mm X 95mm	PCB Board Size
Software		
OS	Windows 2000/XP/7/8/10 (32/64bit)	
API	Windows Client DLL API	
Support	Sample Program	VC++

1-2 Product Applications

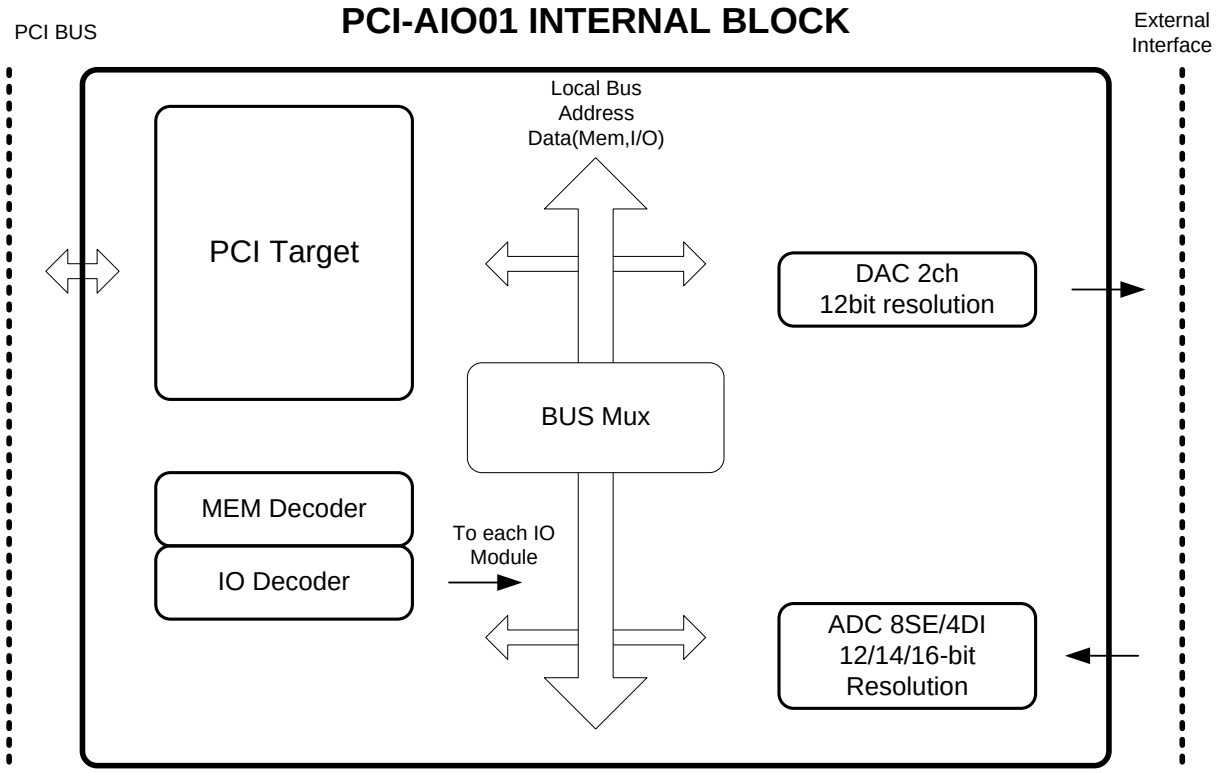
- ◆ PCI development and evaluation
- ◆ Data acquisition
- ◆ Laboratory instrumentation
- ◆ Process control systems
- ◆ Factory automation

➢ DAQ System Analog I/O Products

Products	Analog Input			Analog Output			Timer
	Sampling Rate	Resolution	Channel	Range(V)	Resolution	Channel	Range(V) /Counter
PCI-AIO01		12/14/16	8 Single Ended /4 Differential	0~5, 0~10 ±5, ±10	12	2	0~10, ±10
PCI-AIO02		12/14/16	8 Single Ended /4 Differential	0~5, 0~10 ±5, ±10	16	8	0~5, 0~10, 0~10.8 ±5, ±10, ±10.8
PCI-AIO04		12/14/16	16Single Ended /8 Differential	0~5, 0~10 ±5, ±10	12	2	0~10, ±10
PCI-AIO05		24	4 Single Ended /4 Differential	0~5, 0~10 ±5, ±10			
PCIe-AIO15		24	4 Single Ended /4 Differential	0~5, 0~10 ±5, ±10			
PCI-PID01	52Ksps	16/24	4	±10	16	1	±10

2. PCI-AIO01 Block Diagram

PCI-AIO01 is an analog input/output PCI board that supports 12-bit resolution DAC 2 channels and 12/14/16-bit resolution ADC 8 channels as shown in [Figure 2-1].



