

**USBDAQ – 9100MS**  
Universal Serial Bus  
Multi-Functions Data Acquisition Module  
**User's Guide**



Recycled Paper



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<b>ADLINK Technology Inc.</b>			
Web Site	http://www.adlink.com.tw		
Sales & Service	service@adlink.com.tw		
Technical Support	NuDAQ + USBDAQ	nudaq@adlink.com.tw	
	NuDAM	nudam@adlink.com.tw	
	NuIPC	nuipc@adlink.com.tw	
	NuPRO	nupro@adlink.com.tw	
	Software	sw@adlink.com.tw	
TEL	+886-2-82265877	FAX	+886-2-82265717
Address	9F, No. 166, Jian Yi Road, Chungho City, Taipei, 235 Taiwan,		

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Environment to Use	OS _____ Computer Brand _____ M/B: _____ CPU: _____ Chipset: _____ BIOS: _____ Video Card: _____ Network Interface Card: _____ Other: _____		
Challenge Description			
Suggestions to ADLINK			

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# 1

## Introduction

The Universal Serial Bus (USB) is a new standard for connecting PCs to peripheral devices such as printers, monitors, keyboards and mouse. USB offers several advantages over conventional serial and parallel connections, including higher bandwidth and the ability to provide power to the peripheral devices.

USBDAQ-9100MS is ideal for data acquisition applications, only one cable is required to line the data acquisition device to the PC. In addition, the USB's high – speed data transfer allows for a real time display of acquired data, while eliminating the need for expensive memory in the acquisition device.

USBDAQ-9100MS 100kS/s multifunction I/O USB module delivers high performance and reliable data acquisition capabilities to meet wide range application requirements based on the USB interface.

The USBDAQ avoid many of the limitations of PC-cards data acquisition devices and offer advantages over most PC plug-in data acquisition as well. You get the benefit of USB plug-n-play and portable advantage. The USBDAQ module offers 8-CH differential analog input channels with 10 programmable ranges, and 4 of the 8 input channels support simultaneous sample, 2-CH 12-bit analog output, 16-CH isolated digital I/O and 2 timer/counter.

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## 1.1 USBDAQ-9100MS Features

USBDAQ-9100MS is a Dual-Port Isolated CAN Interface Card with the following features:

- Multi-function data acquisition modules attach to PCs via Universal Serial Bus (USB)
- USB Specification 1.1 Compliant
- 8 differential analog input channels with 12-bit resolution
- Simultaneously sampling of 4 analog input channels (2 sets, totally 8 channels)
- On board 4K samples AD FIFO memory
- Up to 500kS/s AD sampling rate
- Up to 100kS/s Continuous AD sampling (4 channels enabled, 800Kbyte/sec USB throughput rate, system dependent)
- Programmable inputs range (Refer to section 1.3 for details)
- Two 12-bit independent multiplying analog output
- On board 1023 samples analog output FIFO (per channel) for time critical operation
- 8 isolated digital input and 8 isolated digital output (1500V rms isolated)
- 2 General Purpose timer/counter (8254) with programmable interface
- On Board Auto calibration-no potentiometers or adjustments required
- LED Indicator for operation mode
- Windows 98, Windows Me, Windows 2000 driver support



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## 1.2 Applications

- Automatic test equipment
- Industry process monitoring and control
- Manufacture automation
- Portable Measurement
- Laboratory Equipment

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## 1.3 Specifications

### USBDAQ-9100MS Specification Table

◆ **USB Controller:**

- USB Spec. 1.1 compliant
- USB transfer throughput for analog input: 800Kbyte/s
- (equal to 100KS with 4 channel enabled)

◆ **Analog Input:**

- Converter: Successive approximation type
- Channels: 8 Differential Input with 4 channels simultaneous sample Simultaneous sample channels:  
CH1, CH3, CH5, CH7 and  
CH2, CH4, CH6, CH8
- Resolution: 12 bit
- Max. Sampling Rate: 500KS/s(Simultaneous Sampling)  
100KS/s(Multiplex Sampling)
- Input Range: Programmable

Range	Gain	Input Range	
		Bipolar	Unipolar
20V	0.5	±10V	-
10V	1	±5V	0 to 10V
5V	2	±2.5V	0 to 5V
2.5V	4	±1.25V	0 to 2.5V
1.25V	8	-	0 to 1.25V

- Input Coupling: DC
- Over Voltage Protection: 70V peak-peak
- FIFO Buffer Size: 4096 samples
- Input Impedance: 10MΩ
- Trigger Mode: Software, Pacer, External Trigger

- Data Transfer: Program Control, Interrupt

◆ **Analog Output:**

- Converter: Equivalent, monolithic multiplying
- Channels: 2
- Resolution: 12 bit
- Max. Update Rate : 500KS/s
- FIFO Buffer Size: 1023
- Settling Time: 2 $\mu$ S(Full range when load is 10K)
- Output Range:  $\pm 10$ V(Bipolar)
- Output Coupling: DC
- Protection: Short-circuit to ground
- Output Impedance: 0.1 $\Omega$  (min.)
- Output Driving:  $\pm 5$ mA (max.)
- Power On State: Offline
- Data Transfer: Program Control, Trigger, Pattern Generate

