Model PCL - 726

Six Channel
D/A Output Card

PCL-726 SIX CHANNEL D/A OUTPUT CARD

USER'S MANUAL

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1. GENERAL INFORMATION

1.1. Description

The PCL-726 provides six analog output channels on a single PC-BUS add-on card. Each channel can be set individually to any of the following ranges: 0 to 5V, 0 to 10V, +/-5V, +/-10V and 4 to 20mA current output. Designed for rugged environment, the PCL-726 is an ideal and economical solution for industrial application requiring multiple analog voltage and/or current output channels.

In addition to the analog output, PCL-726 also provides 16 channels of digital output and 16 channels of input. The D/I and D/O ports are TTL compatible and designed to be fully compatible with the available daughter boards those offer convenient solution to industrial ON/OFF control and sensing application. These daughter boards include PCLD-782 Isolated D/I Board, PCLD-785 Relay Output Board and PCLD-786 SSR & Relay Driver Board.

A utility program disk is supplied with the purpose to minimize user's software effort. The disk contains ready-to-run calibration program, demonstration program as well as program examples.

1.2. Features

*   6 independent D/A output channels.

*   12 bit resolution, double buffered D/A converters.

*   Multiple voltage ranges: +/- 10V, +/- 5V, 0 to 10V, 0 to 5V and
         4 to 20 mA current loop (sink).

*   All D/A outputs will be at 0 volt initial state after RESET or
         POWER-ON at either bipolar or unipolar mode.

*   16 digital input and 16 digital output channels. They are all TTL
         compatible.

*   D/I and D/O ports are fully compatible with the valid PC-LabCard daughter boards :

    -   PCLD-782 16 channel opto-isolated D/I board.
    -   PCLD-785 16 channel relay output board.
    -   PCLD-786 8 channel SSR output & 8 channel relay driver board.

*   Furnished utility software disk contains

    -   Calibration program.
    -   Demonstration program.
    -   Program examples.

*   DIP switch selectable wait state (0/2/4/6 wait states) insertion to ensure the compatibility with very high speed PC's.

*   Screw terminal board (PCLD-780 or PCLD-781) available for D/A output signal wiring.

1.3. Specifications

1.3.1.   Analog Output

Channels   : 6 channels.

Resolution   : 12 Bits. Double buffered.

Output range   : 0 to +5V (unipolar)
                  0 to +10V (unipolar)
                  +/- 5V (bipolar)
                  4 to 20mA current loop (sink).
                  +/- 10V with external DC or AC reference.

Reference voltage :

    Internal   : -5V (+/- 0.05V)
                   -10v (+/- 0.05V)

External   : DC or AC, +/- 10V max.

Conversion type : 12 bit monolithic multiplying.

Analog devices : AD7541AKN or equivalent.

Linearity   : +/- 1/2 bit.

Accuracy   : +/- 0.012% full scale range.

Temperature draft : 2 PPM/deg C full scale range

Settling time   : 70 usec max, with OP-07 output amplifiers.
                  (5 usec max. with OP-37 output amplifiers upon
                  special request.)

Current loop   : 4 to 20 mA constant current sink.

Voltage output drive : +/- 5mA max.

Current loop excitation voltage : Minimum +8V, maximum 36V for 4
                  to 20mA current loop.

Reset (power-on status) : All D/A channels will be at 0 volt output
                  after reset or power-on, either bipolar or
                  unipolar mode.

1.3.2. Digital Input

Channel   : 16 bits.

Level   : TTL compatible.

Input low   : 0.8V max.

Input high   : 2.0V min.

Input load   : -0.4mA max. at 0.5V.
                  0.05mA max. at 2.7V.

1.3.3 Digital Output

Channel   : 16 bits.

Level   : TTL compatible.

Output low   : 0.5V max. when sink 8mA.

Output high   : 2.4V min. when source 0.05mA.

1.3.4.   General Specifications

Power consumption : +5V : 500mA typ., 1A max.
                             +12V : 50mA typ., 110mA max.
                             -12V : 14mA typ., 90mA max.

I/O connector   : 20-pin post header for Analog/Digital I/O ports.
                     Adapter available to convert to 37 pin D-type
                     connector.

I/O base address : Requires 16 consecutive address locations. Base
                     address definable by the DIP switches for address
                     line A8 - A4. (Factory setting is hex 2C0).

Operating Temp. : 0 to +50 deg. C.

Storage Temp.   : -20 to +65 deg. C.

Weight   : 8.6 oz (242.89 gm).

2. INSTALLATION

2.1. Initial Inspection

Inside the shipping container, you should find this operating manual and the PCL-726 card. The PCL-726 was carefully inspected both mechanically and electrically before being shipped. It should be free of marks and scratches and in perfect working order on receipt.

When unpacking, check the unit for signs of shipping damage (damaged box, scratches, dents, etc). If there is damage to the unit or it fails to meet specifications, notify your local sales representative immediately.

Remove the PCL-726 interface card from its protective packaging by grasping the rear metal panel. Keep the anti-vibration packing. Whenever you remove the card from the PC I/O slot, please store the card in the package for protection.

