1 PCIe/PXIe-6316 Specification

10-Channel,16-bit, 1.5 MS/s/ch, Ch-Ch Isolated Analog input Module

Please download JYTEK <JYPEDIA>, you can quickly inquire the product prices, the key features and available accessories.

Overview

Overview The PXIe-6316 and PCIe-6316 are high-precision, simultaneous analog input modules. Both offer 10 channel-to-channel isolated channels, 16-bit resolution, and a sampling rate of up to 1.5 MS/s per channel. These modules are capable of measuring DC voltage, AC voltage, and various dynamic signals, making them ideal for applications demanding accurate and isolated multi-channel data acquisition. When the sampling rate is set at or below 750 kS/s, an over-sampling mode is enabled to significantly reduce system noise and improve ENOB.

1.1 Main Features

- High accuracy: 310 ppm
- 10 simultaneous high-voltage measurement channels
- 1.5 MS/s per channel
- 16 bits resolution
- Up to 900 kHz bandwidth
- Better than -80 dB THD
- System noise as low as 0.7 µVrms
- Up to 19.1 µV resolution
- Input voltage ranges:
  - Low voltage: ±10 V (with TB-6316/TB-6316C)
  - High voltage: ±300 V (with TB-6316H/TB-6316HC)
- 512MB of FIFO buffer
- Analog and Digital Trigger

1.2 Analog Input Specifications

Number of Input channels	10 DIFF (CH-CH isolation)
ADC resolution (Bits)	16 bits
Sampling Rate (per Channel)	1.5 MS/s
Sampling Timing Accuracy	50 ppm of sample rate
Sampling Timing Resolution	10 ns
Input coupling	DC
CMRR (DC to 60 Hz)	120 dB
Crosstalk	115 dB@1 kHz
Small signal bandwidth (-3 dB)	900 kHz (Low Voltage) 200 kHz (High Voltage)
Input impedance(Device powered on)	
AI+ to AI COM	> 10 GΩ
AI- to AI COM	> 10 GΩ
Input impedance(Device powered off)	
AI+ to AI COM	900 Ω
AI- to AI COM	900 Ω
Input bias current	±100 pA
FIFO Buffer Size	512 MB for all channels
Data transfers	Direct memory access (DMA), programmed I/O
Over-voltage protection(Device on)	
Between AI+ and AI-	±72 V
Anywhere between AI and COM	±72 V
Isolation	
Between channels(Continuous)	300 Vrms, Measurement Category II
Between channels(Transient overvoltage rating)	2500 Vpk

Channel to ground(Continuous)	300 Vrms, Measurement Category II
Channel to ground(Transient overvoltage rating)	2500 Vpk

Table 1 Analog Input Specifications

1.3 Input Range

Low Voltage (TB-6316/TB-6316C)	±10 V, ±5 V, ±2.5 V, ±1.25 V
High Voltage (TB-6316H/TB-6316HC)	±300 V, ±150 V, ±75 V

Table 2 Input Range

1.4 PFI Specifications

Number of channels	3 (DIO <0..2>)
Ground reference	GND
Directional control	Independent control of each channel
Initial state	Low-level input
Digital Input	Logic Low: V_{IL} Min : 0 V / Max : 0.8 V Logic High: V_{IH} Min : 2.0V / Max : 5.0V
Digital Output	Logic Low : 0 V, I_{OL} Max: 12 mA Logic High : 2.0 V～3.3 V, I_{OH}: -12 mA～0 mA
Logic Signal Level	3.3 V LVTTL
Pull-down resistor	10 kΩ ±1%

Table 3 PFI Specifications

1.5 DC Accuracy

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

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.

The Basic DC Accuracy of JY-6316 .

