

PCI9008 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 PCI9008 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.

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.

- PCI9008 Data Acquisition Board
- ART Disk
 - a) user's manual (pdf)
 - b) drive
 - c) catalog
- Warranty Card

FEATURES

Analog Input

- Converter Type: AD7865
- Input Range: $\pm 10V$ (default), $\pm 5V$ (AD7865-1) or $0\sim 5V$, $0\sim 2.5V$ (AD-7865-2)
- 14-bit resolution
- Sampling Rate: 3Hz~80KHz/ch
 - Note: each channel actual sampling rate = sampling rate
 - Frequency division formula = master frequency / the number of frequency division, the master frequency = 20MHz, 32-bit frequency division, and the number of frequency division from 25 to 6666666.
- Input Channels: 16 synchronous inputs
- Analog Input Mode: differential input
- Channel Switching Mode: 16-channel 4-chip to work independently
- Sample Method: synchronous acquisition
- Data Read Mode: non-empty, half-full inquire, interrupt and DMA mode
- Memory Size: 8K word (point) FIFO
- Memory Flag: full, non-empty, half full
- Clock Source: internal clock and external clock
- The Frequency of the Board Clock: the current actual sampling frequency of the AD
- Trigger Mode: software trigger, hardware trigger (external trigger)
- Trigger Type: level trigger, edge trigger
- Trigger Direction: negative, positive, either positive or negative trigger
- Trigger Source: ATR (analog trigger) and DTR (digital trigger)
- ATR Input Range: $0\sim +10V$
- DTR Input Range: standard TTL level
-

- Auto-calibration
- Programmable Gain: 1, 2, 4, 8 times (AD8251, default) or 1, 2, 5, 10 times (AD8250) or 1, 10, 100, 1000 times (AD8253)
- AD Conversion Time: $\leq 2.4\mu\text{s}$
- Analog Input Impedance: $10\text{M}\Omega$
- System Measurement Accuracy: 0.05%
- Non-linear error: $\pm 1\text{LSB}$ (Maximum)
- Operating Temperature Range: $0^{\circ}\text{C}\sim 50^{\circ}\text{C}$
- Storage Temperature Range: $-20^{\circ}\text{C}\sim 70^{\circ}\text{C}$

Other Features

Board Clock Oscillation: 40MHz

Dimension: 152.1mm (L)* 107.8mm (w)

Chapter 2 Components Layout Diagram and a Brief Description

2.1 The Main Component Layout Diagram



2.2 Signal Input and Output Connector

CN1: signal input and output port

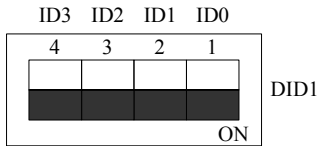
IN: synchronization pulse signal input port

OUT1, OUT2, OUT3: sync pulse signal output port

2.3 Physical ID of DIP Switch

DID1: Set physical ID number. When the PC is installed more than one PCI9008, 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-place 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

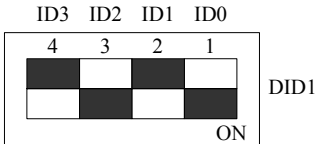
"0." As they are shown in the following diagrams: place "ID3" is the high bit."ID0" is the low bit, and the black part in the diagram represents the location of the switch. (Test software of the company often uses the logic ID management equipments and at this moment the physical ID DIP switch is invalid. If you want to use more than one kind of the equipments in one and the same system at the same time, please use the physical ID as much as possible).



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

2.4 Status indicator

TRIG: trigger status indicator.

PCI: overflow indicator.

