

1. PCIe/PXIe-5113/5113s Specifications

Multi-functional Data Acquisition Boards



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

Overview

JYTEK JY-5113 board includes the PCIe-5113/5113s and PXIe-5113/5113s models, which belong to the JY-5110 series. The PCIe-5113 is a board based on the PCI Express interface, providing up to 64 channels of analog inputs of up to 1M samples per second, 4 channels of analog outputs, 16 channels of digital IO or 4 32-bit counters/timers; the PXIe-5113 is a board based on the PXI Express interface, providing up to 64 channels of analog inputs of up to 1M samples per second, 4 channels of analog outputs, 16 lines of Digital IO or 2 32-bit counters/timers.

1.1. Main Features

- High accuracy: 900 ppm
- Up to 64 single-ended/32 differential analog input channels;
- Sampling rates: 1MS/s; 8-ch 1MS/s/ch (5113s)
- 16 bits ADC
- 64M samples of analog input FIFO buffer

- 4 simultaneous 16-bit analog output channels
- 32M sample FIFO buffer for analog output
- 16 lines of Digital IO
- DIO supports hardware timing up to 10MHz
- 2 channels 32-bit timer/counter
- DMA for AI, AO and DIO
- Analog/Digital/Software Trigger



1.2. Analog Input

Analog Input	PCIe/PXIe-5113	PCIe/PXIe-5113s	
Number of channels	64 SE/ 32 DIFF	64 SE/ 32 DIFF	
ADC resolution (Bits)	16	16	
Single channel maximum sample rate	1 MS/s	1 MS/s or 8-ch 1MS/s/ch	
Multichannel maximum sample rate with same range(aggregate)	1 MS/s/n (n=1,2,364)	1 MS/s/n (n=1,2,38)	
Clock	100 MHz	100 MHz	
Input range(V)	±10/±5/±2.5	±10/±5/±2.5	
Input mode	RSE / Differential	RSE / Differential	
Input impedance	>1MΩ 330pF	>1MΩ 330pF	
Input coupling	DC	DC	
Overvoltage protection	±25 V	±25 V	
CMRR	85 dB	85 dB	
Crosstalk	-74 dB	-74 dB	
DNL	No Missing Code	No Missing Code	
INL	70 ppm of Range Typical	70 ppm of Range Typical	
Input FIFO	128 M Samples	128 M Samples	
Trigger type	Digital, Analog, Software	Digital, Analog, Software	
Trigger mode	StartTrigger, ReferenceTrigger, ReTrigger	StartTrigger, ReferenceTrigger, ReTrigger	
Analog trigger voltage range	±10 V Software Programmable	±10 V Software Programmable	
Overveltage Protection	Continuous : 20 mA, ±25 V	Continuous : 20 mA, ±25 V	
Overvoltage Protection	Instantaneous : 40 mA, ±25 V	Instantaneous : 40 mA, ±25 V	

Table 1 Analog Input Specifications

1.3. Analog Output

Analog Output		PCIe/PXIe-5113	PCIe/PXIe-5113s		
Number of channels	of channels 4				
DAC resolution		16 bit	S		
	1 channel	2 MS/	's		
Maximum update rate (simultaneous)	2 channels (1 channel per bank)*	2 MS/s			
	4 channels	1 MS/	's		
Clock		100 M	Hz		
Clock accuracy		Jitter <20 ps			
Output range(V)		±10			
Output mode		RSE			
Output impedance		0.2 Ω			
Output coupling DC					
Output current drive		±10 m	A		
Output FIFO		32 M Samples			
Trigger source	Trigger source		Digital, Software		
Trigger type		Start Trigger			
* Each bank consists of 2 AO channels. Any channels being used within a single bank will u simultaneously.					

Table 2 Analog Output Specifications



1.4. Counter Input/Output

CIO	PCIe/PXIe-5113 PCIe/PXIe-511				
Number of channels	2				
Resolution	32	bits			
Counter Input	edge count, period measurement, frequency measurement, pulse width measurement, two-edge interval measurement, orthogonal coding, etc.				
Counter Output	Single, finite and continuous pulse				
Clock	100 MHz				
FIFO	4 M Samples				
Input	Gate, Source, Aux				
Output	Ol	JT			

Table 3 Counter Input Operations Specifications

1.5. PFI Specifications

PFI	PCIe/PXIe-5113 PCIe/PXIe-5113			
Number of channels	16			
External digital trigger interface	Trigger voltage : 3.3 V TTL			
External digital trigger interface	Trigger edge: Rising/Falling			
Initial state	Input			

Table 4 PFI Specifications



1.6. Digital IO Specifications

DIO	PCIe/PXIe-5113	PCIe/PXIe-5113s		
Number of channels	16 L	ines		
Ground reference	DG	SND		
Directional control	Independent cor	ntrol of each port		
Max update rate	10 M	MHz		
Max	10 M	MHz		
DI FIFO	32M Sa	amples		
DO FIFO	32M Samples			
Initial state	Input			
Disital Input	Logic Low: VIL Min : 0 / Max : 0.8 V			
Digital Input	Logic High: VIH Mir	Logic High: VIH Min : 2 V / Max : 5.3 V		
Digital Quitaut	Logic Low : 0 V, IOL Max: 12 mA			
Digital Output	Logic High : 2.6 V \sim 3.3 V, IOH: -12 mA \sim 0 mA			

Table 5 Digital IO Specifications

1.7. Basic DC AI Accuracy

JY-5113 Basic Accur	acy = ±(%	Read	ling+% Ra	inge)				
Nominal Range (V)	24 Hou	ur Tca	al ±1C°	90 Day	Тса	l ±5C°	24 Hr Full Scale Accuracy	90 Day Full Scale Accuracy
2.5	0.008	+	0.052	0.020	+	0.130	1500 uV	3800 uV
5	0.008	+	0.051	0.020	+	0.130	3000 uV	7300 uV
10	0.008	+	0.028	0.020	+	0.070	3600 uV	9000 uV
Valid for one channel	only. 95% d	of Co	nfidence Ir	nterval				
Max sampling rates fo	r 5113: 1 N	/IS/s						
Add 20% to Gain and Offset Errors From 91 Days to 1 Year. Preliminary								
10 V range: valid for ±	9.5 V							

Table 6 Basic DC AI Accuracy

AI Bandwidth							
An	Analog Input Bandwidth						
Nominal Range Full Scale (V)	Bandwidth select	-3dB Bandwidth (kHz)					
All range	15KHz	15					
All range	39KHz	31					
All range	80KHz	73					

Table 7 AI Bandwidth Specifications



1.8. Basic AO Accuracy

Nominal Range (V)	24 Hour Tcal ±1C°	acy = ±(% of Output+% of Range) r Tcal ±1C° 90 Days Tcal ± 5°		90 Day Full Scale Accuracy			
10	0.007 + 0.018	0.0167 + 0.0080	2500 uV	6100 uV			
100.007+0.0180.0167+0.00802500 uV6100 uVValid for all update rates.Add accuracy adjustment if temperature is ouside calibration temperature range.Add 20% to Gain and Offset Errors From 91 Days to 1 Year. Preliminary.Maximum update rates(simultaneous)Specs subject to minor changes when more tests become available.							

Table 8 Basic AO Accuracy

1.9. System Noise

Nominal Range (V)	Bandwidth select (KHz)	SystemNoise (µVrms)
2.5	15	56
5	15	91
10	15	170
2.5	39	73
5	39	110
10	39	190
2.5	80	230
5	80	300
10	80	410

Table 9 System Noise Specifications Physical and Environment

1.10. Physical and Environment

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 10 Physical and Environment



1.11. Front Panel and Pin Definition



Figure 1 PCIe/PXIe 5113 Front Panel



	Conr	nector 1		1		Conn	ector 0	
Pin	Identification	Pin	Identification		Pin	Identification	Pin	Identification
1	PFI 8 / DIO_8	35	D_GND		1	PFI 0 / DIO_0	35	D_GND
2	PFI 9 / DIO_9	36	D_GND		2	PFI 1 / DIO_1	36	D_GND
3	PFI 10 / DIO_10	37	D_GND		3	PFI 2 / DIO_2	37	D_GND
4	PFI 11 / DIO_11	38	D_GND		4	PFI 3 / DIO_3	38	D_GND
5	PFI 12 / DIO_12	39	D_GND		5	PFI 4 / DIO_4	39	D_GND
6	PFI 13 / DIO_13	40	D_GND		6	PFI 5 / DIO_5	40	D_GND
7	PFI 14 / DIO_14	41	D_GND		7	PFI 6 / DIO_6	41	D_GND
8	PFI 15 / DIO_15	42	D_GND		8	PFI 7 / DIO_7	42	D_GND
9	AO2	43	AO_GND		9	AO0	43	AO_GND
10	AO3	44	AO_GND		10	AO1	44	AO_GND
11	AI 32 (AI 16+)	45	AI 40 (AI 16-)		11	AI 0 (AI 0+)	45	AI 8 (AI 0-)
12	AI_GND	46	AI_GND		12	AI_GND	46	AI_GND
13	AI 33 (AI 17+)	47	AI 41 (AI 17-)		13	AI 1 (AI 1+)	47	AI 9 (AI 1-)
14	AI 34 (AI 18+)	48	AI 42 (AI 18-)		14	AI 2 (AI 2+)	48	AI 10 (AI 2-)
15	AI_GND	49	AI_GND		15	AI_GND	49	AI_GND
16	AI 35 (AI 19+)	50	AI 43 (AI 19-)		16	AI 3 (AI 3+)	50	AI 11 (AI 3-)
17	AI 36 (AI 20+)	51	AI 44 (AI 20-)		17	AI 4 (AI 4+)	51	AI 12 (AI 4-)
18	AI_GND	52	AI_GND		18	AI_GND	52	AI_GND
19	AI 37 (AI 21+)	53	AI 45 (AI 21-)		19	AI 5 (AI 5+)	53	AI 13 (AI 5-)
20	AI 38 (AI 22+)	54	AI 46 (AI 22-)		20	AI 6 (AI 6+)	54	AI 14 (AI 6-)
21	AI_GND	55	AI_GND		21	AI_GND	55	AI_GND
22	AI 39 (AI 23+)	56	AI 47 (AI 23-)		22	AI 7 (AI 7+)	56	AI 15 (AI 7-)
23	AI 48 (AI 24+)	57	AI 56 (AI 24-)		23	AI 16 (AI 8+)	57	AI 24 (AI 8-)
24	AI_GND	58	AI_GND		24	AI_GND	58	AI_GND
25	AI 49 (AI 25+)	59	AI 57 (AI 25-)		25	AI 17 (AI 9+)	59	AI 25 (AI 9-)
26	AI 50 (AI 26+)	60	AI 58 (AI 26-)		26	AI 18 (AI 10+)	60	AI 26 (AI 10-)
27	AI_GND	61	AI_GND		27	AI_GND	61	AI_GND
28	AI 51 (AI 27+)	62	AI 59 (AI 27-)		28	AI 19 (AI 11+)	62	AI 27 (AI 11-)
29	AI 52 (AI 28+)	63	AI 60 (AI 28-)		29	AI 20 (AI 12+)	63	AI 28 (AI 12-)
30	AI_GND	64	AI_GND		30	AI_GND	64	AI_GND
31	AI 53 (AI 29+)	65	AI 61 (AI 29-)		31	AI 21 (AI 13+)	65	AI 29 (AI 13-)
32	AI 54 (AI 30+)	66	AI 62 (AI 30-)		32	AI 22 (AI 14+)	66	AI 30 (AI 14-)
33	AI_GND	67	AI_GND		33	AI_GND	67	AI_GND
34	AI 55 (AI 31+)	68	AI63 (AI 31-)		34	AI 23 (AI 15+)	68	AI 31 (AI 15-)

Connector 0		Connector 0		
Pin	Identification	Pin	Identification	
1	Ctr0_Source	5	Ctr1Source	
2	Ctr0_Gate	6	Ctr1_Gate	
3	Ctr0_Aux	7	Ctr1_Aux	
4	Ctr0 Out	8	Ctr1 Out	

Table 11 5113 Pin Definition



AI_GND	Analog Input Reference Ground
Al<031>	Analog Input channel
AI SENSE	Analog Input Signal, Suitable for NRSE mode
AO_GND	Analog Output Reference Ground
AO<03>	Analog Output Channel
D_GND	Digital Signal Reference Ground
P<03>.<07>	Digital I/O Channel
PFI<015>	Programmable Function Interface
+5V_OUT	5V power supply

Table 12 Cable Specification



1.12. Accessories

- DIN-68 (PN: JY1717615-01)
 SCSI 68-pin Terminal board
- ACL-1016868-1 (PN: JY1016868-01)
 1M 68pin VHDCI68M-SCSI68M cable
- ACL-1016868-2 (PN: JY1016868-02)
 2M 68pin VHDCI68M-SCSI68M cable



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3. Software

3.1. Supported Operating System

Windows 7/10, x64/x86, Linux. See additional information.

3.2. Programming Languages

Microsoft C#. See additional software information for other languages.

4. Order Information

PCIe-5113 (PN: JY9785803-01)

64-ch AI (16-Bit, 1 MS/s), 4-ch AO (16-Bit, 2 MS/s), 16 DIO PCIe Multifunction I/O Card

• PXIe-5113 (PN: JY4726411-01)

64-ch AI (16-Bit, 1 MS/s), 4-ch AO (16-Bit, 2 MS/s), 16 DIO PXIe Multifunction I/O Card

- PCIe-5113s (PN: JY9785803-02)
 64-ch AI.1 MS/s or 8-ch 1MS/s/ch (16-Bit), 4-ch AO (16-Bit, 2 MS/s), 16 DIO PCIe
 Multifunction I/O Card
- PXIe-5113s (PN: JY4726411-02)
 64-ch AI 1 MS/s or 8-ch 1MS/s/ch (16-Bit), 4-ch AO (16-Bit, 2 MS/s), 16 DIO PXIe
 Multifunction I/O Card

5. 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.



6. Additional Hardware Information

6.1. Basic DC AI Accuracy

The DAQ mode is the normal data acquisition mode commonly found in commercial DAQ hardware. The basic AI DC accuracy Table 6 of the DAQ mode provides accuracy entries when PCIe/PXIe-5113 operates in the single channel mode and within the indicated calibration temperature range. Please note that this accuracy is valid for every single point regardless how many sample points you acquire.

Each entry in the basic accuracy table is a pair of gain and offset coefficients. Using these gain and offset coefficients, your measurement accuracy can be calculated by following formula:

$$Accuracy = \pm(\% of Reading + \% of Range)$$

For example, at the 2.5 V range and 24 Hours column, if your measurement or reading is 1V, the accuracy of this measurement is:

$$\pm (0.008\% * 1 + 0.052\% * 2.5) = \pm 0.00138 V = \pm 1380 \mu V$$

The basic accuracy table also provides full-scale accuracy entries for a quick and convenient look-up. For example, the full-scale accuracy for the 2.5 V range and the 24-Hour calibration column is 1500 μ V.

6.2. Basic AO Accuracy

The AO output accuracy of PCIe/PXIe-5113 when using the analog output function can be calculated according to the corresponding parameters in the Table 8

Each entry in the basic accuracy table is a pair of gain and offset coefficients. Using these gain and offset coefficients, your AO output basic accuracy is calculated by following formula:

$$Accuracy = \pm (\% \ of \ Output + \% \ of \ Range)$$



For example, at the 10V range and 24 Hours column, if your output is 4V, the accuracy of this measurement is:

 $\pm (0.007\% * 4 + 0.018\% * 10) = \pm 0.00208V = \pm 2080 \,\mu V$

The basic accuracy table also provides full-scale accuracy entries for a quick and convenient look-up. For example, the full-scale accuracy for the 5V range and the 24-Hour calibration column is 2500 μ V.



7. Additional Software Information

7.1. System Requirements

The PCIe/PXIe-5113 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 supports the following Linux versions only.

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 13 Supported Linux Versions

7.2. System Software

When using the PCIe/PXIe-5113 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/PXIe-5113 be with .NET Framework 4.0 with Microsoft Visual Studio 2015. JYTEK relies on Microsoft to maintain the compatibility for the newer versions.



