

NET2801

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 NET2801 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 NET2801 is a data acquisition module based on Ethernet. It can be directly inserted into Ethernet interface 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.

- NET2801 Data Acquisition Board
- ART Disk
 - a) user's manual (pdf)
 - b) drive
 - c) catalog
- Warranty Card

FEATURES

Analog Input

- Converter Type: AD7663 (default is AD7663, also can use AD7665)
- Input Range: $\pm 10V$, $\pm 5V$ (default), $\pm 2.5V$, $0\sim 10V$, $0\sim 5V$
- 16-bit resolution
- Sampling Rate: $32Hz\sim 250KHz$ (when use AD7665, it is $31Hz\sim 500KHz$)

Note: The actual channel sampling rate = sampling rate / number of sampling channels

- Analog Input Mode: 32SE/16DI
- Data Read Mode: non-empty and half-full inquire mode
- FIFO Size: 8K word
- Memory Sign: full, non-empty and half-full
- Sample Mode: continuous sampling and group sampling
- Group Interval: software-configurable, minimum value is sampling period, maximum value is $32767\mu s$.
- Loops of Group: software-configurable, minimum value is one time, maximum value is 255 times.
- Trigger Source: DTR
- DTR Range: TTL
- Trigger Mode: software and hardware
- Trigger Direction: positive, negative, either positive or negative
- AD conversion time: $\leq 1.25\mu s$
- Programmed Gain: 1, 2, 4, 8 (AD8251), 1, 2, 5, 10 (AD8250) or 1, 10, 100, 1000 (AD8253)
- Amplifier Set-up Time: 785ns (0.001%)(max)
- Analog Input Impedance: $10M\Omega$
- Non-linear error: $\pm 3LSB$ (Maximum)
- System Measurement Accuracy: 0.1%

- Operating Temperature Range: 0°C~55°C
- Storage Temperature Range: -20°C~70°C

Digital Input

- Input Channels: 16
- Electric Standard: TTL compatible
- High Level: $\cong 2.0V$
- Low Level: $\cong 0.8V$

Digital Output

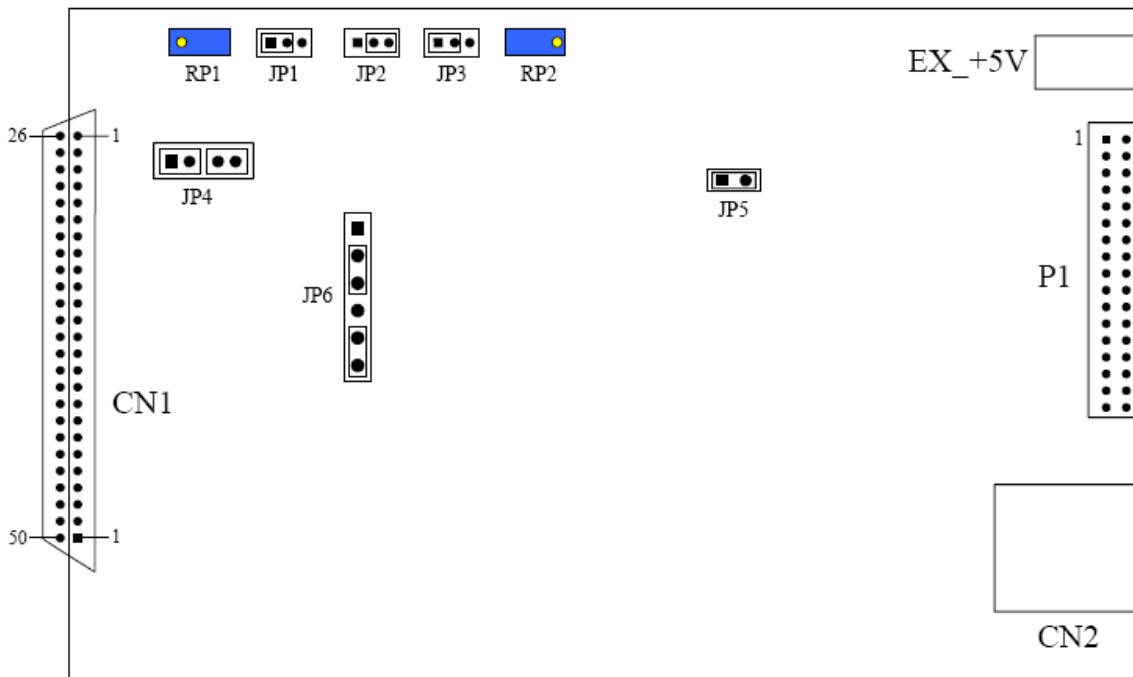
- Output Channels: 16
- Electrical Standard: TTL compatible
- High Level: $\cong 2.4V$
- Low Level: $\cong 0.5V$
- Power-on output: low level

