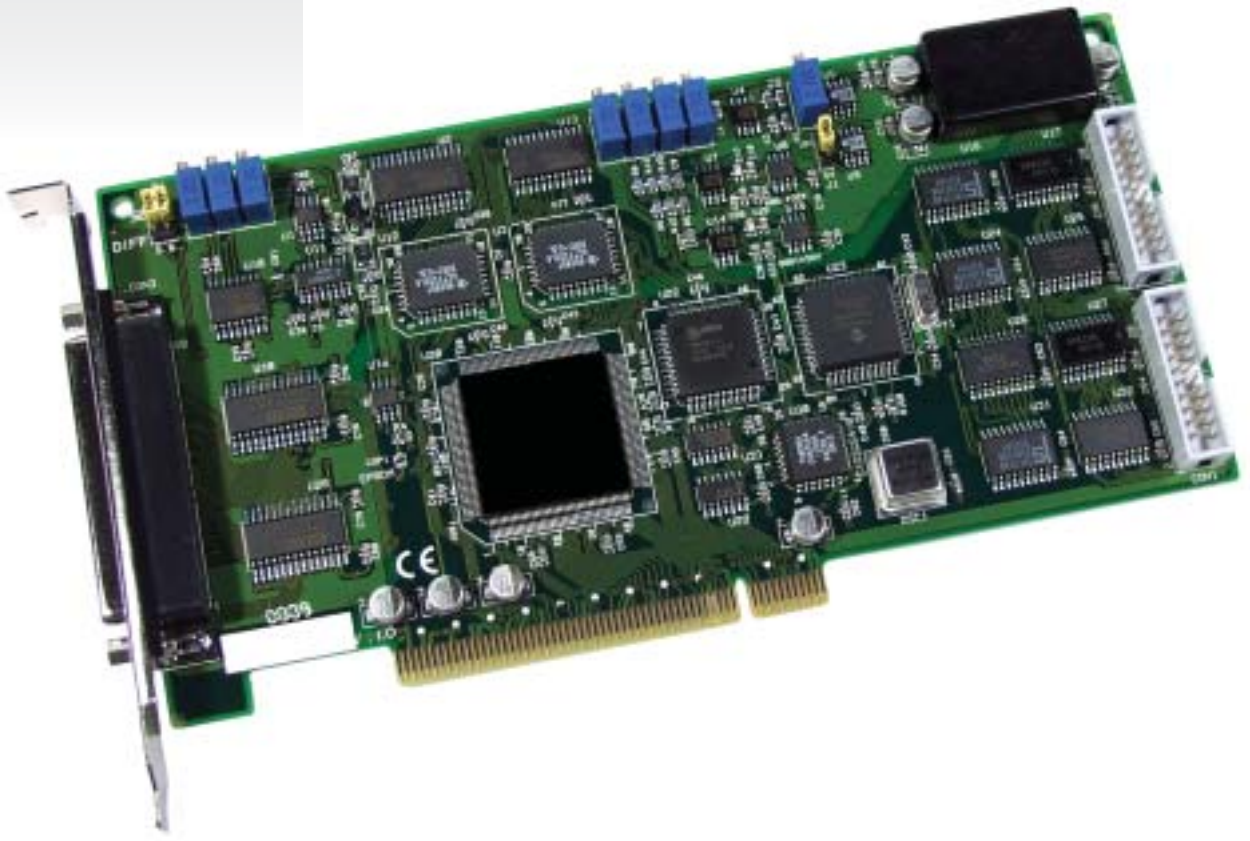
User's Guide



OME-PCI-1202/1602/1800/1802

PCI Data Acquisition Boards

Hardware Manual

omega.com®
OMEGA®

OMEGAnet® Online Service www.omega.com	Internet e-mail info@omega.com

Servicing North America:

USA: ISO 9001 Certified
One Omega Drive, P.O. Box 4047
Stamford CT 06907-0047
TEL: (203) 359-1660 FAX: (203) 359-7700
e-mail: info@omega.com

Canada:
976 Bergar
Laval (Quebec) H7L 5A1, Canada
TEL: (514) 856-6928 FAX: (514) 856-6886
e-mail: info@omega.ca

For immediate technical or application assistance:

USA and Canada: Sales Service: 1-800-826-6342 / 1-800-TC-OMEGA®
Customer Service: 1-800-622-2378 / 1-800-622-BEST®
Engineering Service: 1-800-872-9436 / 1-800-USA-WHEN®
TELEX: 996404 EASYLINK: 62968934 CABLE: OMEGA

Mexico: En Español: (001) 203-359-7803 e-mail: espanol@omega.com
FAX: (001) 203-359-7807 info@omega.com.mx

Servicing Europe:

Benelux:
Postbus 8034, 1180 LA Amstelveen, The Netherlands
TEL: +31 (0)20 3472121 FAX: +31 (0)20 6434643
Toll Free in Benelux: 0800 0993344
e-mail: sales@omegaeng.nl

Czech Republic:
Frystatska 184, 733 01 Karviná, Czech Republic
TEL: +420 (0)59 6311899 FAX: +420 (0)59 6311114
Toll Free: 0800-1-66342 e-mail: info@omegashop.cz

France:
11, rue Jacques Cartier, 78280 Guyancourt, France
TEL: +33 (0)1 61 37 29 00 FAX: +33 (0)1 30 57 54 27
Toll Free in France: 0800 466 342
e-mail: sales@omega.fr

Germany/Austria:
Daimlerstrasse 26, D-75392 Deckenpfronn, Germany
TEL: +49 (0)7056 9398-0 FAX: +49 (0)7056 9398-29
Toll Free in Germany: 0800 639 7678
e-mail: info@omega.de

United Kingdom: ISO 9002 Certified
One Omega Drive, River Bend Technology Centre
Northbank, Irlam, Manchester
M44 5BD United Kingdom
TEL: +44 (0)161 777 6611 FAX: +44 (0)161 777 6622
Toll Free in United Kingdom: 0800-488-488
e-mail: sales@omega.co.uk

Table of Contents

1. Introduction

1.1 General Description

The OME-PCI-1800(H/L) and OME-PCI-1802(H/L) are high performance, multifunction analog and digital I/O PCI boards for PC and compatible computers. This series features a **continuous**, **330K samples/second**, **gap-free** data acquisition under DOS and Windows 95/98/NT/2000/XP. All models feature a 12-bit 330K AD converter, two 12-bit independent DA converters, 16 channels of TTL compatible DI and 16 channels of TTL compatible DO. The 1800H/L provides 16 single-ended or 8 differential analog input channels. The 1802H/L provides 32 single-ended or 16 differential analog input channels. The "**L**" in the part number denotes low gain input range and the "**H**" denotes high gain input range. The two DACs of this multifunction card are independent with bipolar voltage output and jumper selectable output range. The AD scan function of OME-PCI-1800 series is extremely versatile and is called "**MagicScan**". It uses two modes: **the fix channel mode** and **the channel scan mode**, both modes can scan up to 330K samples per second. The boards also provide three trigger modes: software trigger, pacer trigger and external trigger. Each trigger mode uses "**MagicScan**" to perform the data acquisition. The external trigger can be programmed for one of the three trigger types: pre-trigger, post-trigger and middle-trigger. The OME-PCI-1800/1802 fully supports "Plug and Play" under Windows.

The OME-PCI-1202 (H/L) is very similar to OME-PCI-1802 (H/L). The differences are that the OME-PCI-1202 boards only provide a 110K samples/second acquisition rate and a 2 Kword FIFO.

The OME-PCI-1602 features a 16 bit A/D converter. It is very similar to the OME-PCI-1802L. The OME-PCI-1602F has a 200K sample/second acquisition rate and the OME-PCI-1602 has a 100K acquisition rate.

1.2 The Block Diagrams

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

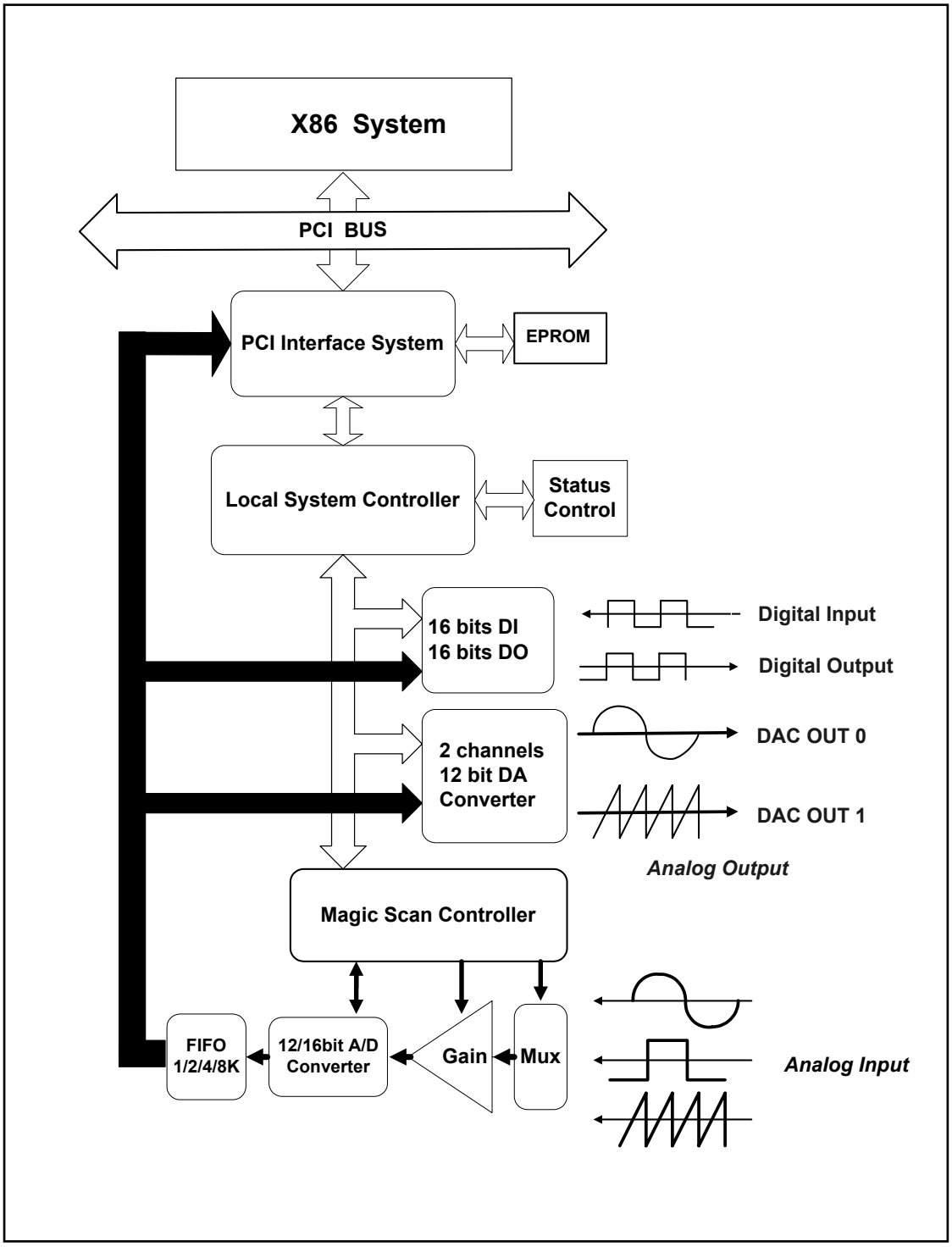


Figure 1-1. The block diagram of OME-PCI-1202/1602/1800/1802.

1.3 Features

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

- Bus: 5V PCI (Peripherals Component Interconnect) bus.

- A/D:
  1. OME-PCI-1800L/1802L: A/D converter = 330K samples/second
     OME-PCI-1800H/1802H: A/D converter = 44K samples/second
     OME-PCI-1602F: A/D converter = 200K samples/second
     OME-PCI-1602: A/D converter = 100K samples/second
     OME-PCI-1202L: A/D converter = 110K samples/second
     OME-PCI-1202H: A/D converter = 44K samples/second
  2. 32 single-ended / 16 differential analog inputs for OME-PCI-1202/1602/1802 H/L.
  3. Three different A/D triggers: software, pacer and external trigger
  4. Three different external triggers: pre-trigger, middle-trigger and post-trigger
  5. Programmable input signal configuration.
  6. "**MagicScan"** advanced scanning function
  7. FIFO: 2K for OME-PCI-1202(H/L)/1800(H/L)
     8K for OME-PCI-1602, OME-PCI-1602F and OME-PCI-1802(H/L)

- D/A:
  1. Two channels independent 12 bits DACs.
  2. Bipolar voltage output with +/-5V or +/- 10V 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:
  1. Three 16-bits timer/counter (8254).
  2. Timer 0 is used as the internal A/D pacer trigger timer.
  3. Timer 1 is used as the external trigger timer.
  4. Timer 2 is used as the machine independent timer for settling time delay.

1.4 Specifications

1.4.1 Power Consumption:

- +5V @ 960mA maximum, OME-PCI-1202/1602/1800/1802.
- Operating temperature : 0°C to +70°C

1.4.2 Analog Inputs

- Channels: (software programmable)
  1. OME-PCI-1202/1602/1802: 32-single-ended/16-differential inputs, jumper select.
  2. OME-PCI-1800: 16-single-ended/8-differential inputs, jumper select.
- Gain control: (software programmable)
  1. OME-PCI-1202/1800/1802 H: 0.5, 1, 5, 10, 50, 100, 500, 1000
  2. OME-PCI-1202/1800/1802 L: 0.5, 1, 2, 4, 8
  3. OME-PCI-1602/1602F: 1,2,4,8

- Bipolar input signal range :
  1. OME-PCI-1202/1800/1802 L: ±10V,±5V, ±2.5V, ±1.25V, ±0.0625V
  2. OME-PCI-1202/1800/1802 H: ±10V,±5V,±1V, ±0.5V, ±0.1V, ±0.05V, ±0.01V, ± 0.005V
  3. OME-PCI-1602/1602F: ±10V,±5V,±2.5V,±1.25V

- Unipolar input signal range :
  1. OME-PCI-1202/1800/1802 L: 0 to10V, 0 to5V, 0 to 2.5V, 0 to 1.25V
  2. OME-PCI-1202/1800/1802 H: 0 to10V, 0 to1V, 0 to 0.1V, 0 to 0.01V
- Input current: 250 nA max (125 nA typical) at 25 °C.
- Over voltage : continuous single channel to **70Vp-p**
- Input impedance :
  OME-PCI-1202/1800/1802 H: $10^{10}\Omega$ // 6pF
  OME-PCI-1202/1602/1800/1802 L: $10^{13}\Omega$ // 1pF

1.4.3 A/D Converter

- Resolution: 12-bit for OME-PCI-1202/1800/1802 H/L
  16-bit for OME-PCI-1602/1602F

- Conversion Cycle: 330K s/s for OME-PCI-1800L/1802L
  44K s/s for OME-PCI-1800H/1802H
  200K s/s for OME-PCI-1602F
  100K s/s for OME-PCI-1602
  110K s/s for OME-PCI-1202L
  44K s/s for OME-PCI-1202H

- Internal sample and hold.

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

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

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

Analog Input	Digital Output Binary Code	Hex Code
	MSB LSB	
+99.9V	0111 1111 1111 1111	7FFF
+0V	0000 0000 0000 0000	0000
-305μV	1111 1111 1111 1111	FFFF
-10V	1000 0000 0000 0000	8000

1.4.4 A/D Trigger Methods

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

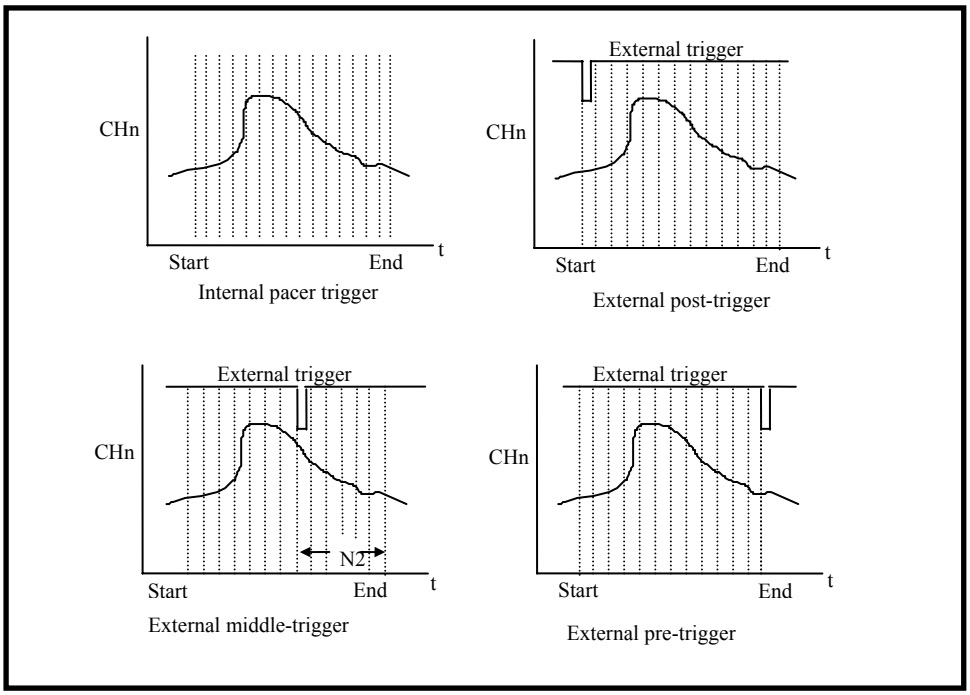


Figure. 1-2. Trigger modes of OME-PCI-1202/1602/1800/1802.

1.4.5 A/D Throughput

Throughput of OME-PCI-1800L/1802L

Gain	Bipolar(V)	Unipolar(V)	Throughput
0.5	±10V	0 to 10V	333 Ks/s
1	±5V	0 to 10V	333 Ks/s
2	±2.5V	0 to 5V	333 Ks/s
4	±1.25V	0 to 2.5V	333 Ks/s
8	±0.625V	0 to 1.25V	333 Ks/s

Throughput of OME-PCI-1602F/1602

Gain	Bipolar(V)	Throughput (1602F)	Throughput (1602)
1	±10V	200 Ks/s	100 Ks/s
2	±5V	200 Ks/s	100 Ks/s
4	±2.5V	200 Ks/s	100 Ks/s
8	±1.25V	200 Ks/s	100 Ks/s

Throughput of OME-PCI-1202L

Gain	Bipolar(V)	Unipolar(V)	Throughput
0.5	±10V	0 to 10V	110 Ks/s
1	±5V	0 to 10V	110 Ks/s
2	±2.5V	0 to 5V	110 Ks/s
4	±1.25V	0 to 2.5V	110 Ks/s
8	±0.625V	0 to 1.25V	110 Ks/s

Throughput of OME-PCI-1202H/1800H/1802H

Gain	Bipolar(V)	Unipolar(V)	Throughput
0.5/1	±10/±5V	0 to 10V	40 Ks/s
5/10	±1/±0.5V	0 to 1V	40 Ks/s
50/100	±0.1/±0.05V	0 to 0.1V	10 Ks/s
500/1000	±0.01/±0.005V	0 to 0.01V	1 Ks/s

1.4.6 D/A Converter

- Channels: 2 independent.
- DAC Type: 12-bit multiplying DA converter.
- Accuracy: ±1 bit.
- Output type: 12-bit double buffered
- Output range: -5 to +5V or -10 to +10V jumper select.
- Output drive: ± 5mA
- Settling time: 0.4 μs (typical) to 0.01% for full scale step.
- Data transfer rate: 2.1 Mwords/second (non-burst mode).