7.3. 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.

7.4. PCIe/PXIe-5113 Hardware Driver

After installing the required application development environment as described above, you need to install the PCIe/PXIe-5113 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-5113 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.



7.5. Install the SeeSharpTools from JYTEK

To efficiently and effectively use PCIe/PXIe-5113 board, 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-5113 hardware. Please register and download the latest SeeSharpTools from our website, www.jytek.com.

7.6. 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.



8. Operating JY5113

This chapter provides the operation guides for PCIe/PXIe-5113, 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/PXIe-5113 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.

8.1. 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/PXIe-5113 products.

If you are already familiar with Microsoft Visual Studio C#, the quickest way to use PCIe/PXIe-5113 board 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/PXIe-5113.

8.2. Data Acquisition Methods

PCIe/PXIe-5113 uses a scanning method to acquire analog data, meaning there is only one ADC chip on the device and all input channels share this ADC. In the scan acquisition mode, you need to configure AI channels and set up some parameters through PCIe/PXIe-5113 driver software. The most important parameters are *Data Acquisition mode, Sample Rate, SamplesToAcquire, Channel Count, ChannelRange* and *Analog Input Terminal Type*.



Al Acquisition mode (*AIMode*): PCIe/PXIe-5113 provides 4 acquisition modes, **Continuous, Finite, Single Point, Record,** which will be described in details in Section 8.2.1-8.2.4.

SampleRate: How fast data are acquired per second per channel. For example, if the sample rate is 1000Hz, you acquire two channels of data, you will have 2000 points/second.

SamplesToAcquire: This parameter behaves differently in the different AI acquisition modes. In the continuous acquisition mode, *SamplesToAcuire* is the buffer size used in the AI acquisition task, please see Section8.2.1; in the finite acquisition mode, it is the total number of samples to capture, please see Section8.2.2.

Channel Count: how many channels you want to collect data. You can set up the channels in different orders, for instance 2,3,1,0. The acquired data will be arranged in the way you specify as shown in Figure 2. In this particular case, *Channel Count* is 4.

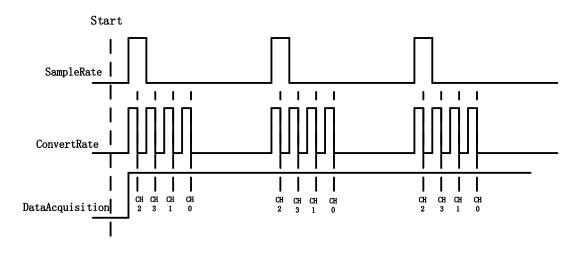


Figure 2 Sample Rate and Internal AD Conversion

ConvertRate denotes the working rate of ADC. In default: *ConvertRate* = *SampleRate* * *ChannelCount* . User can redefine the *ConvertRate* in our software. If user want to redefine *ConvertRate*, *The following conditions must be met*:



Multichannel maximum sample rate (aggregate) >=ConvertRate >= SampleRate * ChannelCount.

User can get Multichannel maximum sample rate (aggregate) from section Appendix.

Learn by Example 8.2

Connect the two signal source's positive outputs to PCIe-5111 AI Ch0 (AI0+, Pin #68) and AI Ch1 (AI1+, Pin#33), two negative terminals to the ground (AI_GND, Pin#67) as shown in Figure 3 and Figure 4 (AI0+, AI_GND) and (AI1+, AI_GND) consist of two channels of RSE inputs and they share the same GND.

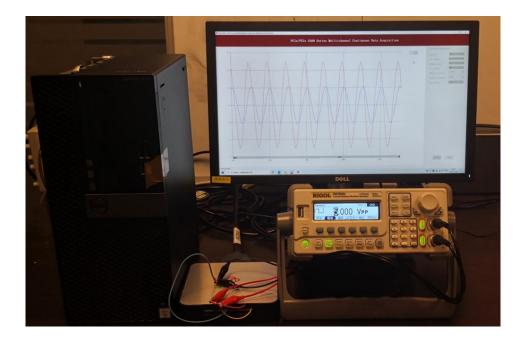


Figure 3 PCIe-5111 experiment



JYTEK	TB-68 SCSI-II terminal bo temperature sen 5500 Series Connector O[Connec	tor 1] Disabled	Sensor Setting SW2 N temperature sensor lefault Mode)
J1 (43) PF12[P2. 2] 9 D_GND (42) PF13[P2. 3] 8 +5V_OUT (41) PF14[P2. 4] 7 D_GND (40) PF113[P3. 5] (6) PF15[P2. 5] (7) PF16[P2. 6] (3) PF16[P2. 6] (3) PF17[P2. 7] (4) D_GND (3) PF18[P3. 0] (3) PF19[P3. 1] (36) D_GND (2) PF112[P3. 4] (35) D_GND (1) PF114[P3. 6]	J2 (51) P0. 5[P1. 5] (17) P0. 1[P1. 1] (50) D_GND (16) P0. 6[P1. 6] (49) P0. 2[P1. 2] (15) D_GND (48) P0. 7[P1. 7] (14) +5V_0UT (47) P0. 3[P1. 3] (13) D_GND (40) PF111[P3. 3] (12) D_GND (45) PF110[P3. 2] (11) PF10[P2. 0] (44) DGND (10) PF11[P2. 1]	J3 (59) A1_GND (25) A16+[A122+] (58) A16-[A122-] (24) A1_GND (57) A17+[A123+] (23) A17-[A123-] (56) A1_GND (24) A00_GND (21) A01[A03] (54) A0_GND (20) APF11 (53) D_GND (19) P0. 4[P1. 4] (52) P0. 0[P1. 0] (18) D_GND	J4 (68) A10+[A116+] (34) A10-[A116-] (67) A1_GND (33) A11+[A117+] (66) A11-[A117-] (32) A1_GND (56) A12+[A118+] (31) A12-[A118+] (31) A12-[A119-] (32) A1_GND (52) A1_GND (52) A1_GND (52) A1_GND (52) A1_GND (52) A1_GND (52) A1_GND (52) A1_GND (52) A1_GND (53) A14+[A120+] (51) A14-[A120+] (51) A14-[A120+] (51) A14-[A120+] (51) A14-[A120+] (51) A14-[A120+] (51) A14-[A120+] (51) A14-[A120+] (51) A15+[A121+] (26) A15+[A121+] (26) A15-[A121+]

Figure 4 TB-68 Terminal Block

- Set a sinewave signal (f=4Hz, Vpp=5V) and a squarewave signal (f=4Hz, Vpp=5V).
- Open Analog Input-->Winform AI Continuous MultiChannel, set the following numbers as shown. This sample program will continuously acquire data from multiple channels.

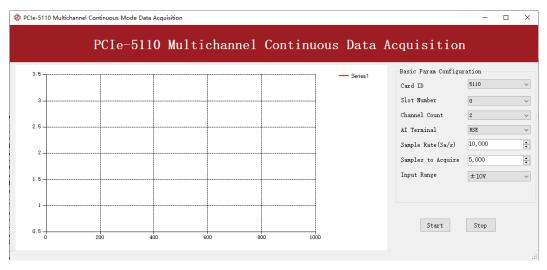


Figure 5 Continuous MultiChannel Paraments

SampleRate is set by Sample Rate



- Samples to Acquire is the samples to be acquired for each channel in one block. The continuous mode will acquire blocks after blocks until Stop button is pressed.
- When start is clicked, it generates a software trigger, which starts the acquisition.
 The result is shown below.

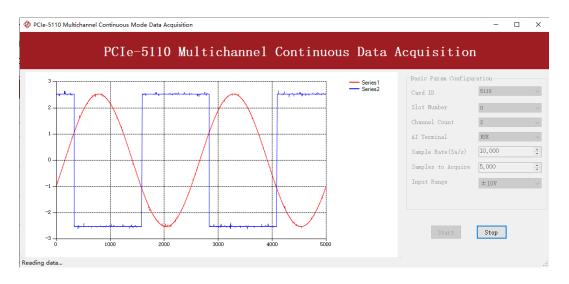


Figure 6 MultiChannel Continuous Acquisition

8.2.1. Continuous Acquisition

An AI acquisition task will acquire the data continuously until the task is stopped. The PCIe/PXIe-5113 device will continue acquiring data and save the data in a circular buffer. You specify how many samples to read back by the user buffer's length, if your program does not read the data fast enough, the circular buffer may overflow. In this case, the driver software will throw out an error message.

Tip: User buffer's length 1/10th to 1/4th *SampleRate* is a good start.

8.2.2. Finite Acquisition

In the Finite Acquisition mode, an AI acquisition task will capture specific total number of samples by the parameter, SamplesToAcquire.

You can use the sample program **Analog Input --> Winform AI Finite** to learn more about Finite Acquisition.



8.2.3. Single Point Acquisition

In the Single Acquisition mode, it is to capture a single sample for each acquisition.

You can use sample program: **Analog Input --> Console AI Single Point** to learn more about the single point Acquisition.

8.2.4. Record Acquisition

Al Task will continuously capture the data and then save them to a storage disk. During the capturing process, user can preview the captured data randomly when the capturing process is available. The mode is particularly useful for high-speed acquisition and recording applications.

8.3. Analog Input Terminal Type

The PCIe/PXIe-5113 provide 3 analog input terminal types:

- Differential (DIFF)
- Referenced Single-Ended (RSE)
- Non-Referenced Single-Ended (NRSE)

The DIFF connection is recommended for ground-referenced signal sources and it is usually better in rejecting the common-mode noise. However, to acquire one input signal, two AI channels are required to form the differential pair. The RSE and NRSE are recommended when the input signal sources are floating signals. In RSE and NRSE modes, these floating signal sources all share the same ground reference (AI_GND). Because of it, the RSE and NRSE modes can acquire twice as many channels than the DIFF mode. Appendix has more details on these 3 modes.

8.3.1. DIFF Mode

The DIFF mode connects signal's positive side to AI's positive input, signal's grounded negative side to AI's negative input as shown in Figure 7. The common noise appears on both positive and negative terminals of the differential amplifier; thus it will be



cancelled out. Therefore, the DIFF mode has better signal-to-noise ratio (SNR). Please see Appendix for more explanations.

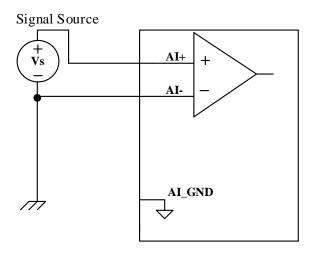


Figure 7 Differential Mode for Grounding Signals

Learn by Example 8.3.1

- Open the program Analog Input-->Winform AI Continuous MultiChannel
- Connect the two signal source's positive outputs to PCIe-5111 AI Ch0 (AI0+, Pin #68) and AI Ch1 (AI1+, Pin#33), two negative terminals to AI Ch0 negative (AI0-, Pin#34) and AI Ch1 negative (AI1-, Pin#66) as shown in Figure 3 and Figure 4. (AI0+, AI0-) and (AI1+, AI1-) consist of two pairs of DIFF inputs;
- Choose Differential in AI Terminal;
- Set other numbers as shown and click **start**.

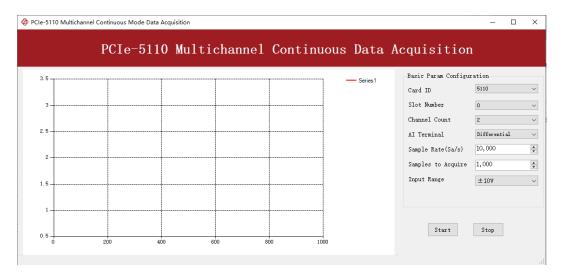


Figure 8 Choose Differential in AI Terminal



8.3.2. RSE Mode

In the RSE mode, all input signals' negative sides are connected to the AI ground of Instrumentation Amplifier, as shown in Figure 9. This mode works for measurements from floating sources. The RSE mode is suitable when these two conditions exist:

- The input signals are floating, meaning they are not connected to the ground
- When the common mode noise is low, meaning a clean environment.

The RSE mode offers twice as many measurement channels as the DIFF mode. Please see Appendix for more explanations.

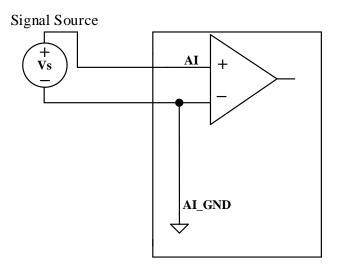


Figure 9 RSE Mode for Floating Signals

8.3.3. NRSE Mode

The NRSE mode is recommended for the measurement of ground-referenced signals, as shown in Figure 10. NRSE is also called the pseudo differential mode, because it looks very similar to a DIFF connection. In this mode, the PCIe/PXIe-5113 device offers a special reference point, AI SENSE. Instead of connecting two grounds directly, signal's ground and PXI device's ground, the input signals' ground is connected to AI SENSE to avoid the ground loop bias. The PCIe/PXIe-5113 is also designed to better reject the common mode noise than the RSE mode. Therefore, the NRSE model still



offers twice many channels as the DIFF mode. Please see Appendix for more explanations.

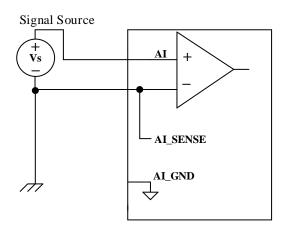


Figure 10 NRSE Mode for Grounding Signals

Learn by Example 8.3.3

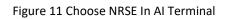
• Open the program **Analog Input-->Winform AI Continuous MultiChannel**.

■ This Example needs two TB-68 terminal blocks, Connector0 and Connector1 and two cables, which are connected to PCIe-5111. Connect the two signal source's positive outputs to PCIe-5111 AI Ch0 (AI0+, Pin #68) and AI Ch1 (AI1+, Pin#33), two negative terminals to AI_SENSE 0 (Pin#62) of the first TB-68 and AI_SENSE 1 (Pin#62) of the second TB-68 as shown in Figure 3 and Figure 4. (AI0+, AI_SENSE 0) and (AI1+, AI_SENSE 1) consist of two channels of NRSE inputs.

- Choose the NRSE in **AI Terminal**
- Set other numbers as shown and click **start**.



	PCIe-51	110 Mu	ltichan	nel Con	tinuou	s Data A	Acquisition	ı
3. 5 3 2. 5 2. 5						— Series 1	Basic Param Configu Card ID Slot Number Channel Count AI Terminal Sample Rate(Sa/s) Samples to Acquire Input Range	tation 5110 0 2 NRSE 10,000 1,000 ±10V
0.5							Start	Stop



8.4. Trigger Source

There are 4 trigger types: Immediate trigger, Software trigger, Analog trigger, and Digital trigger. The trigger type is a property and set by driver software.

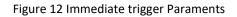
8.4.1. Immediate trigger

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.

Learn by Example 8.4.1

■ Use the same program and connection as in Learn by Example8.2.

	PCIe-	5110 Mu	ltichan	nel Con	tinuou	s Data A	cquisition	1
3.5						- Series 1	-Basic Param Configu	ration
							Card ID	5110
3							Slot Number	0
							Channel Count	2
2.5							AI Terminal	RSE
							Sample Rate(Sa/s)	10,000
2							Samples to Acquire	5,000
							Input Range	±10V
1.5								
1								
0.5							Start	Stop





With Immediate trigger you can click Start to generate the task instead of sending a trigger signal.

8.4.2. Software Trigger

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

Learn by Example 8.4.2

Connect the signal source's positive terminal to PCIe-5111 AI Ch0 (AIO+, Pin#68), the negative terminal to the ground (AI_GND, Pin#67) as shown in Figure 3 and Figure 4. (AIO+, AI_GND) consists of a RSE input.

■ Set a sinewave signal (f=4Hz, Vpp=5V).

Open Analog Input-->Winform AI Continuous Soft Trigger, set the following numbers as shown.

Click **Start** to run the task.

