



PCIe/PXle-5710 Series Family of Analog Output Function Modules User Manual



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1. Introduction

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

1.1 Overview

The PCIe/PXle-5710 Series is a family of Analog Output function modules, which can run on PCIe, PXle, TXI (Thunderbolt) and USB buses (coming soon). Depending on the model number, a 5710 series provide different AO channels, sampling rate.

JYTEK PCIe/PXle-5711 is a 32 channels analog output module with 16 bits resolution.

JYTEK PCIe/PXle-5711 has an output range of ± 10 V with maximum update rate to 2 MS/s. It also provides output current drive in the range of ± 10 mA.

JYTEK PCIe/PXle-5711 has 256M samples FIFO buffer size and supports DMA for data transfers.

Please check with JYTEK for the latest PCIe/PXle-5710 series offering.

1.2 Main Features

- 32 channels of voltage output
- 16 bits DAC
- Output range: ± 10 V
- Maximum update rate
 - 1 channel: 2 MS/s
 - 8 channels (1 channel per bank): 2 MS/s
 - 32 channels: 1 MS/s
- Output current drive: ± 10 mA
- Overdrive current: 15 mA
- 256M samples FIFO buffer size
- DMA for data transfers

1.3 Abbreviations

AO: Analog Output

DI: Digital Input

DO: Digital Output

DAC: Digital-to-Analog Conversion
PFI: Programmable Function Interface
SE: Single-Ended
PPM: Parts Per Million

1.4 Learn by Example (To be added)

JYTEK has added **Learn by Example** in this manual. We provide many sample programs for this device. Please download the sample programs for this device. You can download a [JYPEDIA](#) excel file from our web www.jytek.com. Open JYPEDIA and search for JY5710 in the driver sheet, select **JY5710 Examples.zip**. In addition to the download information, JYPEDIA also has a lot of other valuable information, JYTEK highly recommend you use this file to obtain information from JYTEK.

		Drivers are often updated, please register and receive the update information.		
Drivers	Update Date			
JY5500_V3.0.1_Linux.tar	2020/12/4			
JY5500_V3.0.1_Win.zip	2020/12/4			
JY5500_V1.0.0_LV.zip	2019/10/24			
JY5500_V3.0.1_Examples.zip	2020/12/4			
JY5500_V1.0.0_Python.zip	2019/10/24			
JY5500_V1.0.0_PythonExamples.zip	2019/10/24			

Figure 1 JYPEDIA Information (TBD)

In a **Learn by Example** section, the sample program is in bold style such as **Analog Input-->Winform AI Continuous MultiChannel Soft Trigger**; 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.

In an **Learn by Example** section, the experiment is set up as follow. A PCIe/PXle-5710 card is plugged in a desktop computer. The PCIe/PXle-5710 is connected to a TB-68 terminal block. A signal source is also connected to the same terminal block as shown Figure 2.

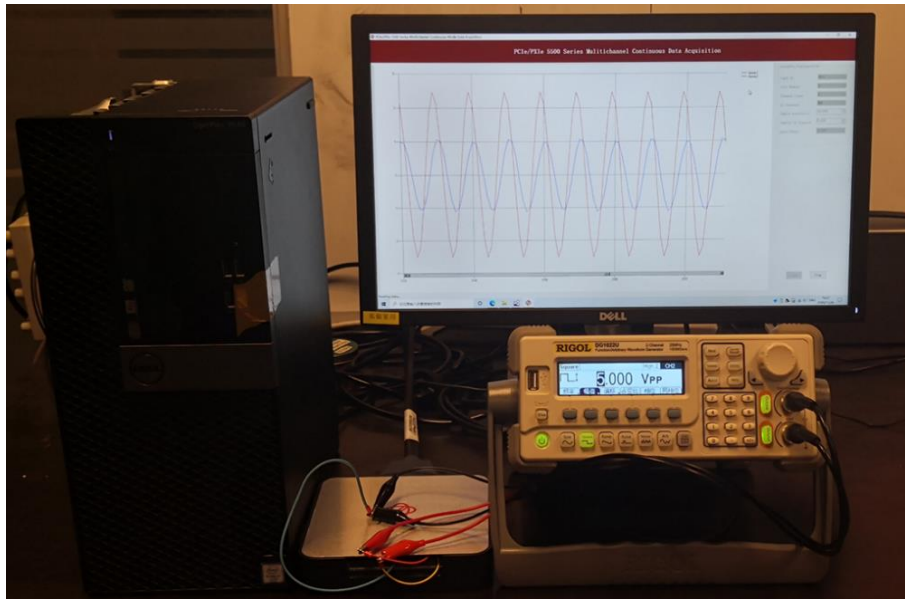


Figure 2 PCIe/PXIe-5710 experiment

The TB-68 has 4 terminal columns, J1 – J4 and is shown below as Figure 3. In the rest of this manual, the wire connection in each **Learn by Example** section will be given by the pin numbers only.

