PXI8009
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 PXI8009 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.

PXI8009 is data acquisition card which is based on fiber-optic communication, and with the use of our product PXI8009, it can transmit data through the optical interface.

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 rebitment. 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.

- PXI8009 Data Acquisition Board
- ART Disk
  a) user's manual (pdf)
  b) drive
  c) catalog
- Warranty Card

FEATURES

Analog Input

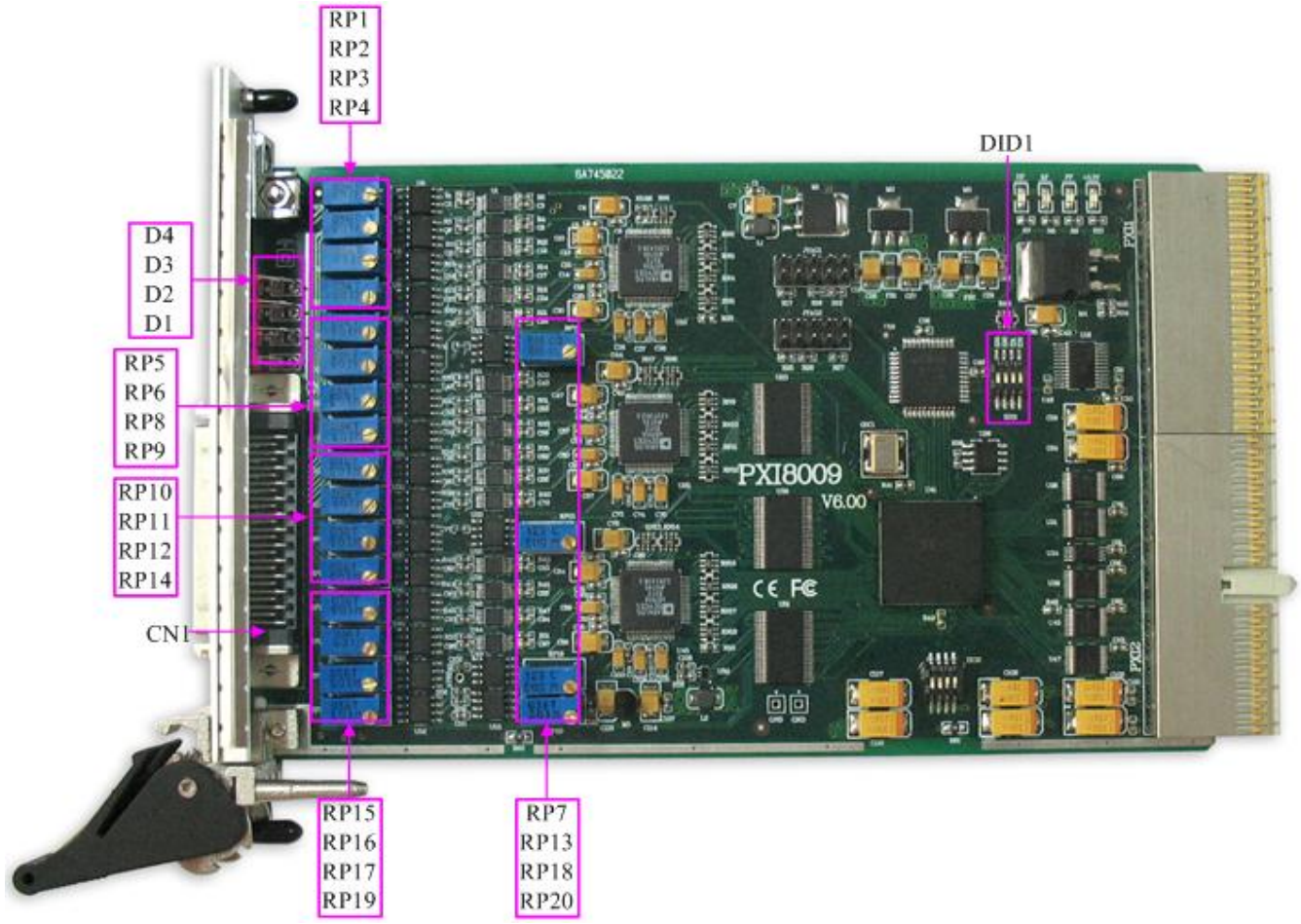
- Converter Type: AD7656 (3 chips)
- Input Range: ±10V, ±5V
- 16-bit resolution
- Sampling Rate: 1Hz~250KHz
- Input Channels: 12
- Analog Input Mode: differential input and single-ended
- Acquisition Mode: 16-ch synchronous acquisition
- Data Read Mode: non-empty, half-full mode, and overflow mode
- FIFO Size: 8K word
- Memory Signs: full, non-empty and half-full
- On-board Clock Output frequency: the current real sampling frequency of AD
- Clock Source: external clock, TRIG0, TRIG1, TRIG7
- Trigger Source: ATR (analog trigger), DTR (digital trigger)
- Trigger Mode: software trigger, hardware trigger (external trigger)
- Trigger Type: level trigger, edge trigger
- Trigger Direction: negative, positive, positive and negative trigger
- Analog Trigger Source (ATR)Input Range: ±10V
- Trigger Source DTR Input Range: standard TTL level
- Trigger Level: 0~10V
- Programmable Gain: 1,2,4,8 times (AD8251) or 1,2,5,10-fold (AD8250) or 1,10,100,1000 times (AD8253)