12- bit DAC output code for OME-PCI-1202/1602/1800/1802 H/L

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)

1.4.7 Digital I/O

- Output port: 16-bit, TTL compatible
- Input port: 16-bit, TTL compatible
- Throughput: 2.1M word/sec (non-burst mode)

1.4.8 Interrupt Channel

- Interrupt: Automatically assigned by ROM BIOS.
- Enable/Disable: Via on-board control register.

1.4.9 Programmable Timer/Counter

- Type: 82C54 programmable timer/counter
- Timers: three 16-bit independent timer
  1. Timer 0 is used as the internal A/D pacer trigger timer.
  2. Timer 1 is used as the external trigger A/D pacer timer.
  3. Timer 2 is used as the machine independent timer.
- Input clock: 8 MHz.

1.5 Applications

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

1.6 Product Check List

In addition to this manual, the package includes the following items:

- OME-PCI-1202/1602/1800/1802 H/L multifunction card.
- NAPPCI/dos CD-ROM or diskette.
- Software User's Manual on CD

Please read the release notes first, they contain the latest updates not found in this and the other user manuals.

Note

If any of these items are missing or damaged, please contact OMEGA. It is suggested that you 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

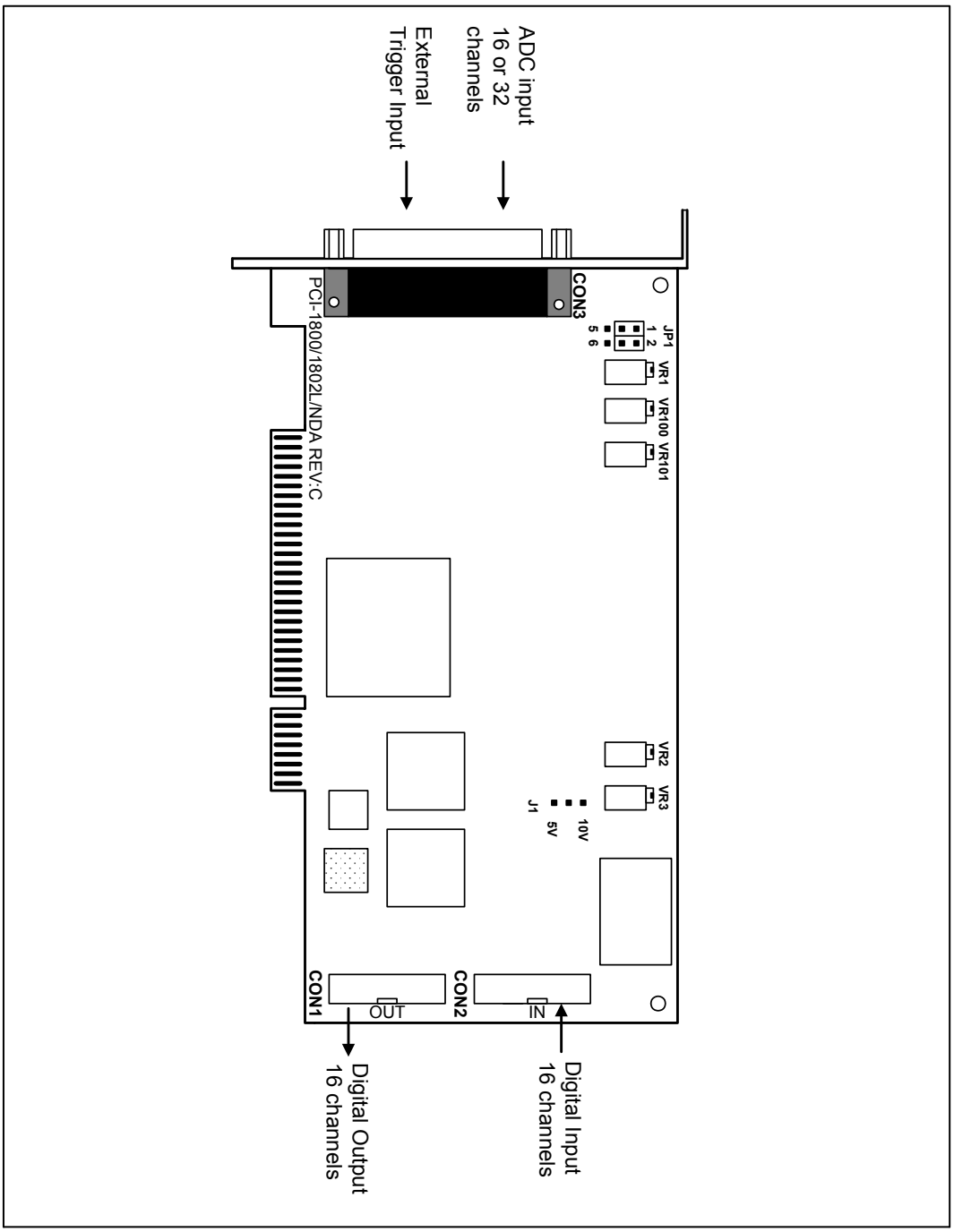


Figure 2-1. OME-PCI-180X(H/L) /NDA board layout.

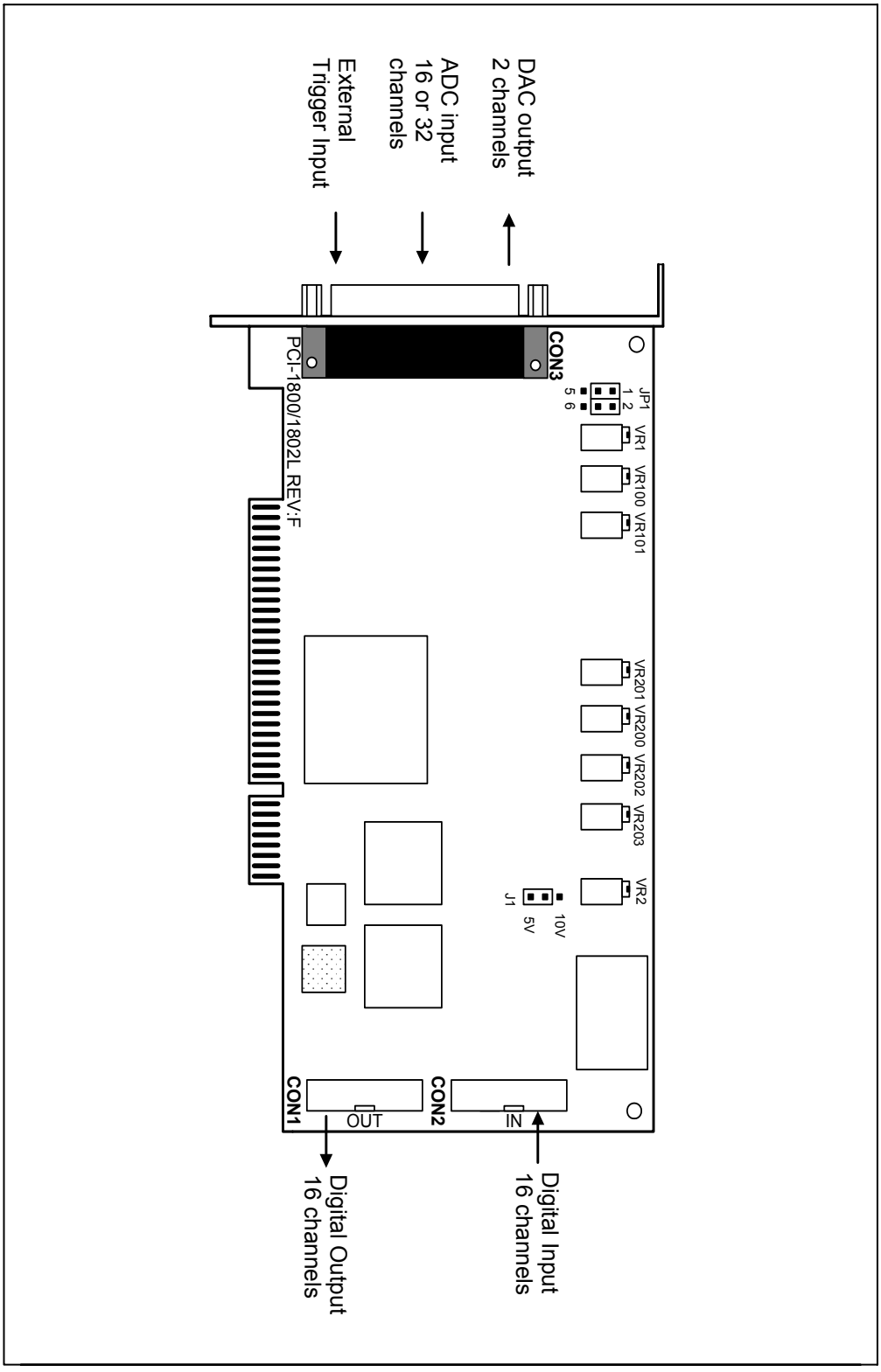


Figure 2-2. OME-PCI-1202(H/L)/1800(H/L)/1802(H/L) board layout.

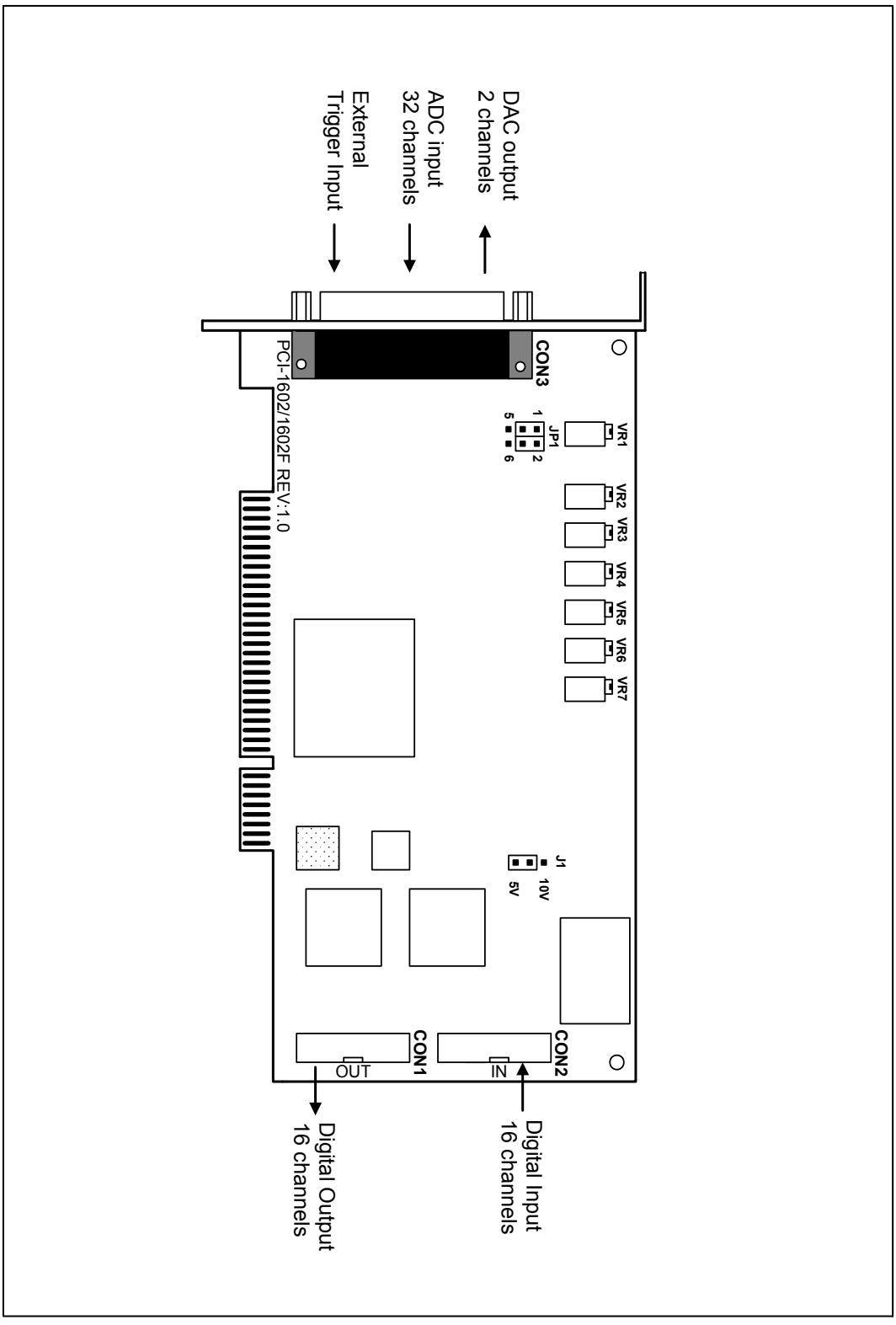
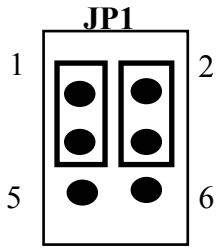


Figure 2-3. OME-PCI-1602/1602F board layout.

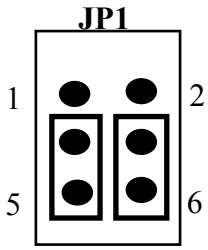
2.2 Jumper Setting

2.2.1 JP1: A/D Input Type Selection

This jumper is used to select the analog input type. For single-ended inputs, connect pin 1,3 and pin 2,4. For differential inputs, pin 3,5 and pin 4,6 should be connected.



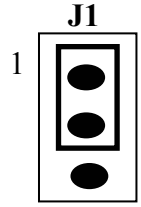
Single-Ended Inputs **(default)**



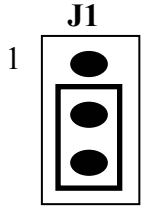
Differential Inputs

2.2.2 J1: D/A Reference Voltage Selection

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



± 10 Voltage output (**default**)

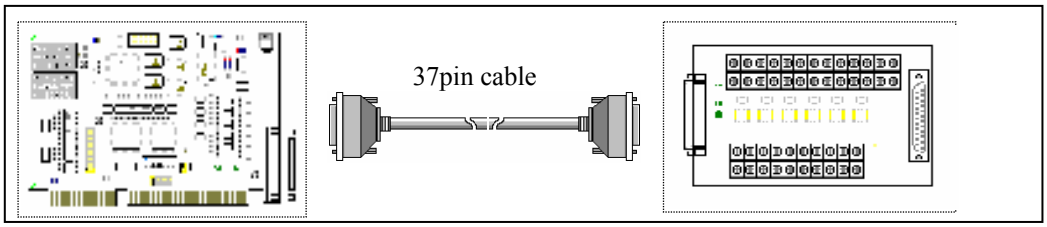


± 5 Voltage output

2.3 Daughter Boards

2.3.1 OME-DB-1825

The OME-DB-1825 is a daughter board designed for 32-channel AD cards such as the OME-PCI-1202/1602/1802. Refer to Appendix A for details on the OME-DB-1825.

