PCI-1202/1602/1800/1802 Series

User Manual

Warranty

All products manufactured by ICP DAS are warranted against defective materials for a period of one year from the date of delivery to the original purchaser.

Warning

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Table of Contents

1. Introduction

1.1 General Description

The PCI-1800 and PCI-1802 series are high performance, multifunction analog, digital I/O board for PC and compatible computers in a 5 V PCI slot. This series features a **continuous**, **330 k Samples/Sec**., **gap-free** data acquisition under DOS. This family has the same features: one 12-bit 330 k AD converter, two 12-bit independent DA converter, 16-channel TTL compatible DI and 16-channel TTL compatible DO. The PCI-1800 series provides 16 single-ended or 8 differential inputs. The PCI-1802 series provides 32 single-ended or 16 differential inputs. Two DACs of this multifunction card are independent bipolar voltage output with jumper selectable voltage output range. The AD scan function of 1800 series is very amazing; we call it "**MagicScan**". It scans with two modes: **the fixed-channel mode** and **the channel-scan mode**, both modes can be up to 330 k samples per second. We also provide three trigger modes for this series: software trigger, pacer trigger and external trigger; each trigger mode uses "**MagicScan**" to perform the data acquisition. The external trigger can be programmed to one of the three trigger methods : pre-trigger, post-trigger and middle-trigger. The PCI-1800/1802 fully supports "Plug and Play" under Windows 98/2000/XP/2003/Vista/7/2008 32/64-bit version.

The PCI-1202HU/LU,PCI-1602U/FU,PCI-1800LU/HU and PCI-1802LU/HU are new version of PCI-1202H/L and PCI-1602 they can be installed in 3.3 V, 5 V or 3.3 V/5 V Universal PCI-Bus. The PCI-1202H/L and PCI-1602/1602F could be replaced with PCI-1202HU/LU,PCI-1602U/1602FU,PCI-1800LU/HU and PCI-1802LU/HU without modifying software.

The PCI-1202 series is very similar to PCI-1802 series. The different items between the PCI-1802 and **PCI-1202** are given as follows:

* A/D sampling rate is **110 k Samples/Sec**. **for PCI-1202(L/LU)**
* FIFO size is **1 k samples**

The PCI-1602/PCI-1602U(FU) is very similar to PCI-1802L. The different items between the PCI-1802 and **PCI-1602** are given as follows:

* A/D is **16-bit**
* A/D sampling rate is **200 k Samples/Sec**. **for PCI-1602F/FU**
* A/D sampling rate is **100 k Samples/Sec**. **for PCI-1602(U)**

1.2 The Block Diagram

The block diagram of PCI-1202/1602/1800/1802 is given as follows:

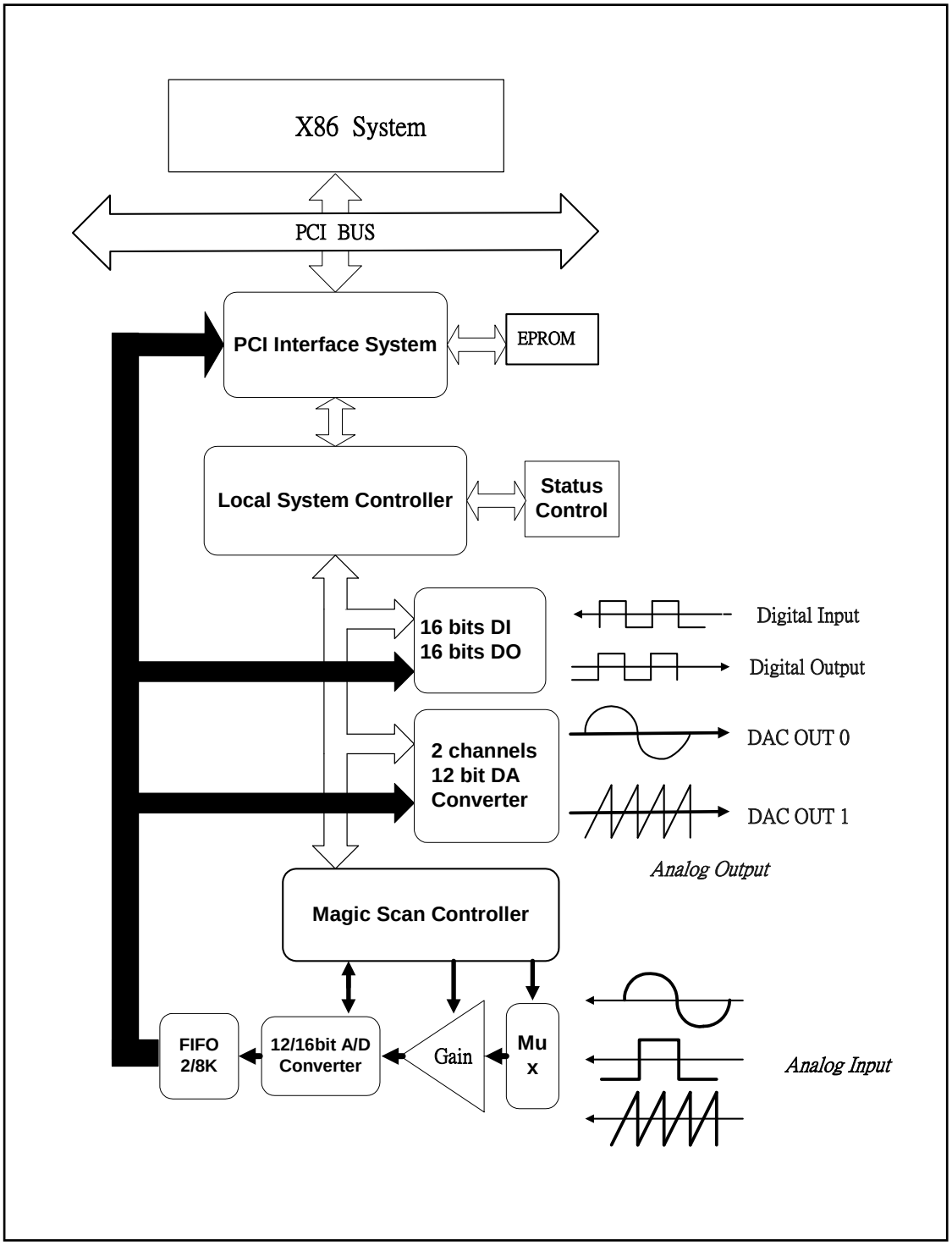


Figure 1-1 The block diagram of PCI-1202/1602/1800/1802

1.3 Features

The general features of PCI-1202/1602/1800/1802 series are given as follows:

* Bus: 5 V PCI (Peripherals Component Interface) bus for PCI-1202/1602/180x H/L
* Universal PCI card, supports both 5 V and 3.3 V PCI bus for PCI-1202HU/LU,1602U/FU

* A/D:
  1. PCI-1800(L)/1802(L) : A/D converter = 330 k Samples/Sec.
     PCI-1800(H)/1802(H) : A/D converter = 44 k Samples/Sec.
     PCI-1602(F/FU): A/D converter = 200 k Samples/Sec.
     PCI-1602(U): A/D converter = 100 k Samples/Sec.
     PCI-1202(L/LU): A/D converter = 110 k Samples/Sec.
     PCI-1202(H/HU): A/D converter = 44 k Samples/Sec.
  2. 32 single-ended / 16 differential analog inputs for PCI-1202/1602/1802 H/L/HU/LU.
  3. Three A/D trigger sources: software, pacer and external trigger
  4. Three external trigger modes: pre-trigger, middle-trigger and post-trigger
  5. Programmable input signal configuration.
  6. Provides "**MagicScan"** function
  7. FIFO: 1 k samples for PCI-1202(H/L/HU/LU)/1800(H/L)
     8 k samples for PCI-1802(H/L)
     8 k samples for PCI-1602, PCI-1602F, PCI-1602U/FU and PCI-1802(H/L)
* D/A:
  1. Two independent 12-bit DACs.
  2. Bipolar voltage output with +/-5 V or +/- 10 V jumper selectable.
  3. High throughput: refer to chapter 10.

* DIO:
  1. 16 channels TTL compatible DI and 16 channels TTL compatible DO.
  2. High speed data transfer rate: refer to chapter 10.

* Timer:
  Three 16-bit independent timers
  1. Timer 0 is used as the internal A/D pacer trigger.
  2. Timer 1 is used as the external trigger.
  3. Timer 2 is used as the machine independent timer.

1.4 Specifications

1.4.1 PCI-1202L/H/LU/HU

Model Name	PCI-1202 L	PCI-1202 H	PCI-1202 LU	PCI-1202 HU
Analog Input				
Channels	32 single-ended / 16 differential			
A/D Converter	12-bit, 8.5 µs conversion time			
Sampling Rate	110 kS/s. max.			
FIFO Size	1024 samples			
Over voltage Protection	Continuous +/-35 Vp-p			
Input Impedance	10 MΩ/6 pF			
Trigger Modes	Software, Internal programmable pacer, External (5 V/TTL compatible)			
Data Transfer	Polling			
Accuracy	0.01 % of FSR ±1 LSB @ 25 °C, ± 10 V			
Zero Drift	+/- 4 ppm/°C of FSR			
Analog Output				
Channels	2			
Resolution	12-bit			
Accuracy	0.06% of FSR ± 1 LSB @ 25 °C, ± 10 V			
Output Range	Bipolar:+/5 V, +/-10 V			
Output Driving	+/- 5 mA			
Slew Rate	8.33 V/µs			
Output Impedance	0.1 Ω max.			
Operating Mode	Software			
Digital Input				
Channels	16			
Compatibility	5 V/TTL			
Input Voltage	Logic 0: 0.8 V max. / Logic 1: 2.0 V min.			
Response Speed	2.0 MHz (Typical)			
Digital Output				
Channels	16			
Compatibility	5 V/TTL			
Output Voltage	Logic 0: 0.4 V max. / Logic 1: 2.4 V min.			
Output Capability	Sink: 2.4 mA @ 0.8 V / Source: 0.8 mA @ 2.0 V			
Response Speed	2.0 MHz (Typical)			
Timer/Counter				
Channels	3(Independent x 1/Internal pacer x 1/External pacer x 1)			
Resolution	16-bit			
Compatibility	5 V/TTL			
Input Frequency	10 MHz max.			
Reference Clock	Internal: 8 MHz			
General				
Bus Type	5 V PCI, 32-bit, 33 MHz		3.3 V/ 5 V Universal PCI, 32-bit, 33 MHz	
Data Bus	16-bit			
Card ID	No		Yes(4-bit) for Version 4.0 or above	
I/O Connector	Female DB37 x 1 / Male 20-bit ribbon x 2			
Dimensions (L x W)	205 mm x 105 mm			
Power Consumption	300 mA @ +5 V			
Operating Temperature	0 ~ 60 °C			
Storage Temperature	-20 ~ 70 °C			
Humidity	5 ~ 85% RH, non-condensing			

1.4.2 PCI-1602/1602F, 1602F/1602FU

Model Name	PCI-1602	PCI-1602U	PCI-1602 F	PCI-1602 FU
Analog Input				
Channels	32 single-ended / 16 differential			
AD Converter	16-bit, 2 μs conversion time			
Sampling Rate	100 kS/s. max.		200 kS/s. max.	
FIFO Size	8192 samples			
Over voltage Protection	Continuous +/-35 Vp-p			
Input Impedance	10 MΩ/6 pF			
Trigger Modes	Software, Internal programmable pacer, External (5 V/TTL compatible)			
Data Transfer	Polling			
Accuracy	0.01 % of FSR ±1 LSB @ 25 °C, ± 10 V			
Zero Drift	+/- 2 ppm/°C of FSR			
Analog Output				
Channels	2			
Resolution	12-bit			
Accuracy	0.06% of FSR ± 1 LSB @ 25 °C, ± 10 V			
Output Range	Bipolar:+/5 V, +/-10 V			
Output Driving	+/- 5 mA			
Slew Rate	8.33 V/μs			
Output Impedance	0.1 Ω max.			
Operating Mode	Software			
Digital Input				
Channels	16			
Compatibility	5 V/TTL			
Input Voltage	Logic 0: 0.8 V max. Logic 1: 2.0 V min.			
Response Speed	2.0 MHz (Typical)			
Digital Output				
Channels	16			
Compatibility	5 V/TTL			
Output Voltage	Logic 0: 0.4 V max. Logic 1: 2.4 V min.			
Output Capability	Sink: 2.4 mA @ 0.8 V Source: 0.8 mA @ 2.0 V			
Response Speed	2.0 MHz (Typical)			
Timer/Counter				
Channels	3(Independent x 1/Internal pacer x 1/External pacer x 1)			
Resolution	16-bit			
Compatibility	5 V/TTL			
Input Frequency	10 MHz max.			
Reference Clock	Internal: 8 MHz			
General				
Bus Type	5 V PCI, 32-bit, 33 MHz	3.3 V/ 5 V Universal PCI, 32-bit, 33 MHz	5 V PCI, 32-bit, 33 MHz	3.3 V/ 5 V Universal PCI, 32-bit, 33 MHz
Data Bus	16-bit			
Card ID	No	Yes(4-bit)	No	Yes(4-bit)
I/O Connector	Female DB37 x 1 / Male 20-bit ribbon x 2			
Dimensions (L x W)	205 mm x 105 mm			
Power Consumption	350 mA @ +5 V			
Operating Temperature	0 ~ 60 °C			
Storage Temperature	-20 ~ 70 °C			
Humidity	5 ~ 85% RH, non-condensing			

1.4.3 PCI-1800/1802

Model Name	PCI-1802H PCI-1802L	PCI-1802HU PCI-1802LU	PCI-1800H PCI-1800L	PCI-1800HU PCI-1800LU
Analog Input				
Channels	32 single-ended / 16 differential		16 single-ended / 8 differential	
AD Converter	12-bit, 3 μs conversion time			
Sampling Rate	330 kS/s. max.			
FIFO Size	8192 samples		1024 samples	
Over voltage Protection	Continuous +/-35 Vp-p			
Input Impedance	10 MΩ/6 pF			
Trigger Modes	Software, Internal programmable pacer, External (5 V/TTL compatible)			
Data Transfer	Polling			
Accuracy	0.01 % of FSR ±1 LSB @ 25 °C, ± 10 V			
Zero Drift	+/- 2 ppm/°C of FSR			
Analog Output				
Channels	2			
Resolution	12-bit			
Accuracy	0.06% of FSR ± 1 LSB @ 25 °C, ± 10 V			
Output Range	Bipolar:+/5 V, +/-10 V			
Output Driving	+/- 5 mA			
Slew Rate	8.33 V/μs			
Output Impedance	0.1 Ω max.			
Operating Mode	Software			
Digital Input				
Channels	16			
Compatibility	5 V/TTL			
Input Voltage	Logic 0: 0.8 V max. / Logic 1: 2.0 V min.			
Response Speed	2.0 MHz (Typical)			
Digital Output				
Channels	16			
Compatibility	5 V/TTL			
Output Voltage	Logic 0: 0.4 V max. / Logic 1: 2.4 V min.			
Output Capability	Sink: 2.4 mA @ 0.8 V Source: 0.8 mA @ 2.0 V			
Response Speed	2.0 MHz (Typical)			
Timer/Counter				
Channels	3(Independent x 1/Internal pacer x 1/External pacer x 1)			
Resolution	16-bit			
Compatibility	5 V/TTL			
Input Frequency	10 MHz max.			
Reference Clock	Internal: 8 MHz			
General				
Bus Type	5 V PCI, 32-bit, 33 MHz	3.3 V/ 5 V Universal PCI, 32-bit, 33 MHz	5 V PCI, 32-bit, 33 MHz	3.3 V/ 5 V Universal PCI, 32-bit, 33 MHz
Data Bus	16-bit			
Card ID	No	Yes(4-bit)	No	Yes(4-bit)
I/O Connector	Female DB37 x 1 / Male 20-bit ribbon x 2			
Dimensions (L x W)	200 mm x 105 mm			
Power Consumption	300 mA @ +5 V			
Operating Temperature	0 ~ 60 °C			
Storage Temperature	-20 ~ 70 °C			
Humidity	5 ~ 85% RH, non-condensing			

1.4.4 Analog Input Range

Model	**PCI-1202 L /PCI-1202 LU (Low-Gain)**				
Gain	0.5	1	2	4	8
Bipolar(V)	+/- 10	+/- 5	+/- 2.5	+/- 1.25	+/- 0.625
Unipolar(V)	-	0 ~ 10	0 ~ 5	0 ~ 2.5	0 ~ 1.25
Sampling Rate Max.	110 kS/s				

Model	**PCI-1202 H / PCI-1202 HU (High-Gain)**							
Gain	0.5	1	5	10	50	100	500	1000
Bipolar(V)	+/- 10	+/- 5	+/- 1	+/- 0.5	+/- 0.1	+/- 0.05	+/- 0.01	+/- 0.005
Unipolar(V)	-	0 ~ 10	-	0 ~ 1	-	0 ~ 0.1	-	0 ~ 0.01
Sampling Rate Max.	44 kS/s				10 kS/s		1 kS/s	

Model	**PCI-1602/1602U**			
Gain	1	2	4	8
Bipolar(V)	+/- 10	+/- 5	+/- 2.5	+/- 1.25
Sampling Rate Max.	100 kS/s			

Model	**PCI-1602F/1602FU**			
Gain	1	2	4	8
Bipolar(V)	+/- 10	+/- 5	+/- 2.5	+/- 1.25
Sampling Rate Max.	200 kS/s			

Model	**PCI-1800 L / PCI-1802 L / PCI-1800 LU / PCI-1802 LU (Low-Gain)**				
Gain	0.5	1	2	4	8
Bipolar(V)	+/- 10	+/- 5	+/- 2.5	+/- 1.25	+/- 0.625
Unipolar(V)	-	0 ~ 10	0 ~ 5	0 ~ 2.5	0 ~ 1.25
Sampling Rate Max.	330 kS/s				

Model	**PCI-1800 H / PCI-1802 H / PCI-1800 HU / PCI-1802 HU (High-Gain)**							
Gain	0.5	1	5	10	50	100	500	1000
Bipolar(V)	+/- 10	+/- 5	+/- 1	+/- 0.5	+/- 0.1	+/- 0.05	+/- 0.01	+/- 0.005
Unipolar(V)	-	0 ~ 10	-	0 ~ 1	-	0 ~ 0.1	-	0 ~ 0.01
Sampling Rate Max.	44 kS/s				10 kS/s		1 kS/s	

- 12-bit ADC Input Voltages and Output Codes for PCI-1202/1800/1802 H/L/HU/LU

Analog Input	Digital Output Binary Code	Hex Code
	MSB LSB	
+9.995 V	1111 1111 1111	FFF
0 V	1000 0000 0000	800
-4.88 mv	0111 1111 1111	7FF
-10 V	0000 0000 0000	000

- 16-bit ADC Input Voltages and Output Codes for PCI-1602 /F/U/FU

Analog Input	Digital Output Binary Code	Hex Code
	MSB LSB	
+9.99 V	0111 1111 1111 1111	7FFF
+0 V	0000 0000 0000 0000	0000
-305 μV	1111 1111 1111 1111	FFFF
-10 V	1000 0000 0000 0000	8000

- 12- bit DAC output code for PCI-1202/1800/1802 H/L/HU/LU

Data Input	Analog Output
MSB LSB	
1111 1111 1111	+Vref (2047/2048)
1000 0000 0001	+Vref (1/2048)
1000 0000 0000	0 Volts
0111 1111 1111	-Vref (1/2048)
0000 0000 0000	-Vref (2048/2048)

1.4.5 A/D Trigger Methods

- **Trigger modes:**
  1. Internal software trigger
  2. Internal pacer trigger
  3. External trigger: pre-trigger, middle-trigger and post-trigger

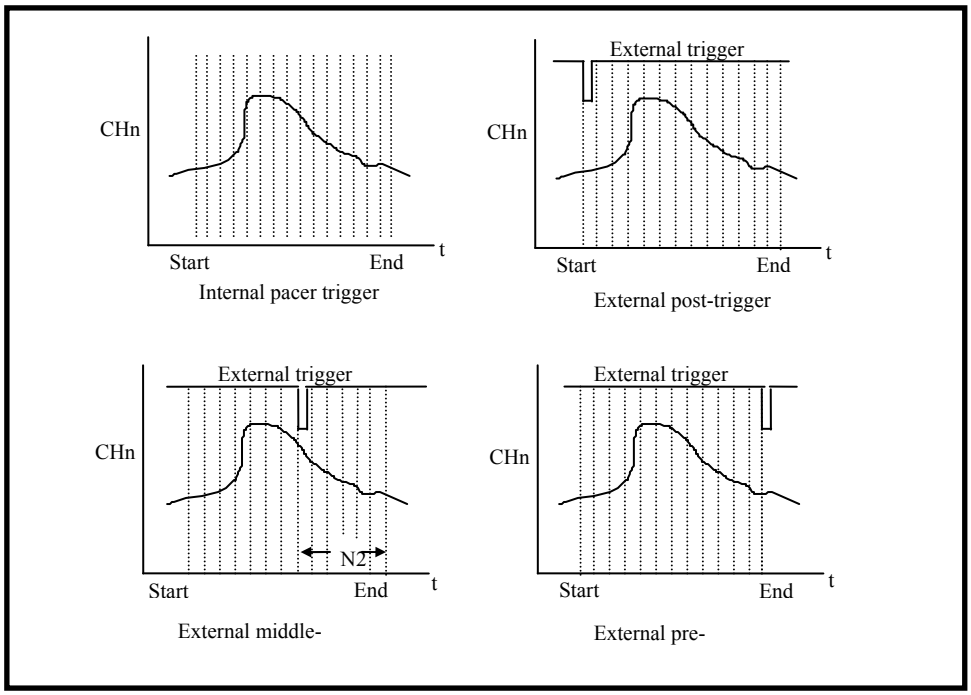


Figure 1-2 Trigger modes of PCI-1202/1602/1800/1802

1.5 Applications

- Signal analysis.
- FFT & frequency analysis.
- Transient analysis.
- Speech analysis.
- Temperature monitor.
- Production test.
- Process control.
- Vibration analysis.
- Energy management.
- Other industrial and laboratory measurement and control.

1.6 Product Check List

The shipping package includes the following items:

- One PCI-1202/1602/1800/1802 series multifunction card.
- One company CD
- One Quick Start Guide

It is recommended to read the Quick Start Guide first. All the necessary and essential information are given in the Quick Start Guide as follows:

1. Where to get the software driver, demo programs and other resources.
2. How to install software driver.
3. How to test the card.

Attention!

If any of these items are missing or damaged, please contact your local field agent. Save the shipping materials and carton in case you want to ship or store the product in the future.

