JY-6302

High Accuracy 24 bits High-Resolution Thermocouple Input Module User Manual

User Manual Version: V1.9.8

Revision Date: July 31, 2024

Table of Contents

1. Introduction

This chapter presents the information how to use this manual and quick start if you are already familiar with Microsoft Visual Studio and C# programming language.

1.1 Overview

JY-6302 is a high-precision, high-resolution voltage and temperature measurement module. It provides up to 32 channels of measurements and supports R/S/B/J/T/E/K/N/C/A types of thermocouples, with input voltage range of ±78.125 mV and sample rate up to 800 Samples/sec. JY-6302 has both PCIe and PXIe version.

1.2 Main Features

- Up to 450 ppm full scale accuracy
- 32 channels of measurements
- Voltage range supported: ±78.125 mV
- Support R/S/B/J/T/E/K/N/C/A types of thermocouples
- 8 cold-junction compensation channels provided by 2 TB-68CJ terminal blocks
- Open Thermocouple Detection (OTD)
- Onboard 128M sample FIFO buffer for analog input
- DMA for analog input
- 24 bits resolution
- Provide voltage (EMF value) to temperature (°C) conversion specified by the standards
- Digital and Software Trigger

1.3 Voltage and Temperature Measurements

Figure 1 shows how JY-6302 is typically used to measure the temperature through thermocouples. A thermocouple converts a temperature measurement to a voltage which is measured by JY-6302.

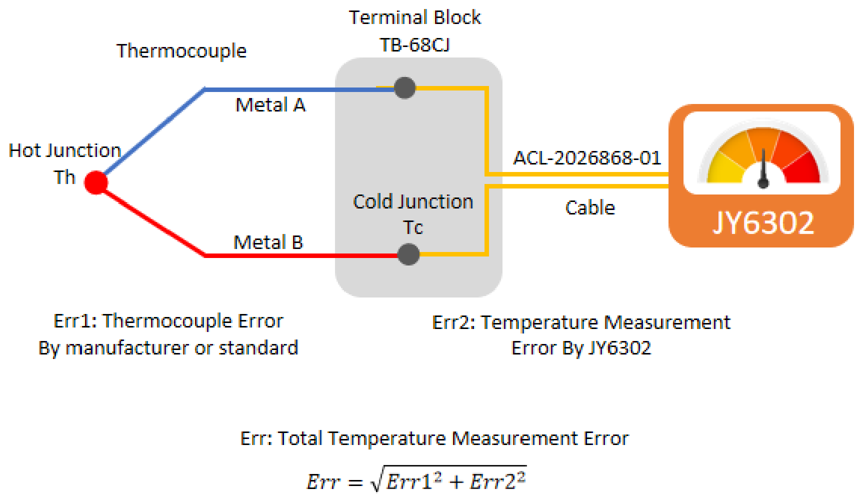


Figure 1 Voltage and Temeratur Measuremets

The accuracy and resolution of the temperature measurement are determined by the those of thermocouples and JY-6302.

1.4 **Abbreviations**

- JY-6302: JYTEK PCIe/PXIe/TXI/USB-6302
- AI: Analog Input
- ADC: Analog to Digital Conversion
- PFI: Programmable Function Interface
- CJ: Cold-Junction
- CJC: Cold-Juntion Compensation
- OTD: Open Thermocouple Detection
- Th: Temperature at measuring junction
- Tc: Temperature at cold junction also called the reference junction
- Tcal: Board calibration temperature

1.5 **JYPEDIA**

JYPEDIA is an excel file, which contains JYTEK product information, pricing, inventory information, drivers, software, technical support, knowledge base etc. You can download a JYPEDIA excel file from our web www.jytek.com. JYTEK highly recommends you use this file to obtain information from JYTEK.

1.4 Learn by Example

Learn by Example is a unique feature in JYTEK product manual. in this manual. We provide many sample programs for this device. Open JYPEDIA and search for JY-6302 in the driver sheet, select **JY6302_Examples.zip.** This will lead you to download the sample program for this device.

Drivers	Update Date	Category
JY6302_V3.0.0_Linux.tar	2022/8/19	Driver
JY6302_V3.0.0_C++Examples.rar	2022/8/19	Example
JY6302_V3.0.0_Win.rar	2022/8/19	Driver
JY6302_V1.0.0_Python.zip	2021/11/5	Driver
JY6302_V1.0.0_PythonExamples.zip	2021/11/5	Example

Figure 2 JYPEDIA Information

In a **Learn by Example** section, the sample program is in bold style such as**Winform AI Continuous**; the property name in the sample program is also in bold style such as **SamplesToAcquire;** the technical names used in the manual is in italic style such as *SampleRate*. You can easily relate the property names in the example program with the manual documentation.

To use **Learn by Example**, you should connect your JY-6302 to a TB- 68CJ terminal block, shown in Figure 3, through an ACL-2026868-01 cable.

Figure 3 TB- 68CJ terminal block.

TB-68CJ has 4 terminal columns, J1 – J4 as shown in Figure 4. In the rest of this manual, the wire connection in each **Learn by Example** section will be referred to by the pin number only.

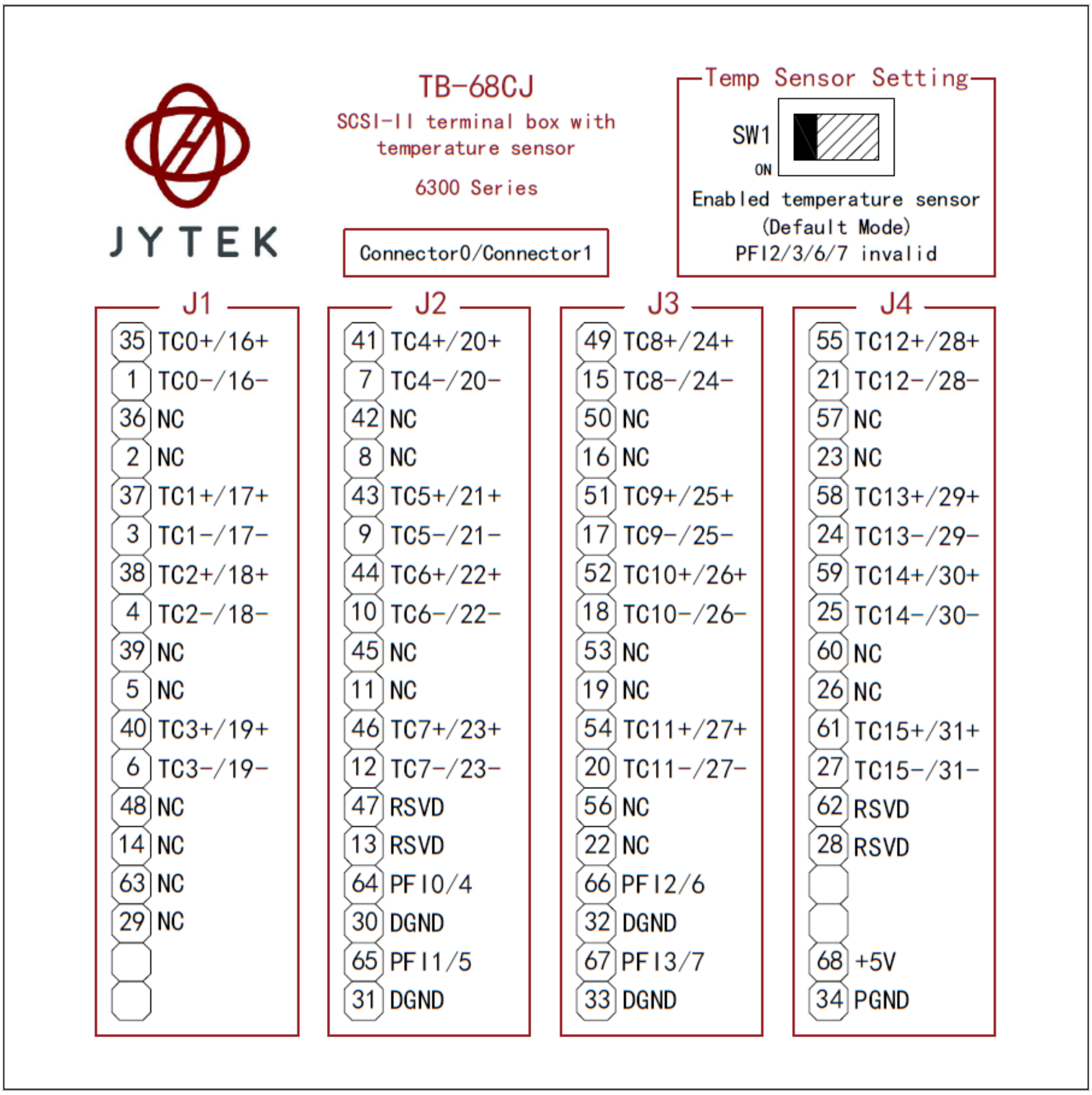


Figure 4 TB-68CJ Pin Defination

2. Voltage Measurement Specifications

This chapter provides the voltage accuracy specifications of JY-6302.

2.1 Gain and Offset Errors

An instrument's accuracy is defined by the gain and offset errors as follows:

Voltage Accuracy = Gain Error (% of reading) + Offset Error (% of range).

Equation 1 Gain and Offset Errors

It should be noted when the reading is close to zero, the gain error is very small and negligible, the offset error is dominant; when the reading is getting close to the full range, the gain error becomes more significant.

2.2 Basic Voltage Accuracy

The basic voltage measurement accuracy of JY-6302 is shown in Table 1.

JY6302 Basic Accuracy = ±(% Reading+% Range)									
Group total sampling rate (Sample/s)	Range (mV)	24 Hour Tcal ±1°C			90 Days Tcal ± 5°C			90 Days Full Scale Accuracy	90 Days Full Scale Accuracy (%)
40	78.125	0.029	+	0.008	0.034	+	0.011	35 µV	0.045
400	78.125	0.029	+	0.011	0.034	+	0.013	37 µV	0.047
800	78.125	0.029	+	0.015	0.034	+	0.016	39 µV	0.050
All Levels works with 24 bits resolution at the range of 78.125 mV Total Samples rates <= 40 Samples/s, accuracy refer to 40 samples/s. 400 Samples/s>=Total Samples rates >40 Samples/s, accuracy refer to 400 samples/s. Total Samples rates >400 Samples/s, accuracy refer to 800 samples/s. Reference (Cold Junction Temperature): same as Operating Temperature Terminal Block: TB-68CJ; Cable: ACL-2026868-01 Add 20% to Gain and Offset Errors From 91 Days to 1 Year.									

Table 1 Basic Voltage Accuracy

2.3 Temperature Drift Adjustment

If JY-6302 operates outside the calibration temperature range, typically Tcal±1°C, the accuracy must be adjusted by Table 2. The entries are per degree C. For example, if the operating temperature is 2°C outside the calibration temperature, the adjustment numbers from the table need to be multiplied by 2. The gain and offset error adjustment should then be added to the basic gain and offset errors in Table 1 Basic Voltage Accuracy to obtain the accuracy after the temperature drift.

JY6302 Additional Accuracy Adjustment = ±(% Reading+% Range)			
Group total sampling rate (Sample/s)	Range (mV)	Temperature Coefficients (per °C)	Full-Scale Temp Adjustment (µV/ °C)
40	78.125	0.00068 + 0.00013	0.63 uV
400	78.125	0.00067 + 0.00013	0.62 uV
800	78.125	0.00067 + 0.00015	0.63 uV
All Levels works with 24 bits resolution at the range of 78.125 mV Total Samples rates <= 40 Samples/s, accuracy refer to 40 samples/s. 400 Samples/s>=Total Samples rates >40 Samples/s, accuracy refer to 400 samples/s. Total Samples rates >400 Samples/s, accuracy refer to 800 samples/s. Reference (Cold Junction Temperature): same as Operating Temperature Terminal Block: TB-68CJ; Cable: ACL-2026868-01			

Table 2 Additional Accuracy Adjustment due to Temperature Drift

2.4 **Example of Calculating Gain and Offset Errors**

Table 3 shows two examples of calculating the total gain and offset errors. The first one has a reading value of 2mV, while the second one has a reading value of 60 mV. For the 2mV reading value, the total gain error is 1.1 µV, while for the 60 mV reading value, the gain error is 33.1 µV, 30 times bigger than the first one. The offset errors for both reading values are the same 12.6 µV.

