

PCI8008

User's Manual

 **Beijing ART Technology Development Co., Ltd.**

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Chapter 1 Overview

In the fields of Real-time Signal Processing, Digital Image Processing and others, high-speed and high-precision data acquisition modules are demanded. ART PCI8008 data acquisition module, which brings in advantages of similar products that produced in china and other countries, is convenient for use, high cost and stable performance.

ART PCI8008 is a data acquisition module based on PCI bus. It can be directly inserted into IBM-PC/AT or a computer which is compatible with PCI8008 to constitute the laboratory, product quality testing center and systems for different areas of data acquisition, waveform analysis and processing. It may also constitute the monitoring system for industrial production process.

Unpacking Checklist

Check the shipping carton for any damage. If the shipping carton and contents are damaged, notify the local dealer or sales for a replacement. Retain the shipping carton and packing material for inspection by the dealer.

Check for the following items in the package. If there are any missing items, contact your local dealer or sales.

- PCI8008 Data Acquisition Board
- ART Disk
 - a) user's manual (pdf)
 - b) drive
 - c) catalog
- Warranty Card

FEATURES

Analog Input

- Input Range: $\pm 10V$ (AD7865-1), $0\sim 5V$, $0\sim 2.5V$ (AD7865-2)
- 14-bit resolution
- Sampling Rate: $3Hz\sim 80KHz$
- Input Channels: 16SE/16DI
- Channel Switch Mode: 16-channel 4 chips independent work
- Data Read Mode: non-empty and half-full query mode, interrupt mode and DMA mode
- FIFO Size: 8K word
- Memory Sign: full, non-empty, half-full
- Clock Source: Internal clock and external clock
- Internal clock frequency: current A/D actual sample rate
- Trigger Mode: software trigger, hardware trigger (external trigger)
- Trigger Type: edge trigger and level trigger
- Trigger Direction: negative, positive, either positive or negative trigger
- Trigger Source: ATR and DTR
- ATR Range: $0\sim 10V$
- DTR Range: TTL
- A/D conversion time: $\leq 2.4\mu S$

- Programmed amplifier: AD8251 (default), AD8250, AD8253 (compatible)
- Analog input impedance: 10M Ω
- Programmed gain: 1, 2, 4, 8 (AD8251); 1, 2, 5, 10 (AD8250) or 1, 10, 100, 1000 (AD8253)
- Non-linear error: ± 1 LSB (Maximum)
- System Measurement Accuracy: 0.05%
- Operating Temperature Range: 0 $^{\circ}$ C~55 $^{\circ}$ C
- Storage Temperature Range: -20 $^{\circ}$ C~70 $^{\circ}$ C

Other features

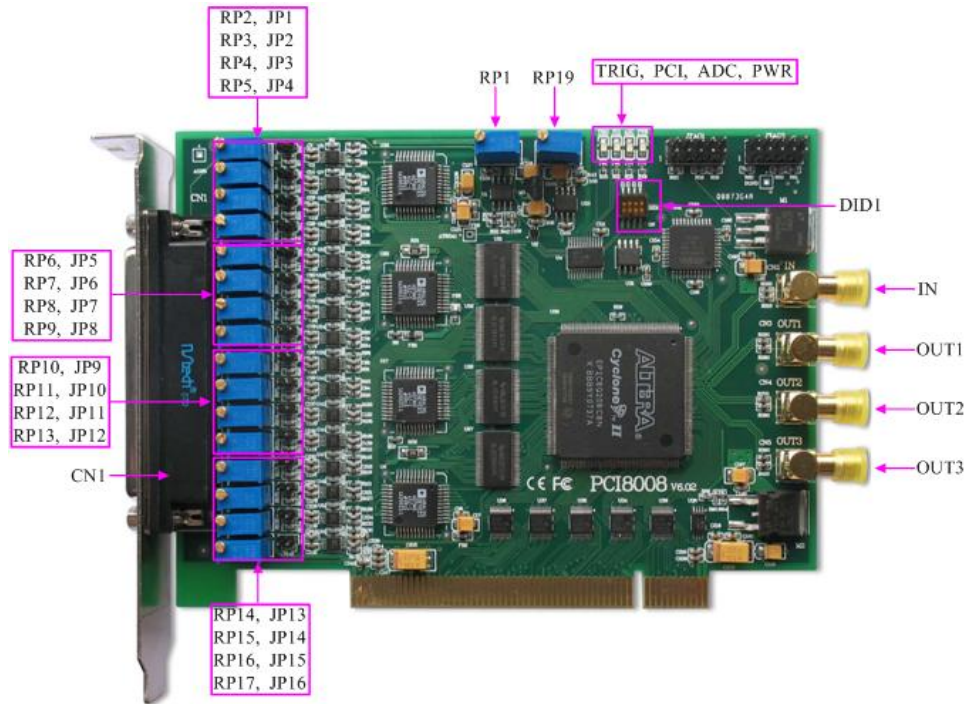
Board Clock Oscillation: 40MHz

Dimension

142mm (L) * 106mm (W)*18mm (H)