2. Hardware Configuration

2.1 Board Layout

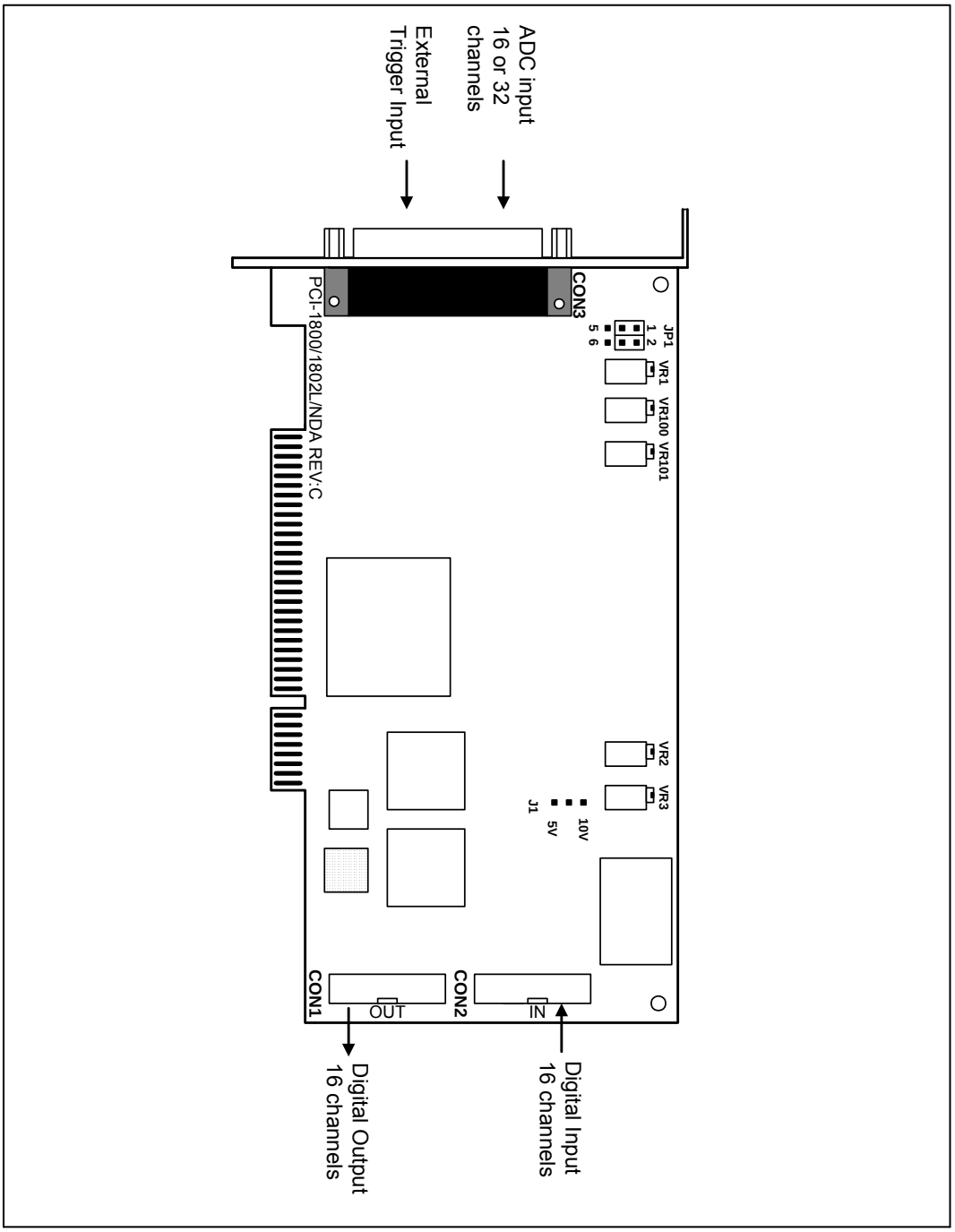


Figure 2-1 PCI-180X(H/L)/NDA board layout

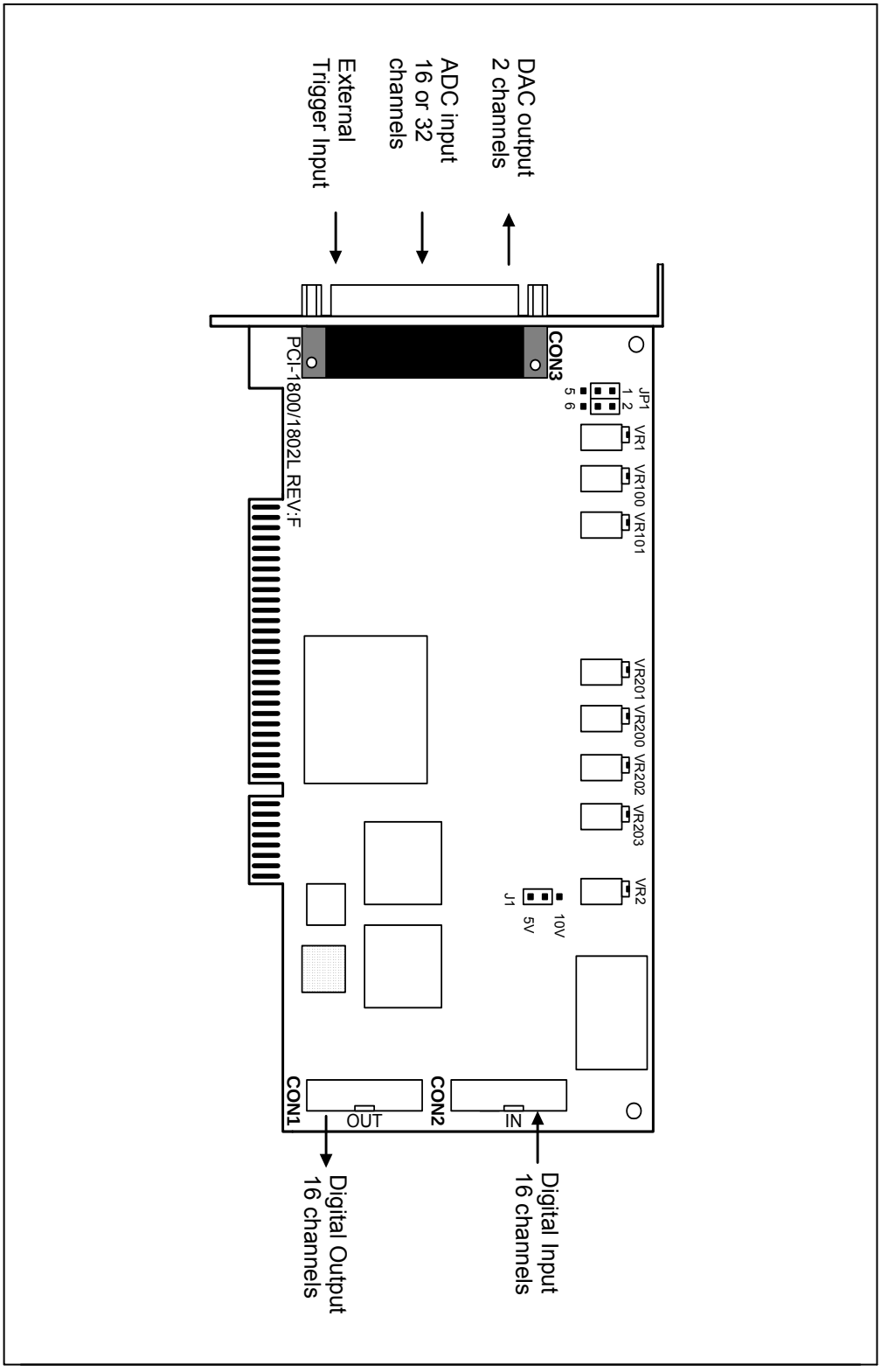


Figure 2-2 PCI-1202(H/L)/1800(H/L)/1802(H/L) board layout

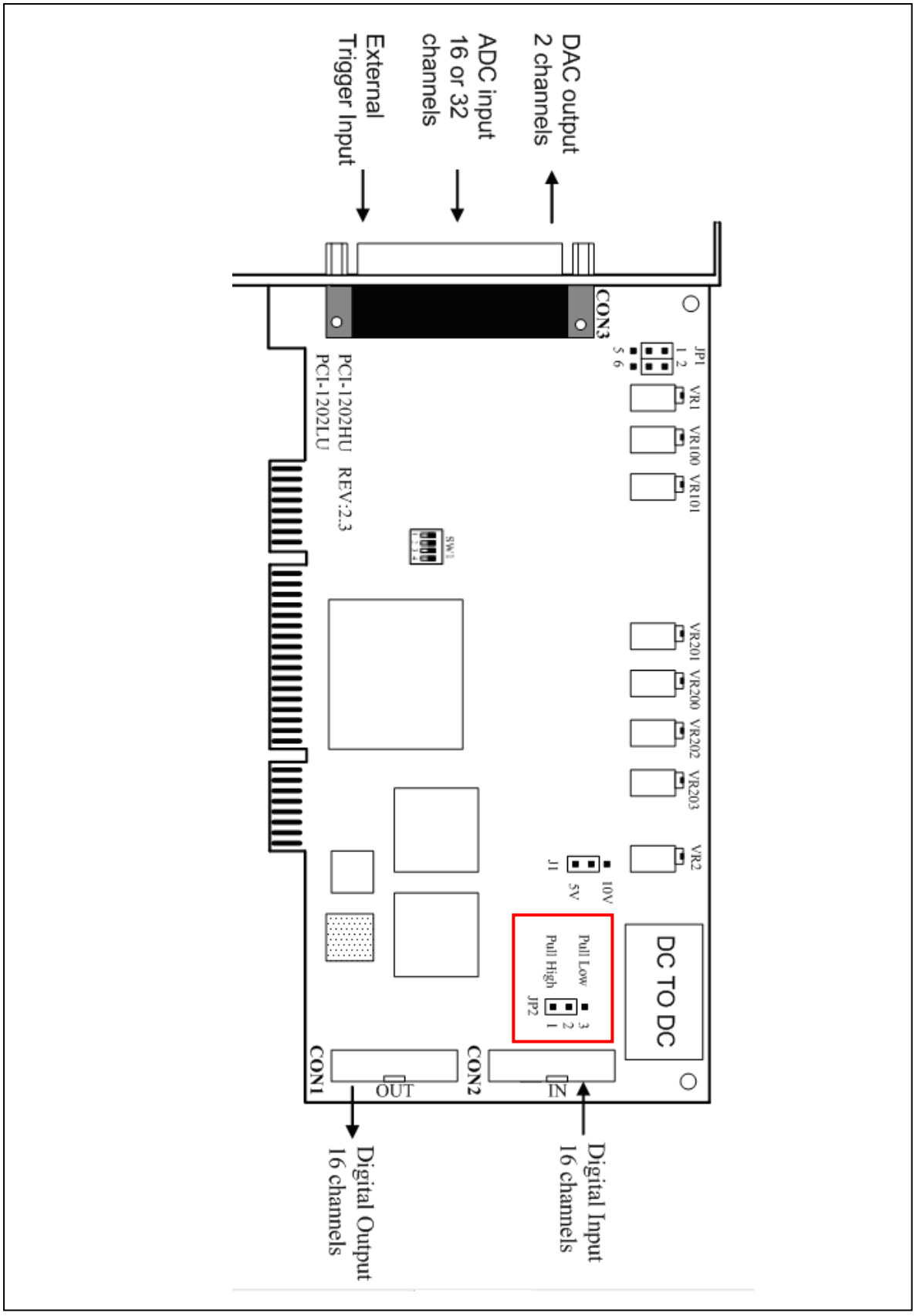


Figure 2-3. PCI-1202(HU/LU) board layout

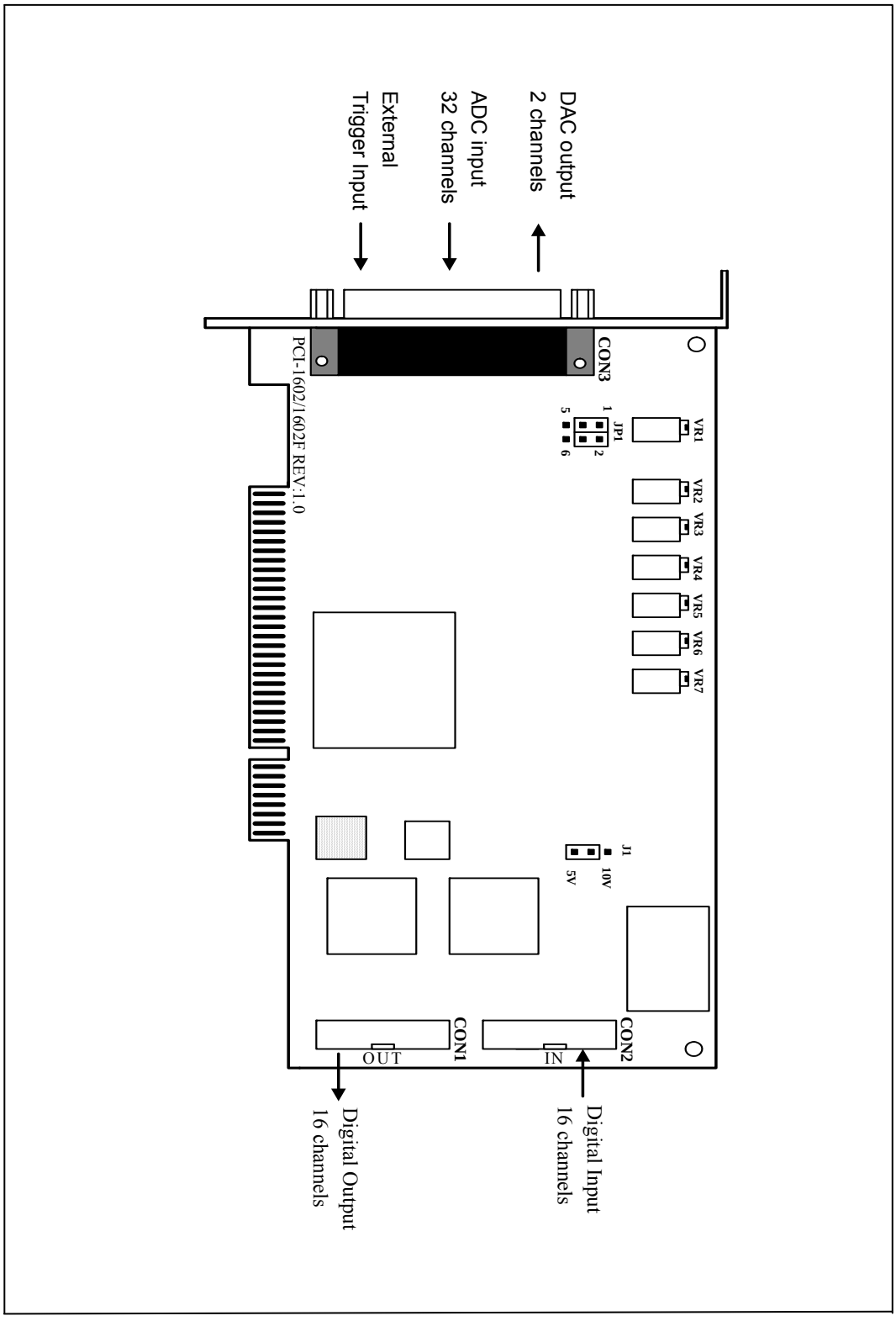


Figure 2-4 PCI-1602/1602F board layout

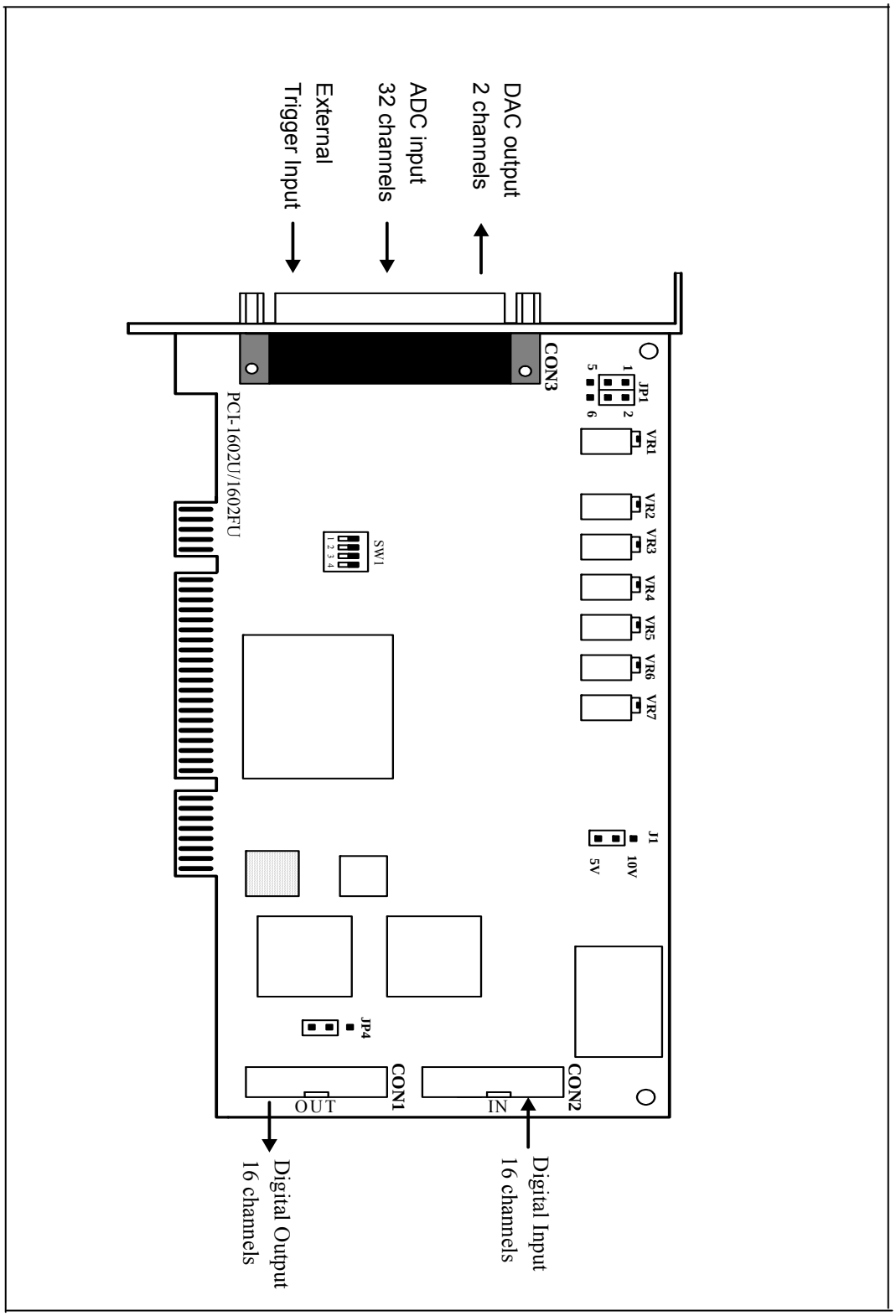
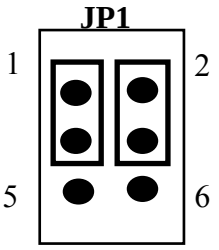


Figure 2-4 PCI-1602U/1602FU board layout

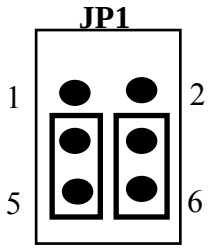
2.2 Jumper Setting

2.2.1 JP1 : A/D Input Type Selection

This jumper is used to select the analog input type. For single-ended inputs, connect pin1, 3 and pin2, 4. For differential inputs, pin3, 5 and pin4, 6 should be connected.



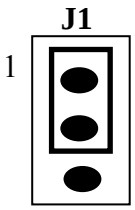
Single-Ended Inputs **(default)**



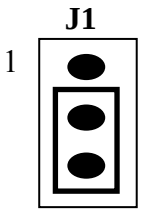
Differential Inputs

2.2.2 J1 : D/A Reference Voltage Selection

J1 is used to select the internal D/A output reference voltage. To select the ±10 V voltage output, the pin 1&2 should be connected. To select the ±5 V voltage output, the pin 2&3 should be connected.



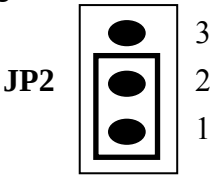
± 10 Voltage output (**default**)



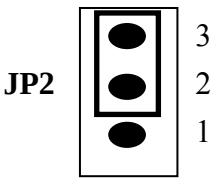
± 5 Voltage output

2.2.3 D/I Port Setting

This DI ports can be pull-high or pull-low that is selected by JP2. The configuration is given as following:



Pull High



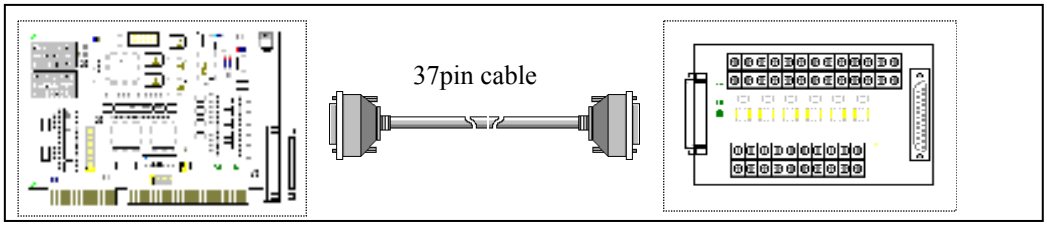
Pull Low

***This function only supports PCI-1202HU/LU,PCI-1602U/1602FU,PCI-1800HU/LU,PCI-1802HU/LU**

2.3 Daughter Boards

2.3.1 DB-1825

The DB-1825 is a daughter board designed for 32 channels AD cards such as ISO_AD32, PCI-1202/1602/1802 that can easy signal connection and measurement. Refer to Appendix A for "DB-1825 user manual".

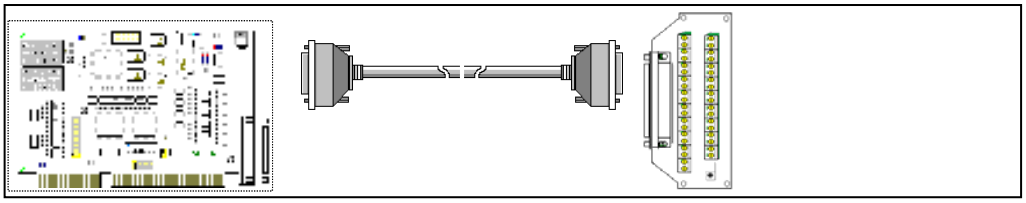


2.3.2 DB-8225

The DB-8225 provides a **on-board CJC**(Cold Junction Compensation) circuit for thermocouple measurement and **terminal block** for easy signal connection and measurement. The CJC is connected to A/D channel_0. The PCI-1800 can connect CON3 direct to DB-8225 through a 37-pin D-sub connector. Refer to "DB-8225 User Manual" for details.

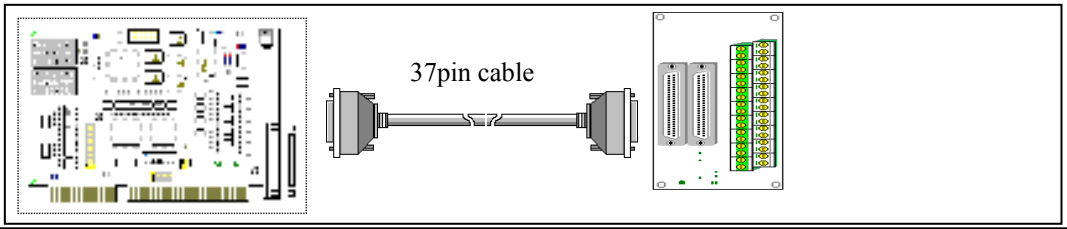
2.3.3 DB37

The DB-37 is a general purpose daughter board for D-sub 37 pins. It is designed for easy wire connection.



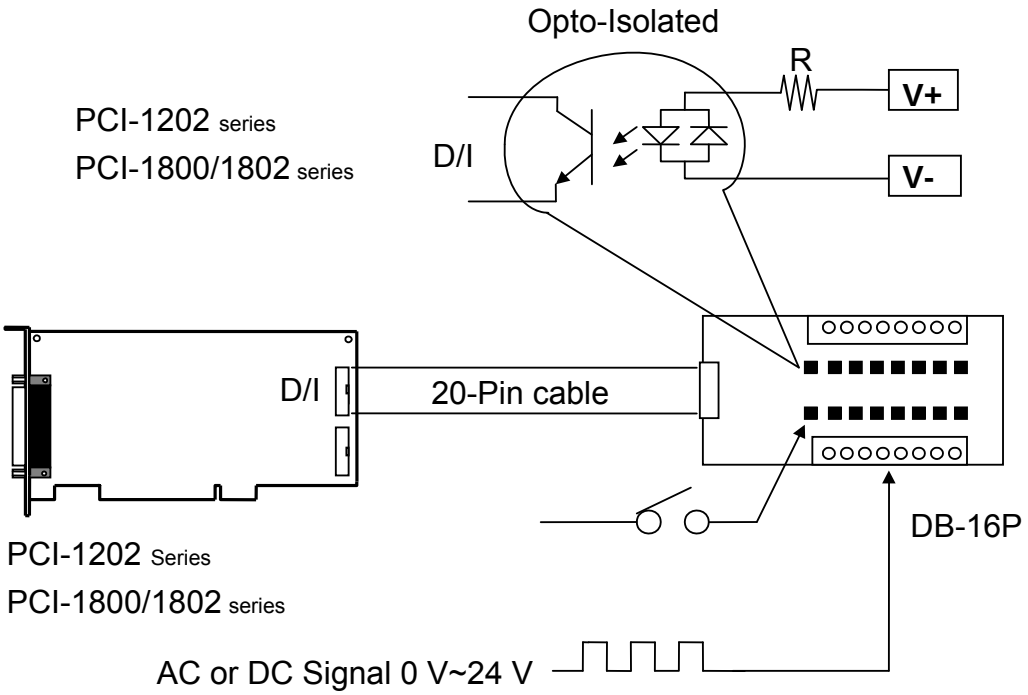
2.3.4 DN37

The DN-37 is a general purpose daughter board for DIN-Rail Mounting. It is designed for easy wire connection. It is DIN-Rail mounting.



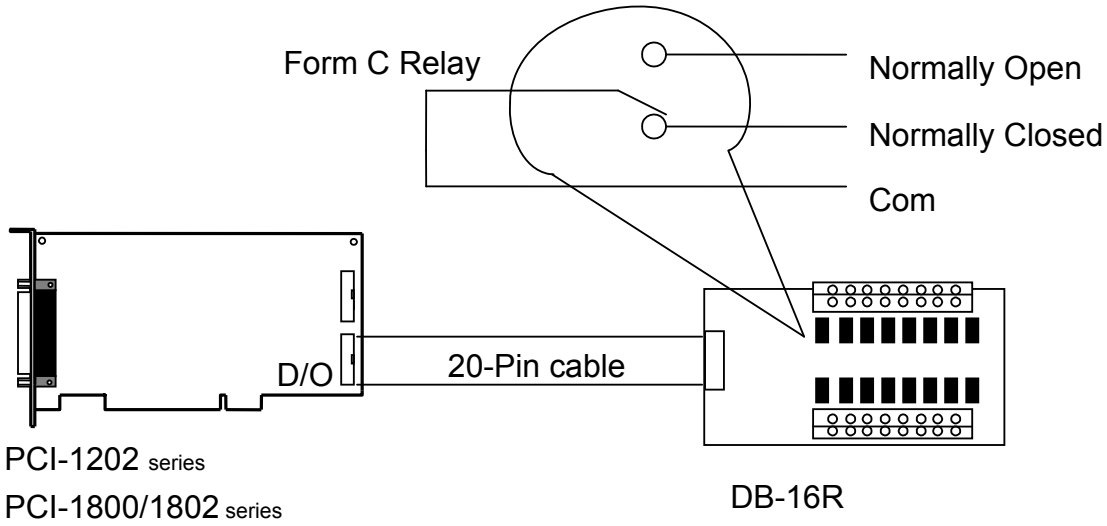
2.3.5 DB-16P Isolated Input Board

The DB-16P is a 16-channel isolated digital input daughter board. The optically isolated inputs of the DB-16P are consisted of are bi-directional optocoupler with resistor for current sensing. You can use the DB-16P to sense DC signal from TTL levels up to 24 V or use the DB-16P to sense a wide range of AC signals. You can use this board to isolate the computer from large common-mode voltage, ground loops and transient voltage spike that often occur in industrial environments.



2.3.6 DB-16R Relay Board

The DB-16R, 16-channel relay output board, consists of 16 Form C relays for efficient switching of load by programmed control. It is connector and functionally compatible with 785 series board but with industrial type terminal block. The relay is energized by applying 5 voltage signal to the appropriate relay channel on the 20-pin flat connector. There are 16 enunciator LEDs for each relay, light when their associated relay is activated. To avoid overloading your PC's power supply, this board provides a screw terminal for external power supply.