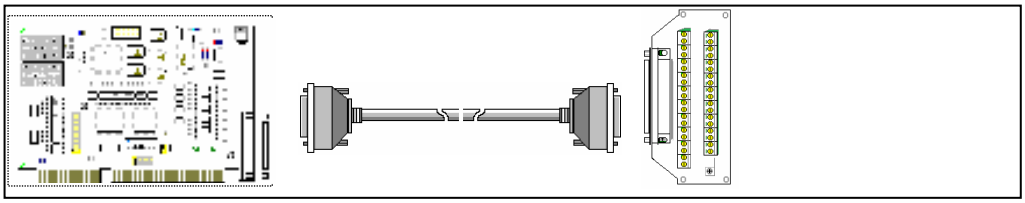


2.3.2 OME-DB-8225

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

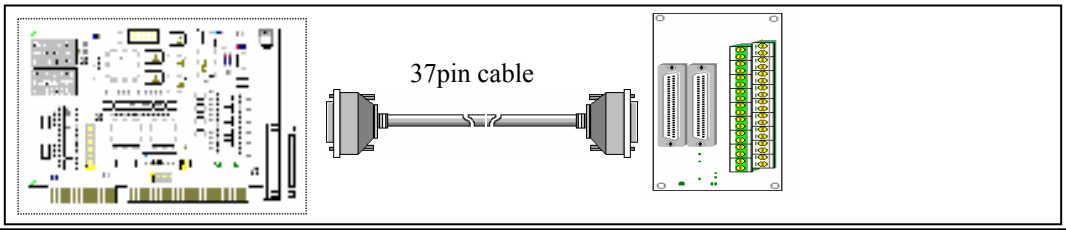
2.3.3 OME-DB-37

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



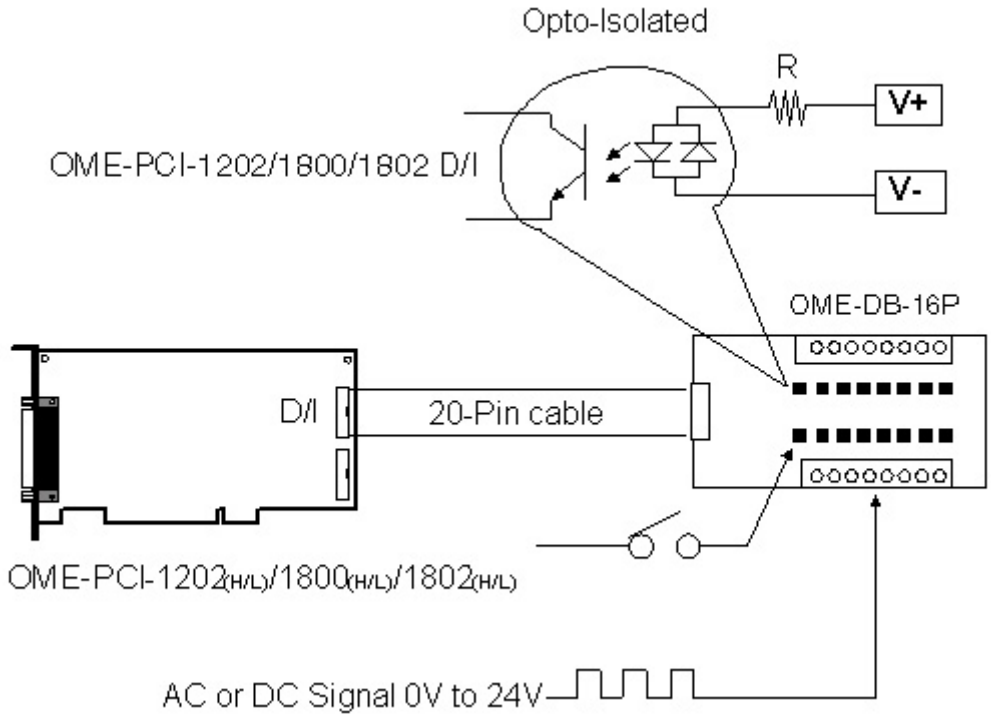
2.3.4 OME-DN-37

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



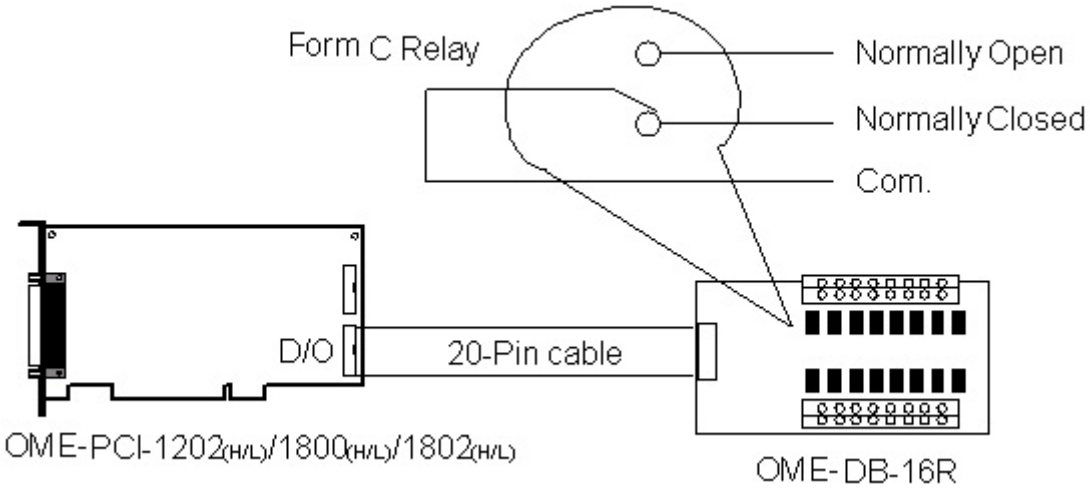
2.3.5 OME-DB-16P Isolated Input Board

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



2.3.6 OME-DB-16R Relay Board

The OME-DB-16R, 16-channel relay output board consists of 16 from C relays used for switching loads under program control. Applying 5 volts to the appropriated relay channel on the 20-pin flat connector energizes the relays. There is 16 status LEDs for each relay, which light when their associated relay is activated. To avoid overloading your PC's power supply, this board provides a screw terminal connection an for external power supply.

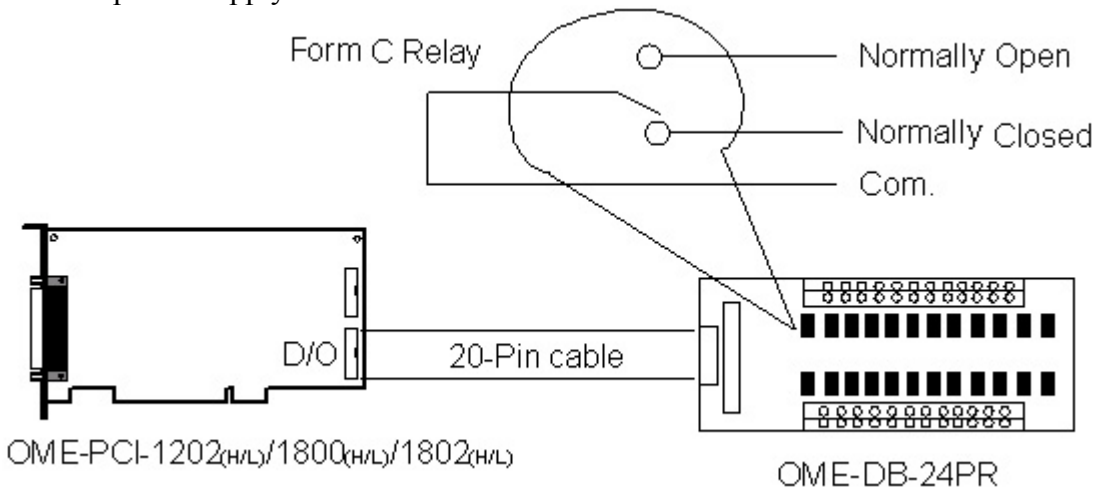


Note: Channel: 16 Form C Relay

Relay: Switching up to 0.5A at 110ACV or 1A at 24 DCV

2.3.7 OME-DB-24PR Power Relay Board

The OME-DB-24PR, 24-channel power relay output board consists of 8 form C and 16 form A electromechanical relays for switching a load under program control. Each relay contact is rated to 5A at 250ACV/30VDCV. The relay is energized by applying a 5 volt signal to the appropriate relay channel on the 20-pin flat cable connector or 50-pin flat cable connector. Each channel has an LED which will light when the associated relay is activated. To avoid overloading your PC's power supply, the board requires a +12VDC or +24VDC external power supply.



Channel: 16 Form A Relays, 8 Form C Relays

Relay: Switching up to 5A at 110ACV / 5A at 30DCV

2.4 Analog Input Signal Connection

The OME-PCI-1202/1602/1800/1802 can measure signals in the single-ended or differential mode. In the differential mode each channel has a unique signal HIGH and signal LOW connection. In the single-ended mode all channels have a unique signal HIGH connection but share a common LOW or ground connection. Differential connections are very useful for low level signals (millivolt), since they better reject electrical noise that can affect the quality of the measurement. A differential connection is also necessary when a common ground is unacceptable. The benefit of using a single-ended connection is that twice the number of channels is available. In general, a single-ended connection is often a good choice when working with higher level signals (5V or 10V for example), especially if the signal is coming from an isolated device such as a signal conditioner. Several different types of wiring diagrams are discussed below.

Figure 2-4A shows a differential connection to a grounded source. If the source is grounded, making a second connection to the card's ground could cause a ground loop resulting in erroneous data. **It is important to note that the maximum common mode voltage between the input source and AGND is 70Vp-p. If the card is connected to a source with a common mode voltage greater than 70Vp-p, the input multiplexer will be permanently damaged!** When measuring common mode voltage, it is best to use an oscilloscope rather than a multi-meter.

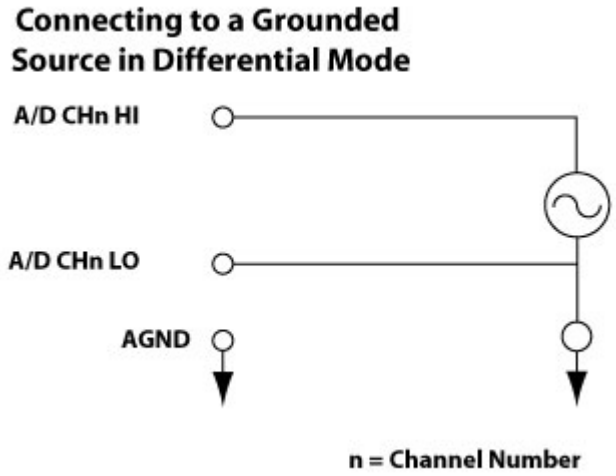
Figure 2-4B shows a differential connection to a floating source. In such cases a connection should be made between the low channel input and analog ground.

Figure 2-5 shows connection of multiple sources in single-ended mode. This connection assumes creating one common ground will not cause a problem. This is normally the case when connecting to devices that are isolated or floating.

Figure 2-6 demonstrates how to connect bridge transducers. Bridge transducers include strain gauges, load cells and certain type of pressure transducers. The diagram assumes that there is a single external power supply providing power to the bridge. Each bridge is connected to a differential channel. No connection is made between channel low and analog ground. A connection should be made between analog ground and the negative of the power supply. An isolated power supply is strongly suggested.

Figure 2-7 demonstrates how to connect a 4-20mA current loop. Since the card reads voltages, the current is converted to voltage by passing it through a shunt resistor. By Ohms law (V=IR), when using a 250Ω resistor, 4 mA will be converted to 1 volt and 20mA to 5V. If the source is linear, the output voltage range will also be linear.

Figure 2-4A



If the source is grounded, a second ground connection on the card could result in a ground loop.

Figure 2-4B

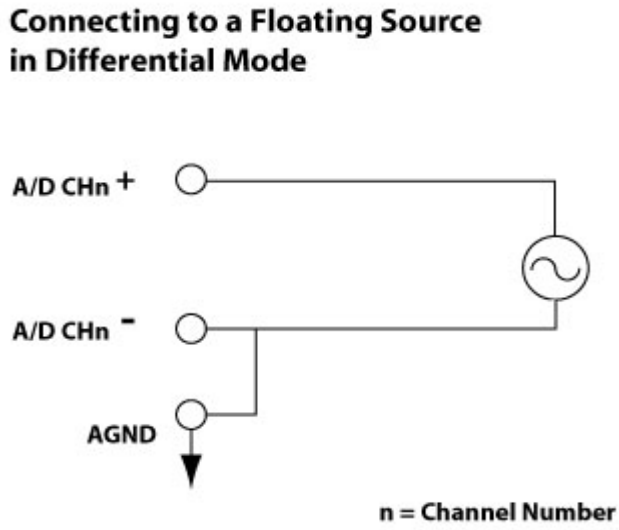


Figure 2-5

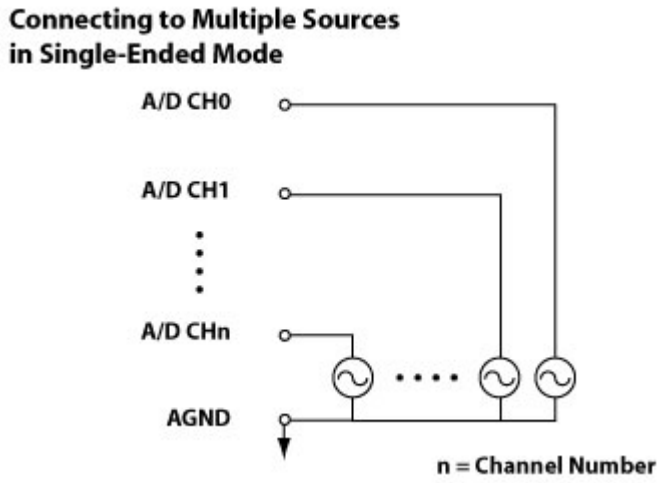


Figure 2-6

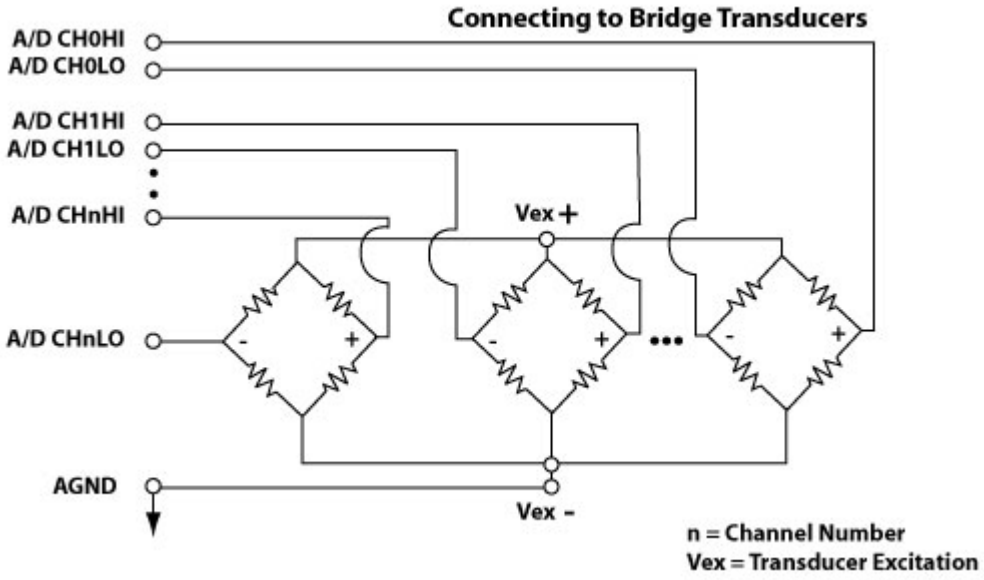
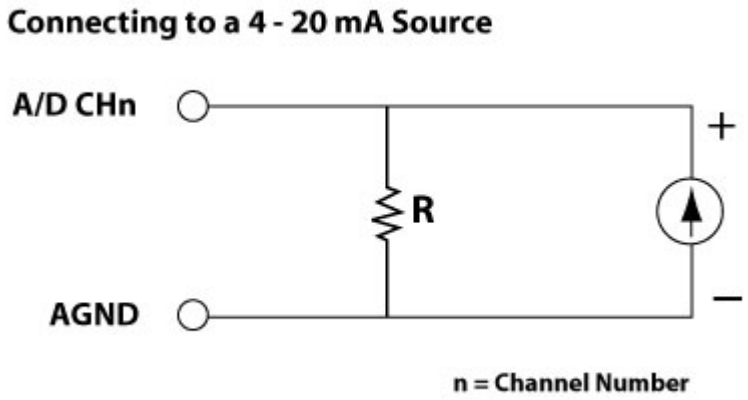


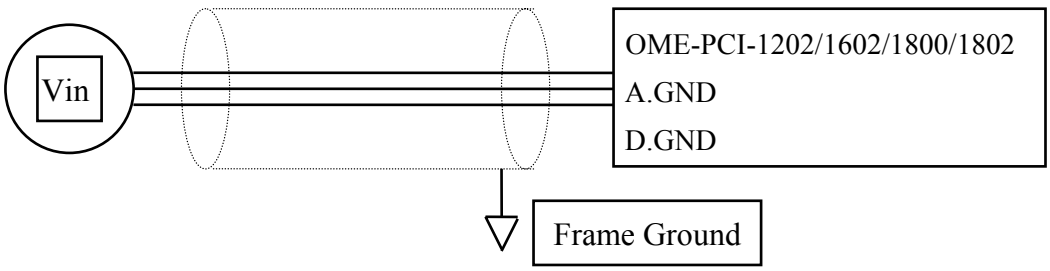
Figure 2-7



R is a shunt resistor. A 250Ω shunt resistor converts 4-20mA to 1-5Vdc.

Signal Shielding

- The signal shielding connections in Figure 2-4 to Figure 2-7 are all the same
- Use a single connection to **frame ground (not A.GND or D.GND)**



2.5 The Connectors

CON1: Pin assignment of the digital output connector

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

CON2: Pin assignment of digital input connector

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

C0N3: pin assignment of single-ended/differential inputs (for OME-PCI-1202/1602/1802H/L)

Pin	Name	Pin	Name
1	Analog input 0/0+	20	Analog input 16/0-
2	Analog input 1/1+	21	Analog input 17/1-
3	Analog input 2/2+	22	Analog input 18/2-
4	Analog input 3/3+	23	Analog input 19/3-
5	Analog input 4/4+	24	Analog input 20/4-
6	Analog input 5/5+	25	Analog input 21/5-
7	Analog input 6/6+	26	Analog input 22/6-
8	Analog input 7/7+	27	Analog input 23/7-
9	Analog input 8/8+	28	Analog input 24/8-
10	Analog input 9/9+	29	Analog input 25/9-
11	Analog input 10/10+	30	Analog input 26/10-
12	Analog input 11/11+	31	Analog input 27/11-
13	Analog input 12/12+	32	Analog input 28/12-
14	Analog input 13/13+	33	Analog input 29/13-
15	Analog input 14/14+	34	Analog input 30/14-
16	Analog input 15/15+	35	Analog input 31/15-
17	Analog ground	36	Analog output 1
18	Analog output 0	37	Digital ground
19	External trigger		

CON3: pin assignment of single-ended/differential input.(for OME-PCI-1800H/L)

Pin	Name	Pin	Name
1	Analog input 0/0+	20	Analog input 8/0-
2	Analog input 1/1+	21	Analog input 9/1-
3	Analog input 2/2+	22	Analog input 10/2-
4	Analog input 3/3+	23	Analog input 11/3-
5	Analog input 4/4+	24	Analog input 12/4-
6	Analog input 5/5+	25	Analog input 13/5-
7	Analog input 6/6+	26	Analog input 14/6-
8	Analog input 7/7+	27	Analog input 15/7-
9	Analog Ground	28	Analog Ground
10	Analog Ground	29	Analog Ground
11	N.C.	30	Analog output 0
12	N.C.	31	N.C.
13	PCB +12V	32	Analog output 1
14	Analog Ground	33	N.C.
15	Digital Ground	34	N.C.
16	N.C.	35	N.C.
17	External Trigger	36	N.C.
18	N.C.	37	N.C.
19	PCB +5V		

N.C.: Abbreviation of "Not Connected ".

3. I/O Control Register

3.1 How to Find the I/O Address

During the computer's power-on stage the plug&play BIOS will assign a valid I/O address to each OME-PCI-1800/1802 card. The P180X_DriverInit(..) can detect how many OME-PCI-1800/1802 cards are in the system and the I/O addresses of these cards. The P180X_DriverInit(..) is supported in both DOS and Windows driver versions. The P180X_DriverInit(..) must be called before any other driver function. The P180X_DriverInit(..) will:

1. Detect how many OME-PCI-1800/1802 cards in the system?
2. Detect and save the I/O control address of every OME-PCI-1800/1802 card

Sample program code is shown below:

```
wRetVal=P180X_DriverInit(&wBoards);     /* call P180X_DriverInit(..) first */
printf("Threre 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 activate a board, */
/* then all operations will apply to the active board. */
printf("Now Active First P180X Card...\n");
P180X_ActiveBoard( 0 );
```

- **P1202_DriverInit(…) is designed for OME-PCI-1202H/L**
- **P1602_DriverInit(…) is designed for OME-PCI-1602 andOME-PCI-1602F**

3.2 The Assignment of I/O Address

The plug & play BIOS will assign a valid I/O address to OME-PCI-1202/1602/1800/1802. If there is only one OME-PCI-1202/1602/1800/1802, the user can easily identify board_1. If there are two OME-PCI-1202/1602/1800/1802 cards in the system, identifying each board is a little more complicated. The software driver can support up to 16 boards. Therefore the user can install 16 boards in one PC system.