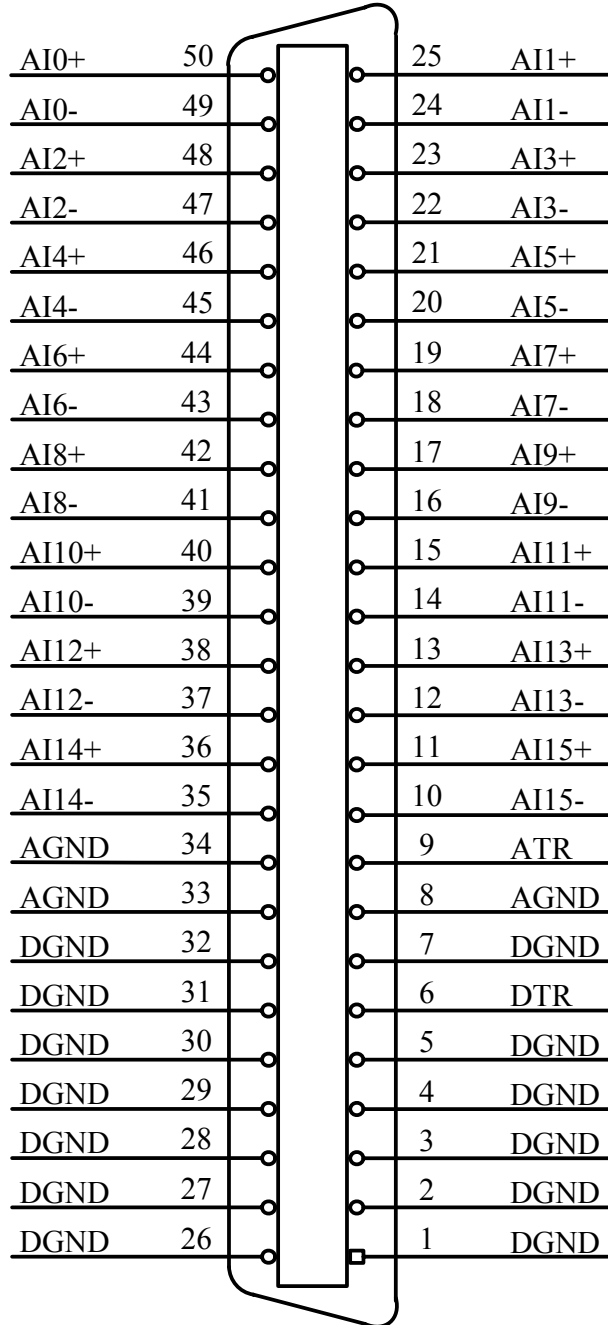
ADC: AD work status indicator.

PWR: power supply indicator.

Chapter 3 Signal Connectors

3.1 The Definition of Signal Input and Output Connectors

CN1: 50-pin D-type definition



Pin definition about AD:

Pin name	Type	Pin function definition
AI0+~AI15+	Input	16-ch analog input positive port.
AI0-~AI15-	Input	16-ch analog input negative port.

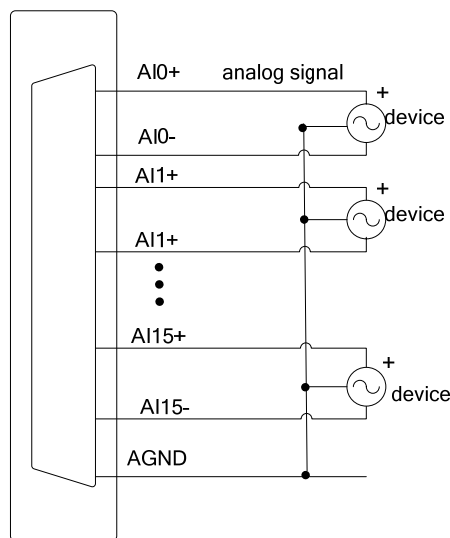
AGND	GND	Analog ground. This AGND pin should be connected to the system's AGND plane.
DGND	GND	Digital ground. Ground reference for Digital circuitry.
ATR	Input	Analog trigger signal input, choose AGND as reference ground.
DTR	Input	Digital trigger signal input, choose DGND as reference ground.

