PCI8018
User's Manual

Beijing ART Technology Development Co., Ltd.

Contents

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 PCI8018 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.

➢ PCI8018 Data Acquisition Board
➢ ART Disk
   a) user's manual (pdf)
   b) drive
   c) catalog
➢ Warranty Card

FEATURES

Analog Input

➢ Converter Type: AD7865
➢ Input Range: ±10V (AD7865-1), 0~5V, 0~2.5V (AD7865-2)
➢ 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: 16 differential inputs, 16 single-ended inputs
➢ Data Read Mode: non-empty, half-full, interrupt and DMA mode
➢ FIFO Size: 8K word
➢ Memory Signs: full, non-empty and half-full
➢ Clock Source: external clock, internal clock (software-configurable)
➢ Board Clock Output Frequency: the real sampling frequency of the current AD
➢ Trigger Mode: software trigger, hardware trigger (external trigger)
➢ Trigger Type: level trigger, edge trigger
➢ Trigger Direction: negative, positive, positive and negative trigger
➢ Trigger Source: ATR, DTR
➢ Analog Trigger Source (ATR)Input Range: 0~10V
➢ Trigger Source DTR Input Range: standard TTL level
➢ 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: ≤2.45μs
➢ Analog Input Impedance: 10MΩ

➢   System Measurement Accuracy: 0.05%

➢   Non-linear error: ±1LSB

➢   Operating Temperature Range: 0℃~50℃

➢   Storage Temperature Range: -20℃~70℃

Board Clock Oscillation: 40MHz

Chapter 2 Components Layout Diagram and a Brief Description

2.1 The Main Component Layout Diagram
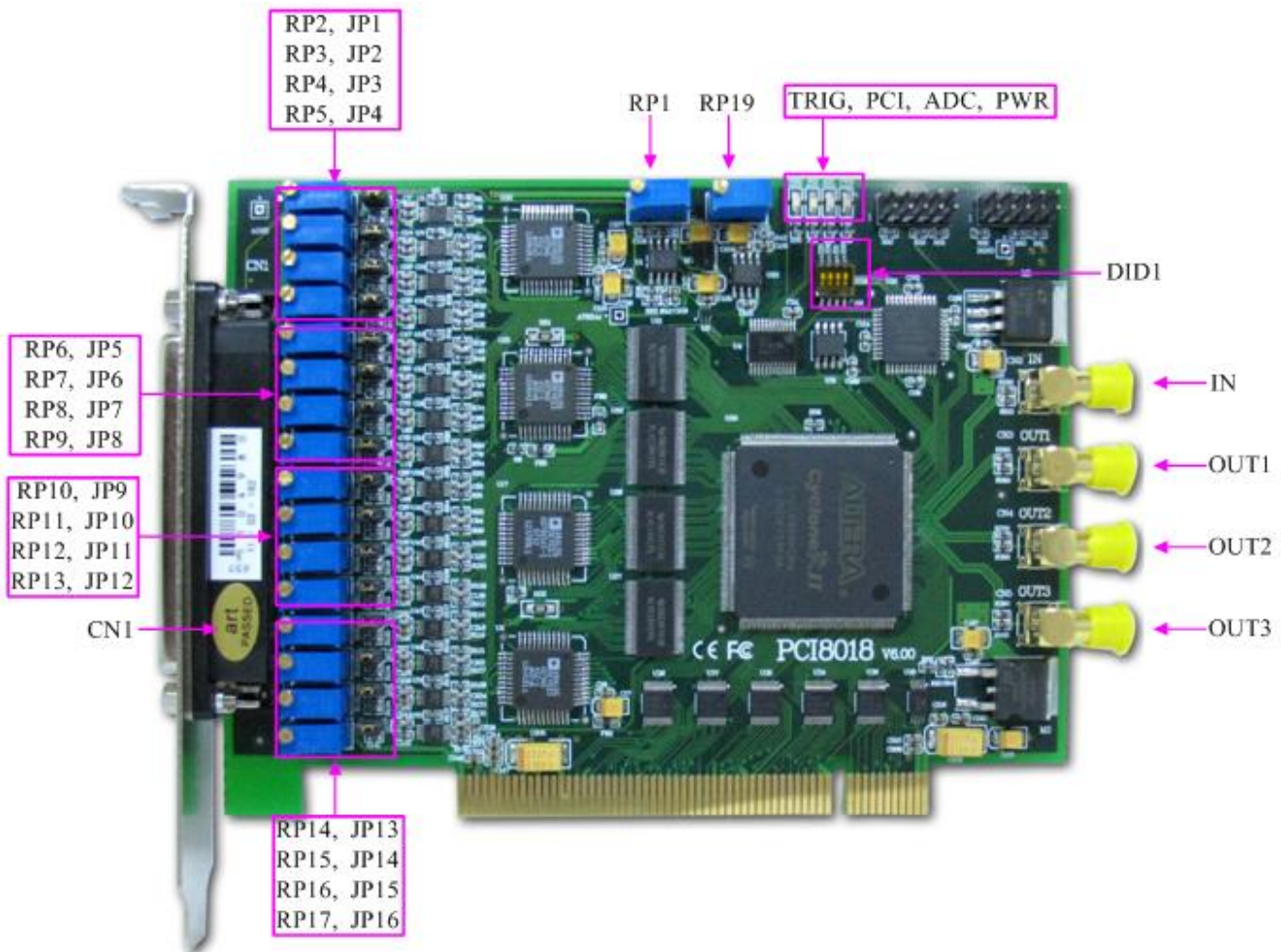
2.2 The Function Description for the Main Component