[Figure 2-1. PCI-AIO01 Internal Block Diagram]

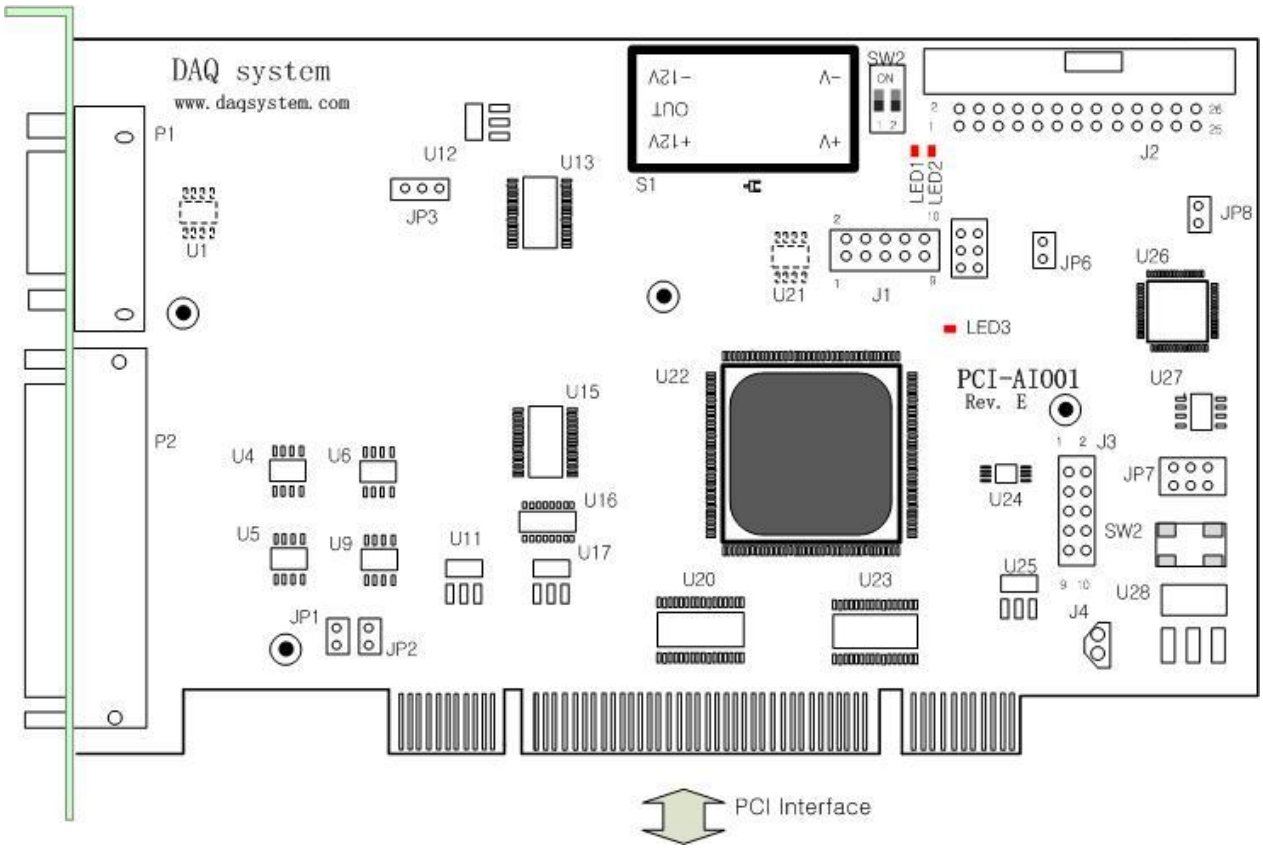
GENERAL DESCRIPTION

- **Multi-function Data acquisition board**
- **PCI target 32bit/33Mhz**
- **12/14/16 bit ADC 8 channel In (8-ch SE or 4-ch DI)**
- **12 bit DAC 2 channel Out**
- **Trigger function for analog In/Out sync**

3. PCI-AIO01 Board Description

Each important board function is briefly described. For detailed function information, please refer to the parts specification.

3-1 Board Layout



[Figure 3-1. PCI-AIO01 Layout]

There are 3 LEDs on the board, and the description of each is as follows.

LED1 : Lights up when the board finishes configuration and ready for operation.

LED2 : Not applied

LED3 : Not applied

3-2 Device Features

(1) D-Sub 9 Pin : P1

DAC 2 channels Output Pin, Synchronous Pin

(2) D-Sub 25 Pin : P2

Analog Input Pin, Pin for Trigger

(3) FPGA : U22

All functions of the board are controlled through this FPGA Logic.

(4) PCI Chipset : U20, U23

PCI Signal Control

(5) CPLD : U26

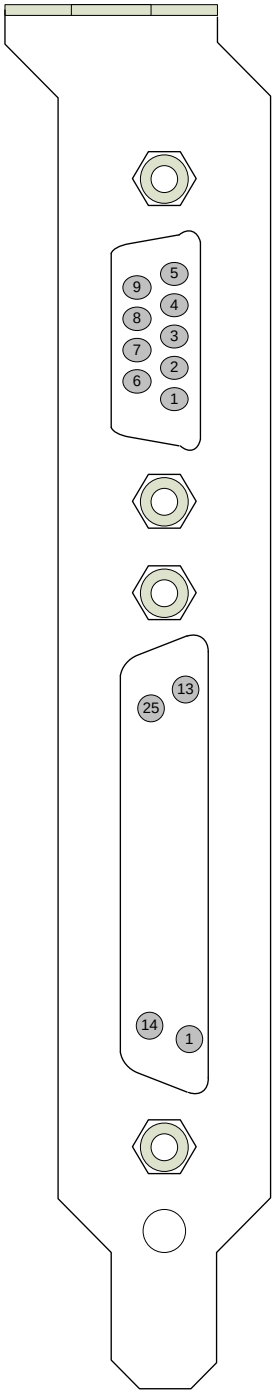
In-system programming for general purpose logic integration is provided.

(6) Regulator : U11, U12, U17, U25, U28

It supplies the power used by the board.