◆ **Isolation Digital I/O:**

- Channels: 8DI/8DO
- Isolation Voltage: 1500Vrms
- External Power or Self-powered
- DO: Darlington Output
- Power On State: Input; High impedance
- Logic Levels:

Level	Min.	Max.
Input Low Voltage	-2.5V	2.5V
Input High Voltage	+3.5V	+24V
Output Low Voltage	-	-
Output High Voltage	-	-

- Data Transfer: Program control,
- ◆ **Timer/Counter I/O:**
  - AD Pacer: 16-bit timer with 32MHz time base
  - Max. Frequency 500KHz
  - Min. Input Pulse Width (10 $\mu$ s)
  - Max DI Sampling Rate 4ms
- ◆ **General-purpose Up/Down Counter/Timer:**
  - Channels: 2
  - Width: 16 bit
  - Compatibility: 5V/TTL
  - Base Clock: 8, 4, 2, 1MHz(Programmable)
  - Data Transfer: Program Control
- ◆ **LED Indicator:**
  - Power On: Orange Light
  - Device found and driver Installed: Red Light
  - Operation: Green Light
- ◆ **Connector:**
  - RCA connector for analog I/O
  - SCSI-68 for digital I/O and timer/counter
  - USB type B
  - Power jack for external AC to DC Adaptor
  - 4-pin PC power connector
- ◆ **Dimension:**
  - 200 (L) x 148 (W) x 42 (H) mm

- Operating Temperature: 0 to 55°C
- Storage Temperature: -20 to 70 °C
- Relative Humidity: 5 to 95% non-condensing
  
- ◆ **Software Support:**
  - USBDAQ Utility for setup, acquisition, & real-time display
  - DLL driver for Visual Basic®, Delphi™, & C++ for Windows® 98/2000

# 2

## Installation

This chapter describes how to install USBDAQ-9100MS. At first, the contents in the package and unpacking information that you should be careful are described.

There are some important things you should note before using USBDAQ-9100MS.

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### 2.1 Before Installation USBDAQ-9100MS

Your USBDAQ-9100MS contains sensitive electronic components that can be easily damaged by static electricity.

Inspect the card module carton for obvious damage. Shipping and handling may cause damage to your module. Be sure there are no shipping and handling damages on the module before processing.

After opening the card module carton, take out the system module and place it only on a grounded anti-static surface component side up.

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**Note:** DO NOT APPLY POWER TO THE MODULE IF IT HAS BEEN DAMAGED.

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*You are now ready to install your USBDAQ-9100MS*

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## 2.2 Installing USBDAQ-9100MS

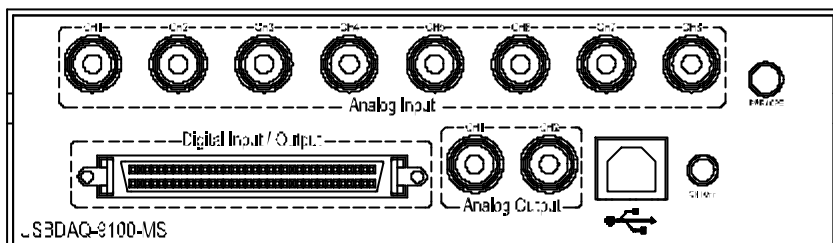
### *What do you have*

In addition to this *User's Manual*, the package includes the following items:

- ◆ **USBDAQ-9100MS multifunction I/O USB module**
- ◆ **Driver CD-ROM**
- ◆ **USB Cable (Type A to Type B)**
- ◆ **AIO Signal Probe**
- ◆ **Stand Arm**

If any of these items is missing or damaged, contact the dealer from whom you purchased the product. Save the shipping materials and carton in case you want to ship or store the product in the future.

## USBDAQ-9100MS Front View



**PWR/STS** : Power Status Indicator

**ORANGE** : Power On, but driver isn't loaded

**Red** : Driver Loaded, but no application is running

**Green** : A application Program is running

**ON/OFF** : Power Push Button

**Analog Input** : CH1 to CH8 RCA differential analog input channel

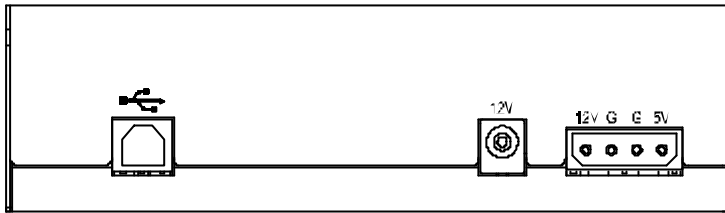
**Analog Output** : CH1 to CH2 RCA single end bipolar analog output