Chapter 2 Components Layout Diagram and a Brief Description

2.1 The Main Component Layout Diagram



2.2 The Function Description for the Main Component

2.2.1 Signal Input and Output Connectors

CN1: Signal input/output connector

IN: Sync pulse signal input ports

OUT1, OUT2, and OUT3: Sync pulse signal output port

2.2.2 Potentiometer

RP1: ATR zero-point adjustment potentiometer

RP2, RP3, RP4 and RP5: AI0~AI3 analog input zero-point adjustment potentiometer

RP6, RP7, RP8 and RP9: AI4~AI7 analog input zero-point adjustment potentiometer

RP10, RP11, RP12 and RP13: AI8~AI11 analog input zero-point adjustment potentiometer

RP14, RP15, RP16 and RP17: AI12~AI15 analog input zero-point adjustment potentiometer

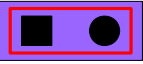

RP19: Analog input full-scale adjustment potentiometer

2.2.3 Jumper

Select analog input mode

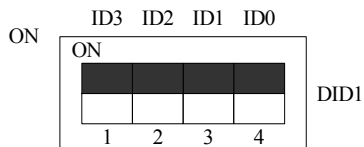
Jumper	JP1	JP2	JP3	JP4	JP5	JP6	JP7	JP8
Input channel	AI0	AI1	AI2	AI3	AI4	AI5	AI6	AI7

Jumper	JP9	JP10	JP11	JP12	JP13	JP14	JP15	JP16
Input channel	AI8	AI9	AI10	AI11	AI12	AI13	AI14	AI15

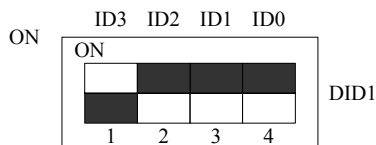
Input Mode	JP1~JP16
Single-ended	
Differential Input	

2.2.4 Physical ID of DIP Switch

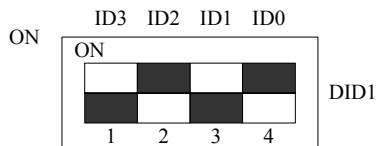
DID1: Set physical ID number. When the PC is installed more than one PCI8008 , you can use the DIP switch to set a physical ID number for each board, which makes it very convenient for users to distinguish and visit each board in the progress of the hardware configuration and software programming. The following four-bit numbers are expressed by the binary system: When DIP switch points to "ON", that means "1", and when it points to the other side, that means "0." As they are shown in the following diagrams: "ID3" is the high bit."ID0" is the low bit, and the black part in the diagram represents the location of the switch. (Test software of the company often uses the logic ID management equipments and at this moment the physical ID DIP switch is invalid. If you want to use more than one device that are the same type in the same system at the same time, please use the physical ID as much as possible. As for the differences between logic ID and physical ID, please refer to the function explanations of "CreateDevice" and "CreateDeviceEx" of *The Prototype Explanation of Device Object Management Function* in *PCI8008S* software specification).



The above chart shows "1111", so it means that the physical ID is 15.



The above chart shows "0111", so it means that the physical ID is 7.



The above chart shows "0101", so it means that the physical ID is 5.

ID3	ID2	ID1	ID0	Physical ID (Hex)	Physical ID (Dec)
OFF (0)	OFF (0)	OFF (0)	OFF (0)	0	0
OFF (0)	OFF (0)	OFF (0)	ON (1)	1	1
OFF (0)	OFF (0)	ON (1)	OFF (0)	2	2
OFF (0)	OFF (0)	ON (1)	ON (1)	3	3
OFF (0)	ON (1)	OFF (0)	OFF (0)	4	4
OFF (0)	ON (1)	OFF (0)	ON (1)	5	5
OFF (0)	ON (1)	ON (1)	OFF (0)	6	6
OFF (0)	ON (1)	ON (1)	ON (1)	7	7
ON (1)	OFF (0)	OFF (0)	OFF (0)	8	8
ON (1)	OFF (0)	OFF (0)	ON (1)	9	9
ON (1)	OFF (0)	ON (1)	OFF (0)	A	10
ON (1)	OFF (0)	ON (1)	ON (1)	B	11
ON (1)	ON (1)	OFF (0)	OFF (0)	C	12
ON (1)	ON (1)	OFF (0)	ON (1)	D	13
ON (1)	ON (1)	ON (1)	OFF (0)	E	14
ON (1)	ON (1)	ON (1)	ON (1)	F	15