Calculating Gain and Offset Errors				
Sample Rate (Sample/s)	40		40	
Error Calculation	Gain	Offset	Gain	Offset
Coef from Basic AccuracyTable (%)	0.029	0.008	0.029	0.008
Coef from Additional Adjustment Table (%)	0.001	0.000	0.001	0.000
Operating temperature outside calibibration temperature range(Tcal±1℃ typical)(°C)	2		2	
Total Coefficient Adjustment (%)	0.001	0.000	0.001	0.000
Total Gain and Offset Error Coefficients (%)	0.030	0.008	0.030	0.008
Reading(mV) and Range (mV)	2.000	78.125	60.000	78.125
Gain and Offset Errors (µV)	0.6	6.5	18.2	6.5
Total Error (Gain+Offset) (µV)	7.1		24.7	

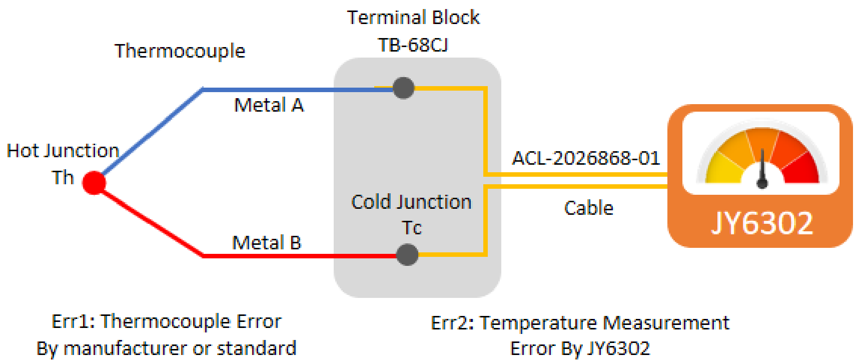
Table 3 Calculating Gain and Offset Errors

3. Temperature Measurement Specifications

The accuracy of the temperature measurement depends on the thermocouple, the connectors, the terminal block, and the measuring device. This chapter provides the temperature measurement accuracy specifications by JY-6302 and specified terminal block only. The effect of the thermocouple is not included.

3.1 Thermocouple Measurement Basics

A Thermocouple temperature measurement utilizes the "Seebeck effect", and its basic measurement principle is shown in the Figure 5 Thermocouple Temperature Measurement Principle.



Err: Total Temperature Measurement Error

$$Err = \sqrt{Err1^2 + Err2^2}$$

Figure 5 Thermocouple Temperature Measurement Principle

Two different types of metals A and B are connected to each other, and the temperature difference between the temperature measuring contact Th (Metal Junction) and the reference contact Tc (Thermocouple Display Instrument Contact) is used to generate the corresponding voltage, also called the Electromotive Force （EMF） in the standards. This voltage is measured by JY-6302 and is then converted the temperature values using a conversion formula defiend by the standard.

3.2 Thermocouple Accuracy

A thermocouple has its own accuracy, also called the error tolerance in many international standards. Table 4 shows the accuracies of common thermocouple types by two commonly used standards. Using the K-type as an example. Each K-type thermocouple falls into one of the three classes. The maximum accuracy of class 1 of the K-type thermocouple is ±1.5°C or ±(0.004*|T|), whichever is bigger. T is the measured temperature value in °C.

If the measured temperature is -30°C, 0.004*|-30| = 0.12°C, so the accuracy is ±1.5°C. If T=1000°C, 1000*0.004=4°C, so the accuracy is ±4°C.

Thermocouple Type	Tolerance Class		Temperature Range (°C)	Thermocouple Error (°C) (Larger between two columns)	
J	IEC-EN 60584-1	Class 1	–40 < T < 750	±1.5	±(0.004 · |T|)
		Class 2	–40 < T < 750	±2.5	±(0.0075 · |T|)
		Class 3	–	–	–
	ASTM E230 ANSI MC96.1	Special	0 < T < 750	±1.1	±(0.004 · |T|)
		Standard	0 < T < 750	±2.2	±(0.0075 · |T|)
K	IEC-EN 60584-1	Class 1	–40 < T < 1000	±1.5	±(0.004 · |T|)
		Class 2	–40 < T < 1200	±2.5	±(0.0075 · |T|)
		Class 3	–200 < T < 40	±2.5	±(0.015 · |T|)
	ASTM E230 ANSI MC96.1	Special	0 < T < 1250	±1.1	±(0.004 · |T|)
		Standard	–200 < T < 0 0 < T < 1250	±2.2 ±2.2	±(0.02 · |T|) ±(0.0075 · |T|)
N	IEC-EN 60584-1	Class 1	–40 < T < 1000	±1.5	±(0.004 · |T|)
		Class 2	–40 < T < 1200	±2.5	±(0.0075 · |T|)
		Class 3	–200 < T < 40	±2.5	±(0.015 · |T|)
	ASTM E230 ANSI MC96.1	Special	0 < T < 1300	±1.1	±(0.004 · |T|)
		Standard	–270 < T < 0 0 < T < 1300	±2.2 ±2.2	±(0.02 · |T|) ±(0.0075 · |T|)
T	IEC-EN 60584-1	Class 1	–40 < T < 350	±0.5	±(0.004 · |T|)
		Class 2	–40 < T < 350	±1.0	±(0.0075 · |T|)
		Class 3	–200 < T < 40	±1.0	±(0.015 · |T|)
	ASTM E230 ANSI MC96.1	Special	–200 < T < 0 0 < T < 350	±0.5 ±0.5	±(0.008 · |T|) ±(0.004 · |T|)
		Standard	–200 < T < 0 0 < T < 350	±1.0 ±1.0	±(0.015 · |T|) ±(0.0075 · |T|)
E	IEC-EN 60584-1	Class 1	–40 < T < 800	±1.5	±(0.004 · |T|)
		Class 2	–40 < T < 900	±2.5	±(0.0075 · |T|)
		Class 3	–200 < T < 40	±2.5	±(0.015 · |T|)
	ASTM E230 ANSI MC96.1	Special	–200 < T < 0 0 < T < 900	±1.0 ±1.0	±(0.005 · |T|) ±(0.004 · |T|)
		Standard	–200 < T < 0 0 < T < 900	±1.7 ±1.7	±(0.01 · |T|) ±(0.005 · |T|)
R & S	IEC-EN 60584-1	Class 1	0 < T < 1600	±1.0	±[1 + 0.003 · (|T| –1100)]
		Class 2	–40 < T < 1600	±1.5	±(0.0025 · |T|)
		Class 3	–	±4.0	±(0.005 · |T|)
	ASTM E230 ANSI MC96.1	Special	0 < T < 1450	±0.6	±(0.001 · |T|)
		Standard	0 < T < 1450	±1.5	±(0.0025 · |T|)
B	IEC-EN 60584-1	Class 1	–	–	–
		Class 2	600 < T < 1700	±1.5	±(0.0025 · |T|)
		Class 3	600 < T < 1700	±4.0	±(0.005 · |T|)
	ASTM E230 ANSI MC96.1	Special	870< T < 1700	–	±(0.0025 · |T|)
		Standard	870< T < 1700	–	±(0.005 · |T|)
C	IEC-EN 60584-1	Class 1	–	–	–
		Class 2	426 < T < 2315	–	±(0.01 · |T|)
		Class 3	–	–	–
	ASTM E230 ANSI MC96.1	Special	–	–	–
		Standard	0 < T < 2315	-	±(0.01 · |T|)

Table 4 Err_1: Thermocouple Tolerance Class Information

The accuracies given by Table 4 are valid for thermocouple material only. It is important that users verify the accuracy of the thermocouple from the thermocouple manufacturer.

3.3 Temperature Measurement Accuracy by JY-6302

A thermocouple converts a temperature reading to a voltage which is then measured by JY-6302. The standard provides the conversion formula for different thermocouples and for different temperature ranges. Table 5 shows the temperature measurement accuracy using JY-6302 for each type and each range of thermocouple. The operating conditions are also listed in the table.

Temperature Measurement Accuracy(°C)				
Thermocouple Type	Temperature Range (°C)	Sample Rate (S/s)		
		40	400	800
J	-210 to 0	0.29	0.37	0.47
	0 to 760	0.29	0.33	0.38
	760 to 1200	0.45	0.49	0.55
K	-200 to 0	0.35	0.45	0.59
	0 to 500	0.29	0.34	0.42
	500 to 1300	0.61	0.67	0.76
N	-200 to 0	0.48	0.63	0.83
	0 to 600	0.32	0.38	0.46
	600 to 1300	0.55	0.61	0.70
T	-200 to 0	0.37	0.47	0.61
	0 to 400	0.19	0.23	0.29
E	-200 to 0	0.26	0.33	0.41
	0 to 1000	0.37	0.40	0.45
R	-50 to 250	1.35	1.85	2.52
	250 to 1064	0.72	0.97	1.30
	1064 to 1664.5	0.88	1.05	1.28
	1664.5 to 1768.1	1.00	1.19	1.45
S	-50 to 250	1.31	1.80	2.45
	250 to 1064	0.79	1.02	1.37
	1064 to 1664.5	0.97	1.18	1.44
	1664.5 to 1768.1	1.13	1.35	1.65
B	250 to 700	4.07	4.98	6.20
	700 to 1820	1.05	1.39	1.85
C	0 to 2315	1.82	2.07	2.40
A	100 to 480	0.50	0.63	0.82
Operating Temperature: Tcal±1°C Total Samples rates <= 40 Samples/s, accuracy refer to 40 samples/s. 400 Samples/s>=Total Samples rates >40 Samples/s, accuracy refer to 400 samples/s. Total Samples rates >400 Samples/s, accuracy refer to 800 samples/s. Reference (Cold Junction Temperature): same as Operating Temperature The measurement errors do not include the errors from the thermocouple Terminal Block: TB-68CJ; Cable: ACL-2026868-01				

Table 5 Err_2: Temperature Measurement Accuracy

It is important to note that the accuracy data only includes the measurement errors by JY-6302, using the specified ACL-2026868-01 cable and the TB-68CJ termial block. It does not include the errors of the thermocouple itself. To get the total measurement accuracy, users must check with thermocouple error specifications from the thermocouple manufacturer. Section 3.4 provides the information how to calculate the total accuracy.

3.4 **Total Temperature Measurement Accuracy**

The total temperature measurement accuracy consists of the errors due to the thermocouple and measurement errors by JY-6302 as shown in Figure 5. It can be calculated by:

$$\text{Total Accuracy } Err = \sqrt{Err_1^2 + Err_2^2}$$

Err_1 is the thermocouple error from Table 4 of Section 3.2. Err_2 is the temperature measurement accuracy from Table 5 of Section 3.3.

Table 6 shows two calculations for the total accuracies when using a class 1 K-type thermocouple to measure 100 °C and 800° C temperatures with 40 Sample/s sample rate. The two temperatures fall into different range. Hence the temperature measurement errors by JY-6302 are different.

Total Temperature Measurement Error		
Sample Rate (Sample/s)	40	
Thermocouple Type and Class	K-1	K-1
Temperature Being Measured (°C)	100	800
Fixed Error from K-1 Standard (°C)	1.50	1.50
Calculated from K-1 Standard (|T| *0.004) (°C)	0.40	3.20
Err1: Total Thermocouple Error for K-1 Standard, Larger of above two lines (°C)	1.50	3.20
Err2: JY6302 Temperature Measurement Error for K-1 (°C)	0.29	0.61
Total Accuracy, sqrt(Err1^2+Err2^2) (°C)	1.53	3.26

Table 6 Calculating Total Error

3.5 **Accuracy Not Listed**

Table 5 lists the temperature measurement accuracies for most common applications. There are other factors affecting the measurement accuracy. Most important factors are 1) when the operating temperature is beyond the Tcal±1°C range, and 2) when the cold junction reference temperature are different from the operating temperature as assumed in Table 5. It is not possible to list all these accuracies. JYTEK provides a utility in JY-6302 C# example to calculate the accuracy for those conditions. Users can enter required operating parameters to obtain accuracy not listed in Table 5.