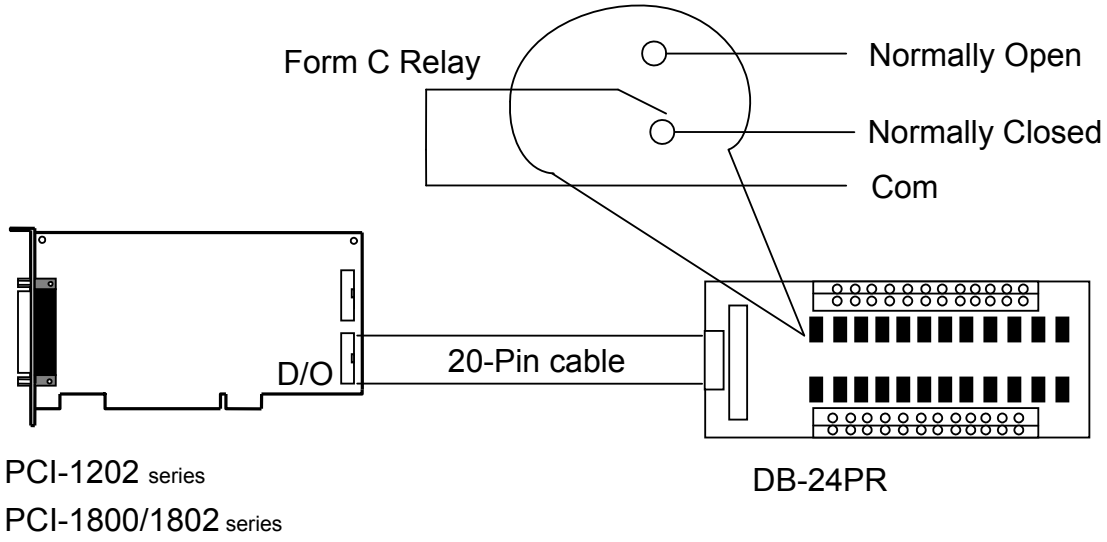


Note: Channel: 16 Form C Relay

Relay: Switching up to 0.5 A at 110 V_{AC} or 1 A at 24 V_{DC}

2.3.7 DB-24PR Power Relay Board

The DB-24PR, 24-channel power relay output board, consists of 8 Form C and 16 Form A electromechanical relays for efficient switching of load by programmed control. The contact of each relay can control a 5 A load at 250 VAC/30 VDC. The relay is energized by applying a 5 voltage signal to the appropriate relay channel on the 20-pin flat cable connector (only 16 relays are used) or 50-pin flat cable connector. (OPTO-22 compatible, for DIO-24 series.) Twenty - four enunciator LEDs, one for each relay, light when their associated relay is activated. To avoid overloading your PC's power supply, this board needs a +12 VDC or +24 VDC external power supply.



Note: 50-Pin connector (OPTO-22 compatible), for DIO-24, DIO-48, DIO-144
20-Pin connector for 16-ch D/O boards, A-82X, A-62X, DIO-64, ISO-DA16/DA8
Channel: 16 Form A Relay , 8 Form C Relay
Relay: Switching up to 5 A at 110 VAC / 5 A at 30 VDC

2.4 Analog Input Signal Connection

The PCI-1202/1602/1800/1802 series can measure single-ended or differential-type analog input signal. Some analog signals can be measured in both modes. However, some analog signals only can be measured in one or the other. The user must decide which mode is suitable for measurement.

In general, there are 4 different analog signal connection methods (shown from **Figure 2.4-1** to **Figure 2.4-5**). The connection in **Figure 2.4-1** is suitable for grounded analog input signals. The **Figure 2.4-3** connection is used to measure more channels than in **Figure 2.4-1**, but it is only suitable for analog signals that large than 1 V. The connection in **Figure 2.4-4** is suitable for thermocouple and the **Figure 2.4-5** connection is suitable for floating analog input signals.

Note: In Figure 2.4-4 the maximum common mode voltage between the analog input source and the AGND is 70Vp-p, so the user must take care that the input signal is under this specification first. If the common mode voltage is over 70Vp-p, the input multiplexer will be permanently damaged!

The simple way to select your input signal connection configuration is listed below.

1. **Grounded source input signal → select Figure 2.4-1**
2. **Thermocouple input signal → select Figure 2.4-4**
3. **Floating signal source l → select Figure 2.4-5**
4. **If Vin > 1 V, the gain<=10 and more channels are needed → select Figure 2.4-3**

If you are unsure of the characteristics of your input signal, follow these test step:

1. **Step1 : Try and record the measurement result of the Figure 2.4-1**
2. **Step2 : Try and record the measurement result of the Figure 2.4-5**
3. **Step3 : Try and record the measurement result of the Figure 2.4-3**
4. **Compare the three results and select the best one**

Figure 2.4-1 Differential input with grounded source (Right way)

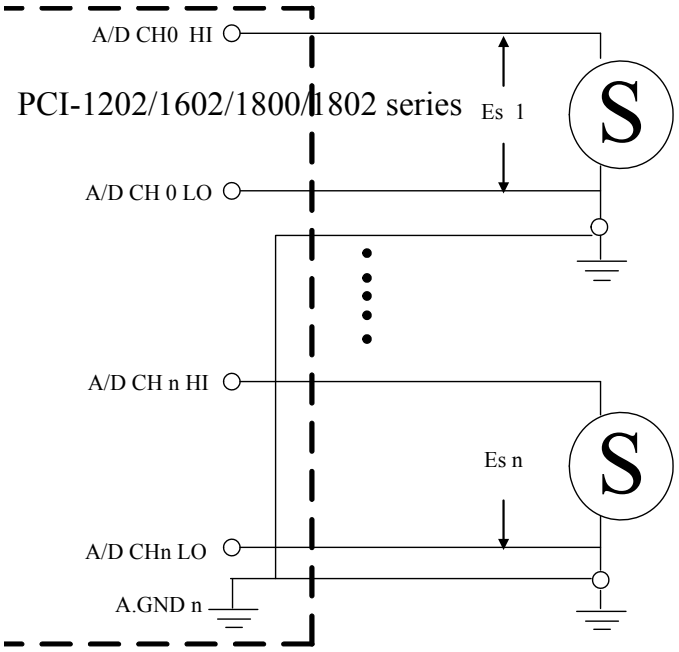


Figure 2.4-2 Ground loop input(Wrong way)

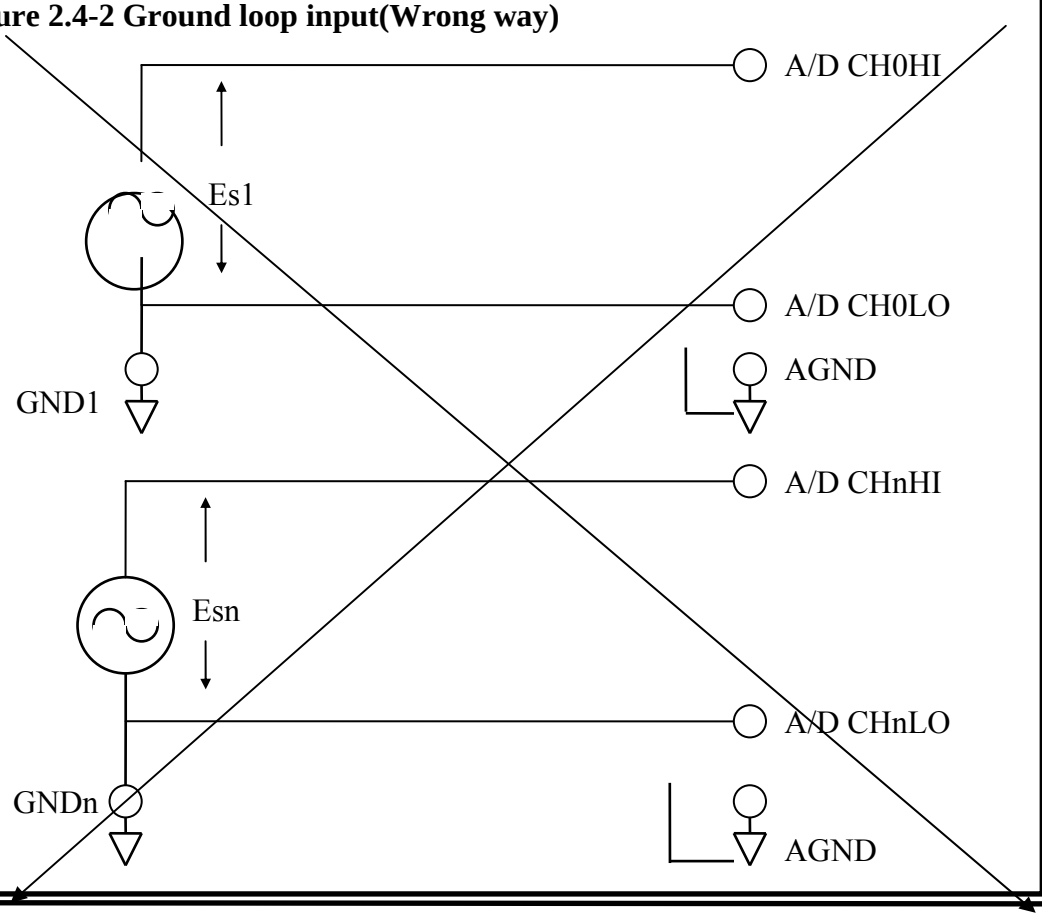


Figure 2.4-3 Single-ended input with floating signal source

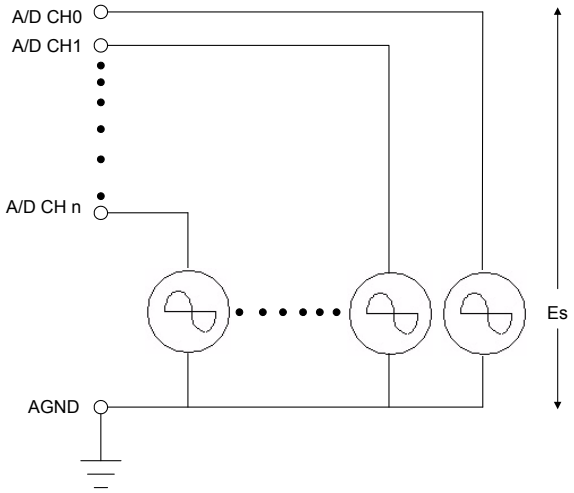
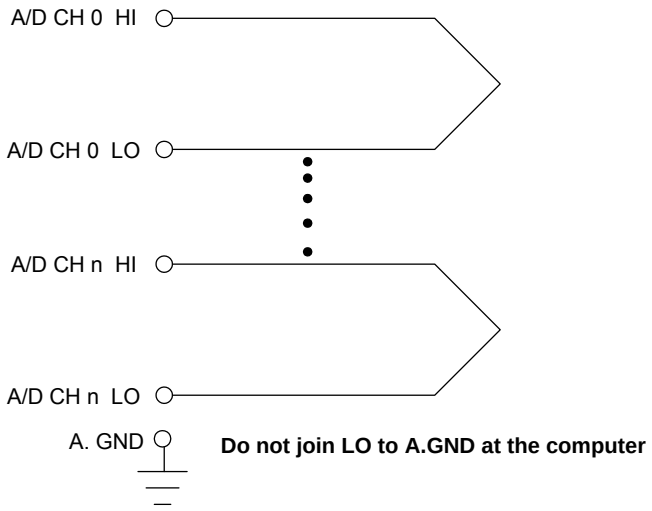


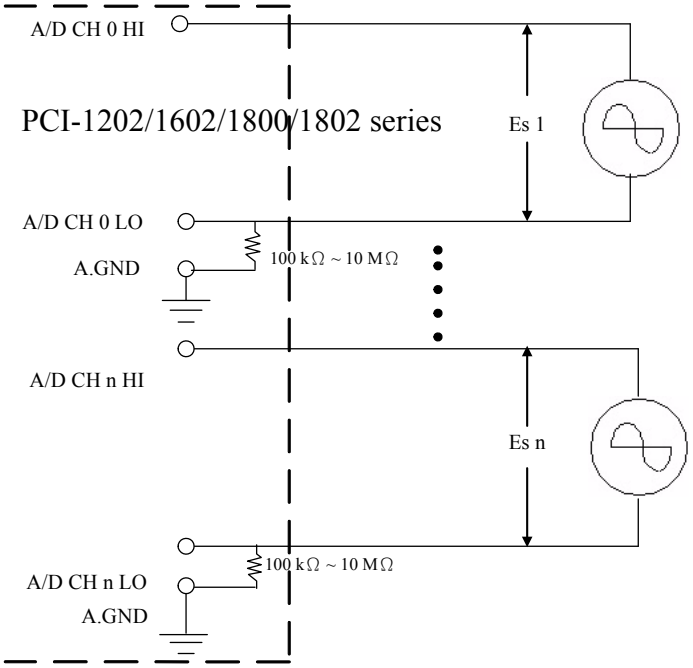
Figure 2.4-4 Differential input with floating thermocouple signal



Note: If the input signal is not thermocouple, the user should use an oscilloscope to measure common mode voltage of Vin before connecting to PCI-1202/1602/1800/1802. Don't use a voltage meter or multimeter.

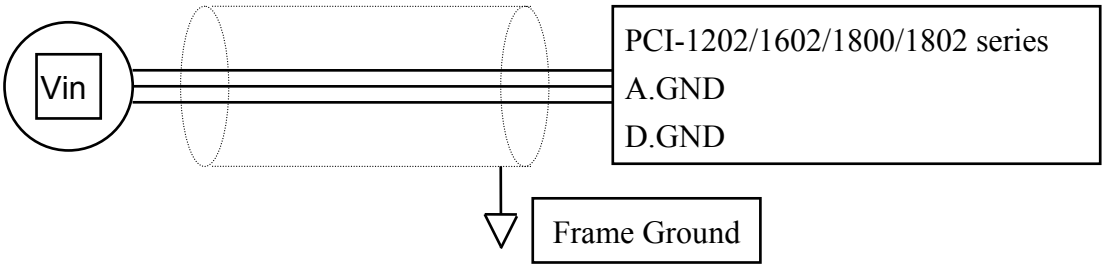
CAUTION: In **Figure 2.4-4**, the maximum common mode voltage between the analog input source and the AGND is 70Vp-p. Make sure that the input signal is under specification first! If the common mode voltage is over 70Vp-p, the input multiplexer will be permanently damaged.

Figure 2.4-5 Differential input with floating signal source



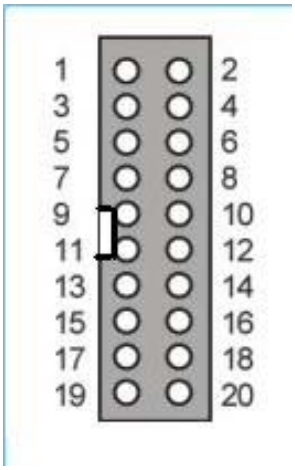
Signal Shielding

- Signal shielding connections in **Figure 2.4-1** to **Figure 2.4-5** are all the same
- Use a single-point connection to **frame ground (not A.GND or D.GND)**



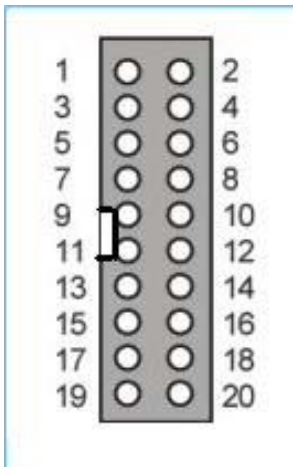
2.5 The Connectors

CON1: Pin assignments of the digital output connector.



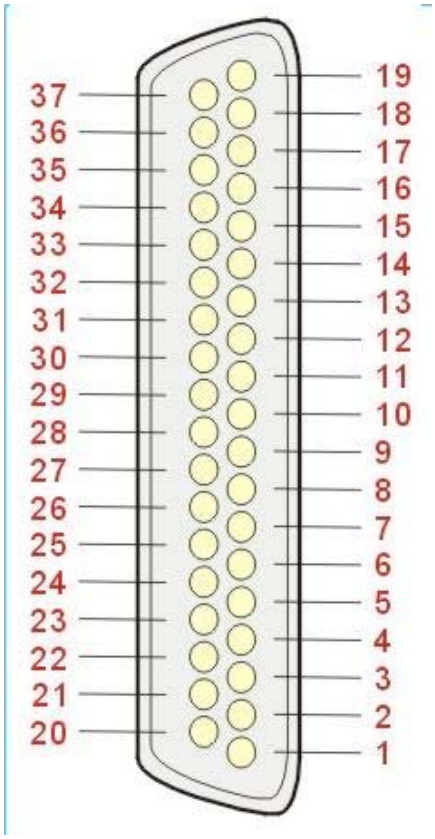
Pin	Name	Pin	Name
1	DO 0	2	DO 1
3	DO 2	4	DO 3
5	DO 4	6	DO 5
7	DO 6	8	DO 7
9	DO 8	10	DO 9
11	DO 10	12	DO 11
13	DO 12	14	DO 13
15	DO 14	16	DO 15
17	Digital GND	18	Digital GND
19	PCB +5V	20	PCB +12V

CON2: Pin assignments of digital input connector.



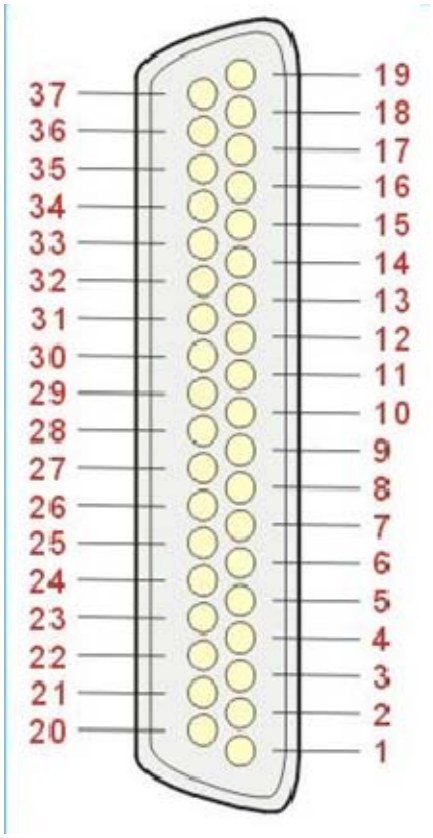
Pin	Name	Pin	Name
1	DI 0	2	DI 1
3	DI 2	4	DI 3
5	DI 4	6	DI 5
7	DI 6	8	DI 7
9	DI 8	10	DI 9
11	DI 10	12	DI 11
13	DI 12	14	DI 13
15	DI 14	16	DI 15
17	Digital GND	18	Digital GND
19	PCB +5V	20	PCB +12V

C0N3: pin assignments of single-ended/differential input.
(for PCI-1202L/1202H/1202LU/1202HU/1602/1602F/
1602U/1602FU/1802L/1802H/1802LU/1802HU)



Pin	Name	Pin	Name
1	AI 0/0+	20	AI 16/0-
2	AI 1/1+	21	AI 17/1-
3	AI 2/2+	22	AI 18/2-
4	AI 3/3+	23	AI 19/3-
5	AI 4/4+	24	AI 20/4-
6	AI 5/5+	25	AI 21/5-
7	AI 6/6+	26	AI 22/6-
8	AI 7/7+	27	AI 23/7-
9	AI 8/8+	28	AI 24/8-
10	AI 9/9+	29	AI 25/9-
11	AI 10/10+	30	AI 26/10-
12	AI 11/11+	31	AI 27/11-
13	AI 12/12+	32	AI 28/12-
14	AI 13/13+	33	AI 29/13-
15	AI 14/14+	34	AI 30/14-
16	AI 15/15+	35	AI 31/15-
17	A.GND	36	AO 1
18	AO 0	37	D.GND
19	EXT_Trigger		

CON3: pin assignments of single-ended/differential input.
(for PCI-1800L/1800H/1800LU/1800HU)



Pin	Name	Pin	Name
1	AI 0/0+	20	AI 8/0-
2	AI 1/1+	21	AI 9/1-
3	AI 2/2+	22	AI 10/2-
4	AI 3/3+	23	AI 11/3-
5	AI 4/4+	24	AI 12/4-
6	AI 5/5+	25	AI 13/5-
7	AI 6/6+	26	AI 14/6-
8	AI 7/7+	27	AI 15/7-
9	A.GND	28	A.GND
10	A.GND	29	A.GND
11	-	30	AO 0
12	-	31	-
13	PCB +12V	32	AO 1
14	A.GND	33	-
15	D.GND	34	-
16	-.	35	-
17	EXT_Trigger	36	-
18	-	37	-
19	PCB +5V		

- : Abbreviation of “ Not Connected “.

3. I/O Control Register

3.1 How to Find the I/O Address

The plug&play BIOS will assign a proper I/O address to every PCI-1800/1802 card in the power-on stage. The P180X_DriverInit(..) can detect how many PCI-1800/1802 cards in the system. Then the P180X_DriverInit(..) will detect the I/O address of these cards. The P180X_DriverInit(..) is implemented based on the PCI plug&play mechanism-2. The P180X_DriverInit(..) must be called once before all the other functions. The function P180X_DriverInit(..) is given as follows:

Detect how many PCI-1800/1802 cards in the system ?

Detect and save the I/O resource information of every PCI-1800/1802 card

The sample is given as follows:

```
wRetVal=P180X_DriverInit(&wBoards);     /* call P180X_DriverInit(..) first */
printf("Threr are %d P180X Cards in this PC\n",wBoards);

/* dump every P180X card's configuration address space */
printf("The Configuration Space -> Timer Control DIO AD/DA \n");
for (i=0; i<wBoards; i++)
  {
  printf("Card %02d: %04xH %04xH %04xH %04xH\n", i,wConfigSpace[i][0],
       wConfigSpace[i][1], wConfigSpace[i][2],wConfigSpace[i][3]);
  }

/* The P180X_ActiveBoard() function must be used to active a board, */
/* then all operation will take effect to the active board. */
printf("Now Active First P180X Card...\n");
P180X_ActiveBoard( 0 );
```

- **P1202_DriverInit(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_DriverInit(…) is designed for PCI-1602/F/U/FU**

3.2 The Assignment of I/O Address

The plug&play BIOS will assign the proper I/O address to PCI-1202/1602/1800/1802. If there is only one PCI-1202/1602/1800/1802, the user can identify the board_0. If there are two PCI-1202/1602/1800/1802 cards in the system, the user will be very difficult to identify which board is board_0. The software driver can support 16 boards max. Therefore the user can install 16 boards in one PC system.

The simplest way to find the board number is to use DEMO15.EXE given in DOS demo program. This demo program will send to D/O and read back from D/I. If the user installs a 20-pin flat cable between CON1 & CON2, the value read from D/I will be the same as D/O. The operation steps are given as follows:

1. Remove all 20-pin flat cable between CON1 and CON2
2. Install all PCI-1202/1602/1800/1802 cards into the PC system
3. Power-on and run DEMO15.EXE
4. Now all D/I value will be different from D/O value
5. Install a 20-pin flat cable into CON1 & CON2 of any PCI-1202/1602/1800/1802 card
6. There will be one card' s D/I value = D/O value, the card number is also shown in screen

Therefore the user can find the card number very easy if he install a 20-pin flat cable into PCI-1202/1602/1800/1802 one-by-one.

3.3 The I/O Address Map

The plug&play BIOS will assign proper I/O address to each PCI-1202/1602/1800/1802 very well. There are five BAR of I/O address used by this card and each section can be assigned to an unused I/O space. The hardware I/O ports are described as follows:

BAR	Offset	Name	Operation	Access
0	0h	PCI controller add-on mail box	W	32-bit
	38h	PCI interrupt control register	R/W	32-bit
	3Ch (or 3Eh, 3Fh)	On board NV-RAM access control register	R/W	32-bit (8-bit)
1	00h	8254 timer0	R/W	8/16/32-bit
	04h	8254 timer1	R/W	8/16/32-bit
	08h	8254 timer2	R/W	8/16/32-bit
	0Ch	8254 control	W	8/16/32-bit
2	00h	Control register	W	16/32-bit
	00h	Status register	R	8/16/32-bit
	04h	A/D software trigger	W	8/16/32-bit
3	00h	DI port	R	16-bit
	00h	DO port	W	16-bit
	04h	Read Card ID	R	4-bit
4	00h	A/D data port	R	16-bit
	00h	D/A channel 1.	W	16-bit
	04h	D/A channel 2.	W	16-bit

The driver name of these address are given as follows:

BAR1 : wAddrTimer	→ save in wConfigSpace[Board][0]
BAR2 : wAddrCtrl	→ save in wConfigSpace[Board][1]
BAR3 : wAddrDio	→ save in wConfigSpace[Board][2]
BAR4 : wAddrAdda	→ save in wConfigSpace[Board][3]

3.5 BAR 1: Timer Control

The timer-0 is used as the internal A/D pacer trigger. The timer-1 is designed for the A/D pacer trigger in the external trigger mode. The timer-2 is used as the machine independent timer. **The timer-2 is very important for settling time delay.** Refer to Intel's "Microsystem Components Handbook" for 8254 programming. The block diagram of the 8254 timer is given as follows:

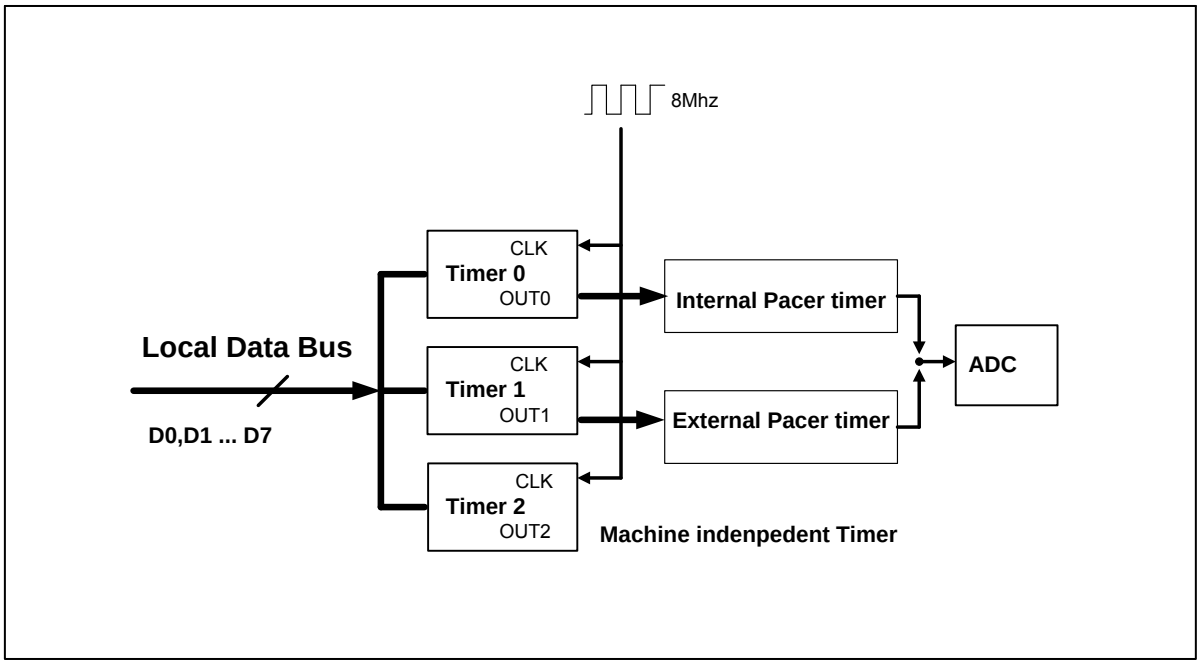


Figure 3-1: The block diagram of PCI-1202/1602/1800/1802 8254 timer.