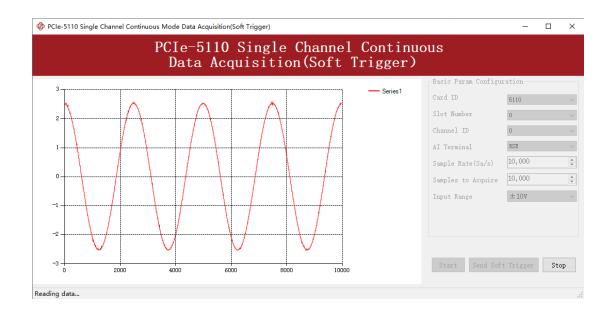
	Data	Acquisi	tion(Sof	nel Continu t Trigger)			
5		Series 1					
					Card ID	5110	
3					Slot Number	0	· · · · · · · · · · · · · · · · · · ·
					Channel ID	0	×
					AI Terminal	RSE	×
					Sample Rate(Sa/s)	10,000	
					Samples to Acquire	10,000	4
					Input Range	±10V	```
5							
1							

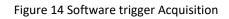
Figure 13 Software trigger Paraments

Data will not be acquired until there is a positive signal from Software Trigger when Send Soft Trigger is clicked.

After sending the trigger signal, the result will be like this:







8.4.3. External Analog Trigger

You can assign one of measurement channels as the analog trigger source. PCIe/PXIe-5113 provides three analog trigger modes:

- Edge comparator,
- Hysteresis comparator,
- Window comparator.

Analog trigger threshold range can be arbitrarily selected in the effective range of the selected channel. When setting the threshold, please pay attention to the physical unit currently in use.

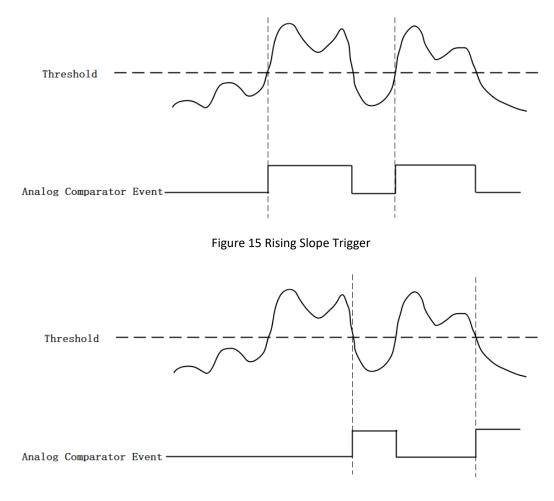
Edge comparator

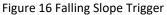
In the Edge comparator, there are two trigger conditions: *Rising Slope Trigger* and *Falling Slope Trigger*.

Rising Slope Trigger: The Edge comparator output is high when the signal goes above the threshold; the output is low when the signal goes below the threshold as shown in Figure 15.



Falling Slope Trigger: The Edge comparator output is high when the signal goes below the threshold; the output is low when the signal goes above the threshold as shown in Figure 16.





Hysteresis Comparator

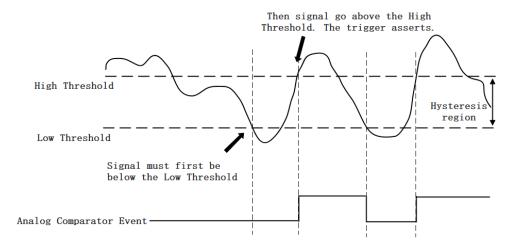
The hysteresis comparator is designed for preventing spurious triggering. You can set hysteresis region by setting high threshold and low threshold. There are two trigger conditions: *Hysteresis with Rising Slope Trigger* and *Hysteresis with Falling Slope Trigger*.

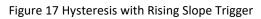
Hysteresis with Rising Slope Trigger: The Hysteresis comparator output is high when the signal must first be below the low threshold, then goes above the high threshold.



The output will change to low when the signal goes below the low threshold as shown in Figure 17.

Hysteresis with Falling Slope Trigger: The Hysteresis comparator output is high when the signal must first be above the high threshold, then goes below the low threshold. The output will change to low when the signal goes above the high threshold as shown in Figure 18.





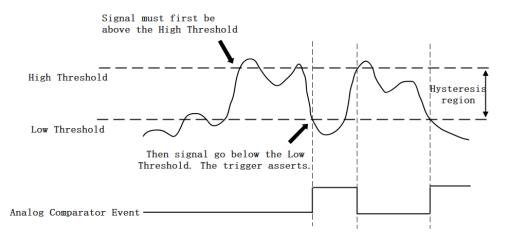


Figure 18 Hysteresis with Falling Slope Trigger

Window comparator

The window comparator is designed to acquire signal from interesting window by setting High Threshold and Low Threshold. There are two trigger conditions: *Entering Window Trigger* and *Leaving Window Trigger*.



Entering Window Trigger: The window comparator output is high when the signal enters the window defined by the *Low Threshold* and *High Threshold*. The output will change to low when the signal leaves the window as shown in Figure 19.

Leaving Window Trigger: The window comparator output is high when the signal leaves the window defined by the *Low Threshold* and *High Threshold*. The output will change to low when the signal enters the window as shown in Figure 20 Leaving Window Trigger.

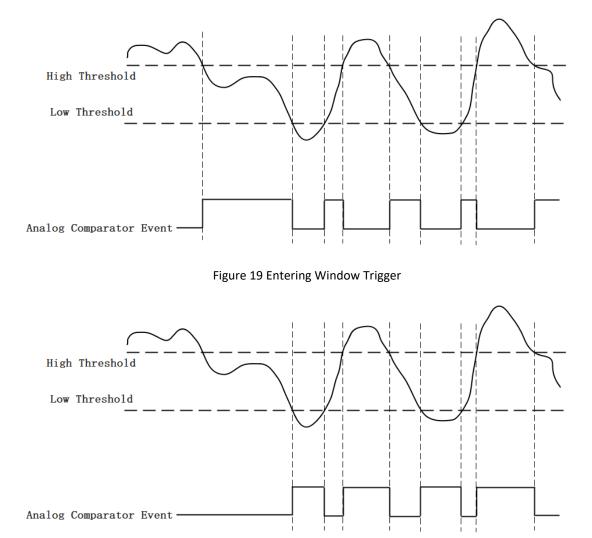


Figure 20 Leaving Window Trigger



Learn by Example 8.4.3

Connect the signal source's positive terminal to PCIe-5111 AI Ch0 (AIO+, Pin#68), the negative terminal to the ground (AI_GND, Pin#67) as shown in Figure 3 and Figure 4. (AIO+, AI_GND) consists of a RSE input.

■ Set a sinewave signal (f=4Hz, Vpp=5V).

Open Analog Input-->Winform AI Continuous Analog Trigger, set the following numbers as shown.

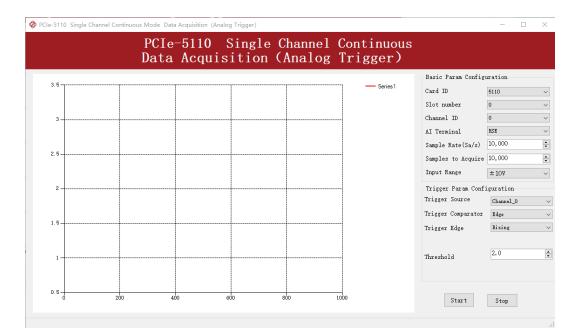


Figure 21 Analog Trigger Paraments

- > Modes of the Analog Trigger are set by **Trigger Comparator.** Set it to **Edge**.
- > The edge of *EdgeComparator* set by **Trigger Edge**. (**Rising** and **Falling**)
- Trigger source can be any channel of PCIe-5111 analog input. Set it to Channel_0.
- According to the rules of **Rising** mentioned above, the signal acquisition will not start until it raises to 2.0 V, which is set by **Threshold** above.
- Click Start, a message will appear in the lower left corner:

Waiting for the trigger signal



This indicates the data acquisition will start only after a triggering event. In this example a trigger signal will occur when the *hysteresis comparator* meets the condition explained in 8.4.3.

PCIe-5110 Single Channel Continuous Mode Data Acquisition (Analog Trigger) PCIe-5110 Single Channel Continuous Data Acquisition (Analog Trigger) -Basic Param Configuration - Series1 5110 0 0 RSE Sample Rate(Sa/s) 10,000 Samples to Acquire 10,000 Input Range $\pm 10 \text{V}$ Trigger Param Configuration 0 Channel_0 Trigger Comparator Edge -1 Trigger Edge Rising 2.0 -3 200 4000 8000 10000 Stop Reading data..

The result is shown below:



> The signal starts at 2.0V, which matches the Edge mode set before.

8.4.4. External Digital Trigger

PCIe/PXIe-5113 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 24





Figure 24 External Digital Trigger

Learn by Example 8.4.4

- Connect the signal source two positive terminals to PCIe-5111 AI Ch0, (AI0+, Pin #68) and digital trigger source (PFI 0, Pin#11), two negative terminals to the ground of analog input (AI_GND, Pin#67) and the ground of digital input/output (DGND, Pin#44) as shown in Figure 3 and Figure 4 (AI0+, AI_GND) consists of a RSE input. (PFI0, DGND) provides the trigger signal.
- Set a sinewave signal (f=4Hz, Vpp=5V) and a squarewave signal (f=4Hz, Vpp=5V).
- Open Analog Input-->Winform AI Continuous Digital Trigger, set the following numbers as shown.

					hannel Cont igital Tri			
3 5						-Basic Param Config	uration	
0.0					Series1	Card ID	5110	
						Slot Number	0	
3						Channel ID	0	
						AI Terminal	RSE	
2.5						Sample Rate(Sa/s)	10,000	
						Samples to Acquire	10,000	
2						Input Range	±10V	
1.5						Trigger Param Conf	iguration	
						Trigger Source	PFIO	
1						Trigger Edge	Rising	
0.5	200	400	600	800	1000			

Figure 25 Digital Trigger Paraments

- **Trigger Source** must match the pin on 5110.
- > There are two **Trigger Edge**: **Rising** and **Falling**.



■ Click **Start** and the result shows below:

					Channel Digital				
3 5						. · .	Basic Param Config	uration	
0.0						Series1	Card ID	5110	
							Slot Number	0	
3							Channel ID	0	
							AI Terminal	RSE	
2.5							Sample Rate(Sa/s)	10,000	
							Samples to Acquire	10,000	
2							Input Range	±10V	
1.5							-Trigger Param Conf	iguration	
							Trigger Source	PFIO	
1							Trigger Edge	Rising	
0.5	200	400	000	800	1000		Start	Stop	

Figure 26 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.

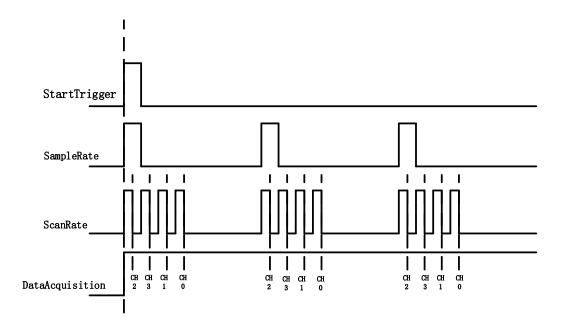
8.5. Trigger Mode

The PCIe/PXIe-5113's analog inputs support several trigger modes: start trigger, reference trigger, and re-trigger.

8.5.1. Start Trigger

In this mode, data acquisition begins immediately after the trigger. This trigger mode is suitable for continuous acquisition and finite acquisition. As shown in Figure 27.







8.5.2. Reference Trigger

This trigger mode is suitable for finite acquisition. In this mode, user can set the number of pre-trigger samples. The default number of pre-trigger points is 0. First you need to start the data acquisition. When the reference trigger condition is met, the routine will return the acquired data points. If when the points less than the pre-trigger samples, the trigger signal be ignored. An example is show below.

Example

- Total samples: 1000;
- Channel Count: 1
- Pre-trigger samples: 10;
- After triggering, it returns total 1000 samples, 10 being pre-triggered, 990 after triggering

The principle is shown in Figure 28.



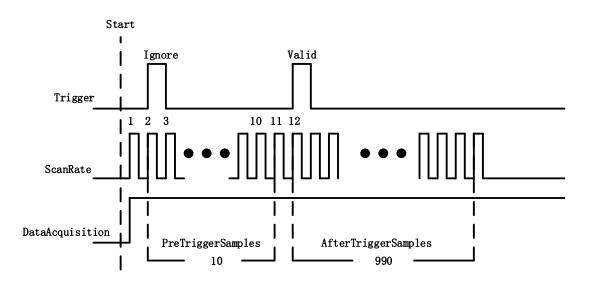


Figure 28 Reference Trigger

8.5.3. ReTrigger

PCIe/PXIe-5113 supports retrigger mode. In the retrigger mode, you can set the number of retrigger and the length of each acquisition. Assuming that the number of re triggers is n and the length of each trigger acquisition is m, the length of all acquisition data is n * m * channelcount. Show in Figure 29.

When the number of retrigger is - 1, it is infinite.

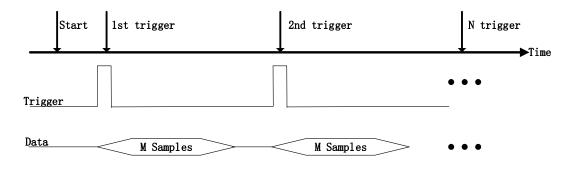


Figure 29 ReTrigger

Learn by Example 8.5

Connect the signal source's positive terminal to PCIe-5111 AI Ch0 (AIO+, Pin#68), the negative terminal to the ground (AI_GND, Pin#67) as shown in Figure 3 and Figure 4. (AIO+, AI_GND) consists of an RSE input.



- Set a sinewave signal (f=4Hz, Vpp=5V).
- Open Analog Input-->Winform AI Finite Analog Trigger, set the following numbers as shown.

quisitio	n (Analog	g Trigger)		
			Basic Param Configur	ration
		- Series I	Card ID	5110
			Slot Number	0
			Channel ID	0
			AI Terminal	RSE
			Sample Rate(Sa/s)	10,000
			Samples to Acquire	10,000
			Input Range	±10V
			Trigger Param Config	guration
 			Trigger Mode	Start
			Trigger Source	Channel_0
			Trigger Comparator	Hysteresis
 			Trigger Edge	Rising
			High Threshold (∀)	2.0
			Low Threshold (V)	0.0
			Retrigger Count	1
				Card ID Slot Number Channel ID AI Terminal Sample Rate(Sa/s) Sample Rate(Sa/s) Sampl

Figure 30 Retrigger Paraments

- You can use three different kinds of triggers in this program as mentioned in 8.5. Start Trigger and Reference Trigger can be set by Trigger Mode. For ReTrigger can be used by changing the numbers in Retrigger Count.
- > PretriggerSamples is set by **Pretrigger Samples**.
- Now the trigger is a Start Trigger. Click Start to begin the data acquisition, the result is shown below:



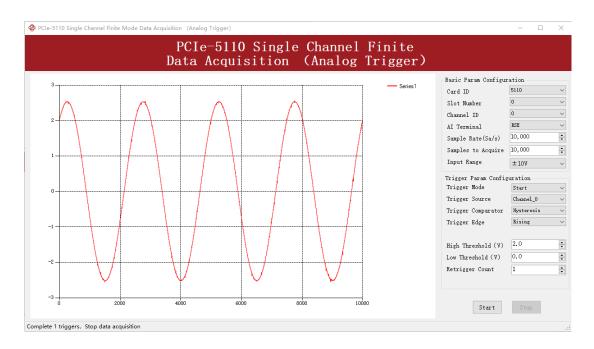


Figure 31 Retrigger In Start Trigger Mode

Now change the **Trigger Mode** to **Reference** mode with **Pretrigger Samples** 1000.

