

PCI-3000 Series Multifunctional Data Acquisition Devices

User Manual

Rev. A

Smacq

Beijing Smacq Technology Co., Ltd.

Smacq.com

Smacq.cn

Statement

Copyright

©2021 Beijing Smacq Technology Co., Ltd. All rights reserved

No content of this manual may be reproduced, modified or abridged without prior consent and written permission.

Trademark information

Smacq is a registered trademark of Beijing Smacq Technology Co., Ltd.

The names of the other products and companies mentioned in this document are trademarks or trade names of their respective companies.

Other Disclaimer

- The information provided in this document may be modified and updated in subsequent versions without prior notice.
- Smacq does not provide any warranties, express or implied, for this document as well as the information inside it, including but not limited to implied warranties of the marketable nature of the product and its suitability for a particular purpose.
- There may be a chance that inaccurate descriptions or errors exist in this document. Smacq does not hold any liability for accidents because of the information and deductive functions provided in this manual, as well as the resulting loss of any chance because of the use of this document.
- Smacq reserves the rights to change product specifications, prices, and decide whether to stop the production.

Contact Us

If you have any questions or need assistance in using this product or this document, please contact us via:

Phone: (+86)10 - 52482802

E-Mail: service@smacq.com

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

<http://www.smacq.cn>

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.

CONTENT

Statement	1
Safety Requirements.....	2
Measurement Categories	3
Environment	4
1. Getting Started.....	7
1.1. Product introduction.....	7
1.2. Function Diagram.....	10
1.3. Product specifications.....	10
1.4. Product unpacking	15
Precautions	15
Check the packing list.....	15
2. Installation	16
2.1. Connector signal pins distribution	16
2.2. Drive installation	19
3. Analog Input (AI)	24
3.1. Signal connection methods.....	24
3.2. Floating grounded signal source	25
Using differential mode (DIFF) connection	25
Non-grounded reference single-ended mode (NRSE) connection.....	27
3.3. Grounded Signal Source.....	28
Use a differential mode (DIFF) connection	28
Use a non-grounded reference single-ended mode (NRSE) connection.....	29
3.4. Signal acquisition mode	30
Continuous acquisition mode	30
Limited number acquisition mode	31
Single point reading	31
3.5. Comprehensive sampling rate and single channel sampling rate.....	31
3.6. Trigger.....	31
Clear trigger	32
4. Analog Output (AO)	33
4.1. Signal output mode.....	33
DC immediate output	33

Finite number output mode	33
Infinite loop output mode.....	34
Infinite non-loop output mode	34
4.2. Output update rate	34
4.3. Trigger.....	34
Clear trigger	35
5. Digital Input (DI)	36
5.1. Signal acquisition mode	36
Continuous acquisition mode	36
Limited number acquisition mode.....	36
Single read	36
5.2. Trigger.....	37
Clear Trigger.....	37
6. Digital Output (DO)	38
6.1. Signal output mode.....	38
Immediate output.....	38
Finite number output mode	38
Infinite loop output mode.....	38
Infinite non-loop output mode	39
6.2. Output update rate	39
6.3. Trigger.....	39
Clear trigger	39
7. Synchronization System	40
7.1. Synchronous clock	40
7.2. External trigger input	40
7.3. Trigger output	40
8. Service and Warranty.....	42
9. Ordering Information.....	43

1. Getting Started

This chapter describes the basic functions of PCI-3000 Series Data Acquisition Device, as well as product specifications and precautions in the process of product unpacking.

1.1. Product introduction

PCI-3000 series data acquisition device is a multi-functional 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-3000 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-3000 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
- Up to 1MS/s sampling rate for analog input
- The input can be set to various ranges of $\pm 10V/5V/2.5V/1.25V/0.6V$ by software.
- Analog input channels support single-ended or differential wiring.
- 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

PCI-3000 series data acquisition device contains several models, and the main differences of each model are as follows:

	PCI-3210	PCI-3211	PCI-3212	PCI-3213
Analog input channel quantity	8 Single-Ended / 4 Difference	8 Single-Ended / 4 Difference	8 Single-Ended / 4 Difference	8 Single-Ended / 4 Difference
Analog input resolution	16-bit	16-bit	16-bit	16-bit
Analog input Sampling rate	125kS/s	250kS/s	500kS/s	1MS/s
Analog output channel quantity	0	0	0	0
	PCI-3220	PCI-3221	PCI-3222	PCI-3223
Analog input channel quantity	16 Single-Ended / 8 Difference	16 Single-Ended / 8 Difference	16 Single-Ended / 8 Difference	16 Single-Ended / 8 Difference
Analog input resolution	16-bit	16-bit	16-bit	16-bit
Analog input Sampling rate	125kS/s	250kS/s	500kS/s	1MS/s
Analog output channel quantity	0	0	0	0
	PCI-3110	PCI-3111	PCI-3112	PCI-3113
Analog input channel quantity	8 Single-Ended / 4 Difference	8 Single-Ended / 4 Difference	8 Single-Ended / 4 Difference	8 Single-Ended / 4 Difference
Analog input resolution	16-bit	16-bit	16-bit	16-bit
Analog input Sampling rate	125kS/s	250kS/s	500kS/s	1MS/s
Analog output channel quantity	2	2	2	2
Analog output resolution	16-bit	16-bit	16-bit	16-bit
Analog output Sampling rate	1MS/s	1MS/s	1MS/s	1MS/s

	PCI-3120	PCI-3121	PCI-3122	PCI-3123
Analog input channel quantity	16 Single-Ended / 8 Difference	16 Single-Ended / 8 Difference	16 Single-Ended / 8 Difference	16 Single-Ended / 8 Difference
Analog input resolution	16-bit	16-bit	16-bit	16-bit
Analog input Sampling rate	125kS/s	250kS/s	500kS/s	1MS/s
Analog output channel quantity	2	2	2	2
Analog output resolution	16-bit	16-bit	16-bit	16-bit
Analog output Sampling rate	1MS/s	1MS/s	1MS/s	1MS/s

1.2. Function Diagram

Figure 1.1 shows the schematic diagram of PCI-3000 series data acquisition device.