Other features

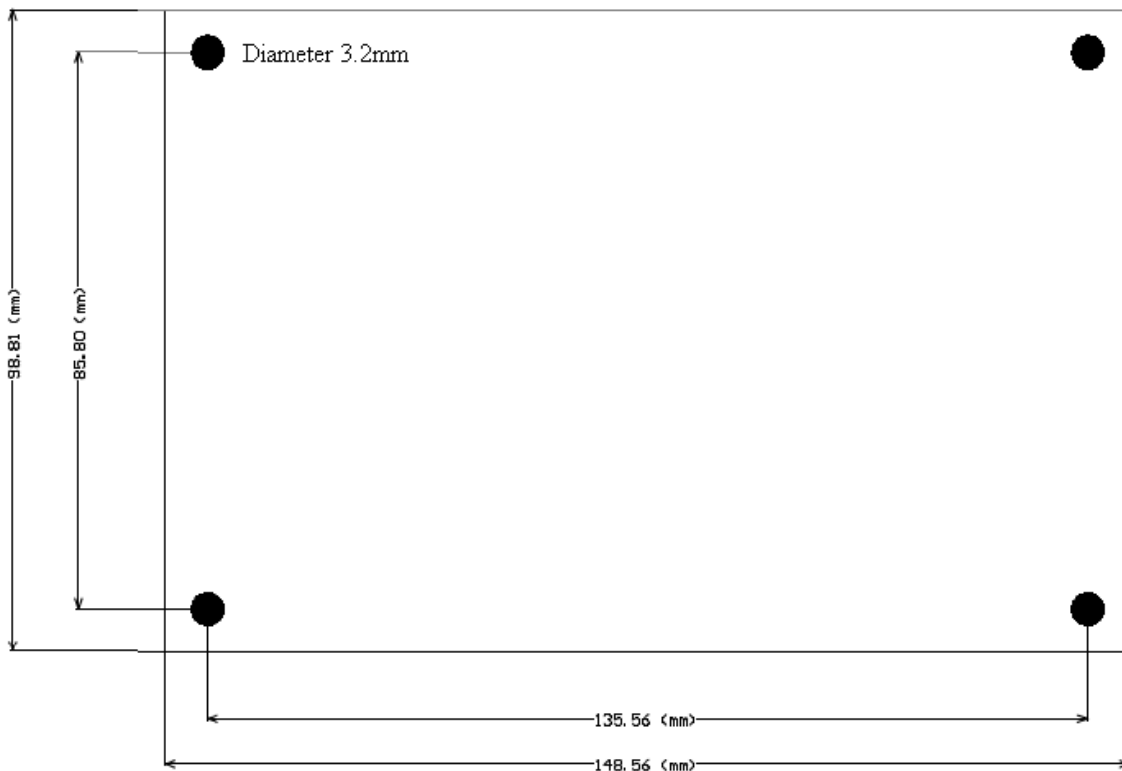
Board Clock Oscillation: 10MHz

Chapter 2 Components Layout Diagram and a Brief Description

2.1 The Main Component Layout Diagram



2.2 Dimension



2.3 The Function Description for the Main Component

2.3.1 Signal Input and Output Connectors

CN1: Analog input connector

CN2: Ethernet interface

P1: Digital I input and output connector







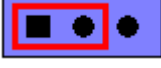
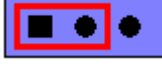
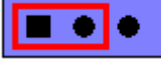






2.3.2 Potentiometer

RP1: Analog signal input zero-point adjustment potentiometer


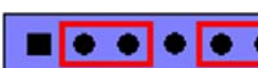


RP2: Analog signal input full-scale adjustment potentiometer

2.3.3 Jumper

1. Analog input range selected.

| Input Range | JP1 | JP2 | JP3 |
|-------------|---|---|---|
| $\pm 10V$ |  |  |  |
| $\pm 5V$ |  |  |  |
| $\pm 2.5V$ |  |  |  |
| 0~10V |  |  |  |
| 0~5V |  |  |  |

2. Analog input mode selected.

| Input Mode | JP4 | JP6 |
|---------------------|---|---|
| Single-ended |  |  |
| Differential Inputs |  |  |

2.3.4 Status Indicator

EF: FIFO non-empty status indicator

HF: FIFO half-full status indicator

FF: FIFO full status indicator

+3.3V: 3.3V power indicator, ON for normal

2.3.5 Reset DIP Switch

D1D2: When the NET2801's network configuration information error, or forget the last modified value, just power off and allocate the ID0 bit to the OFF side. Power-on for another time, the NET2801 reverts to the default settings.