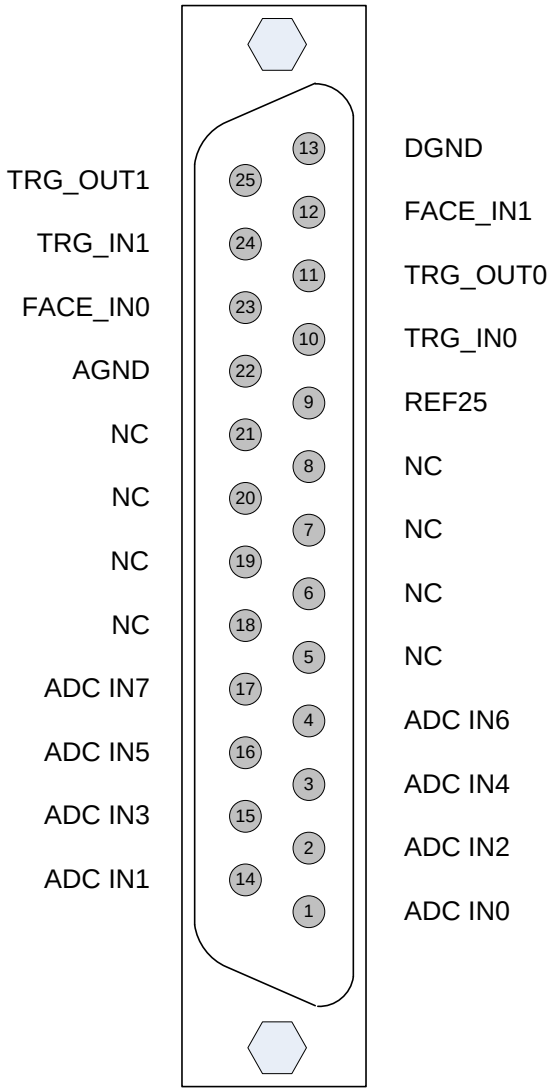
3-3 Connector and Switch

D-SUB 9-pin and 25-pin connectors fixed to standard PCI brackets are used for analog signal output and input, respectively.



[Figure 3-2. PCI-AIO01 PCI Bracket]

3-3-1 D-Sub25 Connector (P2)



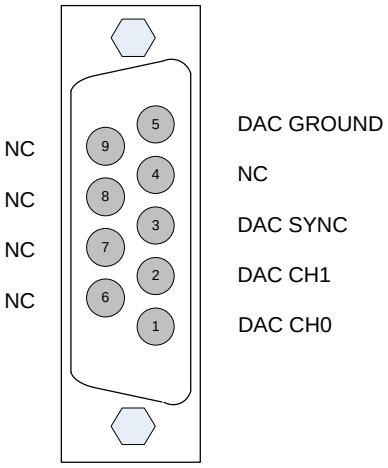
[Figure 3-3. PCI-AIO01 D-sub25 Connector]

[Table 1. PCI-AIO01 D-sub 25Pin Connector]

Pin No.	Name	Description	Remark
1	ADC IN0	Analog Input Channel 0	+/- 10V Input
2	ADC IN2	Analog Input Channel 2	+/- 10V Input
3	ADC IN4	Analog Input Channel 4	+/- 10V Input
4	ADC IN6	Analog Input Channel 6	+/- 10V Input
5	NC	Unused	
6	NC	Unused	
7	NC	Unused	
8	NC	Unused	
9	REF25	2.5V Analog Reference Output	2.5V Output

10	TRG_IN0	Add future features	
11	TRG_OUT0	Add future features	
12	FACE_IN1	Add future features	
13	DGND	Digital GROUND	0V GROUND
14	ADC IN1	Analog Input Channel 1	+/- 10V Input
15	ADC IN3	Analog Input Channel 3	+/- 10V Input
16	ADC IN5	Analog Input Channel 5	+/- 10V Input
17	ADC IN7	Analog Input Channel 7	+/- 10V Input
18	NC	Unused	
19	NC	Unused	
20	NC	Unused	
21	NC	Unused	
22	AGND	Analog Input GROUND	0V GROUND
23	FACE_IN0	Add future features	
24	TRG_IN1	Add future features	
25	TRG_OUT1	Add future features	

3-3-2 D-Sub 9 Connector (P1)



[Figure 3-4. PCI-AIO01 D-sub9 Connector]

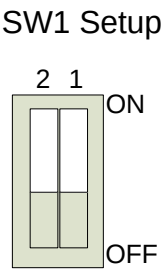
[Table 2. PCI-AIO01 D-sub 9Pin Connector]

Pin No.	Name	Description	Remark
1	DAC CH0	Analog Output Channel 0	+/- 10V Output
2	DAC CH1	Analog Output Channel 1	+/- 10V Output
3	DAC SYNC	Digital SYNC Output	Open-collector Output
4	NC	Unused	
5	DAC GND	Analog Output GROUND	0V GROUND
6	NC	Unused	
7	NC	Unused	
8	NC	Unused	
9	NC	Unused	

3-3-3 SW1 Switch

In a system that requires many I/O ports, if several AIO series boards are installed in one system, each board address must be used separately.