2.2.1 Signal Input and Output Connectors

CN1: signal connector

IN: sync pulse signal input

OUT1, OUT2, OUT3: sync pulse signal output, clock output ports

2.2.2 Potentiometer

RP1: ATR trigger signal zero-point adjustment potentiometer

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

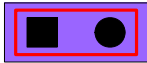RP6, RP7, RP8, RP9: AI4 ~ AI7 analog input zero-adjustment potentiometer

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

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

RP19: AD analog input full-scale adjustment potentiometer

2.2.3 Jumper

JP1, JP2, JP3, JP4: AI0 ~ AI3 single-ended and differential selection

JP5, JP6, JP7, JP8: AI4 ~ AI7 single-ended and differential selection

JP9, JP10, JP11, JP12: AI8 ~ AI11 single-ended and differential selection

JP13, JP14, JP15, JP16: AI0 ~ AI3 single-ended and differential selection

2.2.4 Jumper Setting

Analog signal single-ended and differential selection as follows: (the same for each channel)

Input Mode	JP1~JP16
Single-ended	
Differential	

2.2.5 Physical ID of DIP Switch

DID1: Set physical ID number. When the PC is installed more than one PCI8018 , 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 softwares of the company often use 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.
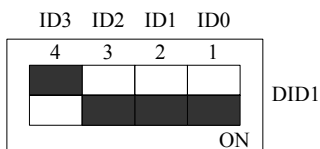
The above chart shows"0111", so it means that the physical ID is 7.
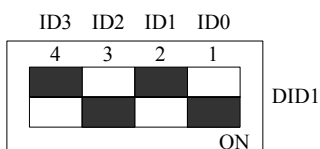
The above chart shows"0101", so it means that the physical ID is 5.