The I/O address of 8254 timer is given as follows:

- I/O address of timer/counter_0 = wAddrTimer+0*4
- I/O address of timer/counter_1 = wAddrTimer+1*4
- I/O address of timer/counter_2 = wAddrTimer+2*4
- I/O address of control register = wAddrTimer+3*4

// timer0 → for pacer trigger

```
void enable_timer0(WORD divv)  // for internal pacer trigger
{
   outport((WORD)(wAddrTimer+3*4), 0x34);   /* enable pacer timer_0 */
   outport((WORD)(wAddrTimer+0*4), (WORD)(divv & 0xff));
   outport((WORD)(wAddrTimer+0*4), (WORD)((divv>>8) & 0xff));
}

void disable_timer0(void)
{
   outport((WORD)(wAddrTimer+3*4), 0x34);   /* disable pacer timer_0 */
   outport((WORD)(wAddrTimer+0*4), 0x01);
   outport((WORD)(wAddrTimer+0*4), 0x00);
}
```

// timer1 → for external trigger

```
void enable_timer1(WORD divv)              /* for external trigger pacer timer */
{
   outport((WORD)(wAddrTimer+3*4), 0x74);  /* enable pacer timer_1 */
   outport((WORD)(wAddrTimer+1*4), (WORD)(divv & 0xff));
   outport((WORD)(wAddrTimer+1*4), (WORD)((divv>>8) & 0xff));
}

void disable_timer1(void)
{
   outport((WORD)(wAddrTimer+3*4), 0x74);    /* disable timer_1 */
   outport((WORD)(wAddrTimer+1*4), 0x01);
   outport((WORD)(wAddrTimer+1*4), 0x00);
}
```

// timer2 → for Machine Independent Timer

```
/* address of timer 2    = wAddrTimer+2*4
   address of ctrl       = wAddrTimer+3*4
   input clock           = 8 M
   down count 8 time     = 1 μs
   down count 65536/8 = 8192 μs --> max 8191 μs
*/
WORD  P180X_DelayUs(WORD wDelayUs)
{
    WORD wDownCount,wLow,wHigh,wVal;
    double fTimeOut;

    if (wDelayUs>=8191) return(InvalidateDelay);
    wDownCount=wDelayUs*8;
    wLow=wDownCount&0xff;
    wHigh=(wDownCount>>8)&0xff;
    outport((wAddrTimer+3*4), 0xb0);          /* timer_2 mode_0 0xb0 */
    outport((wAddrTimer+2*4), wLow);
    outport((wAddrTimer+2*4), wHigh);

    fTimeOut=1.0; // wait 1 to stop
    for (;;)
    {
        wVal=inport(wAddrCtrl)&0x01;
        if (wVal!=0) return(NoError);          /* if the timer is up, this bit will be 1 */
        fTimeOut+=1.0;
        if (fTimeOut>6553500.0)
        return(DelayTimeOut);
    }
}
```

- **P1202_DelayUs(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_DelayUs(…) is designed for PCI-1602 and PCI-1602F**

3.6 BAR 2: Control Register

● I/O address of control register	= wAddrCtrl + 0*4
● I/O address of status register	= wAddrCtrl + 0*4
● I/O address of trigger register	= wAddrCtrl + 1*4

The flow path of analog input signal is given as follows:

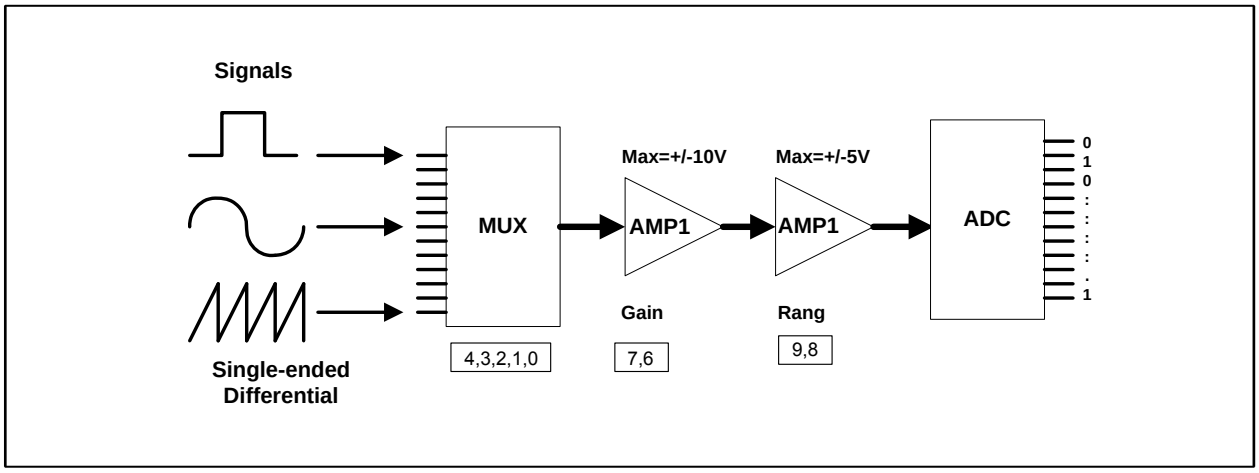


Figure 3-2: The flow path of Analog input signal.

3.6.1 The control register

The format of the control register is given as follows:

B15	B14	B13	B12 ~ B10	B9, B8	B7, B6	B5	B4 ~ B0

- B4~ B0: A/D channel select
- B7, B6: A/D gain control.
- B9, B8: A/D input range control.
- B12~B10: external trigger control.
- B13: handshake control to MagicScan controller.
- B15: clear FIFO.
- B5, B14: reserved

3.6.1.1 Bit4~ Bit0: A/D channel select

A/D channel	B4	B3	B2	B1	B0	
0	0	0	0	0	0	1800/1202/1602/1802
15	0	1	1	1	1	1800/1202/1602/1802
16	1	0	0	0	0	1202/1602/1802
31	1	1	1	1	1	1202/1602/1802

3.6.1.2 Gain control

[B7, B6]	PCI-1XXX L/LU	PCI-1XXX H/HU
[0, 0]	PGA=1	PGA=1
[0, 1]	PGA=2	PGA=10
[1, 0]	PGA=4	PGA=100
[1, 1]	PGA=8	PGA=1000

3.6.1.3 Input range control

[B9, B8]	Unipolar/Biploar	Gain	Example
[0, 0]	Biploar	PGA=1	-5 V ~ +5 V
[1, 0]	Unipolar	PGA=1	0 V ~ +5 V
[0, 1]	Biploar	PGA=1/2	-10 V ~ + 10 V
[1, 1]	Unipolar	PGA=1/2	0 V ~ + 10 V

3.6.1.4 Configuration Table

The configuration table of PCI-1202/1800/1802 L/LU is given as follows:

Bipolar/Unipolar	Input Signal Range	Gain	Settling Time	[B9,B8,B7,B6]
Bipolar	+/- 5 V	1	3 μs	0000
Bipolar	+/- 2.5 V	2	3 μs	0001
Bipolar	+/- 1.25 V	4	3 μs	0010
Bipolar	+/- 0.625 V	8	3 μs	0011
Bipolar	+/- 10 V	0.5	3 μs	0100
Bipolar	+/- 5 V	1	3 μs	0101
Bipolar	+/- 2.5 V	2	3 μs	0110
Bipolar	+/- 1.25 V	4	3 μs	0111
Unipolar	0 V ~ 10 V	1	3 μs	1000
Unipolar	0 V ~ 5 V	2	3 μs	1001
Unipolar	0 V ~ 2.5 V	4	3 μs	1010
Unipolar	0 V ~ 1.25 V	8	3 μs	1011

The configuration table of PCI-1202/1800/1802 H/HU is given as follows:

Bipolar/Unipolar	Input Signal Range	Gain	Settling Time	[B9,B8,B7,B6]
Bipolar	+/- 5 V	1	23 μs	0000
Bipolar	+/- 0.5 V	10	28 μs	0001
Bipolar	+/- 0.05 V	100	140 μs	0010
Bipolar	+/- 0.005 V	1000	1300 μs	0011
Bipolar	+/- 10 V	0.5	23 μs	0100
Bipolar	+/- 1 V	5	28 μs	0101
Bipolar	+/- 0.1 V	50	140 μs	0110
Bipolar	+/- 0.01 V	500	1300 μs	0111
Unipolar	0 V ~ 10 V	1	23 μs	1000
Unipolar	0 V ~ 1 V	10	28 μs	1001
Unipolar	0 V ~ 0.1 V	100	140 μs	1010
Unipolar	0 V ~ 0.01 V	1000	1300 μs	1011

3.6.1.5 Set Channel Configuration

The demo program to set the channel/gain is given as follows:

```
WORD P180X_SetChannelConfig(WORD wAdChannel, WORD wAdConfig)
{
WORD wConfig,wChannel;

wChannel   = (wAdChannel&0x1f);
wSysConfig = (wAdConfig&0x1f);     // store for P1802_AdPolling
wConfig    = (wAdConfig&0x0f);
wConfig    = wConfig << 6;
wConfig  += wChannel;

/*  Bit15=1 --> no reset FIFO
   Bit14=?
   Bit13=?
   Bit12=0 --> command [001] --> set channel&Config command
   Bit11=0
   Bit10=1
   Bit9 =B --> Range control code [BB] --> unipolar/bipolar & divided by 2
   Bit8 =B
   Bit7 =B --> gain control code [BB]  --> 1/10/100/1000 or 1/2/4/8
   Bit6 =B
   Bit5 =?
   Bit4-Bit0 --> channel number */
   wConfig+= 0x8400;      // this is set channel config command
   return(pic_control(wConfig));
}
```

- **P1202_SetChannelConfig(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_SetChannelConfig(…) is designed for PCI-1602 and PCI-1602F**

3.6.1.6 Calculate the A/D Value

The demo program to calculate the real A/D value is given as follows:

```
double ComputeRealValue(DWORD dwAdConfig, DWORD dwAdHex)
{
WORD wZERO;
double dfMAX, dfVal;

switch (dwAdConfig)
{    case 0 : wZERO=2048; dfMAX=5.0;    break;
     case 1 : wZERO=2048; dfMAX=2.5;    break;
     case 2 : wZERO=2048; dfMAX=1.25;   break;
     case 3 : wZERO=2048; dfMAX=0.625;  break;
     case 4 : wZERO=2048; dfMAX=10.0;   break;
     case 5 : wZERO=2048; dfMAX=5.0;    break;
     case 6 : wZERO=2048; dfMAX=2.5;    break;
     case 7 : wZERO=2048; dfMAX=1.25;   break ;
     case 8 : wZERO=    0; dfMAX=10.0/2.0;    break;
     case 9 : wZERO=    0; dfMAX=5.0/2.0;     break;
     case 10: wZERO=    0; dfMAX=2.5/2.0;     break;
     case 11: wZERO=    0; dfMAX=1.25/2.0;    break;
     case 0x10 : wZERO=2048; dfMAX=5.0;     break;
     case 0x11 : wZERO=2048; dfMAX=0.5;     break;
     case 0x12 : wZERO=2048; dfMAX=0.05;    break;
     case 0x13 : wZERO=2048; dfMAX=0.005;   break;
     case 0x14 : wZERO=2048; dfMAX=10.0;    break;
     case 0x15 : wZERO=2048; dfMAX=1.0;     break ;
     case 0x16 : wZERO=2048; dfMAX=0.1;     break;
     case 0x17 : wZERO=2048; dfMAX=0.01;    break;
     case 0x18 : wZERO=  0; dfMAX=10.0/2.0; break ;
     case 0x19 : wZERO=  0; dfMAX=1.0/2.0;  break;
     case 0x1A : wZERO=  0; dfMAX=0.1/2.0;  break;
     case 0x1B : wZERO=  0; dfMAX=0.01/2.0; break;
     default: return(ConfigCodeError); }
dfVal=(((double)(wAdHex)-wZERO)/2048.0)*dfMAX;
return(dfVal);
}
```

For PCI-1202/1800/1802L

Note: B4=0 is used to identify PGL

For PCI-1202/1800/1802H

Note: B4=1 is used to identify PGH

3.6.1.7 Command Sets of MagicScan Controller

The command sets of MagicScan controller are given as follows:

Command	[B12~B10]	Descriptions
Reset	[0 0 0]	Reset the MagicScan controller. **The software driver must send this command once after power-on.**
Set channel/gain	[0 0 1]	Set the channel/gain value of the **fixed-channel mode.** It will not affect the scan queue.
Add to scan queue	[1 0 0]	Add the channel/gain code to the scan queue. (At most 48 scan-channels can be stored in the MagicScan controller.)
Start MagicScan	[1 0 1]	Start the MagicScan controller
Stop MagicScan	[0 1 0]	Stop the MagicScan controller.
Get ODM number	[1 1 0]	Get the ODM number of the PCI-1202/1602/1800/1802.

The demo program to reset the MagicScan controller is given as follows:

```
wVal=pic_control(0xC000);                /* 11?0 00?? ???? ???? cmd_000=reset */
```

The demo program to clear MagicScan queue is given as follows:

```
WORD  P180X_ClearScan(void)
{
WORD i;
for(i=0; i<32; i++)  wMagicScanSave[i]=0;
disable_timer0();
disable_timer1();
return(pic_control(0xC000));             /* 11?0 00?? ???? ???? cmd_000=reset */
}
```

- **P1202_ClearScan(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_ClearScan(…) is designed for PCI-1602 and PCI-1602F**

The demo program of send command to MagicScan control is given as follows:

```
WORD pic_control(WORD i)
{
WORD j;

if  ((inport(wAddrCtrl)&0x04)==0)
   {
   outport(wAddrCtrl,0xffff);                    /* send a recovery to PIC */
   }

j=0;
while ((inport(wAddrCtrl)&0x04)==0)
    {
    j++;
    if  (j>65530) return(AdControllerError);  /* time out */
    }

i = i & 0xDFFF;                                    /* set pic low !!  */
outport(wAddrCtrl,i);

j=0;
while ((inport(wAddrCtrl)&0x04)!=0)
    {
    j++;
    if (j>65530) return(AdControllerError);  /* time out */
    }

outport(wAddrCtrl,(WORD)(i | 0x2000));  /* set pic high !! */
j=0;
while ((inport(wAddrCtrl)&0x04)==0)
    {
    j++;
    if (j>65530) return(AdControllerError);  /* time out */
    }
return(NoError);
}
```

The demo program to set the channel/gain is given as follows:

```
WORD P180X_SetChannelConfig(WORD wAdChannel, WORD wAdConfig)
{
WORD wConfig,wChannel;

wChannel   = (wAdChannel&0x1f);
wSysConfig = (wAdConfig&0x1f);     // store for P1802_AdPolling
wConfig    = (wAdConfig&0x0f);
wConfig    = wConfig << 6;
wConfig  += wChannel;

/*  Bit15=1 --> no reset FIFO
   Bit14=?
   Bit13=?
   Bit12=0 --> command [001] --> set channel&Config command
   Bit11=0
   Bit10=1
   Bit9 =B --> Range control code [BB] --> unipolar/bipolar & divided by 2
   Bit8 =B
   Bit7 =B --> gain control code [BB]  --> 1/10/100/1000 or 1/2/4/8
   Bit6 =B
   Bit5 =?
   Bit4-Bit0 --> channel number */
   wConfig+= 0x8400;      // this is set channel config command
   return(pic_control(wConfig));
}
```

- **P1202_SetChannelConfig(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_SetChannelConfig(…) is designed for PCI-1602 and PCI-1602F**

The demo program to add to MagicScan queue is given as follows:

```
WORD P180X_AddToScan(WORD wAdChannel, WORD wAdConfig, WORD
wAverage, WORD wLowAlarm, WORD wHighAlarm, WORD wAlarmType)
{WORD wConfig,wChannel,wRetVal;

if (wAlarmType>=5) return(AlarmTypeError);
wMagicLowAlarm[wMP]=wLowAlarm;
wMagicHighAlarm[wMP]=wHighAlarm;
wMagicAlarmType[wMP]=wAlarmType;
wChannel   = wAdChannel&0x1f;
wMagicChannel[wMP]=wChannel;
wSysConfig = wAdConfig&0x1f;        /* Store for P180X_AdPolling */
wMagicConfig[wMP]=wSysConfig;
wMagicAve[wMP]=wAverage;
wConfig    = wAdConfig&0x0f;
wConfig    = wConfig << 6;
wConfig   += wChannel;

/*  Bit15=1 --> no reset FIFO
    Bit14=1
    Bit13=?
    Bit12=1 --> command [100] --> add_to_scan command
    Bit11=0
    Bit10=0
    Bit9 =B --> Range control code [BB] --> unipolar/bipolar & divided by 2
    Bit8 =B
    Bit7 =B --> gain control code [BB]  --> 1/10/100/1000 or 1/2/4/8
    Bit6 =B
    Bit5 =?
    Bit4-Bit0 --> channel number  */
wConfig+= 0xD000;                   /* this is add_to_scan_queue command */
wRetVal=pic_control(wConfig);
if (wRetVal!=0) return(wRetVal);
return(NoError);
}
```

- **P1202_AddToScan(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_AddToScan(…) is designed for PCI-1602 and PCI-1602F**

The demo program to start MagicScan operation is given as follows:

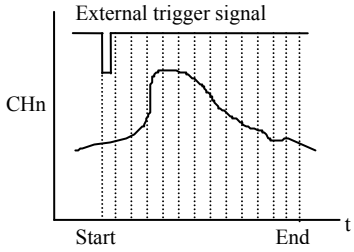
```
WORD  P180X_StartScan(WORD wSampleRate, WORD wNum)
{
WORD wVal;
WORD wRetVal;

wMagicNum=wNum;
disable_timer0();                    /* Disable pacer timer first */
                                     /* start MagicScan controller */
wRetVal=pic_control(0xD400);   /* 11?1 01?? ???? ???? cmd_101=start scan */
if (wRetVal!=0) return(wVal);

                                     /*  Clear FIFO to clear all data */
outport(wAddrCtrl,0x2000);        /* Bit15=0=clear FIFO, Bit13=1=not PIC cmd  */
outport(wAddrCtrl,0xA000);        /* Bit15=1=no reset FIFO, BIT13=1=not PIC cmd */

enable_timer0(wSampleRate);     /* Enable pacer timer, sampling rate=8 M/dwSample */
magic_scan();                      /* Call MagicScan subroutine(DOS) or thread(Windows) */
return(NoError);
}
```

- **P1202_StartScan(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_StartScan(…) is designed for PCI-1602 and PCI-1602F**

3.6.1.8 External Trigger Control

The operation steps of **post-trigger** are given as follows:

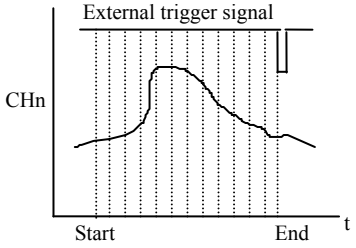
Step 1: Disable all external trigger
Step 2: Set the pacer rate of timer-1
Step 3: Clear FIFO & disable timer-1
Step4: Wait until external trigger signal to enable timer-1
Step 5: Fetch N data(N=End-Start)
Step 6: Stop all timer



External post-trigger timing

The operation steps of **pre-trigger** are given as follows:

Step 1: Disable all external trigger
Step 2: Set the pacer rate of timer-1
Step 3: Clear FIFO & enable timer-1
Step 4: Circular-fetch N-data until external trigger signal to disable timer-1 (N=End-Start)
Step 5: Stop all timer

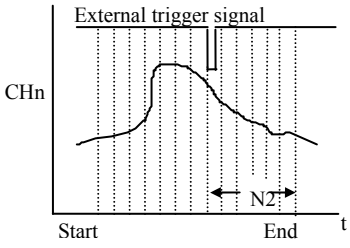


External pre-trigger timing diagram

NOTE: The circular-fetch operation is performed by software

The operation steps of **middle-trigger** are given as follows:

Step 1: Disable all external trigger
Step 2: Set the pacer rate of timer-1
Step 3: Clear FIFO & enable timer-1
Step4: Circular-fetch N-data until external trigger signal (N=End-Start)
Step 5:Fetch more N2-data & stop timer-1
Step 6: Stop all timer

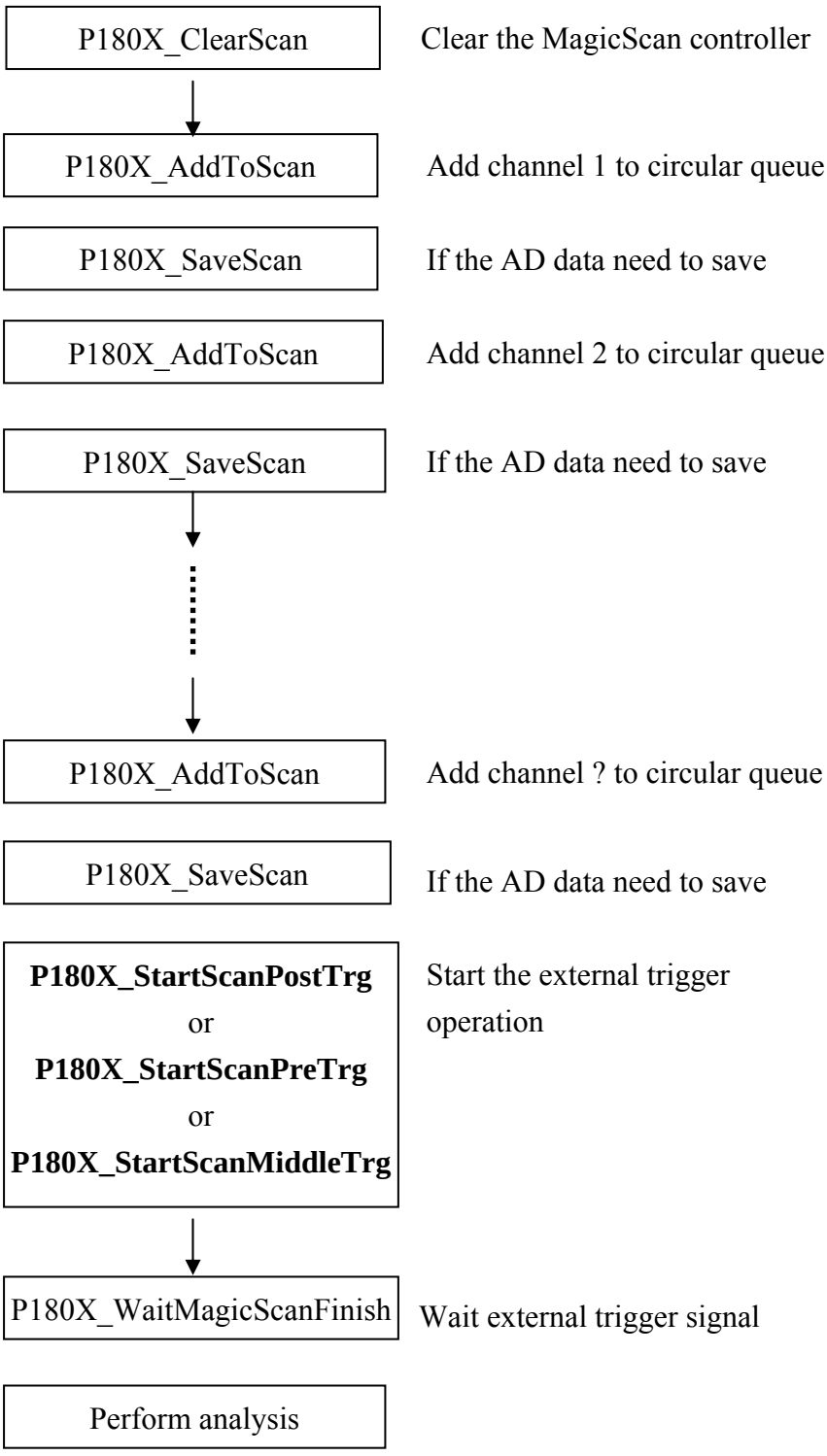


External middle-trigger timing diagram

NOTE: The circular-fetch operation is performed by software

- **Note 1: The external trigger operation must use with the MagicScan controller. The software flowchart of external trigger is given in next page.**
- **Note 2: The post-trigger operation can use all MagicScan function.**
- **Note 3: The user can't enable MagicScan HI/LO alarm and digital filter function in the pre-trigger & middle-trigger operation.**

The software flowchart of external trigger operation is given as follows:



- Refer to chapter-4 for more information
- This flowchart is validate for PCI-1202/1602/1800/1802

The demo program of post-trigger is given as follows:

```
wRetVal=P180X_ClearScan();
wRetVal += P180X_AddToScan(0,0,1,0,0,0);      // CH:0 to scan
wRetVal += P180X_SaveScan(0,wV0);
wRetVal += P180X_AddToScan(2,0,1,0,0,0);      // CH:2 to scan
wRetVal += P180X_SaveScan(1,wV2);             // Notice: 1 not 2
                          //         ^ : This is a ordinal number in
                          //   Scan Queue not a channel number.
wRetVal += P180X_StartScanPostTrg(wSampleRateDiv,DATALENGTH,nPriority);
```

```
if (wRetVal==0) sprintf(cShow,"2. External Post-Trigger Setup OK");
else sprintf(cShow,"2.  External Post-Trigger Setup Error");
TextOut(hdc,x*dx,(y+iLine)*dy,cShow,strlen(cShow)); iLine++;
```

```
for (; ;)
    {
    P180X_ReadScanStatus(&wStatus,&dwLowAlarm,&dwHighAlarm);
    if (wStatus>1) break;
    Sleep(10);
    }
sprintf(cShow,"3. ScanStatus=%x",wStatus);
TextOut(hdc,x*dx,(y+iLine)*dy,cShow,strlen(cShow)); iLine++;
```

```
wRetVal=P180X_StopMagicScan();
if  (wRetVal!=NoError)
    {
    sprintf(cShow,"4. StopMagicScan Error");
    TextOut(hdc,x*dx,(y+iLine)*dy,cShow,strlen(cShow)); iLine++;
    for (dwI=0; dwI<100; dwI++) Beep(10,10);
    }

SHOW_WAVE(hwnd,LINE1,wV0,1);

SHOW_WAVE(hwnd,LINE2,wV2,1);
```