JY-6316 Basic Accuracy (with TB-6316H/TB-6316HC) = ±(% of Reading+% of Range)												
Nominal Range (V)	24 Hour Tcal ±1°C			90 Days Tcal±5°C			Temperature Coefficients(/°C)			24 Hr Full Scale Accuracy	90 Days Full Scale Accuracy	Full Scale Accuracy(%)
75	0.009	+	0.013	0.044	+	0.019	0.0015	+	0.0010	17 mV	47 mV	0.063
150	0.009	+	0.007	0.043	+	0.014	0.0015	+	0.0010	24 mV	86 mV	0.057
300	0.009	+	0.006	0.043	+	0.011	0.0015	+	0.0010	45 mV	162 mV	0.054

Table 4 AI Accuracy of JY-6316 (High Voltage)

JY-6316 Basic Accuracy (with TB-6316/TB-6316C) = ±(% of Reading+% of Range)												
Nominal Range (V)	24 Hour Tcal ±1°C			90 Days Tcal±5°C			Temperature Coefficients(/°C)			24 Hr Full Scale Accuracy	90 Days Full Scale Accuracy	Full Scale Accuracy(%)
1.25	0.006	+	0.009	0.021	+	0.019	0.0003	+	0.0005	188 uV	500 uV	0.040
2.5	0.006	+	0.005	0.020	+	0.014	0.0003	+	0.0003	275 uV	850 uV	0.034
5	0.006	+	0.005	0.020	+	0.011	0.0003	+	0.0002	550 uV	1550 uV	0.031
10	0.005	+	0.005	0.020	+	0.011	0.0003	+	0.0002	1000 uV	3100 uV	0.031

Table 5 AI Accuracy of JY-6316 (Low Voltage)

1.6 System Noise(μVrms)

Sample Rate(kS/s)*	1.25V	2.5V	5V	10V	75V	150V	300V
1500	27.9	42.4	78.4	150.8	2,820.0	3,300.0	4,810.0
760	27.8	41.1	77.3	152.5	2,750.0	3,200.0	4,880.0
500	22.3	31.1	54.4	107.9	1,910.0	2,240.0	3,420.0
100	14.1	17.5	27.4	54.1	910.0	1,090.0	1,710.0
50	7.7	10.2	15.4	28.5	450.0	540.0	880.0
10	2.2	3.4	6.5	12.5	190.0	250.0	390.0
5	1.4	2.2	4.3	8.2	120.0	150.0	250.0
1	0.7	1.2	2.2	3.5	60.0	70.0	120.0

*Note: Over-sampling mode is enabled when the sampling rate is less than or equal to 750 kS/s

Table 6 System Noise of JY-6316

1.7 Clock

The Clock of JY-6316 is shown in Table 7

Clock	
Source	On-board clock, PXIe_Clk100 (RefClk only)
Destinations	Sample Clock, Sample Clock Timebase, Reference Clock
Polarity	Software-selectable(Except for the Reference Clock)
Reference Clock Source	Onboard Clock. PXIe_Clk100 (RefClk only)
Sample Clock Source	Internal, PXI_Trig, PFI

Table 7 Clock of JY-6316

1.8 Bus Interface

Form factor (PXIe)	3U PXI Express peripheral module
Form factor(PCIe)	PCIe Gen2 × 4
Slot compatibility(PXIe)	x1 and x4 PXI Express or PXI Express hybrid slots

Table 8 Bus Interface

1.9 Calibration

Recommended warm-up time	15 minutes
Calibration interval	1 year

Table 9 Calibration

1.10 Physical and Environment

Dimensions	Standard 3U PXIe, 211.24mm*130.45mm*20.29mm
Weight	212.6 g (PXIe-6316)
I/O connector	48-pin male DIN 41612/IEC 60603-2 connector
Operating Environment	
Ambient temperature range	0 °C to 50 °C
Relative humidity range	10% to 90%, noncondensing
Environmental Specifications	
Maximum altitude	2,000 m (800 mbar), Ambient temperature 25 °C
Pollution Degree	2
Storage Environment	
Ambient temperature range	-40 °C to 71 °C
Relative humidity range	5% to 95%, noncondensing
Power Requirement	
3.3 V	0.5 W
12 V	15 W

Table 10 Physical and Environment Specifications

2 Order Information

- PXIe-6316 (PN: JY5957560-01)

  10-Channel,16-bit, 1.5 MS/s/ch, Ch-Ch Isolated PXIe Analog input Module

- PCIe-6316 (PN: JY8267599-01)

  10-Channel, 16-bit, 1.5 MS/s/ch, Ch-Ch Isolated PCIe Analog input Module

- Accessories

  - TB-6316 (PN: JY4230636-01): ±10VDC Direct Mount Terminal Block for PXIe-6316

  - TB-6316H (PN: JY2596782-01): ±300VDC Direct Mount Terminal Block for PXIe-6316

  - TB-6316C (PN: JY9201886-01): ±10VDC Direct Mount Terminal Block for PCIe-6316

  - TB-6316HC (PN: JY5580291-01): ±300VDC Direct Mount Terminal Block for PCIe-6316

Table of Contents

3 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.