PCIe-5110 Single Channel Finite Mode Data Acquisition (Analog Trigger) PCIe-5110 Single Channel Finite Data Acquisition (Analog Trigger) Basic Param Configuration - Series1 Card ID 5110 0 Slot Number 0 \sim Channel ID RSE AI Terminal Sample Rate(Sa/s) 10,000 ÷ Samples to Acquire 10,000 **^** Input Range ±10V Trigger Param Configuration Trigger Mode \sim Reference n Trigger Source Channel_0 Trigger Comparator Hysteresis \sim Trigger Edge Rising \sim -1 High Threshold (V) 2.0 ÷ Low Threshold (V) 0.0 ÷ Retrigger Count 5 • Pretrigger Samples 1000 --3+ 2000 4000 Start Stop Complete 5 triggers, Stop data acquisition

A different result shows below:

Figure 32 Retrigger In Reference Trigger Mode

 You can see the horizontal movement between two signals due to the change of Trigger Mode.



Now change the mode of trigger to *Retrigger* through giving **Retrigger Count** a number other than 0 and click **Start**. A message will appear in the lower left corner: "Complete the nth trigger".

Complete the 2th trigger

Figure 33 Complete Retrigger Count

> It shows the acquisition process through every trigger signal.

8.6. AO Operations

The PCIe/PXIe-5113 AO provides 16-bit simultaneous outputs. The analog output has three modes of operation: Finite, ContinuousWrapping, and ContinuousNoWrapping.

8.6.1. 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.

Learn by Example 8.6.1

- Connect PCIe-5111 AO Ch0 (AO0, Pin #22) to AI Ch0 (AI0+, Pin#68), Ground of AO0 (AO_GND, Pin#55) to Ground of AI0 (AI_GND, Pin#67). (AI0+, AI_GND) consists of a RSE input; (AO0, AO_GND) consists of an output.
- PCIe-5111 sends an analog signal through (AOO, AO_GND) and reads back the signal from (AIO+, AI_GND).
- Open Analog Input-->Winform AI Continuous, set the following numbers as shown.

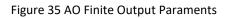


]	PCIe-511	lO Singl	e Channe	el Cont:	inuous	Data Ac	equisition	1
3.5							-Basic Param Configu	uration
J. J						- Series1	Card ID	5110
							Slot Number	0
3							Channel ID	0
							AI Terminal	RSE
2.5							Sample Clock	Internal
							External Clock	PFI2
2							Sample Rate(Sa/s)	10,000
							Samples to Acquire	3.000
1.5							Input Range	±10V
								±104
1								

Figure 34 AI Continuous Paraments

- Click **Start** to start the data acquisition.
- Open Analog Output-->Winform AO Finite, set the following numbers as shown:

	PCIe-	-5110	Single	Channel	Finite Out	put
					-Basic Param Configu	ration
. .	[Series1	Card ID	5110
					Slot Number	0
3					Channel ID	0
					Output Range	±10V
. 5					Update Rate(Sa/s)	500,000
					Samples to Update	250,000
2					- Waveform Configurat	
						SineWave
.5						
					Wave Amplitude	5
					Wave Frequency	10
1						



■ Click **Start** to generate a **SineWave**. The generated signal is shown below:



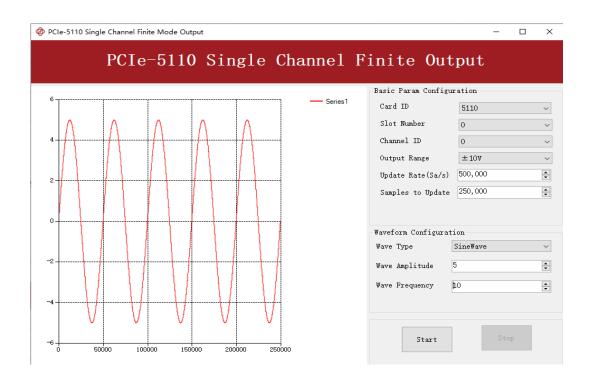
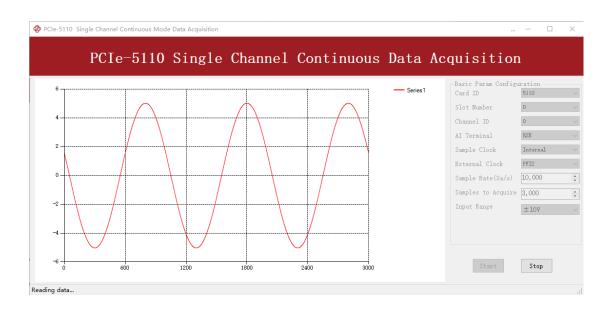


Figure 36 AO Finite Signal

■ And the received signal is shown below.





> The analog signal is successfully generated and received by PCIe-5111.



8.6.2. Continuous NoWrappping 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.

Learn by Example 8.6.2

- Connect PCIe-5111 AO Ch0 (AO0, Pin #22) to AI Ch0 (AI0+, Pin#68), Ground of AO0 (AO_GND, Pin#55) to Ground of AI0 (AI_GND, Pin#67). (AI0+, AI_GND) consists of a RSE input; (AO0, AO_GND) consists of an output.
- PCIe-5111 sends an analog signal through (AOO, AO_GND) and reads back the signal from (AIO+, AI_GND).
- Open Analog Input-->Winform AI Continuous, set the following numbers as shown.

	PCIe-511	0 Singl	e Chann	el Cont:	inuous l	Data Ad	equisition	ļ
3.5							-Basic Param Configu	uration
3.8						Series1	Card ID	5110
							Slot Number	0
3							Channel ID	0
							AI Terminal	RSE
2.5							Sample Clock	Internal
							External Clock	PFI2
2							Sample Rate(Sa/s)	10,000
							Samples to Acquire	3,000
1.5							Input Range	±10V
								- 10+
1								
0.5								

Figure 38 AI Continuous Paraments

- Click **Start** to start the data acquisition.
- Open Analog Output-->Winform AO Continuous NoWrapping, set the following numbers as shown:



Cle-5110 S	ingle Channel Finit	te Mode Outpu	t			- 0
	PCIe	-5110	Single	Channe1	Finite Out	put
_					-Basic Param Configu	ration
.5				Series1	Card ID	5110
					Slot Number	0
3					Channel ID	0
					Output Range	±10V
.5					Update Rate(Sa/s)	500,000
					Samples to Update	
2					W C a Ci -	
					-Waveform Configurat	
					Wave Type	SineWave
.5					Wave Amplitude	5
					Wave Frequency	10
1		ļ				
						Stop
.5	200 4	00 600	800	1000	Start	5100

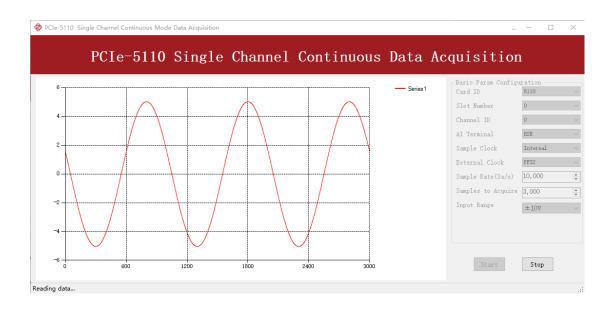
Figure 39 AO ContinuousNoWrapping Output Paraments

- In no wrapping analog output you can change the parameter of the signal whenever you want in Waveform Configuration when generating the wave. After the configuration you should click Update to apply the changes.
- Click **Start** to generate a sine wave first. The result is shown below.

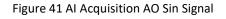


Ø PCIe-5110 Sin	gle Channel Fini	ite Mode Output				– 🗆 X
	PCIe	-5110	Single	Channe1	Finite Out	put
					-Basic Param Configu	ration
6				Series1	Card ID	5110 ~
Δ	Δ	Λ Λ	Δ		Slot Number	0 ~
4 + + + + + + + + + + + + + + + + + + +					Channel ID	0 ~
					Output Range	±10V ~
2					Update Rate(Sa/s)	500,000
					Samples to Update	250,000
0					-Waveform Configurat:	ion
						SineWave ~
-2					Wave Amplitude	5
					Wave Frequency	10 🔹
-4						
V	V	V	V V			
-6	0000 100	000 150000	200000 2	50000	Start	Stop

Figure 40 AO ContinuousNoWrapping Signal



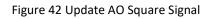
■ And the received signal is shown below.

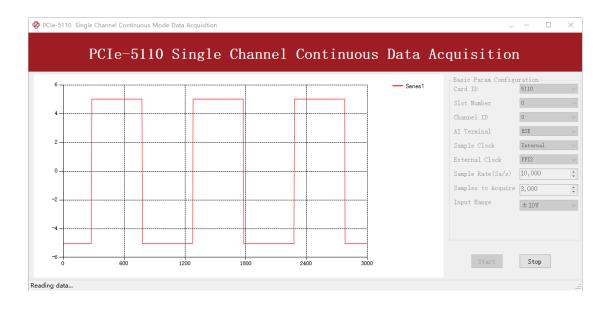


Now change the Wave Type to SquareWave and click Update to generate it. The result is shown below.

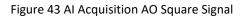


PCIe-5110 Single Char	nnel Continuous NoWrapping O	itput				- 🗆 X
PCIe-	5110 Single	Channel	Conti	nuous NoWr	apping O	utput
6			- Series1	-Basic Param Configurati Card ID	ion 5110	~
4	<u></u>			Slot Number	0	\sim
				Channel ID Update Rate(Sa/s)	0	~
2				Output Range	±10V	▼ ~
0				Waveform Configuration		
				Wave Type	SquareWave	~
-2				Wave Amplitude	5	-
-4				Wave Frequency	10	
-6 - 200000	400000 600000 8	00000 1000000		Start	Update	Stop





■ And the received signal is shown below.



> The analog signal is successfully generated and received by PCIe-5111.

8.6.3. 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.



Learn by Example 8.6.3

- Connect PCIe-5111 AO Ch0 (AO0, Pin #22) to AI Ch0 (AI0+, Pin#68), Ground of AO0 (AO_GND, Pin#55) to Ground of AI0 (AI_GND, Pin#67). (AI0+, AI_GND) consists of a RSE input; (AO0, AO_GND) consists of an output.
- PCIe-5111 sends an analog signal through (AOO, AO_GND) and reads back the signal from (AIO+, AI_GND).
- Open Analog Input-->Winform AI Continuous, set the following numbers as shown.

I	PCIe-511	0 Singl	e Channe	1 Cont:	inuous 1	Data Ac	equisition	1
3.5						Series1	-Basic Param Configu Card ID	tration 5110
3							Slot Number Channel ID	0
2.5							AI Terminal Sample Clock	RSE Internal
2							External Clock Sample Rate(Sa/s)	PFI2
1.5							Samples to Acquire Input Range	3,000 ±10V
1								
0.5								

Figure 44 AI Continuous Paraments

- Click **Start** to start the data acquisition.
- Open Analog Output-->Winform AO Continuous Wrapping, set the numbers as shown.

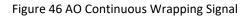


PCIe-5110 Single Channel Con	tinuous Wrapping Output					- 🗆	×
PCIe-5110	Single Ch	nannel (Conti	inuous Wrag	oping	Output	
6			Series 1	Basic Param Configuratio Card ID Slot Number Channel ID Update Rate(Sa/s) Output Range Waveform Configuration Wave Type	n 5110 0 1,000,000 ±10V SineWave	> > >	
-2 -4 -6 0 20000 40000	600000 800000	1000000		Wave Amplitude Wave Frequency Start	5 10	Stop	

Figure 45 AO Continuous Wrapping Paraments

Click **Start** to generate the signal. The result is shown below.

PCIe-5110 Single Channel Continuous	s Wrapping Output	– 🗆 X
PCIe-5110 Si	ngle Channel Contin	nuous Wrapping Output
		sic Param Configuration rd ID 5110 ot Number 0 annel ID 0 date Rate (Sa/s) 1,000,000 tput Range ±10V veform Configuration ave Type SineWave ave Amplitude 5 ave Frequency 10 Start Stop



And the received signal is shown below.



PCIe-8	5110 Single C	Channel Con	itinuous l	Data Ac	quisition	
				— Series 1	Basic Param Configu Card ID Slot Number Channel ID AI Terminal Sample Clock External Clock Sample Rate(Sa/s) Samples to Acquire Input Range	5110 0 RSE Internal PFI2 10,000
-6 - 600	1200	1800 2400	3000		Start	Stop

Figure 47 AI Acquisition AO Signal

> The analog signal is successfully generated and received by PCIe-5111.

8.7. Digital I/O Operations

The PCIe/PXIe-5113 provides powerful programmable digital I/O functions.

8.7.1. Static DI/DO

Programmable I/O supports static TTL, 16 digital I/O channels. User can access these I/O information through software polling.

Learn by Example 8.7.1

- In this example PCIe-5111 outputs a digital signal by its DO function and reads it back by its DI function.
- Connect Connector1 of PCIe-5111 to the TB-68 terminal block according to Figure
 4.
- Connect Port 1/Line 0~7 (P1.0~P1.7) to Port 2/Line 0~7 (P2.1~2.7).PCIe-5111 sends a digital signal through Port 1 and reads the signal back from Port 2.
- Open the first program **Digital Output-->Winform DO SinglePoint.**



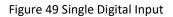
- Select port 1 for Digital Output, Set Line 1,3,5 in High-Level positions, make sure all other lines are in Low-Level positions. Click Start to generate the High-Levels as shown.
- Open the second program **Digital Input-->Winform DI SinglePoint**.
- Select port 2 for Digital Input as shown, and click Check DI Status. The result is shown below.

PCIe-5110 Single Mode Digital Sig	nal Outj	X
PCIe-	-51	10 Single Digital Output
-Basic Param Configuration-	port0	Line (0~7) HighLevel (true) LovLevel (false)
Card ID 5110 V port0 port2 port3	portl	Line (0~7) HighLevel (true)
port4 port5	port2	Line (0^7) HighLevel (true) LowLevel (false)
Start Stop	port3	Line (0^7) HighLevel (true) LowLevel (false)
	port4	Line (0°7) HighLevel (true) LowLevel (false)
	port5	Line (0°7) HighLevel (true) LowLevel (false)

Figure 48 Single Digital Output



PCIe-5110 Single Mode Digital Signal Input						-	-		×
PCIe-5110 Single	Digit	al	Si	gn	al	In	ıpu	t	
Basic Param Configuration									
Card ID 5110 ~	۵ س							L7	
port0 port1	18	19	L10	L11	L12	L13	L14	L15	
✓ port2 □ port3 □ port4 □ port5	L16	L17	L18	L19	120	121	L22	123	
Check DI Status	L24	125	126	127	128	L29	L30	L31	
	L32	L33	L34	L35	L36	L37	L38	L39	
	L40	141	142	143	144	145	1 46	1 47	
	L40	1.41	142	143	144	140	140	141	



> The result matches the high and low levels set before.

8.7.2. Dynamic DI/DO

The PCIe/PXIe-5113 supports both dynamic DI/DO operation with a maximum sample rate (update rate) of up to 10MHz. User can acquire or output digital waveforms in this way.

Learn by Example 8.7.2

- In this example PCIe-5111 outputs a squarewave by its DO function and reads it back by its DI function.
- Connect Connector1 of PCIe-5111
- Connect PCIe-5111 Port 1/Line 0 (P1.0,pin#52) to Port 2/Line 0(P2.0,pin #11)
- PCIe-5111 sends digital signals through Port 1/Port 0 and reads them back from Port 2/Port 1
- Open Digital Input-->Winform DI Continuous and set the numbers as shown. Select port 2 or port 1.



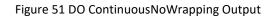
Pele-Sillo Contil	nuous Mode Digital Signal $ m PCIe^{-5110}$		Digital	Signal Input
^{з. Б} Т	11		- Series1	Basic Param Configuration
3				Card ID 5110
				Slot Number 0
2.5				Sample Rate
2				Samples to Acquire 10,000
1.5				port0 port1 port2
1				port3
0.5	00 400 600	0 800 1000		Start Stop

Figure 50 DI Continuous Paraments

- Click **Start** to begin the data acquisition.
- Open Digital Output--> Winform DO Continuous NoWrapping and set the numbers as shown.