Chapter 4 Connection Ways for Each Signal

4.1 Analog Signal Connection

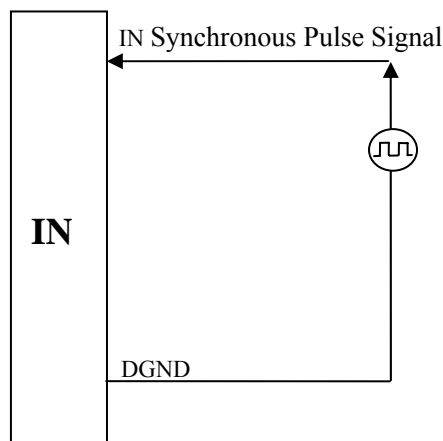
Double-ended input mode, which was also called differential input mode, uses positive and negative channels to input a signal. This mode is mostly used when biggish interference happens and the channel numbers are few.

According to the diagram below, PCI9008board can be connected as analog voltage double-ended input mode, which can effectively suppress common-mode interference signal to improve the accuracy of acquisition. Positive side of the 8-channel analog input signal is connected to AI0+~AI15+, the negative side of the analog input signal is connected to AI0~-AI15-, equipments in industrial sites share the AGND with PCI9008board.

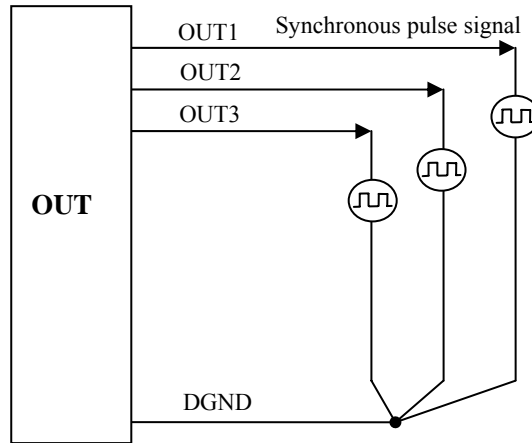


4.2 Synchronous Trigger Pulse Signal Connection

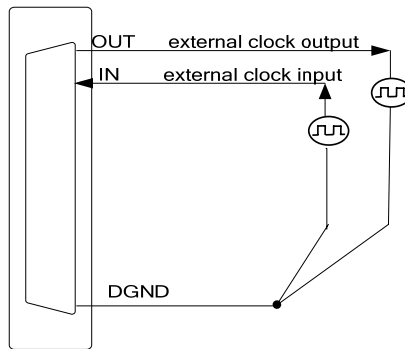
4.2.1 Synchronous Trigger Pulse Signal Input Connection



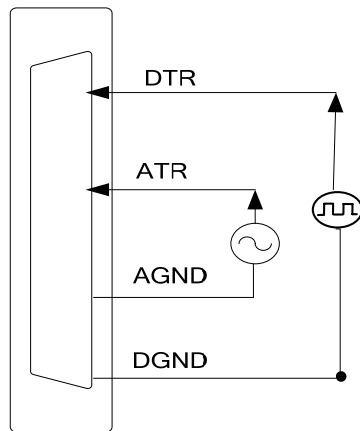
4.2.2 Synchronous Trigger Pulse Signal Output Connection



4.3 Clock Signal Connection



4.4 Trigger Signal Connection

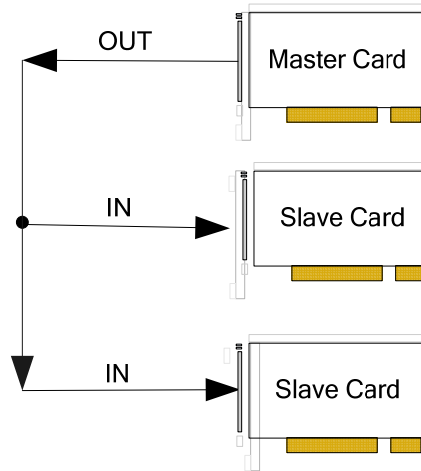


4.5 Multiple-Instrument Synchronization

Three methods can realize the synchronization for the PCI8502, the first method is using the Master-slave card cascade, the second one is using the common external trigger, and the last one is using the common external clock.

