

PCI-5000 Series Multifunctional Data Acquisition Devices

User Manual

Rev. A

Smacq

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Statement

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Safety Requirements



Warning Only the voltage within the specified range can be connected. Voltage exceeding the specified range may cause damage to the device, and even present a negative impact on personal safety. Check the product specification for detailed reference to the range of voltages that can be connected by each port.



Warning Do not attempt to operate the device in other ways that are not mentioned in this document. Incorrect use of the device may be dangerous. In the event of device damage, the internal security protection mechanism will also be affected.



Warning Do not attempt to replace device components or change devices in other ways that are not mentioned in this document. Do not repair the device yourself in the event of a product failure.



Warning Do not use the device in an environment where an explosion may occur or where flammable flue or gas is present. If you must use the device in this kind of environment, please fit it into a proper case.



Warning While the device is running, all chassis covers and fill panels need to be closed.



Warning For equipment with exhaust vents, do not insert foreign objects into the vents or block air circulation in the vents.

Measurement Categories



Warning

For use in measurement category I (CAT I) only. Do not use in measurement category II/III/IV. Use this device to connect signals or make measurements.

Measurement categories Note

Measurement categories I (CAT I) means that measurements are made on a circuit that is not directly connected to the main power supply. For example, a circuit that is not exported from the main power supply, especially a circuit that is exported from a protected (internal) primary power supply, is measured. In the latter case, the instantaneous stress will change. Therefore, the user should be aware of the instantaneous affordability of the device.

Measurement categories II (CAT II) means that measurements are made on a circuit that is directly connected to a low-voltage device. For example, a measurement on household appliances, portable tools and similar equipment.

Measurement categories III (CAT III) means that measurements are made in construction equipment. For example, a measurement on the distribution boards, circuit breakers, wiring (including cables, Busbars, junction boxes, switches, sockets) in fixed equipment and equipment for industrial use and certain other equipment (for example, fixed motors that are permanently connected to fixtures).

Measurement categories IV (CAT IV) means that measurements are made on the source of low-voltage equipment. For example, a measurement on a meter, a major overcurrent protection device, and a pulse control unit.

Environment

Temperature	
Operating	0°C ~ 55°C
Storage	-40°C ~ 85°C
Humidity	
Operating	5%RH ~ 95%RH, no condensation
Storage	5%RH ~ 95%RH, no condensation
Pollution degree	2
Highest elevation	2000 m

Pollution degree description

Pollution degree 1: No pollution, or only dry non-conductive pollution. This pollution degree has no effect. For example: a clean room or an air-conditioned office environment.

Pollution degree 2: Generally only dry non-conductive pollution occurs. Temporary conduction can sometimes occur due to condensation. For example: General indoor environment.

Pollution degree 3: Conductive pollution occurs, or dry non-conductive pollution becomes conductive due to condensation. For example, an outdoor sheltered environment.

Pollution degree 4: Permanent conductive pollution caused by conductive dust, rain, or snow. For example: Outdoor places.

Recycle precautions



Warning

Some of the substances contained in this product may be harmful to the environment or human health. In order to avoid releasing harmful substances into the environment or endangering human health, it is recommended that appropriate methods be used to recover this product to ensure that most materials can be properly reused or recycled. For information about processing or recycling, please contact your local professional organizations.

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1. Getting Started

This chapter describes the basic functions of PCI-5000 Series Data Acquisition Device, as well as product specifications and precautions in the process of product unpacking.

1.1. Product introduction

PCI-5000 series data acquisition device is a synchronize data acquisition device based on PCI bus, which can be used for continuous high-speed signal acquisition and control signal output when installed in a computer.

PCI-5000 series of data acquisition devices can measure analog and digital signals continuously and save the data to the computer hard drive without interruption. It can also provide digital signal output, periodic repetitive signal output

PCI-5000 series data acquisition device supports operating in Windows OS, providing standard DLLs and support for mainstream development languages including VC++, VB, C#, LabVIEW, and MATLAB.

Key Features

- 16-bit analog input resolution, support continuous uninterrupted acquisition
- Analog inter-channel synchronization, up to 500kS/s/Ch sampling rate.
- The analog input can be set to various ranges of $\pm 10V/5V$ by software.
- 16-bit analog output resolution, with output range of $\pm 10V$
- Up to 1MS/s sampling rate for analog input
- Up to 10MS/s/Ch sampling rate for digital I/O

1.2. Function Diagram

Figure 1.1 shows the schematic diagram of PCI-5000 series data acquisition device.