- Refer to **DEMO23.C** for completely source program

The B13 must set to 1 to set the external trigger logic. The external trigger controller commands are given as follows:

Trigger	Command sequences [B12, B11, B10]	Descriptions
Disable external trigger (for PCI-1800/1X02)	[1, 0, X]	Disable all external trigger.
Post-trigger (for PCI-1202/1602/ 1800/1802)	[1, 0, X] [1, 0, X] [1, 1, 1] [1, 0, X]	(1) disable all external trigger (2) set pacer time-1 (3) clear FIFO and disable timer-1 (4) waiting for external signal to enable timer-1 (5) fetch N data (6) stop all timer & disable all external trigger
Pre-trigger (for PCI-1202/1602 & PCI-1800/1802/ver-F)	[1, 0, X] [0, 1, X] [1, 1, 0] [1, 0, X]	(1) disable all external trigger (2) set pacer timer-1 (3) clear FIFO and enable timer-1 (4) waiting for the external signal to stop timer-1. (5) circular-fetch the last N data (6) stop all timer & disable all trigger
Middle-trigger (for PCI-1202/1602 & PCI-1800/1802/ver-F)	[1, 0, X] [0, 1, X] [1, 1, 1] [1, 0, X]	(1) disable all external trigger (2) set pacer timer-1 (3) clear FIFO and enable timer-1 (4) waiting for the external signal. (5) fetch more N2 data (circular-fetch) (6) stop all timer & disable all trigger
Pre-trigger (for PCI-1800/1802) **(version-C)**	[1, 0, X] [0, 1, X] [1, 1, 1] [1, 0, X]	(1) disable all external trigger (2) set pacer timer-1 (3) clear FIFO and enable timer-1 (4) waiting for the external signal to stop timer-1. (5) keep the last N data (circular-fetch) (6) stop all timer & disable all trigger
Middle-trigger (for PCI-1800/1802) **(version-C)**	[1, 0, X] [0, 1, X] [1, 1, 0] [0, 1, X] [1, 0, X]	(1) disable all external trigger (2) set pacer timer-1 (3) clear FIFO and enable timer-1 (4) waiting for the external signal to stop timer-1 (5) enable timer-1 (6) fetch more N2 data (7) stop all timer & disable all trigger

The source code of the post-trigger function (Windows version) is given as follows:

```
WORD CALLBACK P180X_StartScanPostTrg(WORD wSampleRateDiv, DWORD dwNum,
SHORT nPriority)
{
disable_timer0();    // disable internal pacer timer
disable_timer1();    // disable external pacer timer

wVal=pic_control(0xD400); /* 11?1 01?? ???? ???? cmd_101=start scan */
if (wVal!=0) return(wVal);

_outpw(wAddrCtrl,0xf000);          // 1. disable all external trigger
enable_timer1(wSampleRateDiv); // 2. Sampling rate=8M/dwSampleRateDiv
_outpw(wAddrCtrl,0x7000);          // 3. B15=0,S2=1,S1=S0=0 --> clr FIFO
_outpw(wAddrCtrl,0xf000);          // 3. B15=1,S2=1,S1=S0=0 --> disable timer-1
_outpw(wAddrCtrl,0xfc00);          // 4. S2=1, S1=1, S0=1 --> wait ext signal to
                                   //                         enable timer-1

// create magicscan thread
InitializeCriticalSection(&MagicScan_CS);
wThreadStatus=0; wAskThreadStop=0;
hThread=CreateThread(NULL,0,(LPTHREAD_START_ROUTINE)magic_scan,
                        NULL, 0,&dwThreadID);// can use all MagicScan functions
SetThreadPriority(hThread,nPriority);
i=0;
for(;;)
    {
    EnterCriticalSection(&MagicScan_CS);
    j=wThreadStatus;
    LeaveCriticalSection(&MagicScan_CS);
    if (j!=0) break;
    i++; Sleep(1);
    if (i>1000) return(ThreadCreateError);
    }
return(NoError);
}
```

- **P1202_StartScanPostTrg(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_StartScanPostTrg(…) is designed for PCI-1602 and PCI-1602F**

The source code of the pre-trigger function (Windows version) is given as follows:

```
WORD CALLBACK P180X_StartScanPreTrg(WORD wSampleRateDiv, DWORD dwNum,
SHORT nPriority)
{
disable_timer0();    // disable internal pacer timer
disable_timer1();    // disable external pacer timer

wVal=pic_control(0xD400); /* 11?1 01?? ???? ???? cmd_101=start scan */
if (wVal!=0) return(wVal);

_outpw(wAddrCtrl,0xf000);          // 1. disable all external trigger
enable_timer1(wSampleRateDiv); // 2. Sampling rate=8M/dwSampleRateDiv
_outpw(wAddrCtrl,0x6800);          // 3. B15=0,S2=0,S1=1,S0=0 --> clr FIFO
_outpw(wAddrCtrl,0xE800);          // 3. B15=1,S2=0,S1=1,S0=0 --> enable timer-1
_outpw(wAddrCtrl,0xF800);          // 4. S2=1; S1=1; S0=0 --> wait ext signal to
                                   //                         disable timer-1
// create magicscan thread
InitializeCriticalSection(&MagicScan_CS);
wThreadStatus=0; wPreMid=0; wAskThreadStop=0;   // pre-trigger
hThread=CreateThread(NULL,0,(LPTHREAD_START_ROUTINE)
            magic_scan_pre_mid_trg, NULL, 0,&dwThreadID);
SetThreadPriority(hThread,nPriority); // can not use HI/LO alarm & digital filter
i=0;
for(;;)
    {
    EnterCriticalSection(&MagicScan_CS);
    j=wThreadStatus;
    LeaveCriticalSection(&MagicScan_CS);
    if (j!=0) break;
    i++; Sleep(1);
    if (i>1000) return(ThreadCreateError);
    }
return(NoError);
}
```

- **P1202_StartScanPostTrg(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_StartScanPostTrg(…) is designed for PCI-1602 and PCI-1602F**

The source code of the middle-trigger function (Windows version) is given as follows:

```
WORD CALLBACK P180X_StartScanMiddleTrg(WORD wSampleRateDiv, DWORD
dwNum, SHORT nPriority)
{
disable_timer0();    // disable internal pacer timer
disable_timer1();    // disable external pacer timer

wVal=pic_control(0xD400); /* 11?1 01?? ???? ???? cmd_101=start scan */
if (wVal!=0) return(wVal);

_outpw(wAddrCtrl,0xf000);          // 1. disable all external trigger
enable_timer1(wSampleRateDiv); // 2. Sampling rate=8M/dwSampleRateDiv
_outpw(wAddrCtrl,0x6800);          // 3. B15=0,S2=0,S1=1,S0=0 --> clr FIFO
_outpw(wAddrCtrl,0xE800);          // 3. B15=1,S2=0,S1=1,S0=0 --> enable timer-1
_outpw(wAddrCtrl,0xFC00);          // 4. S2=1; S1=1; S0=1 --> wait ext signal

// create magicscan thread
InitializeCriticalSection(&MagicScan_CS);
wThreadStatus=0; wPreMid=1; wAskThreadStop=0; // middle-trigger
hThread=CreateThread(NULL,0,(LPTHREAD_START_ROUTINE,
            magic_scan_pre_mid_trg, NULL, 0,&dwThreadID);
SetThreadPriority(hThread,nPriority); // can not use HI/LO alarm & digital filter

i=0;
for(;;)
    {
    EnterCriticalSection(&MagicScan_CS);
    j=wThreadStatus;
    LeaveCriticalSection(&MagicScan_CS);
    if (j!=0) break;
    i++; Sleep(1);
    if (i>1000) return(ThreadCreateError);
    }
return(NoError);
}
```

- **P1202_StartScanPostTrg(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_StartScanPostTrg(…) is designed for PCI-1602 and PCI-1602F**

The source code of the pre-trigger function for PCI-1800/1802/ver-C is given as follows:

```
WORD CALLBACK P180X_StartScanPreTrgVerC(WORD wSampleRateDiv, DWORD
dwNum, SHORT nPriority)
{
disable_timer0();    // disable internal pacer timer
disable_timer1();    // disable external pacer timer

wVal=pic_control(0xD400); /* 11?1 01?? ???? ???? cmd_101=start scan */
if (wVal!=0) return(wVal);

_outpw(wAddrCtrl,0xf000);          // 1. disable all external trigger
enable_timer1(wSampleRateDiv); // 2. Sampling rate=8M/dwSampleRateDiv
_outpw(wAddrCtrl,0x6800);          // 3. B15=0,S2=0,S1=1,S0=0 --> clr FIFO
_outpw(wAddrCtrl,0xE800);          // 3. B15=1,S2=0,S1=1,S0=0 --> enable timer-1
_outpw(wAddrCtrl,0xF800);          // 4. S2=1; S1=1; S0=0 --> wait ext signal to
                                   //                         disable timer-1
// create magicscan thread
InitializeCriticalSection(&MagicScan_CS);
wThreadStatus=0; wPreMid=0; wAskThreadStop=0;   // pre-trigger
hThread=CreateThread(NULL,0,(LPTHREAD_START_ROUTINE,
            magic_scan_pre_mid_trg_ver_c, NULL, 0,&dwThreadID);
SetThreadPriority(hThread,nPriority);
i=0;
for(;;)
    {
    EnterCriticalSection(&MagicScan_CS);
    j=wThreadStatus;
    LeaveCriticalSection(&MagicScan_CS);
    if (j!=0) break;
    i++; Sleep(1);
    if (i>1000) return(ThreadCreateError);
    }
return(NoError);
}
```

- **This driver is designed for PCI-1800/1802 version-C**

The source code of the middle-trigger function for PCI-1800/1802/ver-C is given as follows:

```
WORD CALLBACK P180X_StartScanMiddleTrgVerC(WORD wSampleRateDiv, DWORD
dwNum, SHORT nPriority)
{
disable_timer0();    // disable internal pacer timer
disable_timer1();    // disable external pacer timer

wVal=pic_control(0xD400); /* 11?1 01?? ???? ???? cmd_101=start scan */
if (wVal!=0) return(wVal);

_outpw(wAddrCtrl,0xf000);          // 1. disable all external trigger
enable_timer1(wSampleRateDiv); // 2. Sampling rate=8M/dwSampleRateDiv
_outpw(wAddrCtrl,0x6800);          // 3. B15=0,S2=0,S1=1,S0=0 --> clr FIFO
_outpw(wAddrCtrl,0xE800);          // 3. B15=1,S2=0,S1=1,S0=0 --> enable timer-1
_outpw(wAddrCtrl,0xF800);          // 4. S2=1; S1=1; S0=0 --> wait ext signal to
                                   //                         disable timer-1
// create magicscan thread
InitializeCriticalSection(&MagicScan_CS);
wThreadStatus=0; wPreMid=1; wAskThreadStop=0; // middle-trigger
hThread=CreateThread(NULL,0,(LPTHREAD_START_ROUTINE,
            magic_scan_pre_mid_trg_ver_c, NULL, 0,&dwThreadID);
SetThreadPriority(hThread,nPriority);
i=0;
for(;;)
    {
    EnterCriticalSection(&MagicScan_CS);
    j=wThreadStatus;
    LeaveCriticalSection(&MagicScan_CS);
    if (j!=0) break;
    i++; Sleep(1);
    if (i>1000) return(ThreadCreateError);
    }
return(NoError);
}
```

- **This driver is designed for PCI-1800/1802 version-C**

The external trigger functions are given as follows:

Driver Name	demo program	Applications
P180X_StartScanPostTrg(…)	demo23.c	for PCI-1800/1802 ver-C & ver-F
P180X_StartScanPreTrg(…)	demo24.c	for PCI-1800/1802 ver-F
P180X_StartScanMiddleTrg(…)	demo25.c	for PCI-1800/1802 ver-F
P180X_StartScanPreTrgOld(…)	demo26.c	for PCI-1800/1802 ver-C
P180X_StartScanMiddleTrgOld(…)	demo27.c	for PCI-1800/1802 ver-C
P1202_StartScanPostTrg(…)	demo23.c	for PCI-1202
P1202_StartScanPreTrg(…)	demo24.c	for PCI-1202
P1202_StartScanMiddleTrg(…)	demo25.c	for PCI-1202
P1602_StartScanPostTrg(…)	demo23.c	for PCI-1602
P1602_StartScanPreTrg(…)	demo24.c	for PCI-1602
P1602_StartScanMiddleTrg(…)	demo25.c	for PCI-1602

3.6.1.9 Clear FIFO Bit

The B15 is used to reset the on-board FIFO. When set to low, FIFO will be cleared. The FIFO must be cleared once after power-on.

The demo program of handshaking is given as follows:

```
// Clear FIFO to clear all data
outport(wAddrCtrl,0x2000);     /* Bit15=0=clear FIFO, Bit13=1=not PIC cmd  */
outport(wAddrCtrl,0xA000);     /* Bit15=1=no reset FIFO, BIT13=1=not PIC cmd  */
```

3.6.1.10 Handshake Control Bit

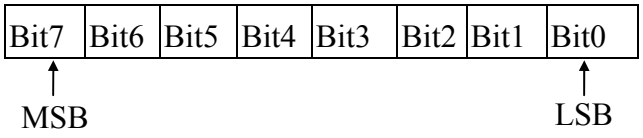
Set the B13 to 0 if the command is sent to the MagicScan controller. Keep this bit at high when not used.

The demo program of handshaking is given as follows:

```
WORD pic_control(WORD i)
{
WORD j;

if  ((inport(wAddrCtrl)&0x04)==0)
   {
   outport(wAddrCtrl,0xffff);                    /* send a recovery to PIC */
   }
j=0;
while ((inport(wAddrCtrl)&0x04)==0)
    {
    j++;
    if  (j>65530) return(AdControllerError);  /* time out */
    }
i = i & 0xDFFF;                                  /* set pic low !! */
outport(wAddrCtrl,i);
j=0;
while ((inport(wAddrCtrl)&0x04)!=0)
    {
    j++;
    if (j>65530) return(AdControllerError);   /* time out */
    }
outport(wAddrCtrl,(WORD)(i | 0x2000));   /* set pic high !! */
j=0;
while ((inport(wAddrCtrl)&0x04)==0)
    {
    j++;
    if (j>65530) return(AdControllerError); //time out
    }
return(NoError);
}
```

3.6.2 The status register

The format of the status register is given as follows:



Bit 7: FIFO half-full : 0 → FIFO is half-full.

Bit 6: FIFO full : 0 → FIFO is full.

Bit 5: FIFO empty : 0 → FIFO is empty.

Bit 4: ADC busy : 0 → ADC is busy.

Bit 3: External trigger : For PCI-180x Ver. C: 0 → timer-1 is disable
1 → timer-1 is enable
For PCI-180x Ver. F: 0 → waiting external trigger signal
1 →external trigger signal is active.

Bit 2: handshake signal between host (PC) and MagicScan controller.

Bit 1: ODM indicator: non-ODM version → 0.
ODM version → ODM bit string.

Bit 0: The status of the machine independent timer.

0 →enable

1→disable

3.6.3 The A/D software trigger register

Writing to this port will perform a software trigger signal to trigger an A/D conversion. Although the PC can send very fast trigger signal (more than 333 k), the max. sampling rate of A/D conversion cannot over 330 k Samples/Sec.. The timing diagram is given as follows:

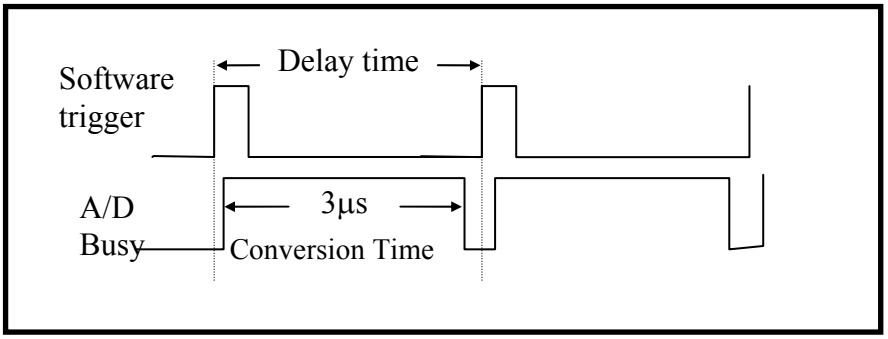


Figure 3-3: Trigger delay time.

The sample code of software trigger A/D conversion is given as follows:

```
WORD  P180X_AdPollingHex(Word *AdVal)
{
WORD  wVal, wTime;
//Clear FIFO
outport(wAddrCtrl,0x2000); //B15=0=clear FIFO, B13=1=not MagicScan controller cmd
outport(wAddrCtrl,0xA000); //B15=1=no clear FIFO, B13=1= not MagicScan controller cmd
outport((WORD)(wAddrCtrl+4),0xffff);   /* generate a software trigger pulse */
wTime=0;
for (;;)
  {
  wVal=inport(wAddrCtrl)&0x20;// wait for ready signal
  if (wVal!=0) break;                    /* If B4==1 → A/D data ready */
  wTime++;
  if (wTime>32760) return(AdPollingTimeOut);
  }
AdVal=inport(wAddrAdda)&0x0fff;   /* Read the available A/D data from FIFO */
return(NoError);                        /* 0xffff for PCI-1602/1602F  */
}
```

- **P1202_AdPollingHex(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_AdPollingHex(…) is designed for PCI-1602 and PCI-1602F**

3.7 BAR 3: DI/DO Register

3.7.1 Digital Output/Digital Input

- I/O address of D/I = wAddrDio
- I/O address of D/O = wAddrDio

The PCI-1800/1802 provides 16-channel digital input and 16-channel digital output. All levels of DI/DO are TTL compatible. The connections diagram and block diagram are given below:

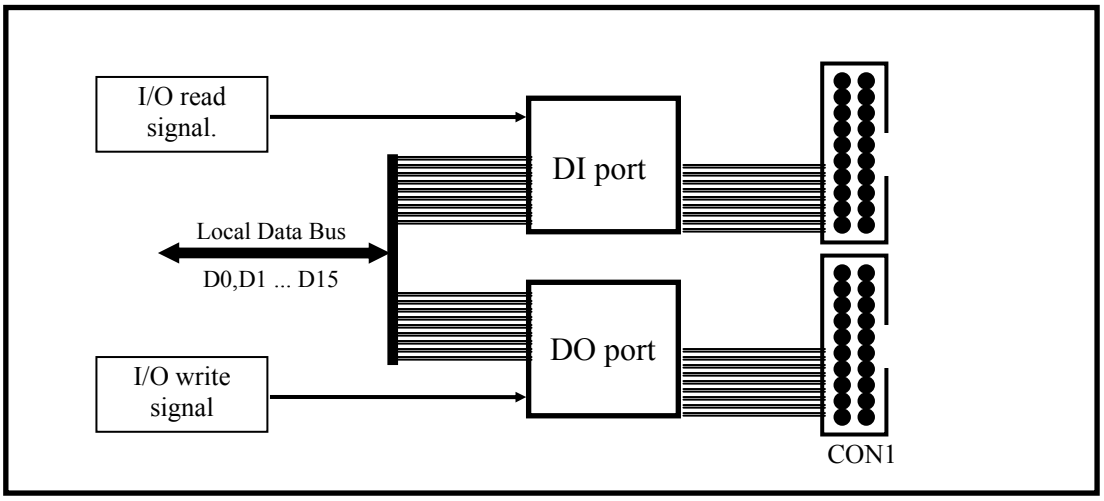


Figure 3-4: DIO block diagram.

The D/I port can be connected to the DB-16P. The DB-16P is a 16-channel isolated digital input daughter board. The D/O port can be connected to the DB-16R or DB-24PR. The DB-16R is a 16-channel relay output board. The DB-24R is a 24-channel power relay output board.

The sample code of DI/DO is given as follows:

```
WORD  P180X_Di(WORD *wDi)
{
*wDi=inport(wAddrDio)&0xffff;
return(NoError);
}
```

- P1202_Di(…) for PCI-1202
- P1602_Di(…) for PCI-1602

```
WORD  P180X_Do(WORD wDo)
{
outport(wAddrDio,wDo);
return(NoError);
}
```

- P1202_Do(…) for PCI-1202
- P1602_Do(…) for PCI-1602

3.7.2 Card ID Register

The format of the Card_ID register is given as follows:

wAddrDio+0x4h

X	X	X	X	Bit3	Bit2	Bit1	Bit0

It can be used to read the card ID set from SW1 switch

The sample code of reading the is given as follows:

```
WORD  P180X_ID(WORD *wDi)
{
*wID=inport(wAddrDio+ 0x04)&0x000f;
return(NoError);
}
```

3.8 BAR 4: A/D & D/A Register

- I/O address of DA-0 = wAddrAdda
- I/O address of DA-1 = wAddrAdda + 1*4
- I/O address of FIFO = wAddrAdda

This BAR4 address is used to write data to the DACs and to read data from the A/D FIFO. The read/write operation is given as follows:

Port	Read	Write
BAR4 + 0	A/D FIFO.	DAC1 write.
BAR4 + 4	Reserved	DAC2 write.

The PCI-1800/1802 provides 2 independent 12-bits D/A converters with double buffer, bipolar voltage output. The output voltage can be ±5 V or ±10 V selected by J1. When the PCI-1800/1802 is first power-on, the D/A will be in the floating state. The D/A will go to the programmed state after executing D/A output command. The block diagram is given as below:

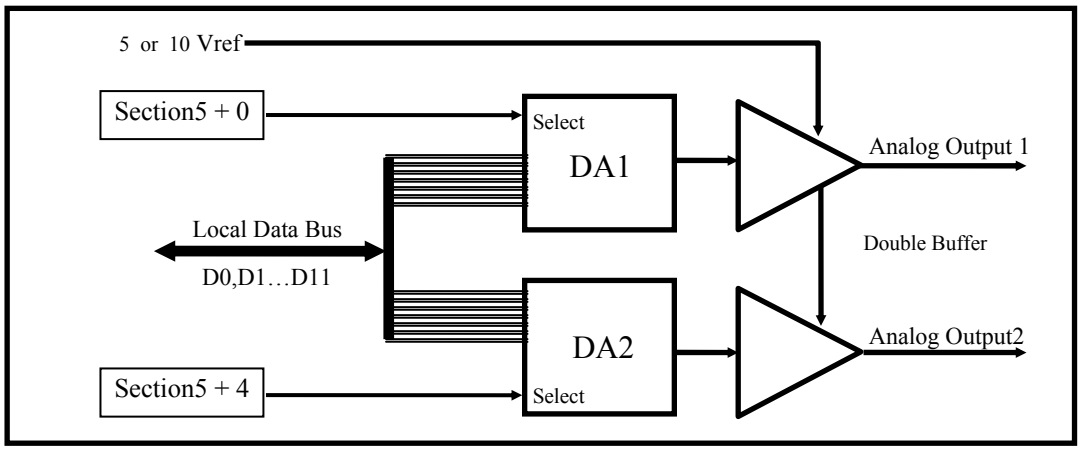


Figure 4-2 : D/A output diagram.

Note: The D/A output is **floating after first power-on**. The D/A output will be enabled after executing D/A output command. This is the common feature of PCI-1202/1602/1800/1802.

The sample code for D/A is given as follows:

```
WORD  P180X_Da(WORD wDaChannel, WORD wDaVal)
{
if  (wDaChannel==0)        /* channel 0 */
  {
  outport(wAddrAdda,wDaVal);
  return(NoError);
  }
  else if (wDaChannel==1)  /* channel_1 */
    {
    outport((wAddrAdda+4),wDaVal);
    return(NoError);
    }
  else return(DaChannelError);
}
```

- P1202_Da(…) for PCI-1202
- P1602_Da(…) for PCI-1602

The sample code of software trigger A/D conversion is given as follows:

```
WORD  P180X_AdPollingHex(Word *AdVal)
{
WORD     wVal, wTime ;

//Clear FIFO
outport(wAddrCtrl,0x2000);  // B15=0=clear FIFO, B13=1=not MagicScan controller cmd
outport(wAddrCtrl,0xA000); // B15=1=no clear FIFO, B13=1= not MagicScan controller cmd
outport((WORD)(wAddrCtrl+4),0xffff);   /* generate a software trigger pulse */

wTime=0;
for (;;)
  {
  wVal=inport(wAddrCtrl)&0x20;// wait for ready signal
  if (wVal!=0) break;                    /* if B4==1 → A/D data ready */
  wTime++;
  if (wTime>32760) return(AdPollingTimeOut);
  }
AdVal=inport(wAddrAdda)&0x0fff;     /* Read the available A/D data from FIFO */
return(NoError);                      /* 0x0fff for 12-bit ADC, 0xffff for 16-bit ADC */
}
```

- P1202_AdPollingHex(…) for PCI-1202
- P1602_AdPollingHex(…) for PCI-1602

4. A/D Conversion Operation

4.1 The Configuration Code Table

PCI-1202/1800/1802 L/LU Configuration Code Table

Bipolar Unipolar	Input Range	Gain	Settling Time	Configuration Code
Bipolar	+/- 5 V	1	3 μs	0x00
Bipolar	+/- 2.5 V	2	3 μs	0x01
Bipolar	+/- 1.25 V	4	3 μs	0x02
Bipolar	+/- 0.625 V	8	3 μs	0x03
Bipolar	+/- 10 V	0.5	3 μs	0x04
Bipolar	+/- 5 V	1	3 μs	0x05
Bipolar	+/- 2.5 V	2	3 μs	0x06
Bipolar	+/- 1.25 V	4	3 μs	0x07
Unipolar	0 V ~ 10 V	1	3 μs	0x08
Unipolar	0 V ~ 5 V	2	3 μs	0x09
Unipolar	0 V ~ 2.5 V	4	3 μs	0x0A
Unipolar	0 V ~ 1.25 V	8	3 μs	0x0B

PCI-1602/1602U Configuration Code Table

Bipolar Uniploar	Input Range	Gain	Settling Time	Configuration Code
Bipolar	+/-10 V	1	10 μs	0x0
Bipolar	+/-5 V	2	10 μs	0x1
Bipolar	+/-2.5 V	4	10 μs	0x2
Bipolar	+/-1.25 V	8	10 μs	0x3

PCI-1602F/1602FU Configuration Code Table

Bipolar Uniploar	Input Range	Gain	Settling Time	Configuration Code
Bipolar	+/-10 V	1	5 μs	0x0
Bipolar	+/-5 V	2	5 μs	0x1
Bipolar	+/-2.5 V	4	5 μs	0x2
Bipolar	+/-1.25 V	8	5 μs	0x3

PCI-1202/1800/1802 H/HU Configuration Code Table

Bipolar Unipolar	Input Range	Gain	Settling Time	Configuration Code
Bipolar	+/- 5 V	1	23 μs	0x10
Bipolar	+/- 0.5 V	10	28 μs	0x11
Bipolar	+/- 0.05 V	100	140 μs	0x12
Bipolar	+/- 0.005 V	1000	1300 μs	0x13
Bipolar	+/- 10 V	0.5	23 μs	0x14
Bipolar	+/- 1 V	5	28 μs	0x15
Bipolar	+/- 0.1 V	50	140 μs	0x16
Bipolar	+/- 0.01 V	500	1300 μs	0x17
Unipolar	0 V ~ 10 V	1	23 μs	0x18
Unipolar	0 V ~ 1 V	10	28 μs	0x19
Unipolar	0 V ~ 0.1 V	100	140 μs	0x1A
Unipolar	0 V ~ 0.01 V	1000	1300 μs	0x1B

4.2 The Unipolar/Bipolar

If the analog input signal is unipolar, you can measure this signal with bipolar setting (**this will reduce resolution**). If the analog input is bipolar, you must select bipolar configuration code to measure this signal.