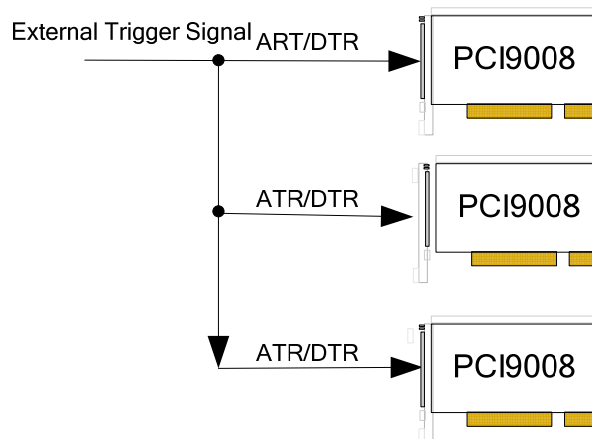
When using master-slave cascade card programs, the master card and slave card use the same TRG signal, general, the master card uses internal clock source, the slave card uses external clock source, after the master card, and slave card are initialized, first, start the all slave cards, because the main card has not been started, so there is no output clock signal, then the slave cards into a wait state until the master card is activated, at this time, all slave cards are started. Then we achieve synchronization data acquisition.

See the following figure:



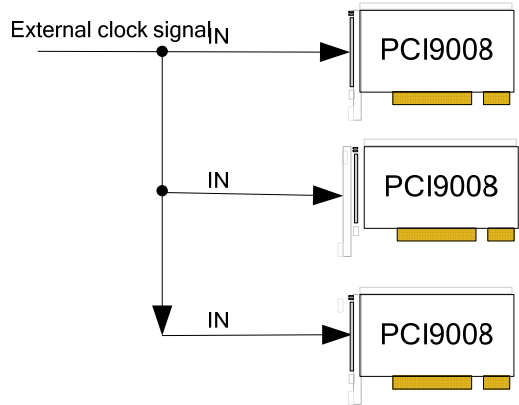
When using the common external trigger, please make sure all parameters of different PCI9008 are the same. At first, configure hardware parameters, and use analog or digital signal triggering (ATR or DTR), then connect the signal that will be sampled by PCI9008, input triggering signal from ART pin or DTR pin, then click “Start Sampling” button, at this time, PCI9008 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 PCI9008 are the same. At first, configure hardware parameters, and use external clock, then connect the signal that will be sampled by PCI9008, then click “Start Sampling” button, at this time, PCI9008 does not sample any signal, but wait for external clock signal. When each module is 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:

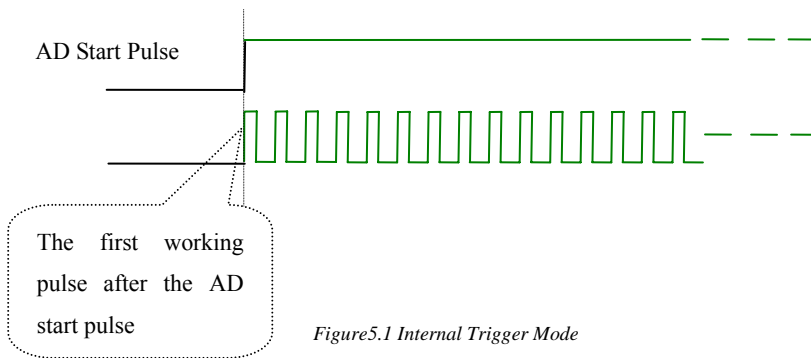


Chapter 5 The Instruction of the AD Trigger Function

5.1 AD Internal Trigger Mode

When AD is in the initialization, if the AD hardware parameter ADPara.TriggerMode = PCI9008_TRIGMODE_SOFT, we can achieve the internal trigger acquisition. In this function, when calling the StartDeviceProAD function, it will generate AD start pulse, AD 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 AD work pulse is decided by the sampling frequency.