**Digital Input/Output** : solated Digital Input, Isolated Digital Output, Timer/Counter Pins

**Type B USB connector** : Plug the USB cable to Hub or your computer (Note 1)



## USBDAQ-9100MS Rear View



**Rear USB Connector**

**DC Jack**

**Power Jack**

**Type B USB connector** : Plug the USB cable to Hub or your computer (Note 1)

**DC Jack** : 12V DC adapter (Note 2)

**Power Jack** : The Power Connector to Power Supply (Note 2)

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### Note :

- 1.The front and rear USB connector should be used only one at the same time.
  - 2.DC Jack and Power Jack should be used only one at the same time.
-

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## 2.3 Installing USBDAQ-9100MS Windows 98/Me/2000 Driver

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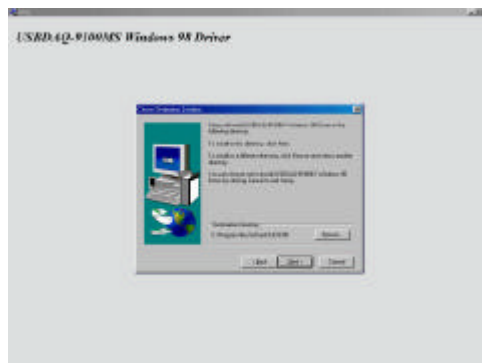
**Note:** Before Plug USBDAQ-9100MS. You should install driver first.

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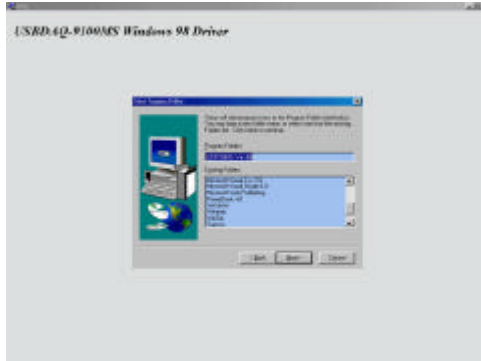
1. Run Setup.exe in the driver folder, You should see the screen like this. Press Next.



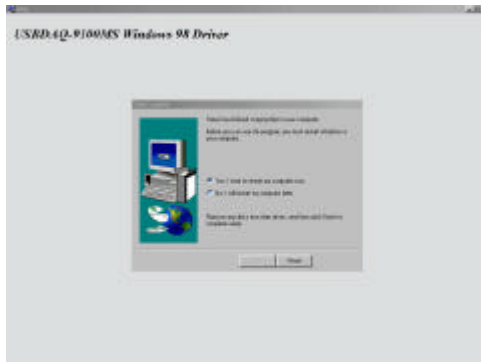
2. Choose the destination folder, Default folder is C:\Program Files\ADLINK\UD-9100MS, You can change the destination folder by Press Browse.



3. Select the Program Folder.



4. Restart the computer.



After the driver installation is done. Plug USBDAQ-9100MS and Push the power button.

You should see the LED light up in orange color. After found new hardware notify, please redirect the driver to where you install. The Windows will perform the driver installation process. All above done, USBDAQ-9100MS is now plug-and-play.

***LED Status Note:***

Power On: Orange Light

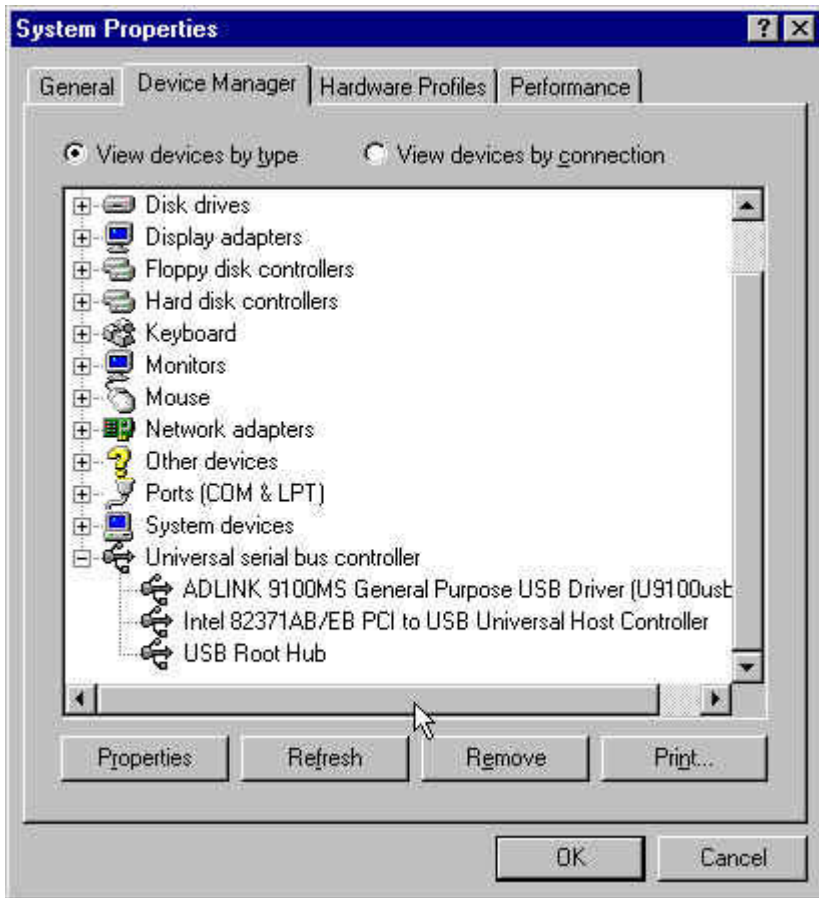
Device found and driver Installed: Red Light