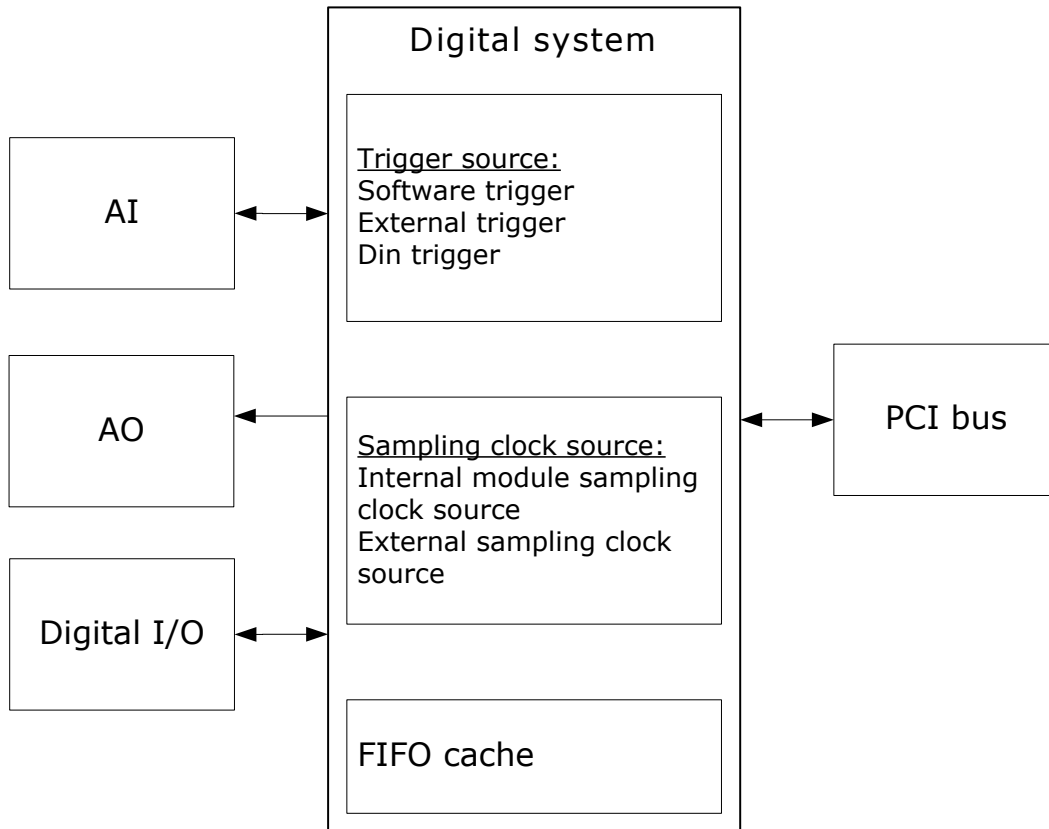


Figure 1.1 PCI-3000 series data acquisition device functions

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	PCI-3210/3211/3212/3213/3110/3111/3112/3113: 8 Single-Ended / 4 Difference PCI-3220/3221/3222/3223/3120/3121/3122/3123: 16 Single-Ended / 8 Difference
ADC type	SAR
Resolution	16-bit

Highest sampling rate	(If multi-channel is used, the sampling rate refers to the sum of multi-channel sampling rates.) PCI-3213/3223/3113/3123: 1MS/s max., continuous PCI-3212/3222/3112/3122: 500kS/s max, continuous PCI-3211/3221/3111/3121: 250kS/s max, continuous PCI-3210/3220/3110/3120: 125kS/s max, continuous
Timing resolution	10ns
Channel synchronization	No
Range	$\pm 10.24V/\pm 5.12V/\pm 2.56V/\pm 1.28V/\pm 0.64V/$
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 number acquisition mode / Single point reading

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)
$\pm 10.24\text{V}$	20	10	195	820
$\pm 5.12\text{V}$	50	15	110	550
$\pm 2.56\text{V}$	55	30	70	215
$\pm 1.28\text{V}$	100	60	60	220
$\pm 0.64\text{V}$	200	120	50	100

Analog output

Number of channels	2
Resolution	16-bit
DNL	± 1 LSB
Output voltage establishment time	1 μs
Edge slope	V/ μs
Channel synchronization	Yes
Output range	$\pm 10\text{V}$
Output coupling	DC
Output impedance	50 Ω
Output drive current	10 mA
Power-on status	The initial power-on value can be set.
AO output mode	DC direct output / finite length waveform output / Infinite non-loop output

Analog output accuracy

Range (V)	-10 ~ 10
Gain error (reading's ppm)	30
Gain temperature coefficient (reading's ppm/°C)	5
Offset error (range's ppm)	50
Offset temperature coefficient (range's ppm/°C)	5
Full range absolute precision (mV)	5
Reference temperature coefficient (ppm/°C)	5
INL error (range's ppm)	120

Digital I/O

Number of channels	8
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 mode / Limited collection mode / Single read
Digital output mode	Direct output / finite length waveform output / Infinite non-loop 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-3000 series data acquisition device.