	PCTo-	-5110 (Continu		Vrapping	r Digit		ignol	011+	put	
	1016	5110 (Jon tinu	ous noi	nappin	g Digit	lai S.	Ignai	out	pui	
300						Series1	-Basic Par	am Configur	ation		
250	} ∳p						Card ID 5110		Slot Number O	r Update	e Rate(S: DO
200							Channel Co	nfiguration Signal Fr	equency	Duty Cycle	
150							Port0	1,000	*		A V
100							Port1	4	÷	0.5	÷
50							Port3	10,000			<u>^</u>

■ Click **Start** to generate the signal. The result is shown below.



In program Winform DI Continuous, you can see the acquired signal. Select port
 1 or port 0.



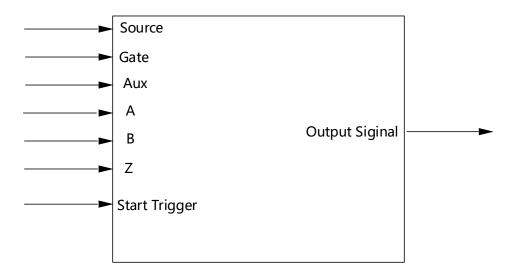
PCIe-5110 Cont	inuous Mode Digital Signal	Input		_		×
	PCIe-5110	Continuous	Digital	Signal Input		
255. 1			Series1	-Basic Param Configuration		
254.9]		Card ID 5110		\sim
254. 7				Slot Number 0 Sample Rate 10,000		~ *
254. 5				Samples to Acquire 10,000		×
254. 3				□ port0 □ port1 ☑ port2		
254. 1				port3		
253.9 0 0 Reading in data	2000 4000 600			Start Sta	p	

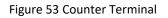
Figure 52 DI Continuous Acquisition

> The digital signal is successfully generated and acquired by PCIe-5111.

8.8. Counter Input Operations

The PCIe/PXIe-5113 has four or two identical 32 bits timers/counters.





Each counter has seven input terminals and one output terminal, and these terminals have different functions in different counter input application types, including:



- Edge Counting
- Pulse Measurement
- Frequency Measurement
- Period Measurement
- Two-Edge Separation
- Quadrature Encoder (X1, X2, X4)
- Two-Pulse Encoder

For buffered acquisition, each counter has a separate DDR storage space and requires a sample clock.

For each counter input application type, the measured signal needs to be connected to different terminals, as shown in the following table.

Measured Signal	Terminal
Edge Counting	Source
Pulse Measurement	Gate
Frequency Measurement	Gate
Period Measurement	Gate
Two-Edge Separation	Gate、Aux
Quadrature Encoder (X1, X2, X4)	A、B、Z
Two-Pulse Encoder	A、 B

Figure 54 Counter Signal Wiring Instruction

8.8.1. Edge Counting

The counter counts the number of active edges of input signal.

Timing

1) Single Mode

The count value is written to the register on each rising edge or falling edge of the signal to measure as shown in Figure 55.



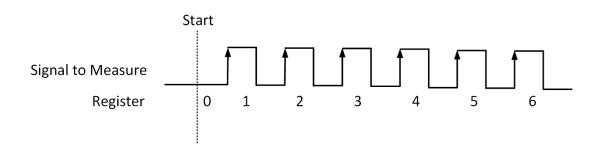


Figure 55 Simple Edge Counting in Single Mode

2) Finite/Continuous Mode with Internal Sample Clock

The count value is stored into the buffer on each rising edge or falling edge of the sample clock as shown in Figure 56.

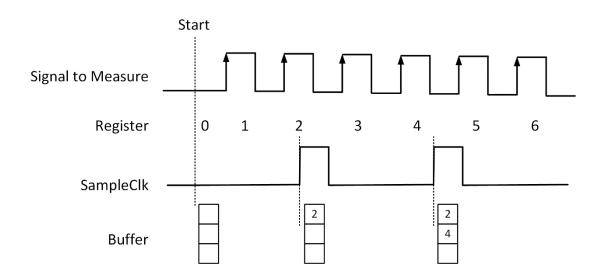


Figure 56 Buffered Edge Counting with Internal Sample Clock

3) Finite/Continuous Mode with Implicit Sample Clock

The count value is stored into the buffer on each rising edge or falling edge of the signal to measure as shown in Figure 57.



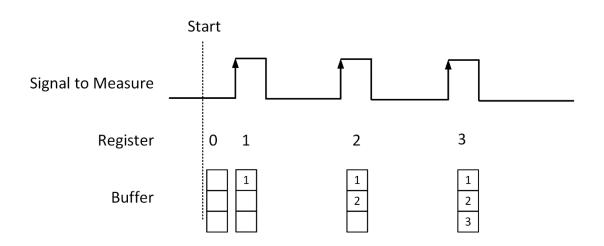
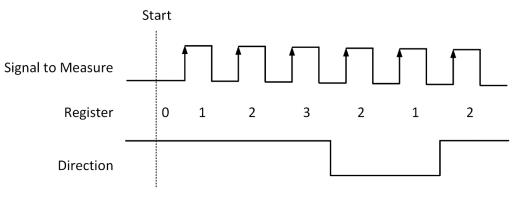
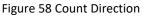


Figure 57 Simple Edge Counting with Implicit SampleClk

Counting Direction

User can control the counting direction through software configuration or by an input signal with Gate terminal. When using an input signal to control the counting direction, the counter counts up when the signal is high and counts down when the signal is low as shown in Figure 58.





Learn by Examples8.8.1

- Connect the signal source's positive terminal of a signal source to PCIe-5111 counterO's edge counting source (CTR0_Source/A, Pin#11), negative terminal to the ground (DGND, Pin#44) as shown in Figure 3 and Figure 4. (CTR0_Source, DGND) consists of an edge counting counter input and they share the same ground.
- Set a squarewave signal (f=1Hz, Vpp=5V).



Single Mode

Open Counter Input-->Winform CI Single EdgeCounting, set the following numbers as shown:

PCIe-5110 Single Mode E	dgeCounting				_		×				
PCIe-5110 Single EdgeCounting											
-Basic Param Configuratio	n	5110_5111									
Slot Number	Counter ID	Pin	Signal Name	Pin	Signal	Name					
0 ~	0 ~	11	CTR0_Source/A	42	CTR1_	Source	A/A				
Counter Direction	Init Count 0	10	CTR0_Gate/Z	41	CTR1_	Gate/Z					
Up ~	•	43	CTR0_AUX/B	6	CTR1_/	AUX/B					
Count Result		2	CTR0_OUT	40	CTR1_	OUT					
Counter Value 0		5	CTR2_Source/A	3	CTR3_	Source	A/A				
		38	CTR2_Gate/Z	45	CTR3_	Gate/Z					
		37	CTR2_AUX/B	46	CTR3_/	AUX/B					
Start	Stop	1	CTR2_OUT	39	CTR3_	OUT					

Figure 59 EdgeCounting For Single Mode

- Counter Direction is set by **Counter Direction**.
- > The table in the sample program is a connection diagram for your convenience.
 - The *rising edge counter* works when **Start** is clicked.
 - The result is shown by Counter Value. In this example the Counter Value increases by 1 every second for a 1Hz sinewave.

Finite/Continuous Mode

- Change the squarewave frequency to 50 Hz.
- Open Counter Input-->Winform CI Finite/Continuous EdgeCounting, set the following numbers as shown:



PCIe-5110 Finite	Mode EdgeCo	unting			_	×
	PC	[e-5]	110 Finite	e EdgeCounting		
-Basic Param Conf	iguration			CounterValues		
Slot Number	0	~ S	ample Rate			
Counter ID	0	~ 1	100			
Counter Direction	ո Մթ	~ s	amples to Acquire			
Clock Source	Internal	~ 1	LO			
Init Count	0	÷				
S	tart	S	top			
5110_5111						
Pin Sign	al Name	Pin	Signal Name			
11 CTR	0_Source/A	42	CTR1_Source/A			
10 CTR	0_Gate/Z	41	CTR1_Gate/Z			
43 CTR	0_AUX/B	6	CTR1_AUX/B			
2 CTR	0_OUT	40	CTR1_OUT			
5 CTR	2_Source/A	3	CTR3_Source/A			
38 CTR	2_Gate/Z	45	CTR3_Gate/Z			
37 CTR	2_AUX/B	46	CTR3_AUX/B			
1 CTR	2_OUT	39	CTR3_OUT			

Figure 60 EdgeCounting For Finite Mode

- > The table in the sample program is a connection diagram for your convenience.
- Counter Direction is set by **Counter Direction**.
- There are two clock sources in PCIe-5111 Internal and Implicit: This example uses Internal mode set by Clock Source.
 - Click **Start** to start counting by rising edge. The result is shown below:

CounterValues	
)	
1	
1	
2	
2	
3	
3	
4	
4	
5	

Figure 61 Counter Values For Internal Clock



- > The numbers are stored in a buffer **CounterValues**.
- Change the **Clock Source** to **Implicit**:

CounterValues	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Figure 62 Counter Values For Implicit Clock

- > The numbers are stored in a buffer **CounterValues.**
- The counter values are different as before because of the change from Clock Source.

8.8.2. Pulse Measurement

The counter measures the high-level and low-level duration of signal.

Timing

1) Single Mode

The count value of the duration of the high-level or low-level is written to the register on each rising or falling edge of the pulse to measure, as shown in Figure 63.



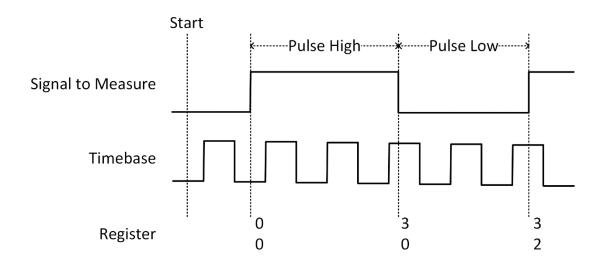


Figure 63 Pulse Measurement in Single Mode

2) Finite/Continuous Mode with Internal Sample Clock

The count value of the duration of the high or low level is stored into the buffer on each rising or falling edge of the sample clock, as shown in Figure 64.

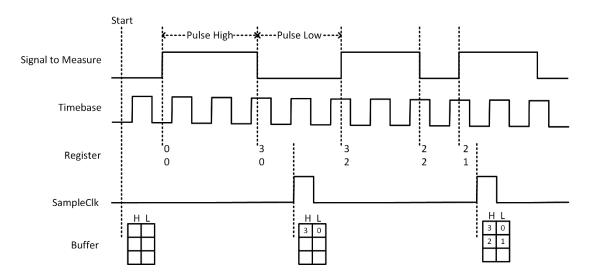


Figure 64 Pulse Measurement with Internal SampleClk

3) Finite/Continuous Mode with Implicit Sample Clock

The count value of the duration of the high-level or low-level is stored into the buffer on each rising or falling edge of the pulse to measure, as shown in Figure 65.



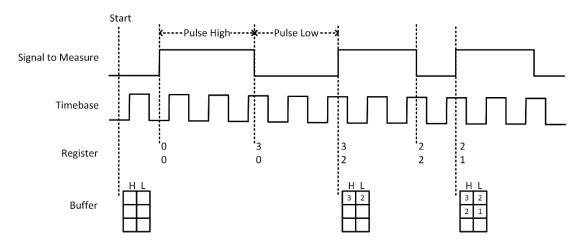


Figure 65 Pulse Measurement with Implicit SampleClk

Learn by Examples 8.8.2

- Connect the signal source's positive terminal to PCIe-5111 counter0's pulse measure source (CTR0_Gate/Z, Pin#10), negative terminal to the ground (DGND, Pin#44) as shown in Figure 3 and Figure 4. (CTR0_Gate/Z, DGND) consists of a pulse measure counter input and they share the same ground.
 - Set a squarewave signal (f=1Hz, Duty Cycle=50%, Vpp=5V).

Single Mode

Open Counter Input-->Winform CI Single PulseMeasure, set the following numbers as shown:

PCIe-5110 Single Mode Pulse Meas	ure				- □ >	×							
PCIe-5110 Single Pulse Measure													
-Basic Param Configuration	Measure Result	5110_5111											
Slot Number 0 ~	High Pulse Measure(S)	Pin	Signal Name	Pin	Signal Name								
	0	11	CTR0_Source/A	42	CTR1_Source/A	۸.							
Counter ID 0 ~	Low Pulse Measure(S)	10	CTR0_Gate/Z	41	CTR1_Gate/Z								
		43	CTR0_AUX/B	6	CTR1_AUX/B								
Measure Type PulseMeasure	0	2	CTR0_OUT	40	CTR1_OUT								
		5	CTR2_Source/A	3	CTR3_Source/A	۱.							
		38	CTR2_Gate/Z	45	CTR3_Gate/Z								
Start	Stop	37	CTR2_AUX/B	46	CTR3_AUX/B								
Start	Stop	1	CTR2_OUT	39	CTR3_OUT								

Figure 66 Pulse Measure For Single Mode



- > The table in the sample program is a connection diagram for your convenience.
- Click Start to start measuring the pulses. The result is shown by High Pulse
 Measure(S) and Low Pulse Measure(S):

PCIe-5110 Single Mode Pulse Meas	ure				_		\times
PCIe-	5110 Single	Puls	e Meası	ıre			
-Basic Param Configuration	Measure Result	5110_5111					
Slot Number 0 ~	High Pulse Measure(S)	Pin	Signal Name	Pin	Signal	Name	
	0.4999926	11	CTR0_Source/A	42	CTR1_	Source	/A
Counter ID 0 ~	Low Pulse Measure(S)	10	CTR0_Gate/Z	41	CTR1_0	Gate/Z	
	0. 499992635	43	CTR0_AUX/B	6	CTR1_/	AUX/B	
Measure Type PulseMeasure	0.499992035	2	CTR0_OUT	40	CTR1_	OUT	
		5	CTR2_Source/A	3	CTR3_	Source	/A
		38	CTR2_Gate/Z	45	CTR3_(Gate/Z	
Start	Stop	37	CTR2_AUX/B	46	CTR3_/	AUX/B	
Start	Stop	1	CTR2_OUT	39	CTR3_	OUT	

Figure 67 Pulse Measure Value For Single Mode

The numbers show the duration of High/Low Pulse in one signal period and match the duty cycle set before.

Finite/Continuous Mode

- Change the frequency of Squarewave to 50 Hz.
- Open Counter Input-->Winform Cl Finite/Continuous PulseMeasure, set the following numbers as shown:



,	🖗 PCIe-511() Finite Mode Pulse Me	easure						_		×
		PCIe	e-511	0 Fin	nite	Pulse	Meas	sure			
F	Basic Param	Configuration				High Pulse Meas	urea(S)	Low Pulse Measu	rea(S	0	
	Slot Numbe	r	∼ Samp	le Rate							
	Counter ID	0	~ 100		▲ ▼						
	Measure Ty	ne PulseMeasure	Samp	les to Acqu							
	-	-			÷						
	Clock Sour	ce Internal	~ 10		•						
	5110_5111	Start	S	top							
	Pin	Signal Name	Pin	Signal Na	ame						
	11	CTR0_Source/A	42	CTR1_So	urce/A						
	10	CTR0_Gate/Z	41	CTR1_Ga	te/Z						
	43	CTR0_AUX/B	6	CTR1_AU	IX/B						
1	2	CTR0_OUT	40	CTR1_O	UT						
	5	CTR2_Source/A	3	CTR3_So	urce/A						
	38	CTR2_Gate/Z	45	CTR3_Ga	te/Z						
	37	CTR2_AUX/B	46	CTR3_AU	IX/B						
	1	CTR2_OUT	39	CTR3_O	UT						

Figure 68 Pulse Measure For Finite Mode

- > The table in the sample program is a connection diagram for your convenience.
- Click Start to begin the finite/continuous pulse measurement. The result is shown below:

High Pulse Measurea(S)	Low Pulse Measurea(S)
0	0
0.009999835	0
0.009999835	0.009999865
0.009999835	0.009999865
0.009999835	0. 00999986
0.009999835	0. 00999986
0.009999835	0. 009999865
0.009999835	0. 009999865
0.009999835	0. 009999865
0.009999835	0. 009999865

Figure 69 Pulse Measure Values For Finite Mode



- The numbers show the duration of High/Low Pulse in one signal period and match the duty cycle set before.
- Please refer to Learn by Examples8.8.1 Finite/Continuous Mode about the difference between Internal and Implicit.