4. Additional Specifications

Additional specifications provide some useful information for using JY-6302.

4.1 Input Characteristics

Basic

Number of channels	32 channels
ADC resolution	24 bits
Type of ADC	Δ-Σ
Sensor support	R/S/B/J/T/E/K/N/C/A thermocouple
Sampling mode:	Scanned
Sampling rate	800 Samples/s MAX (4 channels)
	100 Samples/s (all 32 channels)
Voltage measurement range	±78.125 mV
Temperature measurement range	Full J, K, T, E, N, B, R, S thermocouple range
Overvoltage protection	±30 V
ESD protection	4 kV
Synchronous acquisition	NO
Storage depth	64M Samples
Differential input impedance:	15 MΩ
Typical DC linearity:	±2 ppm
Maximum DC linearity:	±15 ppm

Open Thermocouple Detection(OTD)

OTD selection:	Software
OTD detection:	Per channel
OTD enabled input current:	0.5 µA/2 µA/4 µA
OTD disabled input current:	1 nA(SE) 200 pA(DS)

Input bandwidth(-3 dB)

Sampling Rate(Sample/s)	50Hz Rejection Mode	60Hz Rejection Mode
5	2 Hz	2 Hz
25	19 Hz	11 Hz
40	19 Hz	22 Hz
400	222 Hz	222 Hz
800	445 Hz	445 Hz

PFI

Number of channels	4 channels PFI<0..3>
External digital trigger	Trigger voltage：5 V TTL Trigger edge：rising/falling
Direcrion	Input
6302's PFI is only used for external digital triggering	

Table 7 Input Characteristics

4.2 **Timing and Trigger**

Digital Trigger

	PXIe-6302	PCIe-6302	TXI-6302	USB-6302
Trigger source	PXI_TRIG <0..7> PXI_STAR PFI<0..3>	SSI<0..7>* PFI<0..3>	SSI<0..7>* PFI<0..3>	PFI<0..3>
Trigger Mode	Start Reference ReTrigger	Start Reference ReTrigger	Start Reference ReTrigger	Start Reference ReTrigger
Polarity	Software selectable	Software selectable	Software selectable	Software selectable
*SSI<0..7> definition please refer to section 6.7				

Table 8 Timing and Trigger Specification

4.3 **Front Panel conections and Pinout Definition**

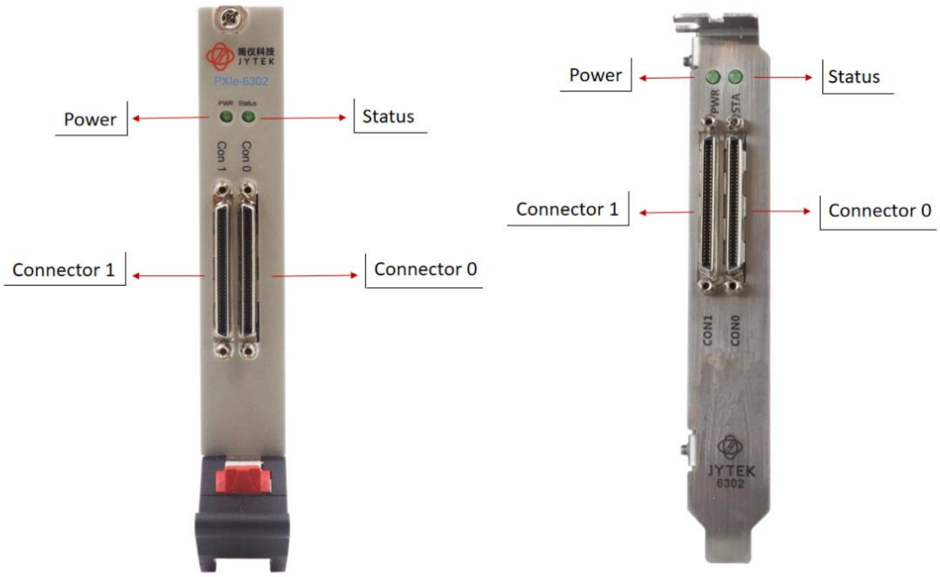


Figure 6 PXIe/PCIe 6302 Front Panel

JY-6302 provides 32 channels of thermocouple measurements and 4 digital input channels (for digital triggering).

Connector 1 (Left)

Channel	Pin	Defination
Ch16	P35	TC+, Voltage measurement high side
	P1	TC-, Voltage measurement low side
Ch17	P37	TC+, Voltage measurement high side
	P3	TC-, Voltage measurement low side
Ch18	P38	TC+, Voltage measurement high side
	P4	TC-, Voltage measurement low side
Ch19	P40	TC+, Voltage measurement high side
	P6	TC-, Voltage measurement low side
Ch20	P41	TC+, Voltage measurement high side
	P7	TC-, Voltage measurement low side
Ch21	P43	TC+, Voltage measurement high side
	P9	TC-, Voltage measurement low side
Ch22	P44	TC+, Voltage measurement high side
	P10	TC-, Voltage measurement low side
Ch23	P46	TC+, Voltage measurement high side
	P12	TC-, Voltage measurement low side
Ch24	P49	TC+, Voltage measurement high side
	P15	TC-, Voltage measurement low side
Ch25	P51	TC+, Voltage measurement high side
	P17	TC-, Voltage measurement low side
Ch26	P52	TC+, Voltage measurement high side
	P18	TC-, Voltage measurement low side
Ch27	P54	TC+, Voltage measurement high side
	P20	TC-, Voltage measurement low side
Ch28	P55	TC+, Voltage measurement high side
	P21	TC-, Voltage measurement low side
Ch29	P58	TC+, Voltage measurement high side
	P24	TC-, Voltage measurement low side
Ch30	P59	TC+, Voltage measurement high side
	P25	TC-, Voltage measurement low side
Ch31	P61	TC+, Voltage measurement high side
	P27	TC-, Voltage measurement low side
GND	P30	GND
	P31	
	P32	
	P33	
	P34	
PFI	P64	PFI2
	P65	PFI3
Other	P13	Reseved, Do not connect
	P47	Reseved, Do not connect
	P28	Reseved, Do not connect
	P62	Reseved, Do not connect
	P68	+5V
	P66	Reseved, Do not connect
	P67	Reseved, Do not connect

Connector 0 (Right)

Channel	Pin	Definiation
Ch0	P35	TC+, Voltage measurement high side
	P1	TC-, Voltage measurement low side
Ch1	P37	TC+, Voltage measurement high side
	P3	TC-, Voltage measurement low side
Ch2	P38	TC+, Voltage measurement high side
	P4	TC-, Voltage measurement low side
Ch3	P40	TC+, Voltage measurement high side
	P6	TC-, Voltage measurement low side
Ch4	P41	TC+, Voltage measurement high side
	P7	TC-, Voltage measurement low side
Ch5	P43	TC+, Voltage measurement high side
	P9	TC-, Voltage measurement low side
Ch6	P44	TC+, Voltage measurement high side
	P10	TC-, Voltage measurement low side
Ch7	P46	TC+, Voltage measurement high side
	P12	TC-, Voltage measurement low side
Ch8	P49	TC+, Voltage measurement high side
	P15	TC-, Voltage measurement low side
Ch9	P51	TC+, Voltage measurement high side
	P17	TC-, Voltage measurement low side
Ch10	P52	TC+, Voltage measurement high side
	P18	TC-, Voltage measurement low side
Ch11	P54	TC+, Voltage measurement high side
	P20	TC-, Voltage measurement low side
Ch12	P55	TC+, Voltage measurement high side
	P21	TC-, Voltage measurement low side
Ch13	P58	TC+, Voltage measurement high side
	P24	TC-, Voltage measurement low side
Ch14	P59	TC+, Voltage measurement high side
	P25	TC-, Voltage measurement low side
Ch15	P61	TC+, Voltage measurement high side
	P27	TC-, Voltage measurement low side
GND	P30	GND
	P31	
	P32	
	P33	
	P34	
PFI	P64	PFI0
	P65	PFI1
Other	P13	Reseved, Do not connect
	P47	Reseved, Do not connect
	P28	Reseved, Do not connect
	P62	Reseved, Do not connect
	P68	+5V
	P66	Reseved, Do not connect
	P67	Reseved, Do not connect

Table 9 Pinout defination

4.4 **Channel Groups**

JY-6302 has 4 groups, each supports 8 channels as shown in Table 10.

Group	Channels
Group 0	Ch0, Ch1, Ch2, Ch3, Ch4, Ch5, Ch6, Ch7
Group 1	Ch8, Ch9, Ch10, Ch11, Ch12, Ch13, Ch14, Ch15
Group 2	Ch16, Ch17, Ch18, Ch19, Ch20, Ch21, Ch22, Ch23
Group 3	Ch24, Ch25, Ch26, Ch27, Ch28, Ch29, Ch30, Ch31

Table 10 JY-6302 channel groups

4.5 **Physical and Environment**

Bus

	PXIe-6302	PCIe-6302	TXI-6302	USB-6302
Bus Type	x4 PXI Express peripheral module Specification V1.0 compliant	x4 PCI Express 2.0	Thunderbolt3	USB3.0
Slot supported	x1 and x4 PXI Express or PXI Express hybrid slots	x4/x8/x16 PCIe slot	Thunderbolt3/Thunderbolt4/USB 4.0	USB3.0

Size and Weight

Product Model	Size(mm)	Weight(g)
PXIe-6302	160 x 100	196
PCIe-6302	167.7 x 111.2	177
USB-6302	208.1 x 128 x 36.4*	964
*Length including connectors		

Power

3.3V	2.0 A
12V	0.04 A

Operating Environment

Ambient temperature range	0 °C to 50 °C
Relative humidity range	20% to 80%, noncondensing

Storage Environment

Ambient temperature range	-20 °C to 80 °C
Relative humidity range	10% to 90%, noncondensing

Table 11 Physical and Environment

5. Software

5.1 System Requirements

JY-6302 modules can be used in a Windows or a Linux operating system.

Microsoft Windows: Windows 7 32/64 bit, Windows 10 32/64 bit. We highly recommend the user to use Windows 10 whenever possible.

Linux Kernel Versions: There are many Linux versions. It is not possible JYTEK can support and test our devices under all different Linux versions. JYTEK will at the best support the following Linux versions.

Linux Version
Ubuntu LTS
16.04： 4.4.0-21-generic(desktop/server)
16.04.6：4.15.0-45-generic(desktop) 4.4.0-142-generic(server)
18.04： 4.15.0-20-generic(desktop) 4.15.0-91-generic(server)
18.04.4：5.3.0-28-generic (desktop) 4.15.0-91-generic(server)
Localized Chinese Version
中标麒麟桌面操作系统软件（兆芯版）V7.0（Build61）: 3.10.0-862.9.1.nd7.zx.18.x86_64
中标麒麟高级服务器操作系统软件V7.0U6: 3.10.0-957.el7.x86_64

Table 12 Supported Linux Versions

5.2 System Software

When using JY-6302 in the Window enviornment, you need to install the following software from Microsoft:

Visual Studio Version 2015 or above,

.NET version is 4.0 or above.

.NET is coming with Windows 10. For Windows 7, please check .NET verson and upgrade to 4.0 or later version.

Given the resouces limitation, JYTEK only tested JY-6302 modules with .NET 4.0 with Visual Studio 2015. JYTEK relies on Microsoft to maintain the compatibility for the newer versions.

5.3 C# Programming Language

All JYTEK defaut programming language is Microsoft C#. This is Microsoft recommended programming language in Visual Studio and is particularly suitable for the test and measurement applications. C# is also a cross platform programming language.

5.4 C ++ Programming Language

JYTEK provides QT C++ drivers for C++ programmers. We also provide many QT C++ examples. However, due to our limited resources, we do not support C++ based applications.