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

1. If present, remove the 20-pin flat cable between CON1 and CON2
2. Install the OME-PCI-1202/1602/1800/1802 cards into the PC
3. Power-on and run DEMO15.EXE
4. At this time, all D/I values will be different from the D/O values
5. Install on any OME-PCI-1202/1602/1800/1802 card, a 20-pin flat cable between CON1 & CON2
6. In the software one of the cards will have the same D/I value and D/O value. That is the card with the cable.
7. Repeat the process to identify the remaining cards

3.3 The I/O Address Map

The I/O address of OME-PCI-1202/1602/1800/1802 is automatically assigned by the computer's ROM BIOS. The I/O address can also be reassigned by the user. **It is strongly recommended that the user not change the I/O address assigned by the BIOS.** There are five sections of I/O addresses used by this card and each section can be assigned to an unused I/O space. The hardware I/O ports are described below:

Section	Address	Name	Operation	Access
1	Section1 + 0h	PCI controller add-on mail box	W	32-bits
	Section1 + 38h	PCI interrupt control register	R/W	32bits
	Section1 + 3Ch (or 3Eh, 3Fh)	On board NV-RAM access control register	R/W	32 bits (8 bits)
2	Section2 + 00h	8254 timer1	R/W	8/16/32 bits
	Section2 + 04h	8254 timer2	R/W	8/16/32 bits
	Section2 + 08h	8254 timer3	R/W	8/16/32 bits
	Section2 + 0Ch	8254 control	W	8/16/32 bits
3	Section3 +00h	Control register	W	16/32 bits
	Section3 + 00h	Status register	R	8/16/32 bits
	Section3 + 04h	A/D sofware trigger	W	8/16/32 bits
4	Section4 + 00h	DI port	R	16 bits
	Section4 + 00h	DO port	W	16 bits
5	Section5 + 00h	A/D data port	R	16 bits
	Section5 + 00h	D/A channel 1.	W	16 bits
	Section5 + 04h	D/A channel 2.	W	16 bits

The driver name of these address are given as follows:

```
section_2 : wAddrTimer   → save in wConfigSpace[Board][0]
section_3 : wAddrCtrl    → save in wConfigSpace[Board][1]
section_4 : wAddrDio     → save in wConfigSpace[Board][2]
section_5 : wAddrAdda    → save in wConfigSpace[Board][3]
```

3.4 Section 1: PCI Controller

Although 64 I/O ports are used by the on-board OME-PCI-controller, only 3 registers can be directly accessed by the user.

Address		Access	Functions	Operation
+ 0		Write only (32 bit)	Out-going mail-box	Write a 0 to wait for add-on interrupt.
+38		Write (32bit)	Enable/Re-enable/ Disable target interrupt	1. Enable : Write 00010010h to this port. 2. Re-enable: Write 00010010h to this port. 3. Disable : Write 0 to this port.
		Read (32bit)	Read interrupt status.	Bit 16 : 1 → interrupt generated. 0 → no interrupt.
+3C (32bit)	+3F (8bits)	Write (8bit)	Write command to nvRAM control register	0x80 : load low address 0xA0: load high address 0xC0: begin write. 0xE0: begin read.
		Read (8bit)	Read status from nvRAM control register	Bit 7 : 1 → busy 0 → ready
	+3E (8bits)	Write (8bit)	Write nvRAM address or nvRAM data to register.	After finish writing to nvRAM control register, write data to this port.
		Read (8bit)	Read nvRAM data from this register.	After finish writing to nvRAM control register, read data from this port..

The user does not normally need to access this register. Refer to "AMCC S5933 PCI Controllers User Manual" for all registers details.

3.5 Section 2: Timer Control

The timer-0 is used as the internal trigger A/D pacer timer. The timer-1 is used for the external trigger pacer timer. The timer-2 is used as the machine independent timer. **Timer-2 is used for settling time delay, a critical function.** Refer to Intel's "Microsystem Components Handbook" for 8254 programming. The block diagram of the 8254 timer is show below:

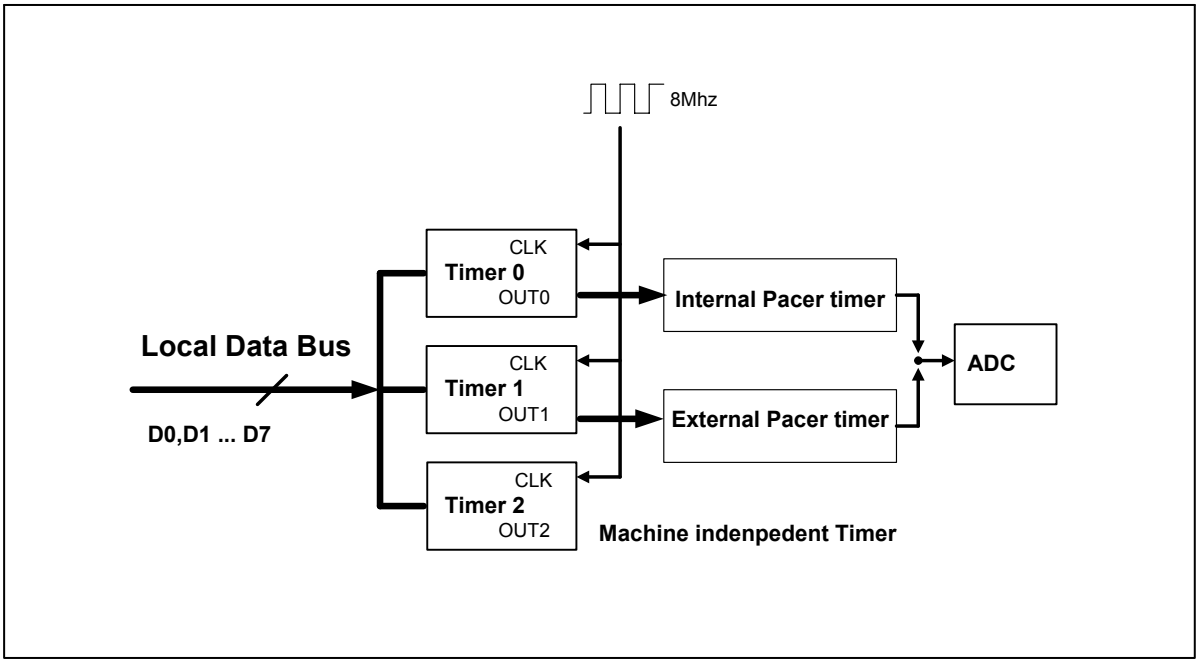


Figure 3-1: The block diagram of OME-PCI-1202/1602/1800/1802 8254 timer.

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           = 8M
   down count 8 time     = 1 us
   down count 65536/8 = 8192 uS --> max 8191 uS
*/
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 forOME-PCI-1202H/L**
- **P1602_DelayUs(…) is designed forOME-PCI-1602 andOME-PCI-1602F**

3.6 Section 3: Control Register

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

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

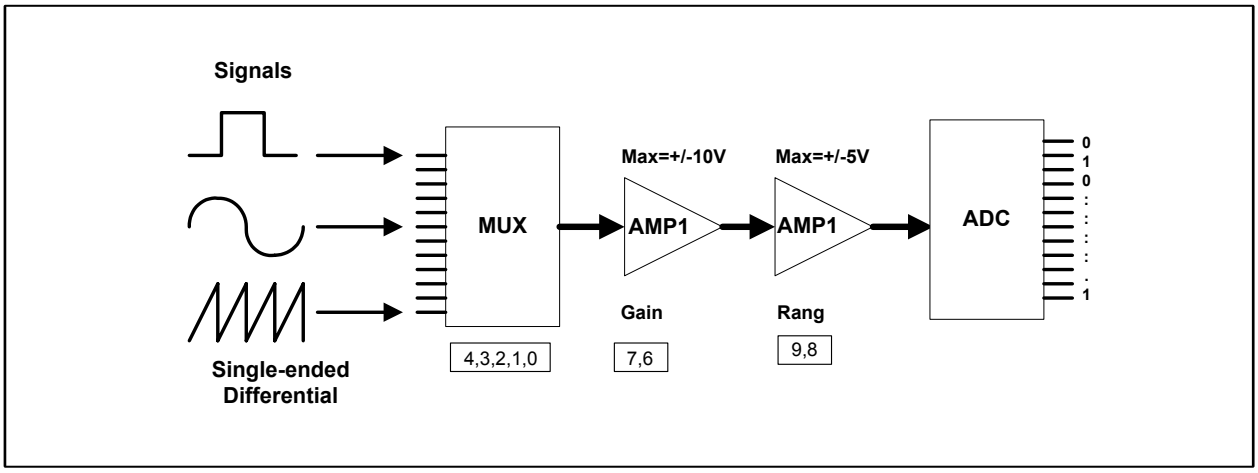


Figure 3-2: The flow diagram of an analog input signal.

3.6.1 The Control Register

The format of the control register is given as follows:

B15	B14	B13	B12 toB10	B9, B8	B7, B6	B5	B4 to 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-1XXXL	PCI-1XXXH
[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]	Output
[0, 0]	PGA
[1, 0]	PGA-5
[0, 1]	PGA/2
[1, 1]	PGA/2 - 5

3.6.1.4 Configuration Table

Configuration table for OME-PCI-1202L/1800L/1802L

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

Configuration table of OME-PCI-1202H/1800H/1802H

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

3.6.1.5 Set Channel Configuration

The SetChannelConfig command sets the channel/gain:

```
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 used for OME-PCI-1202H/L**
- **P1602_SetChannelConfig(…) is used for OME-PCI-1602 and OME-PCI-1602F**

3.6.1.6 Calculate the A/D Value

Converting A/D value to a real number:

```
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 OM-EPCI-1202/1800/1802L

Note: B4=0 is used to identify PGL

For OME-PCI-1202/1800/1802H

Note: B4=1 is used to identify PGH

3.6.1.7 MagicScan Controller Commands

Command	[B12toB10]	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 OME-PCI-1202/1602/1800/1802.

Resetting the MagicScan controller:

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

The program code to clear the MagicScan queue is shown below:

```
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 OME-PCI-1202H/L**
- **P1602_ClearScan(…) is designed for OME-PCI-1602 and OME-PCI-1602F**

Sending commands to the MagicScan controller is shown below:

```
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 program code to set the channel/gain is shown below:

```
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 OME-PCI-1202H/L**
- **P1602_SetChannelConfig(…) is designed for OME-PCI-1602 and OME-PCI-1602F**

The program code to add to the MagicScan queue is shown below:

```
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 OME-PCI-1202H/L**
- **P1602_AddToScan(…) is designed for OME-PCI-1602 and OME-PCI-1602F**

The program code to start the MagicScan operation is shown below:

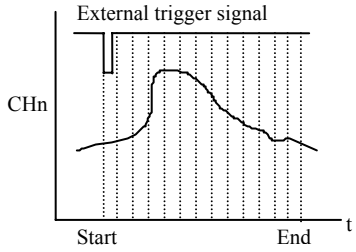
```
WORD  P180X_StartScan(WORD wSampleRate, WORD wNum)
{
WORD wVal;
WORD wRetVal;

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=8M/dwSample */
magic_scan();                     /* Call MagicScan subroutine(DOS) or thread(Windows) */
return(NoError);
}
```

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

3.6.1.8 External Trigger Control

*Setting a **post-trigger***

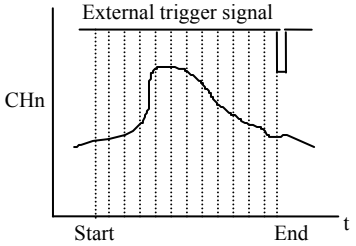
Step 1: Disable all external triggers
Step 2: Set the pacer rate of timer-1
Step 3: Clear FIFO & disable timer-1
Step4: Wait until external trigger signal to enable timer-1
Step 5: Fetch N data(N=End-Start)
Step 6: Stop all timers



External post-trigger timing

Setting a **pre-trigger**

Step 1: Disable all external triggers
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 timers

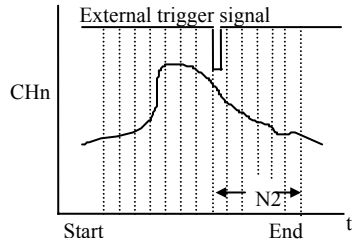


External pre-trigger timing diagram

NOTE: The circular-fetch operation is performed by software

Setting a **middle-trigger**:

Step 1: Disable all external triggers
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 timers

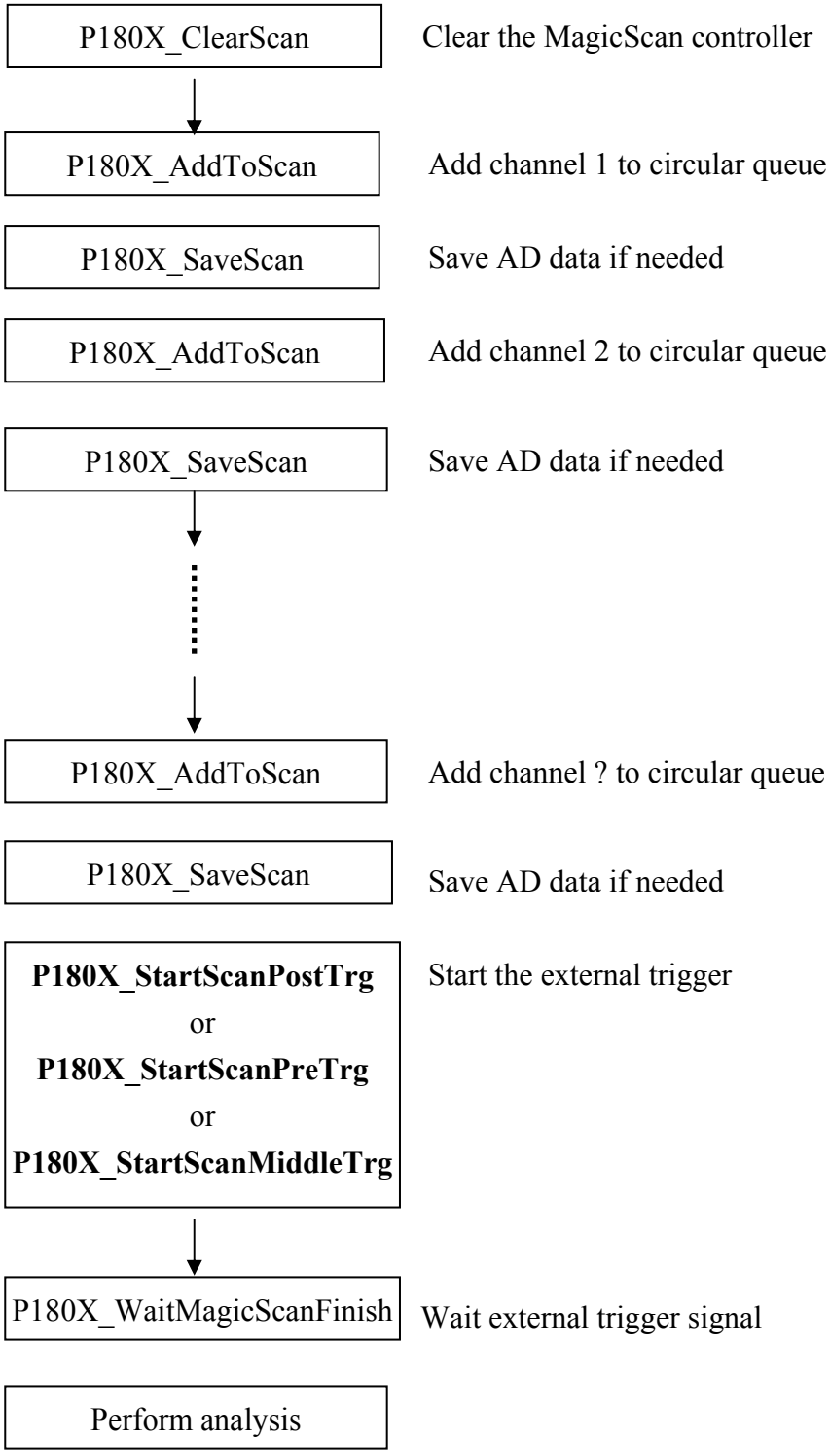


External middle-trigger timing diagram

NOTE: The circular-fetch operation is performed by software

- **Note 1: The external trigger operation must use the MagicScan controller. The software flowchart for the external trigger is given in next page.**
- **Note 2: The post-trigger operation can use all MagicScan functions.**
- **Note 3: The user should not enable the MagicScan HI/LO alarms and/or digital filter functions when using a pre-trigger or middle-trigger.**

Flowchart for External Trigger



- Refer to chapter 4 for additional details
- This flowchart is valid for the OME-PCI-1202/1602/1800/1802

Sample Program Code for Post-trigger

```
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 an 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 complete source code

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

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

The Windows program code for a post-trigger 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 OME-PCI-1202H/L**
- **P1602_StartScanPostTrg(…) is designed for OME-PCI-1602 and OME-PCI-1602F**

The windows driver of pre-trigger 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 OME-PCI-1202H/L**
- **P1602_StartScanPostTrg(…) is designed for OME-PCI-1602 and OME-PCI-1602F**

Windows Program code for Middle-trigger:

```
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 for 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 OME-PCI-1202H/L**
- **P1602_StartScanPostTrg(…) is designed for OME-PCI-1602 and OME-PCI-1602F**

Program Code for Pre-trigger for OME-PCI-1800/1802/ver-C

```
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 function is designed for the OME-PCI-1800/1802 version-C**

Program Code for Middle-trigger for the OME-PCI-1800/1802/ver-C :

```
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 function is designed for the OME-PCI-1800/1802 version-C**

The external trigger drivers are given as follows:

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

3.6.1.9 Clear FIFO Bit

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

Program Code for Clearing FIFO:

```
// 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

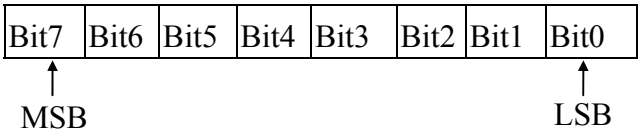
Set B13 to 0 when a command is sent to the MagicScan controller, otherwise keep this bit high.

The program code below demonstrates the use of the of handshaking control bit:

```
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 shown below:



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 OME-PCI-180x Ver. C: 0 → timer-1 is disabled

1 → timer-1 is enabled

For OME-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: Output of the machine independent timer. This bit will be set to 0 when the machine independent timer is started. This bit will be set to 1 when the time period has elapsed.