8.8.3. Frequency Measurement

The counter measures the frequency of signal to measure.

Timing

1) Single Mode

Frequency Measurement without sample clock is actually using Pulse Width Measurement internally, refer to chapter 8.8.2 for more information.

Every time the user reads the data, driver will automatically calculate the frequency (f_x) according to the HighTick $(tick_h)$, LowTick $(tick_l)$ values and known frequency of the timebase (f_{base}) according to the formula 1 and return the result to the user.

$$f_x = f_{base} \times \frac{1}{tick_h + tick_l}$$

To configure the counter to work in this mode, set JY5113CITask.Mode to CIMode.Single.

2) Finite/Continuous Mode with Internal Sample Clock (Averaging)

Between every two rising edges of the sample clock, the counter counts the numbers of full periods (T1) of the signal to measure, and the number of rising edges of timebase (T2) during those full periods. These two values are stored into the buffer on each rising edge of the sample clock, as shown in Figure 70.



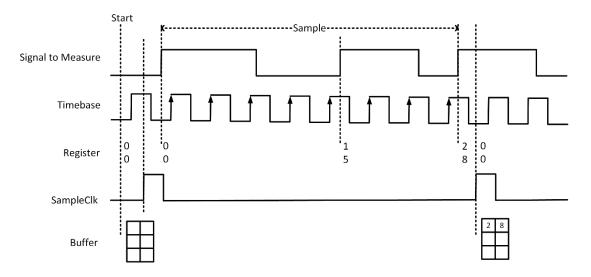


Figure 70 Frequency Measurement with Internal Sample Clock

Every time the user reads the data, driver will automatically calculate the frequency (f_x) according to the buffered values and known frequency of the timebase (f_{base}) by using following formula and return the result to user.

$$f_x = f_{base} \times \frac{T1}{T2}$$

3) Finite/Continuous Mode with Implicit Sample Clock

Frequency Measurement with implicit sample clock is actually using Pulse Measurement internally. refer to chapter 8.8.2 for more information.

Every time the user reads the data, driver will automatically calculate the frequency (f_x) according to the HighTick (T_h) and LowTick (T_l) values according to the formula 1 and return the result to the user.

$$f_x = \frac{1}{T_h + T_l}$$

Learn by Examples 8.8.3

 Connect the signal source's positive terminal to PCIe-5111 counter0's frequency measure source (CTR0_Gate/Z, Pin#10), negative terminal to the ground (DGND,



Pin#44) as shown in Figure 3 and Figure 4. (CTR0_Gate/Z, DGND) consists of a frequency measure counter input and they share the same ground.

■ Set a squarewave signal (f=50Hz, Duty Cycle=50%, Vpp=5V).

Single Mode

Open Counter Input-->Winform Cl Single Frequency Measure and click Start. The result is shown below by Frequency Measure (Hz):

PCIe-5110 Single Mode Frequency Meas	ure				-		×
PCIe-5	5110 Single	Freq	uency Mea	isure			
-Basic Param Configuration	Measure Result	5110_5111					
Slot Number 0 🗸		Pin	Signal Name	Pin	Signal	Name	
	Frequency Measure(Hz)	11	CTR0_Source/A	42	CTR1_	Source	/A
Counter ID 0 \sim	50.0007500112502	10	CTR0_Gate/Z	41	CTR1_	Gate/Z	
		43	CTR0_AUX/B	6	CTR1_	AUX/B	
Measure Type FrequencyMeasure		2	CTR0_OUT	40	CTR1_	OUT	
		5	CTR2_Source/A	3	CTR3_	Source	/A
		38	CTR2_Gate/Z	45	CTR3	Gate/Z	
		37	CTR2_AUX/B	46	CTR3_	AUX/B	
Start St	сор	1	CTR2_OUT	39	CTR3_	OUT	

Figure 71 Frequency Measure For Single Mode

- > The table in the sample program is a connection diagram for your convenience.
- > The result matches the frequency set before.

Finite/Continuous Mode

■ Open Counter Input-->Winform Cl Finite/Continuous Frequency Measure.

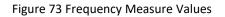


PCIe-5110 Continuous Frequency Measure					×
	PCI	e-51	10 Continu	uous Frequency Measure	
Basic Pa	ram Configuration			FrequencyMeasure(Hz)	
Slot Numl	ber O	\sim	Sample Rate		
Counter 3	ID 0	\sim	10		
Measure (Type FrequencyMeasu		Samples to Acquire		
Clock So	urce Internal	\sim			
	Start	S	itop		
5110_5111					
Pin	Signal Name	Pin	Signal Name		
11	CTR0_Source/A	42	CTR1_Source/A		
10	CTR0_Gate/Z	41	CTR1_Gate/Z		
43	CTR0_AUX/B	6	CTR1_AUX/B		
2	CTR0_OUT	40	CTR1_OUT		
5	CTR2_Source/A	3	CTR3_Source/A		
38	CTR2 Gate/Z	45	CTR3 Gate/Z		
		40			
37	CTR2_AUX/B	46	CTR3_AUX/B		

Figure 72 Frequency Measure For Continuous Mode

- > The table in the sample program is a connection diagram for your convenience.
- Internal and Implicit Sample Clocks are set by Clock Source as before. (Please refer to Finite/Continuous Mode for more information.)
- Click Start and it will show the frequency 50 as set in the signal resource.

FrequencyMeasure(Hz)	
50.0007500112502	
50.0007531363441	
50.0007500112502	
50.0007531363441	
50.0007500112502	
50.0007531363441	
50.0007500112502	
50.0007500112502	
50.0007500112502	
50.0007500112502	





8.8.4. Period Measurement

The counter measures the period of signal to measure. Period Measurements is using Frequency Measurement internally and returns the inverse result of Frequency Measurement. Refer to chapter 8.8.3 for more information.

Learn by Examples 8.8.4

- Connect the signal source's positive terminal to PCIe-5111 counter0's period measure source (CTR0_Gate/Z, Pin#10), negative terminal to the ground (DGND, Pin#44) as shown in Figure 3 and Figure 4. (CTR0_Gate/Z, DGND) consists of a period measure counter input and share the same ground.
- Set a squarewave signal (f=200Hz, Duty Cycle=50%, Vpp=5V).

Single Mode

Open Counter Input-->Winform CI Single Period Measure and click Start. The result is shown below by Period Measure(S):

PCIe-5110 Single Mode Peroid Meas	ure				_	×
PCIe-5	110 Single	Peroi	d Meas	ure		
Basic Param Configuration	Measure Result	5110_5111				
Slot Number 0 🗸		Pin	Signal Name	Pin	Signal Nar	ne
	Peroid Measure(S)	11	CTR0_Source/A	42	CTR1_Sou	rce/A
Counter ID 0 ~	0.004999925	10	CTR0_Gate/Z	41	CTR1_Gate	e/Z
		43	CTR0_AUX/B	6	CTR1_AUX	(/B
Measure Type PeroidMeasure		2	CTR0_OUT	40	CTR1_OU	Т
		5	CTR2_Source/A	3	CTR3_Sou	rce/A
		38	CTR2_Gate/Z	45	CTR3_Gate	e/Z
Start	Stop	37	CTR2_AUX/B	46	CTR3_AUX	(/B
		1	CTR2_OUT	39	CTR3_OU	Т

Figure 74 Peroid Measure For Single Mode

- > The table in the sample program is a connection diagram for your convenience.
- The result of Period Measure(S) shows the correspond to the frequency set before.



Finite/Continuous Mode

Open Counter Input-->Winform CI Finite/Continuous Period Measure and click
 Start. The result is shown below by PeriodMeasure (S).

PCIe-5	110 Continuous Period	Measure		
	PCI	e-511	0 Contin	uous Period Measure
-Basic Pa	ram Configuration—			PeroidMeas(S)
Slot Num	ber 0	~ <	Sample Rate	0.00499992657894737
			ampie Kate	0.00499992684210526
Counter	ID 0	~ [10 🗘	0. 00499992657894737
Measure	Type PeriodMeasu	re .		0. 00499992657894737
		_	Samples to Acquire	0. 00499992657894737
Clock So	urce Internal	\sim	10	0. 00499992657894737
				0.00499992657894737
				0.00499992657894737
	Start	Ste	op	0. 00499992657894737
				0. 00499992657894737
5110_5111				
Pin	Signal Name	Pin	Signal Name	
11	CTR0_Source/A	42	CTR1_Source/A	
10	CTR0_Gate/Z	41	CTR1_Gate/Z	
43	CTR0_AUX/B	6	CTR1_AUX/B	
2	CTR0_OUT	40	CTR1_OUT	
5	CTR2_Source/A	3	CTR3_Source/A	
38	CTR2_Gate/Z	45	CTR3_Gate/Z	
37	CTR2_AUX/B	46	CTR3_AUX/B	
1	CTR2_OUT	39	CTR3_OUT	

Figure 75 Peroid Measure For Continuous Mode

- > The table in the sample program is a connection diagram for your convenience.
- The result of Period Measure(S) shows the correspond to the frequency set before.

8.8.5. Two-Edge Separation

The counter measures the separation between the rising edges of two signals.

Timing

1) Single Mode

The number of rising edges of timebase between the rising edge of the first signal and the rising edge of the second signal is written to the register on each rising edge of the second signal.



The number of rising edges of timebase between previous rising edge of the second signal and current rising edge of the first signal is written to the register on each rising edge of the first signal as shown in Figure 76.

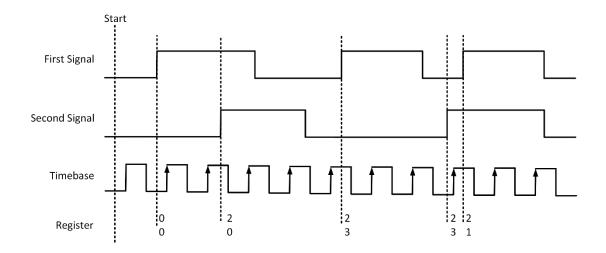


Figure 76 Two-Edge Separation in Single Mode

2) Finite/Continuous Mode with Internal Sample Clock:

The count values of rising edges of timebase between first signal and second signal are stored into buffer on each rising edge of the sample clock, as shown in Figure 77.

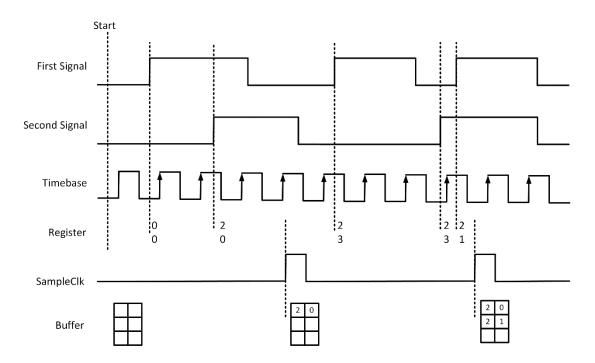


Figure 77 Two-Edge Separation with Internal Sample Clock



3) Finite/Continuous Mode with Implicit Sample Clock

The count values of rising edges of timebase between first signal and second signal are stored into buffer on each rising edge of the first signal, as shown in Figure 78.

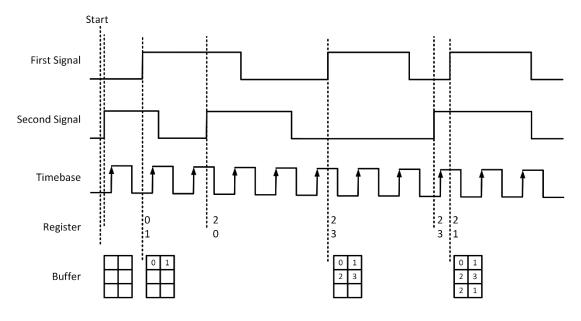


Figure 78 Two-Edge Separation with Implicit Sample Clock

Learn by Examples 8.8.5

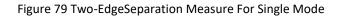
- Connect the signal source's two positive terminals to PCIe-5111 first signal input (squarewave, CTR0_Gate/Z, Pin #10) and second signal input (squarewave, CTR0_AUX/B, Pin#43), two negative terminals to the ground (DGND, Pin#44) and (D_GND, Pin#9) as shown in Figure 3 and Figure 4.
- Set a squarewave signal (f=1Hz, Phase=0°) and a squarewave signal (f=1Hz, Phase=135°).

Single Mode

Open Counter Input-->Winform CI Single TwoEdgeSeparation Measure and click Start. The result is shown below by First to Second(S) and Second to First(S), which represent the time difference between the rising edges of the two signals:



	ode TwoEdgeSeparation Measure				
	CIe-5110 Sing	le Twoł	dgeSeparati	on Me	asure
Basic Param Configu	ration	5110_5111			
Slot Number	0 ~	Pin	Signal Name	Pin	Signal Name
Counter ID	0 ~	11	CTR0_Source/A	42	CTR1_Source/A
Measure Type	TwoEdgeSeparation	10	CTR0_Gate/Z	41	CTR1_Gate/Z
Measure Result		43	CTR0_AUX/B	6	CTR1_AUX/B
First to Second(S)	0.374994635	2	CTR0_OUT	40	CTR1_OUT
Second to First(S)	0.62499105	5	CTR2_Source/A	3	CTR3_Source/A
		38	CTR2_Gate/Z	45	CTR3_Gate/Z
		37	CTR2_AUX/B	46	CTR3_AUX/B
Start	Stop	1	CTR2_OUT	39	CTR3 OUT



- > The table in the sample program is a connection diagram for your convenience.
- Due to the phase-difference between First Signal and Second Signal, First to
 Second and Second to First are different and summarize as 1.

Finite/Continuous Mode

Open Counter Input-->Winform CI Finite/Continuous TwoEdge Separation Measure and click Start. The result is shown below by First to Second(S) and Second to First(S), which represent the time difference between the rising edges of the two signals:



PCIe-511	0 Finite Mode TwoEdge	Separation	Measure		
	PCIe-51	10 F	inite Twol	EdgeSeparatio	on Measure
Basic Para	m Configuration			First to Second Measurea(S)	Second to First Measurea(S)
Slot Number	0	√ Sa	ample Rate	0	0.624991095
		10	0 🗘	0. 37499466	0.624991095
Counter ID	0	\sim		0. 37499466	0. 624991095
-1 1 -			amples to Acquire	0. 37499466	0.624991095
Clock Sourc	e Implicit	<u> </u>		0. 37499466	0. 624991085
Measure Typ	e TwoEdgeSeparation	- L		0. 37499465	0. 624991085
		-		0. 374994655	0.62499109
				0. 374994655	0. 624991085
	Start		Stop	0.374994655	0.624991085
	otart		0.0010	0. 37499465	0.624991085
5110_5111					
Pin	Signal Name	Pin	Signal Name		
11	CTR0_Source/A	42	CTR1_Source/A		
10	CTR0_Gate/Z	41	CTR1_Gate/Z		
43	CTR0_AUX/B	6	CTR1_AUX/B		
2	CTR0_OUT	40	CTR1_OUT		
5	CTR2_Source/A	3	CTR3_Source/A		
38	CTR2_Gate/Z	45	CTR3_Gate/Z		
	CTR2 AUX/B	46	CTR3 AUX/B		
37					

Figure 80 Two-EdgeSeparation Measure For Finite Mode

- > The result in this picture is similar to the result in **Single Mode** before.
- The table in the sample program is a connection diagram for your convenience.

8.8.6. Quadrature Encoder

The quadrature encoder includes three encoding types: x1, x2, and x4.

Encoding Type

1) x1 Encoding

When A leads B, the count increase occurs on the rising edge of A; when B leads A, the count decrease occurs on the falling edge of A as shown in Figure 81.

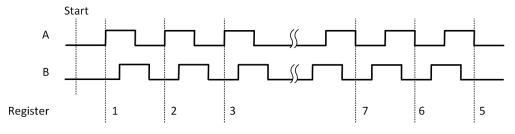


Figure 81 Quadrature Encoder x1 Mode



2) x2 Encoding

When A leads B, the count increase occurs on the rising edge and the falling edge of A; when B leads A, the count reduction occurs on the rising edge and falling edge of A as shown in Figure 82.

