VK701H+ USB high-speed 24-bit DAQ

Hardware Manual V1.30

Shenzhen Vkinging Electronics Co.,Ltd

——Precision Accurate Fast Reliable

VK701H+ Applications

- Weak Signal Measurement Acquisition

- High resistance differential signal measurement

- IEPE/ICP sensor measurement

- 0~20mA current to voltage measurement

- High-division resolution signal measurement

Directory

1.Product Introduction

1.1 Characteristics

VK701H+ is a USB-type high-speed data acquisition card with 4-channel single-ended to differential inputs, 24-bit resolution, single-channel 102.4KS/s, maximum sampling rate of 409.6KS/s, precision preamplification, USB optical isolation, USB power supply isolation protection and other features.This product uses a number of high-precision 24-bit ADC unit and with the front differential amplifier module, making the product has a high speed, high resolution, high accuracy, ultra-low noise, high rejection ratio, wide measurement range, low temperature drift advantages, suitable for precision and high speed acquisition of a variety of occasions. Acquisition card expansion for the series version, optional LAN type: Ethernet version see VK701N, WIFI high-speed transmission type see VK701W.

VK701H+ capture card adopts full metal shielding, which can be adapted to the application of strong industrial interference occasions, and has the advantages of moisture-proof, shock-proof and anti-interference.

1.2 List of characteristics

High precision and high resolution	24-Bit resolution
Ultra-low noise preamplification	Measures signals down to uV
High-speed synchronised acquisition	Single-channel up to 102.4ksps (102.4 thousand samples per second), and 409.6ksps when operating in 4-channel mode.
IEPE/ICP support	Each channel can independently switch IEPE/ADC/0~20mA
0~20mA to Voltage Support	0~20mA to 0~5V
ADC Infusion Range	0 ~ ± 10V
Counting/Frequency Measurement	Counting or frequency measurement
Integration of 1 DAC output	0~3.3V analogue
Integration of 2 PWM outputs	16-Bit adjustable PWM

Supports temperature and humidity measurement.	Digital Humidity Sensor
Isolated USB Input	Electrical isolation
Metal shielded enclosure	High anti-interference capability

1.3 System block diagram
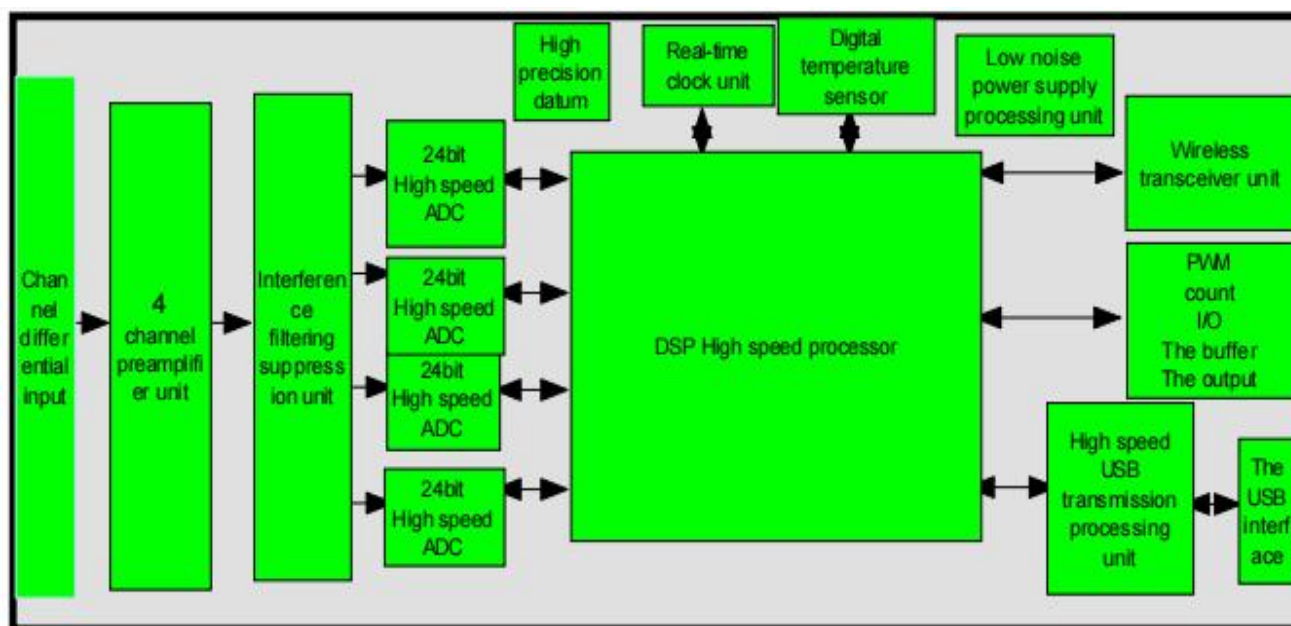
1.4 Port Functions

port number	Name	functionality	note
1	+5V	Digital power supply 5V for digital power supply, can provide up to 50mA load current	
2	DIO1/Aout	Digital power supply 5V for digital power supply, can provide up to 50mA load current	Function 2 choose 1(*Note 1)
3	DIO2/PWM1	DIO 2 - configured as a digital input/output port PWM 1 - configured as a PWM output port	Function 2 choose 1(*Note 2)
4	DIO3/PWM2	DIO 3——configured as a digital input/output port PWM2——configured as a PWM output port	Function 2 choose 1(*Note 2)
5	DIO4/CNT	DIO 4——configured as a digital input/output port CNT——Configured as a counter/frequency meter input port Ext Trig——Configure external trigger acquisition (falling edge trigger)	Function 3 choose 1(*Note 3)
6	DGND	Digital Terrestrial	
1	CH1	Analogue inputs - channel 1	BNC inner core for

2	CH2	Analogue inputs - channel 2	signal, AGND outer
3	CH3	Analogue inputs - channel 3	layer.
4	CH4	Analogue inputs - channel 4	