2.2.5 Status Indicator

TRIG: Trigger status indicator

PCI: Overflow status indicator

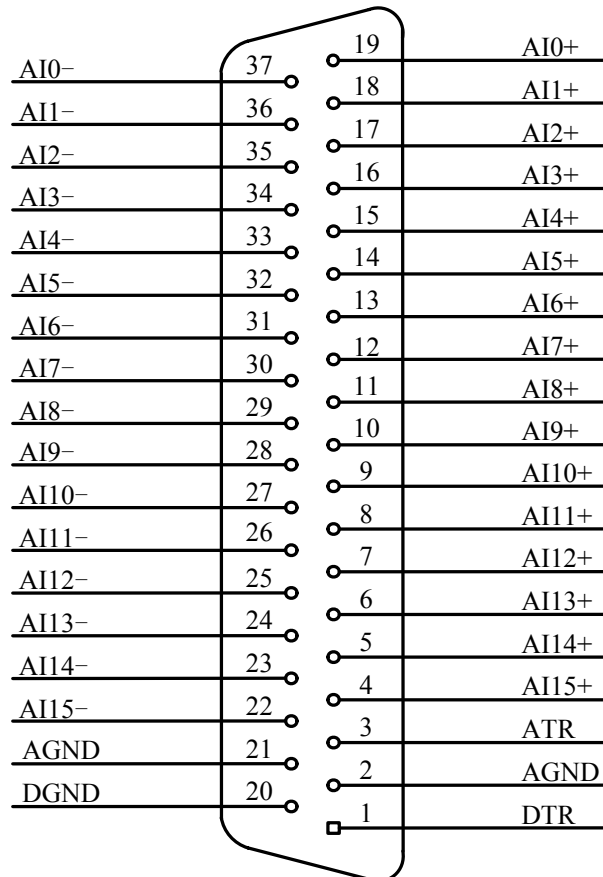
ADC: A/D work status indicator

PWR: Power supply status indicator.

Chapter 3 Signal Connectors

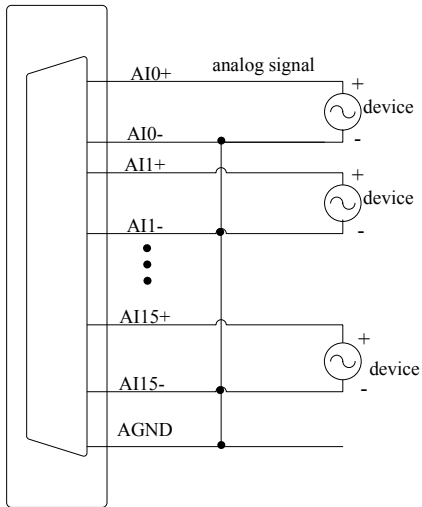
3.1 Analog Input Connector

37 core plug on the CN1 pin definition

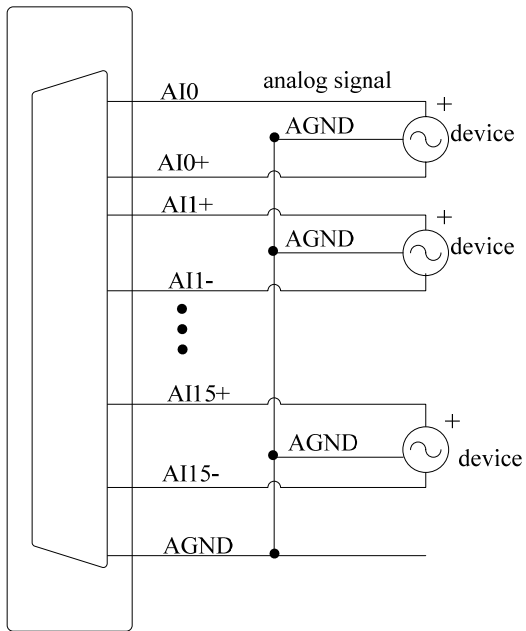


Pin Name	Dir	Description
AI0+~AI15+	Input	Analog input, correspond to analog single-ended signal when using single-ended; correspond to analog positive end input when using differential inputs
AI0-~AI15-	Input	Analog input, connect to GND when using single-ended; correspond to analog negative end input when using differential input
AGND	GND	Analog ground.
DGND	GND	Digital ground.
ATR	Input	Analog trigger, reference ground is AGND.
DTR	Input	Digital trigger, reference ground is DGND.