2.1. Connector signal pins distribution

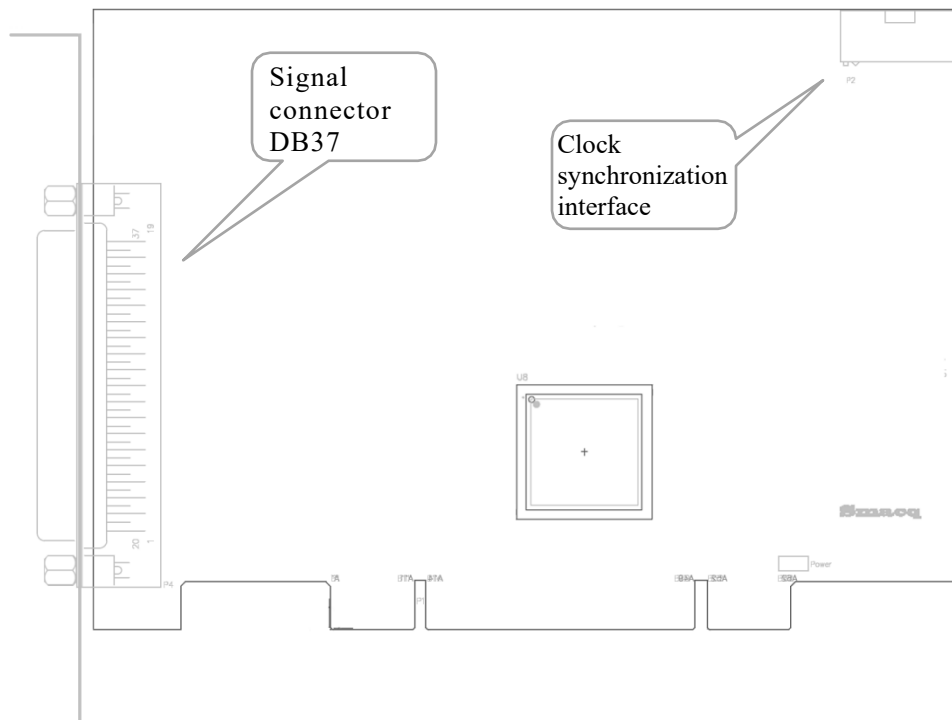


Figure 2.1 PCI-3000 signal pins distribution

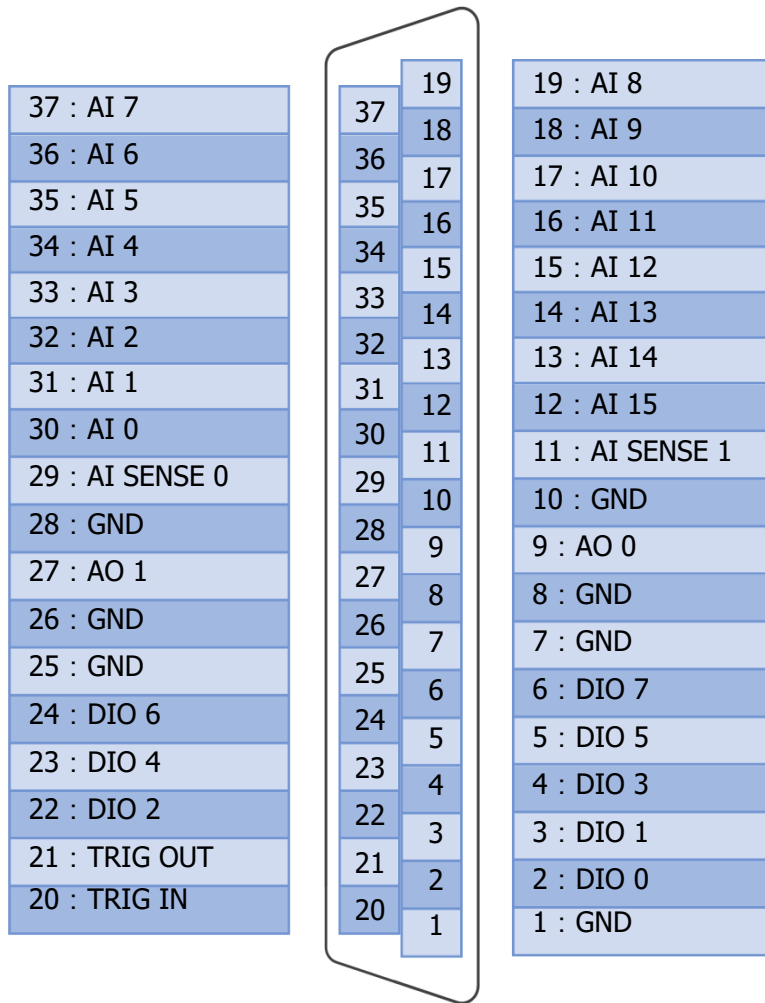


Figure 2.2 Signal connector distribution diagram

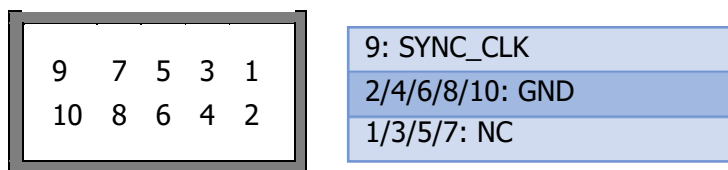


Figure 2.3 Clock interface signal distribution diagram

Table 2.1, Signal pin allocation

Signal name	Single-ended input	Differential input
AI 0	Analog input 0	Analog input 0 Cathode
AI 1	Analog input 1	Analog input 0 Negative
AI 2	Analog input 2	Analog input 2 Cathode
AI 3	Analog input 3	Analog input 2 Negative
AI 4	Analog input 4	Analog input 4 Cathode

Signal name	Single-ended input	Differential input
AI 5	Analog input 5	Analog input 4 Negative
AI 6	Analog input 6	Analog input 6 Cathode
AI 7	Analog input 7	Analog input 6 Negative
AI SENSE 0	Signal negative pole of AI 0~ 7 single-ended input	--
AI 8	Analog input 8	Analog input 8 Cathode
AI 9	Analog input 9	Analog input 8 Negative
AI 10	Analog input 10	Analog input 10 Cathode
AI 11	Analog input 11	Analog input 10 Negative
AI 12	Analog input 12	Analog input 12 Cathode
AI 13	Analog input 13	Analog input 12 Negative
AI 14	Analog input 14	Analog input 14 Cathode
AI 15	Analog input 15	Analog input 14 Negative
AI SENSE 1	Signal negative pole of AI 8~ 15 single-ended input	--
AO 0	Analog output 0	--
AO 1	Analog output 1	--
GND	Reference ground	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	--
DIO 6	Input/output 6	--
DIO 7	Input/output 7	--
TRIG OUT	Trigger signal output	--

TRIG IN	External trigger signal input	--
SYNC_CLK	System synchronous clock input/output	
NC	Not connected	Not connected

2.2. Drive installation

PCI-3xxx 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-3000 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.

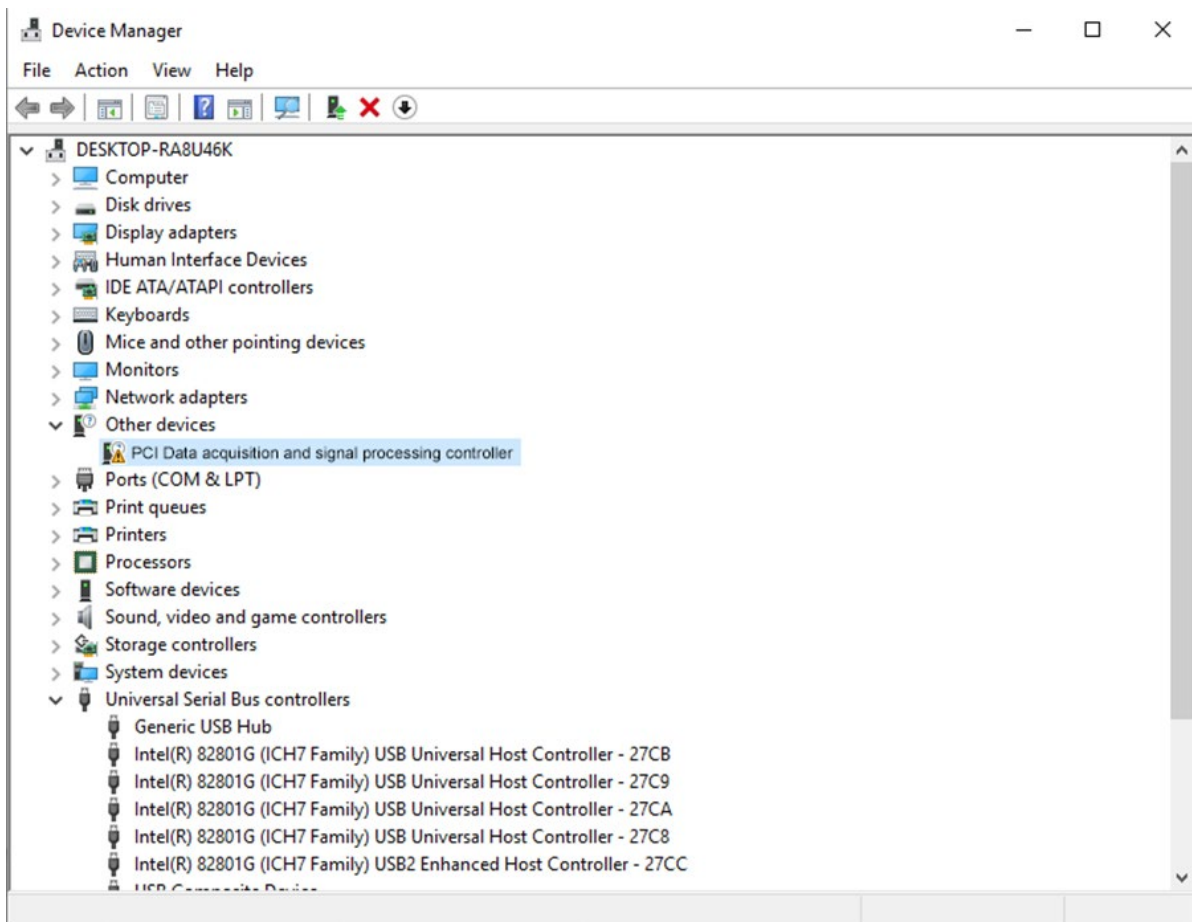


Figure 2.4 Before the driver is installed

- 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.