2. Hardware parameters and interface description

2.1 Product port function description

1） Digital IO port

GND	DIO4 /CNT	DIO2 /PWM	DIO1 /Aout	VCC

2） Acquisition status indicator

3） USB connection indicator

4） USB ports

5） Extended application selection terminal (reserved function)

6） Input Interface
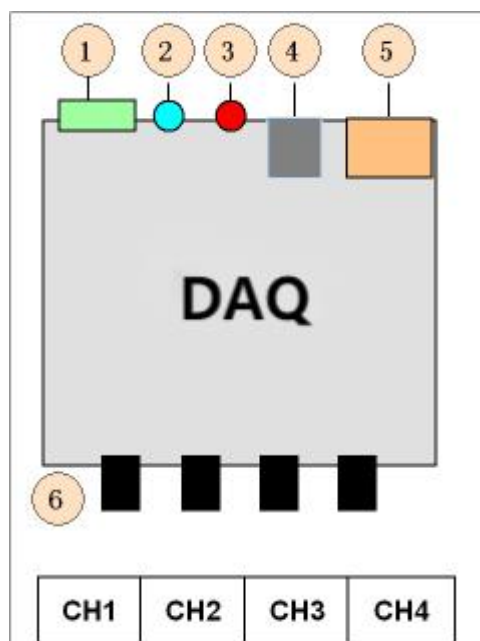
2.2 Integrated electrical parameters

Sports Event	unit (of measure)	Typical values	Scope/Remarks
USB supply voltage	V	5	4.5~5.5
USB power supply current	mA	50	30~100
ADC Analogue Port Input Voltages	V		+/-10
ADC Reference Supply Absolute Accuracy		$\pm$ 0.05%	
ADC Reference Supply Temperature Drift		$\pm$ 3ppm	
ADC Analogue Signal Input Bandwidth	Khz	0~20Khz	20Khz@-3db
ADC Anti-alias Filter Frequency Response		0.2 * fs @ -3db 0.5 * fs @ -10db	fs = Set sample rate

IEPE mode AC coupling low pass frequency	Hz	0.4Hz@ -3db	Note 1
0~20mA Current Mode Load Resistor	Ω	250 ±0.1%	
0~20mA current mode maximum measurable current		25mA	
Anti-alias filter type		Sinc3	
IEPE Driving Voltage	V	24	22~26
IEPE Drive Current	mA	4	3.6~4.4
Digital port input VL low	V	0	-0.3~1
Digital port input VH high	V	3.3	2~5.5
Digital Port Output Voltage	V	3.3	3.2~3.4
Digital port output drive current (when output is high)	mA	10	
Digital port input absorption current (at 5V input voltage)	uA	170	
Digital port (DIO4) triggered acquisition		Falling Edge Trigger	
ADC Maximum Sample Rate	ksps	102.4	4-channel synchronisation
Aout Output Voltage	V		0~3.3
PWM output frequency (P0.2/PWM1, P0.3/PWM2 ports)	Hz		0~100k
PWM duty cycle (P0.2/PWM1, P0.3/PWM2 ports)	%		0~100
Counter input maximum frequency (P0.4/CNT port)	Hz		100K
Counter input maximum count value		2^{64}th power	
USB Isolation Voltage	V	5KV	
Operating Temperature	degrees centigrade		-40~ 85
Storage temperature	degrees centigrade		-40~ 105
Physical dimensions (LWH)	mm	112*80*24	Without connector length

Note 1:The low pass frequency of 0.4Hz@ -3db in IEPE mode means that the turning point of the 0.7x amplitude-frequency characteristic is 0.4Hz, and the corresponding 0.95x is 3Hz@ -0.5db, but the -0.5db parameter is usually not concerned.

In addition, the corresponding 0.95x is 3Hz@ -0.5db, but the -0.5db parameter is usually not a concern.

2.3 Safe use of the absolute maximum

Sports Event	unit (of measure)	numerical value	
USB supply voltage:	V	-1~+6	*Exceeding the absolute maximum value may damage the device and cause irreversible damage.
ADC Analogue Port	V	-15V~+24V	
Digital Ports	V	-1V~+5V	
DAC Output Ports	V	-15V~+15V	
Electrostatic input (ESD) on all ports	V	2000	

2.4 ADC analogue conversion unit

2.4.1 ADC input detailed electrical parameters

Sports Event	Unit (of measure)	Typical Case	Note
Differential Input Common Mode Rejection Ratio (CMRR)	dB	130	
Input Bias Current	nA	1	
Input Bias Voltages	uv	10	
Input Equivalent Voltage Noise	nVp-p	200	Maximum value is 400 when +-10V is selected for the input range.
Input Equivalent Current Noise (IECN)	pAp-p	1	Maximum value is 2
Equivalent Input Capacitance	pF	400	
Input Resistance	GΩ	1	
ADC Reference Accuracy		0.05%	
Overall maximum temperature drift of ADC amplification acquisition unit	ppm/℃	6	

2.4.2 Input Ranges vs. Bottom Noise

Set the value	Corresponding measuring range	Background noise	Note
0	-10V~+10V	0.15mV	@1KS/s
1	-5V~+5V	60uV	
2	-2.5V~+2.5V	35uV	
3	-1V~+1V	16uV	
4	-500mV~+500mV	10uV	
5	-100mV~+100mV	5uV	
6	-20mV~+20mV	4uV	

2.4.3 Sample rate vs. effective resolution

sampling rate	effective resolution(*附 1)	note
1 ~ 4Ksps	21bit	The higher the sampling rate, the higher the noise of the ADC and the surrounding internal devices, and the lower the effective resolution (*Note2).
4K~15Ksps	20bit	
15k~35Ksps	19bit	
35k~64Ksps	17bit	
64k~102.4Ksps	16bit	