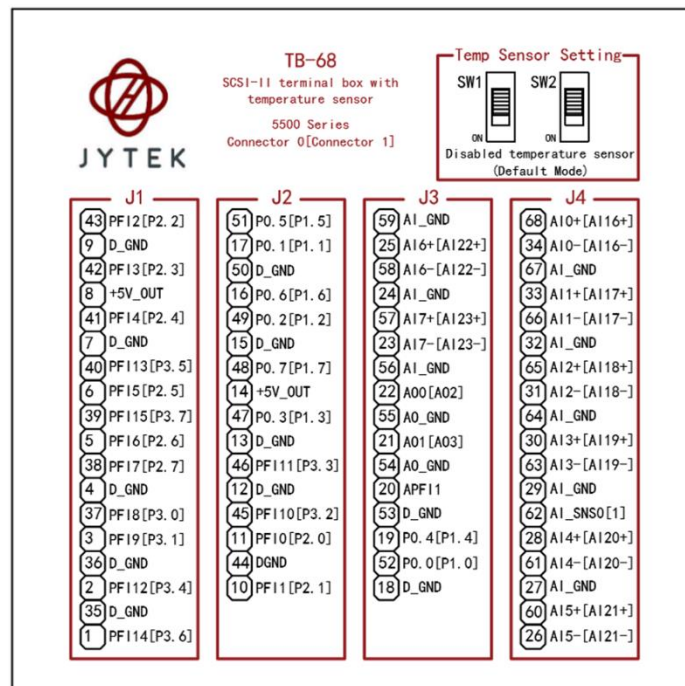


Figure 3 TB-68 Terminal Block

*Tip: PCIe/PXIe-5710 also has the analog output capability. If you do not have a signal source, you can use the outputs of PCIe/PXIe-5710 as the signal source. In this case you need first run example program **Analog Output-->Winform AO Continuous Wrapping Multichannel** to generate the output.*

2. Hardware Specifications

2.1 Analog Output Specifications

Number of channels	32 ch
Resolution	16 bits
DNL	±1 LSB
Unscaled data format	2's complement
Monotonicity	16 bits
Maximum update rate(1ch)	2 MS/s
Maximum update rate(8ch), 1 channel per bank*	2 MS/s
Maximum update rate(32ch)	1 MS/s
Output range	±10 V
Output coupling	DC
Output impedance	0.2 Ω
Output current drive	±10 mA
Overdrive protection	±15 V
Overdrive current	15 mA
Power-on state	±200 mV
FIFO buffer size	256M Samples
Data transfers	DMA
AO waveform modes	Nonperiodic waveform, Periodic waveform regeneration mode from onboard FIFO, Periodic waveform regeneration from host buffer including dynamic update
Ready time	2 μs
Slew rate	20 V/μs
Noise	400 μVrms, DC to 1 MHz
AO update glitch Glitch energy	5 nVs
Channel crosstalk	-65 dB
Reference clock	PXIe_DSTARA, PXIe_DSTARB, PXIe_CLK100
External sample clock	PFI, PXI_TRIG
Trigger source	Digital, Software
Trigger type	Start Trigger
Digital trigger source	PFI, PXI_TRIG
* Each bank consists of four AO channels using two DACs. Any channels being used within a single bank will update simultaneously.	