Operation: Green Light

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## 2.3 Check USBDAQ-9100MS for Properly Installation

After the driver installation is done, you can plug USBDAQ-9100MS, and push the Power Button.



Now, you can use USBDAQ-9100MS.

# 3

## Signal Connections

This chapter describes the connector of USBDAQ-9100MS, also the signal connection between USBDAQ-9100MS and external devices, such as daughter boards or other devices.

### 3.1 Digital Input/Output Pin Assignment

USBDAQ-9100MS is equipped with one SCSI-68 pin assignment.

Pin	I/O Type	Function	Pin	I/O Type	Function
1	PWR	Externally Power	35	OGND	Isolated Digital Output Ground
2	IDO0	Isolated Digital Output 0	36	OGND	Isolated Digital Output Ground
3	IDO1	Isolated Digital Output 1	37	OGND	Isolated Digital Output Ground
4	IDO2	Isolated Digital Output 2	38	OGND	Isolated Digital Output Ground
5	IDO3	Isolated Digital Output 3	39	OGND	Isolated Digital Output Ground
6	IDO4	Isolated Digital Output 4	40	OGND	Isolated Digital Output Ground
7	IDO5	Isolated Digital Output 5	41	OGND	Isolated Digital Output Ground
8	IDO6	Isolated Digital Output 6	42	OGND	Isolated Digital Output Ground
9	IDO7	Isolated Digital Output 7	43	OGND	Isolated Digital Output Ground
10	NC	Not Connected	44	NC	Not Connected
11	NC	Not Connected	45	NC	Not Connected
12	NC	Not Connected	46	NC	Not Connected
13	NC	Not Connected	47	NC	Not Connected
14	NC	Not Connected	48	NC	Not Connected
15	NC	Not Connected	49	NC	Not Connected
16	NC	Not Connected	50	NC	Not Connected
17	NC	Not Connected	51	NC	Not Connected
18	IDI0	Isolated Digital Input 0	52	IGND	Isolated Digital Input Ground
19	IDI1	Isolated Digital Input 1	53	IGND	Isolated Digital Input Ground
20	IDI2	Isolated Digital Input 2	54	IGND	Isolated Digital Input Ground
21	IDI3	Isolated Digital Input 3	55	IGND	Isolated Digital Input Ground
22	IDI4	Isolated Digital Input 4	56	IGND	Isolated Digital Input Ground
23	IDI5	Isolated Digital Input 5	57	IGND	Isolated Digital Input Ground
24	IDI6	Isolated Digital Input 6	58	IGND	Isolated Digital Input Ground
25	IDI7	Isolated Digital Input 7	59	IGND	Isolated Digital Input Ground
26	CLK0	8254 External Timer 0 Clock	60	GND	Board Digital Ground
27	GATE0	8254 External Timer 0 Gate	61	GND	Board Digital Ground
28	OUT0	8254 Timer 0 OUT	62	GND	Board Digital Ground
29	CLK1	8254 External Timer 1 Clock	63	GND	Board Digital Ground
30	GATE1	8254 External Timer 1 Gate	64	GND	Board Digital Ground

31	OUT1	8254 Timer 1 OUT	65	GND	Board Digital Ground
32	TGIN	External Digital Trigger Input	66	GND	Board Digital Ground
33	TGOUT	Digital Trigger Synchronous Output	67	GND	Board Digital Ground
34	NC	Not Connected	68	NC	Not Connected

### I/O Type

#### **PWR : Power Input**

Supply an external voltage source for Darlington Circuit (TD62083AP).  
Voltage Range: ( to 24V)

This digital ground is also wire to computer's digital ground through USB cable. Please care about that to prevent the damage happened in your device.

#### **IDOn : Isolated Digital Output**

It uses Darlington Circuit for current sink.



**IDIn : Isolated Digital Input**

Digital input channels are isolated by photocouplers . (Please refer to section 3.2 for details) And the current that needed to turn on the photocoupler is about 5mA.