Note1：Effective resolution is a characteristic of all ADCs: the last few bits of the ADC bounce back and forth, and the first bits that don't bounce are the effective bits. The bouncing bits are not random but normally distributed, so that the actual physical resolution of 24 bits is meaningful when using digital filtering.
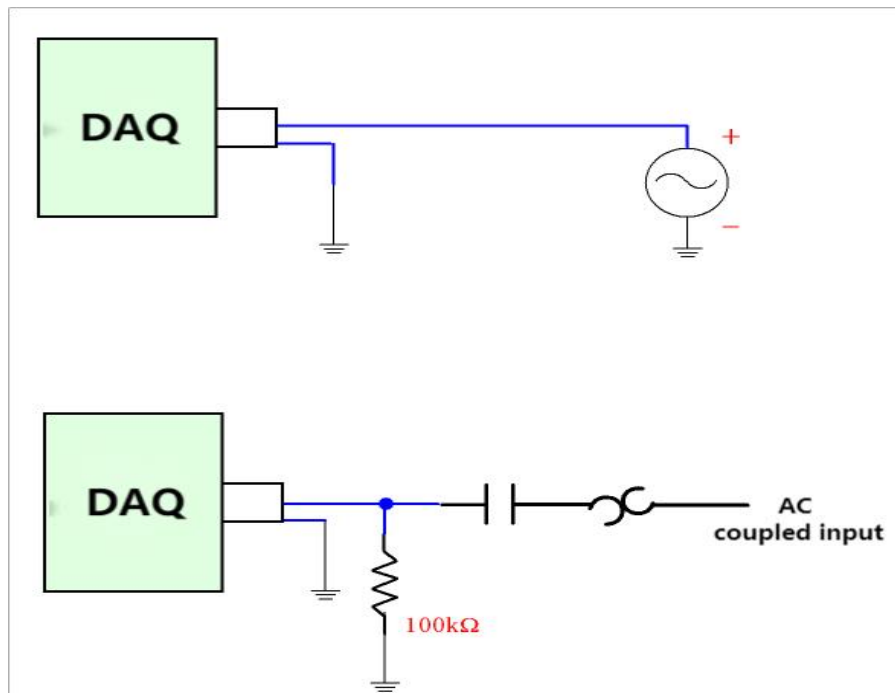
Note2 ： Signal acquisition takes into account both the noise floor of the ADC and the effective resolution corresponding to the sampling rate.

3. Precautions for use

3.1　ADC Voltage Input Modes

The input of the capture card is BNC input, the outer layer is ground and the inner core is signal.

The capture card defaults to ADC mode after power

The card can be switched to different ranges, after switching to the lower range if the input exceeds the range will cause saturation at the edge of the range clipping, will not cause any damage to the card. In other words, the maximum safe voltage for ADC access in different ranges is also ±10V range.

3.2 IEPE/ICP Sensor Access Mode

Schematic diagram of the internal IEPE/ICP drive unit
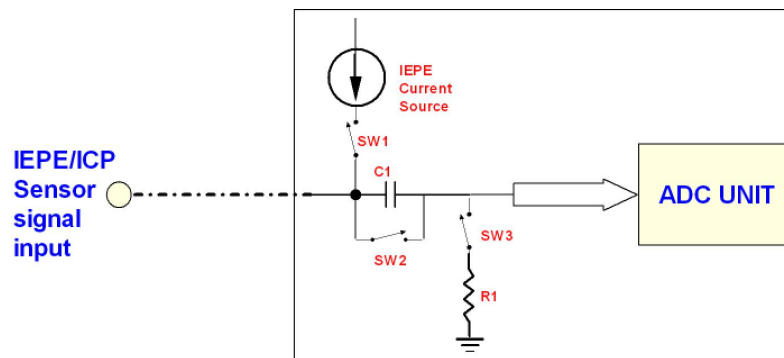
- This capture card has integrated IEPE/ICP hardware function support.
- The acquisition card integrates a 24V power supply unit, a constant current driver and a receiver unit, and each channel can be individually switched to ADC/IEPE/20mA mode by software settings.
- In IEPE mode, the output is 24V 4mA constant current (2mA compatible), and the ADC input is automatically switched to AC coupled input state.
- 4 channels can be independently switched controllable.

3.3 Current 0~20mA mode

The internal integration of 250 ohm high-precision low-temperature-drift current measurement resistor, the acquisition card can be 0 ~ 20mA range of current and voltage conversion.
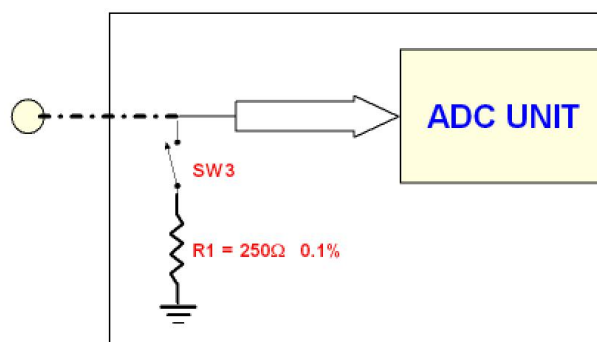
When working in 20mA mode, the outer BNC is negative current and the inner core is positive current. Please make sure the wiring is correct.

*Note: When working in current mode, please pay attention to the positive and negative terminals, each channel has its own protection circuit. However, if the current of multiple channels is reversed at the same time, it will lead to a large current shock inside the card and cause irreversible damage.

- Is recommended to be used with ±5V range in this mode. In this case, 20mA*250Ω = 5V.
- DC coupling in this mode.
- Note the positive and negative poles of the current signal.
- Each channel can be individually switched to ADC/IEPE/20mA mode by software setting.
  *Note: This card receives current, not generates it.