Table 1 Analog Output Specifications

AO Absolute Accuracy

Nominal Range Full Scale (V)	Absolute Accuracy at Full Scale(μV)
±10	2520

Table 2 Analog Output Accuracy

2.2 Digital IO / PFI Specifications

Static Characteristics

Number of channels	3 DIO
Ground reference	DGND
Direction control	Each terminal individually programmable as input or output
Pull-down resistor	50 k Ω typical
Input voltage protection	± 15 V

PFI Functionality

Number of channels	3
External digital trigger interface	Trigger voltage 3.3 V TTL; Trigger edge: Rising/Falling
Initial state	Input

Recommended Operating Conditions

Minimum Input high voltage (V_{IH})	2.2 V
Maximum Input high voltage (V_{IH})	5.25 V
Minimum Input low voltage (V_{IL})	0 V
Maximum Input low voltage (V_{IL})	0.8 V
Maximum Output high current (I_{OH})	-16 mA
Maximum Output low current (I_{OL})	16 mA

Table 3 Digital IO / PFI Specifications

2.3 Bus and Power Specification

Bus Interface

Form factor	x4 PXI Express peripheral module
Slot compatibility	x1 and x4 PXI Express or PXI Express hybrid slots

Power Requirements

3.3 V:	3.0 W
+12 V:	14.0 W

Table 4 Bus and Power Specification

2.4 Physical and Environment

Environment

Operating Ambient temperature range	0 ~ 50 °C
Operating Relative humidity range	20% to 80%, noncondensing
Storage Ambient temperature range	-20 °C to 80 °C
Storage Relative humidity range	10% to 90%, noncondensing
Operational shock	30g peak,half-sine,11ms pulse
Operating Random vibration	5-500Hz,0.3g RMS
Nonoperating Random vibration	5-500Hz,2.4g RMS
Maximum altitude	2000m
Pollution Degree	-

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 5 Physical and Environment

2.5 Front Panel and Pin Definition

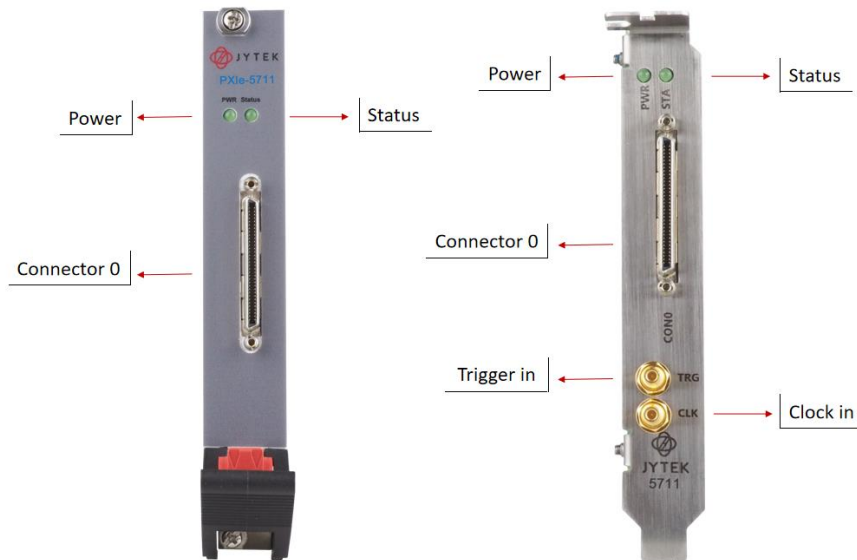


Figure 4 PXle/PCIe 5710 Front Panel

PCIe/PXle-5710 series boards are connected to outside signals by one 68-pin cables for the 32 channel configurations, see Table 6 shows the pin definitions for 32 channels.

Connector 0			
Pin	Signal Name	Pin	Signal Name
1	PFI0/DIO_0	35	DGND
2	PFI1/DIO_1	36	PFI2/DIO_2
3	AO_OUT0	37	AO_GND
4	AO_OUT1	38	AO_GND
5	AO_OUT2	39	AO_GND
6	AO_OUT3	40	AO_GND
7	AO_OUT4	41	AO_GND
8	AO_OUT5	42	AO_GND
9	AO_OUT6	43	AO_GND
10	AO_OUT7	44	AO_GND
11	AO_OUT8	45	AO_GND
12	AO_OUT9	46	AO_GND
13	AO_OUT10	47	AO_GND
14	AO_OUT11	48	AO_GND
15	AO_OUT12	49	AO_GND
16	AO_OUT13	50	AO_GND
17	AO_OUT14	51	AO_GND
18	AO_OUT15	52	AO_GND
19	AO_OUT16	53	AO_GND
20	AO_OUT17	54	AO_GND
21	AO_OUT18	55	AO_GND
22	AO_OUT19	56	AO_GND
23	AO_OUT20	57	AO_GND
24	AO_OUT21	58	AO_GND
25	AO_OUT22	59	AO_GND
26	AO_OUT23	60	AO_GND
27	AO_OUT24	61	AO_GND
28	AO_OUT25	62	AO_GND
29	AO_OUT26	63	AO_GND
30	AO_OUT27	64	AO_GND
31	AO_OUT28	65	AO_GND
32	AO_OUT29	66	AO_GND
33	AO_OUT30	67	AO_GND
34	AO_OUT31	68	AO_GND