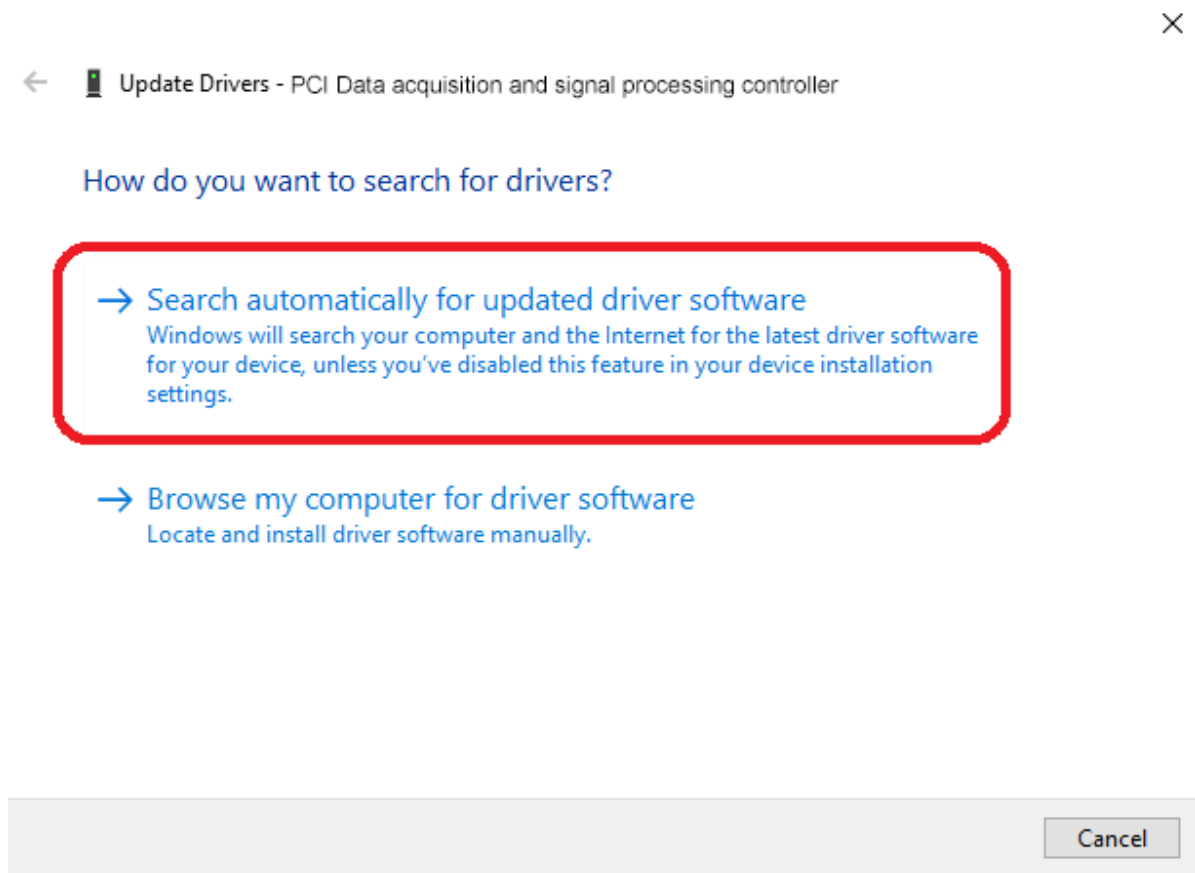


Figure 2.5 Browse my computer for driver software.

- 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.

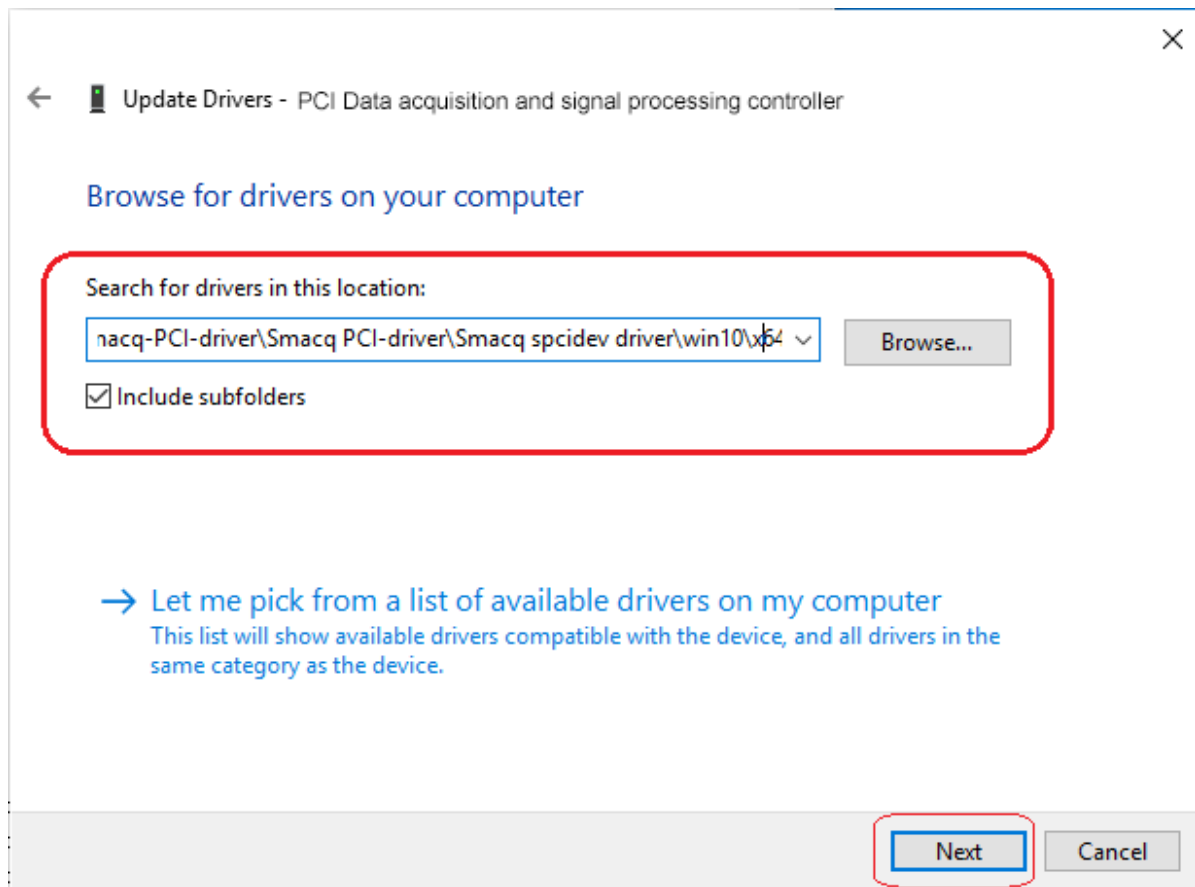


Figure 2.6 Locate the folder where the driver is located.

- 4) The computer starts to enter the driver installation process. After the installation is successful, the dialog box shown in Figure 2.7 below pops up, and the driver installation is completed.