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

2.2.6 Status Indicator

TRIG: trigger status indicator

PCI: overflow status indicator

ADC: AD working status indicator

PWR: power indicator

Chapter 3 Signal Connectors

3.1 Signal Connector

CN1: 37-pin D-type

Pin		Pin
AI0−	37 / 19	AI0+
AI1−	36 / 18	AI1+
AI2−	35 / 17	AI2+
AI3−	34 / 16	AI3+
AI4−	33 / 15	AI4+
AI5−	32 / 14	AI5+
AI6−	31 / 13	AI6+
AI7−	30 / 12	AI7+
AI8−	29 / 11	AI8+
AI9−	28 / 10	AI9+
AI10−	27 / 9	AI10+
AI11−	26 / 8	AI11+
AI12−	25 / 7	AI12+
AI13−	24 / 6	AI13+
AI14−	23 / 5	AI14+
AI15−	22 / 4	AI15+
AGND	21 / 3	ATR
DGND	20 / 2	AGND
	1	DTR
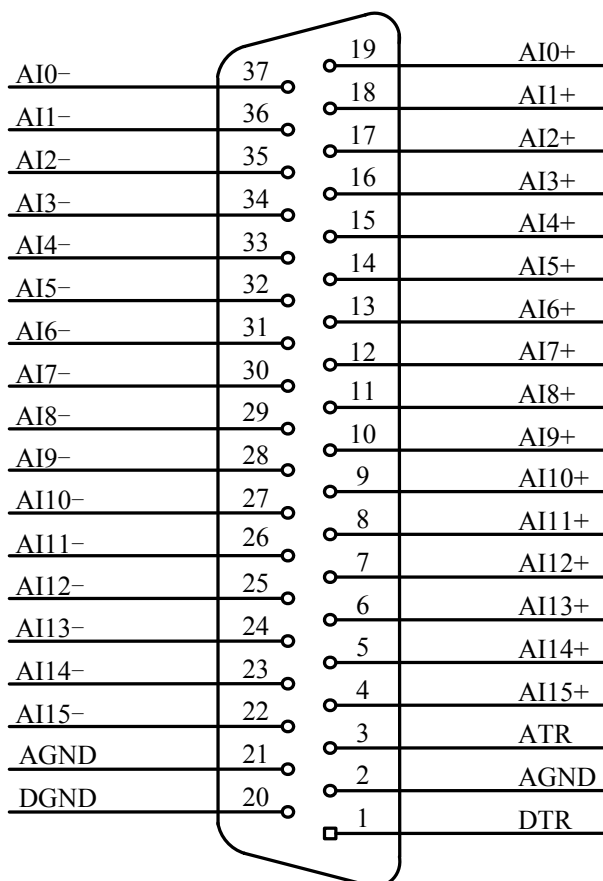
Pin name	Type	Pin function definition
AI0+～AI15+	Input	Analog input (positive)
AI0-～AI15-	Input	Analog input (negative)
AGND	GND	Analog signal ground
DGND	GND	Digital signal ground
ATR	Input	Analog trigger signal input
DTR	Input	Digital trigger signal input

Chapter 4 Connection Ways for Each Signal

## 4.1 Single-ended Input Connection

Single-ended mode can achieve a signal input by one channel, and several signals use the common reference ground. This mode is widely applied in occasions of the small interference and relatively many channels.
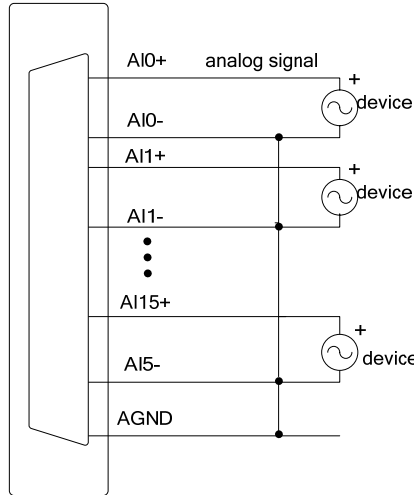
4.2 Analog Signal Connection

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, PCI8018 board 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 PCI8018 board.
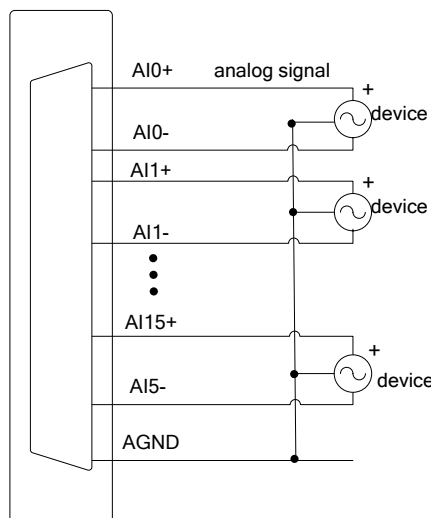
4.3 Synchronous Trigger Pulse Signal Input Connection

NI sync pulse signal input

DGND
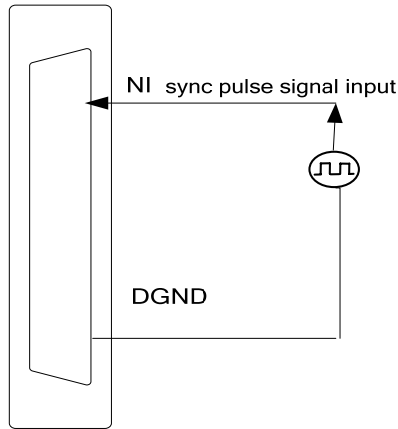
4.4 Synchronous Trigger Pulse Signal Output Connection