Allocate ID0 bit to the ON side, in order to save the modified configuration information.

NET2801 default settings:

IP Address: 192.168.2.70

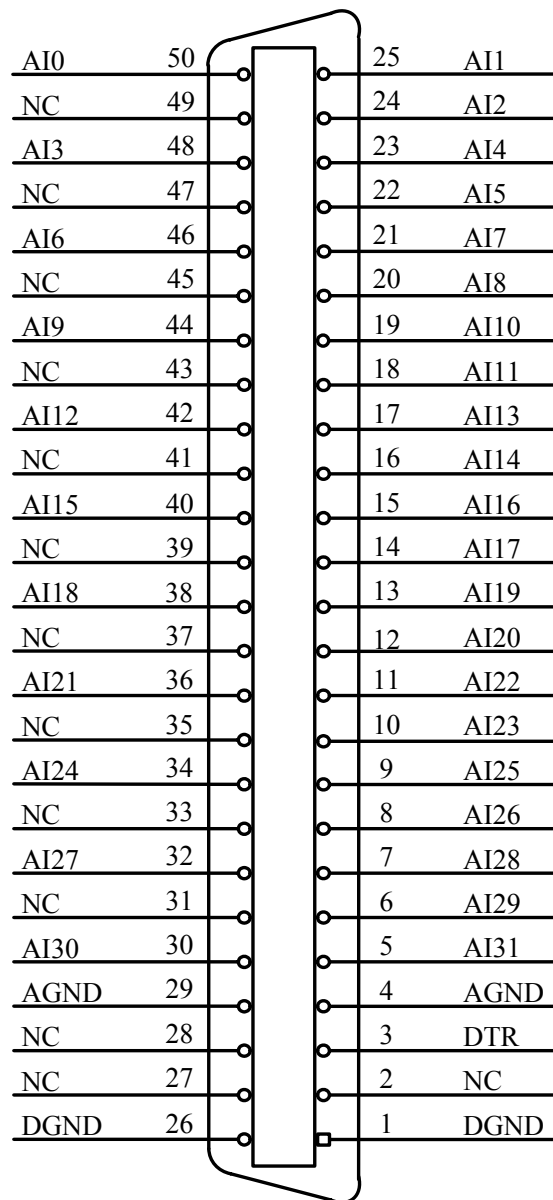
Subnet Mask: 255.255.255.255

Default Gateway: 192.168.2.1

Chapter 3 Signal Connectors

3.1 The Definition of Analog Input Connectors

50 core SCSI plug on the CN1 pin definition

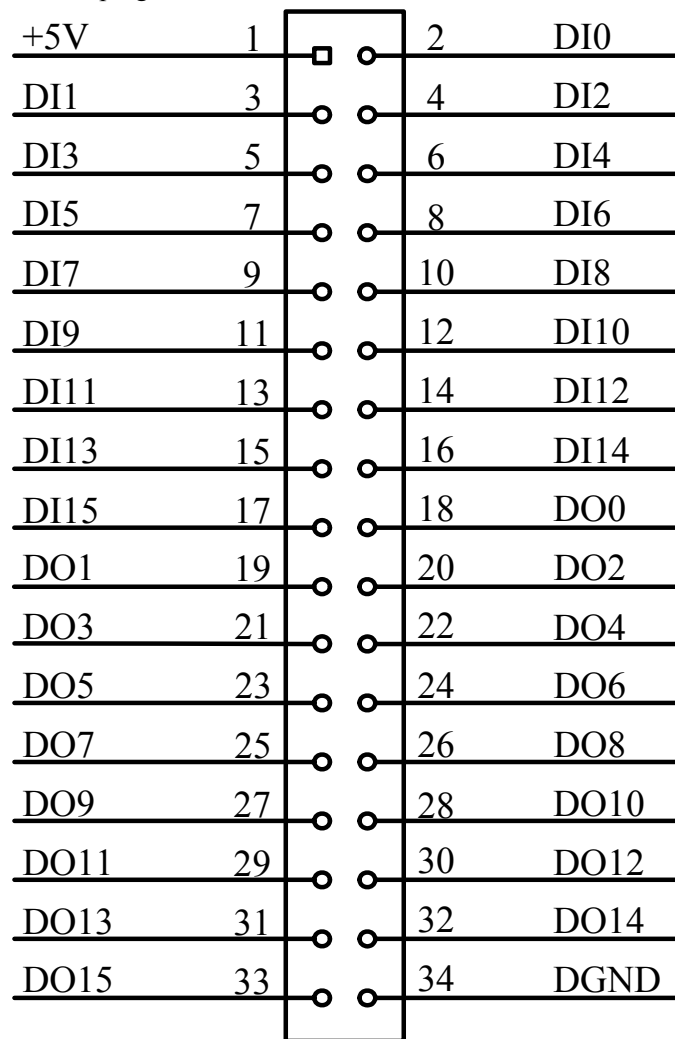


Pin definition about AD:

| Pin name | Type | Pin function definition |
|----------|-------|--|
| AI0~AI31 | Input | Analog input, reference ground is AGND. |
| AGND | GND | Analog ground. This AGND pin should be connected to the system's AGND plane. |
| DTR | Input | Digital ground, reference ground is DGND. |
| DGND | GND | Digital ground. |

3.2 The Definition of Digital Input/Output Connectors

34 core plug P1



| Pin name | Pin Feature | Pin function definition |
|----------|-------------|---|
| DI0~DI15 | Input | Digital signal input |
| DO0~DO15 | Output | Digital signal output |
| +5V | PWR | +5V power supply |
| DGND | GND | Digital signals ground, when use counter/timer we best choose it as reference ground. |

Chapter 4 Connection Ways for Each Signal