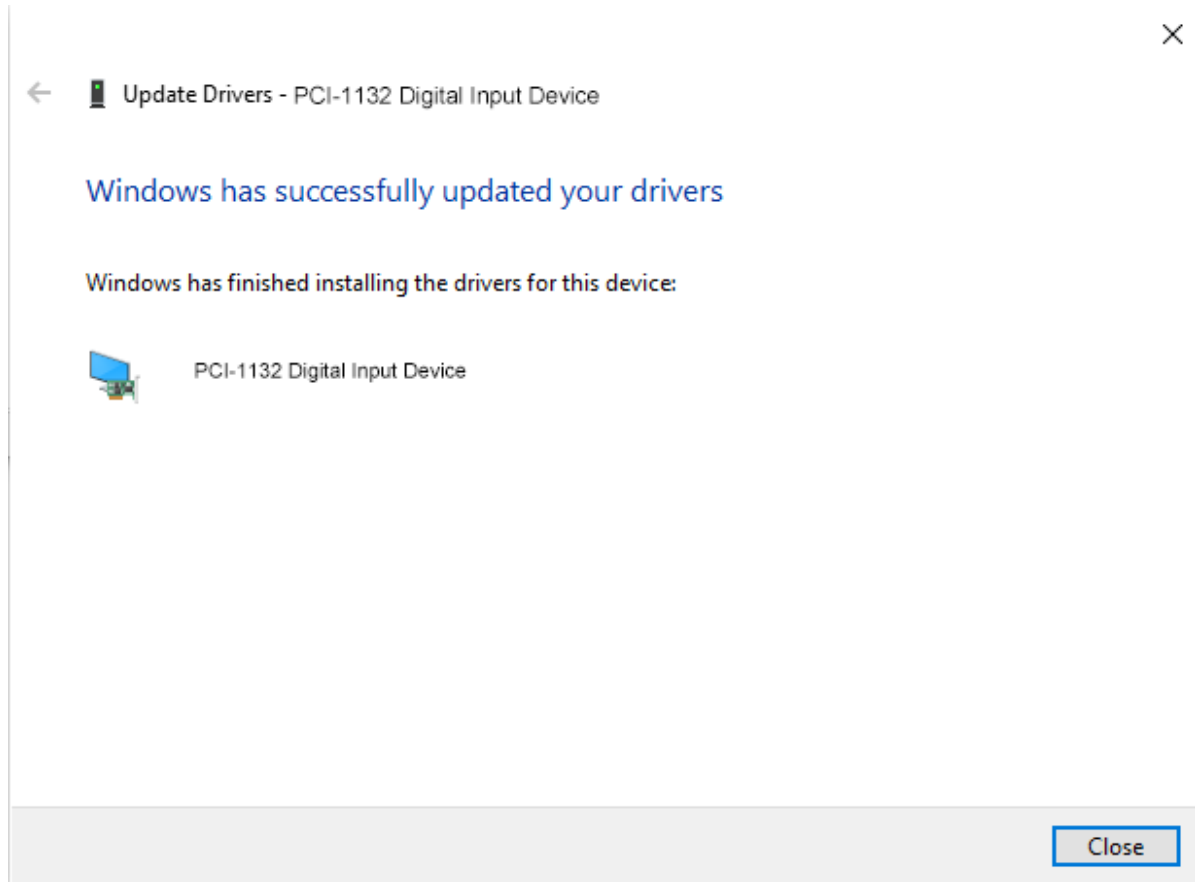


Figure 2.7 Driver installation is complete.

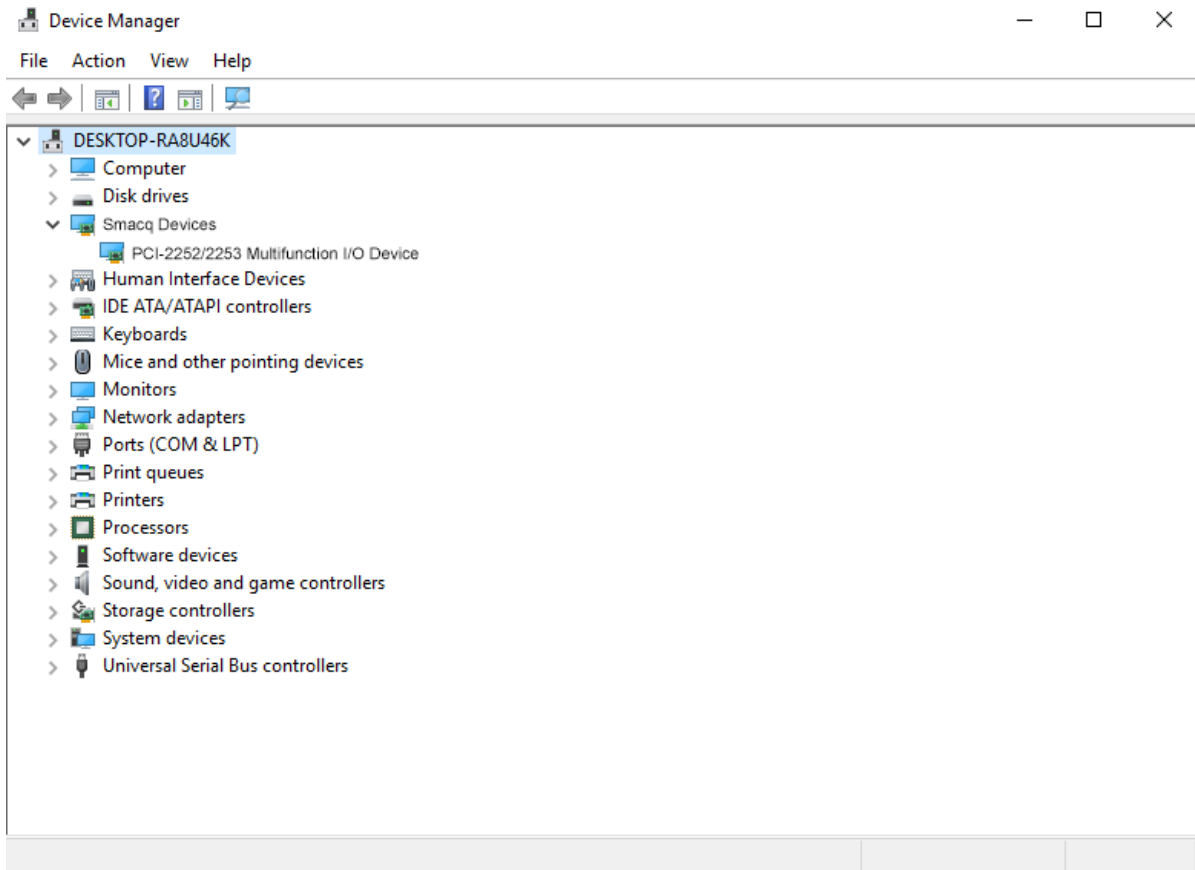


Figure 2.8 Device Manager after successful driver installation

3. Analog Input (AI)

This chapter describes measuring the relevant content of analog input signals on PCI-3000 series data acquisition devices. AI here is short for Analog Input.

3.1. Signal connection methods

PCI-3000 series data acquisition devices support analog input acquisition connection methods of non-grounding reference single-ended input (NRSE) and differential input (DIFF).

Table 3.1 lists the recommended connection methods for floating-ground signal sources and grounding signal sources

Table 3.1 recommended connection methods for floating-ground signal sources and grounding signal sources

Analog input mode	Floating grounded signal source (not connected to GND of the building)	Grounded signal source
Example	<ul style="list-style-type: none"> ● Ungrounded thermocouples ● Signals that are isolated ● Battery-powered devices 	<ul style="list-style-type: none"> ● Signals that are not isolated
Differential input (DIFF)	<p>PCI-3000</p>	<p>PCI-3000</p>
Non-grounded reference single-ended input (NRSE)	<p>PCI-3000</p>	<p>PCI-2252/2253</p> <p>Not recommended</p>

3.2. Floating grounded signal source

A floating grounded signal source is not connected in any way to the building ground system but, it has an isolated ground-reference point. Common floating grounded signal sources are transformers, thermocouples, battery equipment, optical isolators, and isolation amplifier output. An instrument or device with isolated output is a floating-ground signal source.



Attention When measuring the floating grounded signal source, it is important to connect the negative end of the signal source directly or indirectly through the resistor to the AGND.

Using differential mode (DIFF) connection

When any of the following conditions are true, a differential mode should be used to connect the floating signal:

- Analog input AI+ and AI- are all valid signals.
- Low input signal voltage while higher accuracy demanded
- The cable length of the connection signal to the acquisition device exceeds 3 meters
- The input signal requires a separate ground-reference point or a return signal
- There is obvious noise in the environment of the connection wire

Differential connection mode can reduce noise interference and improve the common-mode suppression ability of acquisition device.