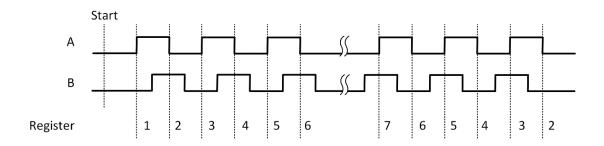


Figure 82 Quadrature Encoder x2 Mode

3) x4 Encoding

When A leads B, the increase of count occurs on the rising and falling edges of A and B. When B leads A, the decrease in count occurs on the rising and falling edges of A and B. As shown in Figure 83.

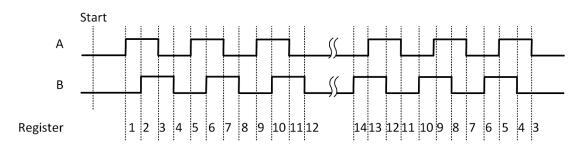


Figure 83 Quadrature Encoder x4 mode

Channel Z Behavior

The phase is reloaded when channel Z is high, A and B are low.

Timing

Take Encoding x1 mode as an example.



1) Single Mode

The count value is written to the register on each rising edge of the signal A, as shown in Figure 55.

To configure the counter to work in this mode, set JY5113CITask. Mode to CIMode.Single.

2) Finite/Continuous Mode with Internal Sample Clock

The count value is stored into the buffer on each rising edge of the sample clock, as shown in Figure 84.

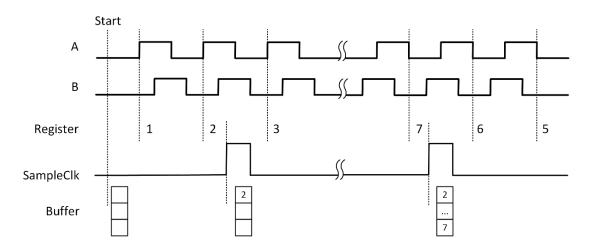


Figure 84 Quadrature Encoder x1 with Sample Clock

3) Finite/Continuous Mode with Implicit Sample Clock

The count value is stored into the buffer every time it changes, as shown in Figure 85.



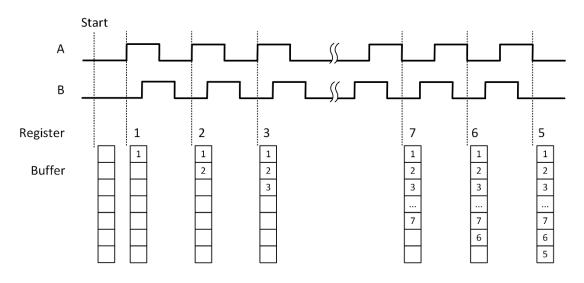


Figure 85 Quadrature Encoder x4 with Implicit Sample Clock

Learn by Examples 8.8.6

- Connect the signal source's two positive terminals to PCIe-5111 first signal input (sinewave, CTR0_Source/A, Pin #11) and second signal input (squarewave , CTR0_AUX/B, Pin#43), two negative terminals to the ground (DGND, Pin#44) and (D_GND, Pin#9) as shown in Figure 3 and Figure 4. (CTR0_Source/A, DGND) consists of the first signal to be measured; (CTR0_AUX/B, D_GND) consists of the second signal to be measured.
- Set a sqaurewave signal (f=10Hz, Phase=90°) and a squarewave signal (f=10Hz, Phase=0°).

Single Mode

Open Counter Input--> Winform CI Single QuadEncoder and click Start. The result is shown below by CounterValue according to the counting rules explained in 8.8.6:



 \times

PCIe-5110 Single Mode QuadEncoder

PCIe-5110 Single QuadEncoder									
-Basic Param Configurat	ion	51	0_5111						
Slot Number	Counter ID	P	in	Signal Name	Pin	Signal Name			
0 ~	0 ~	1	1	CTR0_Source/A	42	CTR1_Source/A			
Encode Type X1	\sim	1	0	CTR0_Gate/Z	41	CTR1_Gate/Z			
Count Result		4	3	CTR0_AUX/B	6	CTR1_AUX/B			
		2		CTR0_OUT	40	CTR1_OUT			
CounterValue 32		5		CTR2_Source/A	3	CTR3_Source/A			
		3	8	CTR2_Gate/Z	45	CTR3_Gate/Z			
		3	7	CTR2_AUX/B	46	CTR3_AUX/B			
Start	Stop	1		CTR2_OUT	39	CTR3_OUT			

Figure 8	6 QuadEncoder	For Si	ingle Mo	de
i igui e u	o Quuuricouci	101.5	ingic mit	uc

- The table in the sample program is a connection diagram for your convenience.
- Encoding Type is set by Encode Type (x1, x2, x4).
- When the *encode type* is changed from x1 to x2 and x4, you can see the rising speed of **CounterValue** is twice and four times than x1Mode.

Continuous Mode

Open Counter Input--> Winform CI Continuous QuadEncoder and click Start. The result is shown below by CounterValues.



Counter ID Sample Rate I Counter ID Image: Sample Rate Image: Sample Rate	×
Slot Number 0 Sample Kate 1 Counter ID 0 i 3 Encode Type X1 Samples to Acquire 4 10 i 6 Clock Source Internal 7 Start Stop 8 5110_5111 Start Stop Pin Signal Name Pin 11 CTR0_Source/A 42 CTR1_Source/A 42 CTR1_Source/A	
Counter ID 0 10 2 3 Encode Type X1 Samples to Acquire 4 5 IO 10 6 6 7 Clock Source Internal 8 9 10 Start Stop 10 10 10 5110_5111 Fin Signal Name 9 10 5110_5111 Fin Signal Name 9 10 5110_5111 CTR0_Source/A 42 CTR1_Source/A 10	
Counter ID 0 10 3 Encode Type XI Samples to Acquire 4 10 5 6 Clock Source Internal 6 Start Stop 8 5110_5111 9 10 Fin Signal Name 9 11 CTR0_Source/A 42 CTR1_Source/A 42 CTR1_Source/A	
Encode Type X1 Internal Internal Internal 5 6 7 6 7 8 9 10 8 9 10 9 10 9 10 9 10 9 11 CTR0_Source/A 42 CTR1_Source/A 10 CTR1_Gate/Z	
Clock Source Internal 10 5 6 7 Clock Source Internal 8 9 10 10 Start Stop 10 10 10 10 5110_5111 Fin Signal Name 9 10 5110_5111 CTR0_Source/A 42 CTR1_Source/A 10 10 CTR0_Gate/Z 41 CTR1_Gate/Z 6	
Clock Source Internal 6 7 8 Start Stop 5110_5111 9 10 5110_Source/A 11 CTR0_Source/A 10 CTR1_Source/A 10 CTR0_Gate/Z	
Start Stop 8 9 5110_5111 10 10 10 Pin Signal Name Pin Signal Name 11 CTR0_Source/A 42 CTR1_Source/A 10 CTR0_Gate/Z 41 CTR1_Gate/Z	
Start Stop 9 5110_5111 10 Pin Signal Name Pin Signal Name 11 CTR0_Source/A 42 CTR1_Source/A 10 CTR0_Gate/Z 41 CTR1_Gate/Z	
Start Stop 5110_5111 Pin Signal Name 11 CTR0_Source/A 10 CTR0_Gate/Z 41 CTR1_Gate/Z	
Signal Name Pin Signal Name 11 CTR0_Source/A 42 CTR1_Source/A 10 CTR0_Gate/Z 41 CTR1_Gate/Z	
Pin Signal Name Pin Signal Name 11 CTR0_Source/A 42 CTR1_Source/A 10 CTR0_Gate/Z 41 CTR1_Gate/Z	_
11 CTR0_Source/A 42 CTR1_Source/A 10 CTR0_Gate/Z 41 CTR1_Gate/Z	
10 CTR0_Gate/Z 41 CTR1_Gate/Z	
43 CTR0_AUX/B 6 CTR1_AUX/B	
2 CTR0_OUT 40 CTR1_OUT	
5 CTR2_Source/A 3 CTR3_Source/A	
38 CTR2_Gate/Z 45 CTR3_Gate/Z	
37 CTR2_AUX/B 46 CTR3_AUX/B	
1 CTR2_OUT 39 CTR3_OUT	

Figure 87 QuadEncoder For Continuous Mode

- > The table in the sample program is a connection diagram for your convenience.
- > Encoding Type is set by Encode Type (x1, x2, x4).
- When the *encode type* is changed from x1 to x2 and x4, you can see the rising speed of **CounterValue** is twice and four times than x1Mode.

8.8.7. Two-Pulse Encoder

The count value increases on the rising edge of A and decreases on the rising edge of

Β.

Timing

1) Single Mode

The count value is written to the register on each rising edge of the signal A, and signal B, as shown in Figure 88.



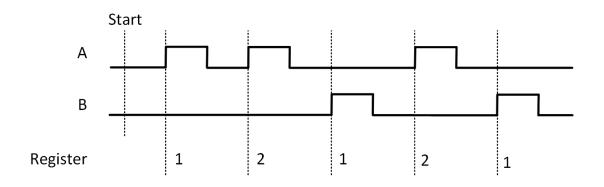


Figure 88 Two-Pulse Encoder in Single Mode

2) Finite/Continuous Mode with Internal Sample Clock

The count value is stored into the buffer on each rising edge of the sample clock, as shown in Figure 89.

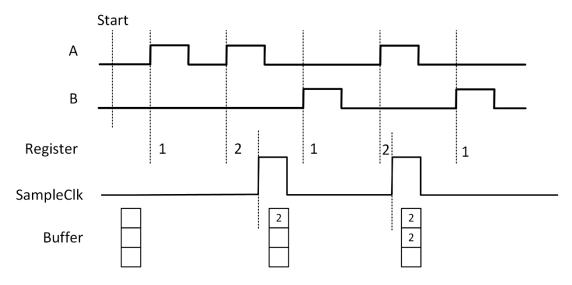


Figure 89 Two-Pulse Encoder with Internal Sample Clock

3) Finite/Continuous Mode with Implicit Sample Clock

The count value is stored into the buffer every time it changed, as shown in Figure 90.



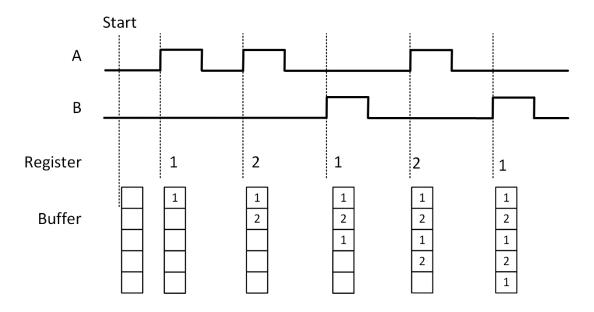


Figure 90 Two-Pulse Encoder with Implicit Sample Clock

Learn by Examples 8.8.7

- Connect the signal source's positive terminal to PCIe-5111 signal input (squarewave, CTR0_Source/A, Pin #11), negative terminal to the ground (DGND, Pin#44).
- Connect the PCIe-5111 signal input(CTR0_AUX/B, Pin#43)to ground (DGND, Pin#44).
- Set a sqaurewave signal (f=40Hz)

Single Mode

Open Counter Input-->Winform CI Single Two PulseEncoder and set the numbers as shown.



© PCIe-5110 Single Mode Two PCIe-		gle Tw	voPu1seE	ncoo	- • × ler
Basic Param Configuration		5110_5111			
Slot Number	Counter ID	Pin	Signal Name	Pin	Signal Name
0 ~	0 ~	11	CTR0_Source/A	42	CTR1_Source/A
Encoder Type Encoder	TwoPulse 🗸	10	CTR0_Gate/Z	41	CTR1_Gate/Z
Count Result		43	CTR0_AUX/B	6	CTR1_AUX/B
CounterWalue 0		2	CTR0_OUT	40	CTR1_OUT
CounterValue 0		5	CTR2_Source/A	3	CTR3_Source/A
		38	CTR2_Gate/Z	45	CTR3_Gate/Z
		37	CTR2_AUX/B	46	CTR3_AUX/B
Start	Stop	1	CTR2_OUT	39	CTR3_OUT

Figure 91	Two-PulseEncoder	For	Single	Mode
inguic JT	I WO I UISCENCOUCI	101	Jingic	wouc

- > The table in the sample program is a connection diagram for your convenience.
- Click Start to start counting. You can see a continuously rising of the Counter
 Value, which follows the counting rules explained in this chapter.

Finite Mode

- Connect the signal source's positive terminal to PCIe-5111 signal input (squarewave, CTR0_AUX/B, Pin#43), negative terminal to the ground (DGND, Pin#44)。
- Connect the PCIe-5111 signal input(CTR0_Source/A, Pin #11)to ground (DGND, Pin#44).
- Set a sqaurewave signal (f=40Hz).
- Open Counter Input-->Winform CI Finite Two PulseEncoder and set the numbers as shown.



🖗 PCle-5	5110 Finite Mode TwoPuls	eEncoder		- o ×
	PC	Ie-5	110 Finit	e TwoPulseEncoder
Basic Pa	ram Configuration			CounterValues
Slot Num	ber 0	√ Saπ	ple Rate	0
Counter	TD	100	•	0
Counter	ID 0	∽ Sam	ples to Acquire	4294967295
Clock So	urce Internal	~ 10	•	4294967295
			Land	4294967294
				4294967294
		_		4294967294
	Start	St		4294967293
				4294967293
5110_5111				4294901292
Pin	Signal Name	Pin	Signal Name	
11	CTR0_Source/A	42	CTR1_Source/A	
10	CTR0_Gate/Z	41	CTR1_Gate/Z	
43	CTR0_AUX/B	6	CTR1_AUX/B	
2	CTR0_OUT	40	CTR1_OUT	
5	CTR2 Source/A	3	CTR3_Source/A	
38	CTR2 Gate/Z	45	CTR3 Gate/Z	
37	CTR2 AUX/B	46	CTR3 AUX/B	

Figure 92 Two-PulseEncoder For Finite Mode

- > The table in the sample program is a connection diagram for your convenience.
- Click Start to start counting. You can see that the CounterValue is decreasing, which follows the counting rules explained in this chapter.

Continuous Mode

Open Counter Input-->Winform CI Continuous Two PulseEncoder and set the numbers as shown.



🖗 PCIe	-5110 Continuous Two	oPulseEnco	der	- 🗆 X
	PC	CIe-	5110 Cor	ntinuous TwoPulseEncoder
-Basic 1	aram Configuration	n		CounterValues
Slot N	umber 0	~ S	ample Rate	4294967132
		1) 🗘	4294967128
Counte:	r ID 0	S	amples to Acquire	4294967124
Clock :	Source Internal	_ 1) 🗘	4294967120
OLOCK .	Jource			4294967116
				4294967112
				4294967108
	Start	Sto	p	4294967104
				4294967100
5110_511	1			4294967096
Pin	Signal Name	Pin	Signal Name	
11	CTR0_Source/A	42	CTR1_Source/A	
10	CTR0_Gate/Z	41	CTR1_Gate/Z	
43	CTR0_AUX/B	6	CTR1_AUX/B	
2	CTR0_OUT	40	CTR1_OUT	
5	CTR2_Source/A	3	CTR3_Source/A	
38	CTR2_Gate/Z	45	CTR3_Gate/Z	
37	CTR2_AUX/B	46	CTR3_AUX/B	
1	CTR2_OUT	39	CTR3 OUT	

Figure 93 Two-PulseEncoder For Continuous Mode

- > The table in the sample program is a connection diagram for your convenience.
- Click Start to start counting. You can see that the CounterValue is decreasing, which follows the counting rules explained in this chapter.

8.9. Counter Output Operations

8.9.1. Single Pulse Output

The PCIe/PXIe-5113 timer/counter can output a single pulse with a specified pulse width. The timing diagram of the pulse output is shown in Figure 94.