4.1 Analog Input Single-ended 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.

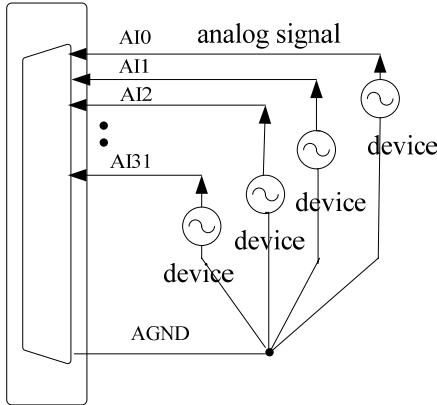


Figure 4.1 single-ended input connection

4.2 Analog Input Differential-ended Mode

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 NET2801 software manual.

According to the diagram below, NET2801 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 AI0~AI15, the negative side of the analog input signal is connected to AI16~AI31, equipments in industrial sites share the AGND with NET2801 board.

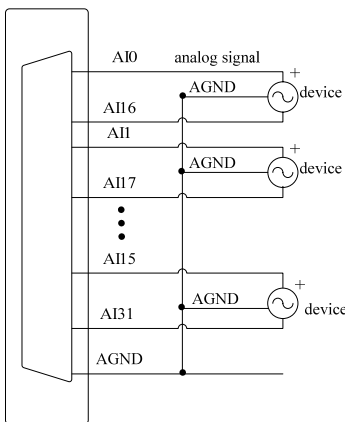


Figure 4.2 double-ended input connection

4.3 Digital Input/Output Connections

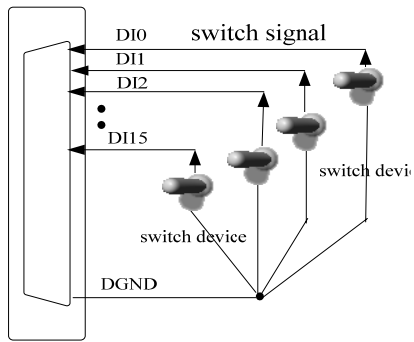


Figure 4.4 digital signal input connection

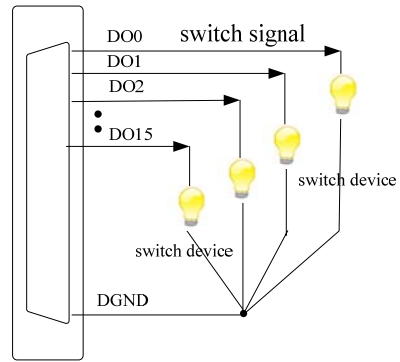


Figure 4.5 digital signal output connection

Chapter 5 The Instruction Trigger Function

5.1 Internal Trigger Mode

When AD is in the initialization, if the AD hardware parameter ADPara.TriggerMode = NET2801_TRIGMODE_SOFT, we can achieve the internal trigger acquisition. In this function, when calling the NET2801_InitDeviceAD 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.