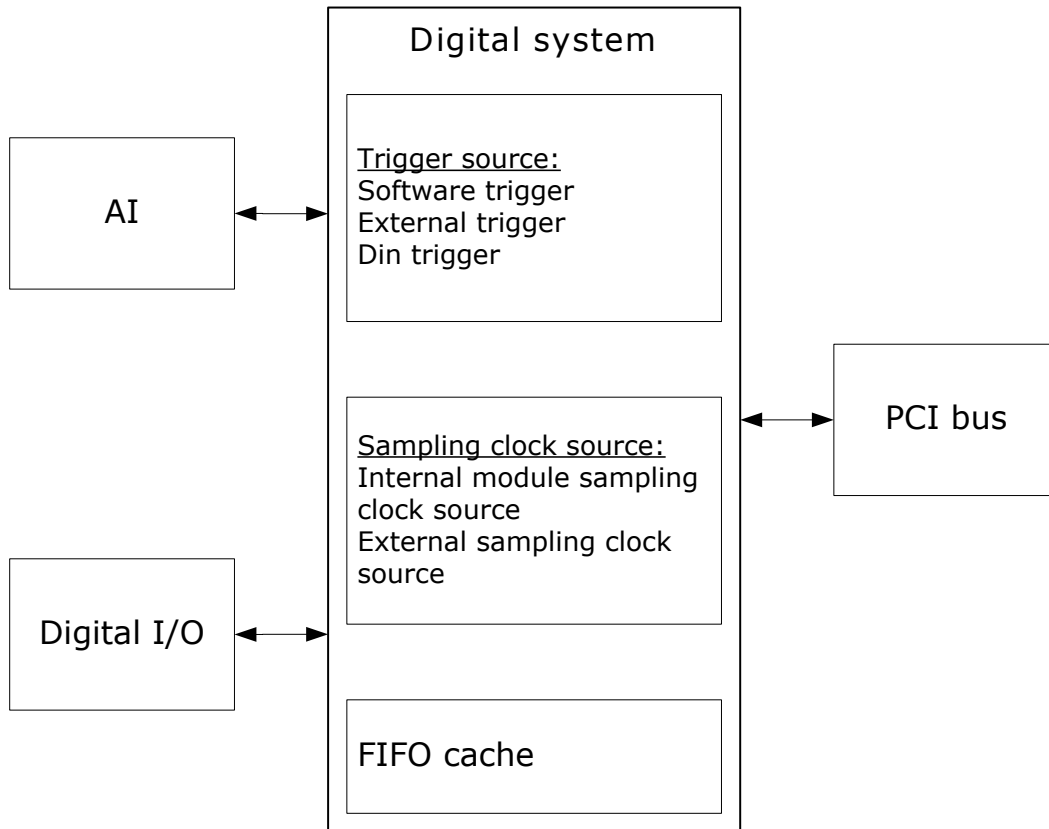


Figure 1.1 PCI-5000 series data acquisition device functions

1.3. Product specifications

The following product specification parameters, unless otherwise stated, are acquired at the temperature of 25°C and the humidity of 40%, while the device is turned on for 20 minutes.

Analog input

Number of channels	8 Single-Ended
ADC type	SAR
Resolution	16-bit
Highest sampling rate	PCI-5210: 250kS/s/Ch PCI-5211: 500kS/s/Ch
Timing resolution	10ns

Channel synchronization	No
Range	$\pm 10V / \pm 5V$
Input coupling mode	DC
Input impedance	High resistance
Small signal bandwidth (-3db)	1MHz
Input bias current	200nA
Analog input max voltage	The ground voltage of each input side does not exceed $\pm 12 V$
Software FIFO	2 MPts/Ch
Onboard FIFO	4096 Pts (shared)
AI capture mode	Continuous acquisition mode / Limited collection mode / Single read

Analog input accuracy (with temperature coefficient of 5 ppm/°C)

Range	Gain error (ppm of reading)	Offset error (ppm of range)	Random noise (μV_{rms})	Full range absolute accuracy (μV)
$\pm 10V$	90	4	180	1100
$\pm 5V$	80	10	90	500

Digital I/O

Number of channels	6
Ground reference	DGND
Direction	I/O can be set, and the power-on default value can be set.
Digital input voltage	High level: 1.95 V ~ 5 V Low level: 0 V ~ 1.2 V
Digital output voltage	High level: 3.3 V Low level: 0 V ~ 0.003 V
Highest sampling rate	10MS/s
Timing resolution	10 ns
Channel synchronization	Yes
Software FIFO	2MPts
Onboard FIFO	4096 Pts(shared)
Digital input acquisition mode	Continuous acquisition / Limited collection / Single read
Digital output mode	Direct output / finite length waveform output / /infinite non-cyclic output

External trigger

Number of channels	1 input, 1 output
Input voltage	High level: 1.95 V ~ 5 V Low level: 0 V ~ 1.2 V
Output voltage	High level: 3.3 V Low level: 0 V ~ 0.003 V
Output power-on status	Low level
Output edge time	Ascending edge: 6ns Descending edge: 8ns

Calibration

Recommended warm-up time	No less than 20Minutes
Recommended calibration interval	1 year

1.4. Product unpacking

Precautions

To prevent electrostatic discharge (ESD) from damaging the device, please note the following:

- Please wear a grounding wristband or touch a grounded object first to ensure being grounded.
- Before removing the equipment from the packaging, please first connect the anti-static packaging to the grounded object.
- Do not touch the exposed pins of the connector.
- Place your device in anti-static packaging when you are not using the device.

Check the packing list

After unpacking the product, follow the packing list in the box, check the host and each attachment individually to ensure that the items in the box are consistent with the packing list.

If you find that any item is missing, please get in touch with us for help as soon as possible.

If you find that the product comes in damaged after unpacking, please get in touch with us as soon as possible. Do not install damaged equipment on your devices.

2. Installation

This chapter describes signal connection and drive installation of PCI-5000 series data acquisition device.