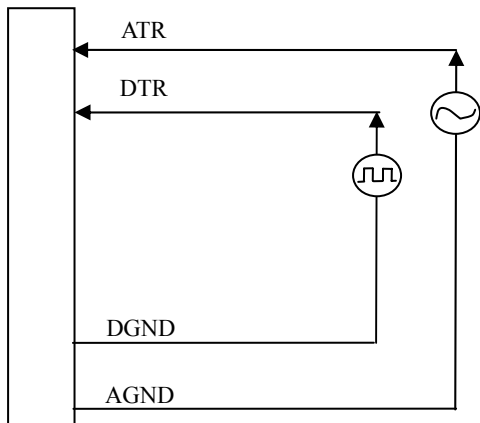
3.2 Analog single-ended input



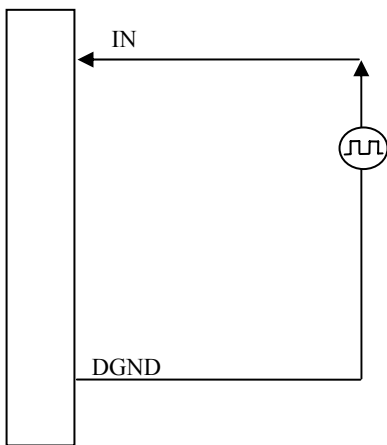
3.3 Analog differential inputs



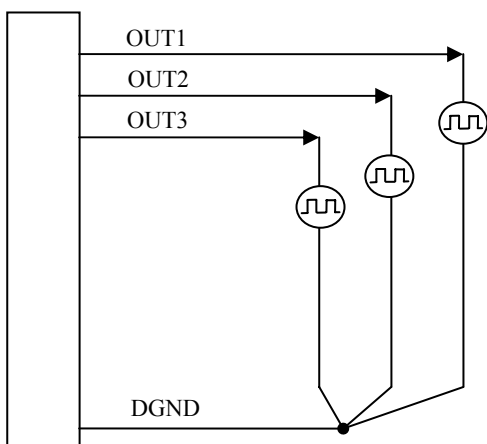
3.4 Trigger signal input



3.5 Sync pulse signal input



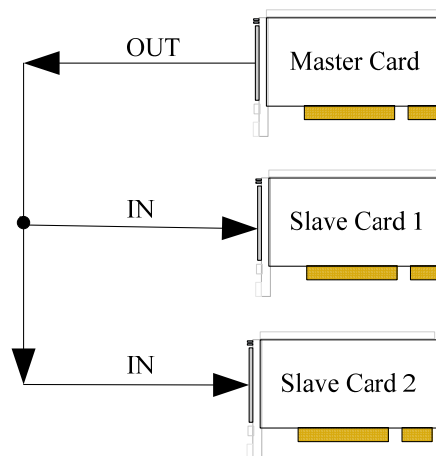
3.6 Sync pulse signal output



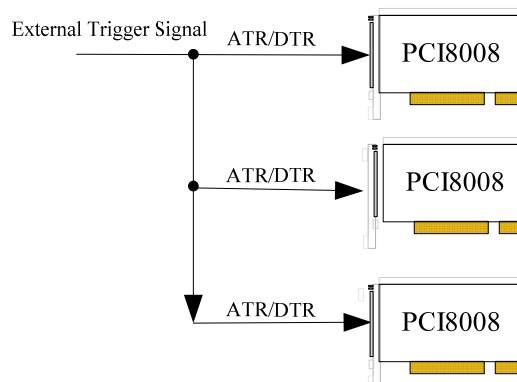
3.7 Methods of Realizing the Multi-card Synchronization

Three methods can realize the synchronization for the PCI8008, the first method is using the cascade master-slave card, the second one is using the common external trigger, and the last one is using the common external clock.