Table 6 5710 Pin Definition

Notes to Legend in the Pin Definitions

AO_GND	Analog Output Reference Ground
AO<0..31>	Analog Output channel
D_GND	Digital Signal Reference Ground
PFI<0..2>	Programmable Function Interface

Table 7 Notes to Legend

3. Performance and Tests

3.1 AO Accuracy

The maximum AO accuracy is limited by two factors: Total Gain Error, Total Offset Error as shown in the following table. The PCIe/PXIe-5710 device is first calibrated. The test temperature is 2 °C from the calibration temperature.

Nominal Range Positive Full Scale	10 V
Nominal Range Negative Full Scale	-10 V
Residual Gain Error	69 ppm
Gain Tempco (ppm/°C)	7.8
Offset Tempco (ppm/°C)	4
Residual Offset Error	60 ppm
INL Error	64 ppm
TempChange From Last Calibration	5 °C
Absolute Accuracy at Full Scale(uV)	2520

Table 8 Typical AO Accuracy

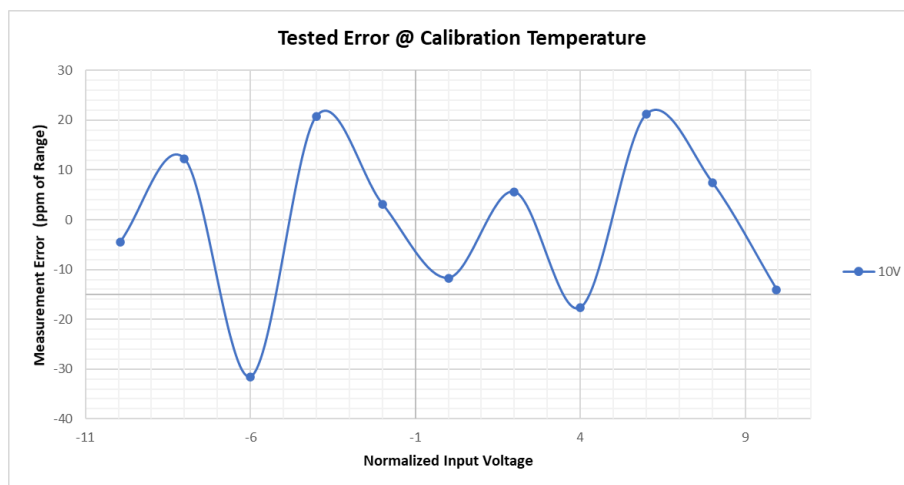


Figure 5 Typical AO Accuracy

3.2 Crosstalk

Reference Channel	Tested Channel	Crosstalk (dB at 100 KHz)
0	1	-71.8
0	15	-71.4
0	16	-70.4
1	2	-71.8
6	7	-71.4
6	22	-70.9
10	11	-72.1
16	17	-67.2
31	30	-71.6

Table 9 Crosstalk

4. Software

4.1 System Requirements

PCIe/PXle-5710 boards can be used in a Windows or a Linux operating system.

Microsoft Windows: Windows 7 32/64 bit, Windows 10 32/64 bit.

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 10 Supported Linux Versions

4.2 System Software

When using the PCIe/PXle-5710 in the Window environment, you need to install the following software from Microsoft website:

Microsoft Visual Studio Version 2015 or above,

.NET Framework version is 4.0 or above.

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

Given the resources limitation, JYTEK only tested PCIe/PXle-5710 be with .NET Framework 4.0 with Microsoft Visual Studio 2015. JYTEK relies on Microsoft to maintain the compatibility for the newer versions.

4.3 C# Programming Language

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

4.4 PCIe/PXIe-5710 Series Hardware Driver

After installing the required application development environment as described above, you need to install the PCIe/PXIe-5710 hardware driver.