OUT1   sync pulse signal input

OUT2

OUT3

DGND
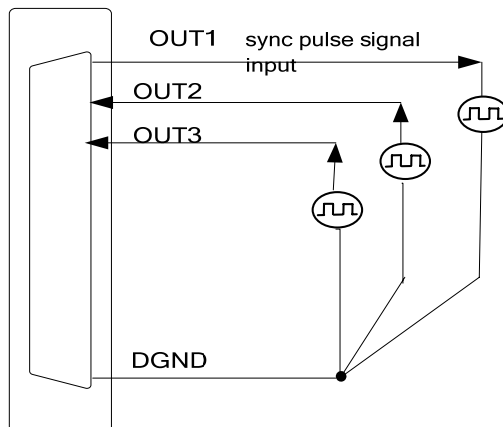
4.5 Clock Input and Output Signal Connection

OUT external clock output

IN external clock input

DGND
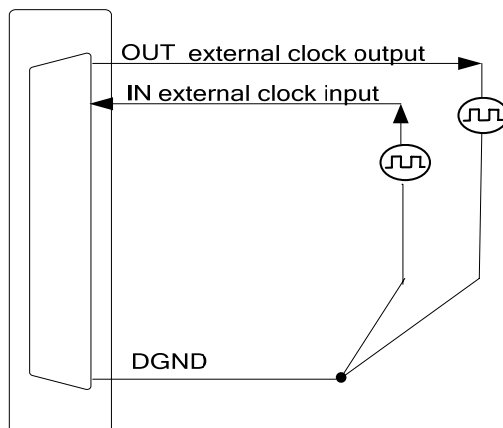
4.4 Trigger Signal Connection

4.5 Methods of Realizing the Multi-card Synchronization

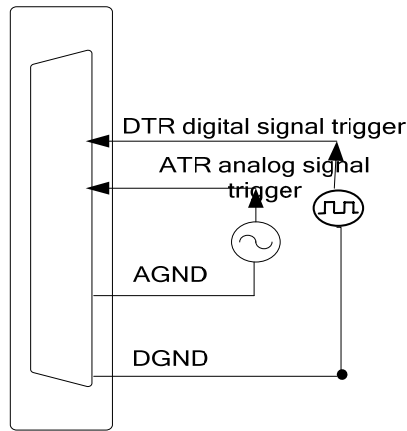Three methods can realize the synchronization for the PCI8018, the first method is using the cascade master-slave card, the second one is using the common external trigger, and the last one is using the common external clock.

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.
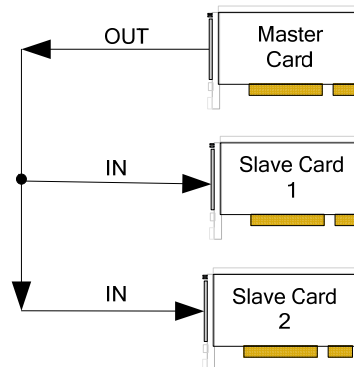
When using the common external trigger, please make sure all parameters of different PCI8018 are the same. At first, configure hardware parameters, and use analog or digital signal triggering (ATR or DTR), then connect the signal that will be sampled by PCI8018, input triggering signal from ART pin or DTR pin, then click "Start Sampling" button, at this time, PCI8018 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:
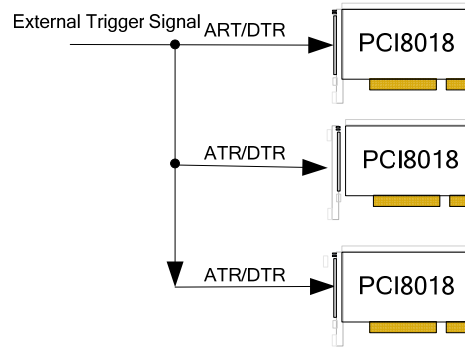
When using the common external clock trigger, please make sure all parameters of different PCI8018 are the same. At first, configure hardware parameters, and use external clock, then connect the signal that will be sampled by PCI8018, , then click "Start Sampling" button, at this time, PCI8018 does not 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:
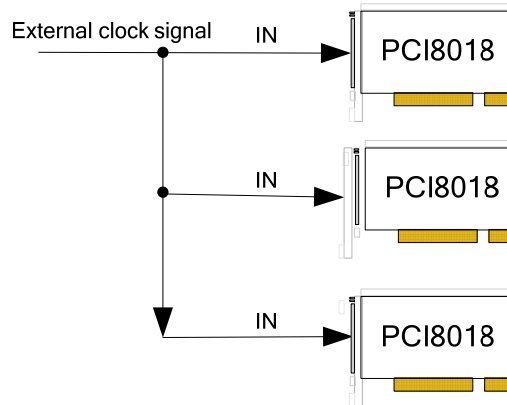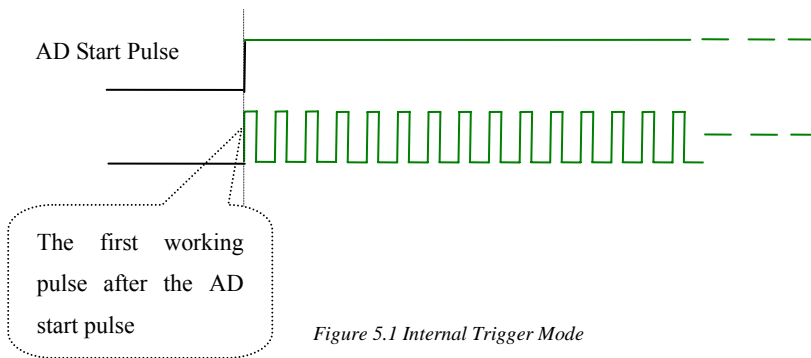
Chapter 5 The Instruction of the AD Trigger Function