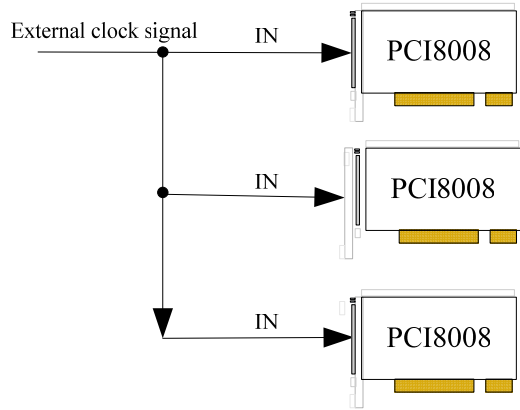
When using master-slave cascade card programs, the master card generally uses the internal clock source model, while the slave card uses the external clock source mode. After the master card and the slave card are initialized according to the corresponding clock source mode. At first, start all the slave cards, as the main card has not been activated and there is no output clock signal, so the slave card enters the wait state until the main card was activated. At this moment, the multi-card synchronization has been realized. When you need to sample more than channels of a card, you could consider using the multi-card cascaded model to expand the number of channels.



When using the common external trigger, please make sure all parameters of different PCI8008 are the same. At first, configure hardware parameters, and use analog or digital signal triggering (ATR or DTR), then connect the signal that will be sampled by PCI8008, input triggering signal from ART pin or DTR pin, then click “Start” button, at this time, PCI8008 does not sample any signal but waits for external trigger signal. When each module is waiting for external trigger signal, use the common external trigger signal to startup modules, at last, we can realize synchronization data acquisition in this way. See the following figure:



When using the common external clock trigger, please make sure all parameters of different PCI8008 are the same. At first, configure hardware parameters, and use external clock, then connect the sampled signal, click “Start” button, at this time, PCI8008 does not sample any signal, but wait for external clock signal. When all modules are waiting for external clock signal, use the common external clock signal to startup modules, at last, we realize synchronization data acquisition in this way. See the following figure:



Chapter 4 The Instruction Trigger Function

4.1 Internal Trigger Mode

When AI is in the initialization, if the AI hardware parameter `ADPara.TriggerMode = PCI8008_TRIGMODE_SOFT`, we can achieve the internal trigger acquisition. In this function, when calling the `StartDeviceProAD` function, it will generate AI start pulse, AI immediately access to the conversion process and not wait for the conditions of any other external hardware. It also can be interpreted as the software trigger.

As for the specific process, please see the figure below, the cycle of the AI work pulse is decided by the sampling frequency.

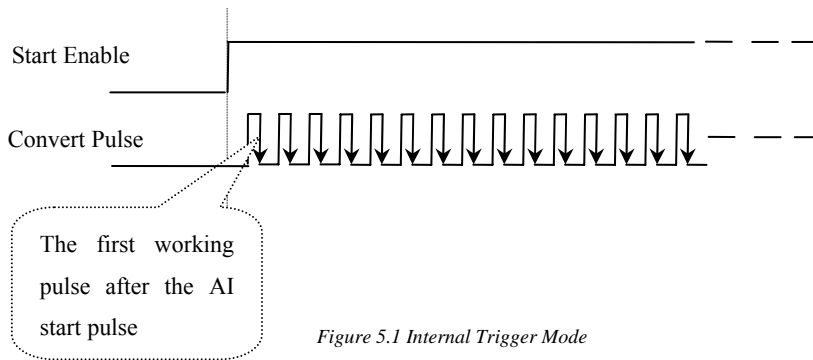


Figure 5.1 Internal Trigger Mode

4.2 External Trigger Mode

When AI is in the initialization, if the AI hardware parameter `ADPara.TriggerMode = PCI8008_TRIGMODE_POST`, we can achieve the external trigger acquisition. In this function, when calling the `StartDeviceProAD` function, A/D will not immediately access to the conversion process but wait for the external trigger source signals accord with the condition, then start converting the data. It also can be interpreted as the hardware trigger. Trigger source includes the DTR (Digital Trigger Source) and ATR (Analog Trigger Source)

The trigger modes include the edge trigger and level trigger.

(1) Edge trigger function

Edge trigger is to capture the characteristics of the changes between the trigger source signal and the trigger level signal to trigger A/D conversion.

When `TriggerType = PCI8008_TRIGTYPE_EDGE`, it is edge trigger.

When `ADPara.TriggerDir = PCI8008_TRIGDIR_NEGATIVE`, choose the trigger mode as the falling edge trigger. That is, when the trigger signal is on the falling edge, A/D will immediately access to the conversion process, and its follow-up changes have no effect on A/D acquisition.