3.6.3 The A/D software trigger register

Writing to this port will software trigger an A/D conversion. Although the PC can send very fast trigger signals (more than 333K), the max. sampling rate of A/D conversion can not exceed 330K samples/second. The timing diagram is shown below:

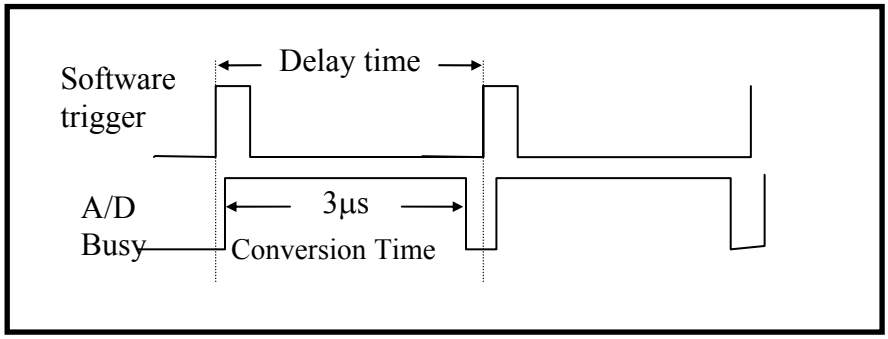


Figure 3-3: Trigger delay time.

Sample program code for software trigger :

```
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 OME-PCI-1602/1602F  */
}
```

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

3.7 Section 4: DI/O Register

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

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

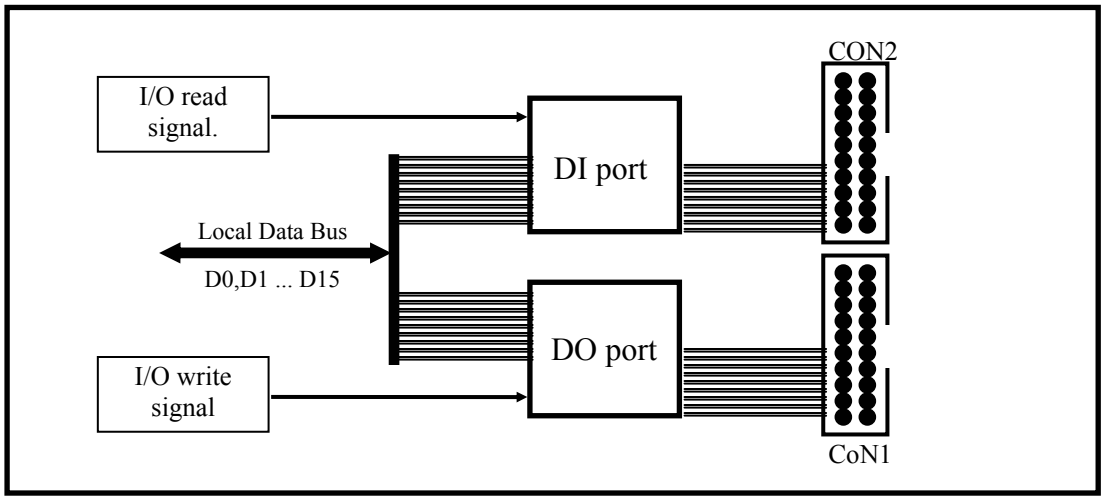


Figure 3-4: DIO block diagram.

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

Sample program code for the D/I/O:

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

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

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

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

3.8 Section 5: A/D & D/A Registers

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

Writing data to this section will write data to the DACs and reading data from this port will read the data from A/D FIFO. The read/write operation is given as follows:

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

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

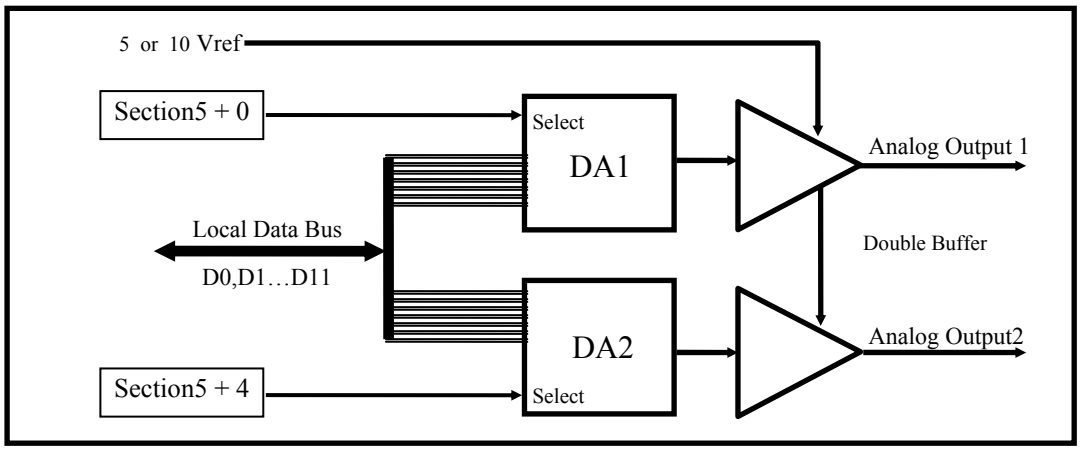


Figure 4-2 : D/A output diagram.

Note: The D/A output is **floating after upon power-on**. The D/A output will be enabled after executing a D/A output command. This applies to all boards in the OME-PCI-1202/1602/1800/1802 family.

Sample program code for D/A conversion:

```
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(…) forOME-PCI-1202
- P1602_Da(…) forOME-PCI-1602

Sample program code for software triggered A/D conversion:

```
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 OME-PCI-1202
- P1602_AdPollingHex(…) for OME-PCI-1602

4. A/D Conversions

4.1 The Configuration Code Table

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

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

OME-PCI-1602 Configuration Code Table

Bipolar/Uniploar	Input Signal Range	Gain	Settling Time	Configuration Code
Bipolar	+/-10V	1	10 us	0
Bipolar	+/-5V	2	10 us	1
Bipolar	+/-2.5V	4	10 us	2
Bipolar	+/-1.25V	8	10 us	3

OME-PCI-1602F Configuration Code Table

Bipolar/Uniploar	Input Signal Range	Gain	Settling Time	Configuration Code
Bipolar	+/-10V	1	5 us	0
Bipolar	+/-5V	2	5 us	1
Bipolar	+/-2.5V	4	5 us	2
Bipolar	+/-1.25V	8	5 us	3

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

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

4.2 Unipolar/Bipolar Measurement

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

4.3 Input Signal Range

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

4.4 The Settling Time

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

4.5 Settling Time Delay

In the software triggered mode, the software steps are as follows:

1. Send software trigger pulse
2. Delay the settling time
3. Read the A/D data

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

4.6 The A/D Conversion Mode

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

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

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

- The MagicScan mode functions are shown below:

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 M_functions are shown below:

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

- Continuous capture functions that store data to main memory are shown below: (two boards operating simultaneously)

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

- Continuous capture functions with that data to main memory are shown below: (single board operating)

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

- Continuous capture functions are shown below:

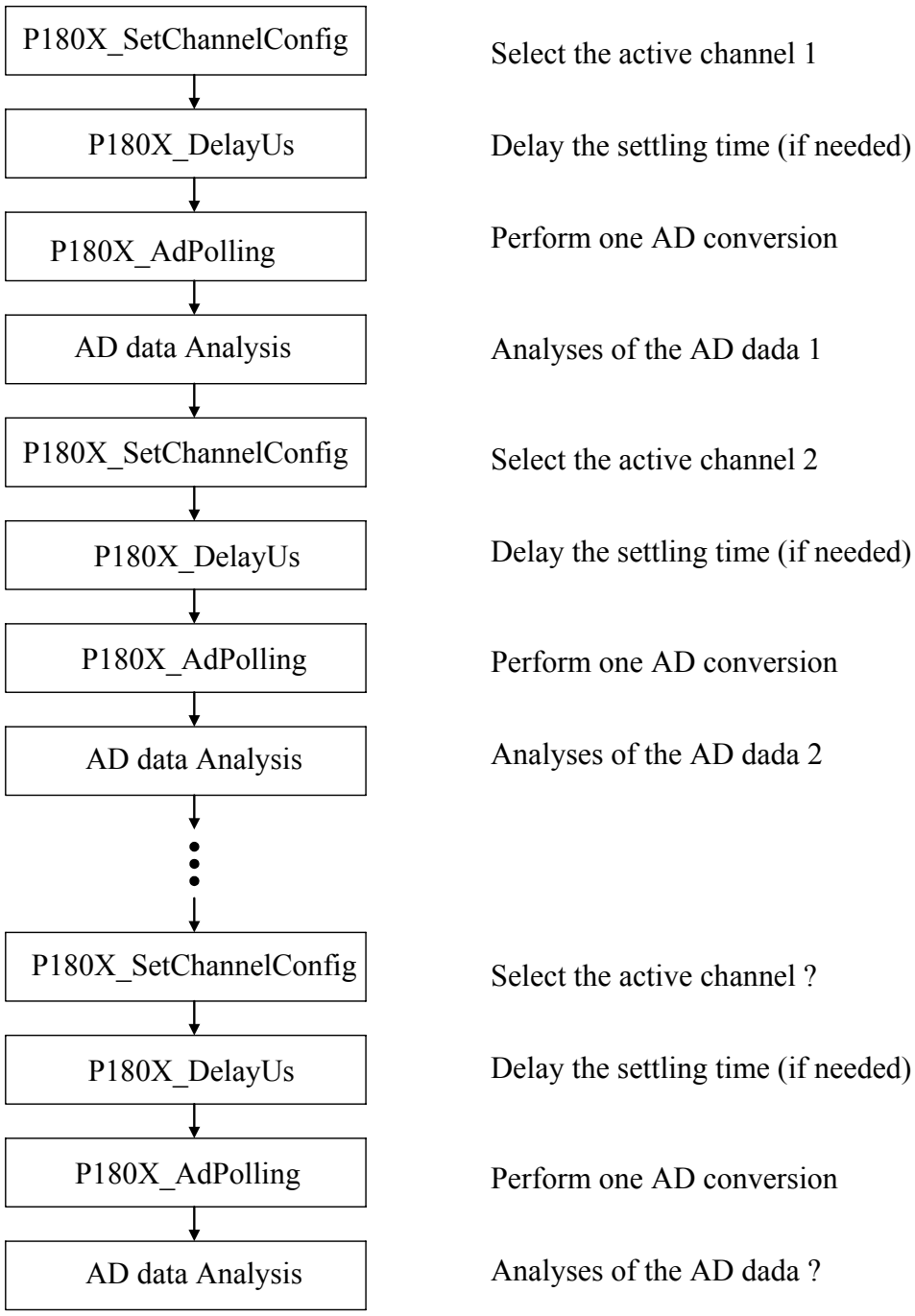
1. P180X_Card0_StartScan
2. P180X_Card0_ReadStatus
3. P180X_Card0_StopScan
4. P180X_Card1_StartScan
5. P180X_Card1_ReadStatus
6. P180X_Card1_StopScan

Group-0: for card_0 continuous capture function

Group-1: for card_1 continuous capture function

4.7 The Fixed-channel Mode A/D Conversion

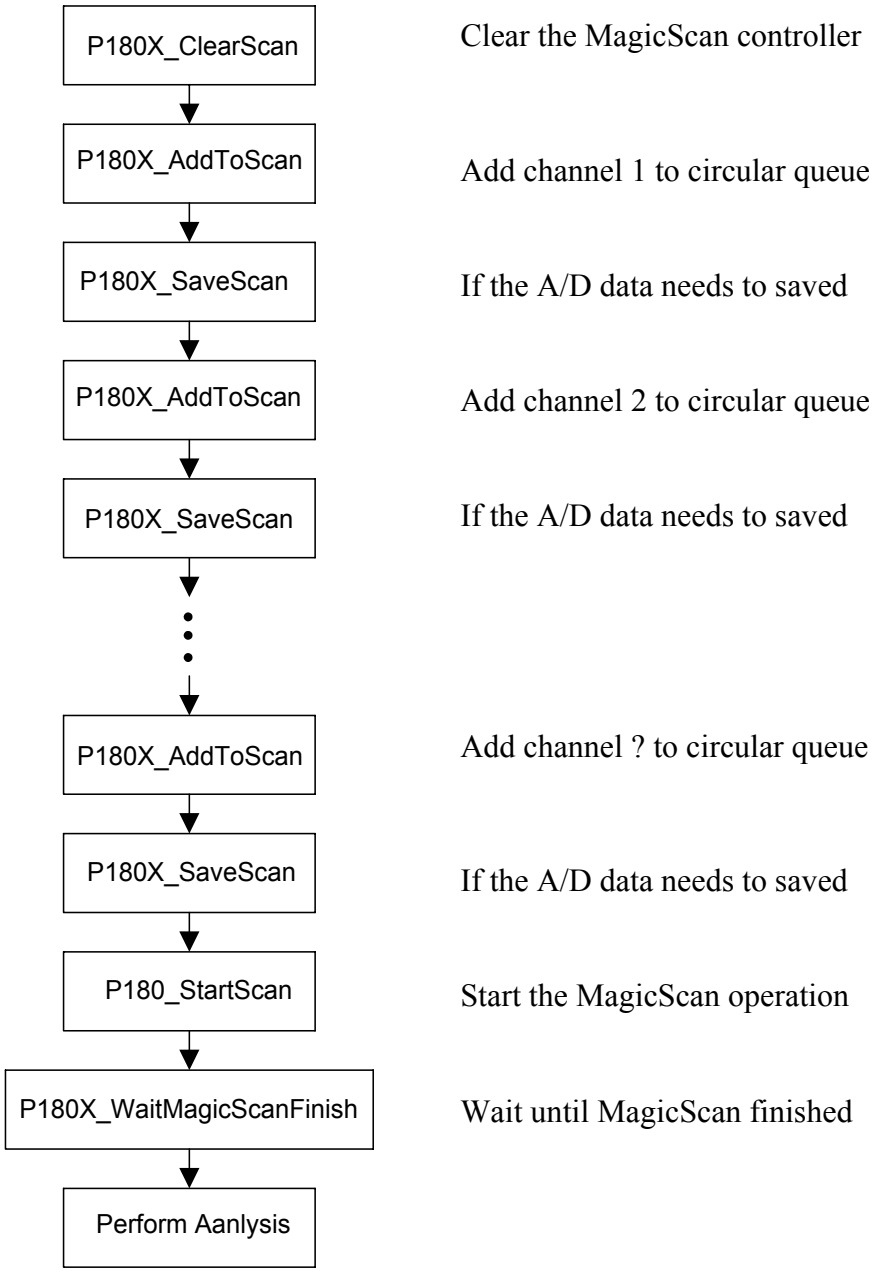
The **P180X_SetChannelConfig** will activate the selected channel and its configuration code. Then the other functions will refer to that channel and configuration. The general flow chart is given as follows:



- **P1202_SetChannelConfig(…) is designed for OME-PCI-1202H/L**
- **P1602_SetChannelConfig(…) is designed for OME-PCI-1602 andOME-PCI-1602F**

4.8 The MagicScan Mode A/D Conversion

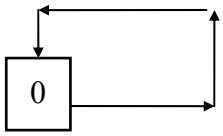
The **P180X_ClearScan** will set the MagicScan controller to its initial state. The **P180X_AddToScan** will add the channels to MagicScan circular queue one by one. **The order of P180X_AddToScan is the scan order.** The maximum queue size is **48.** The scan order is random and can be repeated. The A/D data is not automatically saved. The A/D data can be saved in an array if the **P180X_SaveScan** is used. The flowchart is shown below:



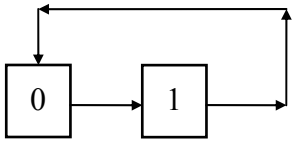
- **P1202_ClearScan(…) is designed for OME-PCI-1202H/L**
- **P1602_ClearScan(…) is designed for OME-PCI-1602 andOME-PCI-1602F**

4.8.1 The MagicScan Circular_Scan_Queue

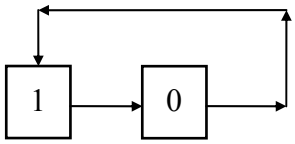
The MagicScan controller creates a **circular scan sequence control queue.** The scan increments the sequence **one by one** and is **repeatable** with the limitation of maximum 48 channels. The following scan sequences are all valid:



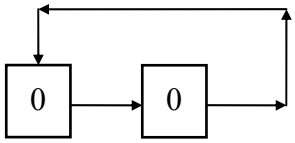
One channel MagicScan



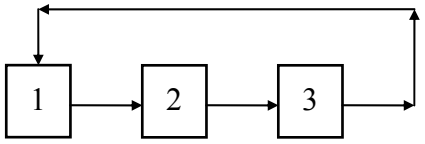
Two channel MagicScan, scan sequence=010101



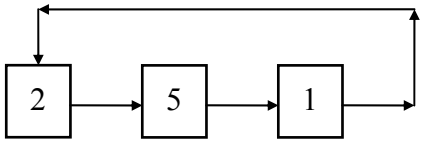
Two channels MagicScan, scan sequence=101010



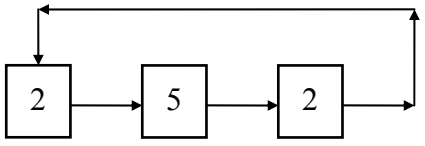
Two channels MagicScan, scan sequence=000000



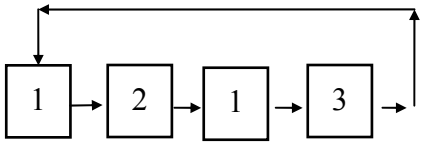
Three channels MagicScan : 123123123



Three channels MagicScan : 251251251



Three channels MagicScan : 252252252



Four channels MagicScan : 12131213

4.8.2 The MagicScan Digital Filter

The digital filter is an **averaging** filter.
Filter value = (V_1+V_2+……+V_n)/n, where n is the number of samples averaged
This filter is useful for smoothing noisy signals.