3.1 Overview

The JY-6316 is a high-precision, 10-channel simultaneous high-voltage measurement module, capable of measuring DC voltage, AC voltage and dynamic signals. Key features include: 310 ppm high accuracy; 10 simultaneous channels; 1.5 MS/s per-channel sampling rates; 16-bit resolution; 900 kHz bandwidth; THD better than -90dB; system noise as low as 0.7µVrms; up to 19.1µV resolution; input voltage ranges from ±1.25V to ±300V; 512MB FIFO buffer; and support for analog and digital triggers.

3.2 Abbreviations

- JY-6316: JYTEK PXIe-6316 / PCIe-6316
- AI: Analog Input
- DIFF: Differential
- ADC: Analog to Digital Conversion
- TB-6316: Terminal Block for PXIe-6316 (Low Voltage)
- TB-6316H: Terminal Block for PXIe-6316 (High Voltage)
- TB-6316C: Terminal Block for PCIe-6313 (Low Voltage)
- TB-6316HC: Terminal Block for PCIe-6313 (High Voltage)
- PFI: Programmable Function Interface
- DIFF: Differential
- RS: Remote Sensing
- SC: Shunt Calibration
- CMRR: Common-Mode Rejection Ratio
- V_{ISO}: Isolation Voltage
- V_{CM}: Common-Mode Voltage

3.3 JYPEDIA and Learn by Example

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.

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-6316 in the driver sheet, select **JY6316_Examples.zip.** This will lead you to download the sample program for this device.