**EIGND : Isolated digital input ground**

**EOGND : Isolated digital output ground**

**CLKn : 8254 Clock Input of Counter #n**

**OUTn : 8254 Clock Output of Counter #n**

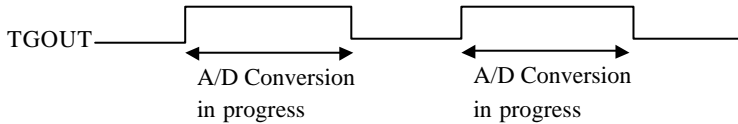
**GATEn : 8254 Gate Input of Counter #n**

**TGIN : External Digital Trigger Input**

Input trigger signal input. Control the starting time of A/D conversion.Generic TTL(5V) digital input. There is some risk that the device could be damaged if electrical shock to this type pin.

**TGOUT: Synchronous Digital Trigger Output**

A/D conversion synchronous trigger output.

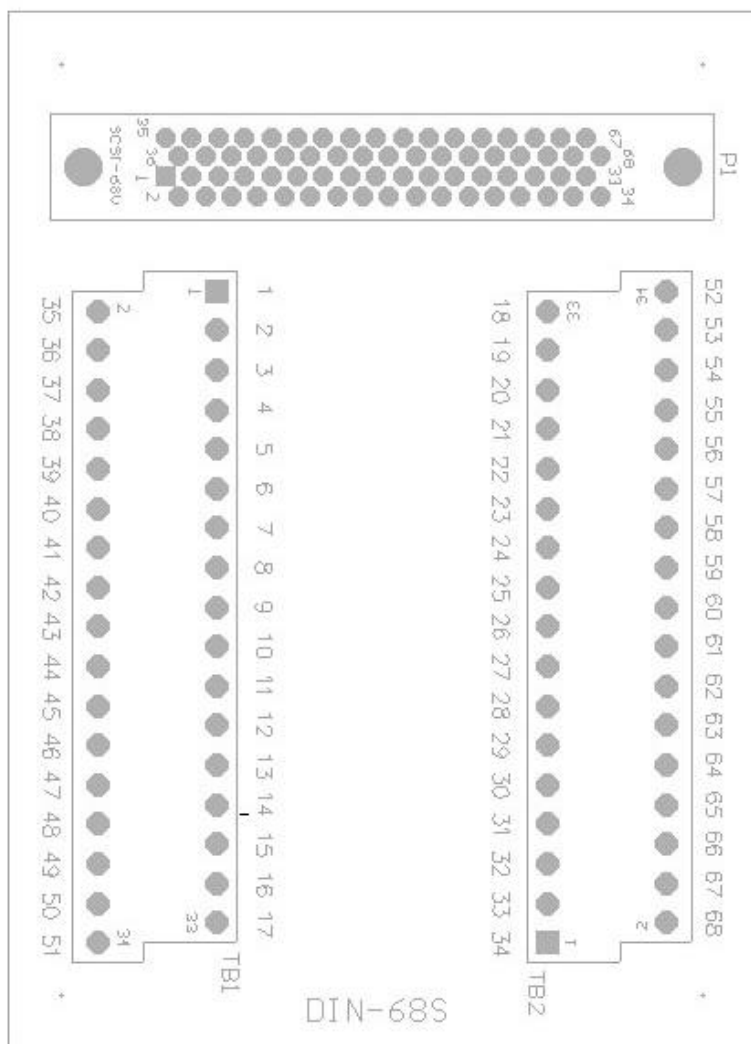


**GND: Digital Ground**

We provide the DIN-68S(optional) to Digital Input/Output Termination Block.

Here is the outline:

## DIN-68S View

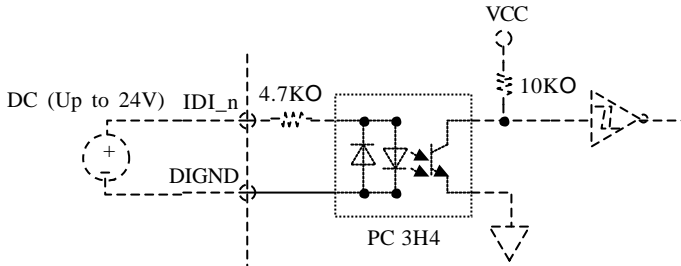


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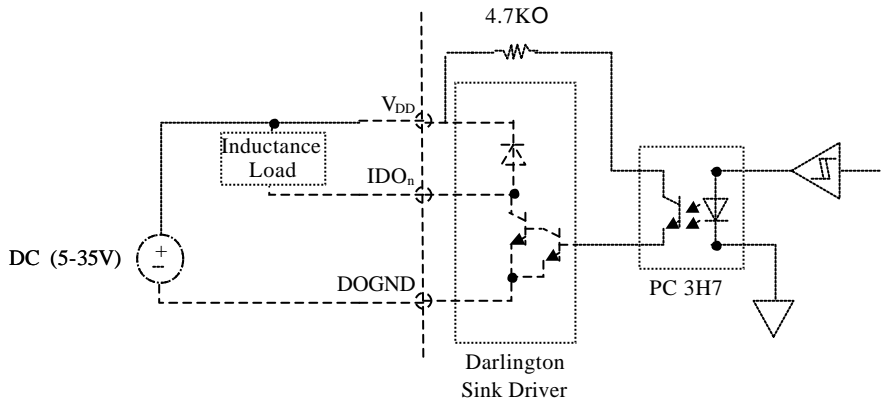
## 3.2 Isolated Digital Input and Digital Output Connection

USBDAQ-9100MS provides 8 isolated digital input and 8 digital output channels on board.