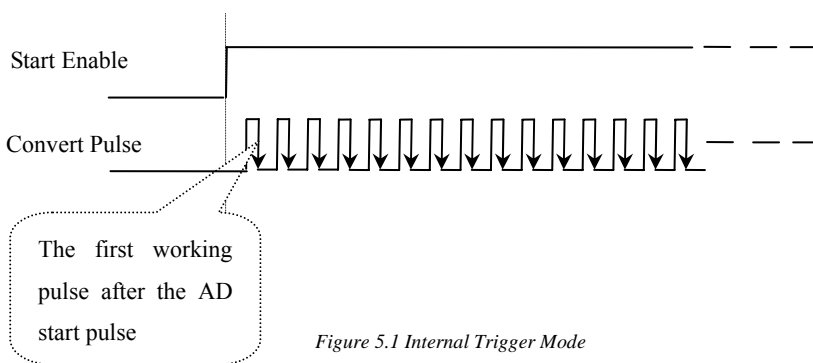


Figure 5.1 Internal Trigger Mode

5.2 External Trigger Mode

When A/D is in the initialization, if the A/D hardware parameter ADPara.TriggerMode = NET2801_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 is DTR (Digital 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 AD conversion.

When TriggerType = NET2801_TRIGTYPE_EDGE, it is dege trigger.

When ADPara.TriggerDir = NET2801_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.

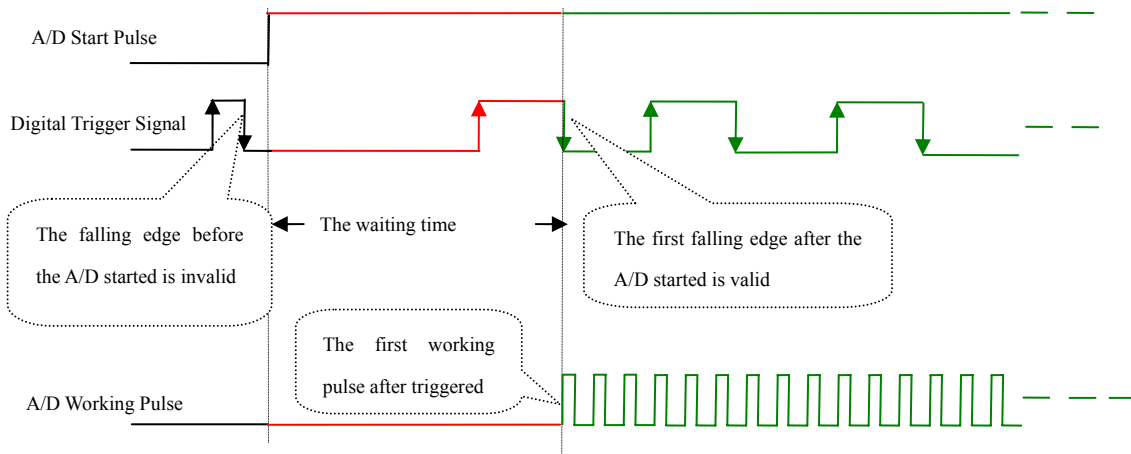


Figure5.2 Falling edge Trigger

When `ADPara.TriggerDir = NET2801_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 = NET2801_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 AD conversion.

When `ADPara.TriggerType = NET2801_TRIGTYPE_PULSE`, it is level trigger.

When `ADPara.TriggerDir = NET2801_TRIGDIR_NEGATIVE`, it means the trigger level is low. When trigger signal is low level, AD 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.