2.1. Connector signal pins distribution

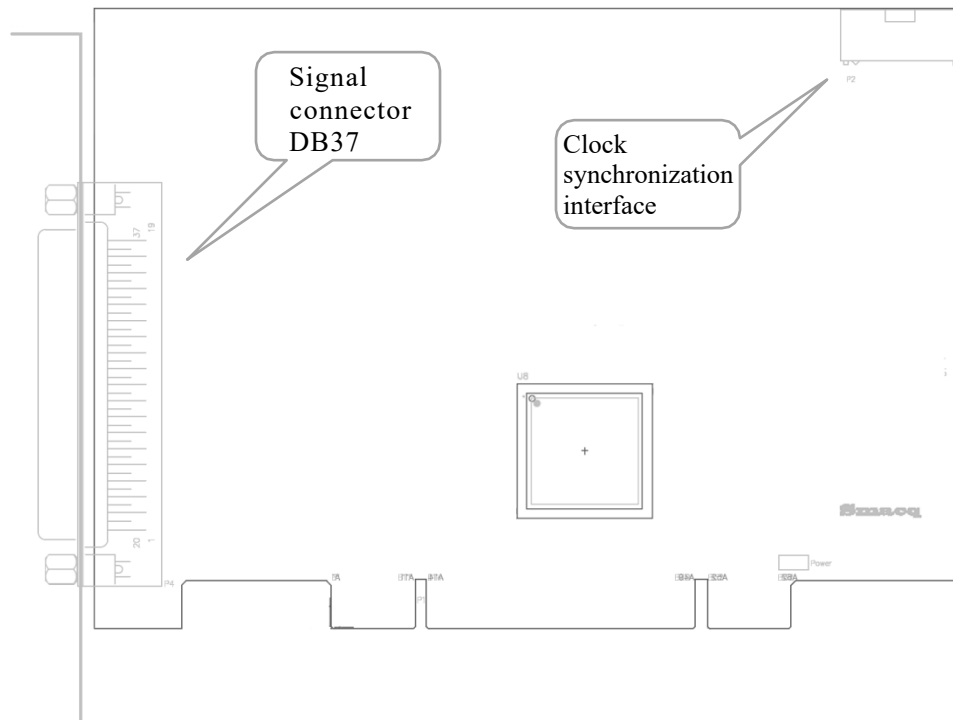


Figure 2.1 PCI-5000 signal pins distribution

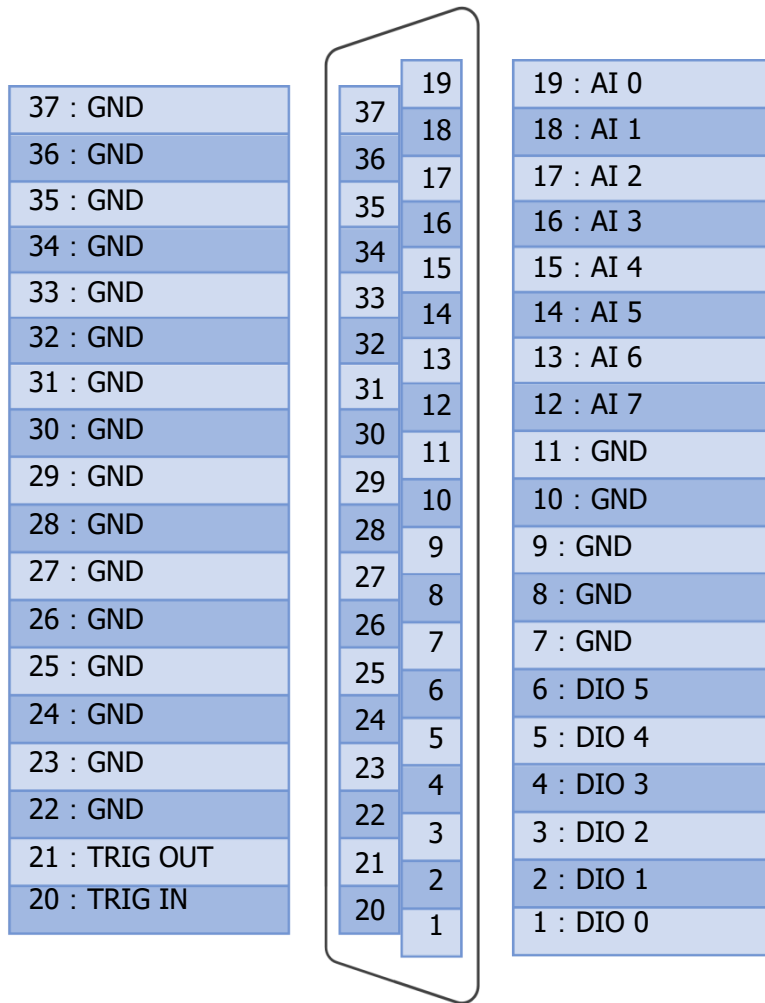


Figure 2.2 Signal connector distribution diagram

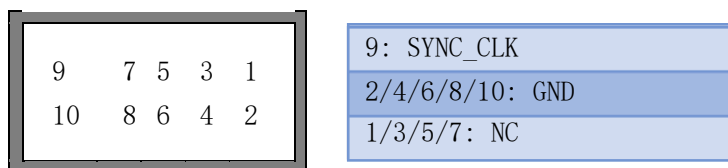


Figure 2.3 Clock interface signal distribution diagram

Table 2.1, Signal pin allocation

Signal name	Notes
AI 0	Analog input 0
AI 1	Analog input 1
AI 2	Analog input 2
AI 3	Analog input 3
AI 4	Analog input 4

Signal name	Notes
AI 5	Analog input 5
AI 6	Analog input 6
AI 7	Analog input 7
GND	Reference ground
DIO 0	Input/output 0
DIO 1	Input/output 1
DIO 2	Input/output 2
DIO 3	Input/output 3
DIO 4	Input/output 4
DIO 5	Input/output 5
TRIG OUT	Trigger signal output
TRIG IN	External trigger signal input
SYNC_CLK	System synchronous clock input/output
NC	Not connected

2.2. Drive installation

PCI-5xxx data acquisition device can be used in Windows 7 and Windows 10, including 32-bit and 64-bit. Here, taking the driver installation in Windows 10 environment as an example, we will introduce how to install the driver of PCI-5000 data acquisition device step by step. The steps of installing drivers in Windows 7 environment are the same as those in Windows 10 environment.

- 1) Open the device manager of Windows operating system, and when the driver is not installed, it is displayed as "PCI Data Capture and Signal Processing Controller", as shown in Figure 2.4 below.