### *Isolated Digital Input*



### *Isolated Digital Output*

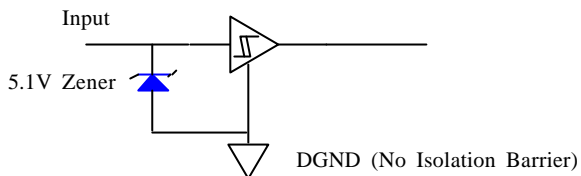


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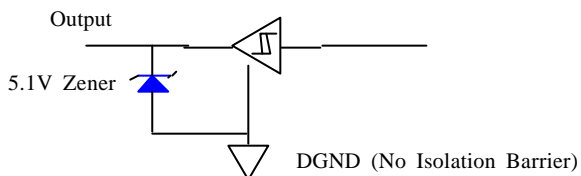
### 3.3 General Purpose Timer/Counter and Digital Trigger

USBDAQ-9100MS provides 2 8254-compatible Timer/Counter and External Trigger Signal. They are TTL level, please DO NOT connect them the External Power Source (+24V) and isolated signals.

#### *TTL Input Signals*



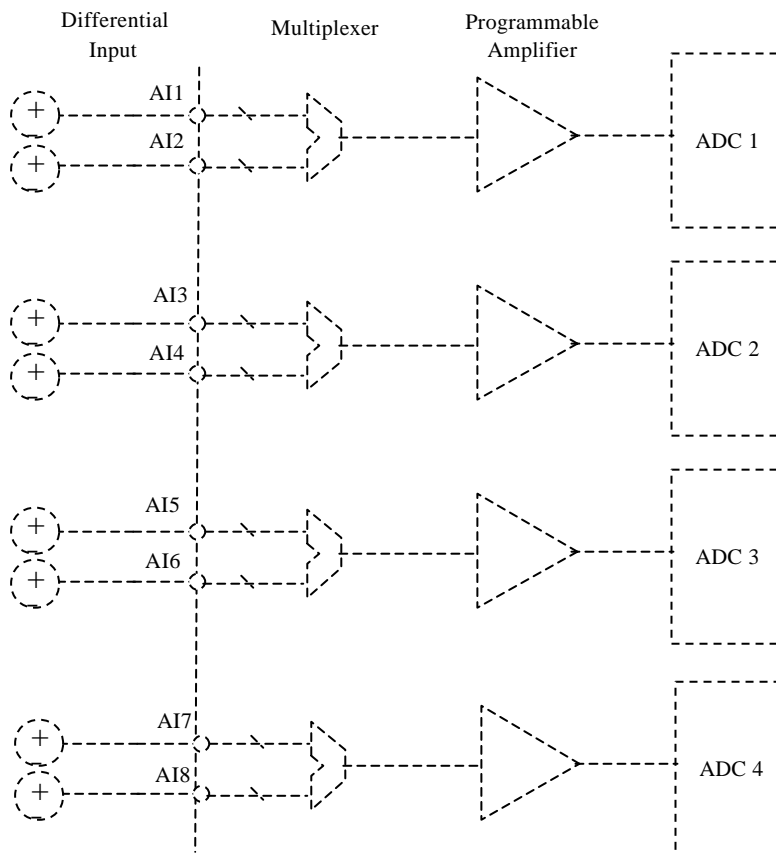
#### *TTL Output Signals*



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### 3.4 Analog Input Signal Connection

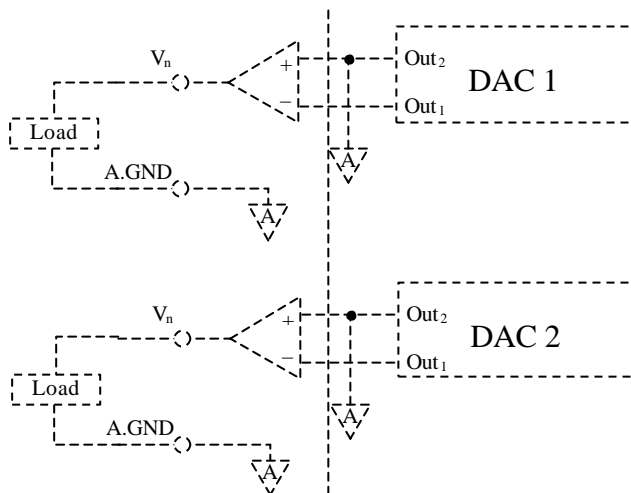
USBDAQ-9100MS provides 8 differential analog input channels. Their resolution is 12-bit.



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### 3.5 Analog Output Signal Connection

USBDAQ-9100MS provides 2 single end analog output channels. Its output is fixed in  $-10V$  to  $+10V$ (actually  $+9.995V$ ) in 12-bit resolution.