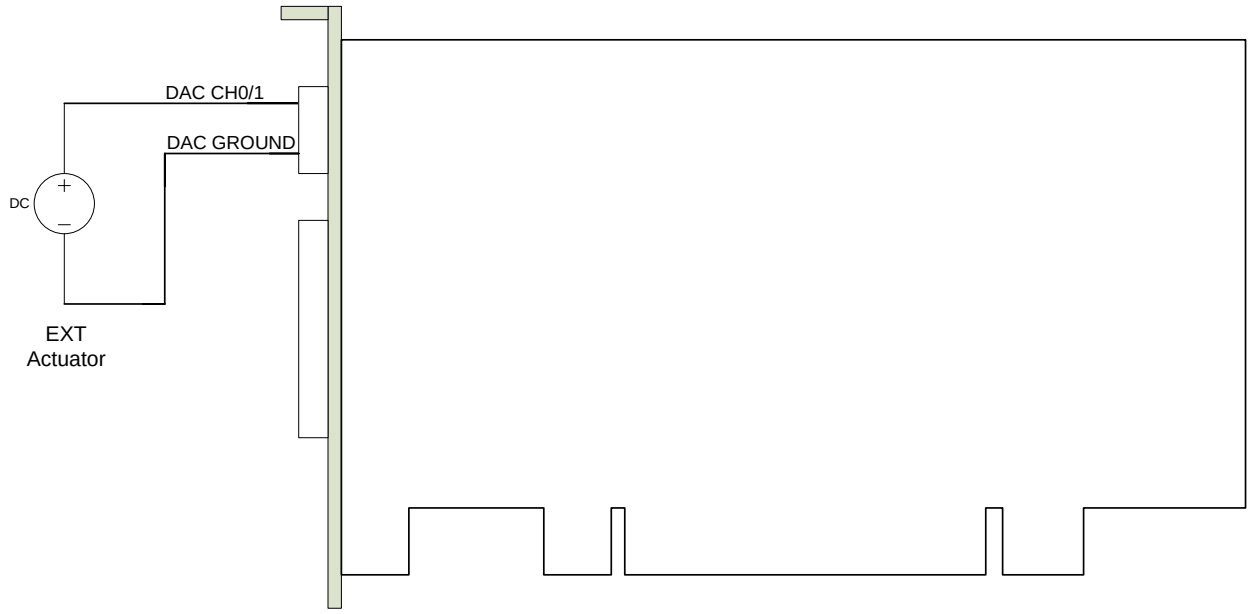
At this time, each board classification uses the DIP switch (SW1) on the board, and the total number of boards that can be installed in one system is four.



1	2	Board No.
OFF	OFF	0
ON	OFF	1
OFF	ON	2
ON	ON	3

[Figure 3-5. Board Address Setup]

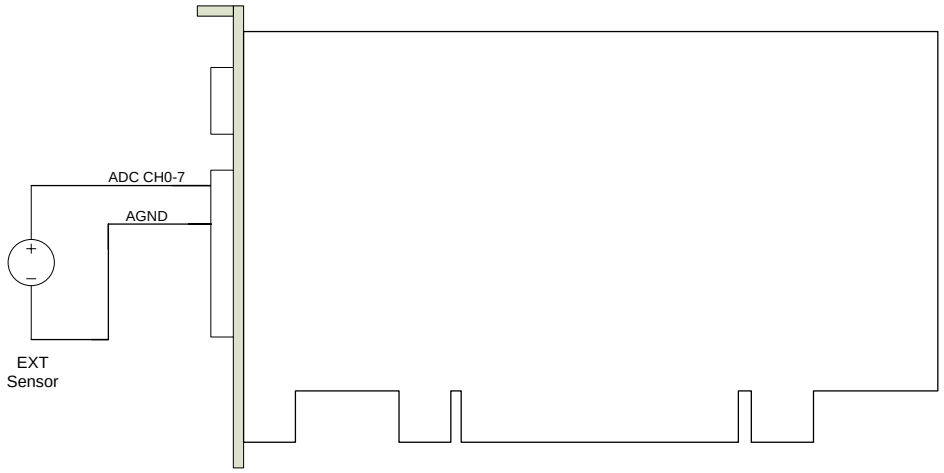
4. Analog Output Wiring



[Figure 4-1. Analog Output Wiring]

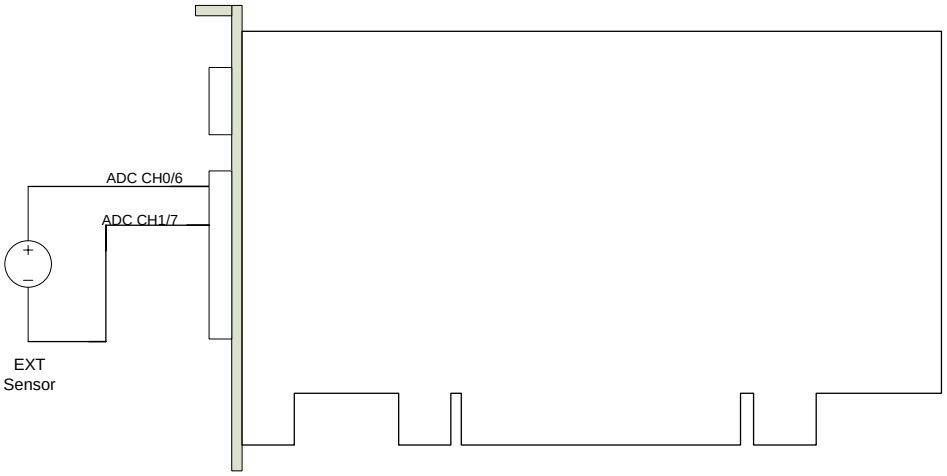
In the figure above, the analog output comes out through the D-sub 9-pin connector. Since the two analog outputs are based on the channel 0 and channel 1 DAC Ground, the output channel and DAC GROUND should always be connected to an external device in pairs.