4.3 The Input Signal Range

If the range of analog signal source is +/- 1 V, you can measure this signal wih +/-10 V, +/-5 V, +/-2.5 V and +/-1.25 V configuration code setting. The only difference is the resolution. The resolution of +/-2.5 V is 4 times higher than in +/-10 V setting. **Select the correct configuration code will get the best resolution**.

4.4 The Settling Time

If the **channel number** or **gain factor** is changed, the hardware need **extra time for signal ready**. This is called the settling time. This limitation will apply both to the **Fixed-channel mode** and **MagicScan mode** of AD conversions. So the user must take care to avoid the settling error. In the MagicScan mode, the MagicScan controller will control all details. The MagicScan controller will change the channel number and gain control just after every pacer trigger signal. **Therefore the limitation is "settling time <= pacer timer" in MagicScan mode.**

4.5 When to Delay the Settling Time

In the software trigger mode, the software operation is given as follows:

1. send software trigger pulse
2. delay for the settling time
3. read the A/D data

The **P180X_DelayUs(...)** is a machine independent timer function. Therefore this function is suitable to delay the settling time. In the pacer trigger mode, the software does not have to call P180X_DelayUs(...) The only limitation is that the pacer timer must be longer than the settling time. Refer to Sec. 4.1 for settling time details.

4.6 The AD Conversion Mode

The AD conversion operation of PCI-1202/1602/1800/1802 can be divided into two different mode: **Fixed-channel mode** and the **MagicScan mode**.

- The functions of fixed-channel mode are given as follows:

1. P180X_SetChannelConfig 2. P180X_AdPolling 3. P180X_AdsPolling 4. P180X_AdsPacer	The reading data is in floating format

- The functions of MagicScan mode are given as follows:

1. P180X_ClearScan 2. P180X_StartScan 3. P180X_ReadScanStatus 4. P180X_AddToScan 5. P180X_SaveScan 6. P180X_WaitMagicScanFinish **7. P180X_StartScanPostTrg** **8. P180X_StartScanPreTrg** **9. P180X_StartScanMiddleTrg**	Data in 12 bits HEX format 7. For external trigger 8. For external trigger 9. For external trigger

- The functions of M_functions are given as follows:

1. P180X_M_FUN_1 2. P180X_M_FUN_2 3. P180X_M_FUN_3 4. P180X_M_FUN_4

- The functions of continuous capture with storing data to main memory are given as follows: (two boards operating simultaneously)

1. P180X_FunA_Start
2. P180X_FunA_ReadStatus
3. P180X_FunA_Stop
4. P180X_FunA_Get

- The functions of continuous capture with storing data to main memory are given as follows: (single board operating)

1. P180X_FunB_Start
2. P180X_FunB_ReadStatus
3. P180X_FunB_Stop
4. P180X_FunB_Get

- The functions of continuous capture are given as follows:

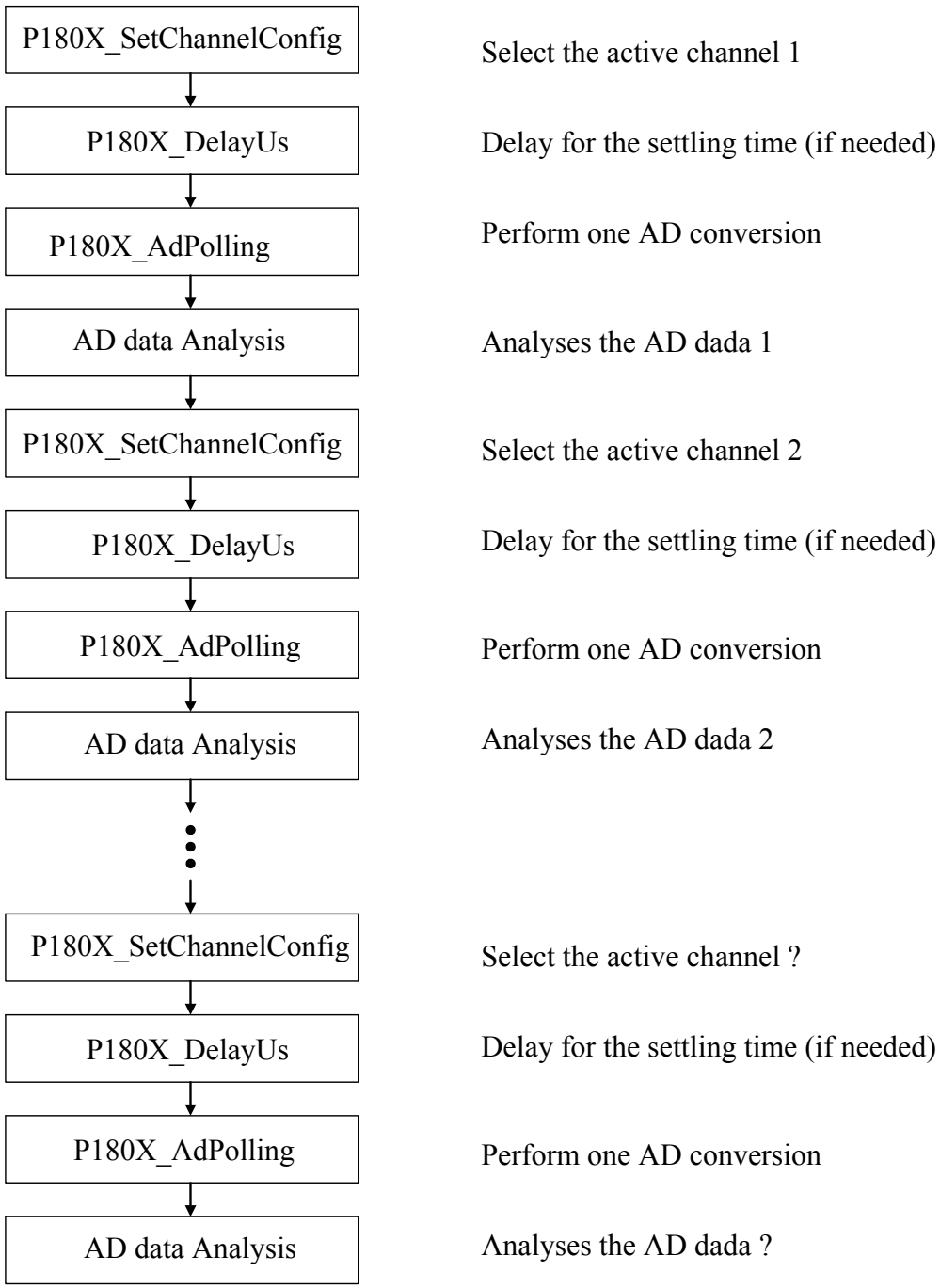
1. P180X_Card0_StartScan
2. P180X_Card0_ReadStatus
3. P180X_Card0_StopScan
4. P180X_Card1_StartScan
5. P180X_Card1_ReadStatus
6. P180X_Card1_StopScan

Group-0: for card_0 continuous capture function

Group-1: for card_1 continuous capture function

4.7 The Fixed-channel Mode AD Conversion

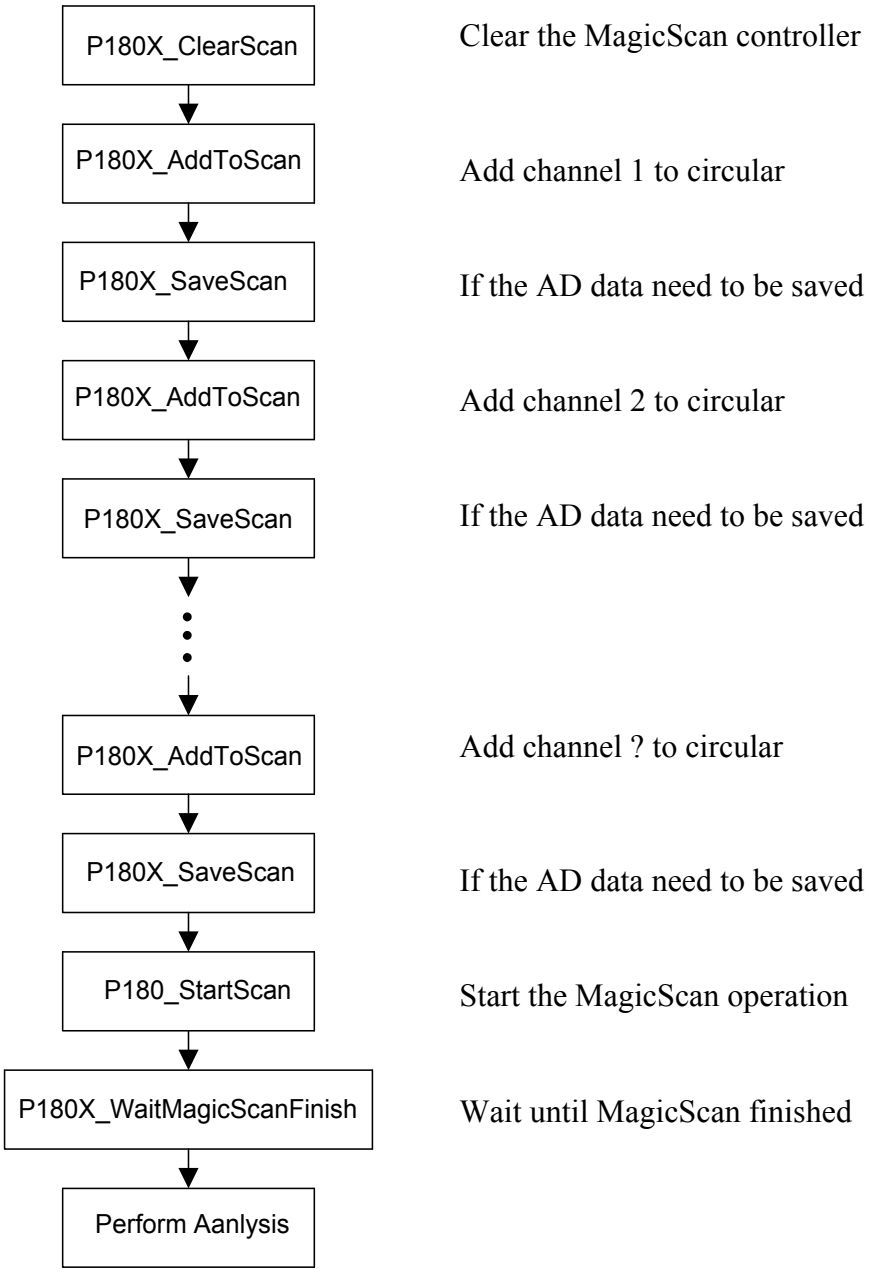
The **P180X_SetChannelConfig** activates the selected channel and sets configuration code. Then the other functions will refer to that channel and configuration. The general flow chart is given as follows :



- **P1202_SetChannelConfig(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_SetChannelConfig(…) is designed for PCI-1602 and PCI-1602F**

4.8 The MagicScan Mode AD Conversion

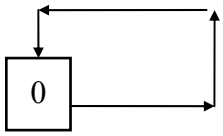
The **P180X_ClearScan** sets the MagicScan controller to its initial state. The **P180X_AddToScan** adds the channels to MagicScan circular queue one by one. **The scan sequence of the channels is depending on the order of the P180X_AddToScan settings.** The maximum queue size is **48.** The channel number in the scan list can be random and duplicated. The AD data of MagicScan can be saved in array if **P180X_SaveScan** is used. The flowchart is given as follows:



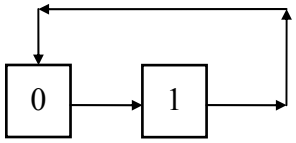
- **P1202_ClearScan(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_ClearScan(…) is designed for PCI-1602/F/U/FU**

4.8.1 The MagicScan Circular_Scan_Queue

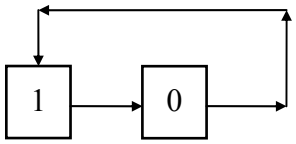
The MagicScan controller is equipped with a **circular queue** for scan sequence control. The scan sequence is **one by one** and **repeatable** with the limitation of maximum 48 channels. So the following scan sequence is all valid:



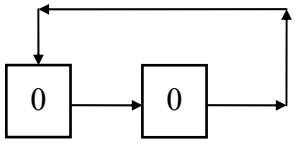
One channel MagicScan



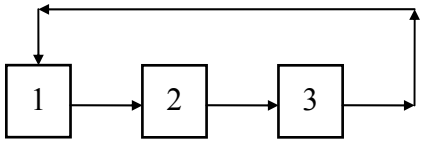
Two channels MagicScan, scan



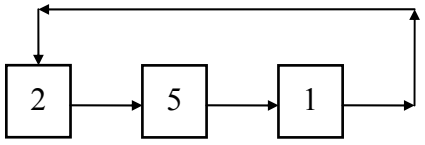
Two channels MagicScan, scan



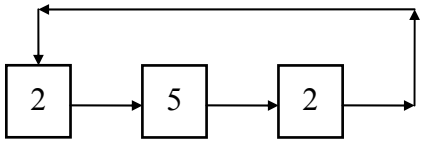
Two channels MagicScan, scan



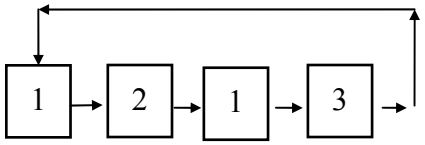
Three channels MagicScan : 123123123



Three channels MagicScan : 251251251



Three channels MagicScan : 252252252



Four channels MagicScan : 12131213

4.8.2 The Digital Filter of MagicScan

The digital filter is a **average** filter.

Filter value = (V_1+V_2+……+V_n)/n, where n is average factor

If the input signal is very noisy, this filter can be used to remove these noises.

4.8.3 The Different Sampling Rate of MagicScan

The MagicScan controller scans the analog inputs in **fixed-sampling-rate**. The **different sampling rate** is implemented with **averaging** technique. **This technique is the same as the digital filter** described in Sec. 4.8.2. If the user wishes to use the different sampling rate between channels, the digital filter will be active at the same time. **This is a situation of ALL or NO. You can use both the digital filter and the different sampling rate at the same time or use neither of them.**

```
P180X_ClearScan();
P180X_AddToScan(?,?,10,….);     → only one channel scan
P180X_StartScan(?,24); → the AD sampling rate = 8 M/24=333 k
                         → the factor=10 → sampling rate=333 k/10=33.3 k
```

```
P180X_ClearScan();
P180X_AddToScan(A,?,1,….);
P180X_AddToScan(B,?,2,….);
P180X_AddToScan(C,?,3,….);
P180X_StartScan(?,24); → the AD sampling rate = 8 M/24=333 k
                         → scan sampling rate=333 k/3=111 k
channel_A sampling rate=111 k/1=111 k
channel_B sampling rate=111 k/2=55.5 k
channel_C sampling rate=111 k/3=37 k
```

- **P1202_ClearScan(…) is designed for PCI-1202H/L/HU/LU**
- **P1602_ClearScan(…) is designed for PCI-1602/F/U/FU**

4.8.4 The High/Low Alarm of MagicScan

There are 5 alarm types are given as follows:

Type 0 : no alarm	
Type 1 : high alarm	**→ any AD data > High_alarm_value**
Type 2 : low alarm	**→ any AD data < Low_alarm_value**
Type 3 : in alarm	**→ Low_alarm_value < any AD data < High_alarm_value**
Type 4 : out alarm	**→ any AD data < Low_alarm_value or any AD data > High_alarm_value**

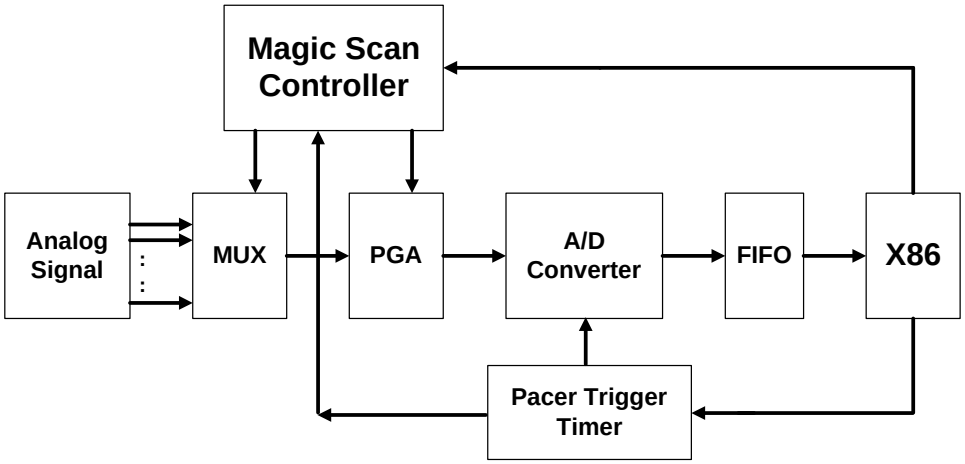
All the alarm_value are defined in HEX format

4.8.5 The MagicScan Function

The features of MagicScan are given as follows:

1. Different gain for each channel
2. Non-sequential order for channel scan
3. Different sampling rate for each channel (use with digital filter)
4. Programmable different digital filter for each scan channel
5. Programmable HI/LO alarm for each channel
6. Three external trigger: post-trigger, pre-trigger and middle-trigger
7. Maintain at 330 k max. for total channel scan
8. Easy programming

The MagicScan function is implemented with software and hardware. The feature 1 and feature 2 are implemented in hardware. The other features are implemented in software. The block diagram of MagicScan function is given as follows:



(1) The Magic Scan controller is a high performance RISC-like controller. It can scan the analog input signal in non-sequential order. It also control the PGA to different predefined gain for each channel.

(2) The pacer timer generates the trigger signal to A/D converter.

(3) The A/D conversion data will be placed in the FIFO.

(4) PC will read the A/D data from FIFO while the data is ready. The FIFO is 1 k samples for PCI-1800 and 8 k samples for PCI-1802. The PC can will compute and analyze the A/D data while the A/D conversion is going. Therefore the speed of PC must compatible with the speed of A/D conversion. The A/D conversion can be 330 k max.in the channel/scan mode. Therefore the PC must handle 330 k samples per second to avoid overflow. The Pentium-120 CPU or more powerful CPU is recommended.

The A/D conversion data in FIFO are in the same sampling rate (refer to (1), (2), (3)).
For example,

* the scan channel is 1→ 2 → 3
* the pacer sampling rate is 330 k
* We want a 110 k sampling rate for channel 1
* We want a 55 k sampling rate for channel 2
* We want a 11 k sampling rate for channel 3

The hardware will scan the analog data into FIFO as follows:

1,2,3,1,2,3,1,2,3,1,2,3,1,2,3,1,2,3……

→ total 330 k

→ every 1,1,1,1,1 is 110 k

→ every 2,2,2,2,2 is 110 k

→ every 3,3,3,3,3 is 110 k

The software has to fetch the 2,2,2,2,2 in 55 k, therefore the software averages the continue two 2 into one 2 to get 55 k as follows:

2,2, 2,2 2,2, 2,2

2, 2, 2, 2, → 55 k

The software has to fetch the 3,3,3,3,3 in 11 k, therefore the software average the continue ten 3 into one 3 to get 11 k.

There are very heavy computation loads for the PC to execute the MagicScan function. These computation loads are given as follows:

1. Averages the continue N data into one data to get different sampling rate data
2. Compares each A/D data with the HI/LO alarm limit
3. Saves the A/D data into memory if the save flag is enabled

The MagicScan function described in this section can be realized in Pentium-120 & Windows 95 without other running programs (like anti-virus of firewall).
Refer to Sec. 4.8.6 for driver source.
Refer to Chapter 8 for demo program.
Refer to Chapter 10 for performance evaluation.

4.8.6 The MagicScan Thread

```
//-----------------------------------------------------------------------
// wThreadStatus : 0x01=MagicScan start
//                 0x02=timeout1
//                 0x04=timeout2
//                 0x08=FIFO overflow
//                 0x80=MagicScan OK

WORD  magic_scan()
{
WORD   wVal,w1,w3;
DWORD  i,dwTime,j,k,dwIndex;

for (j=0; j<wMP; j++)   dwMagicSum[j]=0;
for (j=0; j<wMP; j++)   wMagicNow[j]=wMagicAve[j];
for (j=0; j<wMP; j++)   wMagicP[j]=0;
for (i=0; i<wMP; i++)   // skip the MagicScan settling time
 {
      dwTime=0;
       for  (;;)
        {
        wVal=inport(wAddrCtrl)&0x20;
        if(wVal!=0) break;
        dwTime++;
        if(dwTime>100000)
        return TimeOut;
      }
  inport(wAddrAdda)&0xffff;
 }
  dwMagicLowAlarm=0;
  dwMagicHighAlarm=0;
  for(i=0; i<wMagicNum; i++)
  {
  for (j=0; j<wMP; j++)
    {
        dwTime=0;
```

```
for (;;)
  {
  wVal=inport(wAddrCtrl)&0x60;
  if (wVal==0x20)  return FifoOverflow;
  if (wVal==0x60) break;
  dwTime++;
  if (dwTime>100000)  return TimeOut;
  }
dwMagicSum[j]+=(inport(wAddrAdda)&0x0fff);  /*  0x0fff  for 12-bitADC, 0xffff  for 16-bit ADC */
wMagicNow[j]--;
w1=wMagicNow[j];
if  (w1==0)
  {
  wVal=(WORD)(dwMagicSum[j]/wMagicAve[j]);
  if (wMagicScanSave[j]==1)
  {
     *((wMagicScanBuf[j])+wMagicP[j])=wVal;
     wMagicP[j]++;
  }
  w3=wMagicAlarmType[j];
  if(w3>0)         // 0 = no alarm
  {
     dwIndex=0x01; k=j;
     while (k>0)
          {
          dwIndex=dwIndex<<1;
          k--;
          }
     if  (w3==2)  // 2 = low alarm
        {
        if (wVal<wMagicLowAlarm[j]) dwMagicLowAlarm |= dwIndex;
        }
     else if (w3==1)  // 1 = high alarm
        {
        if (wVal>wMagicHighAlarm[j]) dwMagicHighAlarm |= dwIndex;
        }
     else if (w3==4)  // 4 = high or low  alarm
        {
```

```
                if (wVal<wMagicLowAlarm[j])    dwMagicLowAlarm |= dwIndex;
                if (wVal>wMagicHighAlarm[j]) dwMagicHighAlarm |= dwIndex;
                }
              else if (w3==3)  // 3 = in [low,high]  alarm
                {
                if  ((wVal>wMagicLowAlarm[j])&& (wVal<wMagicHighAlarm[j]))
                  {
                  dwMagicLowAlarm |= dwIndex;
                  dwMagicHighAlarm |= dwIndex;
                  }
                }
            }
            dwMagicSum[j]=0;
            wMagicNow[j]=wMagicAve[j];
      }  // end if(w1
      }   // end  for(j=
  } // end for(i=
  ret_label:
  disable_timer0();
  return 0;
}
```

5. M_Function

Some real world applications have to send out the pre-defined pattern to the external device and measure the output responses for analysis. The user need one arbitrary wave form generator and one high speed A/D converter. **The M_Functions, provided by PCI-1202/1602/1800/1802, can send out the user defined arbitrary waveform (by software) and perform the A/D conversion (by hardware) at the same time.**

The M_Functions can be executed under **DOS, Windows 95/98 and Windows NT/2000/XP**. Some programming languages **(VC++, BC++, VB, Delphi, BCB, VB.NET, C#.NET)** and package**(LabVIEW and more)** can call the M_Functions now. The spectrum output response of the M_FUN_1 by LabView 4.0 is given as follows.

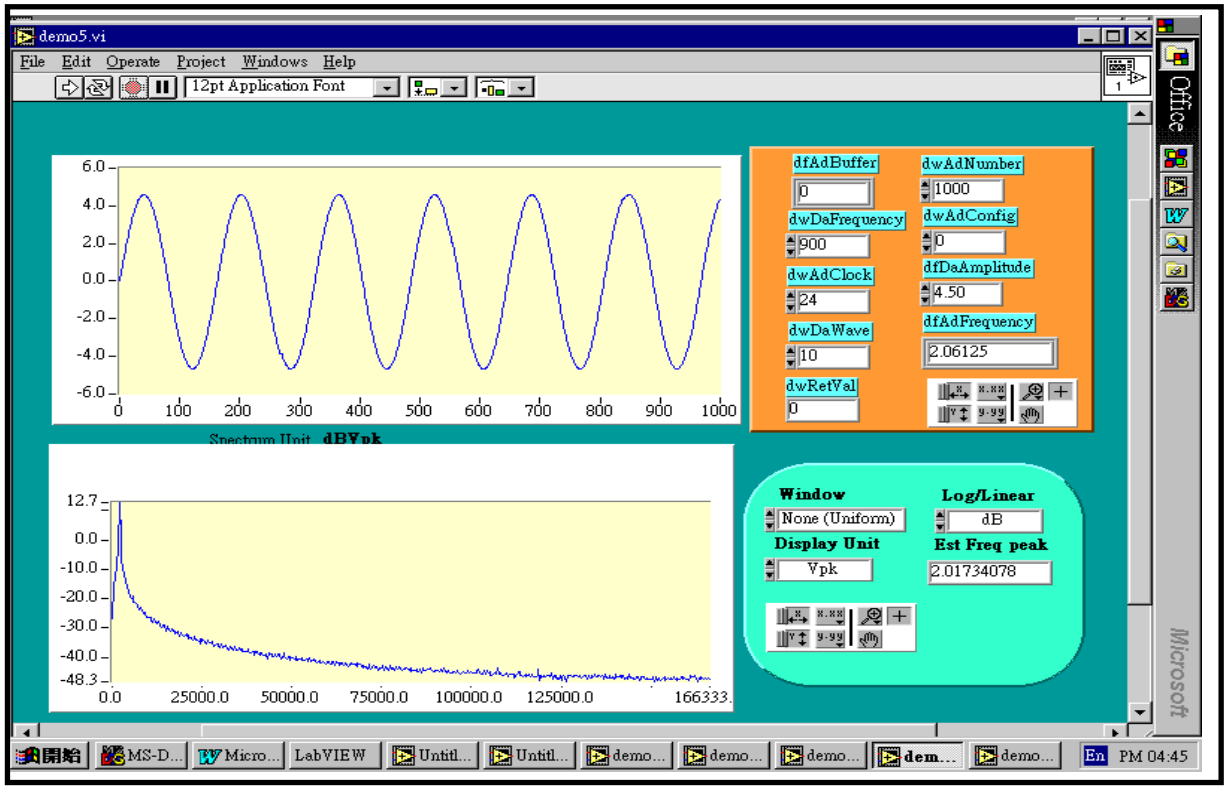


Figure 5-1: The spectrum output response of M_FUN_1.