5.1 AD Internal Trigger Mode

When AD is in the initialization, if the AD hardware parameter ADPara.TriggerMode = PCI8018_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.

AD Start Pulse

The first working pulse after the AD start pulse

Figure 5.1 Internal Trigger Mode

5.2 AD External Trigger Mode

When AD is in the initialization, if the AD hardware parameter ADPara.TriggerMode = PCI8018_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 ATR Trigger

When the trigger signal is the analog signal, using the ATR trigger source. Trigger level needs to be set when using the ATR trigger source, trigger level is 0V~+10V. There are two trigger types: edge trigger and level trigger
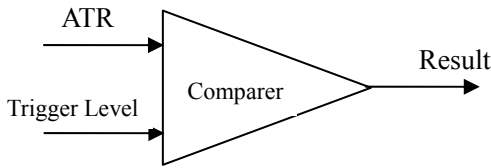
Figure 5.2 Analog compare

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 AD conversion. When TriggerType=PCI8018_TRIGTYPE_EDGE, it is the edge trigger type.

When ADPara.TriggerDir = PCI8018_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.
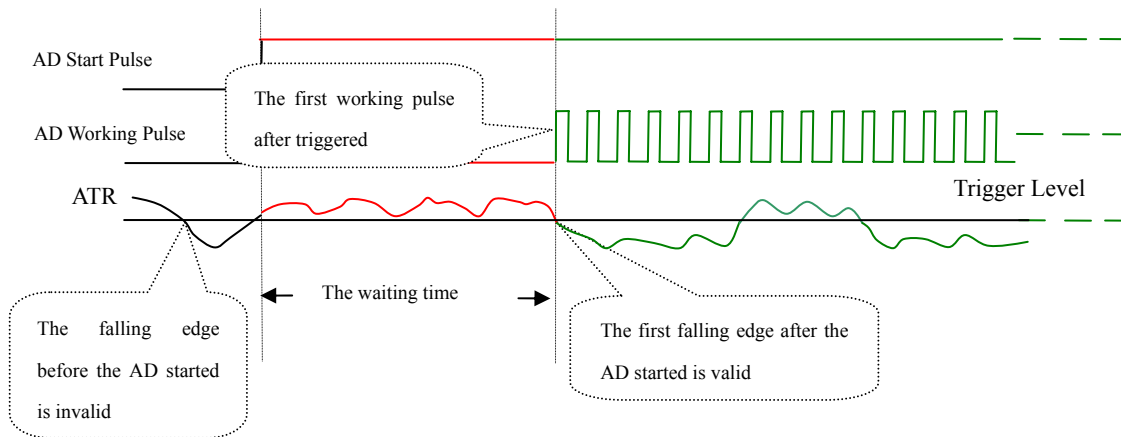

Figure 5.3   Falling edge Trigger

When ADPara.TriggerDir = PCI8018_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 = PCI8018_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.

（2）Triggering level function

Level trigger is to capture the condition that trigger signal is higher or lower than the trigger level to trigger AD conversion. When ADPara.TriggerType = PCI8018_TRIGTYPE_PULSE, it is level trigger type.