3.4 IO Triggered Acquisition Function of ADCs

This capture card supports external trigger function, and the trigger IO is designated as DIO4 port. After entering the trigger mode in the software setting, the falling edge of the level of DIO4 will trigger the function of quantitative acquisition (N acquisition). After triggering the acquisition, the trigger port enters the shielded state until the end of the acquisition before the trigger state is turned on again.
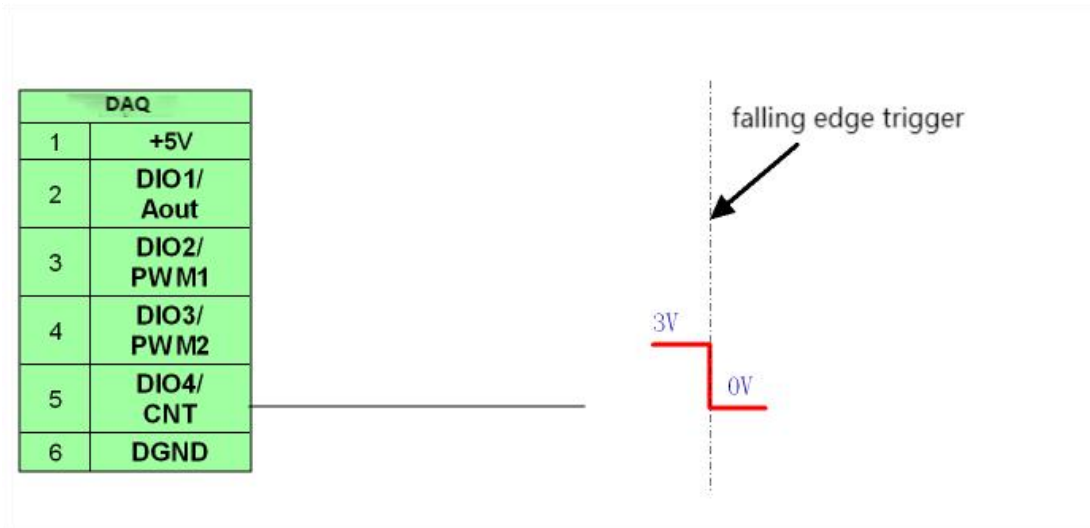

Trigger instructions:

1、After the software setting, enter the trigger mode

2、Set N acquisition related parameters, after triggering the acquisition, it will be acquired in N mode;

3、Falling edge triggering acquisition, the port is disabled after triggering until the end of acquisition;

4、Trigger acquisition mode, other acquisition modes will not be available, you must first exit the trigger acquisition mode and then other modes of operation;

5, trigger port internal default 10K resistor pull-up to 3.3V power supply;

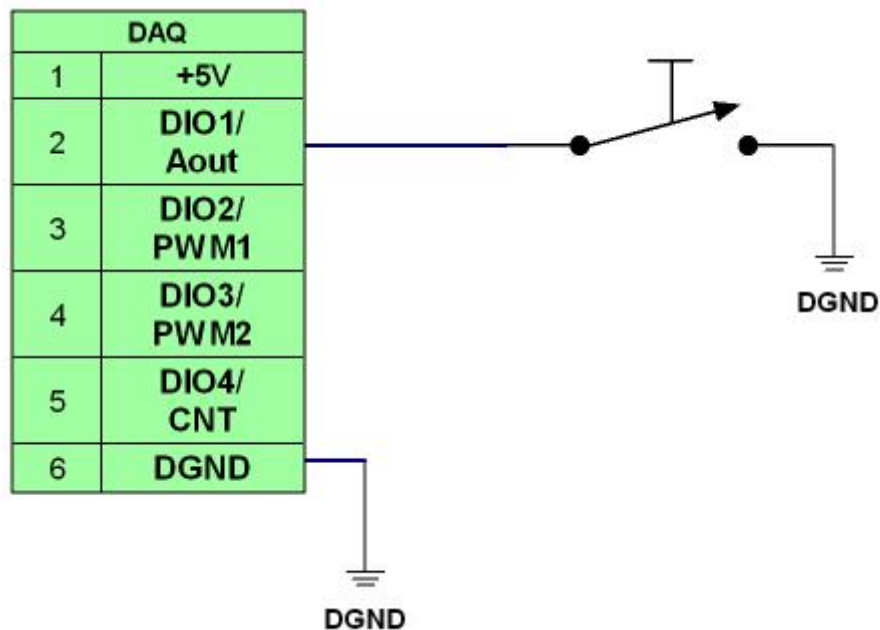6, in the trigger mode, if you set the input and output states will lead to trigger failure

3.5 Digital Port as Input Application

When the capture card is used as an input, its internal pull-up resistor can be used more conveniently.
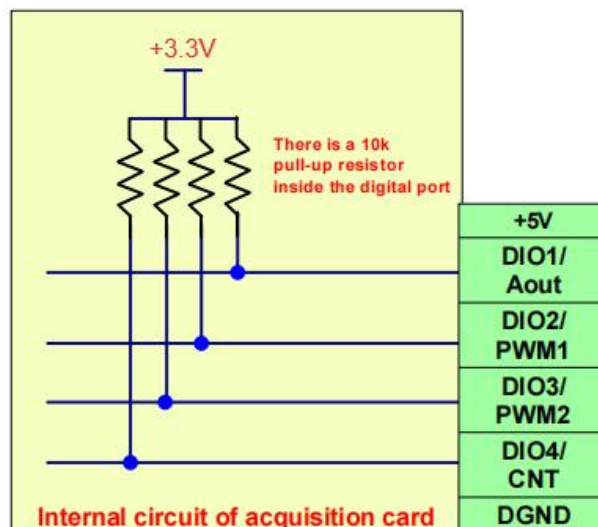
3.6 Key Input Use

When the capture card is used as an input, its internal pull-up resistor can be used more conveniently.