5. Analog Input Wiring



[Figure 5-1. Analog SE(Single Ended) Input Wiring]

For analog SE connection, the input reference becomes the common analog GROUND (AGND). At this time, there are a total of 8 input channels.



[Figure 5-2. Analog DI(Differential Input) Input Wiring]

In analog DI connection, the input reference is the difference between two input channel pairs. In this case, the input pairs that become Pair are as follows. (CH0 <-> CH1), (CH2 <-> CH3), (CH4 <-> CH5), (CH6 <-> CH7). Therefore, in case of DI connection, there are a total of 4 input channels.

In addition, SE and DI mixed wiring is supported, and when using 3 SE and 2 DI inputs, the wiring method can be used by connecting CH0~CH2 SE input, (CH4 <-> CH5), (CH6 <-> CH7) DI input.

6. Installation

Before installing the board, check that the contents of the package are intact.

6-1 Hardware Installation

6-1-1 Product Contents

1. PCI-AIO01 Board
2. CD (Driver/Manual/API/Sample Source etc.)

6-1-2 Installation Process

① Turn off the computer.

② Remove the computer cover according to the computer manual.

③ Insert the product into an empty PCI slot. If possible, insert the boards in the order closest to the CPU.

④ Remove the blocked part at the back of the computer case of the slot where the board is inserted. Tighten the screws between the bracket of the board and the connection part of the case.

⑤ In case of multi-board, repeat from step 3.
Connect the PCI-AIO01 board in the PC to an empty PCI slot.
When you turn on the power, a new hardware search window will appear.

6-2 Driver Installation

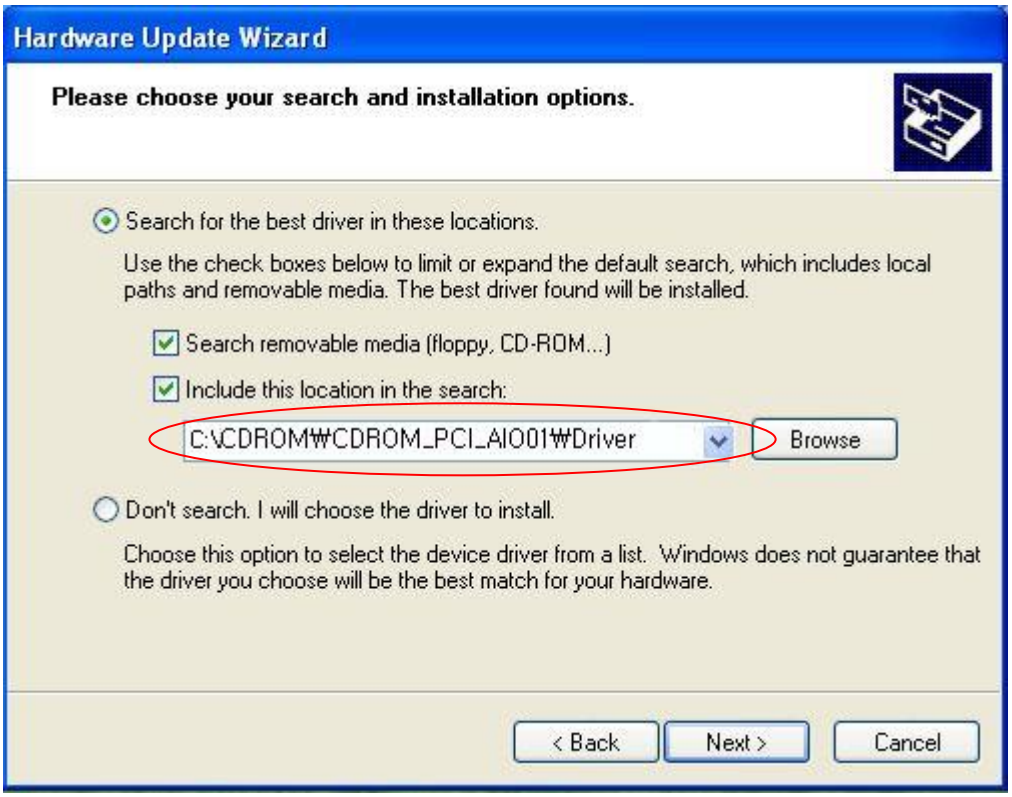
After installing the board, install the driver and sample application to run the board on your PC. For installation, use the supplied CD.

The installation procedure is as follows, and unless otherwise specified, it is explained based on Windows XP.

The board environment must be Windows 2000 SP4 or higher and Windows XP SP1 or higher. First, turn off the PC's power, plug the PCI-AIO01 board into the PCI Slot, and turn on the PC's power. When the "Start New Hardware Wizard" window opens as shown below, selects it as shown below and click the Next button.

The PCI-AIO01 connects to PCI Card Port. After that you can show the below picture of "Found New Hardware Wizard" window.