5.2 AD External Trigger Mode

When AD is in the initialization, if the AD hardware parameter ADPara.TriggerMode = PCI9008_TRIGMODE_POST, we can achieve the external trigger acquisition. In this function, when calling the StartDeviceProAD function, AD 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).

5.2.1 Signal ATR Trigger

The analog trigger uses a signal (ATR) change within a certain range of the analog signal as trigger source. This signal input by the ATR pin of the CN1. The trigger signal and the analog trigger level enter the comparator at the same time, then they do high-speed comparator to produce the expected result (Result) to trigger the AD to convert (see below). The effective range of the analog trigger source signal is 0~10V.

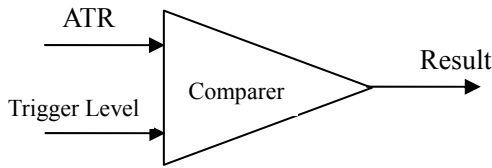


Figure 5.2 Analog compare

When ADPara.TriggerDir = PCI9008_TRIGDIR_NEGATIVE, choose the trigger mode as the falling edge trigger. That is, when the ATR trigger signal is on the falling edge, AD will immediately access to the conversion process, and its follow-up changes have no effect on AD acquisition.

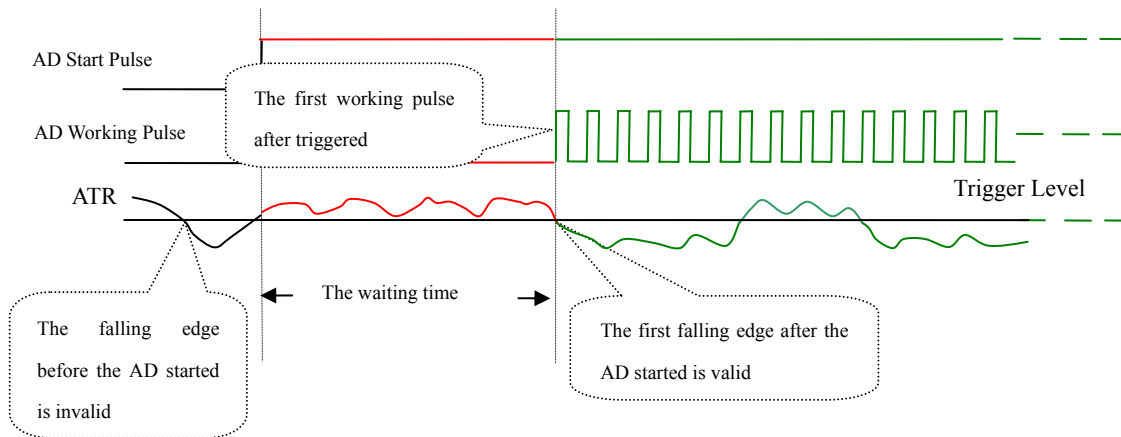


Figure 5.3 Falling edge Trigger

When ADPara.TriggerDir = PCI9008_TRIGDIR_POSITIVE, choose the trigger mode as rising edge trigger. That is, when the ATR trigger signal is on the rising edge, AD will immediately access to the conversion process, and its follow-up changes have no effect on AD acquisition.

When ADPara.TriggerDir = PCI9008_TRIGDIR_POSIT_NEGAT, choose the trigger mode as rising or falling edge trigger. That is, when the ATR trigger signal is on the rising or falling edge, AD will immediately access to the conversion process, and its follow-up changes have no effect on AD acquisition. This function can be used in the case that the acquisition will occur if the exoteric signal changes.

5.2.2 DTR Trigger

When ADPara.TriggerDir = PCI9008_TRIGDIR_NEGATIVE, choose the trigger mode as the falling edge trigger. That is, when the DTR trigger signal is on the falling edge, AD will immediately access to the conversion process, and its follow-up changes have no effect on AD acquisition.