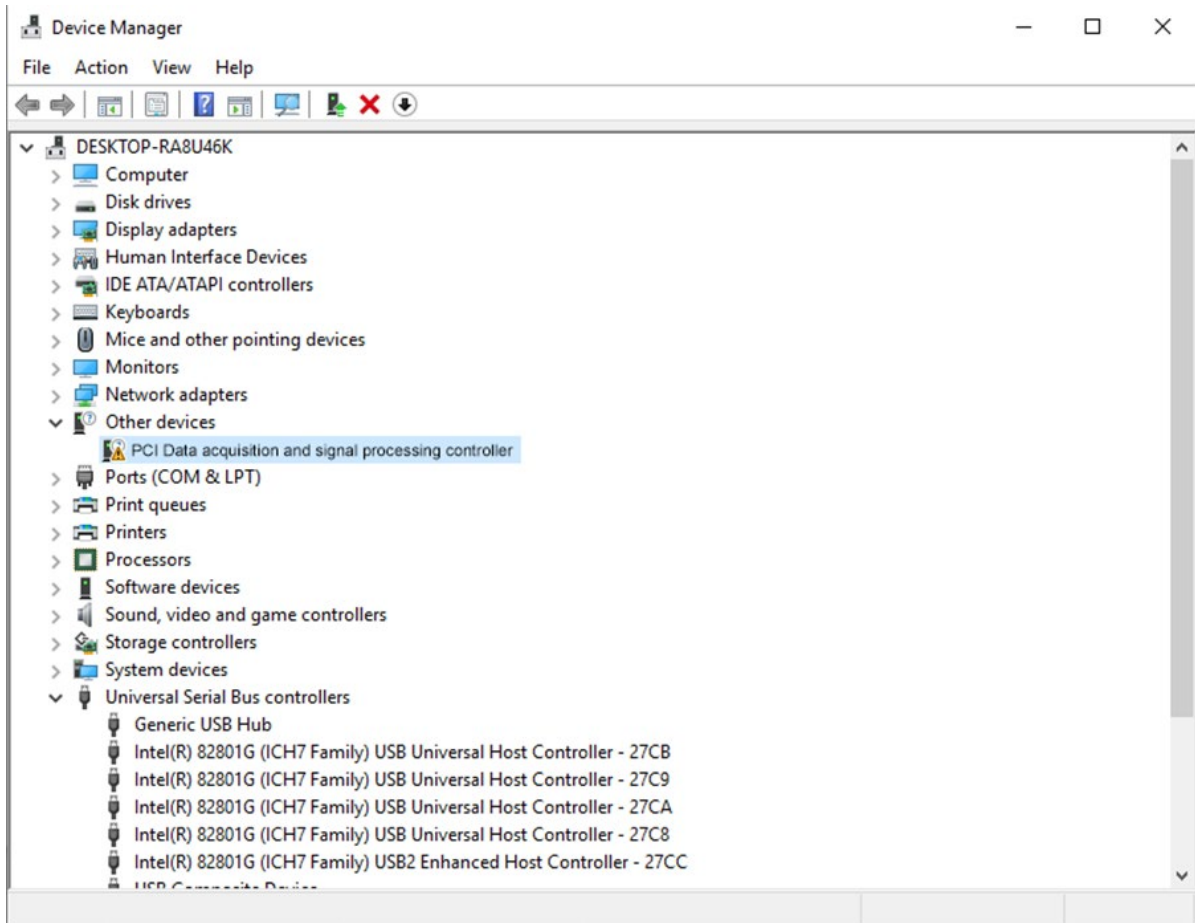


Figure 2.4 Before the driver is installed

- 2) Select "PCI Data Capture and Signal Processing Controller", right-click and select "Update Driver". Select "Browse my computer to find driver software" in the pop-up dialog box, as shown in Figure 2.5 below.

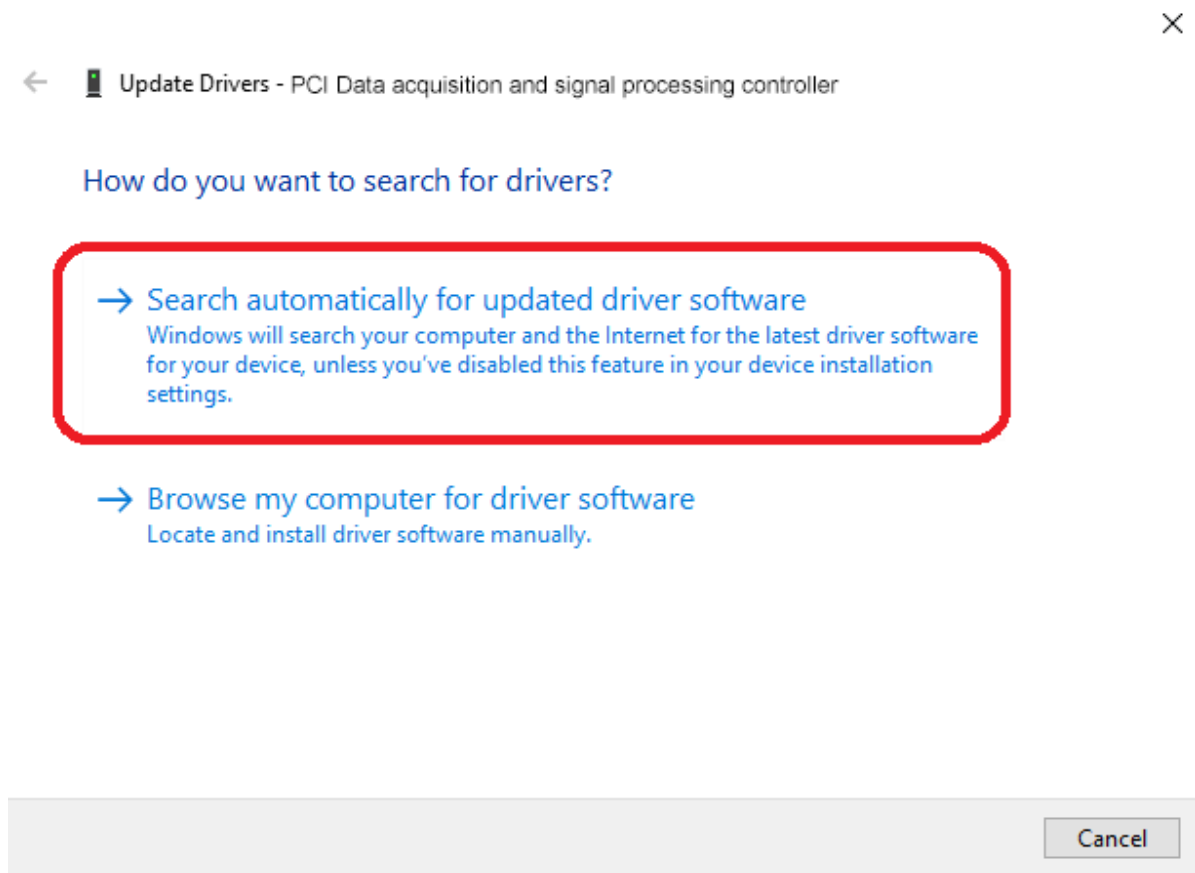


Figure 2.5 Browse my computer for driver software.