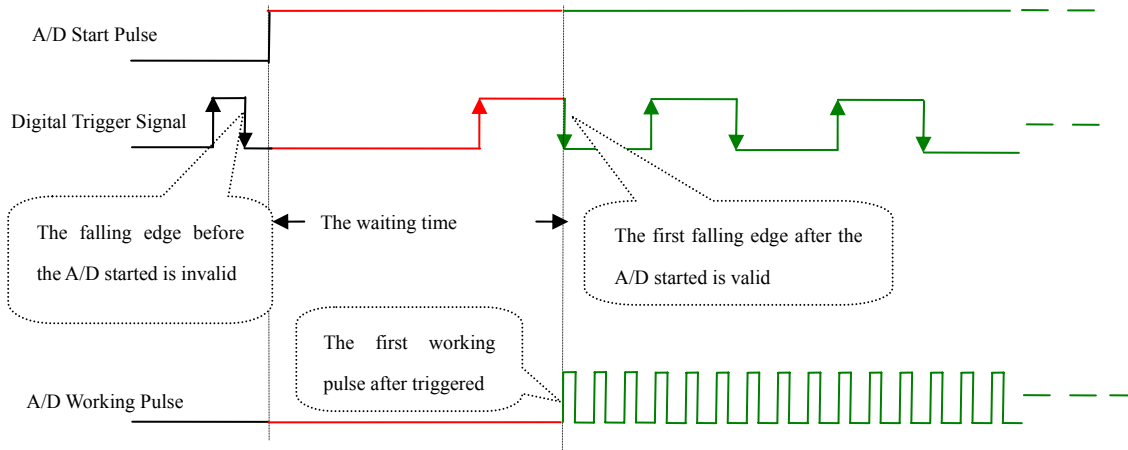


Figure5.2 Digital Trigger Source, Falling edge Trigger

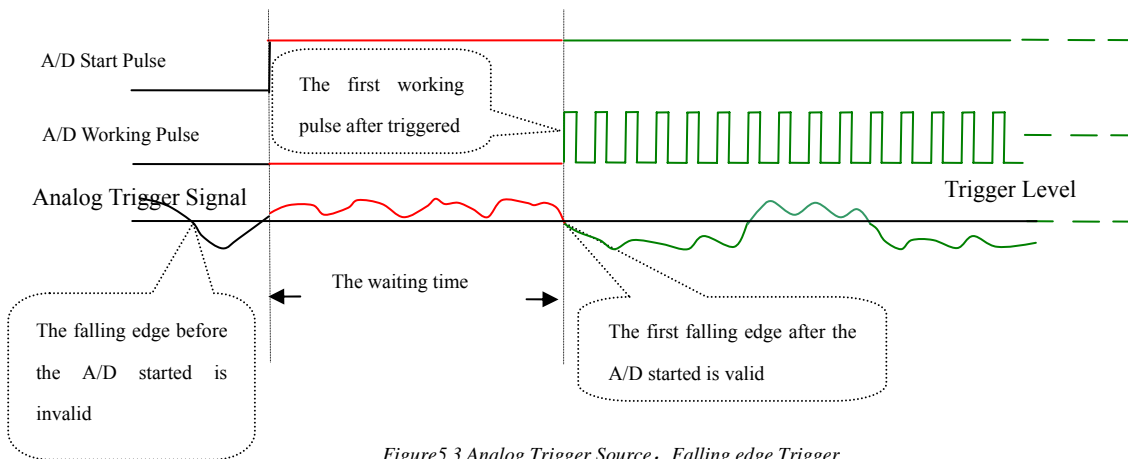


Figure5.3 Analog Trigger Source, Falling edge Trigger

When `ADPara.TriggerDir = PCI8008_TRIGDIR_POSITIVE`, choose the trigger mode as rising edge trigger. That is, when the trigger signal is on the rising edge, A/D will immediately access to the conversion process, and its follow-up changes have no effect on A/D acquisition.

When `ADPara.TriggerDir = PCI8008_TRIGDIR_POSIT_NEGAT`, choose the trigger mode as “either rising or falling edge trigger”. That is, when the trigger signal is on the rising or falling edge, A/D will immediately access to the conversion process, and its follow-up changes have no effect on A/D acquisition. This function can be used in the case that the acquisition will occur if the **exoteric** signal changes.

(2) Level trigger function

Level trigger is to capture the condition that trigger signal is higher or lower than the trigger level to trigger A/D conversion.

When `ADPara.TriggerType = PCI8008_TRIGTYPE_PULSE`, it is level trigger.

When `ADPara.TriggerDir = PCI8008_TRIGDIR_NEGATIVE`, it means the trigger level is low. When trigger signal is low level, A/D is in the conversion process, once the trigger signal is in the high level, A/D conversion will

automatically stop, when the trigger signal is in the low level again, A/D will re-access to the conversion process, that is, only converting the data when the trigger signal is in the low level.