- AD Conversion Time: ≤3μs
- Analog Input Impedance: 10MΩ
- Amplifier Set-up Time: 3.1μs (max)
- Non-linear error: ±1LSB
- System Measurement Accuracy: 0.01%
- Operating Temperature Range: 0℃~55℃
- 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: analog input connector
PXI1, PXI2: PXI port

2.2.2 Potentiometer

RP1, RP2, RP3, RP4: AI0 ~ AI3 analog input zero-point adjustment
RP5, RP6, RP8, RP9: AI4 ~ AI7 analog input zero-point adjustment
RP10, RP11, RP12, RP14: AI8 ~ AI11 analog input zero-point adjustment
RP15, RP16, RP17, RP19: AI12 ~ AI15 analog input zero-point adjustment
RP7: AI0 ~ AI5 analog input full-scale adjustment

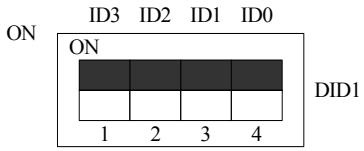
RP13: AI6 ~ AI11 analog input full-scale adjustment
RP18: AI12 ~ AI15 analog input full-scale adjustment
RP20: ATR trigger level full-scale adjustment

2.2.3 Status Indicator

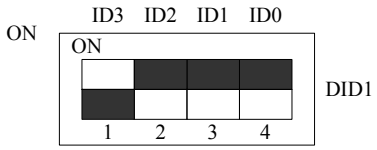
D4 (ADC): AD enable indicator
D3 (PXI): overflow indicator
D2 (TRIG): trigger indicator
D1 (PWR): power indicator
+3.3 V: 3.3V power indicator, on for normal
FF: FIFO overflow status indicator
HF: FIFO half-full status indicator
EF: FIFO non-empty status indicator

2.2.3 Physical ID of DIP Switch

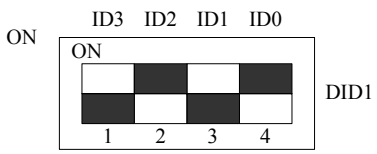
DID1: Set physical ID number. When the PC is installed more than one PXI8009 , you can use the DIP switch to set a physical ID number for each board, which makes it very convenient for users to distinguish and visit each board in the progress of the hardware configuration and software programming. The 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: bit "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.