5.1 Introduction

- **What Is M_Functions?**

The features of the M_Functions are given as follows:

1. Arbitrary wave form generation (by software) from D/A output port (2 channels max.)
2. Perform MagicScan A/D conversion (by hardware) at the same time (32 channels max.)
3. Only one function call is needed
4. Very easy to use

The driver can send out the D/A wave form output to the external device and measure the response(32 channels max.) at the same time. The block diagram of the M_Functions is given as follows:

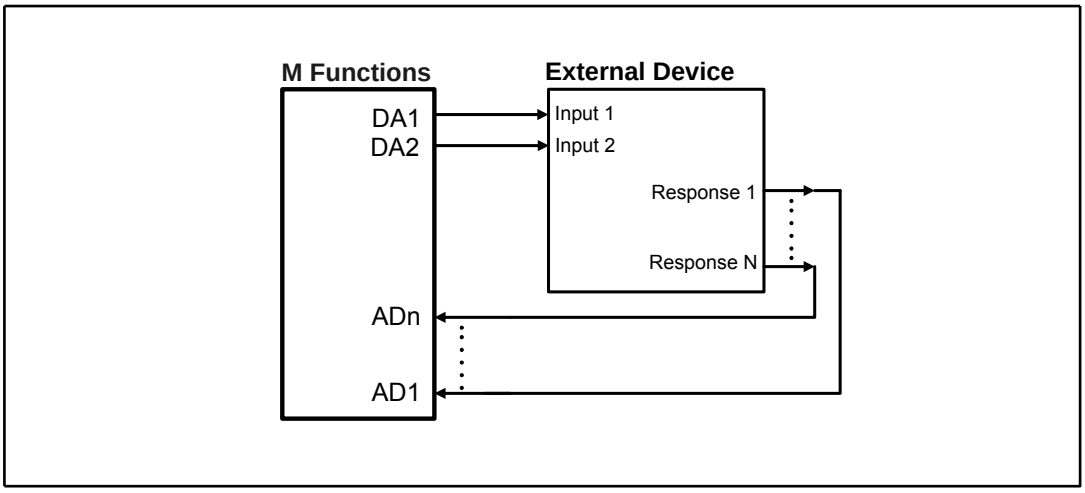


Figure 5-2: The block diagram of M-Functions.

- **Which types of waveform can be generated by the M_Functions ?**

The M_Functions use **wave-form-image-data** format to reconstruct the output waveform. Therefore nearly any types of waveform can be generated. The only limitations are resolution and frequency. It is very difficult to generate a very high resolution and high frequency waveform in a multi-task OS.

If the user want to generate the periodic wave form such as sine, cosine,...., the M_Functions can provide the output wave form over 100 k Samples/sec. The +/- 5 V 100 kS/s sine wave shown in Figure 5-3 and +/- 5 V 200 kS/s sine wave shown in Figure 5-4 are all generated by M_Function1. The Figure 5-3 and Figure 5-4 is measured by Tektronix TDS 220. The display resolution of TDS 220 is limited, so the output waveform does not look smooth. The real output waveform is smooth.

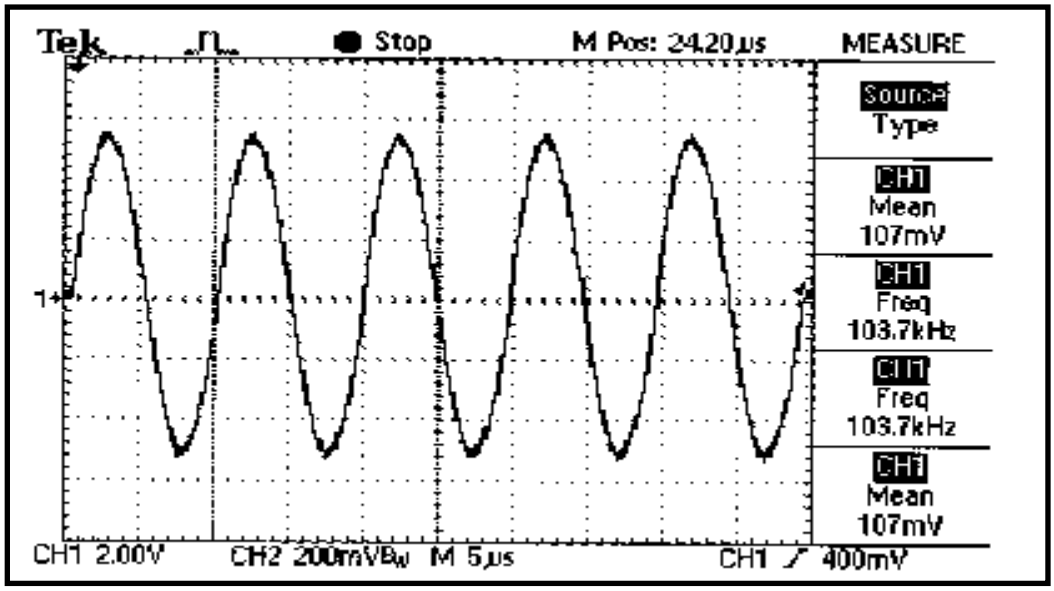


Figure 5-3: The M_Function_1 send out a 100 k, +/-5 V sine wave.
(measured by Tektronix TDS 220)

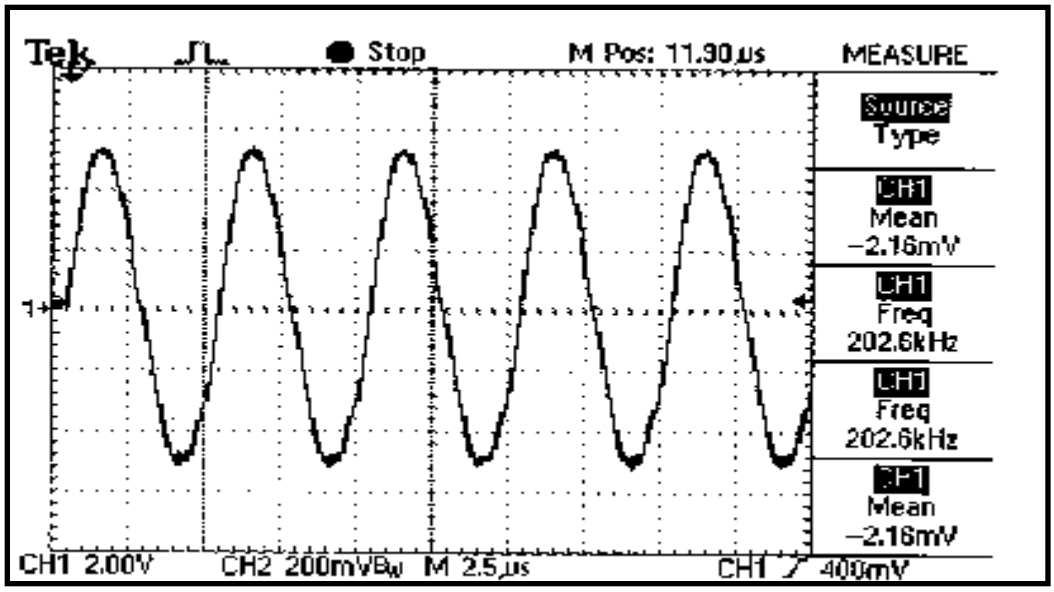


Figure 5-4: The M_Function_1 send out a 200 k, +/-5 V sine wave.
(measured by Tektronix TDS 220)

- **How many M_Functions are ready now ?**

There are four M_Functions, P180X_M_FUN_1, P180X_M_FUN_2, P180X_M_FUN_3 and M_FUN_4 are ready now. The M_FUN_1 will automatic to compute the sine wave output image. The M_FUN_2 is designed for arbitrary waveform generation, so the user can prepare their waveform for M_FUN_2. The M_FUN_3 is similar to M_FUN_1 except the A/D input channels are programmable. The comparison table is given as follows:

driver name	D/A	A/D
P180X_M_FUN_1	Channel_0, sine wave	channel_0, ±10V
P180X_M_FUN_2	Channel_0, arbitrary wave form	channel_0, ±10V
P180X_M_FUN_3	Channel_0, sine wave	channel/gain programmable (32 channels max.)
P180X_M_FUN_4	Channel_0, square wave or semi-square-wave or sine wave	channel/gain programmable (32 channels max.)

- **Which cards support the M_Functions ?**

The PCI-1202/1602/1800/1802 series can support M_Functions now.

- **Which operating systems support the M_Functions ?**

The M_Functions can be executed under DOS, Windows 95/98, Windows NT/2000/XP/2003/Vista/2008/7 now.

- **Limitation**

The system will interrupt the driver software under multi-task OS, like Windows. The partial function of D/A arbitrary waveform generation is implemented by software. Therefore the D/A output waveform will be distorted sometimes. Refer to Figure 5-5 for details.

If the user has to generate the periodic wave form such as sine, cosine …, and the analysis is similar to spectrum analysis, this type of output distortion will cause little trouble. **The D/A output maybe distorted but spectrum response is still stable.**

If the user uses DOS, the D/A output waveform will not be distorted in any time.

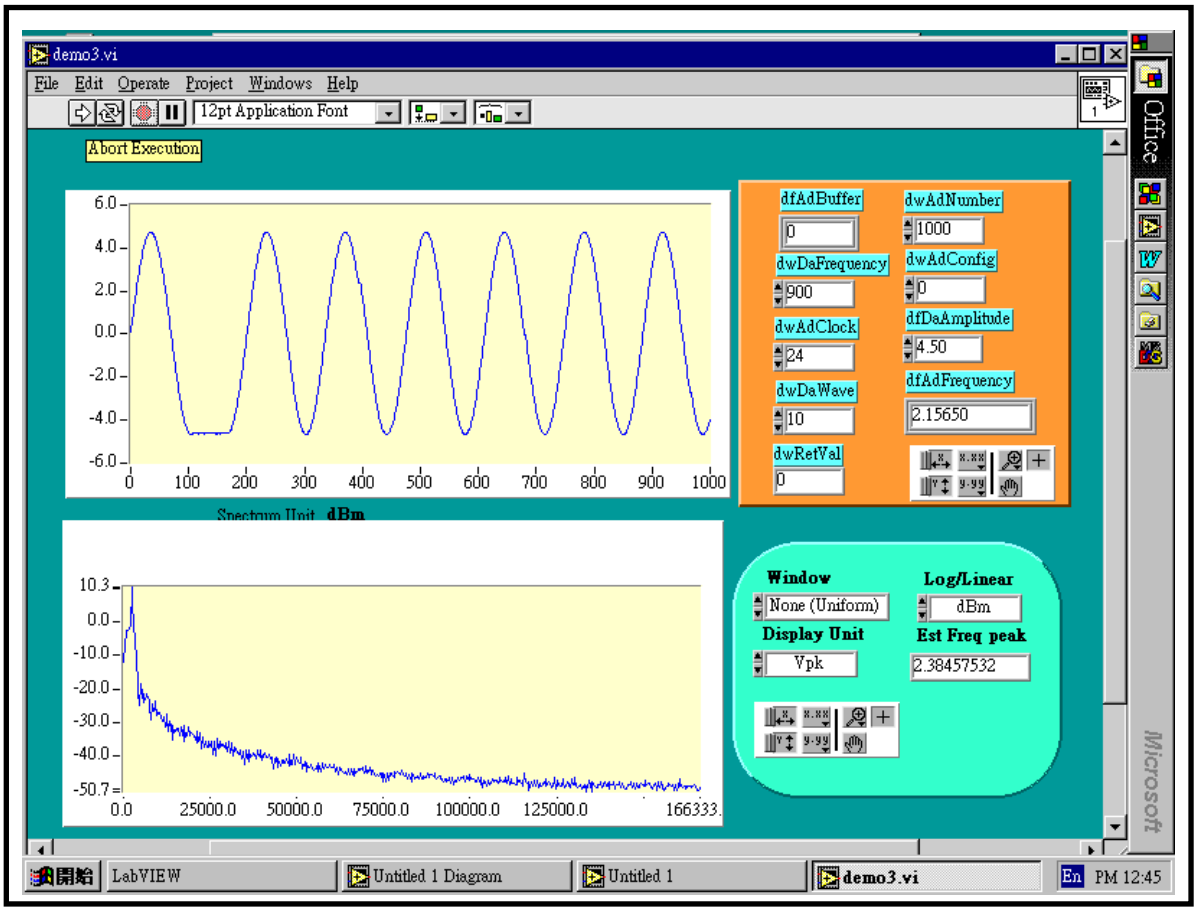


Figure 5-5: The D/A waveform is distorted but the spectrum response is nearly the same.

6. Continuous Capture Functions

The continuous capture functions are very useful in real world applications. It can be used in many types of applications. Those applications are

1. Low speed, no storage, real-time processing, continuous capture
2. High speed, store the A/D data in PC main memory, time is limited by memory size (Referring to P180X_FunA series functions and P180X_FunB series function for more Detail information in 6.2)
3. High speed, store the A/D data in the external NVRAM, time is limited by memory size

6.1 General Purpose Functions

The PCI-1202/1602/1800/1802 is very suitable for these three applications. The software driver can support 16 cards max. in one PC system. The software also supports 2 cards for continuous capture function. The continuous capture functions are specially designed into many groups. Each group is corresponding to one card. There are three functions included in a group as follows:

1. P180X_Card0_StartScan(…)
2. P180X_Card0_ReadStatus(…)
3. P180X_Card0_StopScan(….)

Group-0: for card_0 continuous capture function

1. P180X_Card1_StartScan(…)
2. P180X_Card1_ReadStatus(…)
3. P180X_Card1_StopScan(….)

Group-1: for card_1 continuous capture function

The features of these functions are given as follows:

- Support DOS, Window 98/NT/2000/XP
- Single-card solution → group0, refer to DEMO13.C
- Multiple-card solution → group0 & group1 RUN at the same time, refer to DEMO14.C.
- **P1202_Card0_StartScan(…) is designed for PCI-1202 series**
- **P1602_Card0_StartScan(…) is designed for PCI-1602 series**

The block diagram of continuous capture function is given as follows:

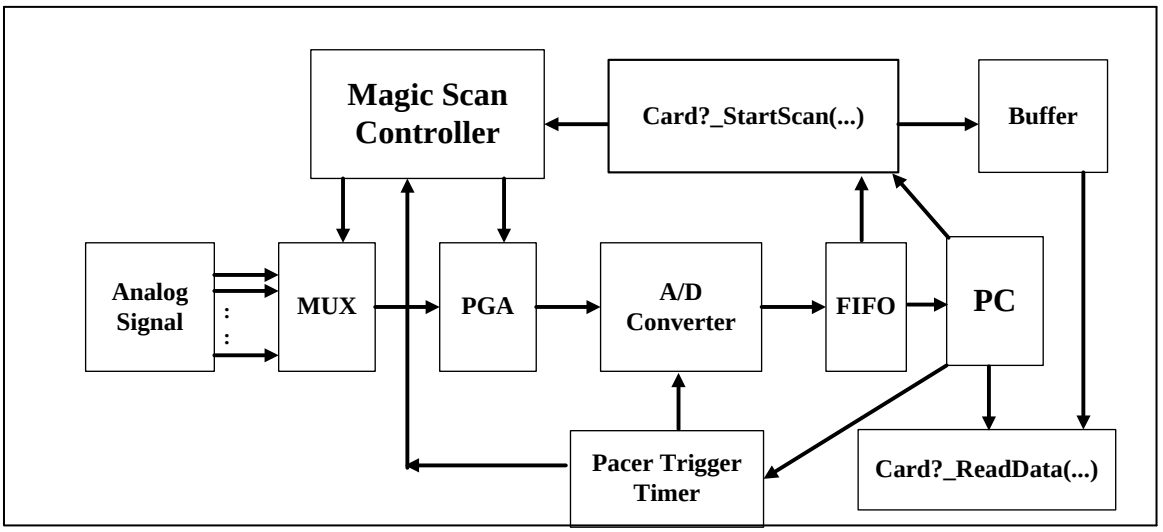


Figure 6-1: The block diagram of continuous capture.

- The P180X_Card?_StartScan(…) will perform the following function:
  1. setup scan-queue
  2. setup channel/gain data
  3. setup continuous capture data
  4. create a multi-task thread for long time data acquisition
  5. If the group A/D data are ready → signal P180X_Card?_ReadStatus(…) to read data
- The P180X_Card?_ReadStatus(…) will read from the buffer prepared by P180X_Card?_StartScan(…). This function is running at the same time with the P180X_Card?_StartScan(…) thread.
- The P180X_Card?_StopScan(…) will stop all threads and return all resource

- The sample code for **single board** is given as follows:

```
wRetVal=P180X_Card0_StartScan(……);        // setup continuous capture function
                                                    // this function will create thread
if (wRet != NoError)
        {
        Show error message & return
        }
// now the thread is active and the continuous capture function is going now
for(;;)
        {
        wRetVal=P180X_Card0_ReadStatus(…);
        if (wRetVal != 0)
                {
                show these A/D data or
                save these A/D data or
                analyze these A/D data
                }
        if (stop flag is ON)        // for example, the user press STOP key here
                {
                Card0_StopScan(…);
                return OK
                }
        }
```

- The sample code for **multi-boards** is given as follows:

```
wRetVal=P180X_Card0_StartScan(……);        // setup continuous capture function
                                                    // this function will create thread
if (wRet != NoError) { Show error message & return }
wRetVal=P180X_Card1_StartScan(……);        // setup continuous capture function
                                                    // this function will create thread
if (wRet != NoError) { Show error message & return }
wRetVal=P180X_Card?_SartScan(……);         // setup continuous capture function
                                                    // this function will create thread
if (wRet != NoError) { Show error message & return }
// now the thread is active and the continuous capture function is going now
```

```
for(;;)
        {
        wRetVal=P180X_Card0_ReadStatus(….);
        if(wRetVal != 0)
                {
                show these A/D data or
                save these A/D data or
                analyze these A/D data
                }
        wRetVal=P180X_Card1_ReadStatus(….);
        if (wRetVal != 0)
                {
                show these A/D data or
                save these A/D data or
                analyze these A/D data
                }

        wRetVal=P180X_Card?_ReadStatus(….);
        if (wRetVal != 0)
                {
                show these A/D data or
                save these A/D data or
                analyze these A/D data
                }

        if (stop flag is ON)        // for example, the user press STOP key here
                {
                Card0_StopScan(…);
                return OK
                }
}
```

Refer to DEMO13.C & DEMO14.C for details.

6.2 Functions for saving Data in PC Memory

The P180X_FunA & P180X_FunB series functions are designed for continuous capture which storing the data into main memory. The features for these P180X_FunA and P180X_FunB are listed as follows:

* Sampling A/D data with high speed (for example, 330K)
* Continues capture for a long period (for example, 2.5 minutes continue)
* A/D data save in the PC memory first, then analyze these data later
  (memory size=330 k*60*2.5=330 k*150=49.5 M word=99 M bytes)
* Refer to demo22.c for **330 k, 2.5 minutes,** continuous capture using **99 M** bytes of the PC memory

The P180X_FunA is designed for two boards and the P180X_FunB (Figure 6-2) is designed for single-board as follows:

P180X_FunA_Start P180X_FunA_ReadStatus P180X_FunA_Stop P180X_FunA_Get	● Support two board ● continuous capture ● data save in PC memory (can be as large as 256 M) ● refer to demo20.c
P180X_FunB_Start P180X_FunB_ReadStatus P180X_FunB_Stop P180X_FunB_Get	● Support single board ● continuous capture ● data save in PC memory (can be as large as 256 M) ● refer to demo21.c

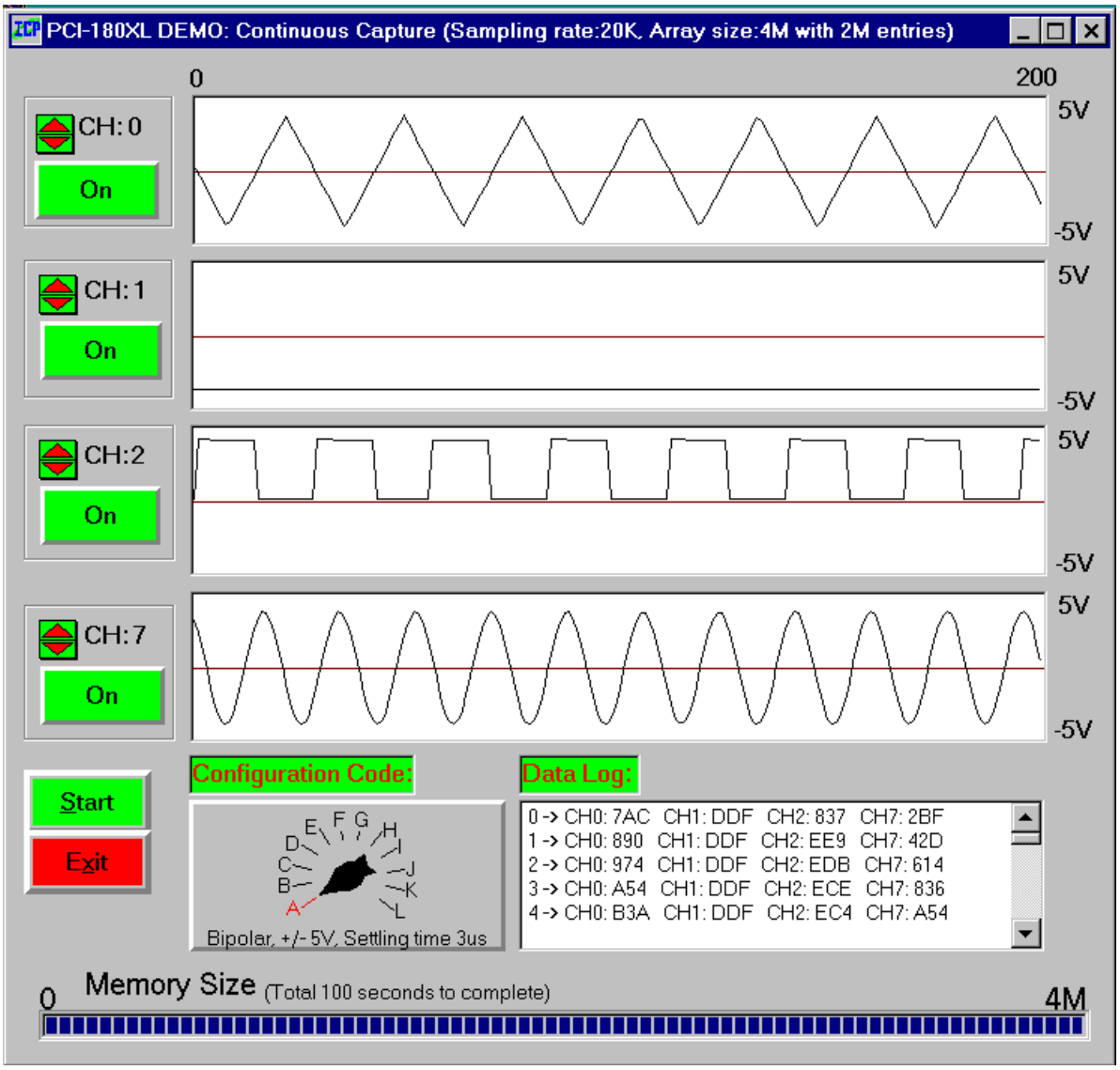


Figure 6-2. The Continuous Capture example.