5.5 JY-6302 Hardware Driver

After installing the required application development environment as described above, you need to install the JY-6302 hardware driver.

JYTEK hardware driver has two parts: the shared common driver kernel software (FirmDrive) and the hardware specific driver software.

Common Driver Kernel Software (FirmDrive): FirmDrive is the JYTEK's kernel software for all hardware products of JYTEK instruments. You need to install this kernel software before using any other JYTEK hardware products. FirmDrive only needs to be installed once. After that, you can install the hardware specific driver.

Hardware Specific Driver: Each JYTEK hardware has a C# hardware specific driver. This driver provides rich and easy-to-use C# interfaces for users to operate various JY-6302 function. JYTEK has standardized the ways JYTEK and other vendor's DAQ cards are used by providing a consistant user interface, using the methods, properties and enumerations in the object-oriented programming enviornment. Once you get yourself familiar with how one JYTEK DAQ card works, you shoud be albe to know how to use all other DAQ hardware using the same methods.

5.6 Install the SeeSharpTools from JYTEK

To efficiently and effectively use JY-6302 boards, you need to install a set of free C# utilities from JYTEK SeeSharp Test and Measurement platform. The SeeSharp platform offers rich user interface functions you will find convenient in developing your applications. They are also needed to run the examples come with JY-6302 hardware.

Please register and down load the latest SeeSharpTools from our website www.jytek.com.

5.7 Running C# Programs in Linux

Most C# written programs in Windows can be run by Microsoft Mono development system in a Linux enviornment. You would develop your C# applications in Windows using Visual Stuido. Once it is done, run this application in the Mono environment. This is JYTEK recommended way to run your C# programs in a Linux environment.

If you want to use your own Linux development system other than Mono, you can do it using our Linux driver. However, JYTEK does not have the capability to support the Linux applications. JYTEK completely relies upon Microsoft to maintain the cross-platform compatibility between Windows and Linux using Mono.

6. Operating JY-6302 Module

This chapter provides the operation guides for JY-6302, including thermocouple input and programmable I/O interface, etc.

JYTEK provides extensive examples, on-line help and documentation to assist you to operate a JY-6302 module. JYTEK strongly recommends you go through these examples before writing your own application. In many cases, an example can also be a good starting point for a user application.

6.1 Quick Start

After you have installed the driver software and the SeeSharpTools, you are ready to use Visual Stuidio and our C# measurement and control platform tools (SeeSharp Platform) to operate the JY-6302 board.

If you are already familiar with Microsoft Visual Studio and C# programming, the quickest way to use JY-6302 cards is to go through our extensive examples. We provide source code of our examples. In many cases, you can modify the source code and start to write your applications.

6.2 AI Operations

The generic AI (ananlog input) operations are for the voltage measurements. When performing AI operations, it will be helpful if you understand the characteristics of the signal to be acquired, then configure JY-6302 accordingly. Once configured, you can use our tools to read data and save it in the memory or on a disk for your future analysis. Please see the provided software examples for more information.

6.2.1 Channel Scan Sequence

The scanning order of the channels is related to the order in which the user adds channels. When the acquisition task starts, the channels added by the user will be assigned to each ADC according to the group to which they belong. Each ADC will automatically switch channels through the multiplexer to traverse all the enabled channels of the ADC for A/D conversion.

For a single ADC, the scan order is always consistent with the order in which the channels within the ADC grouping are added. However, since the four ADCs work at the same time, the scanning order of all channels does not necessarily coincide with the order in which the user adds channels.

Figure 7 shows a typical channel scan sequence. In this case, the user adds all channels (Ch0~Ch31) in sequence, and these channels are automatically assigned to four ADCs. At the beginning of the acquisition task, each ADC will start working at the same time, converting the channels in its group in turn.

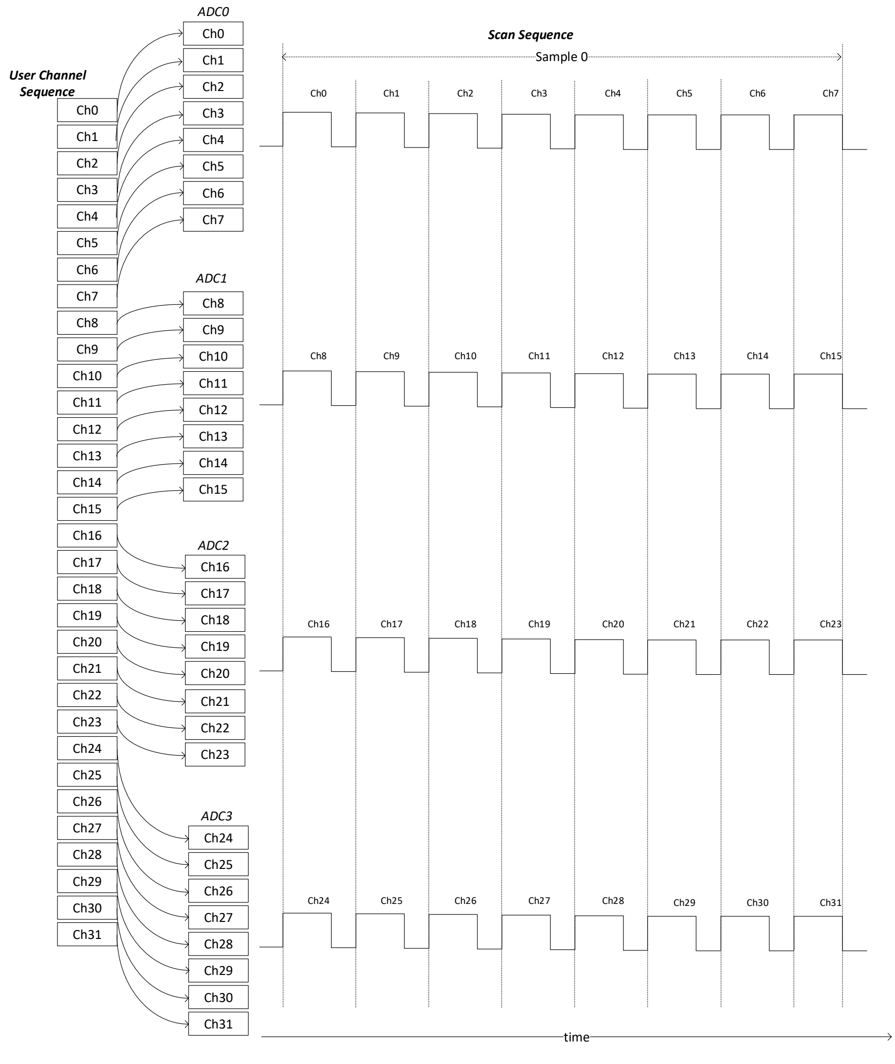


Figure 7 Typical channel scan sequence

Figure 8 shows a random channel scan sequence, in which case the user added some channels in random order.

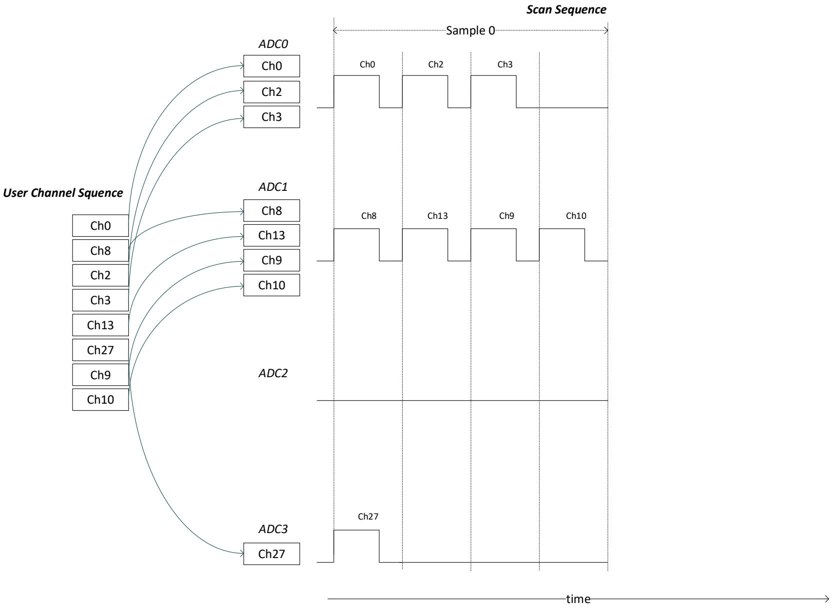


Figure 8 Random channel scan sequence

When using the driver, although the scan order of the channels does not necessarily match the order of adding channels, the data is automatically reordered internally by the driver, so the order of the data of each channel's reading data will always be the same as the order of added channels.

6.2.2 Sample Rates and Noise Reduction

JY-6302 offers 6 fixed sample rates as shown in Table 1. When a user select a sampe rate, the driver software will use it if it is one of these 6 sample rates. If it is not, the driver software will use the next higher sample rate. For example if the user select 500Hz sample rate, the driver will use the 800Hz sample rate.

It is important that the user knows the actual sample rate used by the driver software.

The lower the sampling rate, the better it rejects 50 Hz / 60 Hz interference and the out-of-band noise.

Learn by Example 6.2

- Connect the K-type Thermocouple's positive pole and negative pole to Terminal

Block's TC1+ (Pin#37) and TC1- (Pin#3);

- Open **Winform AI Continuous Raw Data**. Set the other parameters as shown;

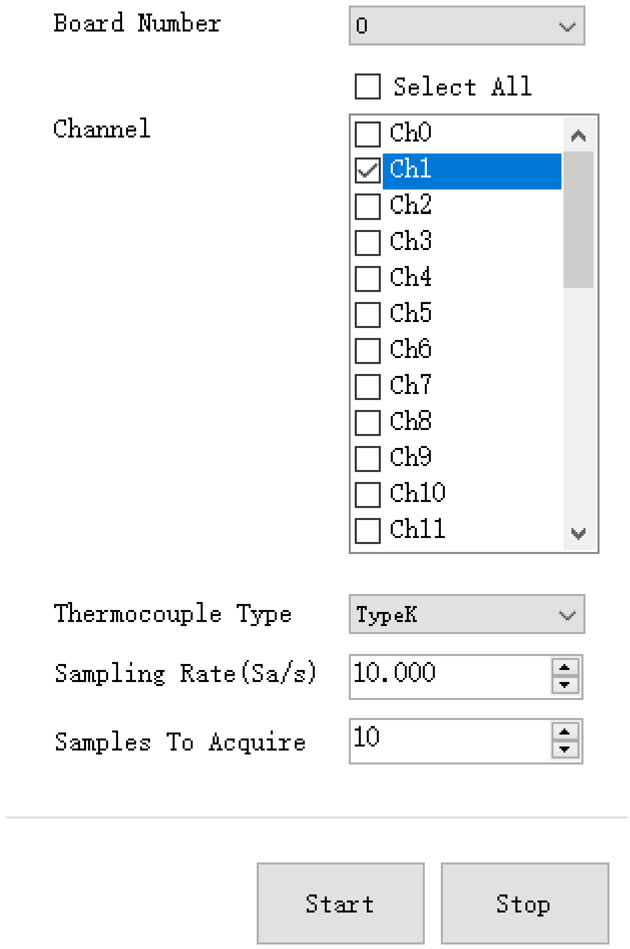


Figure 9 AI Continuous Raw Data Paraments

- Click **Start**. The result is shown below.