4.8.3 Sampling at Different Rates with MagicScan

The MagicScan controller scans the analog inputs at a **fixed-sampling-rate**. **Different sampling rates** for each channel can be achieved by using the **averaging** function. **This is the same technique as used by the digital filter** described in Sec. 4.8.2. If the user wishes to sample at different rates, the digital filter will be active at the same time. **To sample at different rates the digital filter must also be active.**

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

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

- **P1202_ClearScan(…) is designed for OME-PCI-1202H/L**
- **P1602_ClearScan(…) is designed for OME-PCI-1602 andOME-PCI-1602F**

4.8.4 MagicScan High/Low Alarms

There are 5 MagicScan alarm types a given below:

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**

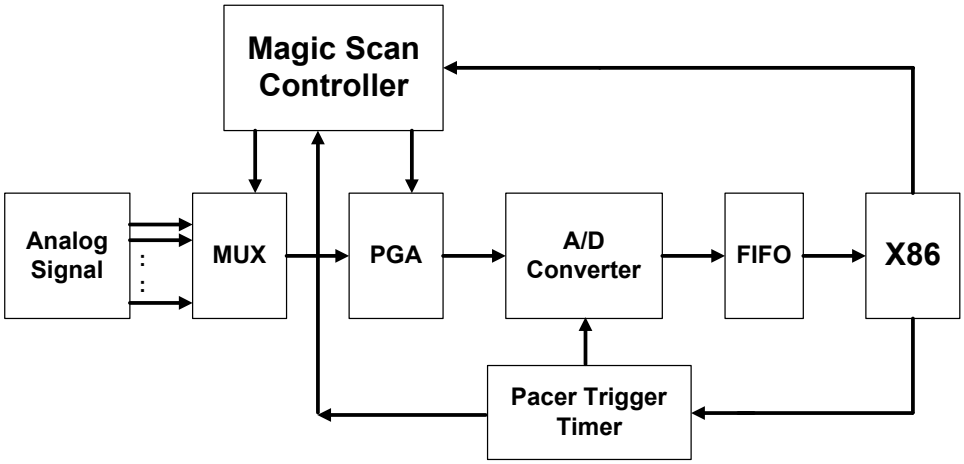
All alarm_value are defined in HEX format

4.8.5 The MagicScan Function

The features of MagicScan are given below:

1. Different gain for each channel
2. Non-sequential order for channel scan
3. Different sampling rates 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 triggers: post-trigger, pre-trigger and middle-trigger
7. Maintains 330K max. for total channel scan
8. Easy programming

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



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

(2) The pacer trigger timer will generate the trigger signal for the A/D converter.

(3) The A/D data is placed in the FIFO.

(4) The X86 will read and analyze the A/D data from FIFO when the CPU is ready. The FIFO is 2K for OME-PCI-1800 and 8K for OME-PCI-1802. The X86 will analyze the A/D data while the A/D conversion is going. Therefore the speed of X86 must be compatible with the speed of A/D conversion. The A/D conversion can be 330K max. in channel/scan mode. Therefore the X86 must handle 330K samples per second to avoid overflow. A Pentium-120 CPU or more powerful CPU is recommended.

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

For example,

- the scan channel is 1→ 2 → 3
- the pacer sampling rate is 330K
- the desired sampling rate for channel 1 is 110K
- the desired sampling rate for channel 2 is 55K
- the desired sampling rate for channel 3 is 11K

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

1,2,3,1,2,3,1,2,3,1,2,3,1,2,3,1,2,3……

→ total sample rate is 330K

→ channel 1 sampled at 110K

→ channel 2 sampled at 110K

→ channel 3 sampled at 110K

The desired sample rate for channel 2 is 55K, therefore the software will average two samples into one to achieve the 55K sample rate.

The desired sample rate for channel 3 is 11K, therefore the software will average ten samples into one to achieve the 11K sample rate.

Some of the MagicScan functions put a high processing load on the computer's CPU. These fucntions include:

1. averaging the continuous N data into one sample to get different sampling rates
2. comparing each A/D data with the HI/LO alarm limit
3. saving the A/D data into memory if the save flag is enabled

The recommended system requirements for these functions are a minimum a Pentium-120 & Windows 95.

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 require sending a pre-defined pattern to an external device and measuring the output responses for analysis. This requires an arbitrary wave form generator and a high speed A/D converter. **The M_Functions, provided by OME-PCI-1202/1602/1800/1802, can generate an arbitrary waveform and perform the A/D conversion at the same time.**

Refer to application note OME-EP001 for details. The application note OME-EP001, contains 33 pages that can be divided into four parts. The introduction and common questions are given in part 1. The demo and analysis VIs for LabVIEW 4.0 are given in part 2. The function descriptions and demo program for VC/C++ 4.0 are given in part 3. The usage for HP-VEE 3.21 is provided in part 4.

The M_Functions can be executed under **DOS and Windows**. Programming languages**(VC++, BC++, VB, Delphi, BCB)** and software packages**(LabVIEW and more)** can call the M_Functions. An example spectrum analyzer created LabView 4.0 using the M_Functions is shown below.

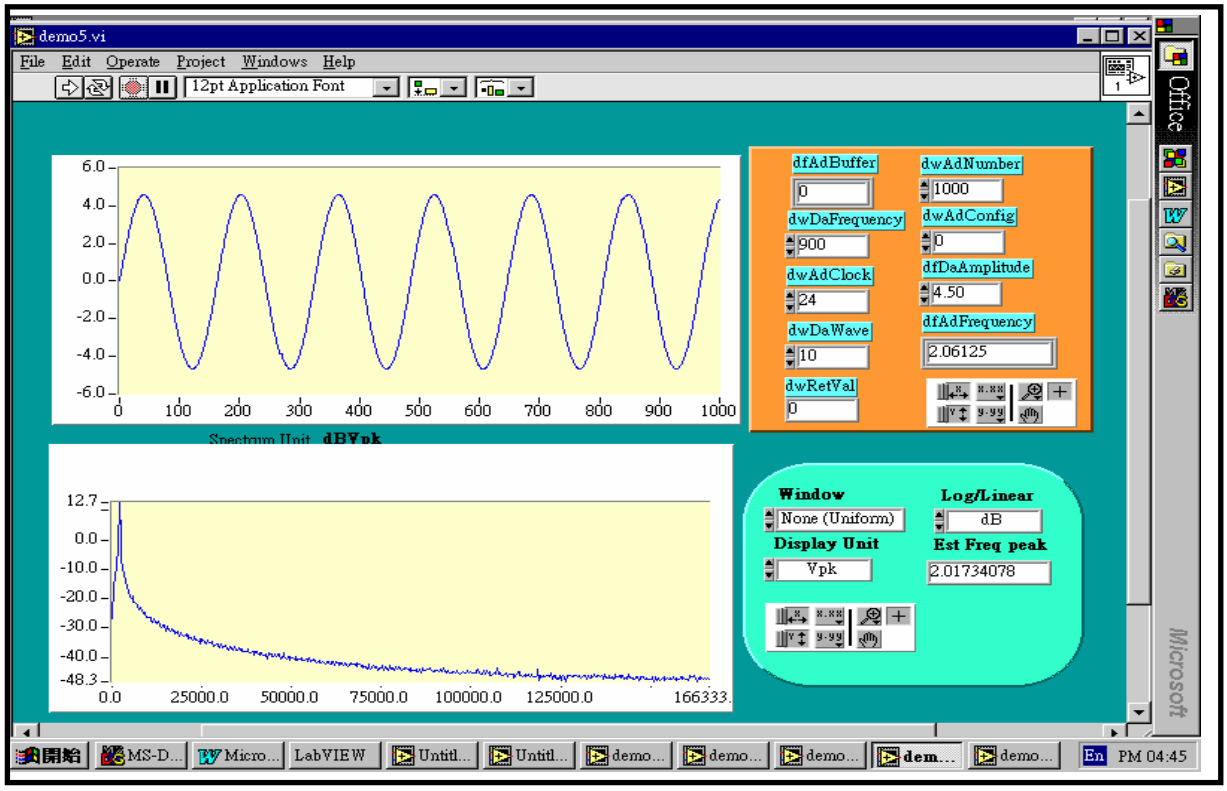


Figure 5-1: Spectrum analyzer created using M-FUN_1.

5.1 Introduction

- **What Are M_Functions?**

M_Functions features are given as follows:

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

The user can send 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:

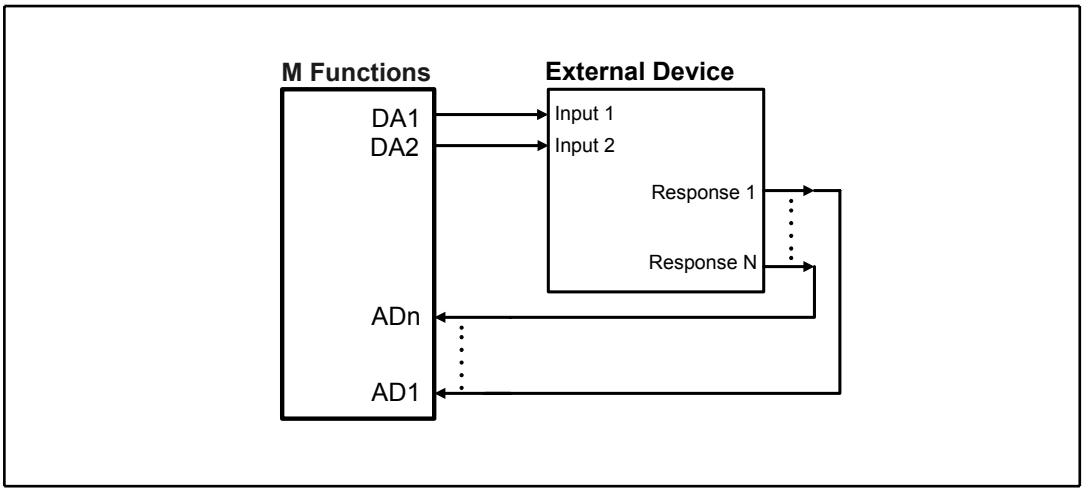


Figure 5-2: The block diagram of M-Functions.

- **Types of waveforms that can be generated by the M_Functions ?**

The M_Functions uses **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.

If the user wants to generate a periodic wave form such as a sine, cosine,...., the M_Functions can provide the output wave form at over 100K samples/sec. The +/- 5V 100Ks/s sine wave shown in Figure 5-3 and +/- 5V 200Ks/s sine wave shown in Figure 5-4 are all generated by M_Function1. Figure 5-4 was captured from the display of an oscilloscope. The display resolution of oscilloscope is limited, so the output waveform appears much less smooth than the actual waveform.

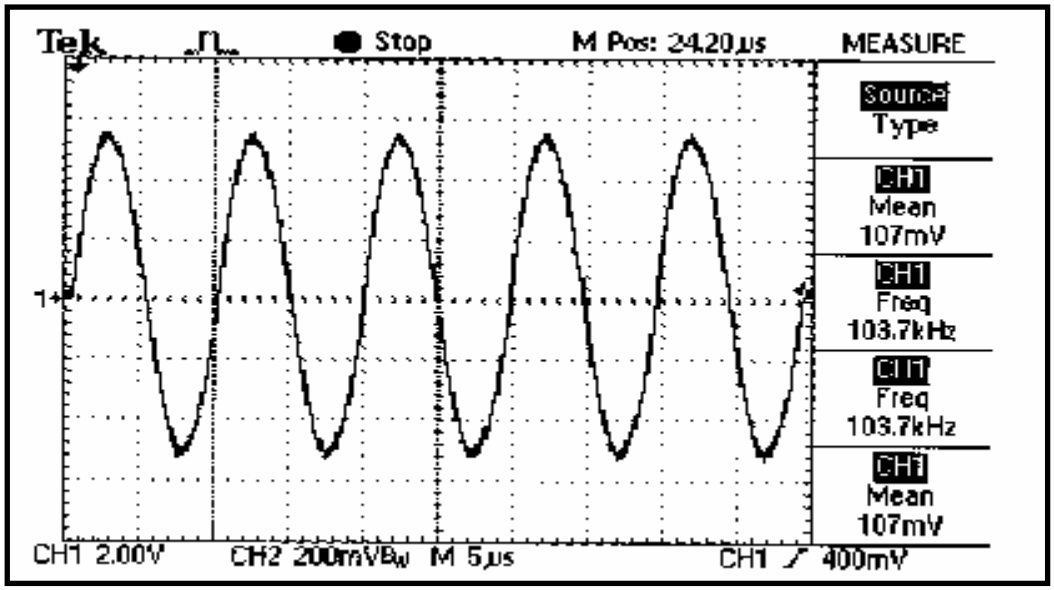


Figure 5-3: The M_Function_1 used to create a 100K, +/- 5V sine wave.
(measured by an oscilloscope)

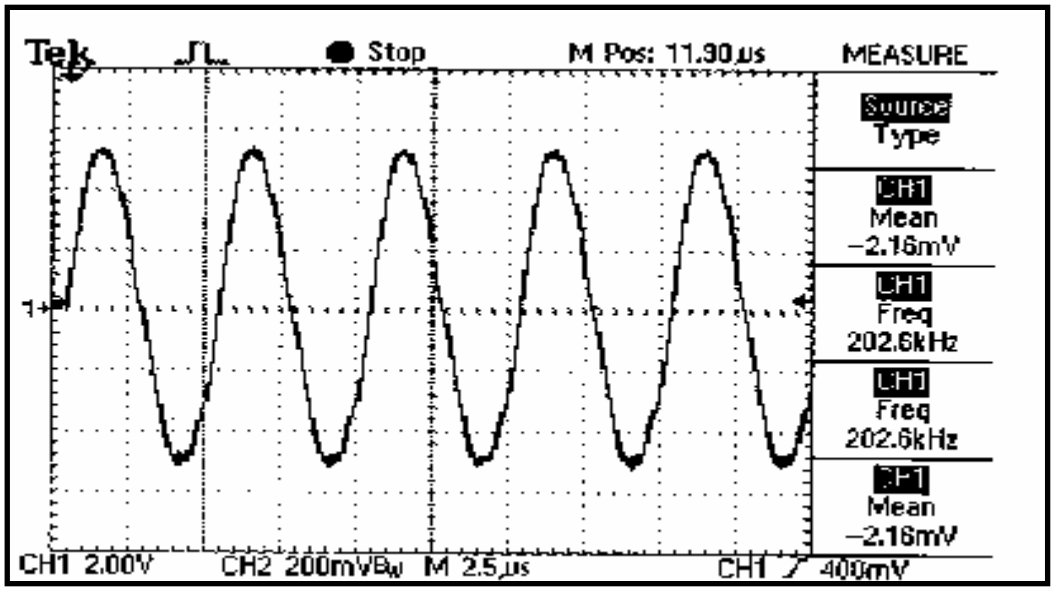


Figure 5-4: The M_Function_1 used to create a 200K, +/-5V sine wave.
(measured by oscilloscope)

- **M_Functions, Types 1 through 4**

There are four M_Functions, P180X_M_FUN_1, P180X_M_FUN_2, P180X_M_FUN_3 and M_FUN_4. The M_FUN_1 will automatically compute a sine wave output image. M_FUN_2 is designed for arbitrary waveform generation, the user can create a custom waveform. 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 OME-PCI-1800H/L, OME-PCI-1802H/L, OME-PCI-1602, OME-PCI-1602F and OME-PCI-1202H/L currently support the M_Functions.

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

The M_Functions can be executed under DOS and Windows.

Limitations

Under Windows operating systems, periodic system level interrupts could interfere with the driver operation. Since the D/A arbitrary waveform generation is partially implemented in software, the output wave form could be distorted. Refer to Figure 5-5 for details.

For periodic waveforms such as sin, cos, etc.; small distortions in the waveform will have minimal impact on the spectrum analysis. **The user can RUN the demo3.vi given in OME-EP001 and select CONTINUE RUN. The D/A output maybe distorted but the spectrum response is still very stable.**

Under DOS, the D/A output waveform will not be distorted.

The future versions of the OME-PCI-1802 H/L, will include on-board memory to house the D/A output waveform image. The output will be generated in hardware, so it will create continuous non-distorted waveforms.

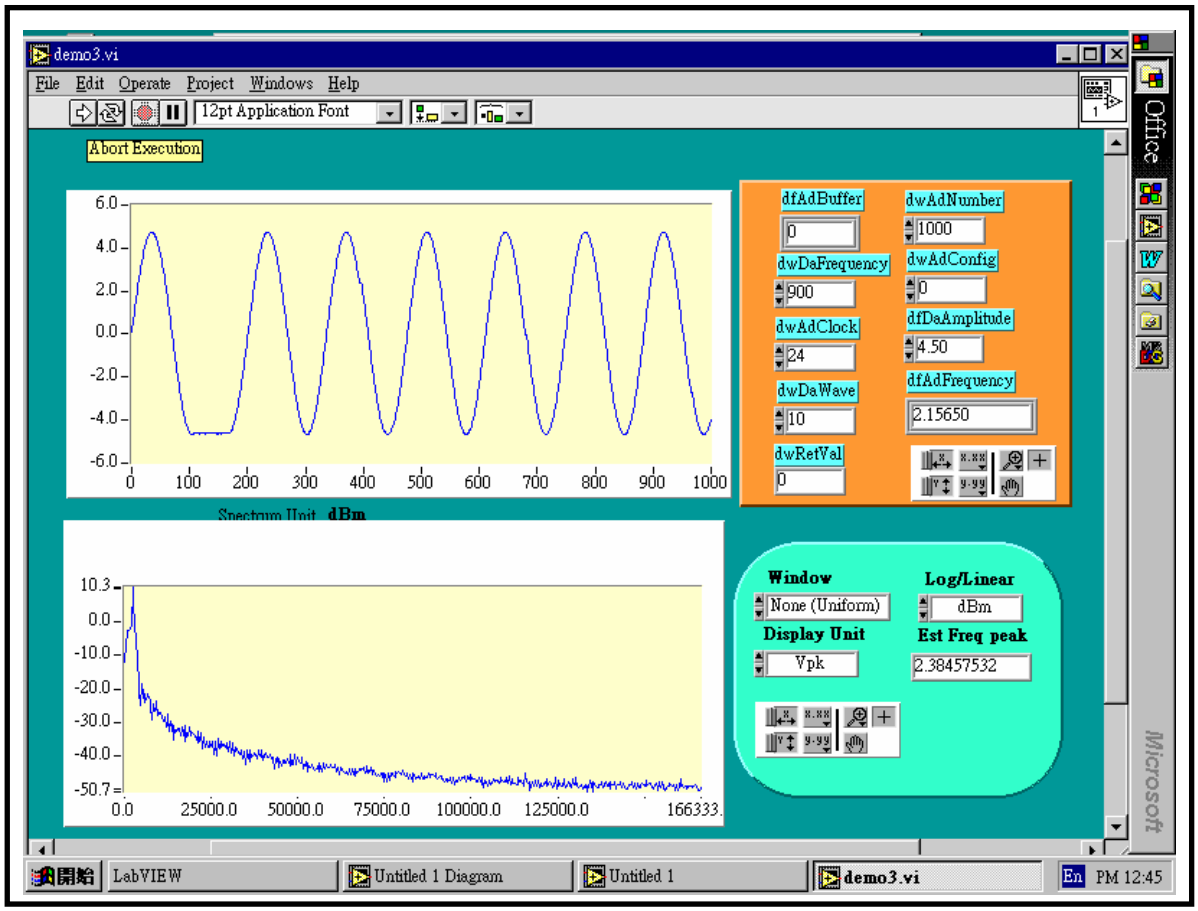


Figure 5-5: The D/A waveform is distorted but the spectrum response is nearly the same.