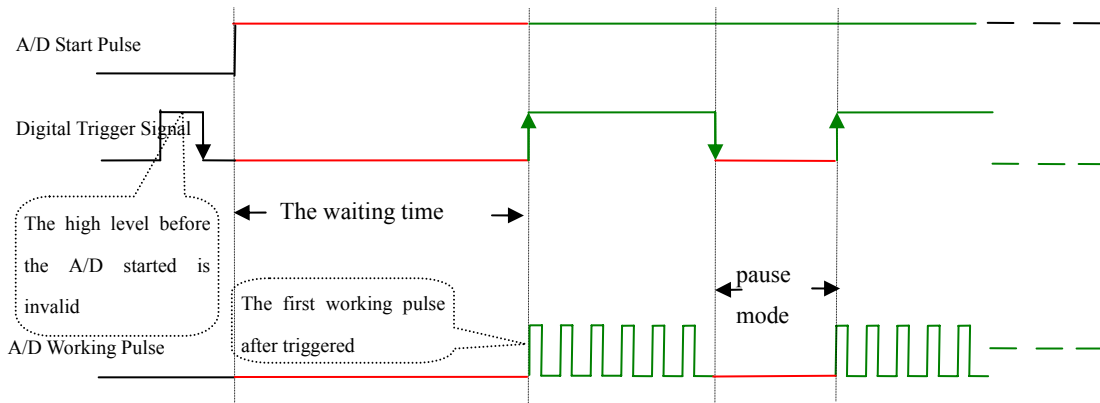


Figure5.4 Digital Trigger Source, High Level Trigger

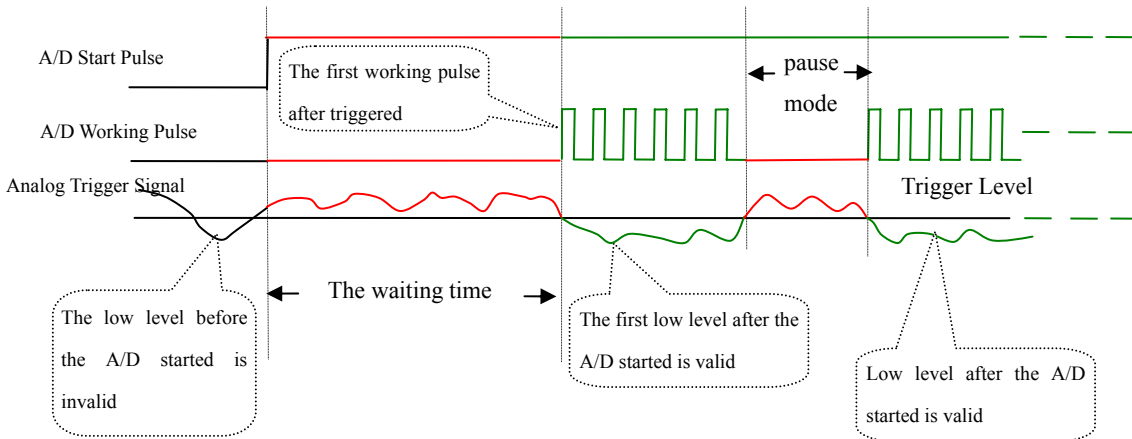


Figure5.4 Digital Trigger Source, Low Level Trigger

When ADPara.TriggerDir = PCI8008_TRIGDIR_POSITIVE, it means the trigger level is high. When trigger signal is in high level, A/D is in the conversion process, once the trigger signal is in the low level, A/D conversion will automatically stop, when the trigger signal is in the high level again, A/D will re-access to the conversion process, that is, only converting the data when the trigger signal is in the high level.

When ADPara.TriggerDir = PCI8008_TRIGDIR_POSIT_NEGAT, it means the trigger level is low. The effect is the same as choosing the internal software trigger.

Chapter 5 Methods of Using Internal and External Clock Function

5.1 Internal Clock Function of A/D

Internal Clock Function refers to the use of on-board clock oscillator and the clock signals which are produced by the user-specified frequency to trigger the AD conversion regularly. To use the clock function, the hardware parameters `ADPara.ClockSource = PCI8008_CLOCKSRC_IN` should be installed in the software. The frequency of the clock in the software depends on the hardware parameters `ADPara.Frequency`. For example, if `Frequency = 100000`, that means A/D work frequency is 100000Hz (that is, 100 KHz, 10uS/point).