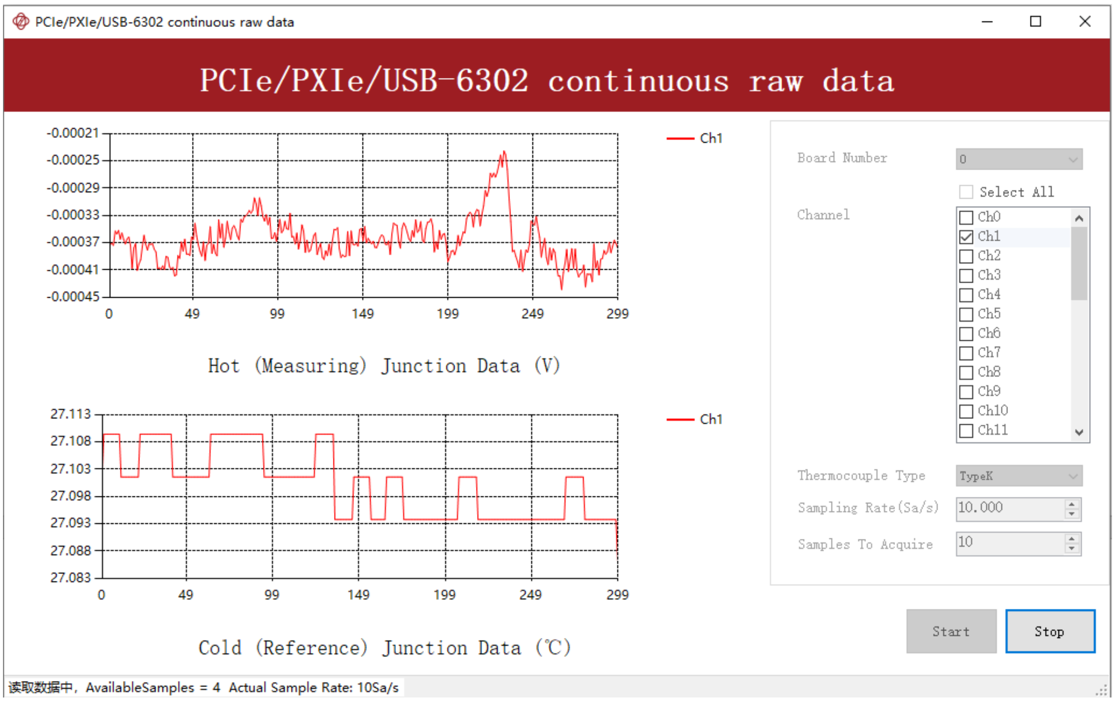


Figure 10 Continuous Raw Data Acquisition

6.3 Cold-junction compensation

JY-6302 is equipped with a dedicated terminal block TB-68CJ, and two TB-68CJ terminal boxes provide a total of 8 cold-junction temperature measurement.

There are four temperature sensors evenly distributed on each TB-68CJ, and each temperature sensor is responsible for the cold-junction temperature measurement of the four channels adjacent to it.

When the user starts a task, JY-6302 will simultaneously scan the cold-junction temperature (reference temperature) and store the data in the onboard memory. When the user reads the data, the JY-6302 driver will automatically pair the measurement channel data with the cold-junction channel data for cold-junction compensation.

Terminal block connection automatic detection

JY-6302's pins include the power and communication interface of the TB-68CJ. The software driver can check whether the TB-68CJ is properly connected.

When the acquisition task is started, the driver will automatically confirm whether the TB-68CJ on the two connectors are connected reliably. If the TB-68CJ is detected as not connected, but the channel belonging to the terminal block is added, the task is not allowed to start and an exception will be thrown.

Customized cold-junction temperature

The JY-6302 driver allows the user to customize the cold junction temperature for each channel. To use this function, you should disable the build-in cold-junction compensation (set the property *BuildInCJCEnabled* to *False*) before start the task, and call the function *SetRJTemperature* to set the cold-junction temperature after starting the task and before reading the data.

Unlike the build-in CJC, this customized cold-junction temperature data is not synchronized with the hot-junction temperature data, but takes effect every time the *ReadData* function is called.

Learn by Example 6.3

- Connect the K-type Thermocouple's positive pole and negative pole to Terminal

Block's TC1+ (Pin#37) and TC1- (Pin#3);

Terminal block connection automatic detection

- Open **Winform Terminal Block State;**
- Set other parameters as shown and click **Connect**, the result is shown below.

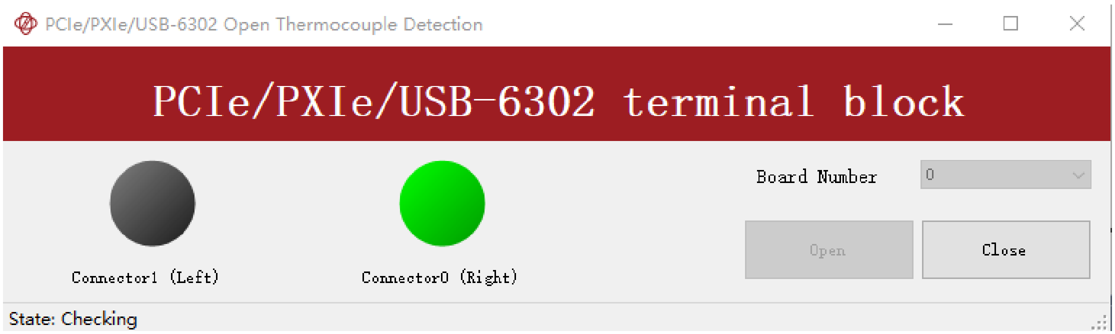


Figure 11 Terminal Block State Check

- **Connectors** show the working state of the **Terminal Block.**

6.4 Open Thermocouple Detection

The thermocouple open circuit detection function is provided in the driver to help the user detect the connection status of the thermocouple.

When the user calls the method PerformOpenThermocoupleDetection, JY-6302 outputs 0.5 μA/ 2 μA/ 4 μA (software configurable) excitation current on all TC+ terminals, traversing each enabled channel for voltage acquisition. This method returns a *Dictionary* that represents the open-circuit detection results for each channel.

Learn by Example 6.4

- Connect the K-type Thermocouple's positive pole and negative pole to Terminal Block's TC1+ (Pin#37) and TC1- (Pin#3);;
- Open **Winform Open Thermocouple Detection;**
- Choose Channels in **Channel ID.**
- Set other numbers as shown and click **Detect**, the result is shown below.

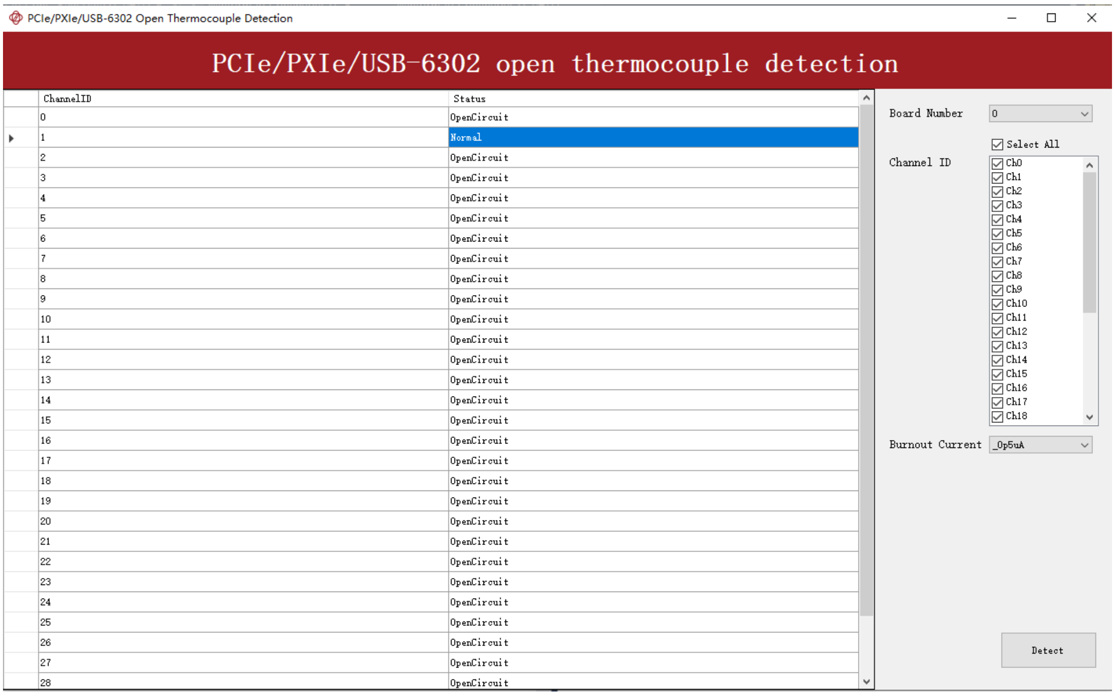


Figure 12 Open Thermocouple Detection

➢ **Status** indicates the current working state of the channel.

6.5 Trigger Source

6.5.1 Immediate Trigger

The module will acquire the signal immediately after executing the acquisition without any trigger condition setting by default.

6.5.2 Software Trigger

The anglog acquisition task will wait in the software trigger mode until receiving a software trigger signal from driver, then will start to acquire the data.

6.5.3 External Digital Trigger

The module supports different external digital trigger sources from PXI Trigger bus (PXI_TRIG<0..7>), PXI_STAR and connectors of front panel (PFI). The high pulse width of digital trigger signal must be longer then 20 ns for effective trigger. The module will monitor the signal on digital trigger source and wait for the rising edge or falling edge of digital signal which depends on the set trigger condition, then causes the module to acquire the data as shown in Figure below:

Figure 13 Rising and falling edges of digital signals

Learn by Example 6.5.3

- Connect the K-type Thermocouple's positive pole and negative pole to Terminal Block's TC1+ (Pin#37) and TC1- (Pin#3), then connect the signal source's positive pole and negative pole to JY-6302 PFI0 (Pin#64) and GND (Pin#30);
- Set the signal source Ch1's output to square wave (f=1Hz, Vpp=5v);
- Open **Winform AI Finite Digital Trigger;**
- Choose **Rising** in **Trigger Condition** and choose **PFI_0** in **Trigger Source;**
- Set other numbers as shown and click **Start.**

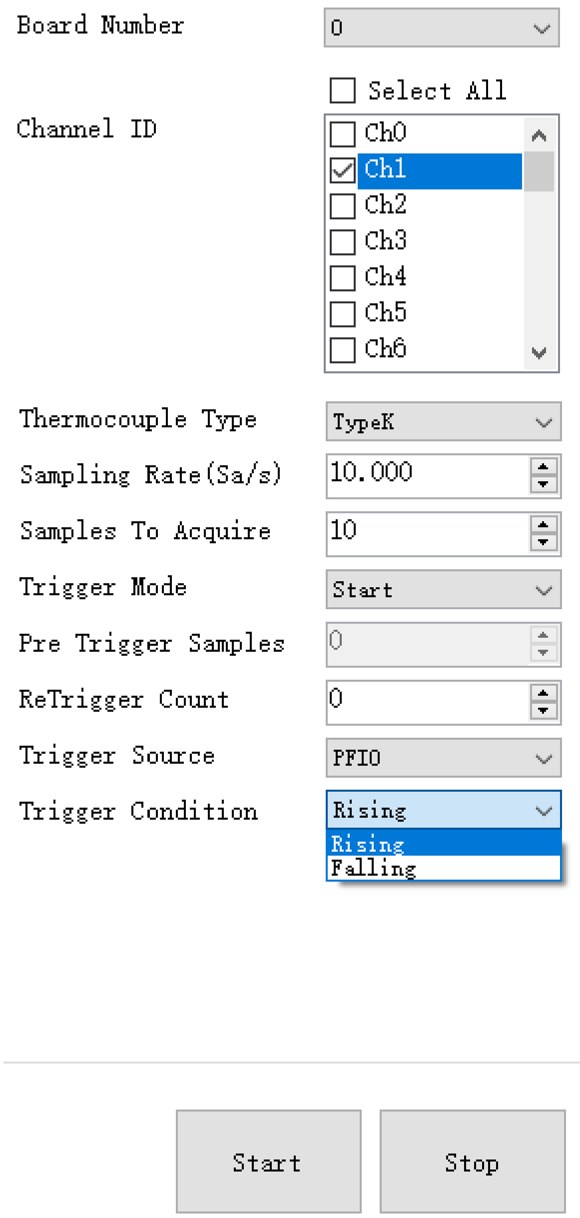


Figure 14 Digital Trigger Paraments

- **Trigger Source** must match the pin on the terminal block.
- There are two **Trigger Conditions**: **Rising** and **Falling**.
  - The result shows below:

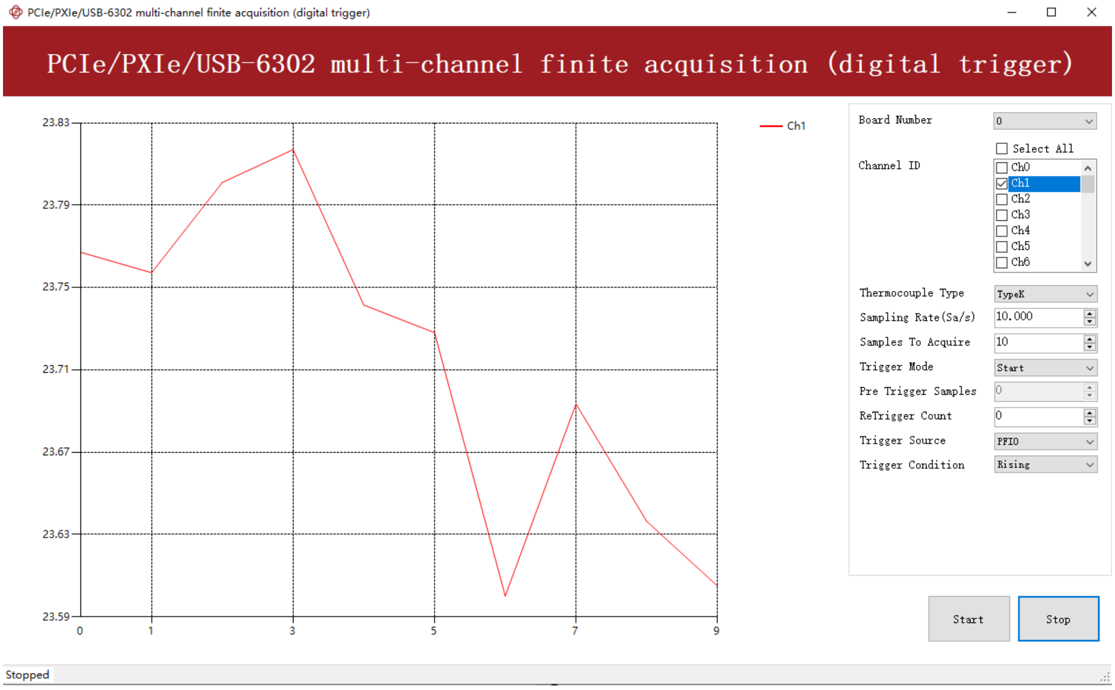


Figure 15 Digital Trigger Acquisition

- Since the squarewave is used for the digital trigger source, when a rising edge of the squarewave occurs, the digital trigger will be activated, and the data acquisition will start.

6.6 **Trigger Mode**

JY-6302 supports several trigger modes: Start Trigger, Reference Trigger and Retrigger.

6.6.1 Start Trigger

In this mode, the analog acquisition task will start to acquire the signal immediately after the trigger asserted as shown in Figure . The Start Trigger mode is suitable for continuous acquisition and finite acquisition mode.

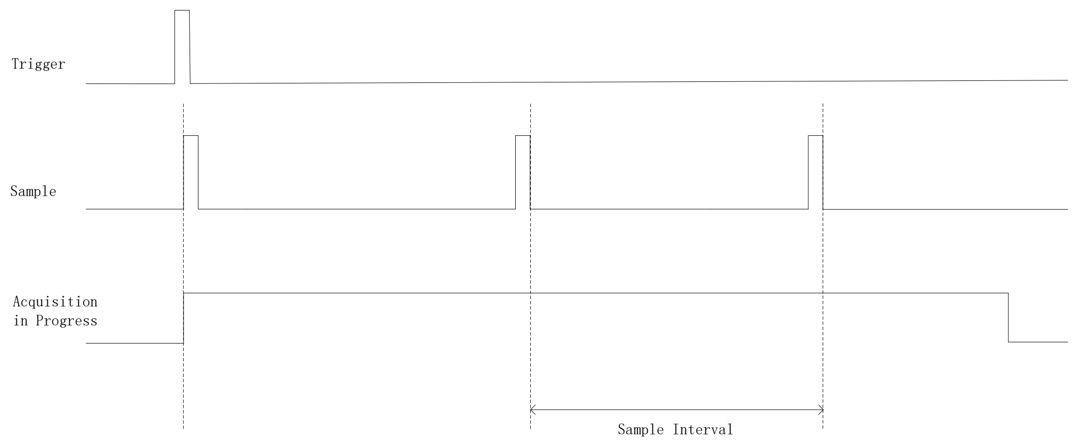


Figure 16 Start Trigger mode

Learn by Example 6.6.1

- Connect the K-type Thermocouple's positive pole and negative pole to Terminal Block's TC1+ (Pin#37) and TC1- (Pin#3);
- Open **Winform AI Continuous,** set the following numbers as shown;

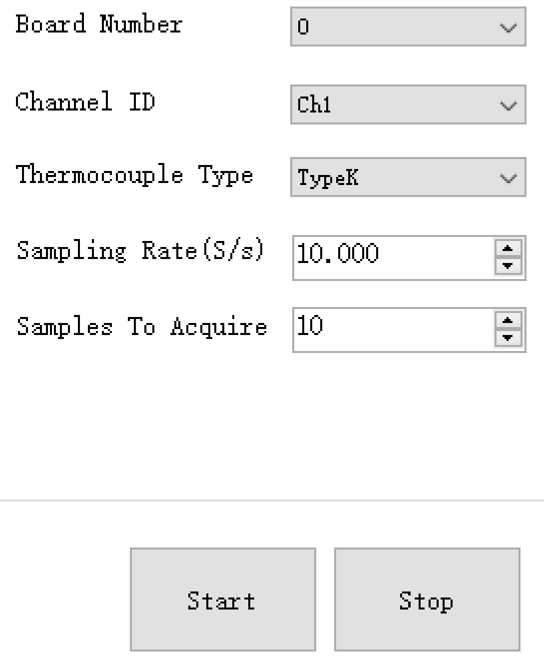


Figure 17 AI Continuous Paraments

- When **Start** is clicked, it generates a start trigger, which starts the acquisition. The result is shown below.

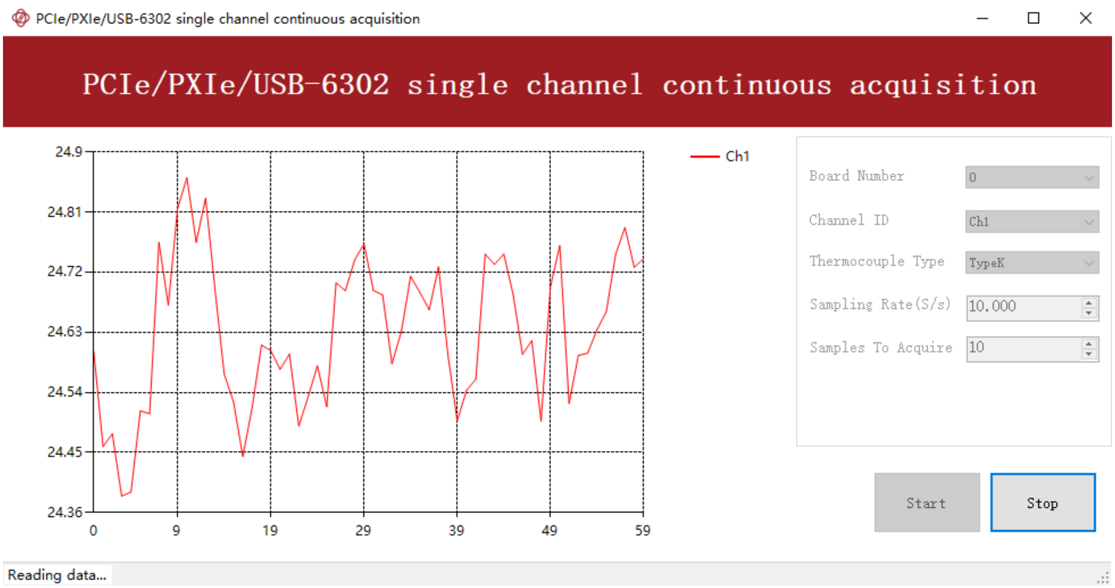


Figure 18 Signel Channel Continuous Acquisition

6.6.2 Reference Trigger

User can configure a trigger condition and acquire the data between trigger asserted in the Reference Trigger mode. Data acquired before trigger occurred is pretrigger samples. Data acquired after trigger occurred is posttrigger samples. User can configure two parameters, “PretriggerSamples” and “SamplesToAcquire” to capture specified data as shown in **错误!未找到引用源。**.

This trigger mode is only suitable for finite acquisition mode. The default number of pretrigger samples is 0.

- SampleToAcquire: 1000
- PreTriggerSamples: 10
- Posttrigger samples: 1000 - 10 = 990

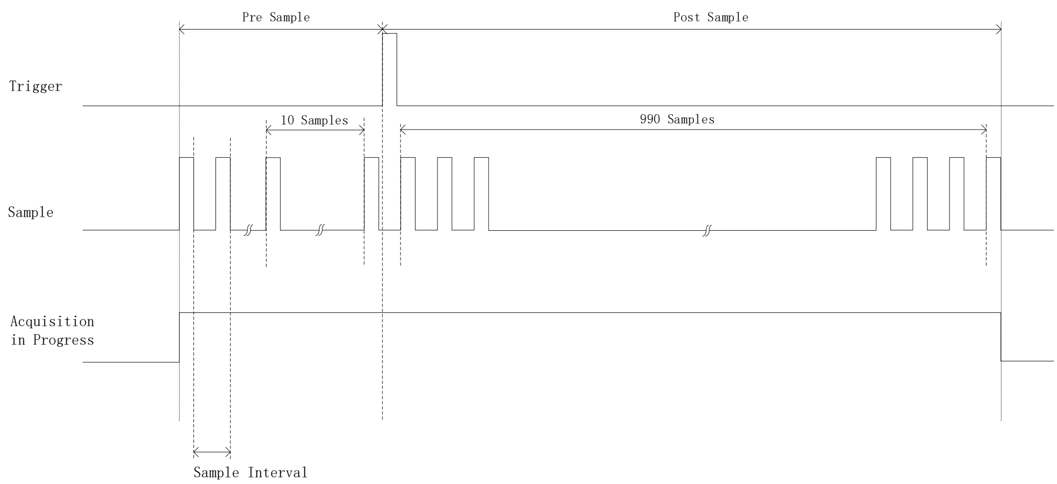


Figure 19 Reference Trigger mode

6.6.3 Retrigger

User can configure a specified trigger condition and repeat trigger times to capture signal. The number of repeat trigger times is set by the parameter “ReTriggerCount”. For example, we set the ReTriggerCount to N and the length of each acquisition to M, therefore the total acquired samples is N * M * channelcounts as shown in Figure .

Note, Retrigger mode is only valid in finite acquisition mode.

When the retriggering number is set to - 1, it will wait on trigger infinitely until aborting the task.

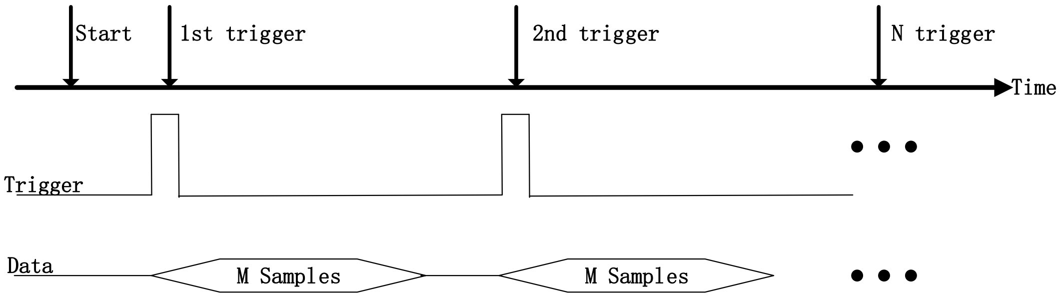


Figure 20 Retrigger mode

Learn by Example 6.6.2 and 6.6.3

- Connect the K-type Thermocouple’s positive pole and negative pole to Terminal Block’s TC1+ (Pin#37) and TC1- (Pin#3), then connect the signal source’s positive pole and negative pole to JY-6302 PFI 1 (Pin#65) and GND (Pin#31);
- Set the signal source Ch1’s output to squarewave signal (f=4Hz, 0-5V).
- Open **Winform AI Finite Digital Trigger**, set the following numbers as shown.