For a floating signal source with less than 100Ω internal resistance, you can directly connect the negative end of the signal to AI- and AI-GND ports and connect the positive end of the signal to AI+ ports, as shown below in figure 3.1.

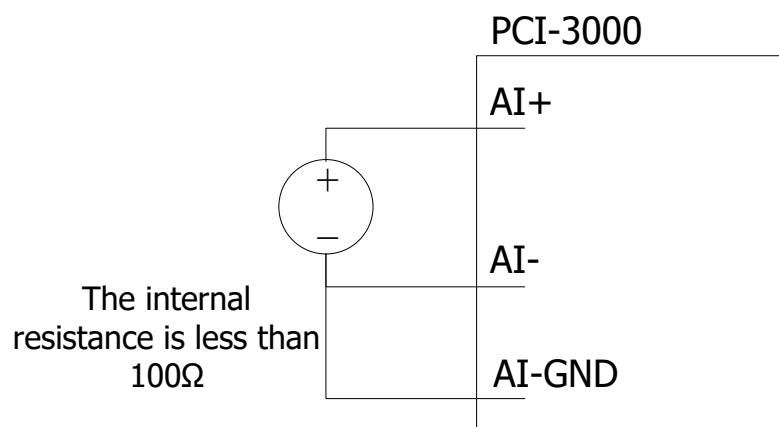


Figure 3.1 differential input mode for direct connection

However, for a floating signal source with large internal resistance, the above connection will lead to the imbalance of differential signal, and the common-mode noise will be coupled to the signal of AI+ while not to AI-, so that the common-mode noise will appear in the measured results. Therefore, for such a signal source, you can use a bias resistor approximately 100 times the internal resistance of the signal source to connect to AI- and AI-GND ports, as shown in Figure 3.2. This can make the differential signal close to equilibrium, hence couple the same amount of noise at both ends of the signal to enable better common-mode noise suppression.

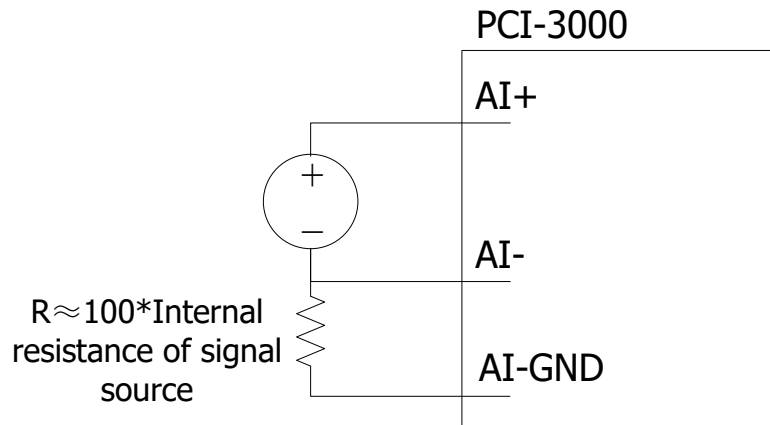


Figure 3.2 differential input mode with single bias resistor

For a floating signal source with a large internal resistance, you can use the differential input mode with two bias resistors, as shown in Figure 3.3. The fully balanced bias resistor connection in this way can provide a slightly better noise suppression, but it can reduce the load on the signal source and result in gain errors. For example, suppose the internal resistance of the signal source is 2kΩ, and two equilibrium resistors are 100kΩ each, then the signal source load is 200 kΩ, which results in a 1% gain error.

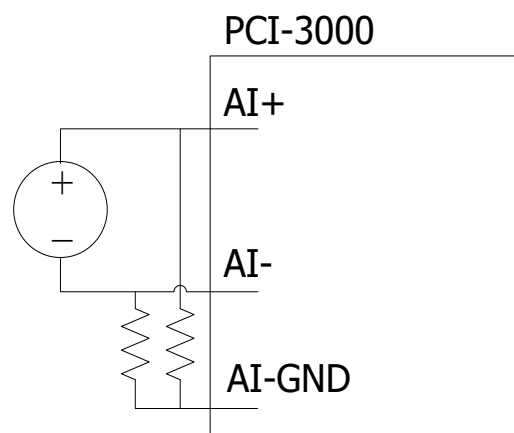


Figure 3.3 balanced bias resistor differential input mode

For AC-coupled floating signal sources, a resistor is required to provide DC loops for the positive input of instrument amplifier, AI+, as shown in Figure 3.4.

If the AC coupled float signal source has a smaller internal resistance, the AI+ and AI-GND connection resistance values should be generally set as 100k Ω to 1M Ω . Hence, it does not aggravate the load of the signal source, nor does it generate an offset voltage due to the bias current of the instrument amplifier. In this case, you can directly connect AI- and AI-GND.

If the internal resistance of the AC coupled floating source signal is large, the differential input mode utilizing the equilibrium bias resistor described earlier should be used, and it is important to note the gain error that may be caused by the equilibrium bias resistor

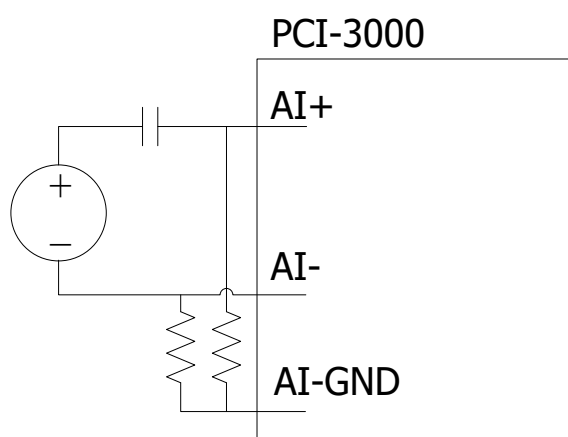


Figure 3.4 Differential input method for AC coupled floating signal source

Non-grounded reference single-ended mode (NRSE) connection

When both the following conditions are true, you can connect the float signal using a non-grounded reference single-end mode:

- The input signal voltage is higher than 1V
- The length of the cable connecting signals to the acquisition device is lower than 3 meters

If the signal does not meet the above conditions, it is recommended to use a differential mode connection to ensure better signal integrity. In single-ended mode, the electrostatic noise and electromagnetic noise of the coupled input signal connection are more than that in differential mode.

Non-grounded reference single-ended mode (NRSE) connection methods are shown in Figure 3.5. Note that the resistance value setting of the grounded resistance is consistent with the that in difference mode.

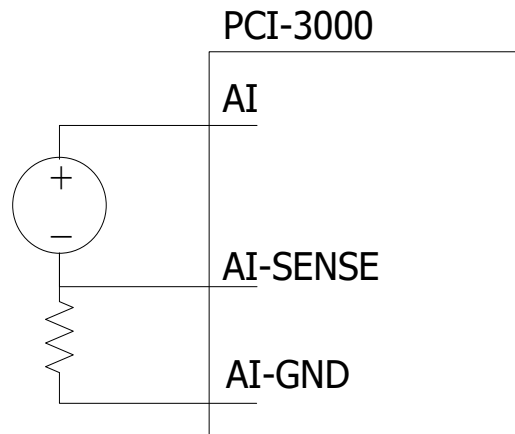


Figure 3.5 floating-grounded signal source NRSE input

3.3. Grounded Signal Source

The grounded signal source is a signal source connected to the building ground. If the computer is connected to the same power supply as the signal source, the source is already connected to a common ground point relative to the device. Instruments and equipment connected to the building power supply system while with non-isolated outputs belong to this type of signal source.