- 3) Then in the pop-up dialog box, click "Browse" button, locate the operating system version folder corresponding to the driver, and then click "Next", as shown in Figure 2.6

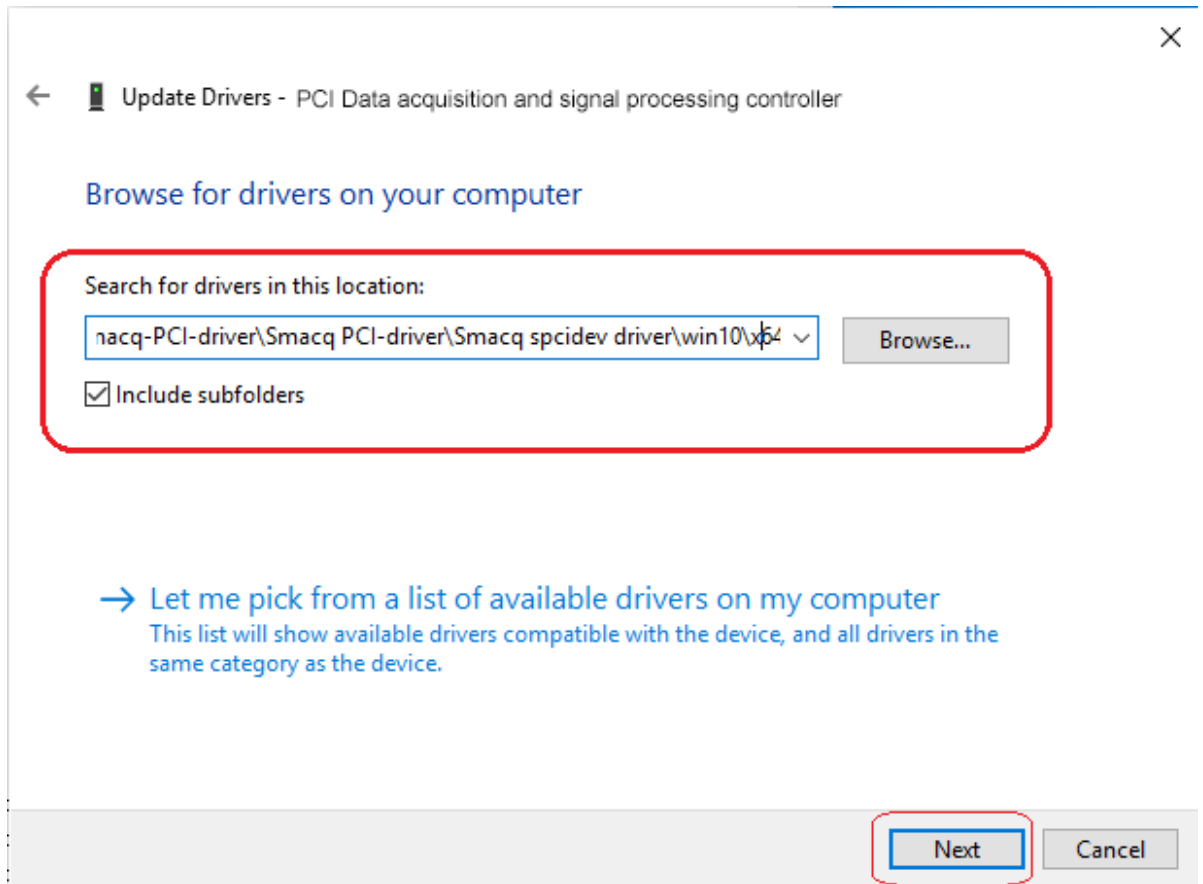


Figure 2.6 Locate the folder where the driver is located.

- 4) The computer starts to enter the driver installation process. After the installation is successful, the dialog box shown in Figure 2.6 below pops up, and the driver installation is completed.