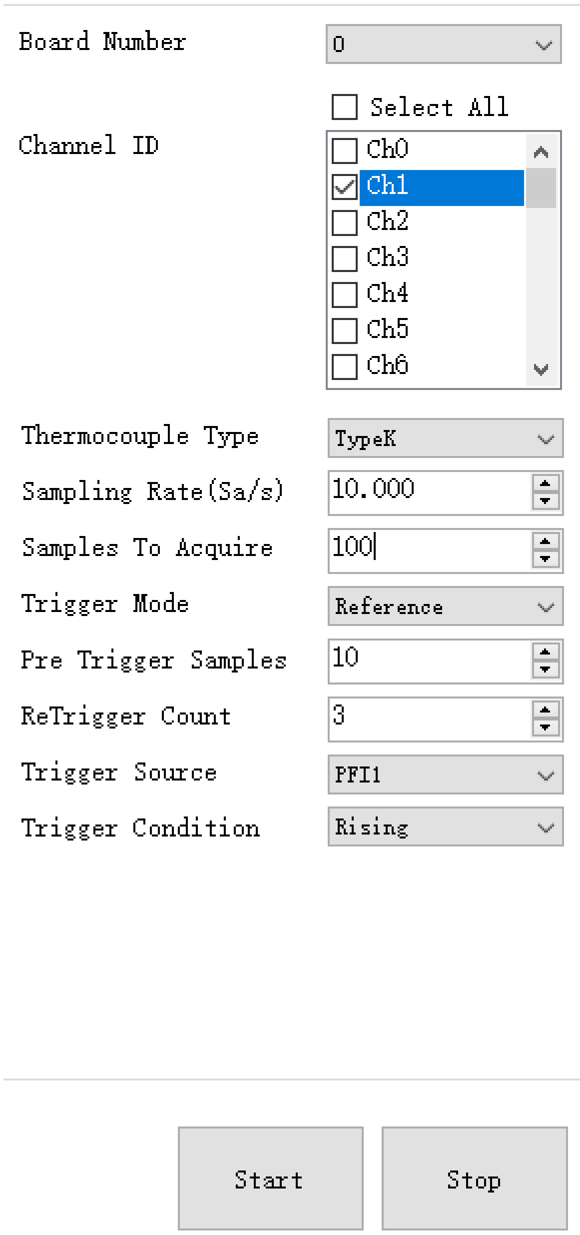


Figure 21 Retrigger Paraments

- You can use three different kinds of triggers in this program as mentioned in this chapter. *Start Trigger* and *Reference Trigger* can be set by **Trigger Mode**. For *Re-Trigger* it can be used by changing the numbers in **Retrigger Count**.
  - Now the **Trigger Mode** is "**Reference**", and the **PreTrigger Samples** are 10. Click **Start** to begin the data acquisition, the result is shown below:

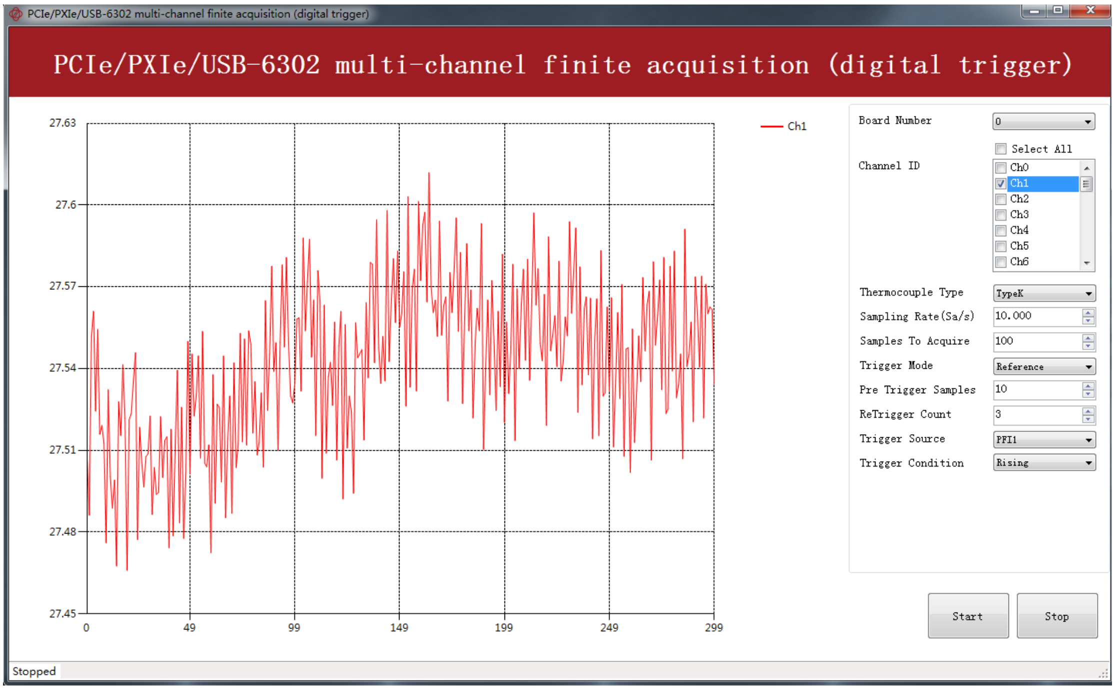


Figure 22 Retrigger In Reference Trigger Mode

- Because the measured waveform is an irregular continuous line, the effect of **Trigger mode** change can not be seen clearly.

  - Now change the mode of trigger to *Retrigger* through giving **Retrigger Count** the number 3 and click **Start**. A message will appear in the lower left corner: "Samples acquired: 200/300".

Figure 23 Retrigger Complete State

- It shows the acquisition process through every trigger signal.

6.7 System Synchronization Interface（SSI）for PCIe Modules

The synchronization between PCIe modules are handled differently from the PXIe synchronization, it is implemented by the system synchronization interface (SSI). SSI is designed as a bidirectional bus and it can synchronize up to four PCIe modules. One PCIe module is designated as the master module and the other PCIe modules are designated as the slave modules.

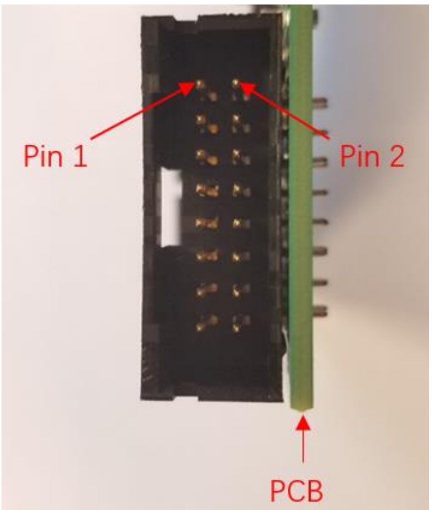


Figure 24 SSI Connector in PCIe-6302

Pin	Signal Name	Signal Name	Pin
1	PXI_TRIG0	GND	2
3	PXI_TRIG1	GND	4
5	PXI_TRIG2	GND	6
7	PXI_TRIG3	GND	8
9	PXI_TRIG4	GND	10
11	PXI_TRIG5	GND	12
13	PXI_TRIG6	GND	14
15	PXI_TRIG7	GND	16

Table 13 SSI Connector Pin Assignment for PCIe-6302

6.8 DIP Switch in PCIe-6302

PCIe-6302 series Module has a DIP switch. The card number can be adjusted manually by changing the DIP switch setting, which is used to identify the boards with different slot position.

For example, if you want to set the card number to 3, you could turn the position 2 and 1 of the DIP switch to the ON position and the orthers to OFF. Find the detail below.

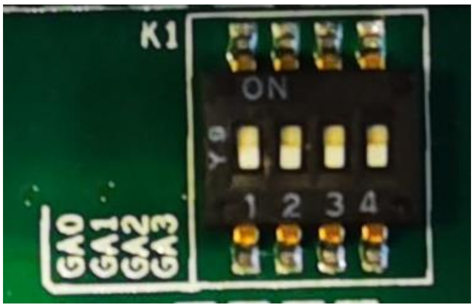


Figure 25 DIP Switch in PCIe-6302

	Position 4 (GA3)	Position 3 (GA2)	Position 2 (GA1)	Position 1 (GA0)
Slot 0	0	0	0	0
Slot 1	0	0	0	1
Slot 2	0	0	1	0
Slot 3	0	0	1	1
Slot 4	0	1	0	0
Slot 5	0	1	0	1
Slot 6	0	1	1	0
Slot 7	0	1	1	1
Slot 8	1	0	0	0
Slot 9	1	0	0	1
Slot 10	1	0	1	0
Slot 11	1	0	1	1
Slot 12	1	1	0	0
Slot 13	1	1	0	1
Slot 14	1	1	1	0
Slot 15	1	1	1	1
Note: OFF=0/ ON=1				

Table 14 Relationship between switch position and slot number

7. Calibration

JYTEK 6302 boards are precalibrated before the shipment. We recommend you recalibrate JY-6302 board periodically to ensure the measurement accuracy. A commonly accepted practice is one year. If you need to recalibrate your board, please contact JYTEK.

8. Using JY-6302 in Other Software

While JYTEK's default application platform is Visual Studio, the programming language is C#, we recognize there are other platforms that are either becoming very popular or have been widely used in the data acquisition applications. Among them are Python, C++. This chapter explains how you can use JY-6302 DAQ card using one of this software.

8.1 Python

JYTEK provides and supports a native python driver for JY-6302 cards. There are many different versions of Python. JYTEK has only tested in CPython version 3.5. There is no guarantee that JYTEK python drivers will work correctly with other versions of Python.

If you want to be our paNEGer to support different Python platforms, please contact us.

9. Appendix

9.1 Connecting Thermocouple

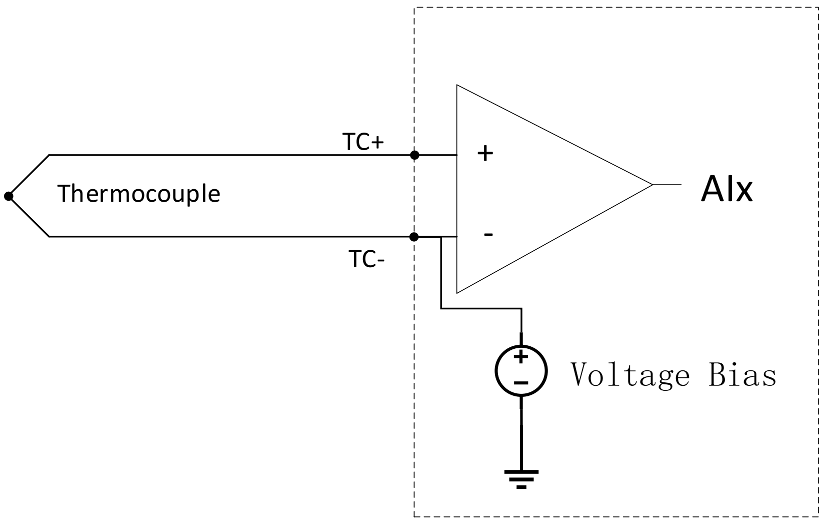


Figure 26 Themocouple connection

Figure shows a typical connection between JY-6302 and the thermocouple. This connection method ensures that the common mode voltage between JY-6302 and the thermocouple is maintained within a reasonable range by applying a suitable voltage bias to the TC- terminal, instead of using a common reference ground signal (a wire connects the reference potential point of the measuring device to the reference potential point of the measuring device).