3.7 Powering the Sensor Inputs Using the Internal 5V Supply

When the capture card is used as an input, its internal pull-up resistor can be used more conveniently.
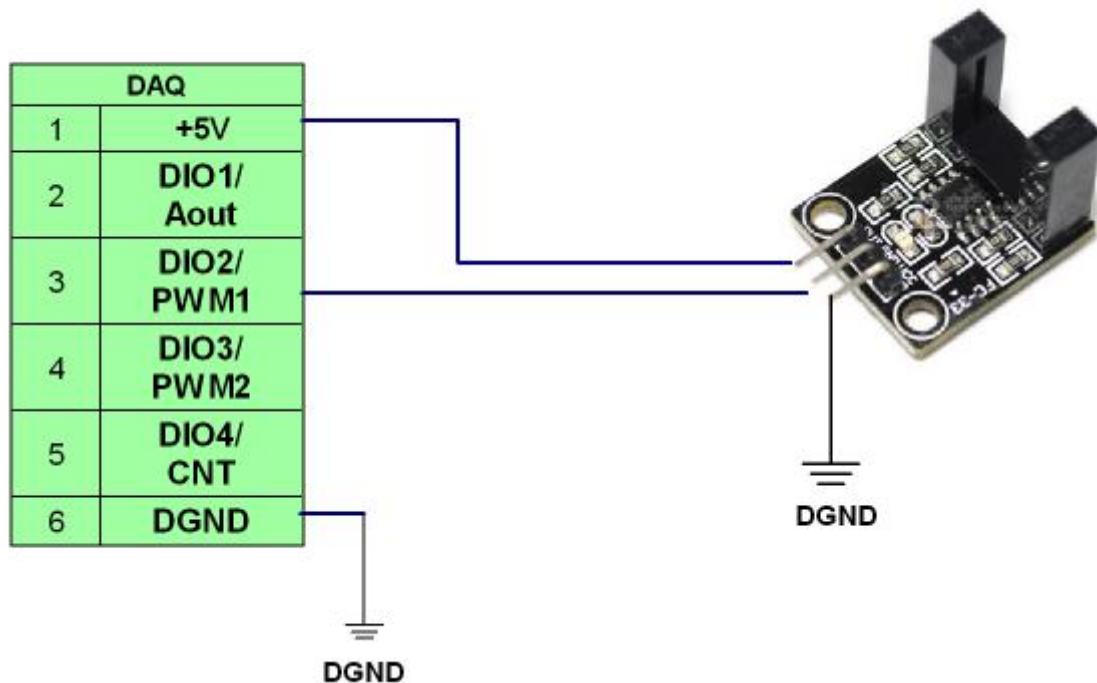
3.8 Any digital port can be connected to a digital temperature sensor.

Digital temperature sensors with cable lengths up to 5 metres
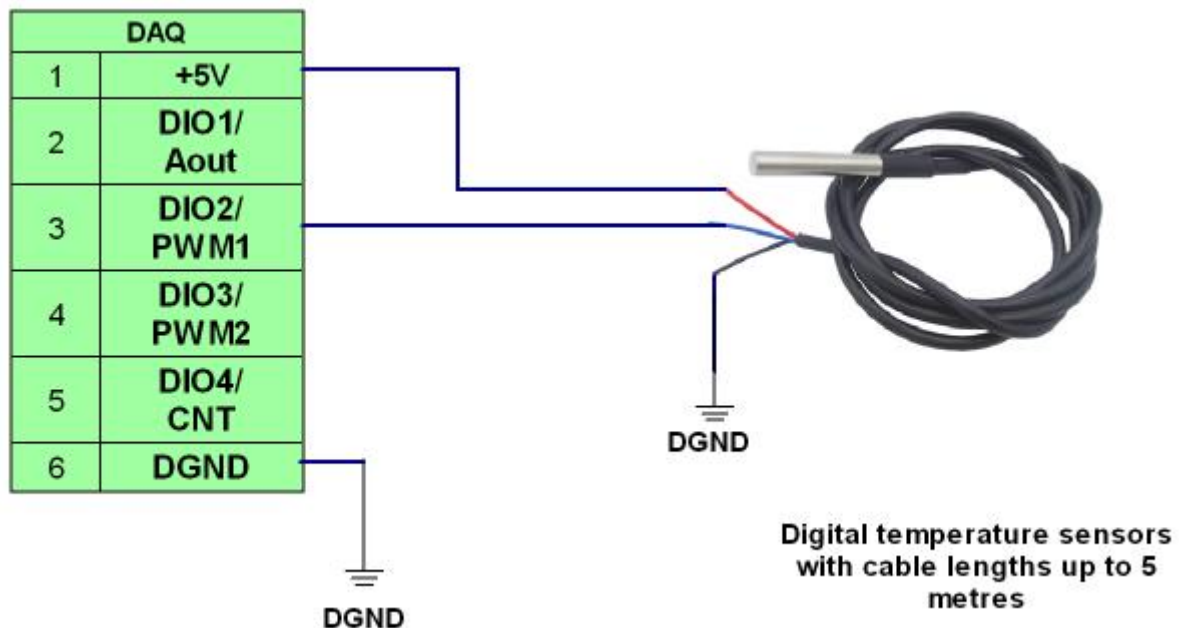
Any digital port of the acquisition card can be equipped with an 18B20 digital temperature sensor to read out the temperature value directly, and the cable length of the digital temperature sensor can be up to 5 metres.

3.9 Digital port for digital temperature and humidity sensors (SI7021 only)
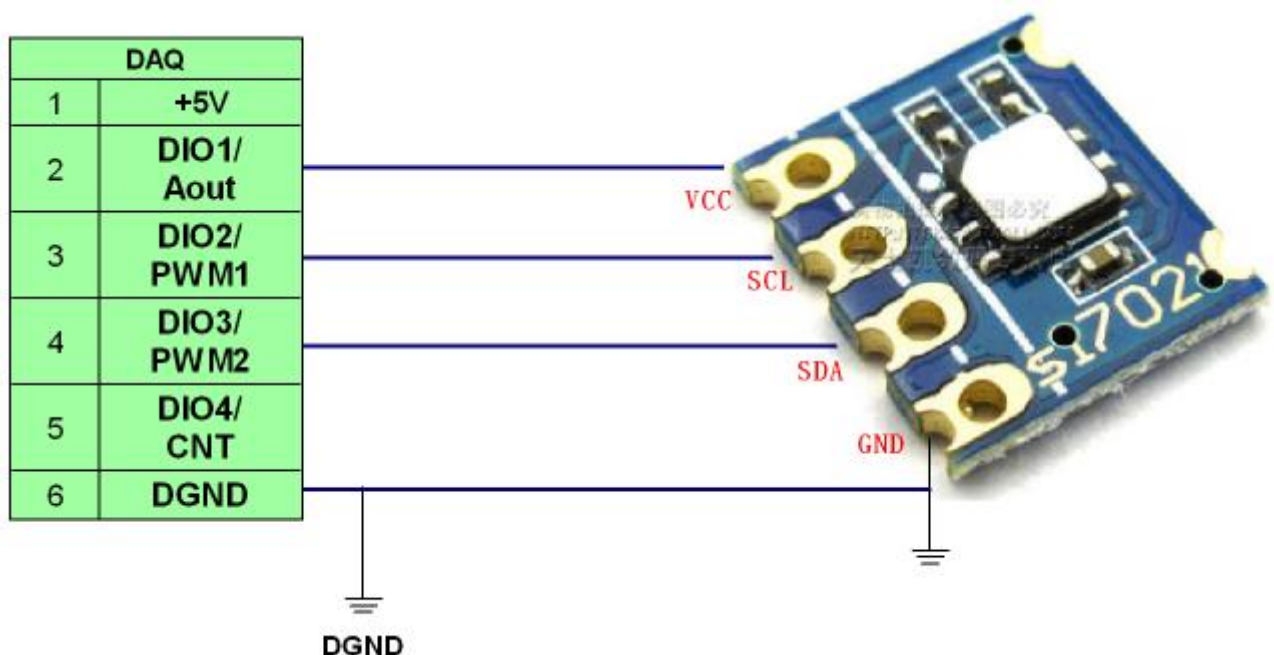
3.10 Measurement of strong interference signals