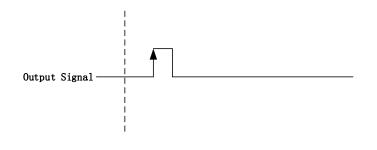


Figure 94 Single Pulse Output



In single pulse output mode, the user could set up the pulse width by configuring the frequency and duty cycle.

If you want to generate a single pulse with 1 ms pulse width, the parameter, frequency should be setup 500Hz and the duty cycle is 50%. Here is the formula for frequency setting:

Frequency = 1 / (1ms / 0.5) = 500Hz

Learn by Example 8.9.1

- To see the signal that PCIe-5111 Counter Output generates, it is recommended to connect PCIe-5111 Counter Output (CTR0_OUT, Pin#2) to PCIe-5111 AI Ch0 input (AI0+, Pin#68). Please note Counter Output and AI Ch0 input share the same ground so only one connection is needed.
- Open Counter Output-->Winform CO Single and click Start and set the numbers as follow:

🖗 PCIe-5110 Single	Mode Pulse Generation	5110 Cir		Dula	o Conorati	ion	– – ×
Basic Param Config		5110 511	igrei	5110_5111	e Generat:		
Slot Number	0	\checkmark		Pin	Signal Name	Pin	Signal Name
Counter ID	0	~		11	CTR0 Source/A	42	CTR1 Source/A
Pulse Delay	0	÷		10	CTR0 Gate/Z	41	CTR1 Gate/Z
Pulse Parameter		Frequency		43	CTR0 AUX/B	6	CTR1 AUX/B
OutputPulse Type	DutyCycleFrequency	 2.000 		2	CTR0_OUT	40	CTR1_OUT
Idle State	LowLevel	V Duty Cycle	÷	5	CTR2 Source/A	3	CTR3 Source/A
				38	CTR2 Gate/Z	45	CTR3 Gate/Z
	start	Stop		37	CTR2_AUX/B	46	CTR3 AUX/B
	STALL	Stop		1	CTR2_OUT	39	CTR3 OUT

Figure 95 Single Pulse Generation

- > The table in the sample program is a connection diagram for your convenience.
- > The frequency and duty cycle of the pulse are set by **Frequency** and **Duty Cycle**.



- Please refer Learn by Example to configure an analog input to receive the signal from Counter Output.
- Click **Start** to generate a single pulse as shown.

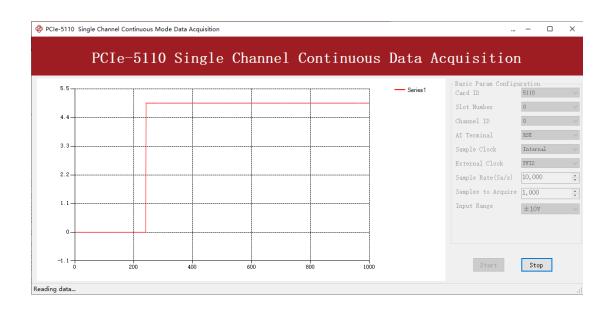
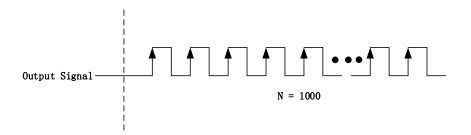
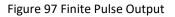


Figure 96 AI Acquisition Single Pulse

8.9.2. Finite Pulse Output

The pulse output timing is as shown in Figure 97.





In finite pulse output mode, the user is required to configure the output frequency, duty cycle and the number of output pulses.

Assuming that the pulse width to be output by the user is 1ms, the frequency calculated according to the duty cycle of 50% is as follows:

Set frequency = 1 / (1ms / 0.5) = 500Hz



That is to say, when the user sets the frequency as 500Hz and the duty cycle as 0.5, a limited pulse of 1ms pulse width will be obtained.

Learn by Example 8.9.2

- To see the signal that PCIe-5111 Counter Output generates, it is recommended to connect PCIe-5111 Counter Output (CTR0_OUT, Pin#2) to PCIe-5111 AI Ch0 input (AI0+, Pin#68). Please note Counter Output and AI Ch0 input share the same ground so only one connection is needed.
- Open Counter Output-->Winform CO Finite and click Start and set the numbers as follow:

PCIe-5110 Finite Pulse Generation	'n						- 0	×
PCIe	e-5110 Fini	ite Pula	se	Gen	eratio	n		
-Basic Param Configuration	-Pulse Parameter			5110_5111				
Slot Number 0 $$	Pulse Type	Frequency		Pin	Signal Name	Pin	Signal Nam	e
Counter ID 0 🗸	DutyCycleFrequency 🗸	50.000	*	11	CTR0_Source/A	42	CTR1_Sour	ce/A
pulse Count 1000	Idle State	Duty Cycle		10	CTR0_Gate/Z	41	CTR1_Gate	Z
pulse Count 1000	LowLevel 🗸 🗸	0.500	Ť	43	CTR0_AUX/B	6	CTR1_AUX	/B
	\$			2	CTR0_OUT	40	CTR1_OUT	•
				5	CTR2_Source/A	3	CTR3_Sour	ce/A
start	Stop			38	CTR2_Gate/Z	45	CTR3_Gate	Z
				37	CTR2_AUX/B	46	CTR3_AUX	/B
				1	CTR2_OUT	39	CTR3_OUT	•

Figure 98 Finite Pulses Generation

- > The table in the sample program is a connection diagram for your convenience.
- > The frequency and duty cycle of the pulse are set by **Frequency** and **Duty Cycle**.
- Please refer Learn by Example to configure an analog input to receive the signal from Counter Output.
- Click **Start** to generate the pulse shown below.



	PCIe-	-5110	Single	Channe]	l Con ⁻	tinuou	s Data	Acquisitic	n
5.5							Series1	-Basic Param Conf: Card ID	iguration 5110
П								Slot Number	0
4.4								Channel ID	0
								AI Terminal	RSE
3.3								Sample Clock	Internal
								External Clock	PFI2
2.2								Sample Rate(Sa/s) 10,000
								Samples to Acqui:	re 1,000
1.1								Input Range	$\pm 10 V$
0									
-1.1		200	400					Start	Stop

Figure 99 AI Acquisition Finite Pulse

> According to the picture, the *duty cycle* is 0.5 as set before.

8.9.3. Continuous Pulse Output

The pulse output timing is shown in Figure 100 below.

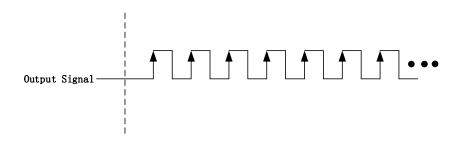


Figure 100 Continuous Pulse Output

In continuous output mode, you need to configure the output frequency and duty cycle. After starting the output, the pulse signal with fixed frequency and duty cycle will be output continuously.

Learn by Example 8.9.3

■ To see the signal that PCIe-5111 Counter Output generates, it is recommended to connect PCIe-5111 Counter Output (CTR0_OUT, Pin#2) to PCIe-5111 AI Ch0 input (AI0+, Pin#68). Please note Counter Output and AI Ch0 input share the same ground so only one connection is needed.



■ Open Counter Output-->Winform CO Continuous and click Start and set the

numbers as follow:

(D 1 4				Pulse Gener		
		Modificat		requency An	d Dut	ty Cycle)
Basic Param Config	-		5110_5111			
Slot Number	0	\sim	Pin	Signal Name	Pin	Signal Name
Counter ID	0	\sim	11	CTR0_Source/A	42	CTR1_Source/A
			10	CTR0_Gate/Z	41	CTR1_Gate/Z
ulse Parameter			43	CTR0_AUX/B	6	CTR1_AUX/B
Pulse Type DutyCycleFreques	na v	Frequency 50.000	2	CTR0_OUT	40	CTR1_OUT
Idle State	nc •	Duty Cycle	5	CTR2_Source/A	3	CTR3_Source/A
LowLevel	\sim	0.500	38	CTR2 Gate/Z	45	CTR3 Gate/Z
			37	CTR2_AUX/B	46	CTR3_AUX/B
at out	dificatio: uency and	Stop	1	CTR2 OUT	39	CTR3 OUT

Figure 101 Continuous Pulse Generation

> The table in the sample program is a connection diagram for your convenience.

The frequency and duty cycle of the pulse are set by Frequency and Duty Cycle.

■ Change the **Duty Cycle** to 0.7 for instance. The result is shown below.

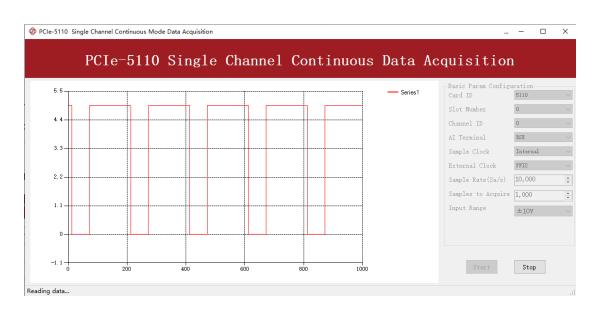


Figure 102 AI Acquisition Continuou	s Pulse
-------------------------------------	---------



> According to the picture, the **duty cycle** is 0.7 as set before.

8.10. 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.

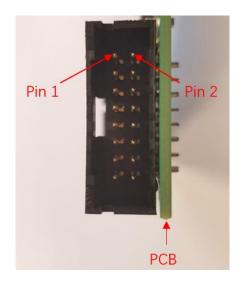


Figure 103 SSI Connector in PCIe-5113

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 14 SSI Connector Pin Assignment for PCIe-5113



8.11. DIP Switch in PCIe/PXIe-5113

PCIe/PXIe-5113 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.

9. Calibration

PCIe/PXIe-5113 boards are precalibrated before the shipment. We recommend you recalibrate PCIe/PXIe-5113 boards 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.



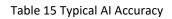
10. Appendix(Measurement Issues)

10.1. Performance and Tests

10.1.1. AI Accuracy

The maximum AI accuracy is limited by three factors: Total Gain Error, Total Offset Error and the Noise Uncertainty as shown in the following table. The PCIe/PXIe-5113 device is first calibrated. The test temperature is 23 °C±5°C.

Typical Tested 5110 AI Accuracy									
	Nominal Range								
Total Gain Error (μV)	314.0	153.5	57.2	29.1	16.4	7.1	5.2		
Total Offset Error (μV)	154.0	95.0	24.8	23.2	19.1	16.9	15.2		
Noise Uncertainty (μV)	2.8	1.6	0.8	0.5	0.4	0.4	0.4		
Absolute Accuracy at Full Scale (µV)	470.8	250.1	82.8	52.8	35.9	24.3	20.8		



A typical test of different input ranges is shown below. The input voltage is normalized to -1.0V and 1.0V.

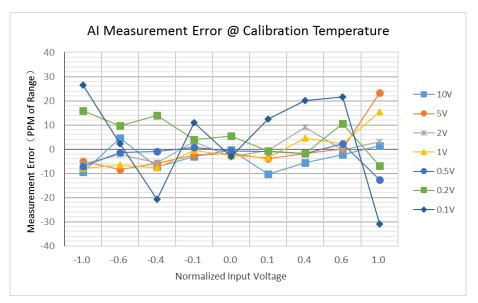


Figure 104 AI Measurement Error



10.1.2. AI Bandwidth

Analog Input Bandwidth							
Nominal Range Full Scale (V)	-3dB Bandwidth (MHz)						
±10	3.26						
±5	2.77						
±2	1.39						
±1	0.78						
±0.5	0.78						
±0.2	0.72						
±0.1	0.63						

Table 16 AI Bandwidth

10.1.3. System Noise

A typical system noise is show below.

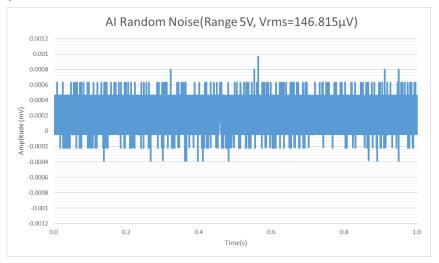
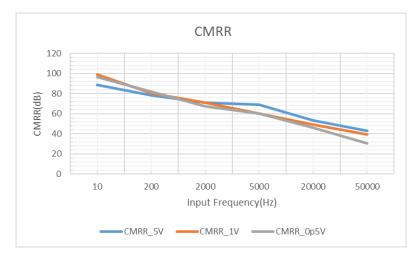


Figure 105 AI Error due to System Random Noise

10.1.4. PCIe/PXIe-5113 CMRR

A typical CMRR performance is shown below.







10.1.5. 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-5113 device is first calibrated. The test temperature is 2 °C from the calibration temperature.

Typical Tested 5110 AO Accuracy							
Nominal Range Positive Full Scale (V)	10	5					
Gain Error	33.7	23.7					
Offset Error	77	59.4					
Absolute Accuracy at Full Scale (µV)	1052	416					

Table 17 Typical AO Accuracy

10.2. Floating Signals and Ground Referenced Signals

Signals to be measured often fall into two categories: floating and ground referenced. The floating signals include battery output, isolated output, thermocouples etc; the ground referenced signals include most instrumentation output signals. Some instruments also offered isolated floating output.

10.3. Differential, NRSE, RSE Modes

The DAQ boards have three measurement modes: differential (DIFF), non-referenced singled end (NRSE), and the referenced single end (RSE). The NRSE mode is also referred as the pseudo differential mode. Under the NRSE mode, the DAQ card provides a common connecting terminal, referred as AI_Sensing. The negative ends of input signal and the DAQ boards are all connected to this terminal, making it look like the differential mode. Thus, the NRSE mode can handle twice as many channels as the DIFF mode.

The three measurement modes and the two types of input signals, floating and ground referenced, form 6 different measurement scenarios as shown in the following.



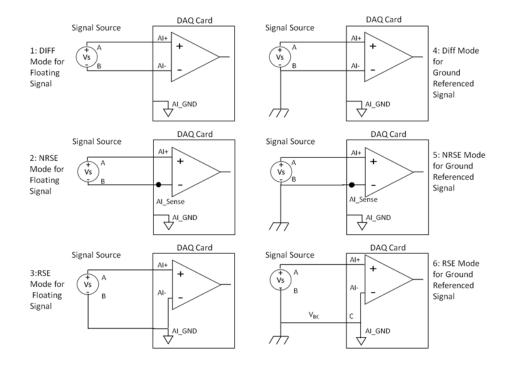


Figure 107 Six Measurement Scenarios

In the first 5 scenarios, V_{AB} is measured voltage. But in the 6th scenario, both the measured signal and the DAQ have own grounds. The two ground may have a voltage difference V_{BC} . The actual measurement is $V_{AC}=V_{AB}+V_{BC}$, not V_{AB} . Due to the ground noise, V_{BC} is quite noisy. This affects the measurement accuracy. The caution must be taken using 6th mode.

10.4. Reducing the Common Mode Voltage Effect

In the first 2 modes, the measured signal is floating. It is quite often that the common mode voltage will appear. To reduce this effect on the measurement accuracy, a resister can be added as shown. The value of this resister depends on the impedance of the signal source. As a rule of thumb, R should be 1000 times of the signal source output impedance, roughly 10K to $100K\Omega$. At this level, R has very little impact on the measurement.



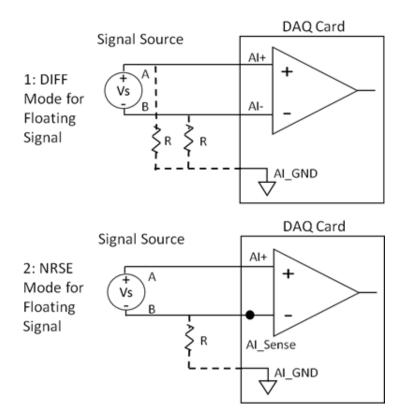


Figure 108 Using Resister to Reduce Common Mode Voltage Effect



11. About JYTEK

11.1. 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.

11.2. 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.

11.3. 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.



12. 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 PCIe/PXIe-5113 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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