When ADPara.TriggerDir = PCI8018_TRIGDIR_NEGATIVE, AD is in the conversion process if the ATR is lower than the trigger level. And AD conversion will automatically stop if the ATR is higher than the trigger level. AD's work status changes with changes of ATR.
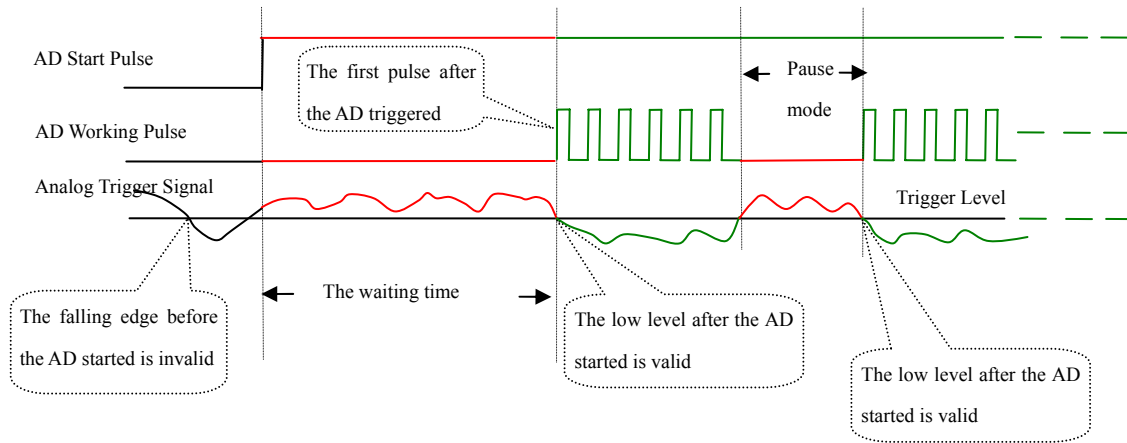
Figure 5.4 Low Level Trigger

When ADPara.TriggerDir = PCI8018_TRIGDIR_POSITIVE, AD is in the conversion process if the ATR is higher than the trigger level. And AD conversion will automatically stop if the ATR is lower than the trigger level. AD's work status changes with changes of ATR.

When ADPara.TriggerDir = PCI8018_TRIGDIR_POSIT_NEGAT, it means the trigger level is low. The effect is the same as the internal software trigger.

5.2.2 DTR Trigger

When the trigger signal is the digital signal (standard TTL-level), using the DTR trigger source.

(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 AD conversion.

When ADPara.TriggerDir = PCI8018_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.
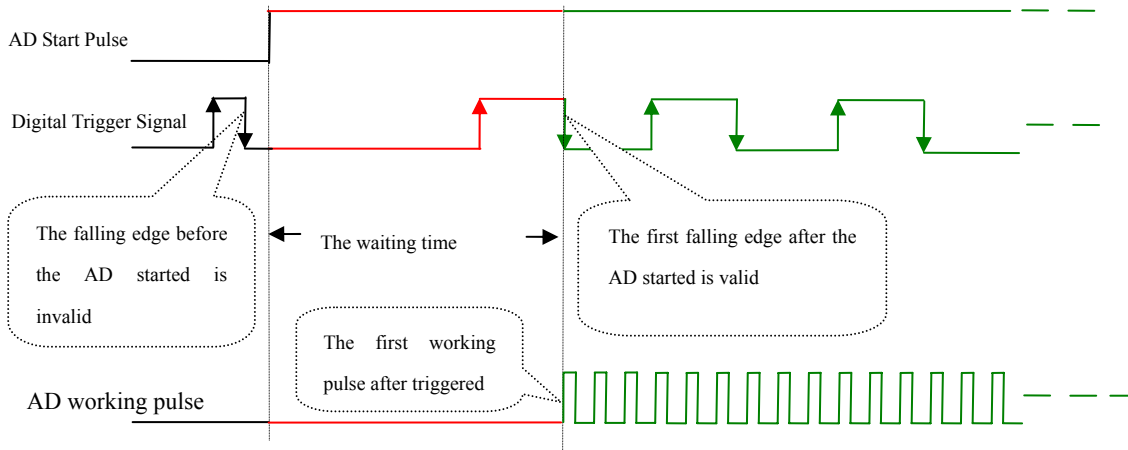
Figure 5.5 Falling edge Trigger

When ADPara.TriggerDir = PCI8018_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 = PCI8018_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.