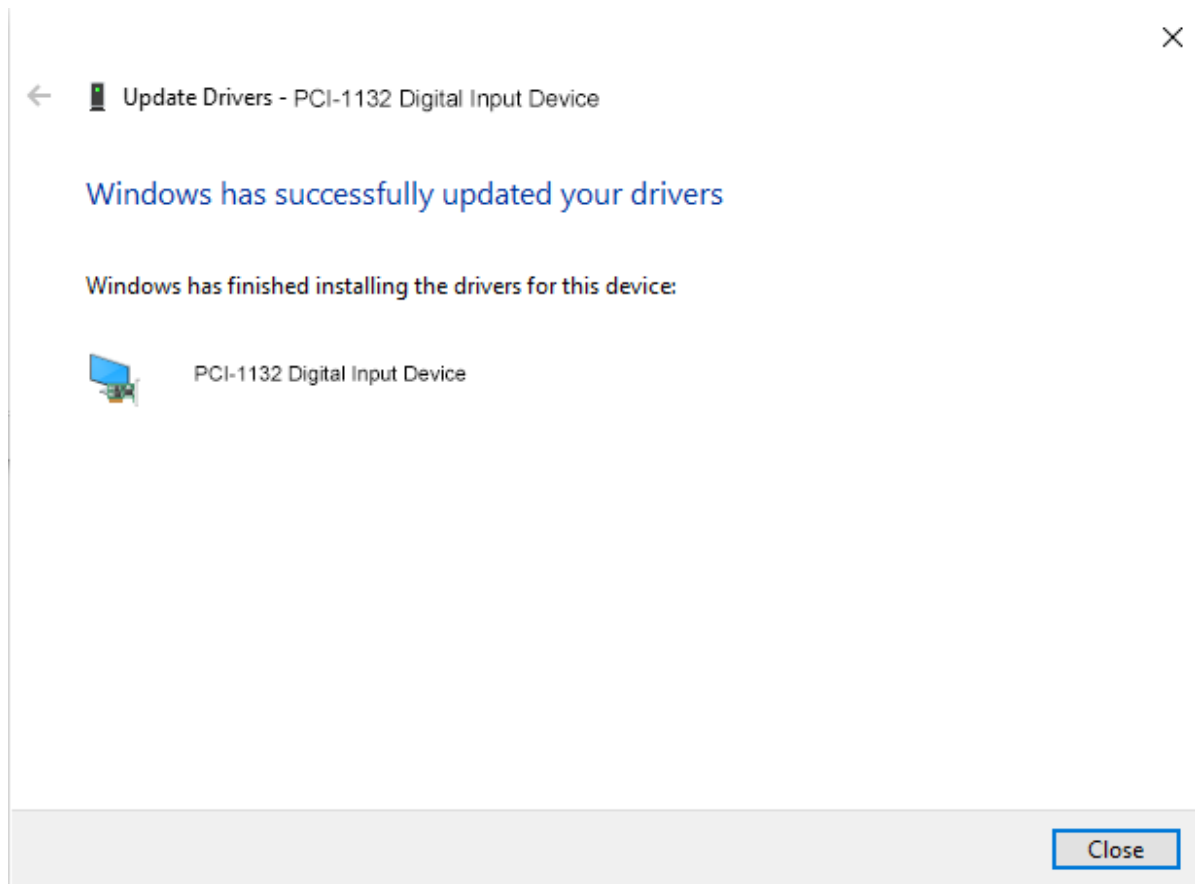


Figure 2.7 Driver installation is complete

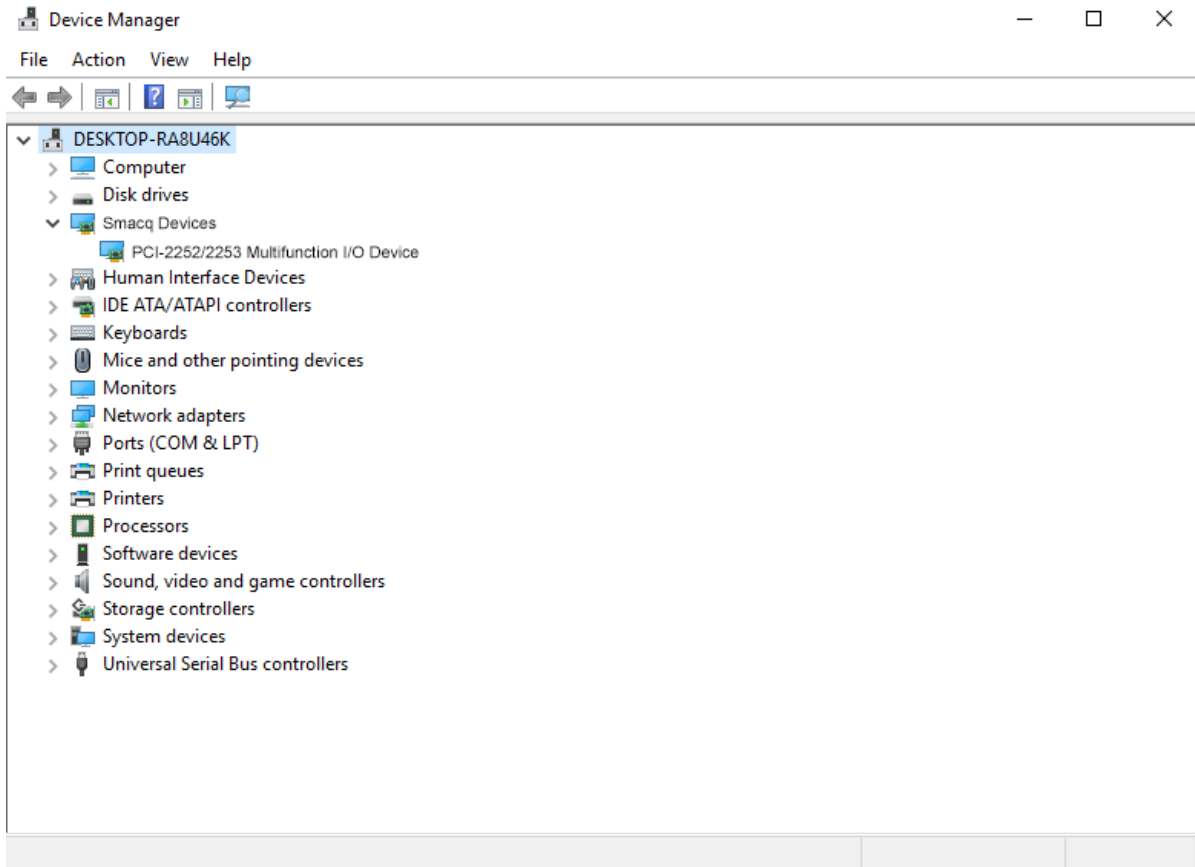


Figure 2.8 Device Manager after successful driver installation

3. Analog Input (AI)

This chapter describes measuring the relevant content of analog input signals on PCI-5000 series data acquisition devices. AI here is short for Analog Input.

Each analog input channel of PCI-5000 series data acquisition device has an independent ADC, so there is no time difference between the measured data of each channel during analog input acquisition, and multi-channel synchronous acquisition is realized.

3.1. Signal connection methods

PCI-5000 series data acquisition devices support analog input acquisition connection methods of grounding reference single-ended input. The positive end of the analog input signal is connected to the AIn port of the analog input port, and the negative end of the input signal is linked to the GND port.

3.2. Signal acquisition mode

When the PCI-5000 series data acquisition device performs analog input measurement, it supports the following three acquisition modes:

- Continuous acquisition mode
- Limited collection mode
- Single read

The sampling rate of the first two modes adopts hardware timing.

The limited number acquisition mode is called OneShot mode.

Continuous acquisition mode

Continuous acquisition mode refers to continuous and uninterrupted collection of data at defined sampling speed.

In continuous acquisition mode, after the AI acquisition is triggered, the acquisition device collects the signal at a fixed sampling speed, buffers data into FIFO, and continuously uploads the data in the FIFO to the computer memory buffer. The user program only needs to continuously process the data in memory to achieve continuous uninterrupted data acquisition.

If the user program does not process the data fast enough, the data will gradually fill the 2M points of storage space in computer memory buffer. New data cannot be written correctly after the memory is filled up, resulting in discontinuous data.

Limited number acquisition mode

Limited number acquisition mode (OneShot mode) refers to one time acquisition to get the set number of collection points at the set sampling speed.

In OneShot mode, after the AI acquisition triggers, the acquisition device automatically stops the acquisition after the acquisition reaches the set number of times according to the set sampling speed. The user program only needs to read the set data amount from the computer memory buffer.



Attention The set number of collection points cannot exceed 2MPts

Single point reading

Single point reading refers to the AD conversion of the selected channel and reading its conversion results.

3.3 Sampling rate

There is an independent ADC in each analog input channel of PCI-5000 series data acquisition device, so all channels can work at the maximum sampling rate at the same time when analog input is collected.

3.4 Trigger

The PCI-5000 series data acquisition device provides rich trigger options. The schematic diagram of the AI acquisition trigger options are shown in Figure 3.1.

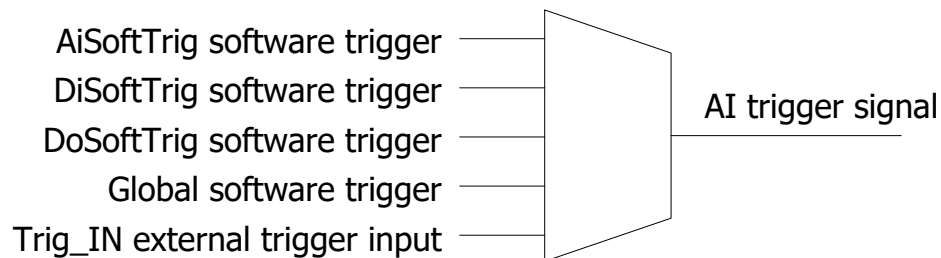


Figure 3.1 AI trigger options

The AI acquisition uses the AiSoftTrig software trigger as the trigger source by default. The AI acquisition can use other trigger sources via software settings to achieve the synchronization of each function.