When the input signal is strong and carries interference, the interference can cause USB communication to be disconnected. It can be measured as follows: Increase the input buffer resistor . (*Common ground between the computer and the source of interference, the interference signal does not pass through the USB cable, thus ensuring stable communication)
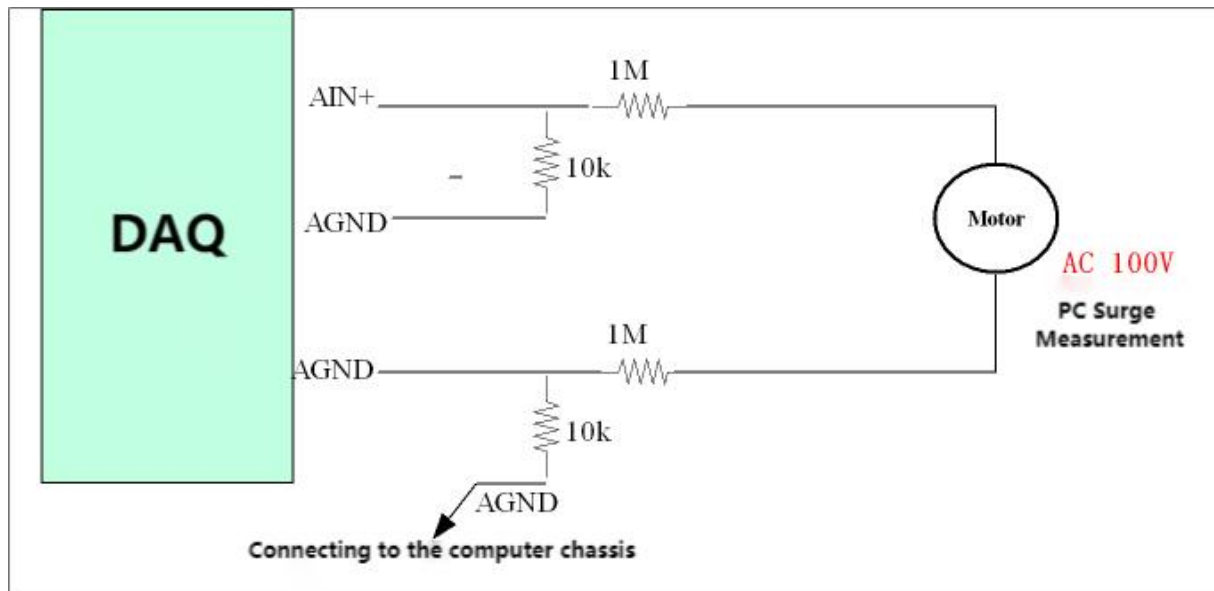
◆   Industrial Application Suggestion: We do not recommend the use of USB type acquisition card (including any other manufacturer's USB acquisition card) as a priority in the high-demand industrial applications, because the USB bus is mainly designed for the convenience of the design, but the anti-jamming ability is limited. High requirements of industrial applications we recommend the use of LAN network port type, with strong anti-interference ability, can be transmitted over long distances to control the advantages of detailed reference to our official website.

3.11 Capture Card Status Indicators

Power status indicator (next to USB port)

Acquisition status indicator (red and blue two-in-one LED)
1、Red and blue LED lights are all off state: normal acquisition is in progress.
2、Blue light flashes non-stop: indicates that the sampling stop state, waiting for a new command to restart sampling, standby state.
3, the red light will flash a little: is being collected if the sampling data overflow, or data errors.
4、Red light is always on: indicates that the data can not be sent, or USB failure.

4. Sample-Trigger-Clock

4.1 ADC clock source

The sampling beat of this capture card can be selected from two sources: 1, software clock 2, hardware clock.

The software clock can be used to set the continuous sampling rate from 1 to 102.4KS/S, which is no problem at all in the time domain application. However, if used in frequency domain analysis, hardware clock mode is necessary. The following table shows the hardware clock sampling frequency points.

Fs :

102400
76800
51200
38400
25600
24576
19200
12800
12288
9600
6400
6144
4800
2400
1200

When you set the frequency points in the above table on the acquisition card, the hardware will automatically enter the hardware clock mode, so as to achieve accurate frequency domain time acquisition.
The hardware clock mode is necessary for FFT/DFT applications.