（2）**Triggering level function**

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

When ADPara.TriggerDir = PCI8018_TRIGDIR_NEGATIVE, it means the trigger level is low. When DTR trigger signal is in low level, AD is in the conversion process, once the trigger signal is in the high level, AD conversion will automatically stop, when the trigger signal is in the low level again, AD will re-access to the conversion process, that is, only converting the data when the trigger signal is in the low level.

Figure 5.6 High Level Trigger

When ADPara.TriggerDir = PCI8018_TRIGDIR_POSITIVE, it means the trigger level is high. When DTR trigger signal is in high level, AD is in the conversion process, once the trigger signal is in the low level, AD conversion will automatically stop, when the trigger signal is in the high level again, AD will re-access to the conversion process, that is, only converting the data when the trigger signal is in the high level.
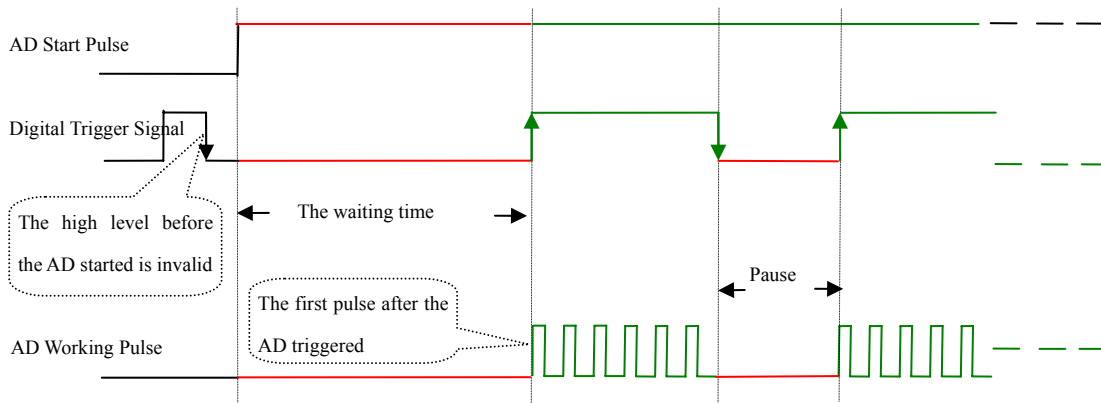
When ADPara.TriggerDir = PCI8018_TRIGDIR_POSIT_NEGAT, it means the trigger level is low or high. The effect is the same as the internal software trigger.

Chapter 6 Methods of using AD Internal and External Clock Function

6.1 Internal Clock Function of AD

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 = PCI8018 _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 outside clock signals to trigger the AD conversion regularly. The clock signals is provide by the IN pin.   The outside clock can be provided by other equipments, for example clock frequency generators.   To   use   the   external   clock   function,   the   hardware   parameters   ADPara.ClockSource   = PCI8018_CLOCKSRC_OUT should be installed in the software.

Chapter 7 Notes, Calibration and Warranty Policy

7.1 Notes

In our products' packing, user can find a user manual, a PCI8018 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 PCI8018, in order to prevent the IC (chip) from electrostatic harm, please do not touch IC (chip) in the front panel of PCI8018 module.

7.2 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. PCI8018 default input range: ±5V, in the manual, we introduce how to calibrate PCI8018 in ±10V, calibrations of other input ranges are similar.

Prepare a digital voltage instrument which the resolution is more than 5.5 bit, install the PCI8018 module, and then power on, warm-up for fifteen minutes.

1) Zero adjustment: select one channel of analog inputs, take the channel AI0 for example, connect 0V to AI0, and then run ART Data Acquisition Measurement Suite in the WINDOWS. Choose channel 0, ±10V input range and start sampling, adjust potentiometer RP2 in order to make voltage value is 0.000V or about 0.000V. Zero adjustment of other channels is alike.

2) Full-scale adjustment: select one channel of analog inputs, take the channel AI0 for example, connect 9998.77mV to AI0, and then run ART Data Acquisition Measurement Suite in the WINDOWS. Choose channel 0, ±10V input range and start sampling, adjust potentiometer RP19 in order to make voltage value is 9998.77mV or about 9998.77mV. Full-scale adjustment of other channels is alike.

3) Trigger Level Calibration: when use trigger functions, the user can set the trigger level from 0 to 10V, by adjusting the potentiometer RP1 to adjust the zero-point.

4) Repeat steps above until meet the requirement.

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.