Software triggering means that the computer sends a command to the acquisition device to achieve the effect of device triggering.

Trig_IN external trigger means that when Trig_IN receives a rising edge, the device triggers.

Clear trigger

The AI trigger status can be reset to an untriggered state by software settings.

4. Digital Input (DI)

This chapter introduces the digital input signal acquisition on PCI-5000 series data acquisition devices. DI is the abbreviation of Digital Input here.

4.1. Signal acquisition mode

When the PCI-5000 series data acquisition device performs DI acquisition, it supports the following three acquisition modes

- Continuous acquisition mode
- Limited collection mode
- Single read

The sampling rate of the first two modes adopts hardware timing.

The limited number acquisition mode is called OneShot mode.

Continuous acquisition mode

The continuous acquisition mode refers to continuous and uninterrupted data acquisition at a set sampling speed.

In the continuous acquisition mode, after the DI acquisition triggers, the acquisition device collects the signal at a fixed sampling speed, buffers it in the FIFO, and continuously uploads the data in the FIFO to the computer memory buffer. The user program only needs to continuously process the data in memory to achieve continuous uninterrupted data collection.

If the user program could not process the data fast enough, the data will gradually fill up the 2M points of storage space in the computer's memory buffer. After filling it up, the new data cannot be written into memory buffer correctly, resulting in data discontinuity.

Limited number acquisition mode

Limited number of acquisition modes (OneShotmode) refers to one-time acquisition of the set number of collection points at the set sampling speed.

In OneShot mode, after the DI acquisition triggers, the acquisition device will start acquiring set number of data at the set sampling speed and stop the acquisition automatically after. The user program only needs to read the set data amount from the computer memory buffer.



Attention The number of set collection points cannot exceed 2MPts.

Single point reading

Single point reading refers to reading the status of the current digital input port once.

4.2. Trigger

The PCI-5000 series data acquisition device provides rich trigger options. The DI acquisition trigger options are shown in Figure 4.1.

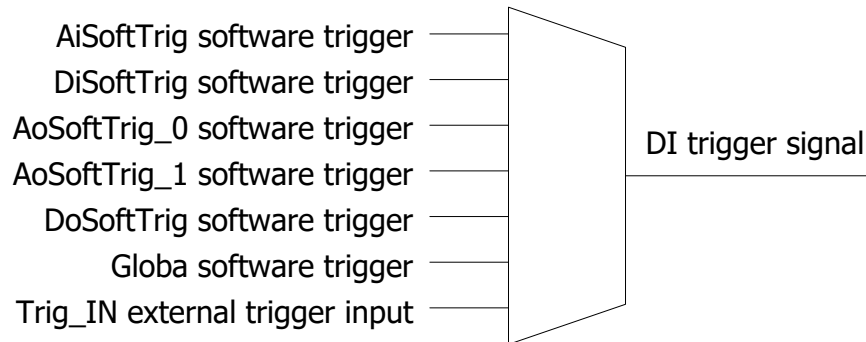


Figure 4.1 DI trigger options

The DI acquisition uses the DiSoftTrig software trigger as the trigger source by default. The DI acquisition can use other trigger sources via software settings to achieve the synchronization of each function.

Software triggering means that the computer sends a command to the acquisition device to achieve the effect of device triggering.

Trig_IN external trigger means that when Trig_IN receives a rising edge, the device triggers.

Clear Trigger

Trigger status can be reset to an untriggered state via software settings.

5. Digital Output (DO)

This chapter introduces the digital signal output for the PCI-5000 series data acquisition device. The digital input is referred to as DO here, the abbreviation of Digital Output.

5.1. Signal output mode

When the PCI-5000 series data acquisition device is utilized for digital output, the following four output modes are supported:

- Immediate output
- Finite number output
- Unlimited number of loop output
- Infinite non-loop output

The limited output mode and infinite cycle output mode are collectively called n-cycle mode. When the output number n-cycle is set to 0, AO works in the infinite cycle output mode; When the output number n-cycle setting is greater than 0, AO works in the limited output mode.

Immediate output

Immediate output refers to the output state without buffer and no waveform. The computer sends a command to the acquisition device, and it immediately outputs the specified level state.

Finite number output mode

The limited number of output modes means that the digital waveform data to be output is first stored in the hardware FIFO, then the output sampling rate is set, the number of times the waveform needs to be output is set, and the channel for outputting the digital waveform is set. After the DO output is triggered, the capture card begins to output a digital waveform in accordance with the set parameters. After the set number of outputs is reached, the capture card stops outputting the digital waveform.



Attention When the specified number of outputs is completed, the DO output level state stays at the level defined by the last point of the waveform data.

Infinite loop output mode

Infinite loop output mode means that the digital waveform data to be output is first stored in the hardware FIFO, and then the output sampling rate is set. After the DO is triggered, the acquisition device starts to output the digital waveform according to the set parameters, and continuously loops the output until the DO triggers cleared to an untriggered state.



Attention After clearing the DO trigger to the untriggered state, the DO output level state stays at the level state at which the DO trigger is cleared.

Infinite non-loop output mode

The infinite loop output mode refers to a waveform in which the DO output exceeds the length of the hardware FIFO space, and the computer transfers the data in batches to the DO hardware FIFO.

For example, a waveform with a length of 1M point needs to be output at a sampling rate of 10kSa/s, and the DO hardware FIFO space is only 2k points, so the waveform of 1M point length needs to be transferred to the DO hardware FIFO in 500 times. The 2k point data in the hardware FIFO, with an output sampling rate of 10kSa/s, can be transmitted in 0.2 seconds. Therefore, the computer must start a new data transmission in less than 0.2 seconds to ensure the continuity of DO output waveform.

When the waveform output in the hardware FIFO is complete and no new data arrives, the DO output level state will remain at the level defined by the last point.