The potential difference between devices connected to the power supply system of the same building is usually 1mV to 100mV, but the potential difference may be larger if the distribution line is not properly connected. If the measurement method is improper, the potential difference may cause measurement errors. Follow the connection guide for the grounded signal source below to reduce the grounded potential difference of the measured signal.

Use a differential mode (DIFF) connection

Differential mode connection should be used when any of the following conditions is true:

- All analog input channels are connected with valid signal
- Low input signal voltage while high accuracy demanded
- The cable connecting the signal to the acquisition device exceeds 3 meters
- The input signal requires a separate reference location or a return signal
- There is obvious noise in the environment of the signal wire

Differential connection mode can reduce noise interference and improve the common-mode suppression of the acquisition device. Differential connection allows the input signal to float within the common-mode operating range of the instrument amplifier.

Figure 3.6 shows how to use differential mode to connect the grounded signal source

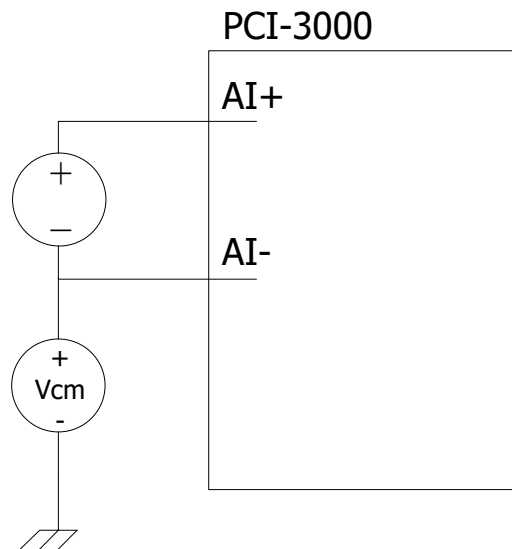


Figure 3.6 grounded signal source DIFF input

Use a non-grounded reference single-ended mode (NRSE) connection

When all of the following conditions are true, you can connect the float signal using a non-grounded reference single-ended mode:

- The input signal voltage is higher than 1V
- The cable connecting the signal to the acquisition device is less than 3 meters long
- The input signal shares a reference point whose voltage is not AI-GND.

If the signal does not meet the above conditions, it is recommended to use a differential mode connection to ensure better signal integrity. In single-ended mode, the electrostatic noise and electromagnetic noise of the coupled input signal connection are more than that in the difference mode.

Figure 3.7 shows the grounded signal source (NRSE) connection in non-grounded reference single-ended mode.

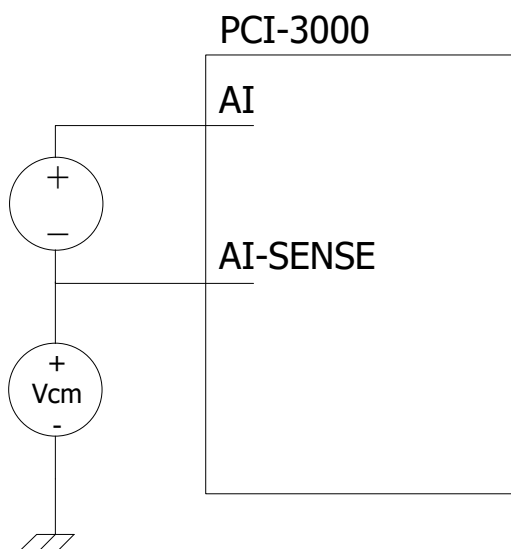


Figure 3.7 grounded signal source NRSE input

3.4. Signal acquisition mode

When the PCI-3000 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.

3.5. Comprehensive sampling rate and single channel sampling rate

When the PCI-3000 series data acquisition device is used for single channel acquisition, the channel can achieve the maximum sampling rate.

If two channels are enabled for one acquisition, the sample rate for each channel is half the set sample rate; if three channels are enabled, the sample rate for each channel is one third of the set sample rate. When you have more channels, the calculation method is like this.

3.6. Trigger

The PCI-3000 series data acquisition device provides rich trigger options. The schematic diagram of the AI acquisition trigger options are shown in Figure 3.8.

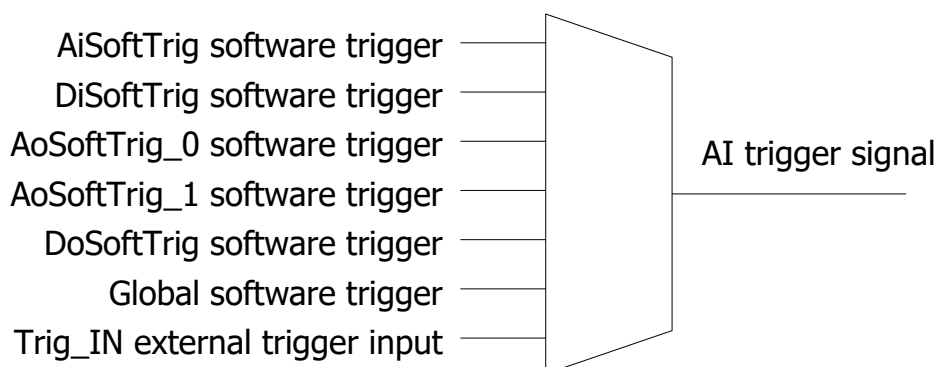


Figure 3.8 AI trigger options

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

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

4. Analog Output (AO)

This chapter introduces the analog signal output on PCI-3000 series data acquisition devices. AO is the abbreviation of Analog Output here.

Only the data acquisition device with PCI-31xx product model has the AO function.

4.1. Signal output mode

When the PCI-31xx series data acquisition device is utilized for analog output, the following four output modes are supported:

- DC immediate output
- Finite number output
- Infinite 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.

DC immediate output

DC 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 voltage.



Attention The specified voltage cannot exceed the DAQ range of AO output. If exceeded, it will generate errors.

Finite number output mode

The limited number of output modes means that the 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 AO 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 AO 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 AO is triggered, the acquisition device starts to output the digital waveform according to the set parameters, and continuously loops the output until the AO trigger is cleared to an untriggered state.



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

Infinite non-loop output mode

The infinite non-loop output mode refers to a waveform in which the AO output exceeds the length of the hardware FIFO space, and the computer transfers the data in batches to the AO 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 AO hardware FIFO space is only 2k points, so the waveform of 1M point length needs to be transferred to the AO 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 AO output waveform.

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

4.2. Output update rate

PCI-3000 series data acquisition device can reach an AO output update rate up to 1MS/s/, which is also the DAC output sampling rate.

4.3. Trigger

The PCI-31xx series data acquisition device provides rich trigger options. The schematic diagram of the AO acquisition trigger options are shown in Figure 4.1.