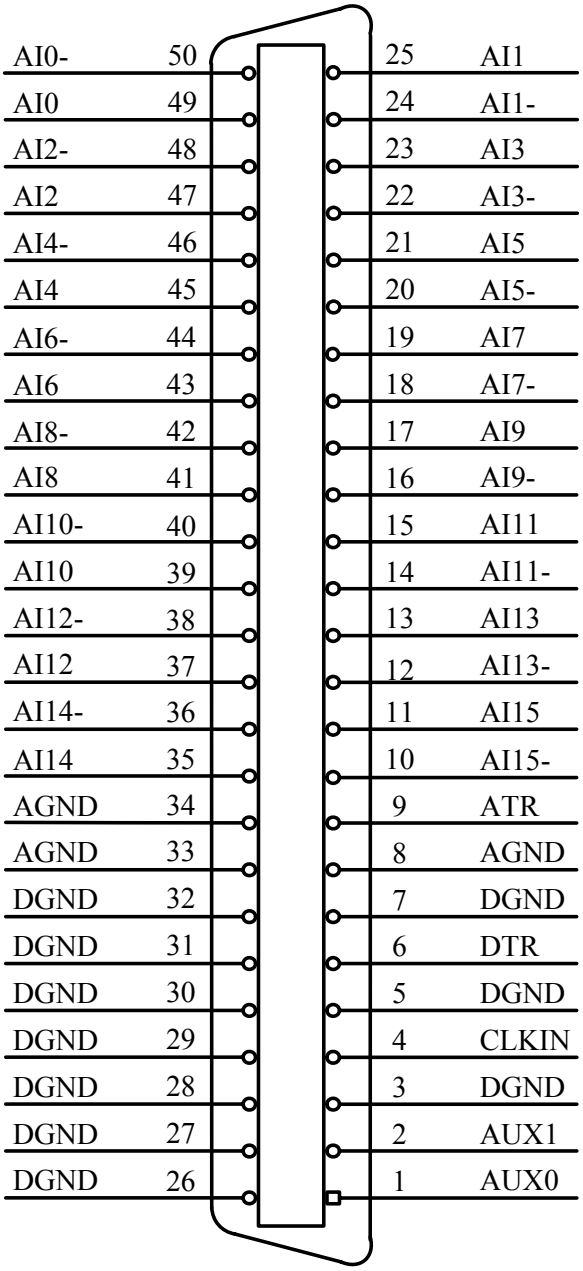


The above chart shows"0101", so it means that the physical ID is 5.

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

Chapter 3 Signal Connectors

CN1: 50-pin SCSI

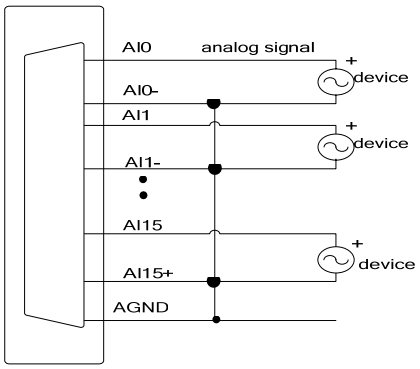


Pin name	Type	Pin function definition
AI0～AI15	Input	Analog input (positive)
AI0-～AI15-	Input	Analog input (negative)
AGND	GND	Analog signal ground
DGND	GND	Digital signal ground
CLKIN	Input	NC
ATR	Input	Analog trigger.
DTR	Input	Digital trigger.
AUX0		NC
AUX1		NC