4.2 Externally Triggered Acquisition Mode

This acquisition card can set the digital port as the trigger source to trigger the acquisition action.
The specific process is as follows: After setting into the mode, when the falling edge of the level is contacted with the N acquisition, the acquisition process will not respond to other triggers until the end of the acquisition.
When the hardware IO falls again, it will trigger N acquisition again.   Until exit trigger acquisition mode.
Trigger Acquisition - Mode 1: P0.4 triggers N acquisition (N acquisition = limited number of acquisitions)

DAQ	
1	+5V
2	P0.1/ Aout
3	P0.2/ PWM1
4	P0.3/ PWM2
5	P0.4/ Ext Trig
6	DGND

```
Operation process.
1, set N acquisition for 500 data points and sampling rate
2, set P0.4 to IO trigger N acquisition mode.
3, then, each falling edge of P0.4 will trigger a
continuous acquisition of 500 data points.

Before this N acquisition is completed, the trigger will
be turned off until the acquisition is completed.
```

*Note : For details of software operation, refer to <VK702N LAN Series (TCP) Operation Example.pdf>.

4.3 External Acquisition Clock Mode

Trigger Acquisition - Mode 2: P0.4 is used as the acquisition clock input port for acquisition, and one data point is acquired per pulse (1 high and 1 low level for 1 pulse).

DAQ	
1	+5V
2	P0.1/ Aout
3	P0.2/ PWM1
4	P0.3/ PWM2
5	P0.4/ Ext Trig
6	DGND

CP

```
Operation process.
1, Set P0.4 to IO as ADC sampling clock mode.
2, P0.4 input every 1 pulse collector to collect a data.
The maximum input frequency is 50kHz.

Input 1K number of pulses, the collector will output 1K
sets of collected data.
```

*Note : For details of software operation, refer to <VK702N LAN Series (TCP) Operation Example.pdf>.

5. Quick installation and easy testing

Please go to our official website to download the information package directly www.vkinging.com

5.1 Installation of driver and test software

Our accompanying test software is designed for evaluation testing purposes, and various development routines are provided in the package.Once installed, the test software is ready to run.

5.2 Simple use of test software for testing

We have test software, you can test the hardware directly.
The following picture shows the interface of the software:
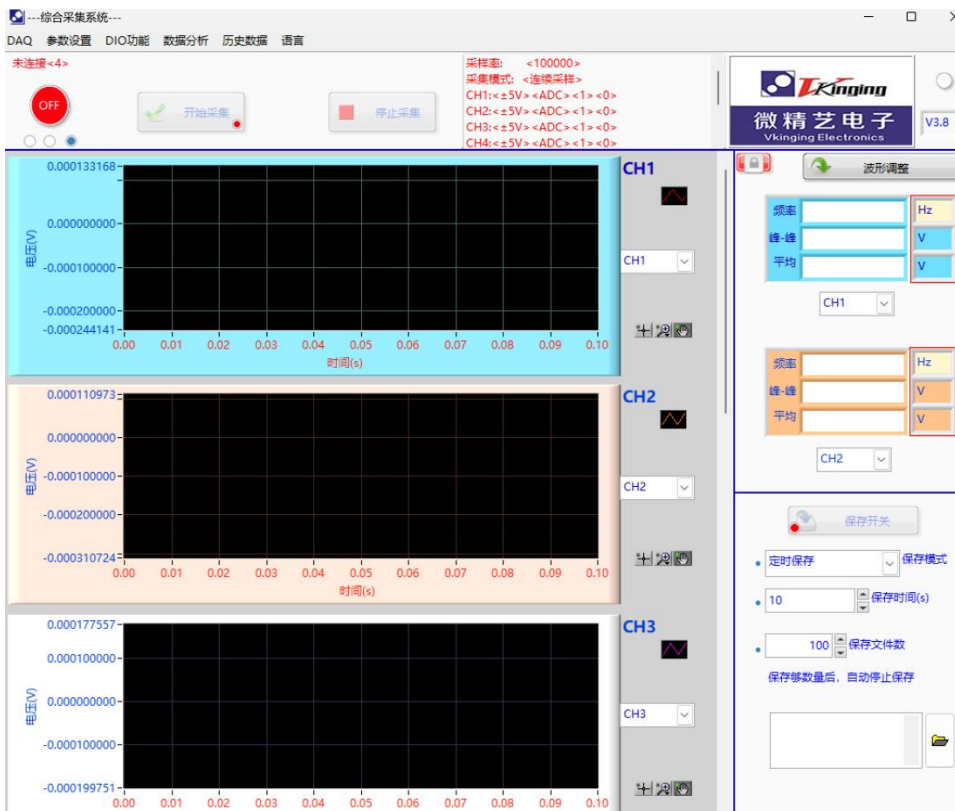
6. Advanced: Brief description of programming and development

We provide DLL development mode, user configuration and development more convenient and concise.
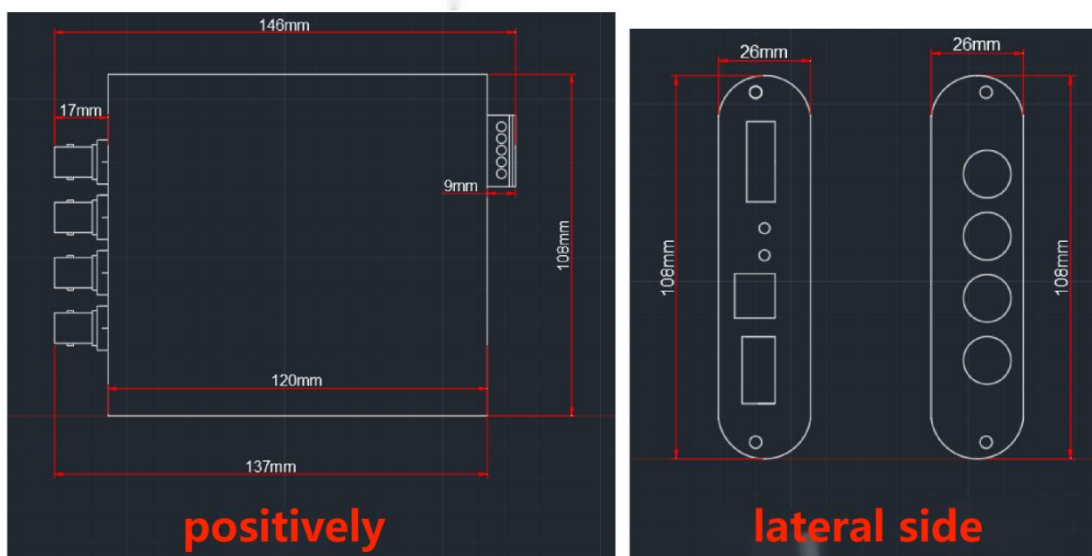
This capture card can be used across a variety of platforms, in addition, we provide a variety of routines and Win7/8/10/11/Linux/Android development routines.