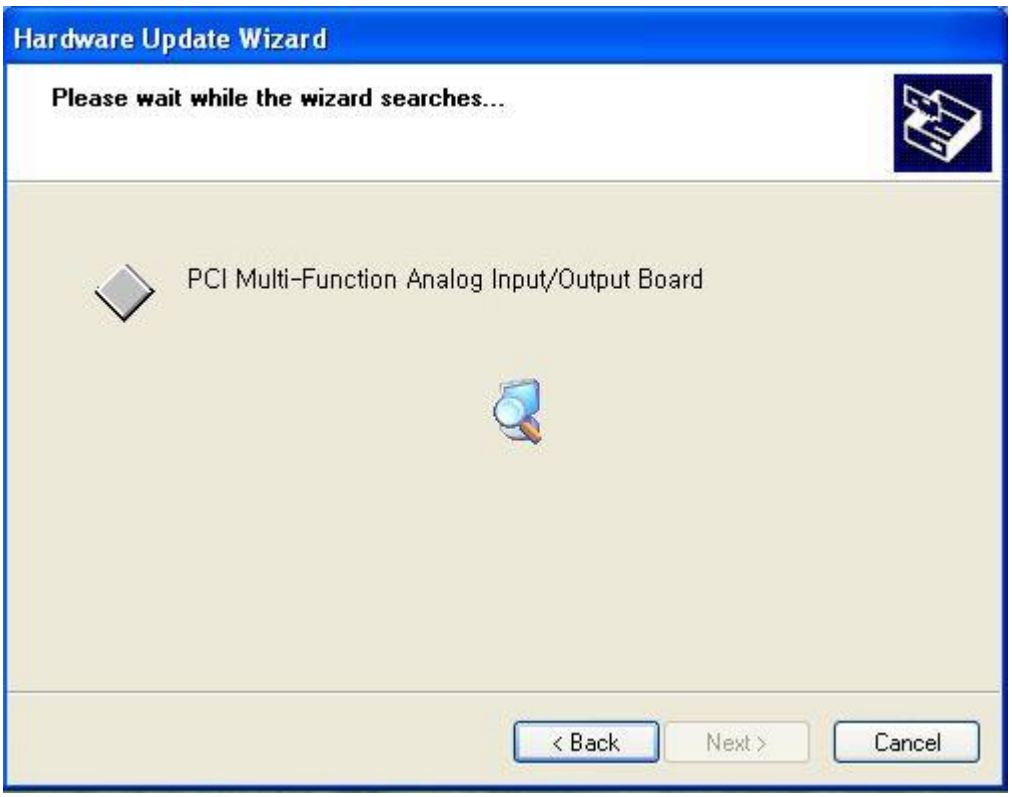
If new hardware is found, Wizard will ask you to install the corresponding driver. For installation of the driver, select the item "Install from a list or specific location (Advanced)" and click "Next" as in the figure.



The driver folder includes a file of **"pci_aio01.inf"** and **"pci_aio01.sys"** that it is necessary for driver installation.

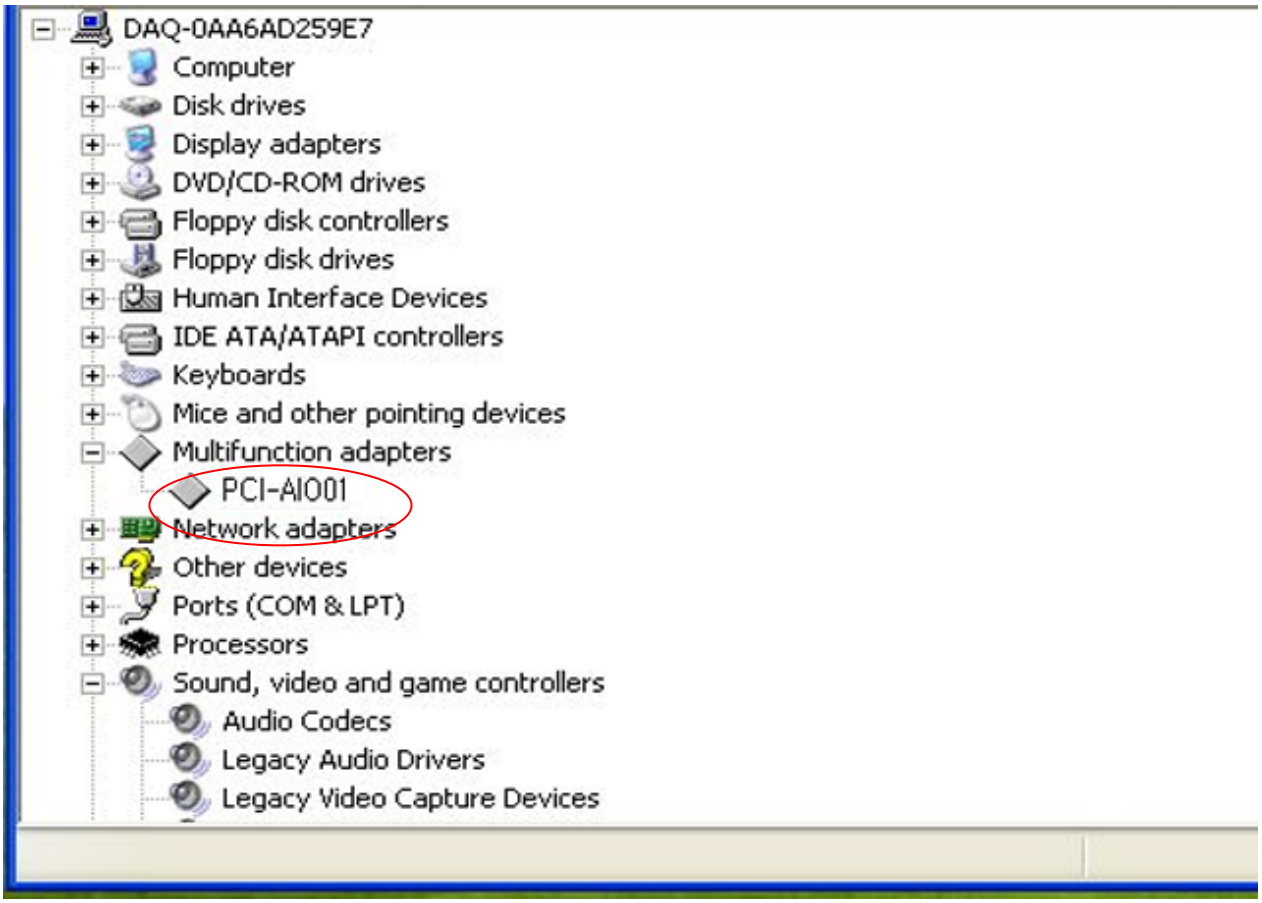
A warning message appears during installation here, press "Continue Anyway" button.