Chapter 4 Analog Signal Connection

4.1 Single-ended Input Connection

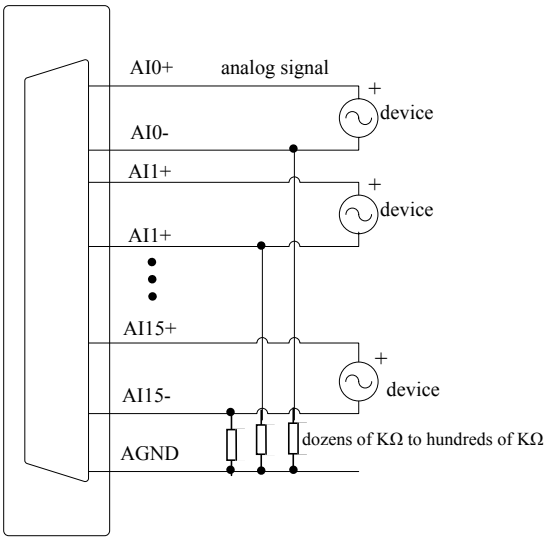
Single-ended mode can achieve a signal input by one channel, and several signals use the common reference ground. This mode is widely applied in occasions of the small interference and relatively many channels.



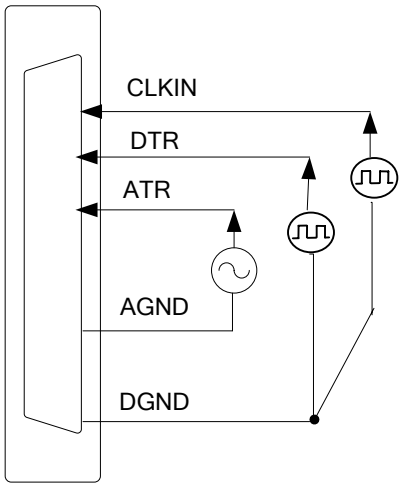
4.2 Differential Input Connection

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. Single-ended/double-ended mode can be set by the software, please refer to PXI8009 software manual.

According to the diagram below, PXI8009 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 16-channel analog input signal is connected to AI+~AI15+, the negative side of the analog input signal is connected to AI0-~AI15-, equipments in industrial sites share the AGND with PXI8009 board.



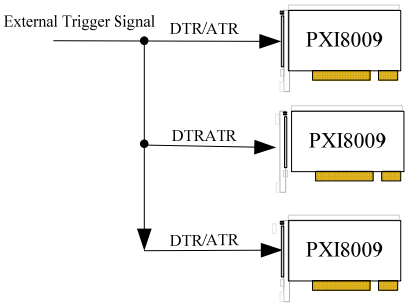
4.3 Clock and Trigger Signal Connection



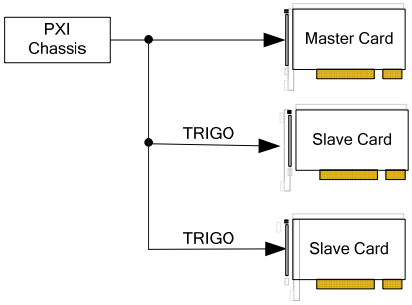
4.4 Methods of Realizing the Multi-card Synchronization

Three methods can realize the synchronization for the PXI8009, the first method is using the cascade master-slave card; the second one is using the common external trigger.

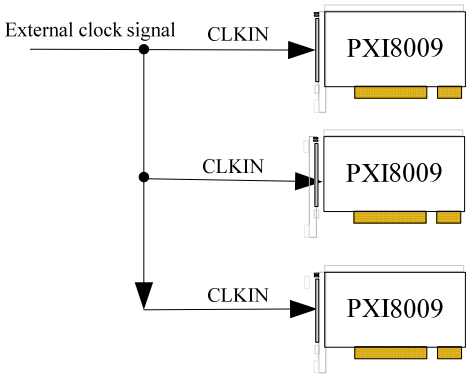
When using the common external trigger, please make sure all parameters of different PXI8009 are the same. At first, configure hardware parameters, and use analog or digital signal triggering (ATR or DTR), then connect the signal that will be sampled by PXI8009, input triggering signal from ART or DTR pin, then click “Start Sampling” button, at this time, PXI8009 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 master-slave cascade card programs, the master card generally uses the “software trigger”, the trigger source is “TRIG0” or “TRIG1”or “TRIG7”, select “allow trigger signal output” mode, while the slave card uses the “external trigger” mode, the trigger source, trigger type and trigger direction are the same as the master card. 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 trigger signal output, 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 clock trigger, please make sure all parameters of different PXI8009 are the same. At first, configure hardware parameters, and use external clock, then connect the signal that will be sampled by PXI8009, input trigger signal from ART pin or DTR pin, then click “Start Sampling” button, at this time, PXI8009 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 Trigger Function