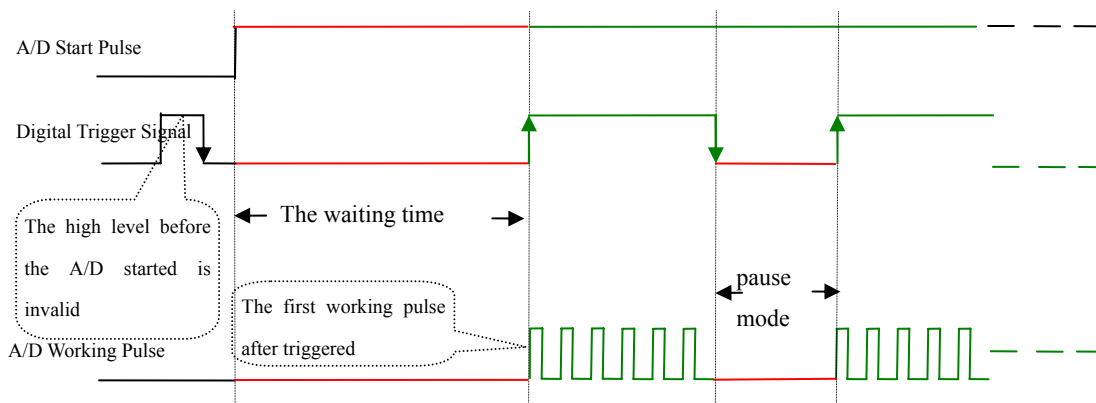


Figure5.3 High Level Trigger

When `ADPara.TriggerDir = NET2801_TRIGDIR_POSITIVE`, it means the trigger level is high. When trigger signal is in high level, AD 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 = NET2801_TRIGDIR_POSIT_NEGAT`, it means the trigger level is low. The effect is the same as choosing the internal software trigger.

Chapter 6 Continuous and Grouping Sampling Function

6.1 AD Continuum Sampling Function

The continuous acquisition function means the sampling periods for every two data points are completely equal in the sampling process of AD, that is, completely uniform speed acquisition, without any pause, so we call that continuous acquisition.

To use the continuous acquisition function, the hardware parameters ADPara.ADMode = NET2801_ADMODE_SEQUENCE should be installed in the software. For example, in the internal clock mode, hardware parameters ADPara.Frequency = 100000 (100KHz) should be installed, and 10 microseconds after the AD converts the first data point, the second data point conversion starts, and then 10 microseconds later the third data point begins to convert, and so on.

6.2 AD Grouping Sampling Function

Grouping acquisition (pseudo-synchronous acquisition) function refers to the sampling clock frequency conversion among the channels of the group in the AD sampling process, and also a certain waiting time exists between every two groups, this period of time is known as the Group Interval. Loops of group refer to numbers of the cycle acquisition for each channel in the same group. In the internal clock mode and the fixed-frequency external clock mode, the time between the groups is known as group cycle. The conversion process of this acquisition mode as follows: a short time stop after the channels conversion in the group (that is, Group Interval), and then converting the next group, followed by repeated operations in order, so we call it grouping acquisition.

The purpose of the application of the grouping acquisition is that: at a relatively slow frequency, to ensure that all of the time difference between channels to become smaller in order to make the phase difference become smaller, thus to ensure the synchronization of the channels, so we also say it is the pseudo-synchronous acquisition function. In a group, the higher the sampling frequency is, the longer Group Interval is, and the better the relative synchronization signal is. The sampling frequency in a group depends on ADPara. Frequency, Loops of group depends on ADPara.LoopsOfGroup, the Group Interval depend on ADPara. Group Interval.

Based on the grouping function, it can be divided into the internal clock mode and the external clock mode. Under the internal clock mode, the group cycle is decided by the internal clock sampling period, the total number of sampling channels, Loops of group and Group Interval together. In each cycle of a group, AD only collects a set of data. Under the external clock mode, external clock cycle \geq internal clock sampling cycle \times the total number of sampling channels \times Loops of group + AD chip conversion time, AD data acquisition is controlled and triggered by external clock. The external clock mode is divided into fixed frequency external clock mode and unfixed frequency external clock mode. Under the fixed frequency external clock mode, the group cycle is the sampling period of the external clock.

The formula for calculating the external signal frequency is as follows:

Under the internal clock mode:

Group Cycle = the internal clock sampling period \times the total number of sample channels \times Loops of group + AD chips

conversion time + Group Interval

External signal cycle = (cycle signal points / Loops of group) × Group Cycle

External signal frequency = 1 / external signal cycle

Under the external clock mode: (a fixed-frequency external clock)

Group Cycle = external clock cycle

External signal cycle = (cycle signal points / Loops of group) × Group Cycle

External signal frequency = 1 / external signal cycle

Formula Notes:

The internal sampling clock cycle = 1 / (AD Para. Frequency)

The total number of sampling channels = AD Para. Last Channel – AD Para. First Channel + 1

Loops of group == ADPara.LoopsOfGroup

AD Chips conversion time = see "AD Analog Input Function" parameter

Group Interval = AD Para. Group Interval

Signal Cycle Points = with the display of the waveform signal in test procedures, we can use the mouse to measure the signal cycle points.