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

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

Specific Hardware Driver: Each JYTEK hardware has a C# specific hardware driver. This driver provides rich and easy-to-use C# interfaces for users to operate various PCIe/PXIe-5710 function. JYTEK has standardized the ways which JYTEK and other vendor's DAQ boards 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 by using the same methods.

Note that this driver does not support cross-process, and if you are using more than one function, it is best to operate in one process.

4.5 Install the SeeSharpTools from JYTEK

To efficiently and effectively use PCIe/PXIe-5710 boards, you need to install a set of free C# utilities, SeeSharpTools from JYTEK. The SeeSharpTools offers rich user interface functions you will find convenient in developing your applications. They are also needed to run the examples come with PCIe/PXIe-5710 hardware. Please register and down load the latest SeeSharpTools from our website, www.jytek.com.

4.6 Running C# Programs in Linux

Most C# written programs in Windows can be run by MonoDevelop development system in a Linux environment. You would develop your C# applications in Windows using Microsoft Visual Studio. Once it is done, run this application in the MonoDevelop 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 MonoDevelop, you can do it by 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 MonoDevelop.

5. Operating PCIe/PXle-5710

This chapter provides the operation guides for PCIe/PXle-5710, including AI, AO, DI, DO, Timer and programmable I/O interface, etc.

JYTEK provides extensive examples, on-line help and documentation to assist you to operate the PCIe/PXle-5710 board. 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.

5.1 Quick Start

After you have installed the driver software and the SeeSharpTools, you are ready to use Microsoft Visual Studio C# to operate the PCIe/PXle-5710 products.

If you are already familiar with Microsoft Visual Studio C#, the quickest way to use PCIe/PXle-5710 boards 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.

We also provide **Learn by Example** in the following sections. These examples will help you navigate and learn how to use this PCIe/PXle-5710.

5.2 AO Operations

The PCIe/PXle-5710 AO provides 16-bit simultaneous outputs. The analog output has three modes of operation: Finite, ContinuousWrapping, and ContinuousNoWrapping.

5.2.1 Finite Output

The finite output requires the user to write a piece of data. After starting the AO, it starts to output the written data until the output is completed.

5.2.2 Continuous NoWrapping Output

The continuous acyclic output needs to write a piece of data before starting the AO. After the AO starts, user needs to continuously write new data to ensure the continuous output of the AO.

5.2.3 Continuous Wrapping Output

The continuous loop output first writes a piece of data before starting the AO. After the AO starts, the board will repeatedly output this data until user sends a stop command.

5.3 Trigger Source

There are 3 trigger types: Immediate trigger, Software trigger, and Digital trigger. The trigger type is a property and set by driver software.

5.3.1 Immediate trigger

This trigger mode does not require configuration and is triggered immediately when an operation starts. The operation can be AI, AO, DI, DO, CI, CO etc.

5.3.2 Software Trigger

A software trigger must be configured by the driver software. The trigger starts when a trigger software routine is called.

5.3.3 External Digital Trigger

PCIe/PXIe-5710 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 than 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 depending on the set trigger condition, then cause the module to acquire the data as shown in Figure 6



Figure 6 External Digital Trigger

5.4 Digital I/O Operations

The PCIe/PXIe-5710 provides powerful programmable digital I/O functions.

5.4.1 Static DI/DO

Programmable I/O supports static TTL, 6 ports (0,1,2,3,4,5) which are in total 48 digital I/O channels. User can access these I / O information through software polling.

5.5 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.

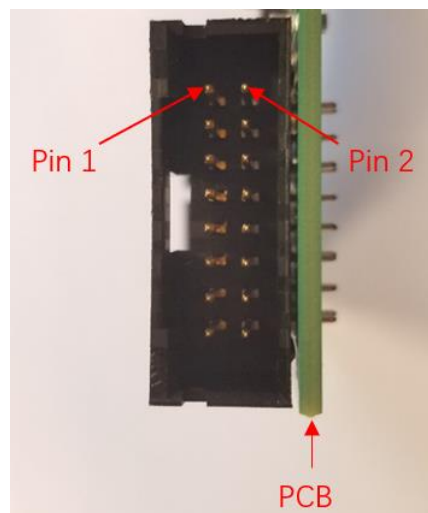


Figure 7 SSI Connector in PCIe-5710

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 11 SSI Connector Pin Assignment for PCIe-5710

5.6 DIP Switch in PCIe-5710

PCIe-5710 series modules have 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 positions.

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 others to OFF. See below for details.