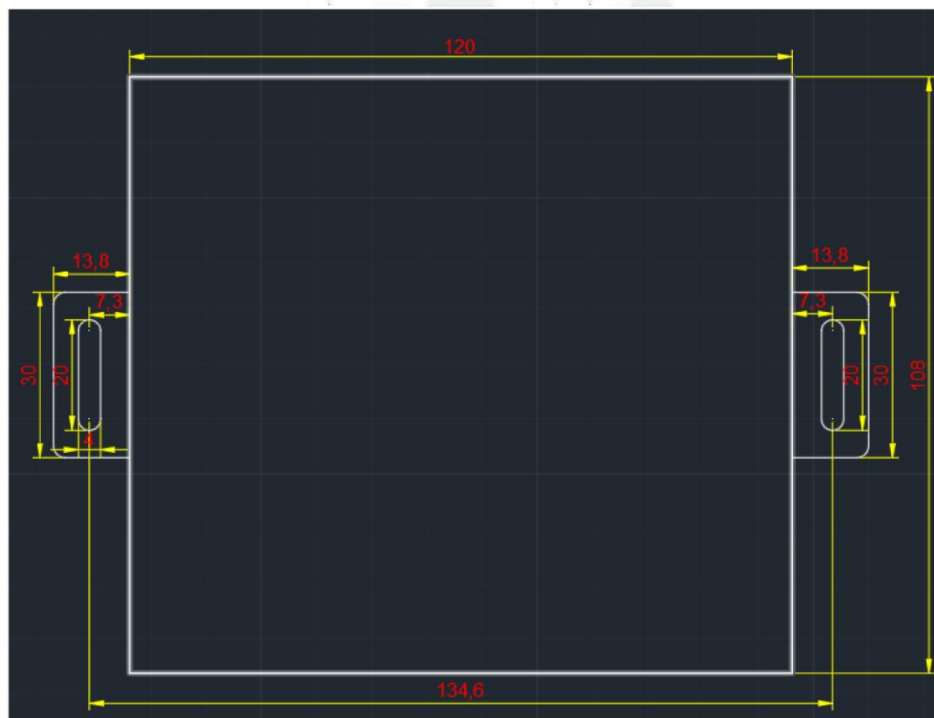For more details, please refer to the folder "Programming Related" in our package.

7. External dimensions and installation

normal version

positively

lateral side

Version with ear mounting

8. Common Problems and Troubleshooting

Description of the problem	Methods of elimination	Other notes
USB Driver Installation	Firstly, connect the computer with USB, make sure the indicator light is on. Then operate the computer, right-click on my computer -> click on Management -> Device Manager -> Port, to see if you can see the VKxx capture card word driver, if not need to install the driver, please refer to the detailed steps in the package, "USB driver installation instructions"!	
USB connection has a serial port but cannot communicate	A new serial port will appear when plugged in, confirm if a new serial port appears. If there is a new serial port then make sure the serial port number and baud rate are correct.	The default virtual serial port baud rate is 9600
USB plugged in cannot display the serial port	1， part of the WIN7 system is optimised for the lack of relevant files. 2， individual computer system files are missing, please replace a computer or other operating systems and then test to confirm 3， Rule out poor contact with the USB cable or USB cable quality problems, replace a cable test.	
No response after USB power up	1,If the USB power supply is used, ensure the quality of the USB cable. If the voltage drop of the cable is too low, it may cause the USB power supply and communication abnormality. At this time, please replace the USB cable test to confirm. 2, you can use the green power supply dedicated seat 8 ~ 24V power supply.	Troubleshooting: Use a multimeter to measure whether the 5V output of the IO terminal is 5V output to
USB easily disconnected	If there is strong interference in the neighbourhood, the USB may disconnect, which is determined by the transmission characteristics of the USB. It is recommended to replace the LAN Ethernet communication method	LAN is recommended for industrial applications
Large temperature drift	1， confirm whether the power supply is normal and stable 2， exclude whether it still exists after resetting the hardware 3， exclude the possibility of sensor causes 4， Replace the sensor channel, compare and confirm the exclusion	
Indicator light is off.	1, to confirm the power-up is correct, available USB power or switch to the dedicated port power 2, to confirm whether all the indicators do not light up If still can not be solved, please contact our after-sales personnel	Usually caused by incorrect power supply
Issues related to the VK701x host computer software		Please refer to the VK701x Software User's Guide included in the packet.

9. After-sales and warranty

一. Warranty:

The company with the attached warranty documents or directly affixed to the back of the equipment on the warranty sticker, to provide a one-year full warranty service, product warranty 10 years.

1 by our technical staff to confirm the initial product quality problems for the company, the customer will return to the product, within 3 days we confirm the maintenance and send back

2. If it is confirmed that the user is caused by improper use, we communicate with both sides to confirm that we will charge a certain amount of related costs.

二. maintenance:

All of our products are provided with 10 years of free maintenance services, the first year of free warranty thereafter, such as the need to replace components in the maintenance process, then only the cost of components charged.

三. exchange:

For new product failures the company provides three months of free replacement service, customers should first send back the faulty product in the form of logistics or express delivery, the company receives another new product back to the customer. Our company bears the freight cost of returning the product to the customer.

10. Version and revision history

Releases	Clarification	Time
V1.00	First version	2023.02.01
V1.10	Add 0~20mA function and related description	2023.03.11
V1.20	Add IEPE Filter Related Descriptions	2023.06.21
V1.30	Change 100KS/s to 102.4KS/s	2023.09.13

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