Under the internal clock mode, for example, sample two-channel 0, 1, and then 0 and 1 become a group. Sampling frequency (Frequency) = 100000Hz (cycle is 10µs), Loops of group is 1, Group Interval = 50µs, then the acquisition process is to collect a set of data first, including a data of channel 0 and a data of channel 1. We need 10µs to sample the two data, 20µs to convert the data from the two channels. After the conversion time of an AD chip, AD will automatically cut-off to enter into the waiting state until the 50µs group interval ends. We start the next group, begin to convert the data of channel 0 and 1, and then enter into the waiting state again, and the conversion is going on in this way, as the diagram following shows:

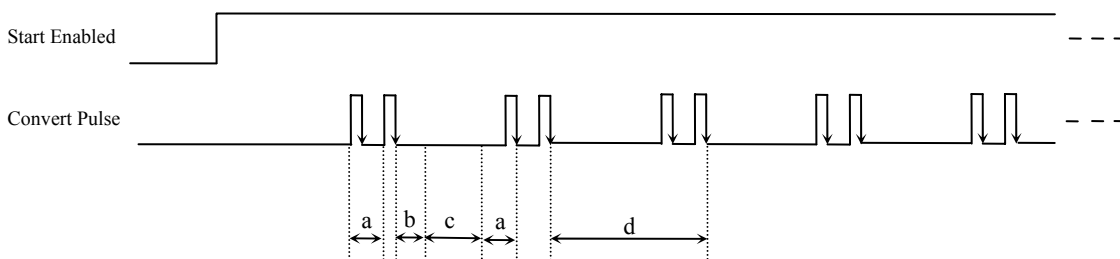


Figure 6.1 Grouping Sampling which grouping cycle No is 1 under the Internal Clock Mode

- Note: a— internal clock sample cycle
- b— AD chips conversion time
- c—Group Interval
- d— group cycle

Change the loops of group into 2, then the acquisition process is to collect the first set of data, including two data of channel 0 and two data of channel 1, the conversion order is 0,1,0,1. We need 10µs to sample each of the four data. After the conversion time of an AD chip, AD will automatically stop to enter into the waiting state until the 50µs Group Interval ends. We start the next group, begin to convert the data of channel 0 and 1, and then enter into the waiting state again, and the conversion is going on in this way, as the diagram following shows:

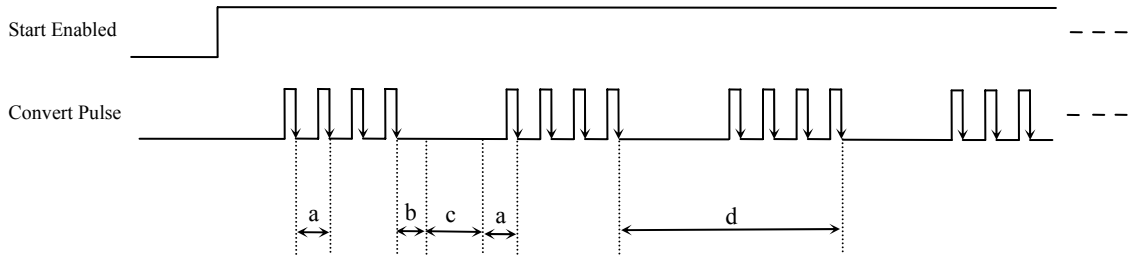


Figure 6.2 Grouping Sampling which grouping cycle No is 2 under the Internal Clock Mode

- Notes: a— internal clock sample cycle
- b— AD chips conversion time
- c—Group Interval
- d— group cycle

Under the external clock mode, the requirement is: the external clock cycle \geq the internal clock sampling period \times the total number of sampling channels \times Loops of group + AD chip conversion time, otherwise, the external clock appearing in the group conversion time will be ignored.