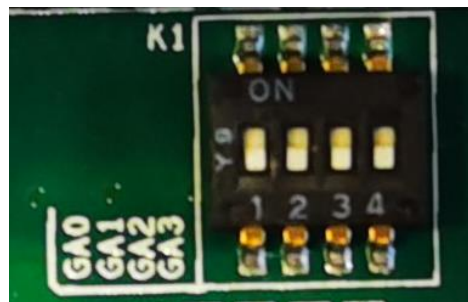


Figure 8 DIP Switch in PCIe-5710

	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 12 Relationship between switch position and slot number

6. Calibration

PCIe/PXIe-5710 Series boards are precalibrated before the shipment. We recommend you recalibrate PCIe/PXIe-5710 board periodically to ensure the measurement accuracy. A commonly accepted practice is one year. If for any reason, you need to recalibrate your board, please contact JYTEK.

7. Using PCIe/PXIe-5710 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++ and LabVIEW. This chapter explains how you can use PCIe/PXIe-5710 DAQ card using one of this software.

7.1 Python

JYTEK provides and supports a native Python driver for PCIe/PXIe-5710 boards. There are many different versions of Python. JYTEK has only tested in CPython version 3.5.4. 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.

7.2 C++

JYTEK internally uses our C++ drivers to design the C# drivers. We recommend our customers to use C# drivers because C# platform deliver much better efficiency and performance in most situations. We also make our C++ drivers available. However, due to the limit of our resources, we do not actively support C++ drivers. If you want to be our partner to support C++ drivers, please contact us.

7.3 LabVIEW

LabVIEW is a software product from National Instruments. JYTEK provides LabVIEW interface to PCIe/PXIe-5710 boards. You can down load the LabVIEW drivers from our website. While JYTEK does not support LabVIEW applications, we may recommend you to a third party who can assist you to interface your LabVIEW with our PCIe/PXIe-5710 boards. We can also recommend you if you want to convert your LabVIEW applications to C# based applications.

8. About JYTEK

8.1 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 is a joint venture between Adlink Technologies and a group of experienced professionals from the industry. JYTEK independently develop the software and hardware products and is entirely focused on the Chinese market. Our Shanghai headquarters and production service center have regular stocks to ensure timely supply; we have R&D centers in Xi'an and Chongqing to develop new products; we also have highly trained direct technical sales representatives in Shanghai, Beijing, Tianjin, Xi'an, Chengdu, Nanjing, Wuhan, Haerbin, and Changchun. We also have many partners who provide system level support in various cities.

8.2 JYTEK Korea and JYTEK In Other Countries

JYTEK Korea was the first JYTEK enterprise outside China to promote JYTEK products. Together with Adlink Technologies and JYTEK China, JYTEK is expanding to more countries. Each JYTEK location is an independently owned and operated franchise. It shares JYTEK's philosophy and business approach. Together JYTEK entities promote the JYTEK brand, technology, and products.

8.3 JYTEK Hardware Products

According to JYTEK's agreement with our equity partner Adlink Technologies, JYTEK's hardware is manufactured by the state-of-art manufacturing facility located in Shanghai Zhangjiang Hi-Tech Park. Adlink has over 20 years of the world-class low-volume and high-mix manufacturing expertise with ISO9001-2008, China 3C, UL, ROHS, TL9000, ISO-14001, ISO-13485 certifications. Its 30,000 square meters facilities and three high-speed Panasonic SMT production lines can produce 60,000 pieces boards/month; it also has full supply chain management - planning, sweeping, purchasing, warehousing and distribution. Adlink's manufacturing excellence ensures JYTEK's hardware has word-class manufacturing quality.

One core technical advantage is JYTEK's pursue for the basic and fundamental technology excellence. JYTEK China has developed a unique PCIe, PXIe, USB hardware driver architecture, FirmDrive, upon which many our future hardware will be based.

In addition to our own developed hardware, JYTEK also rebrands Adlink's PXI product lines. In addition, JYTEK has other rebranding agreements to increase our hardware coverage. It is our goal to provide the complete product coverage in PXI and PCI modular instrumentation and data acquisition.

8.4 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.

8.5 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.

9. Statement

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

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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.

Shanghai Jianyi Technology Co., Ltd.

Address: Room 201, Building 3, NO.300 Fangchun Road, Shanghai.

Post Code: 201203

Tel: 021-5047 5899

Website: www.jytek.com