5.2. Output update rate

PCI-5000 series data acquisition device DO output update rate can reach up to 10MSa/s/Ch.

5.3. Trigger

The PCI-5000 series of data acquisition devices provide a rich set of trigger options, as shown in Figure 5.1, which describes trigger options for the DO output.

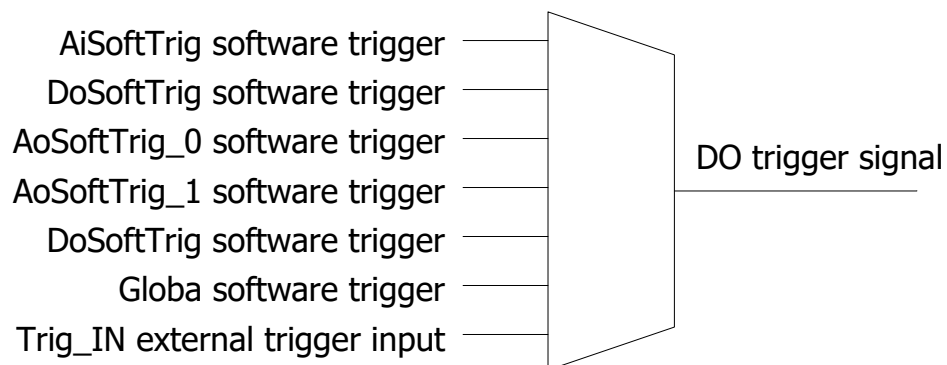


Figure 5.1 DO trigger options

The DO output uses the channel exclusive software trigger signal DoSoftTrig as the trigger source by default. You can set DO output to use other trigger sources to achieve the synchronization of each function via software settings.

Software triggering means that the computer sends a command to the acquisition device to achieve the effect of device triggering.

Trig_IN external trigger means that when Ext_Trig_IN receives a rising edge, the device triggers.

Clear trigger

Trigger status can be reset to an untriggered state via software settings.

6. Synchronization System

This chapter introduces the multi-card synchronization system of the PCI-5000 series data acquisition device. The synchronization system has three ports, synchronization clock, external trigger input and trigger output.

6.1. Synchronous clock

Synchronization clock is the key signal to ensure the synchronization of multiple devices, which is used to eliminate clock errors among multiple devices. The synchronous clock port of PCI-2252/2253 data acquisition device can be set as input or output by software, and the default setting for power-on is input. The circuit diagram of the synchronous clock port is shown in Figure 6.1.

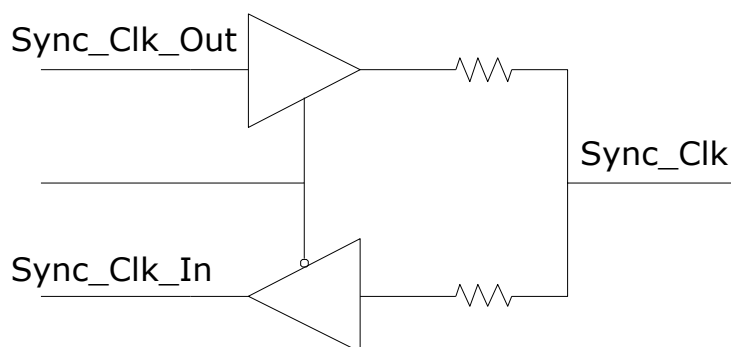


Figure 6.1 The circuit diagram of the synchronous clock port

6.2. External trigger input

External trigger input can realize synchronous triggering of multiple devices. The trigger source of each function of the acquisition device can choose the external trigger input pin Trig_In as the trigger source.

6.3. trigger output

When the trigger signal of the specified function is set as the output source, the Trig_out pin will output a high-level pulse with a duration of 1us while the function is triggered.

The schematic circuit diagram of trigger output Trig_Out is shown in Figure 6.2. The following sources can be selected as output options:

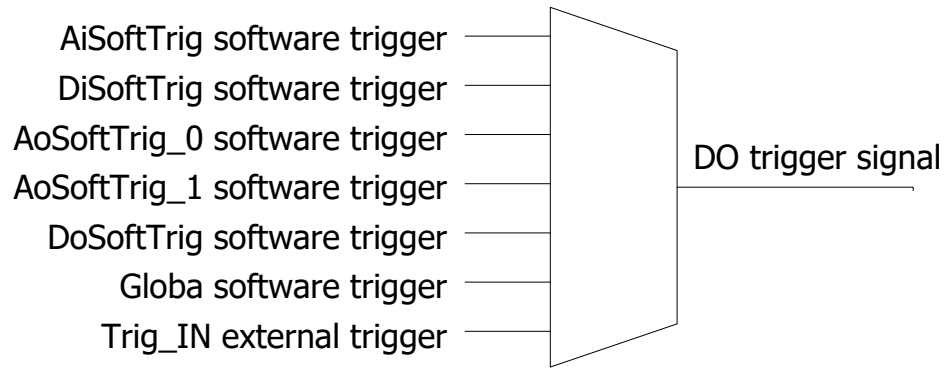


Figure 6.2 Schematic diagram of trigger output circuit

7. Service and Warranty

Beijing Smacq Technology Co., Ltd. is committed to its products during the warranty period, if the product fails under normal use in warranty, we will repair or replace defected parts for free. Please refer to the warranty explanation in the box for detailed instructions.

In addition to the warranties mentioned in this manual and the warranty note, we do not provide any other warranties, express or implied, including, but not limited to, any implied warranties as to the tradable nature of the product and the suitability of the special purpose.

To get more technical support and service details, or if you have any questions about using this product and this document, you are welcome to contact us:

Phone: (+86)10 - 52482802

E-mail: service@smacq.com

Website: <http://www.smacq.com>

<http://www.smacq.cn>

8. Ordering Information

Host

Model	Notes
PCI-5210	8-AI(250kS/s/Ch), 6-DIO
PCI-5211	8-AI(500kS/s/Ch), 6-DIO

Optional accessories

Model	Notes
DB37CB-1.5M	DB37 connecting line, double male, 1.5m.
DB37TB	End board, DIN guide rail installation
CHF-100B	Current sensor, 100A, DC~20kHz, output $\pm 4v$
CHV-600VD	Voltage sensor, 600V, DC~20kHz, isolated differential input, output $\pm 5v$