6. Continuous and Batch Capture Functions

The batch and continuous capture functions are very useful for many real world applications. These applications include:

1. Low speed data continuous collection, real-time processing, continuous capture
2. High speed batch data collection, data saved in PC main memory, time limited by memory size
   (Refer to P180X_FunA function and P180X_FunB function in section 6.2 for additional details)
3. High speed data collection, data saved in the external NVRAM, time is limited by memory size

6.1 General Purpose Driver

The OME-PCI-1202/1602/1800/1802 is well suited for the above three applications. The software driver can support up to 16 cards in one PC (version 2.0 only support 2 cards for the continuous capture function, version 3.0 will support 3 cards). The continuous capture functions are grouped by card as shown below:

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

Group-0: for card_0 continous capture function

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

Group-1: for card_1 continuous capture function

Features of these functions are shown below:

- Support DOS and Windows
- Single-card solution → group0, refer to DEMO13.C
- Multiple-card solution → group0 & group1 RUN at the same time, refer to DEMO14.C.
- Will support more cards in the next version software

- **P1202_Card0_StartScan(…) is designed for the OME-PCI-1202H/L**
- **P1602_Card0_StartScan(…) is designed for the OME-PCI-1602 andOME-PCI-1602F**

The block diagram for the continuous capture function is shown below:

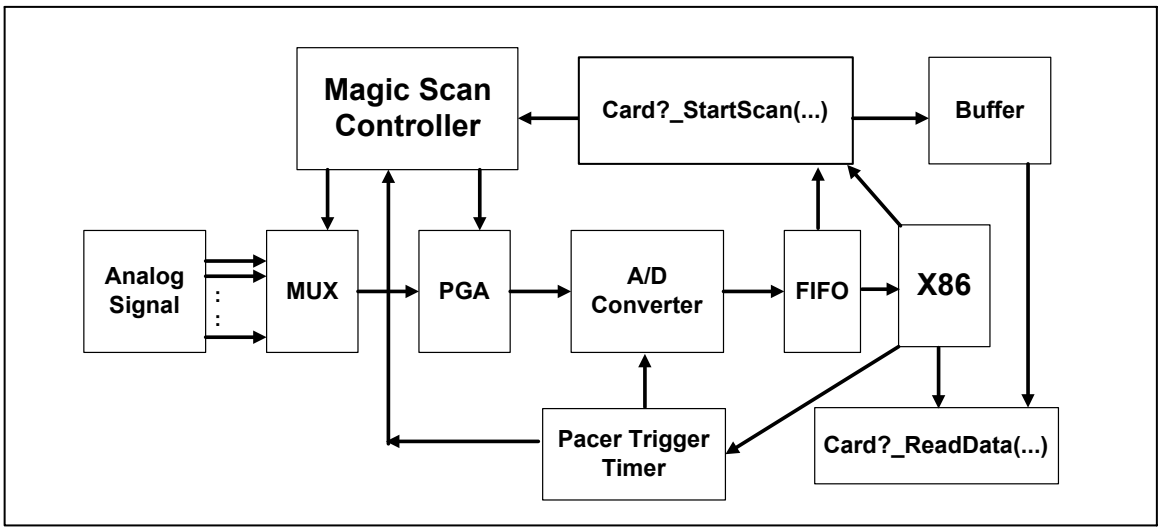


Figure 6-1: The block diagram of the continuous capture.

- The P180X_Card?_StartScan(…) will perform the following functions
  1. Setup scan-queue
  2. Setup channel/gain data
  3. Setup continuous capture data
  4. Create a multi-task thread for long term data acquisition
  5. When the group A/D data is ready → signal P180X_Card?_ReadStatus(…) to read data
- The P180X_Card?_ReadStatus(…) will read from the buffer prepared by P180X_Card?_StartScan(…). This function runs at the same time as the P180X_Card?_StartScan(…) thread. If the group A/D data is ready, the
- The P180X_Card?_StopScan(…) will stop all threads and released all resources

Note: DOS & Windows 3.1 do not support multi-tasking. The software coding is a little different but the coding principle is the same.

Sample program code for a **single board** is shown below:

```
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 running
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
                }
        }
```