5.1 Internal Trigger Mode

When A/D is in the initialization, if the A/D hardware parameter ADPara.TriggerMode = PXI8009_TRIGMODE_SOFT, we can achieve the internal trigger acquisition. In this function, when calling the StartDeviceProAD function, it will generate A/D start pulse, A/D 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 A/D work pulse is decided by the sampling frequency.

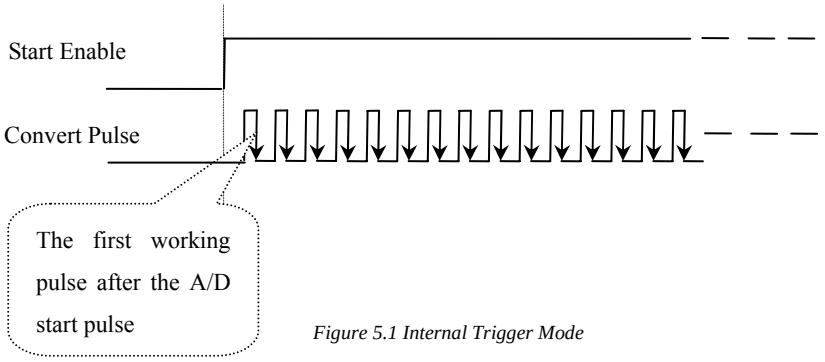


Figure 5.1 Internal Trigger Mode

5.2 External Trigger Mode

When A/D is in the initialization, if the A/D hardware parameter ADPara.TriggerMode = PXI8009_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)

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 -10V~+10V. There are two trigger types: edge trigger and level trigger

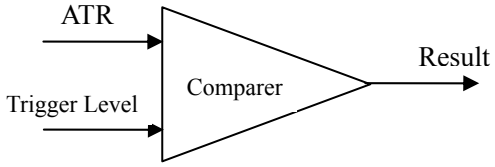


Figure 5.2 Analog compare

The trigger modes include the edge trigger and level trigger.

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= PXI8009_TRIGTYPE_EDGE, it is the edge trigger type.

When ADPara.TriggerDir = PXI8009_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.

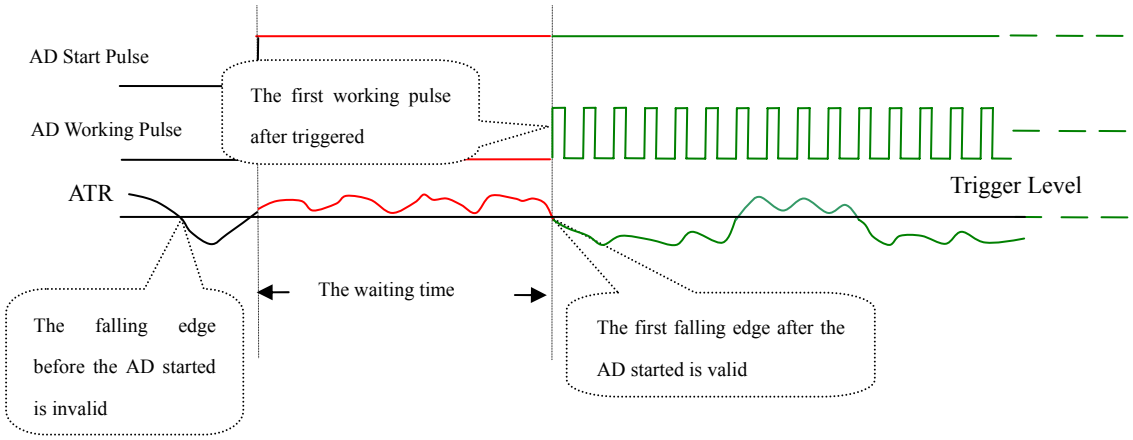


Figure 5.3 Falling edge Trigger

When ADPara.TriggerDir = PXI8009_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 = PXI8009_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.