4 Hardware

4.1 Front Panel, Terminal Block connections and Pinout Definition

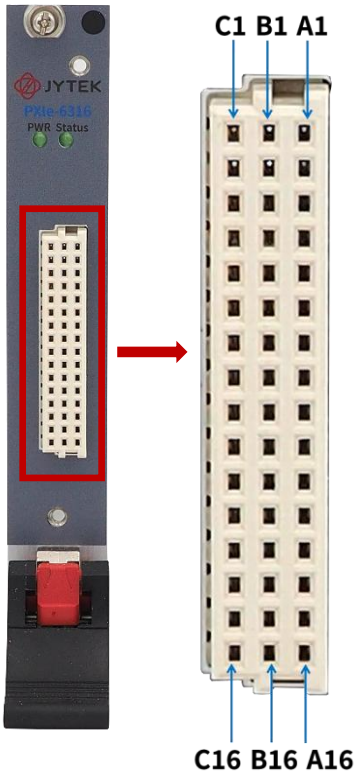

Figure 1 JY-6316 Front Panel and Pinout

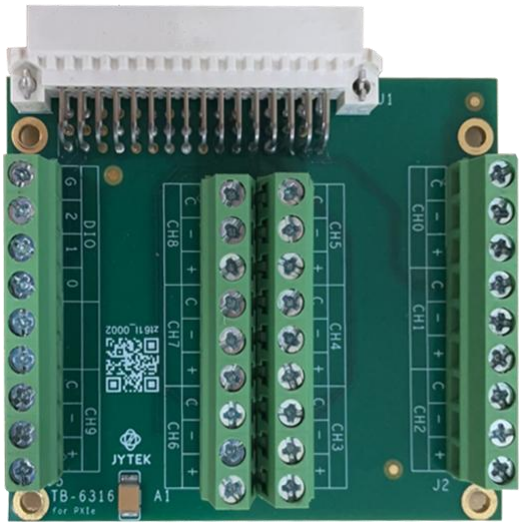

Figure 2 TB-6316 Front Panel and Pinout

Pin of JY-6316	Channel Connection on Terminal Block	Pin of JY-6316	Channel Connection on Terminal Block	Pin of JY-6316	Channel Connection on Terminal Block
A1	**CH0 C**	**B1**	**CH0 +**	**C1**	**CH0 -**
A2	**CH1 C**	**B2**	**CH1 +**	**C2**	**CH1 -**
A3	**CH2 C**	**B3**	**CH2 +**	**C3**	**CH2 -**
A4	**CH3 C**	**B4**	**CH3 +**	**C4**	**CH3 -**
A5	**CH4 C**	**B5**	**CH4 +**	**C5**	**CH4 -**
A6	**CH5 C**	**B6**	**CH5 +**	**C6**	**CH5 -**
A7	**CH6 C**	**B7**	**CH6 +**	**C7**	**CH6 -**
A8	**CH7 C**	**B8**	**CH7 +**	**C8**	**CH7 -**
A9	**CH8 C**	**B9**	**CH8 +**	**C9**	**CH8 -**
A10	**CH9 C**	**B10**	**CH9 +**	**C10**	**CH9 -**
A15	**DIO G**	**B15**	**DIO G**	**C15**	**DIO 0**
A16	**DIO 1**	**B16**	**DIO 2**	**C16**	**Do not Connect**

Note: Pins A11-A14, B11-B14, C11-C14 are unassigned. Leave these pins unconnected when using third-party interfaces.

Table 11 Physical and Environment Specification

4.2 Signal Connection

Here are explanations of the four common signal connection methods for the JY-6316:

1. Wiring Method for Low-Impedance Sources Signal (<100 Ω) with Ground Reference.

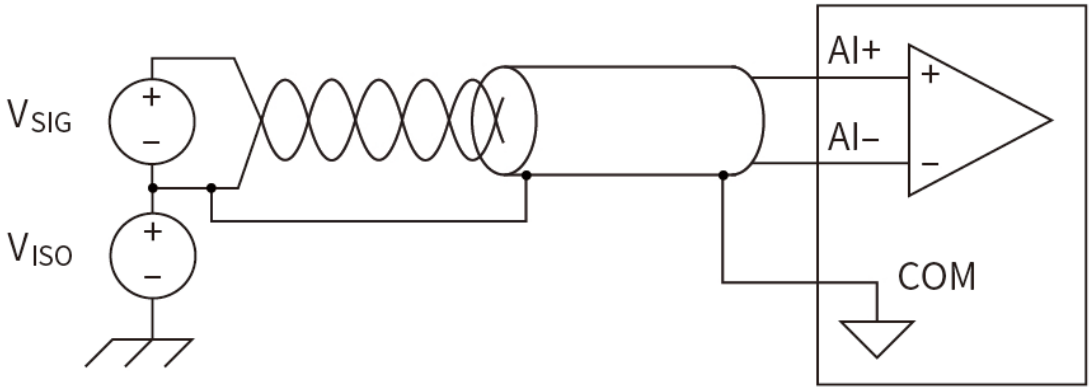

Figure 3 low impedance ground reference source signal wiring method

2. Wiring Method for Low-Impedance Floating Sources Signal (<100 Ω).

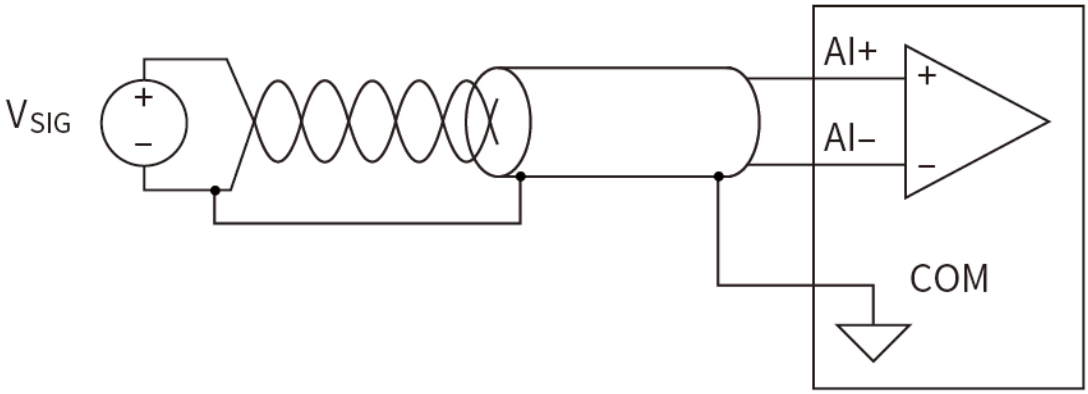

Figure 4 Floating source signal wiring method

3. Wiring Method for High-Impedance Sources Signal (>100 Ω) with Ground Reference.

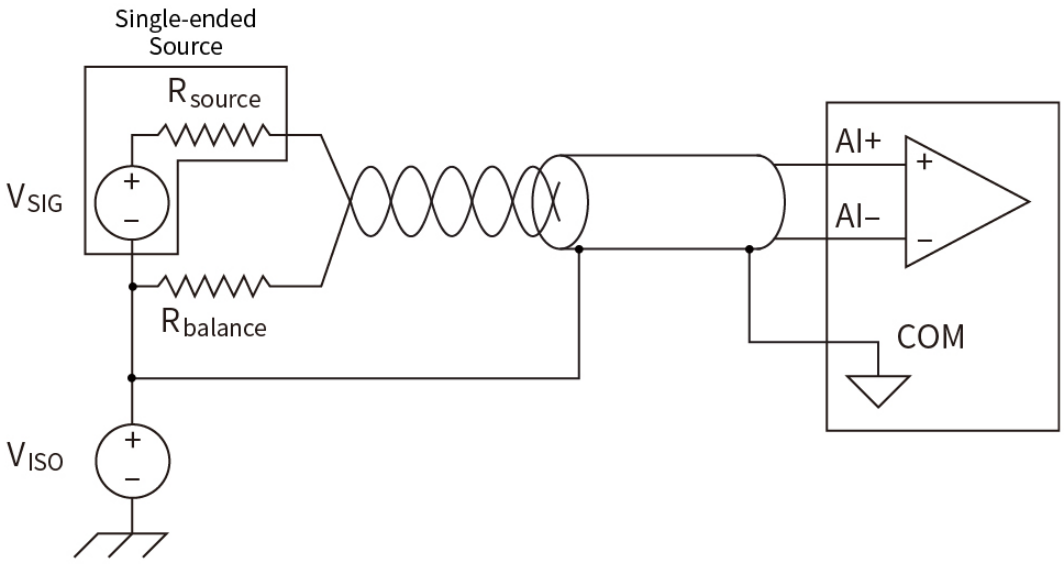

Figure 5 High-impedance source wiring method (source impedance is > 100 Ω)

4. Wiring Method for Ground Reference Sources Signal when using high voltage terminal block. (TB-6316H/TB6316HC)

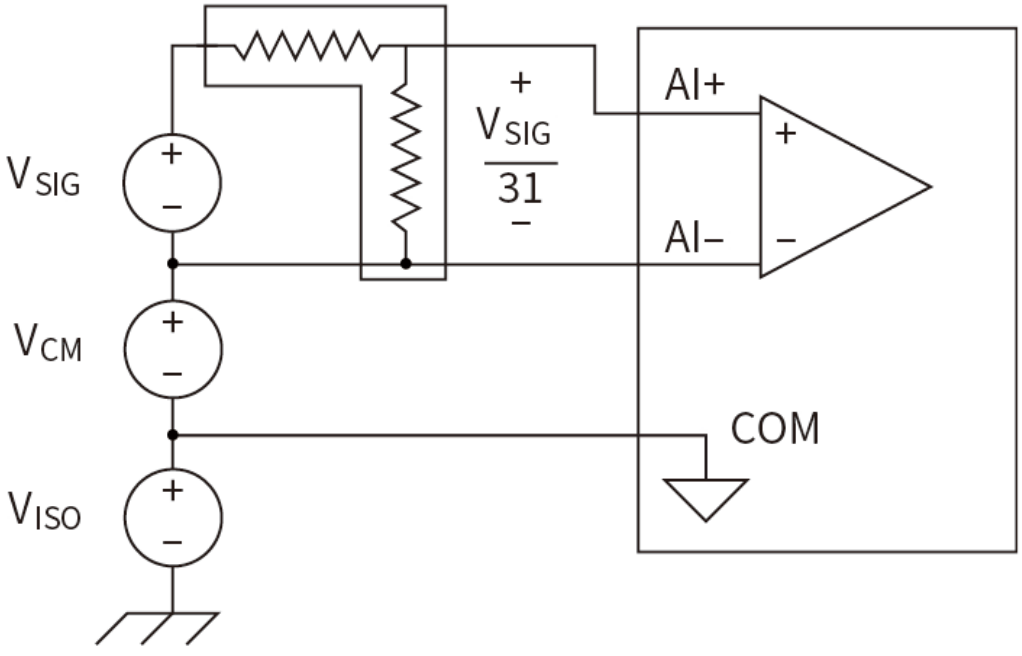

Figure 6 High-impedance source wiring method using high voltage terminal block

5 Software

5.1 System Requirements

JY-6316 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-6316 in the Window environment, 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 version and upgrade to 4.0 or later version.