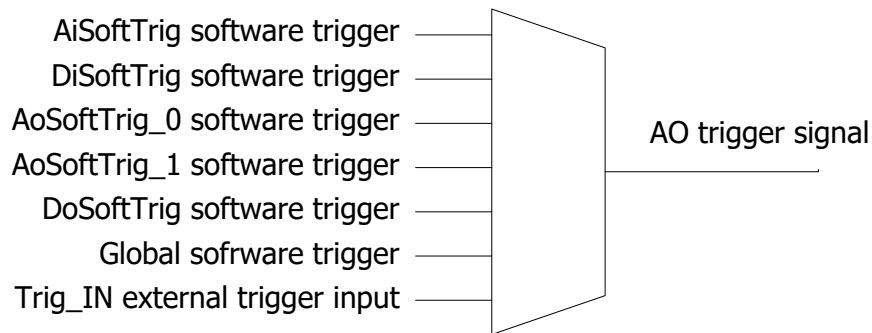


Figure 4.1 AI trigger options

The AO output uses the channel exclusive software trigger signal AoSoftTrig as the trigger source by default. You can set AO 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 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 Input (DI)

This chapter introduces the digital input signal acquisition on PCI-3000 series data acquisition devices. DI is the abbreviation of Digital Input here.

5.1. Signal acquisition mode

When the PCI-3000 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 read

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

5.2. Trigger

The PCI-3000 series data acquisition device provides rich trigger options. The DI acquisition trigger options are shown in Figure 5.1.

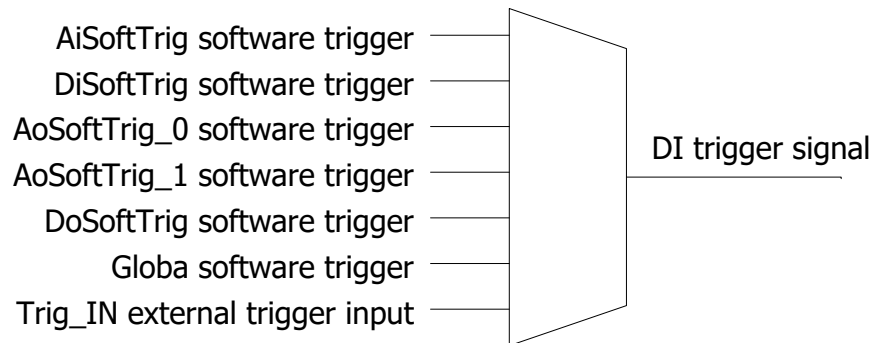


Figure 5.1 DI trigger options

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.

6. Digital Output (DO)

This chapter introduces the digital signal output for the PCI-3000 series data acquisition device. The digital input is referred to as DO here, the abbreviation of Digital Output.

6.1. Signal output mode

When the PCI-3000 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 trigger is 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.

6.2. Output update rate

PCI-3000 series data acquisition device DO output update rate can reach up to 10MSa/s

6.3. Trigger

The PCI-3000 series of data acquisition devices provide a rich set of trigger options, as shown in Figure 6.3, which describes trigger options for the DO output.

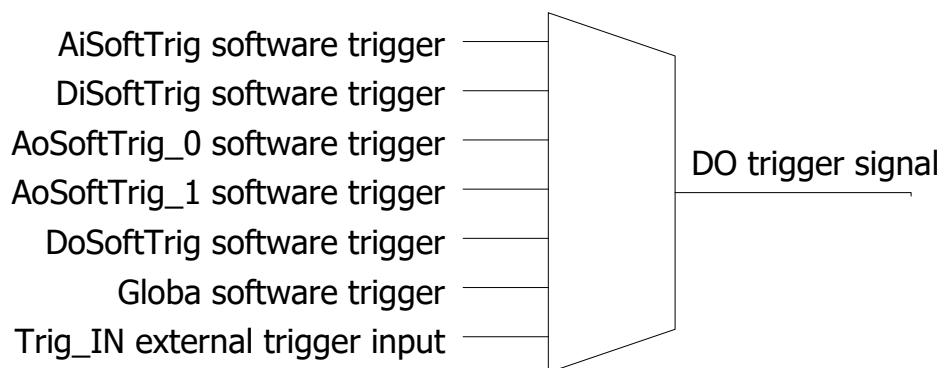


Figure 6.3 DO trigger options

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 Trig_IN receives a rising edge, the device triggers.

Clear trigger

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

7. Synchronization System

This chapter introduces the multi-card synchronization system of PCI-3000 series data acquisition device. The synchronization system has three ports, synchronization clock, external trigger input and trigger output.

7.1. 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-3000 series 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 7.1.

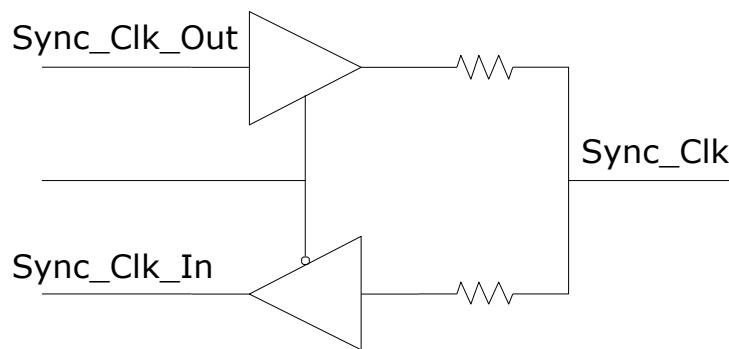


Figure 7.1 The circuit diagram of the synchronous clock port

7.2. 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.

7.3. 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 7.2. The following sources can be selected as output options:

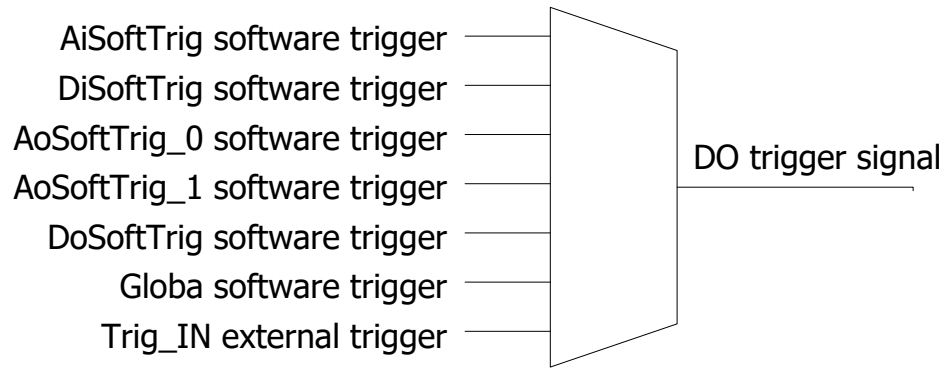


Figure 7.2 Schematic diagram of trigger output circuit

8. 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>

9. Ordering Information

Host

Model	Notes
PCI-3210	8-AI(125kS/s), 8-DIO
PCI-3211	8-AI(250kS/s), 8-DIO
PCI-3212	8-AI(500kS/s), 8-DIO
PCI-3213	8-AI(1MS/s), 8-DIO
PCI-3220	16-AI(125kS/s), 8-DIO
PCI-3221	16-AI(250kS/s), 8-DIO
PCI-3222	16-AI(500kS/s), 8-DIO
PCI-3223	16-AI(1MS/s), 8-DIO
PCI-3110	8-AI(125kS/s), 2-AO, 8-DIO
PCI-3111	8-AI(250kS/s), 2-AO, 8-DIO
PCI-3112	8-AI(500kS/s), 2-AO, 8-DIO
PCI-3113	8-AI(1MS/s), 2-AO, 8-DIO
PCI-3120	16-AI(125kS/s), 2-AO, 8-DIO
PCI-3121	16-AI(250kS/s), 2-AO, 8-DIO
PCI-3122	16-AI(500kS/s), 2-AO, 8-DIO
PCI-3123	16-AI(1MS/s), 2-AO, 8-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 $\pm 5v$