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 = PXI8009_TRIGTYPE_PULSE, it is level trigger type.

When ADPara.TriggerDir = PXI8009_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.

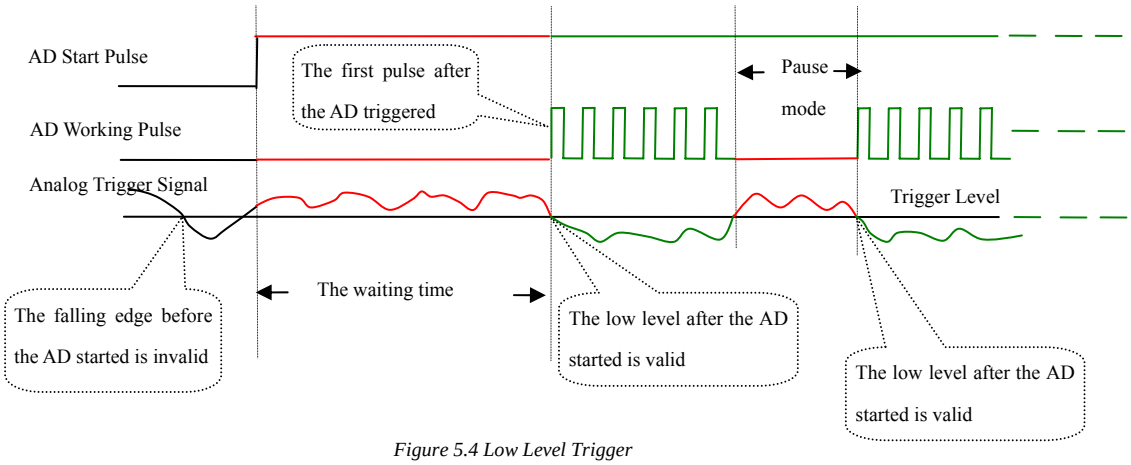


Figure 5.4 Low Level Trigger

When ADPara.TriggerDir = PXI8009_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 = PXI8009_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.

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 = PXI8009_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.

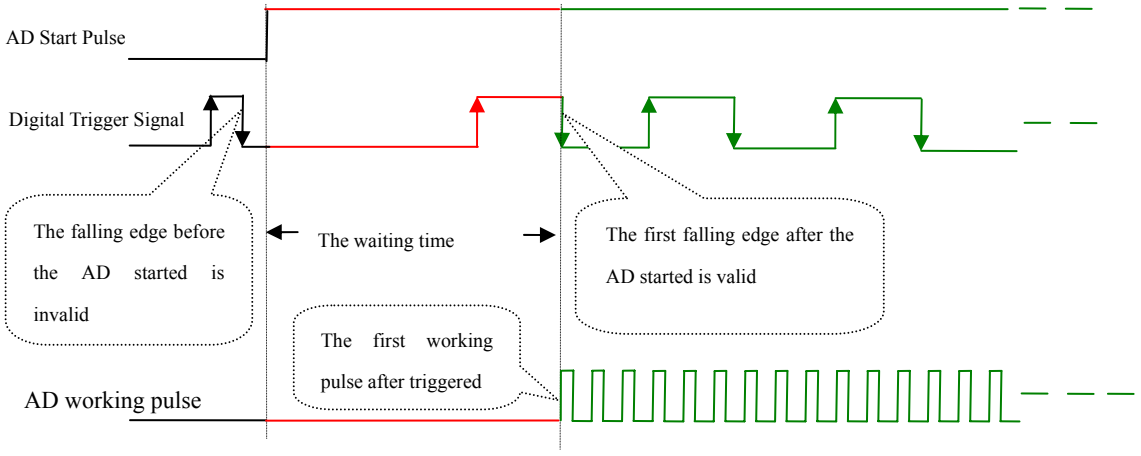


Figure 5.5 Falling edge Trigger

When ADPara.TriggerDir = PXI8009_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 = PXI8009_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.