# 4

## Operation Theorem

The operation theorem of the functions on USBDAQ-9100MS module is described in this chapter. The functions include the A/D conversion, Digital I/O and General Purpose Counter / Timer. The operation theorem can help you to understand how to manipulate or to program USBDAQ-9100MS.

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## 4.1 A/D Conversion

When using an A/D converter, you should know about the properties of the signal to be measured at first. Users can decide which channels to use and connect the signals to USBDAQ-9100MS. Please refer to 3.2. In addition, users should define and control the A/D signal source, including A/D channels, A/D gains, and A/D signal types.

### **Sampling Process:**

USBDAQ-9100MS supports Post-Trigger Mode which means the acquisition starts after the trigger condition happen. The trigger source can be External Input(TGIN), Counter Output and Software command (Default).

After the trigger condition occurred, the A/D acquisition starts automatically. USBDAQ-9100 uses four A/D converters and the input channels are divided into two banks. Bank one is channel 1, 3, 5, 7 and Bank two is channel 2, 4, 6, 8. The data acquired in the channels of the same Bank are simultaneously and after the first bank of data is converted, it will start to scan the other bank of data. Any one of the channels in the Bank can be enabled or disabled and if all the channels in the Bank are disabled, they will not be scanned in the data acquisition. The scan frequency is defined in the Scan Interval Counter (**SIC**). The SIC is a 24-bit register and the scan frequency is calculated as:

$$\text{Scan Frequency} = \text{TimeBase Frequency (32MHz)} / \text{SIC}$$

$$\text{That is Scan Interval (ScanConv)} = \text{SIC} / \text{TimeBase}$$

In the software driver, the Scan Frequency is equal to the variable, **ScanRate**

The sampling interval (ScicConv) is measured by the period from Bank One scan to Bank Two scan. The software driver fixed the sample interval to be half of the Scan Interval, that is

$$\text{SCIC counter} = 0.5 * \text{SIC}$$

Thus

$$\text{Sampling interval (ScicConv)} = \text{SCIC} / \text{TimeBase} = 0.5 * \text{SIC} / \text{TimeBase}$$

Since the software had fixed the Sampling interval to be half of Scan Interval, therefore once **ScanRate** is fixed, Sampling rate is decided.

The total number of scan is specified by the register, SC which is equal to the variable, **ReadCount** in the software driver.



Following is a summary of the register:

*SIC(24 bit): Scan Interval Counter*

*Register for specify the Scan rate*

*And the Scan Interval = SIC\_counter / Timebase*

*SCIC(16 bit):*

*Register for specify the time between Bank One scan and Bank Two Scan*

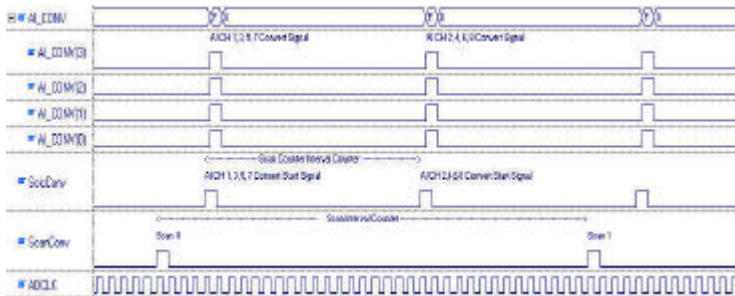
*Specify the data Sampling Interval = SCIC\_counter / Timebase*

*SC(16 bit):*

*Specify the number of scans after trigger*

After an A/D conversion completed, the A/D data is buffered in a Data FIFO and then transferred to PC's through USB bus for further processing.

Here is a brief timing chart.



---

## 4.2 D/A Conversion

USBDAQ-9100MS has 2 single-ended analog output channels. The connection of D/A channels are controlled by 2 relays. That is, output channels are open circuits before you initialize your program. 2 output channels are separated from connectors. Also, before initialize your program, you will measure a floating voltage on RCA connectors.

The D/A output of USBDAQ-9100MS supports two modes. One-shot Output mode and the other is Continuous Output mode. With One-hot data acquisition mode, PC sends one output data to D/A converter. And with Continuous Mode, the output data are stored in the D/A output FIFO memory and data update frequency is defined by the parameter, UpdateRate in software driver. Data can be output in a constant, accurate frequency continuously by this mode.

There is an 1-K FIFO data buffer for each channel (actually size is 1023 samples) . With retransmit function which allows to cyclic restart from the beginning once the end of data buffer is reached.

---

## 4.3 Digital Input and Output

There are 8 isolated digital input channels and 8 isolated digital output channels. To program digital I/O operation is very straightforward. The digital input/output operation is just to read/write data by calling the corresponding software API.

---

## 4.4 General Purpose Timer/Counter Operation

USBDQAQ-9100MS has 2 8254-compatible timer/counter on board. It can offer 2 independent 16-bit programmable down counters and cascaded counters with programmable Gate and CLK Input.