Sample program code for **multiple boards** is shown below::

```
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 running 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 High Speed Batch Capture

The P180X_FunA & P180X_FunB functions are used for batch capture and can save the data into PC memory. The features for P180X_FunA and P180X_FunB are listed below:

- High speed A/D data sampling(for example, 330K)
- Batch capture for extended periods(for example 2.5 minutes)
- A/D data saved in the PC memory
  (Memory size=330K*60*2.5=330K*150=49.5M word=99M bytes)
- Refer to demo22.c for **330K, 2.5 minutes,** continuous capture **99M** bytes PC memory

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

P180X_FunA_Start P180X_FunA_ReadStatus P180X_FunA_Stop P180X_FunA_Get	• Supports two board • batch capture • data saved in PC memory (can be as large as 256M) • refer to demo20.c
P180X_FunB_Start P180X_FunB_ReadStatus P180X_FunB_Stop P180X_FunB_Get	• Supports single board • batch capture • data saved in PC memory (can be as large as 256M) • refer to demo21.c

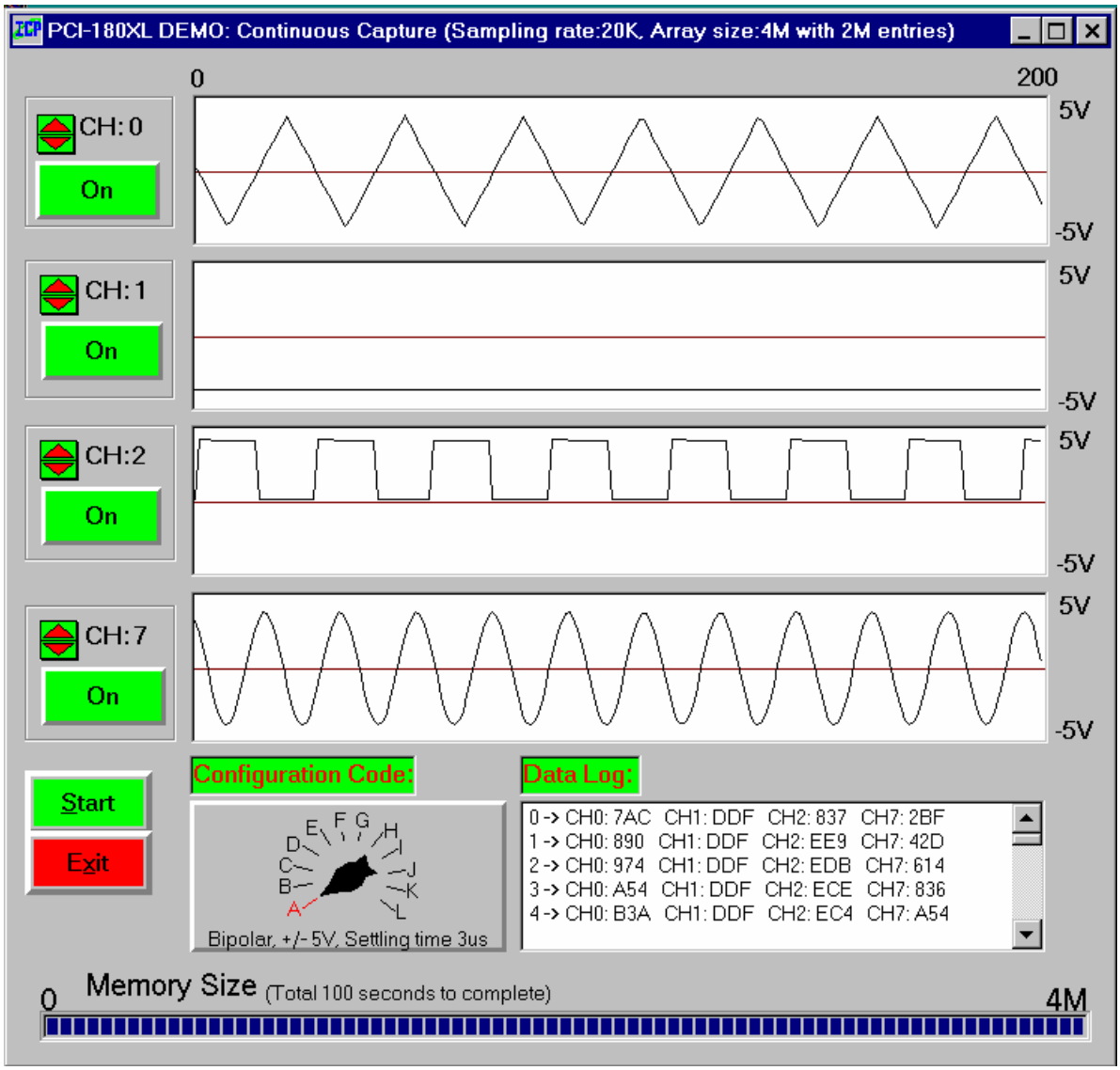


Figure 6-2. The Continuous Capture example.

7. Calibration

7.1 A/D Calibration

- For OME-PCI-1202/1800/1802

Step 1: Apply 0V to channel 0

Step 2: Apply 4.996V to channel 1

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

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

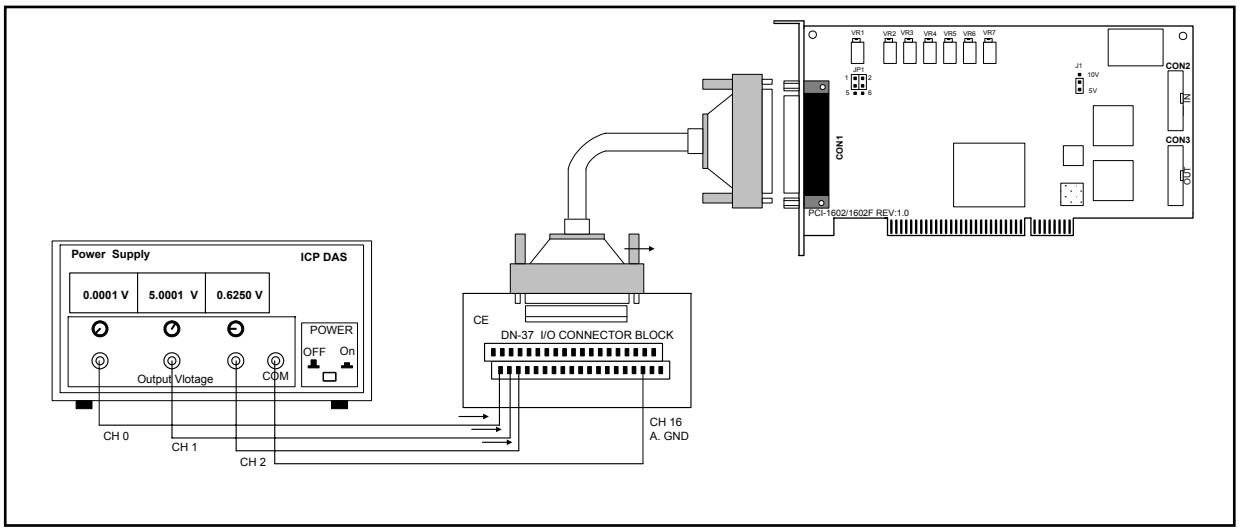


Figure 7-1. A/D Calibration

Note: The CH 16 is the analog signal GND for OME-PCI-1202/1602.1802 card
The CH 9/10 are the analog signal GND for OME-PCI-1800 card

- ForOME-PCI-1602/1602F

Step 1: Apply 0V to channel 0

Step 2: Apply 4.996V to channel 1

Step 3: Apply +0.6245V 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 OME-PCI-1800/1802 version_F & OME-PCI-1202

Step 1: J1 select +10V

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

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

Step 4: Adjust VR200 until voltage meter = 0V

Step 5: Send 0 to D/A channel 0

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

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

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

Step 9: Adjust VR202 until volt meter = 0V

Step 10: Send 0 to D/A channel 1

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

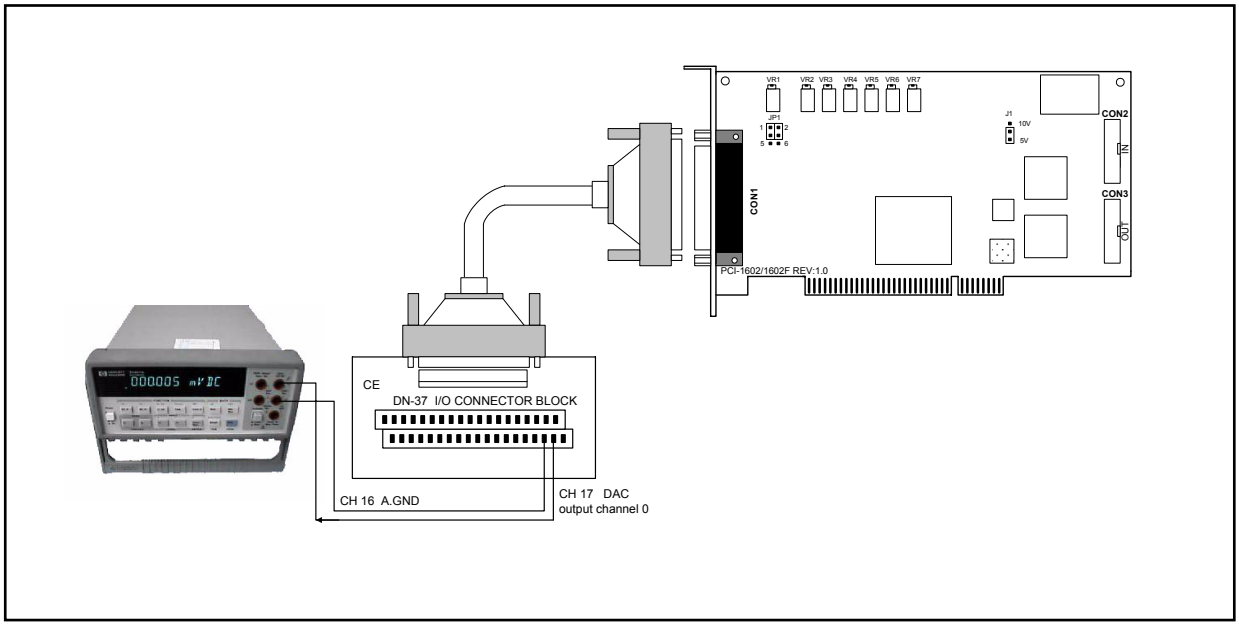


Figure 7-2. D/A Calibration

Note: The CH 18/36 are the output channels 0/1 of DAC for OME-PCI-1202/1602/1802 card

The CH 30/32 are the output channels 0/1 of DAC for OME-PCI-1800 card

- For the OME-PCI-1800/1802 version_C

Step 1: J1 select +10V
Step 2: Connect the D/A channel 0 to volt meter
Step 3: Send 0 to D/A channel 0
Step 4: Adjust VR3 until voltage meter = -10V

- For the OME-PCI-1602

Step 1: J1 select +10V
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 = 0V
Step 5: Send 0 to D/A channel 0
Step 6: Adjust VR5 until voltage meter = -10V
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 = 0V
Step 10: Send 0 to D/A channel 1
Step 11: Adjust VR6 until voltage meter = -10V

8. Driver and Demo Programs

The software drivers can be classified as follows:

- NAPPCI/dos: huge and large mode library for TC, MSC and BC
- NAPPCI/w31: DLLs for VC++, VB
- NAPPCI/win: DLLs for VC++, BC++, VB, Delphi, BCB, LabVIEW
- NAPPCI/wnt: DLLs for VC++, BC++, VB, Delphi, BCB, LabVIEW

The different demo programs are listed below:

- demo1: one board, D/I/O test, D/A test, A/D polling test, general test
- demo2: two boards, same as demo1
- demo3: one board, A/D by software trigger(polling) and A/D by pacer trigger demo
- demo4: two boards, same as demo3
- demo5: one board, M_function_1 demo
- demo6: two boards, same as demo5
- demo7: one board, M_function_2 demo
- demo8: two boards, same as demo7
- demo9: one board, M_function_3 demo
- demo10: two boards, same as demo9
- demo11: one board, MagicScan demo
- demo12: two boards, same as demo11
- demo13: one board, continuous capture demo
- demo14: two boards, continuous capture demo
- demo15: all installed boards, 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 boards, P180X_FUNA, continuous capture demo
- demo21: single board, P180X_FUNB, continuous capture demo
- demo22: single board, P180X_FUNB, 330K, 2.5 min, continuous capture 99M 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 when the incoming data exceeds a pre-defined threshold.
- Demo33: MagicScan total sample rate=176k/sec for 8 channels.
- Demo34: continuous capture, sample rate=33.3K/sec for 32 channels and save to disk (for DOS only).

9. Diagnostic Program

9.1 Power-on Plug & Play Test

The sequence of steps for the power-on plug & play test are given as follows:
Step 1: Power-off PC
Step 2: Install OME-PCI-1202/1602/1800/1802 without any external connections
Step 3: Power-on PC and observe the PC screen for error messages
Step 4: The PC will perform its self-test first
Step 5: The PC will detect the non-PCI physical devices installed in the system
Step 6: The PC will display the information for these devices
Step 7: The PC will detect the PCI plug & play devices installed in the system
Display all OME-PCI-device information → check here carefully
→ There will be a PCI device with vendor_ID=1234, device_ID=5678 (OME-PCI-1800/1802)

vender_ID=1234, device_ID=5678 (PCI-1602)
vender_ID=1234, device_ID=5672 (PCI-1202)

If the plug & play ROM-BIOS can detect the OME-PCI-1202/1602/1800/1802 in the power-on stage, the software driver for DOS and Windows will function properly. If the plug & play ROM-BIOS can not find the OME-PCI-1202/1602/1800/1802, the software driver will not function. Therefore the user must be certain that the power-on detection is correct.

9.2 Driver Plug & Play Test

Step 1: Power-off PC
Step 2: Install OME-PCI-1202/1602/1800/1802 without any extra external connections
Step 3: Power-on PC, run DEMO15.EXE
Step 4: The I/O base address of allOME-PCI-1xxx cards installed in the system will be shown on the screen.
Step 5: Is the total board number correct?
Step 6: Install a 20-pin flat cable on one of these OME-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 OME-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 OME-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: The wave form shown in screen should be a sine wave

9.5 A/D Test

Step 1: Power-off PC
Step 2: Install one OME-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: The waveform shown in screen must be a sine wave
Step 7: Apply analog signals to all A/D channels
Step 8: Run DEMO3.EXE to check all A/D channels

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 → 10K s/s per channels
DEMO14.EXE	20 Ks/s	Continuous capture function, two cards, two channels Total=20 Ks/s → 10K s/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 OME-PCI-1800/1802 MagicScan demo for OME-PCI-1202 MagicScan demo for OME-PCI-1602F MagicScan demo for OME-PCI-1602

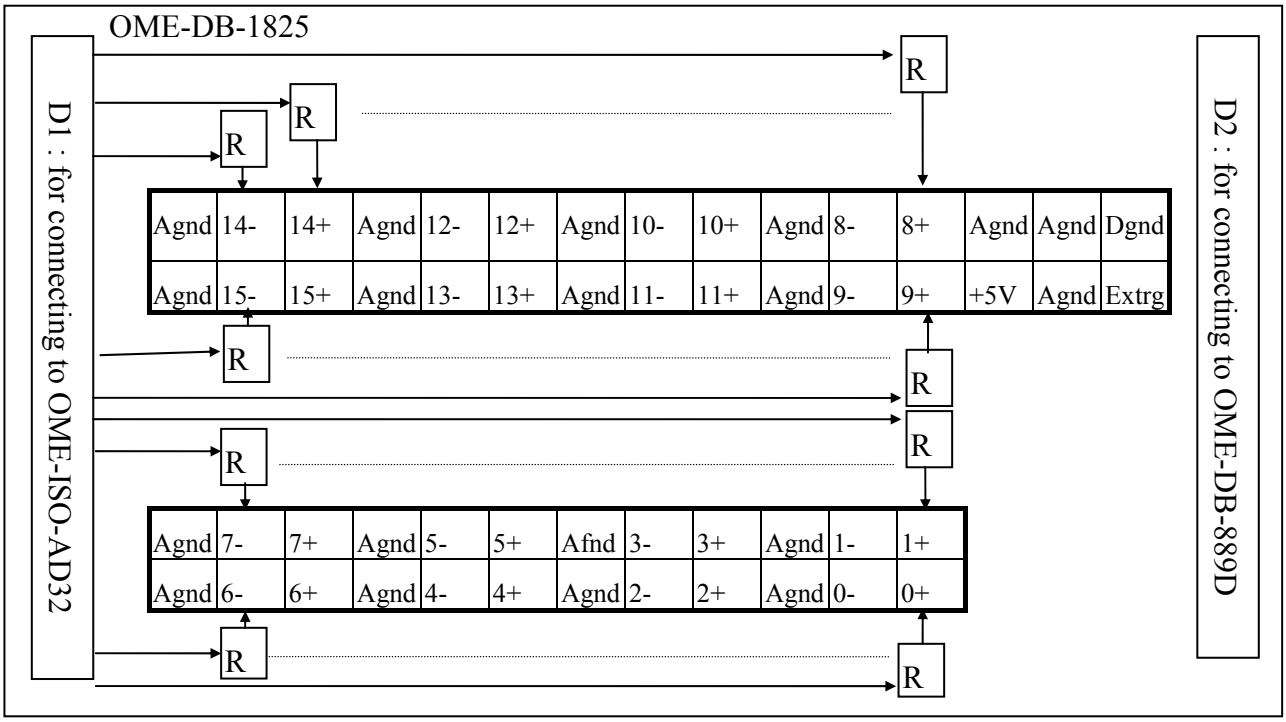
Note:

1. s/s → samples/second
2. All tests are under Windows with a Pentium-200 CPU

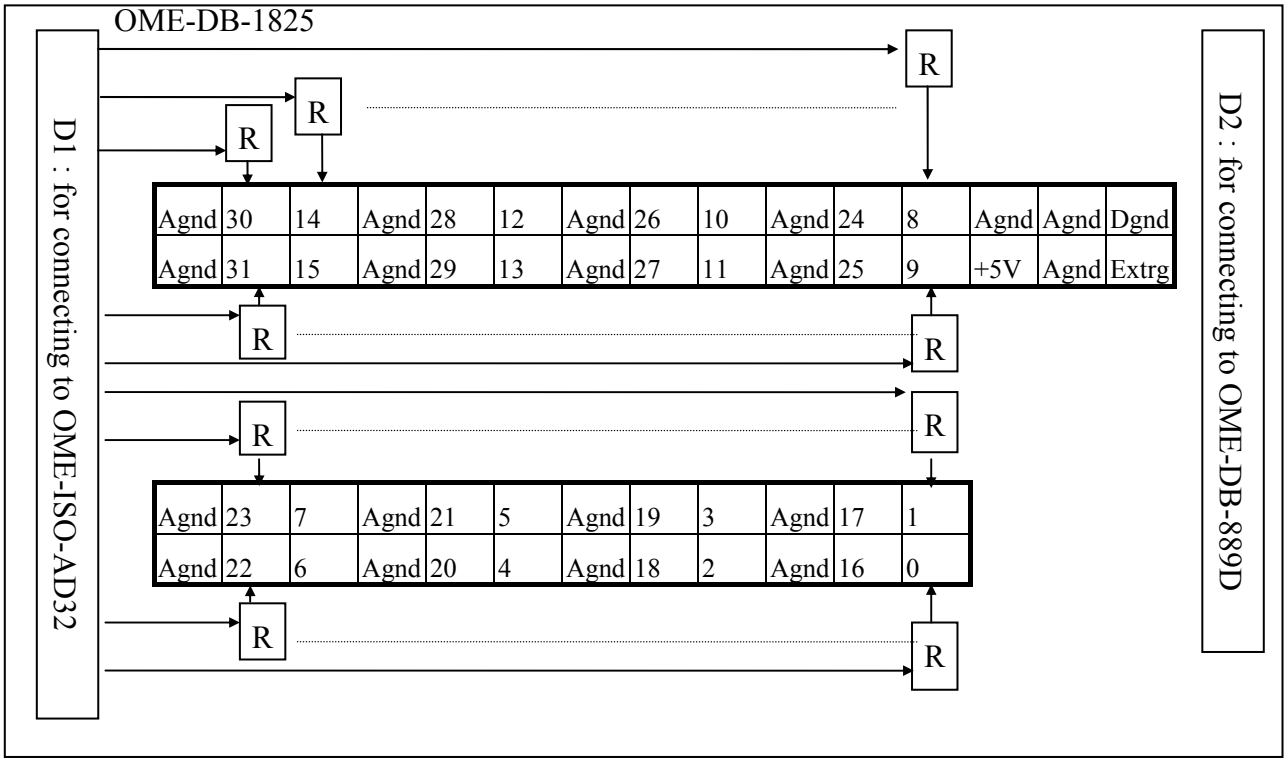
Appendix A: The OME-DB-1825 user manual

A.1: PCB layout for connecting to OME-ISO-AD32:

For differential input (R=0 ohm)



For single-ended input (R=0 ohm)

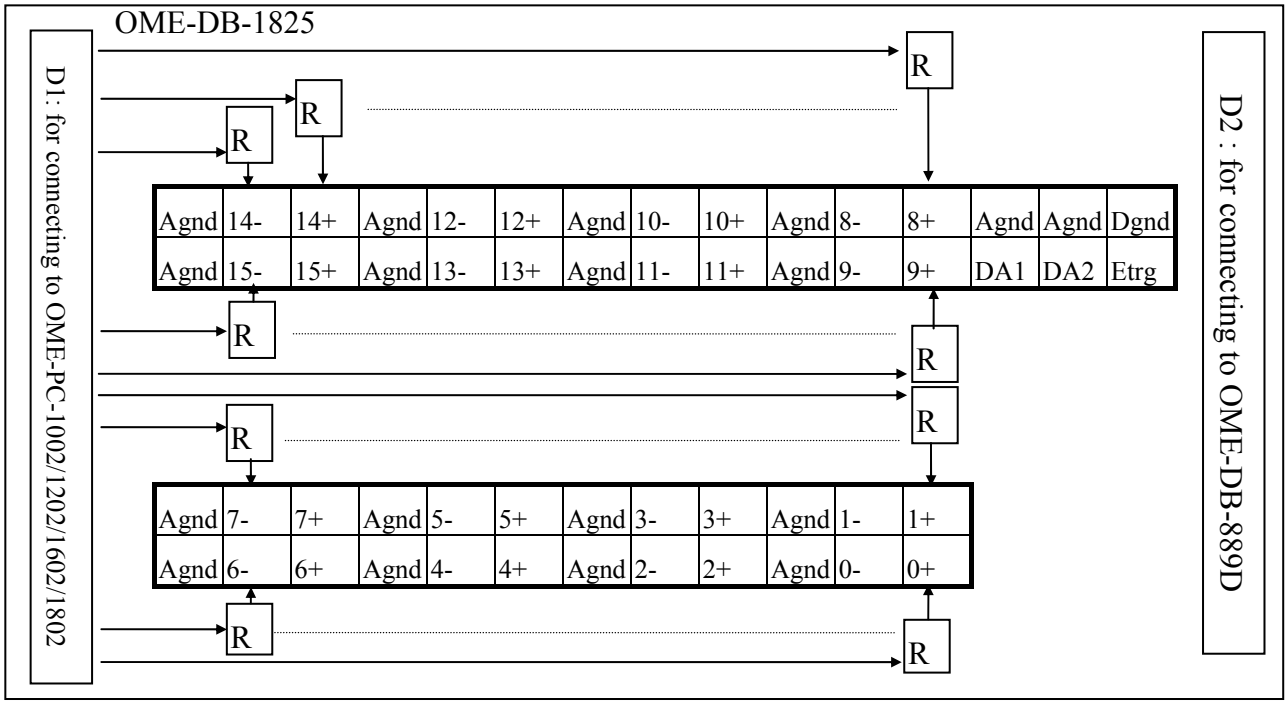


Pin assignment of D1 same as **CN1 of OME-ISO-AD32**

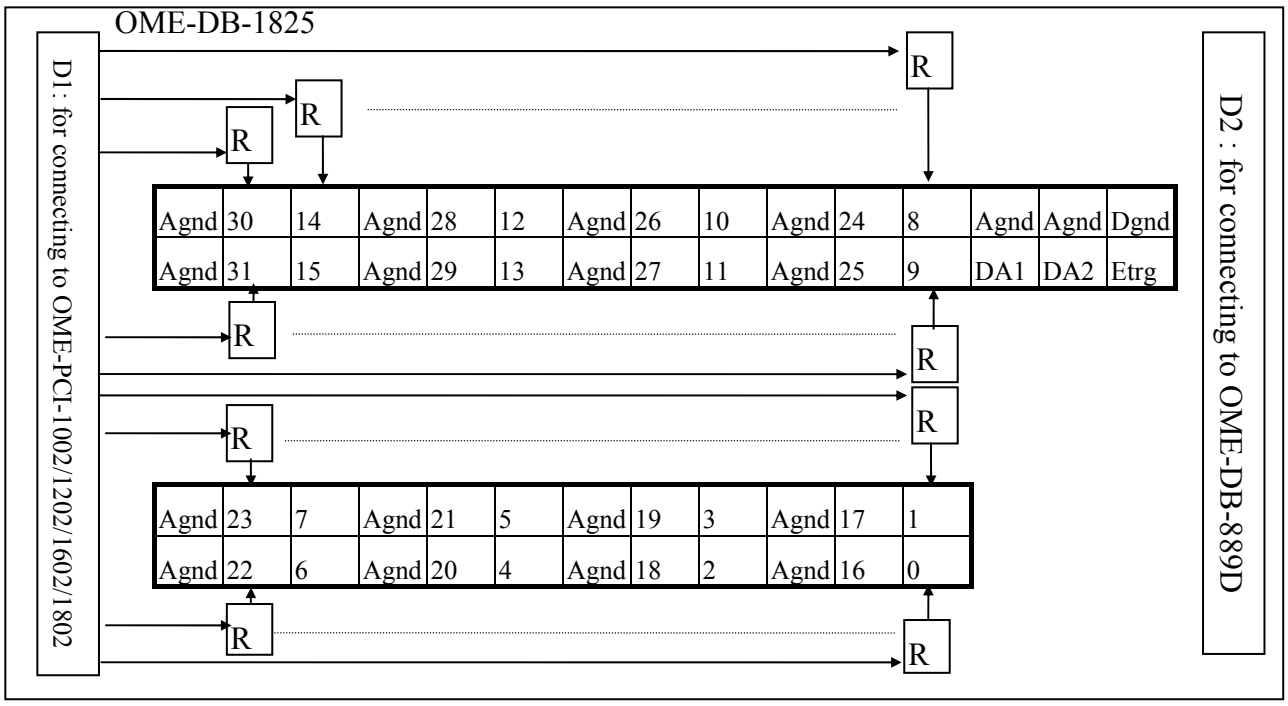
Pin assignment of D2 same as **CN1 of OME-DB-889D**

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

For differential input (R=0 ohm)



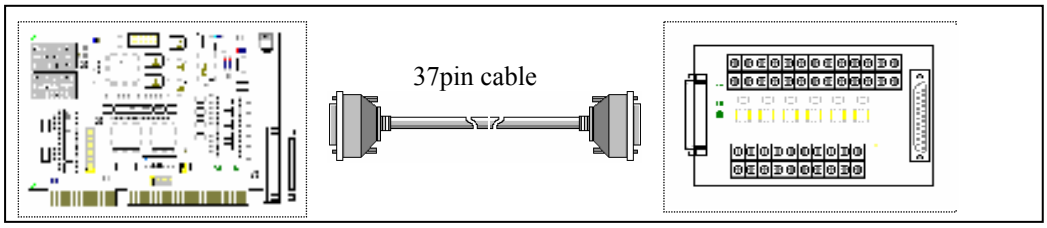
For single-ended input (R=0 ohm)



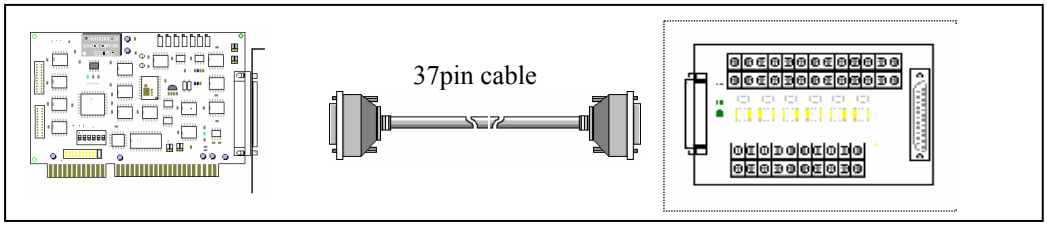
Pin assignment of D1 same as **CON3 ofOME-PCI-1002/1202/1602/1802**

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

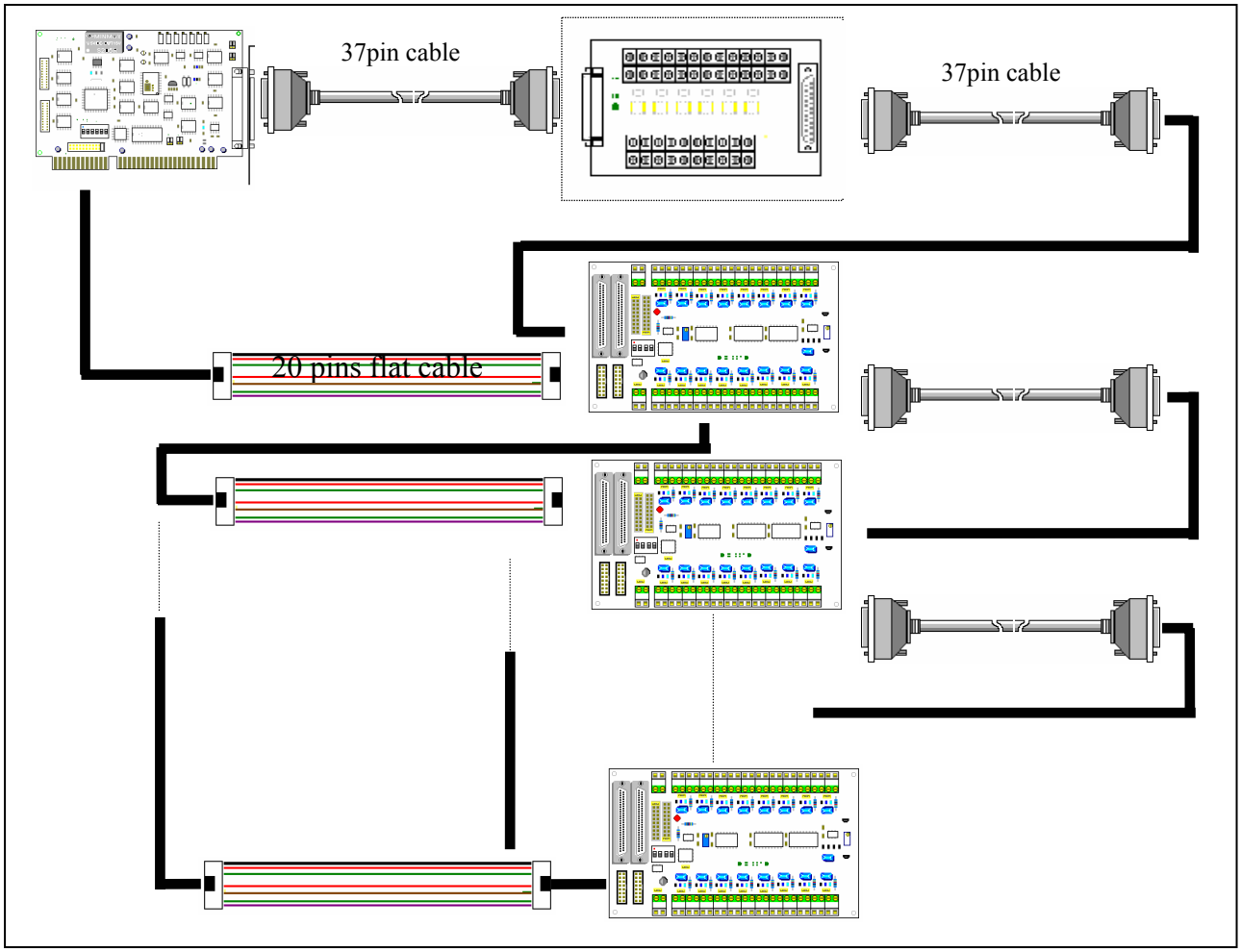
A.3: Connection to OME-ISO-AD32



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



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



WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of 13 months from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR WARRANTY RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR NON-WARRANTY REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

Shop online at www.omega.com

TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE, STRAIN AND FORCE

- Transducers & Strain Gages
- Load Cells & Pressure Gages
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

M3929/0203