7. Calibration

7.1 AD Calibration

- For PCI-1202/1800/1802

Step 1: Apply 0 V to channel 0

Step 2: Apply 4.996 V to channel 1

Step 3: Apply +0.6245 V to channel 2 for PCI-1202(L/LU)/1800(L)/1802(L)

Step 4: Apply +4.996 mV to channel 2 for PCI-1202(H/HU)/1800(H)/1802(H)

Step 5: Run DEMO19.EXE

Step 6: Adjust VR101 until CAL_0 = 7FF or 800

Step 7: Adjust VR100 until CAL_1 = FFE or FFF

Step 8: Repeat Step6 & Step7 until all OK

Step 9: Adjust VR1 until CAL_2 = FFE or FFF

Step 10: Adjust VR2 until CAL_3 = 000 or 001

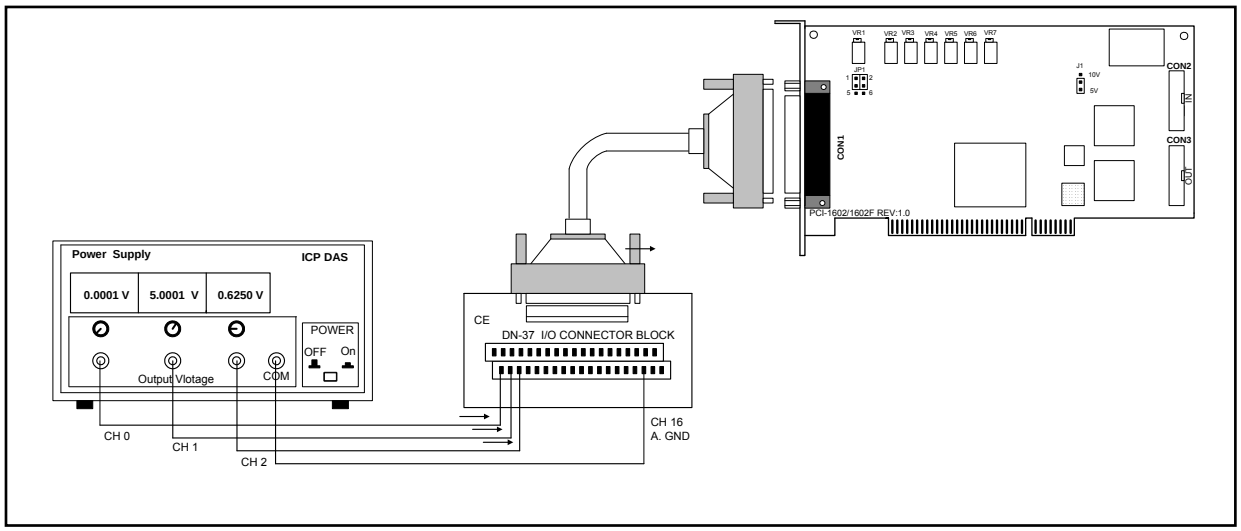


Figure 7-1. AD Calibration

Note: The CH 16 is the GND of analog signal for PCI-1202/1602.1802 card

The CH 9/10 are the GND of analog signal for PCI-1800 card

- For PCI-1602/1602F/1602U/1602FU

Step 1: Apply 0 V to channel 0

Step 2: Apply 4.996 V to channel 1

Step 3: Apply +0.6245 V to channel 2

Step 4: Run DEMO19.EXE

Step 5: Adjust VR3 until channel 0 = 0000 or FFFF

Step 6: Adjust VR2 until channel 1 = 7FFF or 7FFE

Step 7: Repeat Step5 & Step6 until all OK

Step 8: Adjust VR1 until channel 2 = 0FFC or 0FFD

7.2 D/A Calibration

- For PCI-1800/1802 version_F & PCI-1202

Step 1: J1 select +10 V

Step 2: Connect the D/A channel 0 to voltage meter

Step 3: Send 0x800 to D/A channel 0

Step 4: Adjust VR200 until voltage meter = 0 V

Step 5: Send 0 to D/A channel 0

Step 6: Adjust VR201 until voltage meter = -10 V

Step 7: Connect the D/A channel 1 to voltage meter

Step 8: Send 0x800 to D/A channel 1

Step 9: Adjust VR202 until voltage meter = 0 V

Step 10: Send 0 to D/A channel 1

Step 11 : Adjust VR203 until voltage meter = -10 V

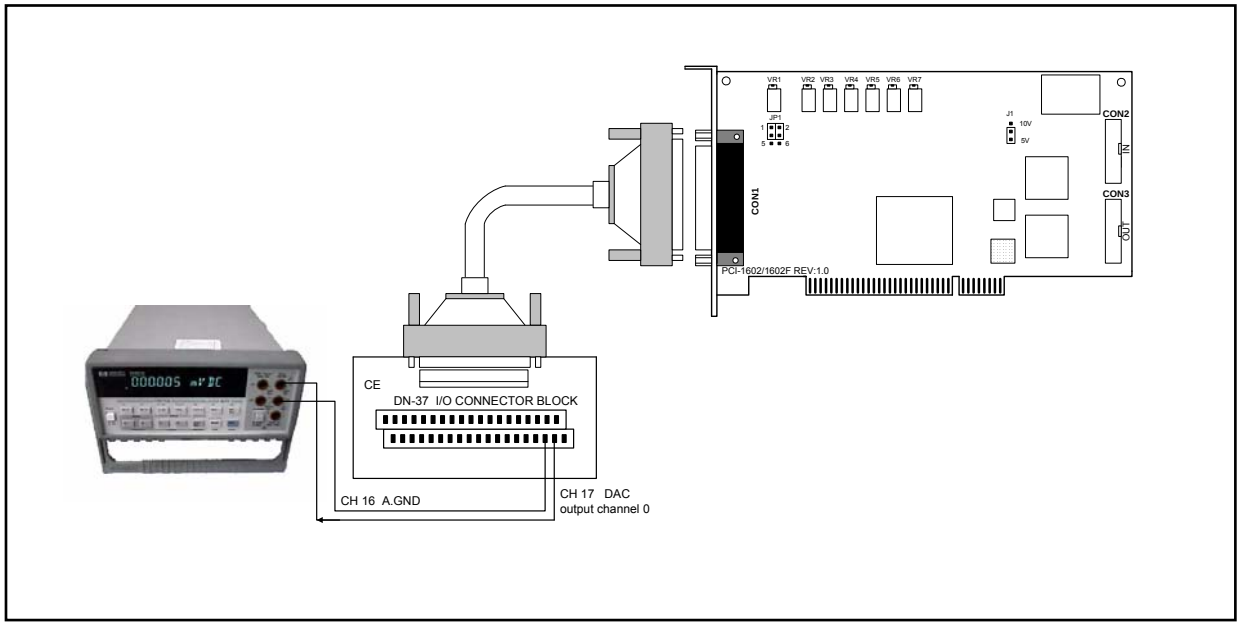


Figure 7-2. D/A Calibration

Note: The CH 18/36 are the output channels 0/1 of DAC for PCI-1202/1602.1802 card
The CH 30/32 are the output channels 0/1 of DAC for PCI-1800 card

- For PCI-1800/1802 version_C

Step 1: J1 select +10 V

Step 2: Connect the D/A channel 0 to voltage meter

Step 3: Send 0 to D/A channel 0

Step 4: Adjust VR3 until voltage meter = -10 V

- For PCI-1602

Step 1: J1 select +10 V

Step 2: Connect the D/A channel 0 to voltage meter

Step 3: Send 0x800 to D/A channel 0

Step 4: Adjust VR4 until voltage meter = 0 V

Step 5: Send 0 to D/A channel 0

Step 6: Adjust VR5 until voltage meter = -10 V

Step 7: Connect the D/A channel 1 to voltage meter

Step 8: Send 0x800 to D/A channel 1

Step 9: Adjust VR7 until voltage meter = 0 V

Step 10: Send 0 to D/A channel 1

Step 11: Adjust VR6 until voltage meter = -10 V

8. Software and Demo Program

The software drivers can be classified as follows:

- for DOS: huge and large mode library for TC, MSC and BC
- for Windows: DLLs for VC++, BC++, VB, Delphi, BCB, LabVIEW

There are about 20 demo program given as follows:

- demo1: one board, D/I/O test, D/A test, A/D polling test, general test
- demo2: two board, same as demo1
- demo3: one board, A/D by software trigger(polling) and A/D by pacer trigger demo
- demo4: two board, same as demo3
- demo5: one board, M_function_1 demo
- demo6: two board, same as demo5
- demo7: one board, M_function_2 demo
- demo8: two board, same as demo7
- demo9: one board, M_function_3 demo
- demo10: two board, same as demo9
- demo11: one board, MagicScan demo
- demo12: two board, same as demo11
- demo13: one board, continuous capture demo
- demo14: two board, continuous capture demo
- demo15: all installed board, D/I/O test for board number identification
- demo16: one board, performance evaluation demo
- demo17: one board, MagicScan demo, scan sequence: 1→2→0
- demo18: one board, MagicScan demo, scan 32 channel, show channel 0/1/15/16/17
- demo19: one board, A/D calibration.
- demo20: two board, P180X_FUNA, continuous capture demo
- demo21: single board, P180X_FUNB, continuous capture demo
- demo22: single board, P180X_FUNB, 330 k, 2.5 min, continuous capture 99 M bytes
- demo23: single board, post-trigger demo
- demo24: single board, pre-trigger demo
- demo25: single board, middle-trigger demo
- demo26: single board, pre-trigger demo for version-C
- demo27: single board, middle-trigger demo for version-C

- demo28: multi-task, critical section driver demo
- demo29: testing for MagicScan controller.
- demo30: testing for Pacer Trigger.
- Demo31: testing for Polling.
- Demo32: monitoring the incoming data from MagicScan, then set a digital out bit on when the incoming data exceed a defined threshold.
- Demo33: MagicScan total sample rate=176 k/sec for 8 channels.
- Demo34: continuous capture scan total sample rate=33.3 k/sec for 32 channels and save to disk (for DOS only).

9. Diagnostic Program

9.1 Power-on Plug&Play Test

The operation steps of power-on plug&play test are given as follows:
Step 1: Power-off PC
Step 2: Install PCI-1202/1602/1800/1802 without any extra external connector
Step 3: Power-on PC and check the PC screen very carefully
Step 4: The PC will performance self-test first
Step 5: Detect the non-PCI physical devices installed in the system
Step 6: Show the information of these device in screen
Step 7: Detect the PCI plug&play devices installed in the system
show all PCI-device information → check here carefully
→ there will be a PCI device with vendor_ID=1234, device_ID=5678 (PCI-1800/1802)
vender_ID=1234, device_ID=5676 (PCI-1602)
vender_ID=1234, device_ID=5672 (PCI-1202)

If the plug&play ROM-BIOS can detect the PCI-1202/1602/1800/1802 in the power-on time, the software driver of DOS, Windows 95/98//NT/2000 will function OK later. If the plug&play ROM-BIOS cannot find the PCI-1202/1602/1800/1802, all software driver will not function. Therefore the user must make sure that the power-on detection is correct.

9.2 Driver Plug&Play Test

Step 1: Power-off PC
Step 2: Install PCI-1202/1602/1800/1802 without any extra external connector
Step 3: Power-on PC, run DEMO15.EXE
Step 4: The I/O base address of all PCI-1xxx installed in the system will be shown in screen.
Step 5: Is the total board number correct?
Step 6: Install a 20-pin flat cable in one of these PCI-1202/1602/1800/1802 cards
Step 7: One card' s D/O=D/I → this is the physical card number, remember this number.
Step 8: Repeat the previous two steps to find the physical card number of all boards.

9.3 D/O Test

Step 1: Power-off PC
Step 2: Install one PCI-1202/1602/1800/1802 card with a 20-pin flat cable between CON1 & CON2
Step 3: Power-on PC, run DEMO15.EXE
Step 4: Check the value of D/O and D/I → must be the same.

9.4 D/A Test

Step 1: Power-off PC
Step 2: Install one PCI-1202/1602/1800/1802 card with DA channel 0 connected to A/D channel 0.
Step 3: Power-on PC, run DEMO1.EXE
Step 4: Check the value of A_0 → = 1.25 volt.
Step 5: Run DEMO5.EXE
Step 6: Check the wave form shown in screen must be sine wave

9.5 A/D Test

Step 1:Power-off PC
Step 2: Install one PCI-1202/1602/1800/1802 card with DA channel 0 connected to A/D channel 0.
Step 3: Power-on PC, run DEMO1.EXE
Step 4: Check the value of A_0 → = 1.25 volt.
Step 5: Run DEMO5.EXE
Step 6: Check the waveform shown in screen must be sine wave
Step 7: Apply analog signals to all A/D channels
Step 8: Run DEMO3.EXE to check all A/D data measured

10. Performance Evaluation

Demo Program	Performance	Description
DEMO16.EXE.	1.7 MS/s	D/I performance
DEMO16.EXE.	2.1 MS/s	D/O performance
DEMO16.EXE.	2.0 MS/s	D/A performance
DEMO13.EXE	20 kS/s	Continuous capture function, one card, two channels Total=20 kS/s → 10 kS/s per channels
DEMO14.EXE	20 kS/s	Continuous capture function, two card, two channels Total=20 kS/s → 10 kS/s per channels
DEMO5.EXE	20 k sine max.	M_function demo, D/A channel_0 to A/D channel_0 20 kHz sine wave max. 20 Hz sine wave min.
DEMO11.EXE	330 k 110 k 200 k 100 k	MagicScan demo for PCI-1800/1802 MagicScan demo for PCI-1202 MagicScan demo for PCI-1602F MagicScan demo for PCI-1602

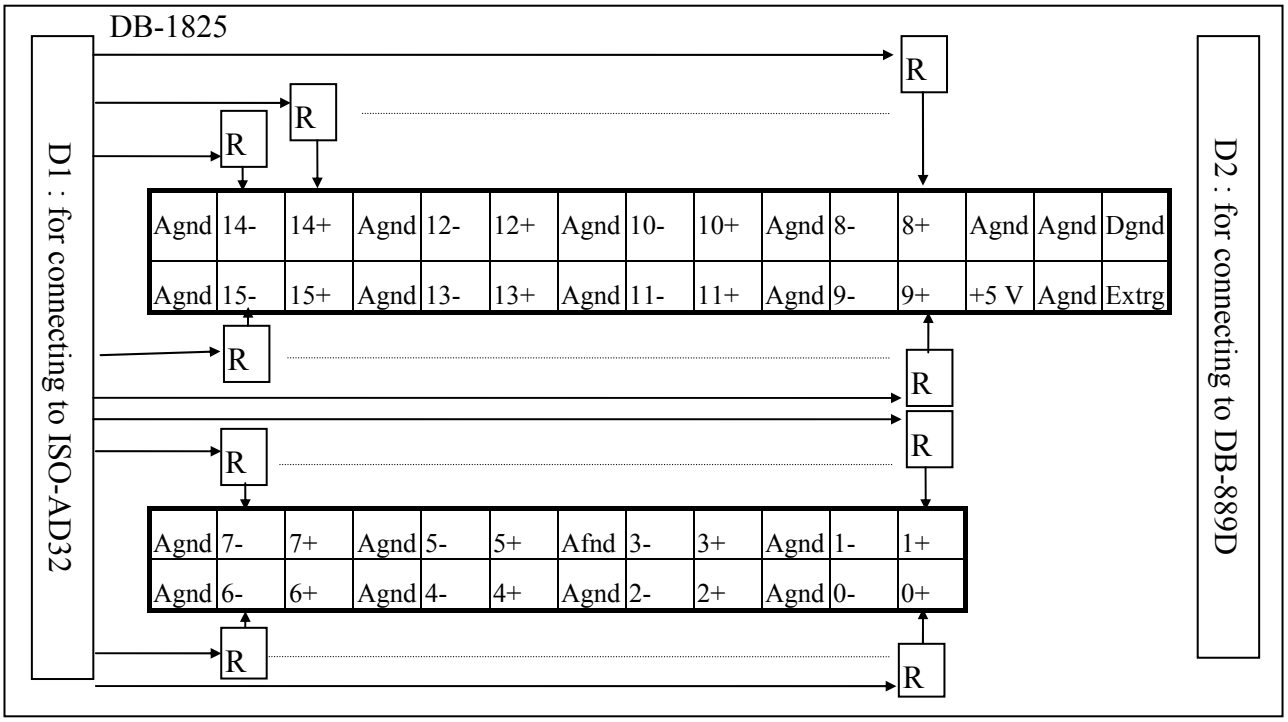
Note:

1. S/s → Samples/Sec.
2. All test are under Windows 98 and Pentium-200 CPU

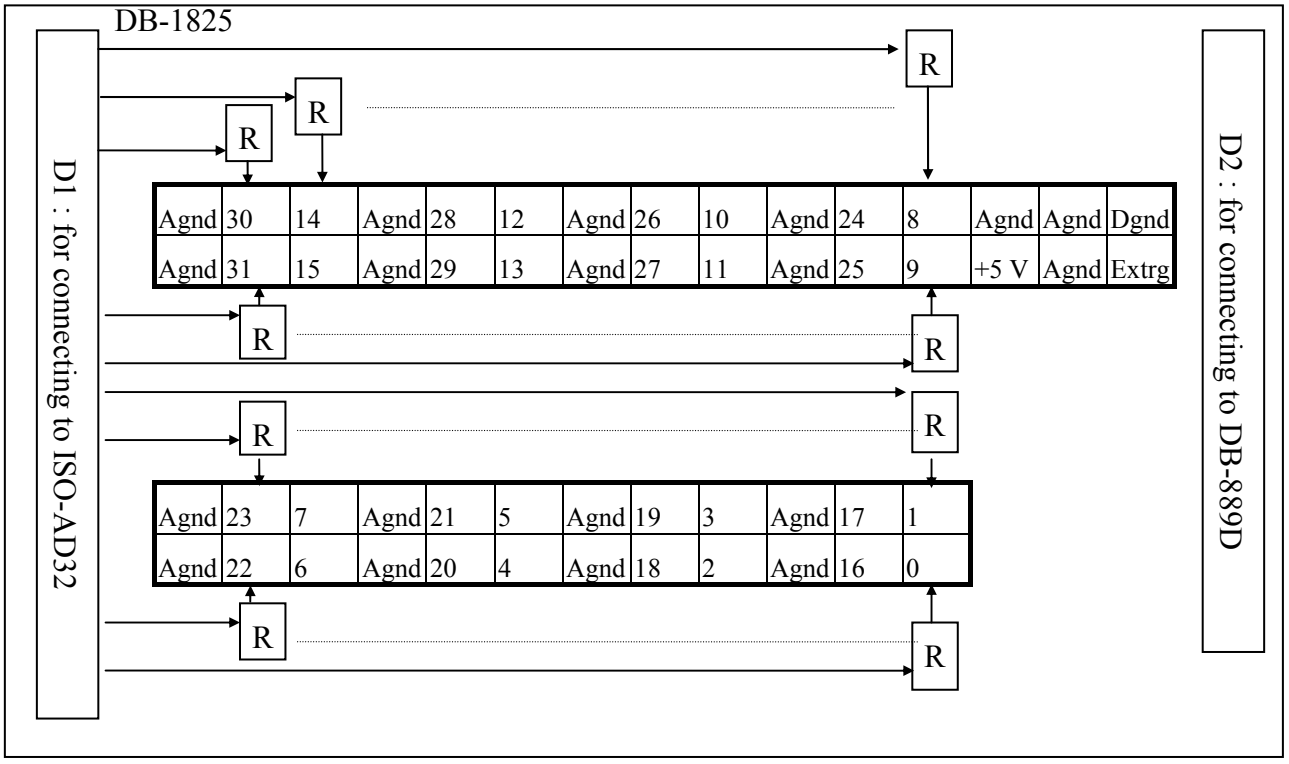
Appendix A : The DB-1825 user manual

A.1 : PCB layout for connecting to ISO_AD32:

For differential input (R=0 ohm)



For single-ended input (R=0 ohm)

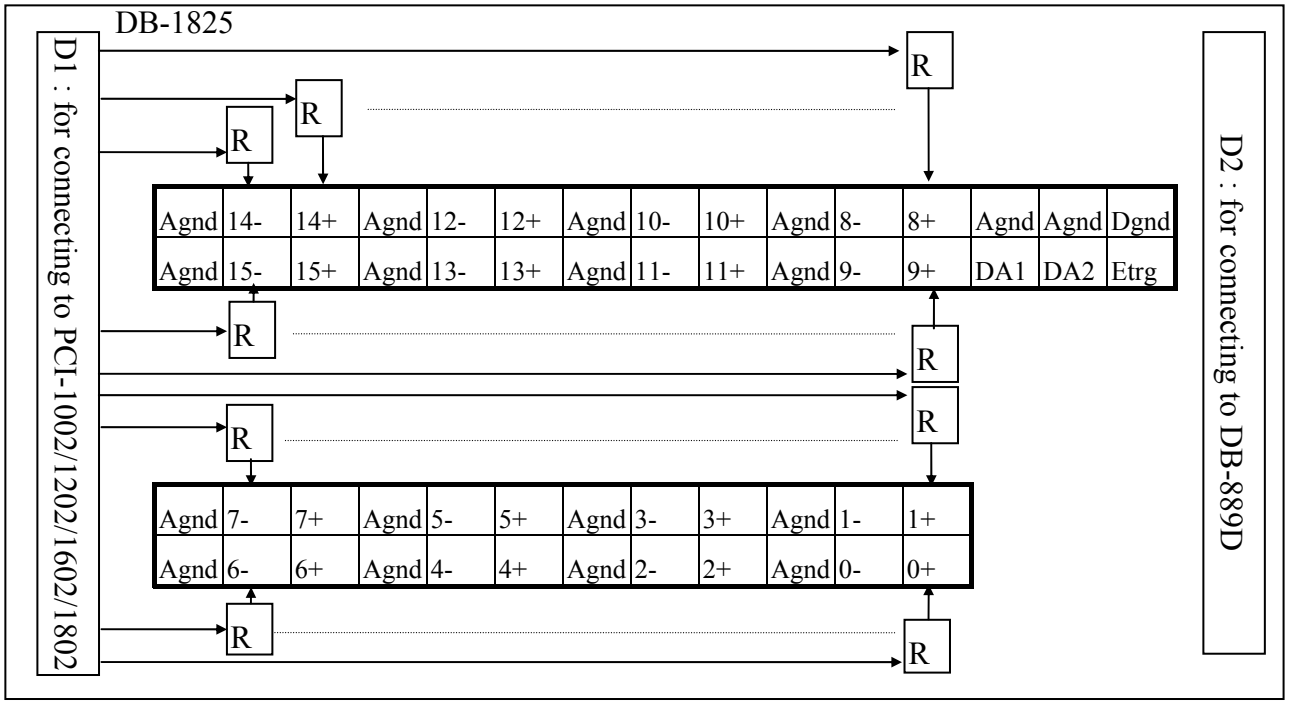


Pin assignment of D1 same as **CN1 of ISO-AD32**

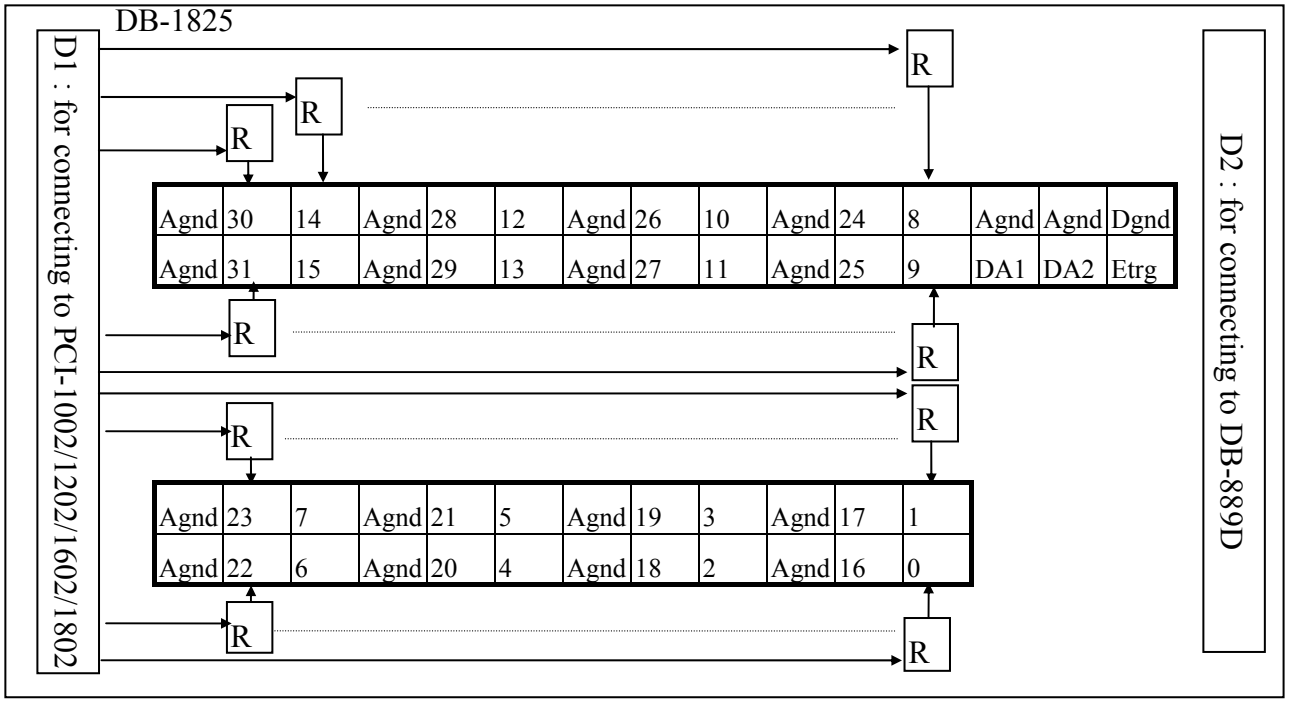
Pin assignment of D2 same as **CN1 of DB-889D**

A.2 : PCB layout for connecting to PCI-1002/1202/1602/1802:

For differential input (R=0 ohm)



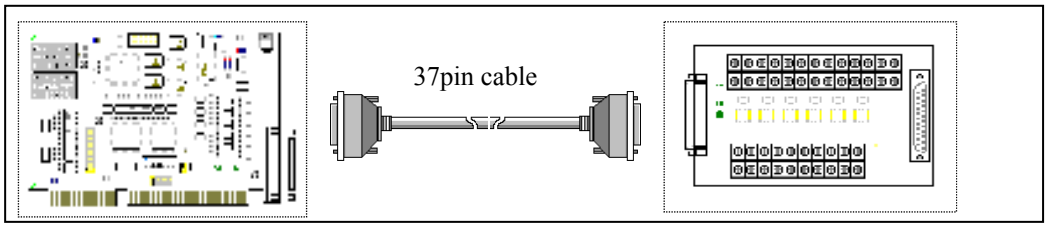
For single-ended input (R=0 ohm)



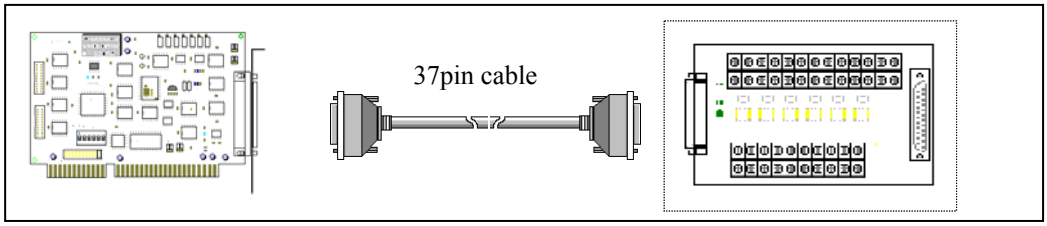
Pin assignment of D1 same as **CON3 of PCI-1002/1202/1602/1802**

Pin assignment of D2 same as **CN1 of DB-889D**

A.3 : connection to ISO-AD32



A.4 : connection to PCI-1002/1202/1602/1802



A.5 : connection to PCI-1x02 and multiple DB-889D(16 channels differential)