You can show below message window. The process progress as follows.



If the installation is completely finished, you can show below message window.

If the installation is completely finished, you confirm it in the following ways. Do the following steps to show up the "Device Manager" window. [My Computer -> properties -> Hardware -> Device Manager -> **Multifunction Adaptors -> PCI-AIO01**]



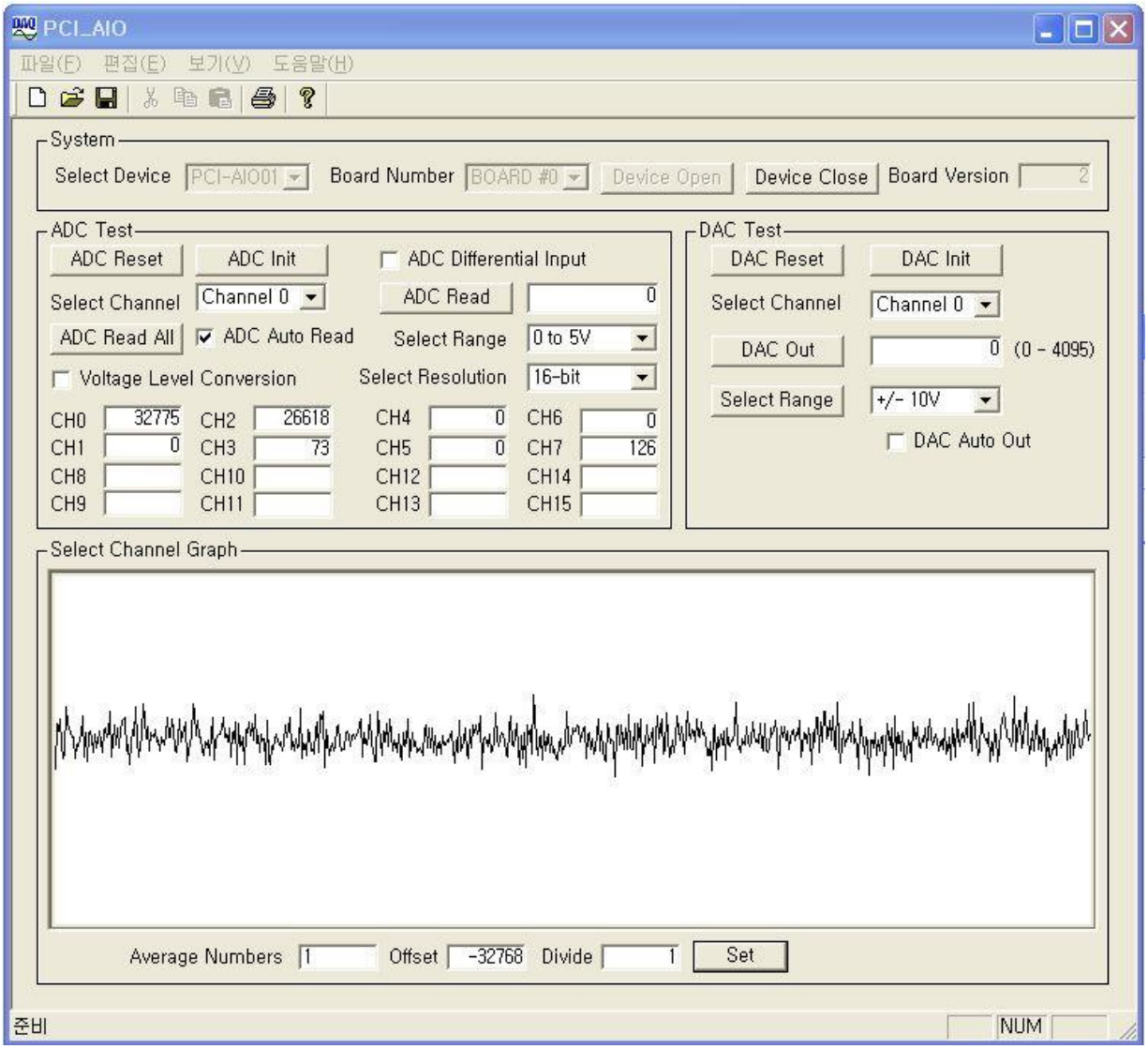
If you can see the "PCI-AIO01" at Multifunction Adaptors, the driver installation is to have been over. (Check the red circle)

Notice : After installation, you should re-boot the system for the proper operation.