Unlike others 8254 devices, USBDAQ-9100MS provides programmable clock and gate input source for timer/counter. You can read the detailed description in the function reference. For example, if you want to generate a square wave, you just need to select the clock input as Internal Clock Source and choose the base clock as 8MHz. You can simply get an 8 MHz clock source.

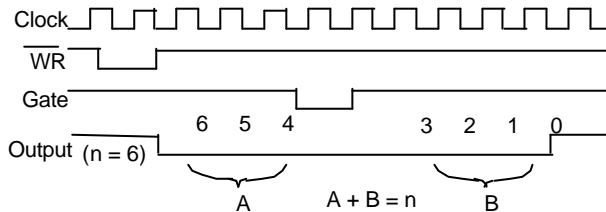
For 8254 operation mode, you can refer various 8254 documents in the book. Here is just a brief description.

There are six modes in the standard 8254 (mode 0 to mode 5).

### **Mode 0 : Interrupt on terminal count**

In this mode, the output goes low after the mode set operation, and the counter begins to count down while the gate input is high. When terminal count is reached, the output goes high and remains high until the selected counter is set to a different mode.

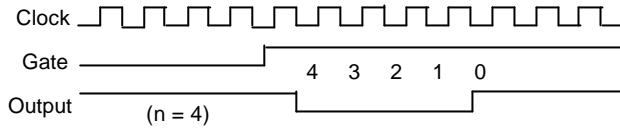
The following diagram shows the timing diagram.



### **Mode 1 : Hardware Retriggerable One Shot**

In this mode, output will be initially high and go low on the clock pulse following a trigger to begin the one-shot pulse, and will remain low until the Counter reaches zero. Output will then go high and remain high until the clock pulse after the next trigger. This Mode functions like a divide-by-N counter. It is typically used to generate a Real Time Clock Interrupt.

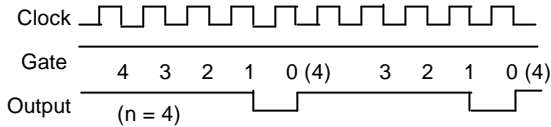
The following diagram shows the timing diagram.



**Mode 2 : Rate Generator**

In this mode, the output goes low for one period of the clock input. The value fill in the counter indicates the period from one output pulse to the next.

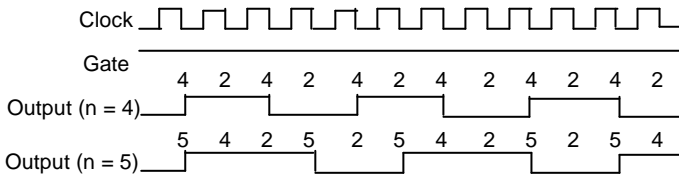
The following diagram shows the timing diagram.



**Mode 3 : Square Wave Mode**

In this mode, the output stays high for one half of the *count* clock pulses and stays low for the other half.

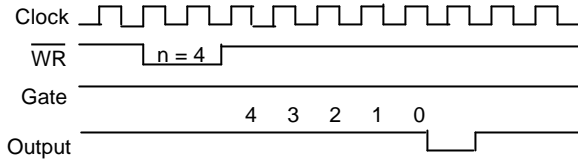
The following diagram shows the timing diagram.



**Mode 4 : Software Triggered Strobe**

In this mode, the output is initially high, and the counter begins to count down while the gate input is high. On terminal count, the output goes low for one clock pulse, and goes high again.

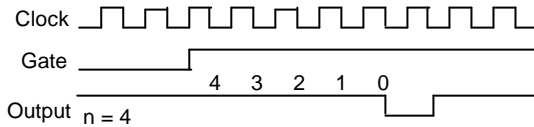
The following diagram shows the timing diagram.



**Mode 5 : Hardware Triggered Strobe(Retriggerable)**

In this mode is similar to Software Trigger mode except that the gate input is used as a trigger to start counting.

The following diagram shows the timing diagram.



**Input/Ouput Diagram**

The 8254 input/output pins are TTL-compatible without isolation. So please be aware about the signal connection.

## Product Warranty/Service

ADLINK warrants that equipment furnished will be free from defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, we shall, at our option, either repair or replace any product that proves to be defective under normal operation.

This warranty shall not apply to equipment that has been previously repaired or altered outside our plant in any way as to, in the judgment of the manufacturer, affect its reliability. Nor will it apply if the equipment has been used in a manner exceeding its specifications or if the serial number has been removed.

ADLINK does not assume any liability for consequential damages as a result from our product uses, and in any event our liability shall not exceed the original selling price of the equipment. The remedies provided herein are the customer's sole and exclusive remedies. In no event shall ADLINK be liable for direct, indirect, special or consequential damages whether based on contract of any other legal theory.

The equipment must be returned postage-prepaid. Package it securely and insure it. You will be charged for parts and labor if the warranty period is expired or the product is proves to be misuse, abuse or unauthorized repair or modification.