9.1.1 Voltage Bias

The selection of voltage offset is an important issue. In the selection process, the input signal amplitude of the thermocouple sensor and the amplified signal amplitude should be taken into account to adapt to the working characteristics of the typical AD acquisition circuit, so as to obtain an ideal dynamic range and accuracy.

JY-6302 uses an asymmetrical power rail design (the midpoint voltage value is used as the voltage offset), and can adjust its own circuit configuration to achieve the best state according to the type of input sensor and signal conditions. In these configurations, the voltage bias is greater than 0V of the reference level. Therefore, the voltage bias of JY-6302 series input modules is not connected to the internal reference "ground" under any circumstances.

9.1.2 Thermocouple Simulator

JY-6302 does not support the use of thermocouple simulator. If a thermocouple simulator whose output level refers to its own "ground" is connected to a JY-6302 series thermocouple temperature input module, JY-6302 circuit will bias its "ground" network to its own non-"ground" level, resulting in Various problems occur (usually resulting in inaccurate measurement results and increased measurement noise).

If you need to use a thermocouple simulator with the data acquisition system, it is recommended to select a thermocouple acquisition module, a DAQ module with a small-scale AI acquisition function, or an isolated input AI acquisition module according to the characteristics of the thermocouple simulation equipment.

9.2 Thermocouple Measurement Noise

Thermocouple measurement of temperature is a common temperature measurement method, which is widely used in industrial production, environmental testing and other fields. The use of thermocouples for temperature measurement is convenient and accurate, which can effectively measure temperature. However, in actual use, the complex working environment will generate various noises and affect the thermocouple measurement results.

Thermocouple is composed of two different metals fused at one end. When the temperature of the contact point changes, a nonlinear voltage is generated on the thermocouple wire in response to the temperature, but the voltage generated by the thermocouple is only in the millivolt range. As the voltage changes, a little noise can have a big impact on the measurement. There are three main sources of noise that affect thermocouple measurements: common mode noise、normal mode noise and electrostatic noise.

9.2.1 Common Mode Noise

Common mode noise can create unwanted voltages on both leads of the thermocouple. Common mode noise is generated by the ground loop. Since the thermocouple contact is a bare wire junction, if the contact is grounded at the measured temperature and there is a potential difference with the ground of the thermocouple measurement end, a ground loop through which current flows will be formed. As shown in Figure .

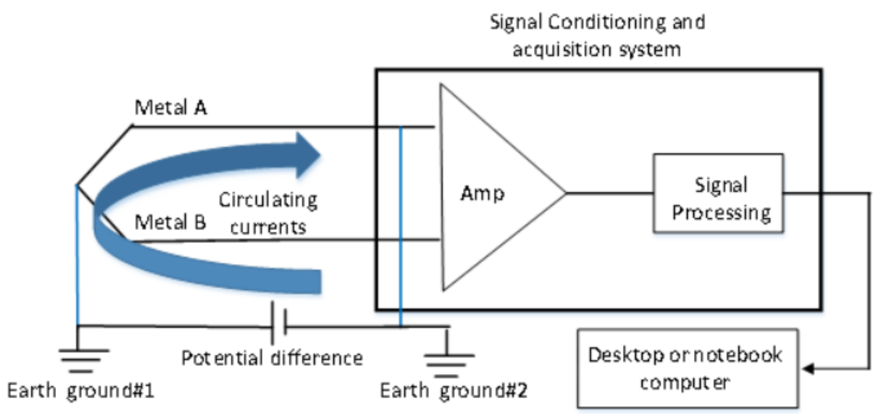


Figure 27 Ground loops generate common mode noise

The best way to prevent ground loops is to use an isolated thermocouple that avoids grounding the thermocouple junction.

9.2.2 Normal Mode Noise

Normal mode noise is typically generated by large AC power supplies that create magnetic fields that induce currents in the measurement loop. This noise generates current in the same direction as the measurement current. As shown in Figure .

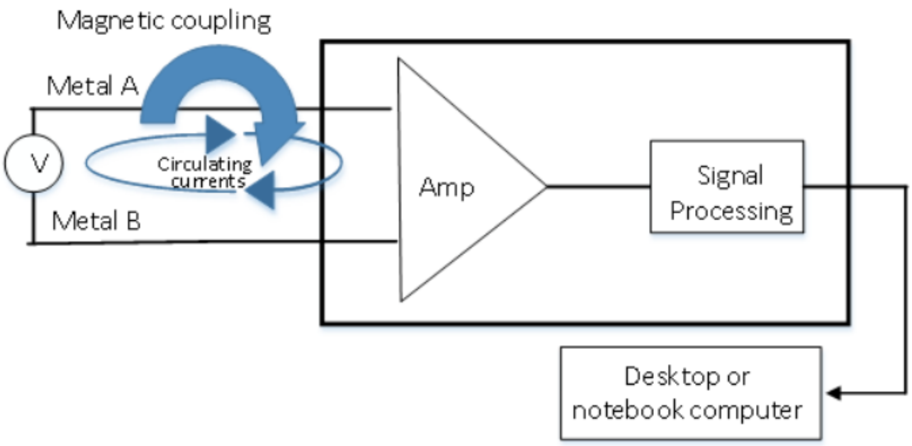


Figure 28 Magnetic field produces normal mode noise

Solutions to reduce conventional noise:

- Reduce the interference of the magnetic field strength on the measurement. It is best to use multiple sets of leads and avoid the thermocouple wire going through the magnetic field;
- Minimize measurement loops. Use twisted pair cables with small gaps between cables;
- Let the measurement line intersect the high current line perpendicularly, thereby changing the direction of the magnetic field. Do not run thermocouples in parallel with power lines or other noisy signal lines.
- The normal mode current is reduced by filtering.

9.2.3 Electrostatic Noise

Electrostatic noise is noise coupled into the measurement path through parasitic capacitance. Electrostatic noise is caused by rotating equipment, generating AC currents that couple capacitively into the measurement path. Parasitic capacitance couples into electrostatic noise through the thermocouple junction, as shown in Figure .

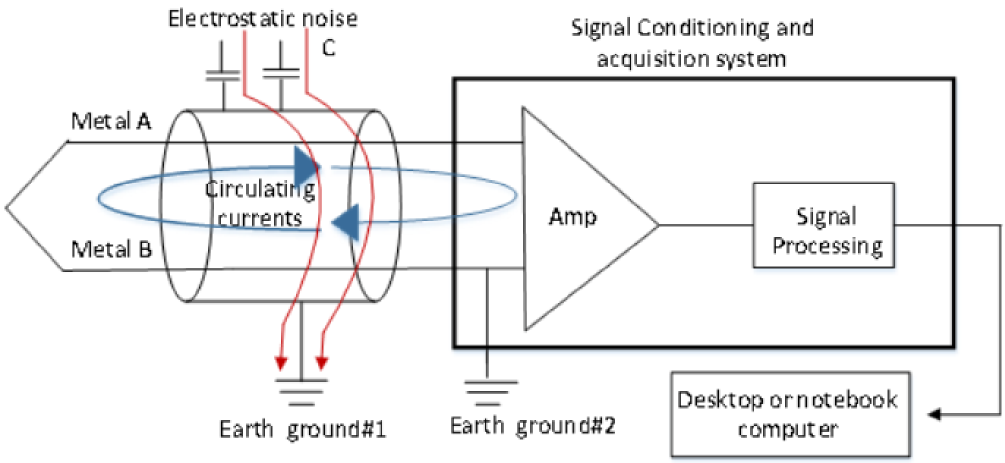


Figure 29 Electrostatic Noise Coupling into Thermocouples

The solution is to use shielded wires to suppress static noise. When shielding to prevent electrostatic noise coupling, ground one end of the shield to prevent loops.

In order to better perform temperature measurement and make the measurement results effectively applied, the influence of noise should be considered in the measurement of environmental conditions, and an environment with lower noise should be selected as much as possible, or the influence of noise should be reduced through reasonable measurement arrangement.

9.3 **Influence of Thermocouple Type on Measurements**

A thermocouple is a temperature measuring element made by using the principle of thermoelectric effect. The thermocouple probe is formed by thermocouple wire built into metal tube. Thermocouple can be divided into three types according to the type of connection point:grounded、exposed and ungrounded. As shown in Figure .

Figure 30 Three Thermocouple Types

Table 15 shows the definitions, advantages and disadvantages of different types of thermocouples, and their corresponding application areas.

Thermocouple Type	Definition	Advantage	Disadvantage	Scope of application
Grounded	The tip of the probe is connected to ground, and the thermocouple is wired to the inside of the probe wall	Good thermal conductivity and fast response	Inaccurate readings due to noise caused by ground loops	Mostly used to measure the temperature of static or flowing corrosive gases and liquids
Exposed	The thermocouple in the form of a bare joint sticks out of the sheath tip and is exposed to the surrounding	Short response time when used in non-corrosive and non-pressure environments	Easily affected by external temperature and humidity	Mostly used to measure static or flowing non-corrosive gas temperature
Ungrounded	Thermocouple junction separated from probe wall	Low electrostatic noise interference and high measurement accuracy	Slow response time	Mostly used in corrosive environments

Table 15 Comparison of different thermocouple types

Regarding the choice of thermocouple type, we give some suggestions:

- Identify application scenarios where thermocouples are used;
- Definite measurement temperature range;
- Chemical resistance of thermocouple or sheath material. Exposed thermocouples are limited to non-corrosive applications. Either grounded or ungrounded thermocouples can be used in corrosive or high voltage environments, and a grounded thermocouple is preferred if faster response is a priority in a corrosive environment.;
- Ungrounded thermocouples have the slowest response, but are still the best choice if electrical isolation and shielding of the thermocouple from the sheath is also required
- Installation requirements (device compatibility, etc.);

9.4 Thermocouple Installation Method

A thermocouples must be correctly installed to achieve good and intended measurement results. The following points should be paid attention to during installation:

- Insertion depth, the thermocouple measuring end is inserted into the temperature position of the measured medium;

- Thermocouples need to be compatible with existing equipment, e.g. existing holes determine the diameter of the probe;
- Installation angle, the thermocouple installation should be kept as vertical as possible, if there is a flow velocity, the thermocouple installation should be inclined 45°;
- For the installation location, try to choose a location away from heat sources, electric fields and strong magnetic fields.

10. About JYTEK

10.1 JYTEK China

Founded in June, 2016, JYTEK China is a leading Chinese test & measurement company, providing complete software and hardware products for the test and measurement industry. The company has evolved from re-branding and reselling PXI(e) and DAQ products to a fully-fledged product company. The company offers complete lines of PXI, DAQ, USB products. More importantly, JYTEK has been promoting open-sourced based ecosystem and offers complete software products. Presently, JYTEK is focused on the Chinese market. Our Shanghai headquarters and production service center have regular stocks to ensure timely supply; we also have R&D centers in Xi'an and Chongqing. We also have highly trained direct technical sales representatives in Shanghai, Beijing, Tianjin, Xi'an, Chengdu, Nanjing, Wuhan, Guangdong, Haerbin, and Changchun. We also have many patners who provide system level support in various cities.

10.2 JYTEK Software Platform

JYTEK has developed a complete software platform, SeeSharp Platform, for the test and measurement applications. We leverage the open sources communities to provide the software tools. Our platform software is also open sourced and is free, thus lowering the cost of tests for our customers. We are the only domestic vendor to offer complete commercial software and hardware tools.

10.3 JYTEK Warranty and SupportServices

With our complete software and hardware products, JYTEK is able to provide technical and sales services to wide range of applications and customers. In most cases, our products are backed by a 1-year warranty. For technical consultation, pre-sale and after-sales support, please contact JYTEK of your country.

11. Statement

The hardware and software products described in this manual are provided by JYTEK China, or JYTEK in short.

This manual provides the product review, quick start, some driver interface explaination for PCIe/PXIe-6301 family of temperature sensor data acquisition cards. The manual is copyrighted by JYTEK.

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While we try to keep this manual up to date, there are factors beyond our control that may affect the accuracy of the manual. Please check the latest manual and product information from our website.

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