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 = PXI8009_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.

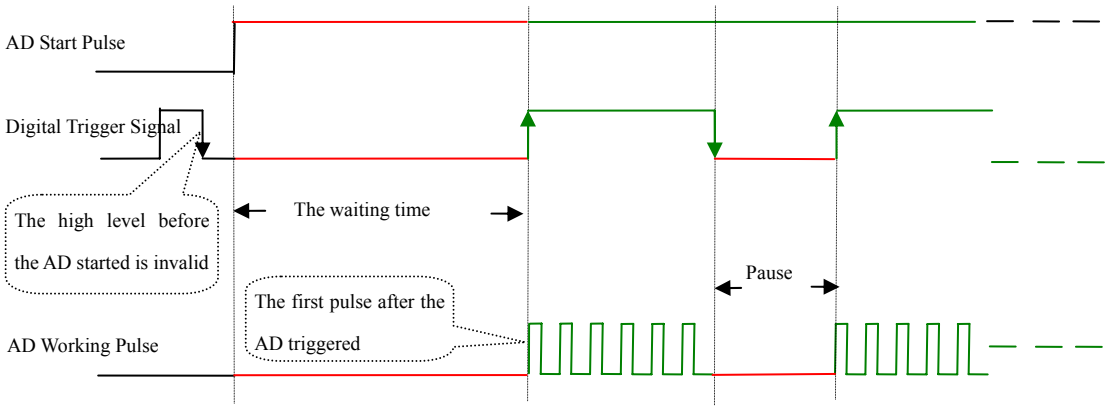


Figure 5.6 High Level Trigger

When ADPara.TriggerDir = PXI8009_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 = PXI8009_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 Internal and External Clock Function

6.1 Internal Clock Function

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 A/D conversion regularly. To use the clock function, the hardware parameters ADPara.ClockSource = PXI8009_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, 10μs /point).

6.2 External Clock Function

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 CLKIN pin of the CN1 connector. The outside clock can be provided by clock frequency generator, as well as other equipments. To use the external clock function, the hardware parameters ADPara.ClockSource = PXI8009_CLOCKSRC_OUT should be installed in the software. The clock frequency depends on the frequency of the external clock, and the clock frequency on-board (that is, the frequency depends on the hardware parameters ADPara.Frequency) only functions in the packet acquisition mode and its sampling frequency of the A/D is fully controlled by 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 PXI8009 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 PXI8009, in order to prevent the IC (chip) from electrostatic harm, please do not touch IC (chip) in the front panel of PXI8009 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. PXI8009 default input range: ±10V, in the manual, we introduce how to calibrate PXI8009 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 PXI8009 module, and then power on, warm-up for fifteen minutes.

1) Zero-point adjustment: select one channel of analog inputs, take channel AI0+ for example, put 0V into AI0, and then run ART Data Acquisition Measurement Suite in the WINDOWS. Choose channel 0, ±10V input range and start sampling, adjust potentiometer RP1 in order to make voltage value is 0.000V or near 0.000V. Other channels zero adjustment is the same as this one.
2) Full-scale adjustment: select one channel of analog inputs, take channel AI0 for example, put 10V into AI0, and then run ART Data Acquisition Measurement Suite in the WINDOWS. Choose channel 0, ±10V input range and start sampling, adjust potentiometer RP17 in order to make voltage value is 9999.69mV or near 9999.69mV. Other channels full-scale adjustment is the same as this one.
3) Trigger Level adjustment: adjust potentiometer RP20 in order to adjust trigger level full-scale (0~10V).
4) Repeat steps heretofore, 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.