Given the resources limitation, JYTEK only tested JY-6316 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 default 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-6316 Hardware Driver

After installing the required application development environment as described above, you need to install the JY-6316hardware 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-6316function. JYTEK has standardized the ways JYTEK and other vendor's DAQ cards are used by providing a consistent user interface, using the methods, properties and enumerations in the object-oriented programming environment. Once you get yourself familiar with how one JYTEK DAQ card works, you should be able 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-6316 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-6316hardware.

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 environment. You would develop your C# applications in Windows using Visual Studio. 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 JYPEDIA

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

7 Additional Software Information

7.1 System Requirements

JY-6316series modules can be used in a Windows or a Linux operating system.

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

Given the resources limitation, JYTEK only tested JY9817 modules with .NET 4.0 with Visual Studio 2015. JYTEK relies on Microsoft to maintain the compatibility for the newer versions.

7.3 C# Programming Language

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7.4 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.

7.5 Python

JYTEK provides and supports a native python driver for JY-6316cards. 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 partner to support different Python platforms, please contact us.

8 Calibration

JYTEK 6316 boards are precalibrated before the shipment. We recommend you recalibrate JY-6316boards periodically to ensure the measurement accuracy. A commonly accepted practice is one year. If you need to recalibrate your board, please contact JYTEK.

9 Appendix

9.1 Typical Measurement Error

Typical measurement error is a term used to describe the variation or uncertainty in a measurement that is repeated under the same conditions. It can be caused by random errors (chance differences between observed and true values) or systematic errors

(consistent biases in measurement).

Typical measurement error can be expressed as a standard deviation (the typical error of measurement) or as a percentage of the mean (the coefficient of variation) .

9.2 System Noise

System noise refers to any unwanted and random fluctuations or disturbances in a physical or electronic system that can interfere with its normal operation. System noise can arise from various sources such as electrical interference, thermal noise, environmental factors, and inherent limitations of the system's components.

In electronic systems, system noise can affect the accuracy and reliability of signal processing and communication. For example, in audio systems, system noise can lead to hissing or humming sounds, and in wireless communication systems, it can cause interference and reduce the quality of the signal.

Reducing system noise is an important consideration in the design and operation of many types of systems, and engineers use various techniques to mitigate its effects, including shielding, filtering, and signal processing algorithms.

9.3 Temperature Drift

Temperature drift refers to the phenomenon where the performance or behavior of a physical or electronic system changes as the temperature changes. Temperature drift can affect various parameters such as frequency, voltage, resistance, and sensitivity, and it can cause errors or inaccuracies in the system's operation.

In electronic systems, temperature drift can arise due to the temperature dependence of the properties of the system's components, such as resistors, capacitors, and transistors. For example, the resistance of a resistor increases with temperature, and this can affect the accuracy of voltage measurements in a circuit. Similarly, the frequency of an oscillator can drift due to the temperature dependence of its resonant circuit components.

Temperature drift is an important consideration in the design and operation of many types of systems, particularly those that require high accuracy and stability over a wide range of temperatures. Engineers use various techniques to compensate for temperature drift, including using temperature sensors to monitor and control the temperature, selecting components with low temperature coefficients, and implementing temperature compensation algorithms in software or firmware.

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 Support Services

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 explanation for JY-6316 family of temperature sensor data acquisition cards. The manual is copyrighted by JYTEK.

No warranty is given as to any implied warranties, express or implied, including any purpose or non-infringement of intellectual property rights, unless such disclaimer is legally invalid. JYTEK is not responsible for any incidental or consequential damages related to performance or use of this manual. The information contained in this manual is subject to change without notice.

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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