5.2 External Clock Function of A/D

External Clock Function refers to the use of the outside clock signals to trigger the A/D conversion regularly. The clock signals are provide by the INCLK pin of J1. The external clock can be provided by another PCI8008's clock output as well as other device such as clock frequency generators. To use the external clock function, set the hardware parameters `ADPara.ClockSource = PCI8008_CLOCKSRC_OUT`. The A/D sample rate depends on the external clock frequency.

Chapter 6 Note, Calibration and Warranty Policy

6.1 Notes

In our products' packing, user can find a user manual, a PCI8008 module and a quality guarantee card. Users must keep quality guarantee card carefully, if the products have some problems and need repairing, please send products together with quality guarantee card to ART, we will provide good after-sale service and solve the problem as quickly as we can.

When using PCI8008, in order to prevent the IC (chip) from electrostatic harm, please do not touch IC (chip) in the front panel of PCI8008 module.

6.2 Analog Signal Input Calibration

Every device has to be calibrated before sending from the factory. It is necessary to calibrate the module again if users want to after using for a period of time or changing the input range. PCI8757 default input range: $\pm 10V$, in the manual, we introduce how to calibrate PCI8008 in $\pm 10V$, calibrations of other input ranges are similar.

Prepare a digital voltage instrument which the resolution is more than 5.5 bit, install the PCI8008 module, and then power on, warm-up for fifteen minutes.

- 1) Zero adjustment: Select AI0 for example; connect a DC voltage source with value equal to 0V to AI0. Adjust RP2 until the input value 0.000V.
- 2) Full-scale adjustment: Select AI1 for example; connect a DC voltage source with value equal to 9998.77mV to AI1. Adjust RP19 until the input value 9998.77mV.
- 3) Repeat steps above until meet the requirement.
- 4) Trigger level calibration: adjust RP1 to finish the calibration of the trigger level's the zero-point.

6.3 Warranty Policy

Thank you for choosing ART. To understand your rights and enjoy all the after-sales services we offer, please read the following carefully.

1. Before using ART's products please read the user manual and follow the instructions exactly. When sending in damaged products for repair, please attach an RMA application form which can be downloaded from: www.art-control.com.

2. All ART products come with a limited two-year warranty:

- The warranty period starts on the day the product is shipped from ART's factory
- For products containing storage devices (hard drives, flash cards, etc.), please back up your data before sending them for repair. ART is not responsible for any loss of data.
- Please ensure the use of properly licensed software with our systems. ART does not condone the use of pirated software and will not service systems using such software. ART will not be held legally responsible for products shipped with unlicensed software installed by the user.

3. Our repair service is not covered by ART's guarantee in the following situations:

- Damage caused by not following instructions in the User's Manual.

- Damage caused by carelessness on the user's part during product transportation.
 - Damage caused by unsuitable storage environments (i.e. high temperatures, high humidity, or volatile chemicals).
 - Damage from improper repair by unauthorized ART technicians.
 - Products with altered and/or damaged serial numbers are not entitled to our service.
4. Customers are responsible for shipping costs to transport damaged products to our company or sales office.
5. To ensure the speed and quality of product repair, please download an RMA application form from our company website.

Products Rapid Installation and Self-check

Rapid Installation

Product-driven procedure is the operating system adaptive installation mode. After inserting the disc, you can select the appropriate board type on the pop-up interface, click the button **【driver installation】** ; or select CD-ROM drive in Resource Explorer, locate the product catalog and enter into the APP folder, and implement Setup.exe file. After the installation, pop-up CD-ROM, shut off your computer, insert the PCI card. If it is a USB product, it can be directly inserted into the device. When the system prompts that it finds a new hardware, you do not specify a drive path, the operating system can automatically look up it from the system directory, and then you can complete the installation.

Self-check

At this moment, there should be installation information of the installed device in the Device Manager (when the device does not work, you can check this item.). Open "Start -> Programs -> ART Demonstration Monitoring and Control System -> Corresponding Board -> Advanced Testing Presentation System", the program is a standard testing procedure. Based on the specification of Pin definition, connect the signal acquisition data and test whether AD is normal or not. Connect the input pins to the corresponding output pins and use the testing procedure to test whether the switch is normal or not.

Delete Wrong Installation

When you select the wrong drive, or viruses lead to driver error, you can carry out the following operations: In Resource Explorer, open CD-ROM drive, run Others-> SUPPORT-> PCI.bat procedures, and delete the hardware information that relevant to our boards, and then carry out the process of section I all over again, we can complete the new installation.