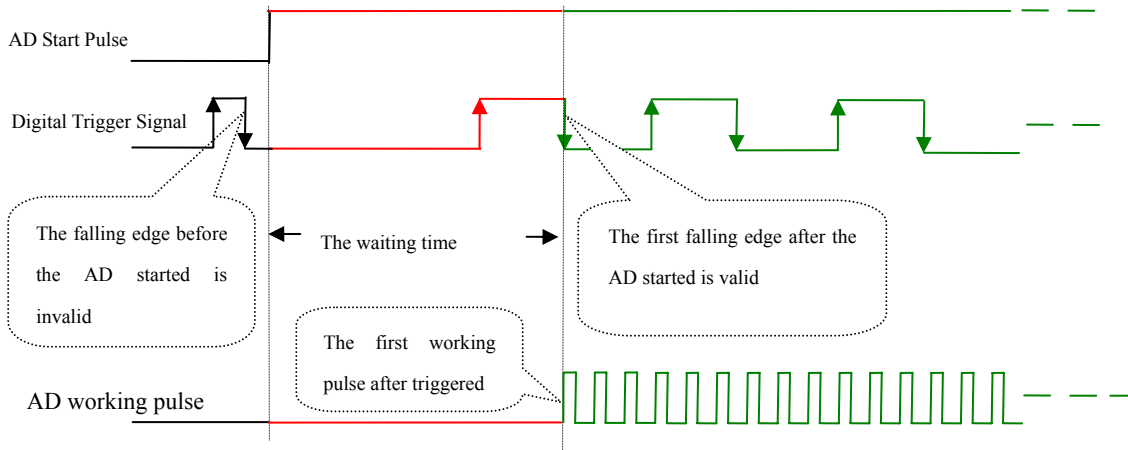


Figure5.4 Falling edge Trigger

When `ADPara.TriggerDir = PCI9008_TRIGDIR_POSITIVE`, choose the trigger mode as rising edge trigger. That is, when the DTR trigger signal is on the rising edge, AD will immediately access to the conversion process, and its follow-up changes have no effect on AD acquisition.

When `ADPara.TriggerDir = PCI9008_TRIGDIR_POSIT_NEGAT`, choose the trigger mode as rising or falling edge trigger. That is, when the DTR trigger signal is on the rising or falling edge, AD will immediately access to the conversion process, and its follow-up changes have no effect on AD acquisition. This function can be used in the case that the acquisition will occur if the exoteric signal changes.

Chapter 6 Methods of using AD Internal and External Clock Function

6.1 Internal Clock Function of AD

Internal Clock Function refers to the clock signals which are produced by on-board clock oscillator through logic control circuit according to user-specified sub-frequency to trigger the AD conversion regularly. To use the clock function, the hardware parameters `ADPara.ClockSource = PCI9008_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 AD work frequency is 100000Hz (that is, 100 KHz, 10 us/point).

6.2 External Clock Function of AD

External Clock Function refers to the use of the external clock signals to trigger the AD conversion regularly. The clock signals are provide by the IN pin. The external clock can be provided by clock frequency generators and so on. To use the external clock function, the hardware parameters `ADPara.ClockSource = PCI9008_CLOCKSRC_OUT` should be set in the software. In continuous acquisition mode, the frequency of the AD converter is the external clock frequency.

Chapter 7 Notes, Calibration and Warranty Policy

7.1 Notes

In our products' packing, user can find a user manual, a PCI9008 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 PCI9008, in order to prevent the IC (chip) from electrostatic harm, please do not touch IC (chip) in the front panel of PCI9008 module.

7.2 Auto-calibration

By using the auto-calibration feature of the PCI9008, the calibration software can measure and correct almost all the calibration errors without any external signal connections, reference voltages, or measurement de-vices.

Automatic calibration is complete, the calibration constants are stored in EEPROM. The default calibration constants are stored in fixed storage area.

Time and temperature will affect the error, so when install PCI9008 in the new environment, we should recalibrate it.

NOTE:

1. Before auto-calibration procedure starts, it is recommended to warn up the card for at least 15 minutes.
2. Please remove the cable before an auto-calibration procedure is initiated because the calibration factor outputs would be changed in the process of the calibration.

7.3 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.