Under the fixed-frequency external clock mode, for example, when sampling data of two-channel 0, 1, then channel 0 and channel 1 consist of a group. Sampling frequency (Frequency) = 100000Hz (the cycle is 10 μ s), Loops of group is 2, then the acquisition process is to collect the first set of data, including two data of channel 0 and two data of channel 1, the order of conversion 0,1,0,1, We need 10 μ s to sample the four data and 40 μ s to convert of the four data. After the conversion time of an AD chip, AD will automatically stop to enter into the waiting state until the next edge of the external clock triggers AD to do the next acquisition, and the conversion is going on in this way, as the diagram following shows:

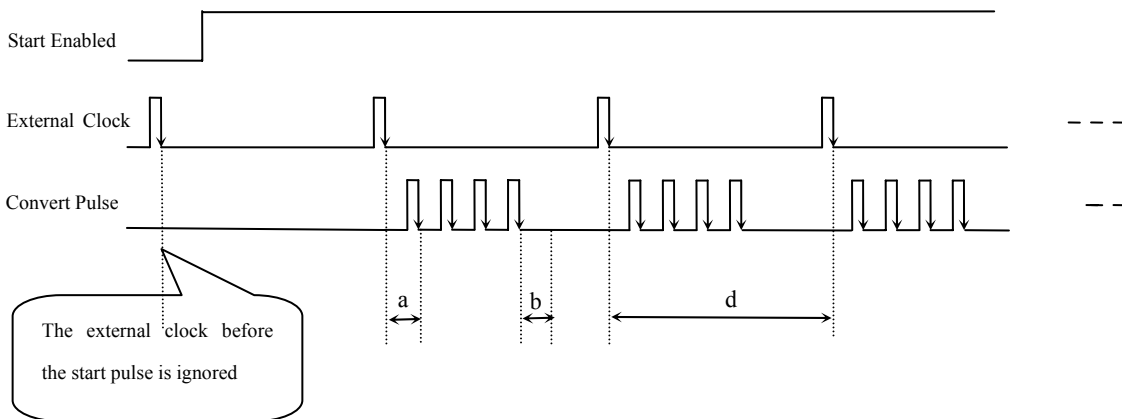


Figure 6.3 Grouping sampling under the fixed frequency external clock mode

- Notes: a— internal clock sample cycle
- b—AD chips conversion time
- d—group cycle (external clock cycle)

Under an unfixed-frequency external clock mode, for example, the grouping sampling principle is the same as that of the fixed-frequency external clock mode. Under this mode, users can control any channel and any number of data.

Users will connect the control signals with the clock input of the card (CLKIN), set the sampling channels and Loops of group. When there are external clock signals, it will sample the data which is set by users. Because the external clock frequency is not fixed, the size of external clock cycle is inconsistent but to meet: the external clock cycle \geq the internal clock sampling period \times the total number of sampling channels \times Loops of group + AD chip conversion time, , otherwise, the external clock edge appearing in the group conversion time will be ignored.

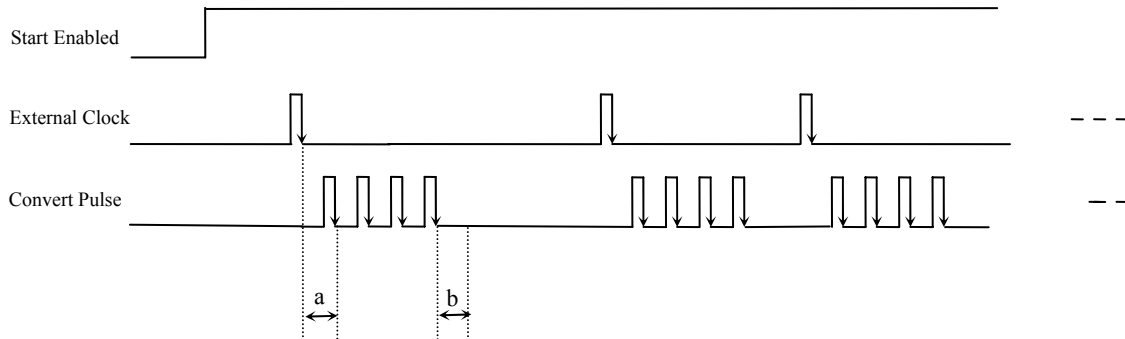


Figure 6.4 Grouping sampling under the not fixed frequency external clock mode

Note: a— internal clock sample cycle
b—AD chips conversion time

Chapter 7 Notes, Calibration and Warranty Policy

7.1 Notes

In our products' packing, user can find a user manual, a NET2801 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 NET2801, in order to prevent the IC (chip) from electrostatic harm, please do not touch IC (chip) in the front panel of NET2801 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. NET2801 default input range: $\pm 10V$, in the manual, we introduce how to calibrate NET2801 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 NET2801 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 RP1 until the actual input value 0.000V.
- 2) Full-scale adjustment: Select AI0 for example; connect a DC voltage source with value equal to 9999.69mV to AI0. Adjust RP2 until the actual input value 9999.69mV.
- 3) 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 USB 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-> USB.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.