7. Sample Program

DAQ system provides a sample program to make the user be familiar with the board operation and to make the program development easier. You can find the sample program in the CDROM accompanying with the board. One of the execution file is **"PCI_AIO.exe"**.

Sample program is provided in source form in order to show the usage of API (Application Programming Interface) of the board and may be modified for customer's own usage.



[Figure 7-1. Sample program "PCI_AIO.exe" execution screen]

API (Application Programming Interface) is required to use the above sample program. API is provided in the form of "DLL", and import library and header file are required for compilation. In order to run the sample program normally, the API DLL **(PCI_AIO.DLL)** must be in the folder of the executable file, or in the Windows system folder or the folder specified by the Path environment variable.

7-1 System Function Description

(1) **Select Device**

Select our own PCI-AIO0 ~ AIO05 board

(2) **Board Number**

Select the board number. Up to 4 selectable

(3) **'Device Open' Button**

Click to open the selected board.

(4) **'Device Close' Button**

Close the running board when clicked.

(5) **Board Version**

Displays the hardware version of the board.

7-2 ADC Test Function Description

(1) **'ADC Reset' Button**

Reset the ADC function.

(2) **'ADC Init' Button**

Initialize the ADC function.

(3) **ADC Differential Input**

When toggled, it receives Differential input.

(4) **Select Channel**

Write down the ADC channel value. The channel number of PCI-AIO01 is from 0 to 7.

(5) **'ADC Read' Button**

Reads the data value of the ADC input of the selected channel once.

(6) **'ADC Read All' Button**

Read all current ADC inputs.

(7) **ADC Auto Read**

Read all current ADC inputs.

(8) **Select Range**

Set the ADC input range for each channel. (0 to 5, ±5, 0 to 10V, ±10V)

(9) **Voltage Level Conversion**

The read data is a value converted to a voltage level.

(10) **Select Resolution**

Set the AD data width (bits).

AD converter on board supports 12, 14, 16 bit 3 resolutions

(11) **CH0 ~ CH15**

In case of PCI-AIO01, use only CH0 ~ CH7.

7-3 DAC Test Function Description

(1) **'DAC Reset' Button**

Reset the function of the DAC.

(2) **'DAC Init' Button**

Initialize the DAC settings.

(3) **Select Channel**

Write down the DAC channel value. The channel number of PCI-AIO01 is from 0 to 1.

(4) **'DAC Out' Button**

The value ranges from 0 to 4095 (refer to the DAC_GetData() function in Chapter 8 API Functions).

Ex) When it is set in the range of 0 to 10V

When outputting 5V, the set value is

(5V/10V) * 4096 = 2048.

For -10 to +10V

When outputting 5V, the set value is

(10+5V/20V) * 4096 = 3072.

When outputting -5V, the set value is

(10-5V/20V) * 4096 = 1024.

(5) **'Select Range' Button**

Set the DAC output range for each channel. (+5V, +10V, +10.8V, ±5, ±10V, ±10.8V)

(6) **DAC Auto Out**

Outputs the current DAC value automatically.

7-4 Select Channel Graph

(1) **Average Numbers**

The number of data to which the moving average is applied is designated as a number from 1 to 255.

It does not apply to AD data collection by ADC_GetData() function.

(2) **Offset**

This is the offset applied to the graph display.

Since the offset value is added to the collected data, it is used when the data is not displayed on the graph.

(3) **Divide**

The division value applied to the graph display.

If the collected data is too large to be displayed, the data value is attenuated and displayed.

(4) **' Set' Button**

Set the Average Number, Offset, Divide value.

Appendix

A-1 Repair Regulations

Thank you for purchasing DAQ SYSTEM's product. Please refer to the following regarding Customer Service stipulated by DAQ SYSTEM.

(1) Please read the user's manual and follow the instructions before using the DAQ SYSTEM product.

(2) When returning the product to be repaired, please send it to the head office with the symptoms of the malfunction as well.

(3) All DAQ SYSTEM products have a one-year warranty.
-. The warranty period is counted from the date the product is shipped from DAQ SYSTEM.
-. Peripherals and third-party products not manufactured by DAQ SYSTEM are covered by the manufacturer's warranty.
-. If repair is required, please contact the contact points below.

(4) Even during the free repair warranty period, paid repairs are made in the following cases.
① Failure or damage caused by not following the user's manual
② Failure or damage caused by customer negligence during product transportation after purchase
③ Natural phenomena such as fire, earthquake, flood, lightning, pollution, etc. or power supply exceeding the recommended range malfunction or damage
④ Failures caused by inappropriate storage environment (eg, high temperature, high humidity, volatile chemicals, etc.) damaged
⑤ Failure or damage due to unreasonable repair or modification
⑥ Products whose serial number has been changed or intentionally removed
⑦ In the event that DAQ SYSTEM determines that it is the customer's negligence for other reasons

(5) The customer must bear the shipping cost of returning the repaired product to DAQ SYSTEM.

(6) The manufacturer is not responsible for any problems caused by incorrect use regardless of our Warranty provisions.

References

1. PCI System Architecture

-- MindShare Inc.

2. PCI Local Bus Specification

-- PCI-SIG

3. General information on PCI board API

-- DAQ system

4. AN201 How to build application using APIs

-- DAQ system

5. AN242 PCI-AIO01/02/04 API Programming

-- DAQ system

MEMO

Contact Point

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