Discharge any static electricity by touching the back of the system unit before you handle this card. You should avoid contact with materials that create static electricity such as plastic, vinyl, and styrofoam. The board should be handled only by the edges to avoid static electric discharge which may damage the integrated circuits on the PCL-726.

2.2. Jumper Settings

The PCL-726 is designed with easy to use in mind. There are one DIP switch and seven jumpers on the PCL-726 card and the function of each switch is discussed in this section. You may want to refer to Appendix B for the physical location of each switch.

2.2.1 Base Address Selection

Switch name: SW1 position 1 to 5

Most PC peripheral devices and interface cards are controlled through the input/output (I/O) ports. These ports are addressed using the I/O

port address space. Appendix C provides a PC I/O port address map to help you locate appropriate addresses for different devices.

The I/O port base address for the PCL-726 is selectable via an 8 position DIP switch. The PCL-726 requires 16 consecutive address locations in the I/O space. Valid addresses are from hex 200 to hex 3F0, however you might have used some of these addresses for other devices. Your PCL-726 base address switch setting is set to hex 2C0 in the factory. If you need to adjust it to some other address range, the switch settings for various base addresses are illustrated as below:

```
-----------------------------------------------
I/O Address                 Switch Position
Range (Hex)            1    2    3    4    5
                      A9   A8   A7   A6   A5   A4
----------------(Fixed)---------------------
200-20F               1    0    0    0    0    0
210-21F               1    0    0    0    0    1
220-22F               1    0    0    0    0    0
   .
   .
2C0-2CF     *         1    0    1    1    0    0
   .
   .
300-30F               1    1    0    0    0    0
   .
3F0-3FF               1    1    1    1    1    1
-----------------------------------------------
```

Note :   -   ON = 0, OFF = 1
          -    A4...A9 correspond to PC bus address lines.
          -    * means factory setting.
          -    Switch position 6 is not used.

2.2.2 Wait State Selection

Switch name: SW1 position 7 and 8

Some high speed PC's may require that wait states are inserted to achieve stable data transfer. The PCL-726 can be configured with 0, 2, 4, or 6 wait state delays fur each transfer of data. The length of the

wait state can be selected with the positions 7 and 8 on SW1, as shown below :

```
--------------------------------
Switch Position      Wait state
7        8           time delay
--------------------------------
0        0       *       0
1        0               2
0        1               4
1        1               6
--------------------------------
```

Note: * means factory setting

2.2.3 Reference and Mode Selection

Jumper name : JP1, JP2 of each channel

There are two jumpers for D/A reference source and output mode selections on each D/A conversion channel. The JP1 setting selects the reference of -5V: -10V or external voltage. The JP2 setting selects bipolar or unipolar mode of D/A output.

```
JP1 setting :     Unipolar            Bipolar

                  o  o   Unipolar   o  o   Unipolar
                  o  o              o  o
                  o  o   Bipolar    o  o   Bipolar


JP2 setting :   External ref.     -10V ref.        -5V ref.

                  o  o  EXT      o  o  EXT       o  o  EXT
                  o  o  -10V     o  o  -10V      o  o  -10V
                  o  o  -5V      o  o  -5V       o  o  -5V
```
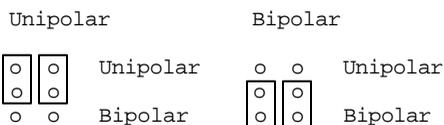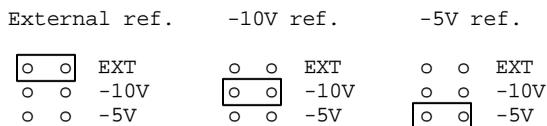
Some typical combinations of JP1 and JP2 are shown as following:

```
Output range        JP2                    JP1
--------------------------------------------------
                 o    o              ┌─┐  ┌─┐
  *  0 to +5V     o    o             │o│  │o│
     Unipolar    [o    o]            │o│  │o│
--------------------------------------------------└─┘──└─┘─o────o──────
                 o    o              ┌─┐  ┌─┐
     0 to +10V   [o    o]            │o│  │o│
     Unipolar    o    o        .     │o│  │o│
--------------------------------------------------o────o──────
                 o    o              o    o
     +/-5V        o    o             ┌─┐  ┌─┐
     Bipolar     [o    o]            │o│  │o│
--------------------------------------------------│o│──│o│──
                 o    o              o    o
     +/-10V      [o    o]            ┌─┐  ┌─┐
     Bipolar     o    o              │o│  │o│
--------------------------------------------------│o│──│o│──
                 o    o              ┌─┐  ┌─┐
     4 to 20mA   o    o              │o│  │o│
                 [o    o]            │o│  │o│
--------------------------------------------------o────o──────
     Ext. Ref.   [o    o]            ┌─┐  ┌─┐
     (Programmable o    o            │o│  │o│
     Attenuator)  o    o             │o│  │o│
--------------------------------------------------o────o──────
```
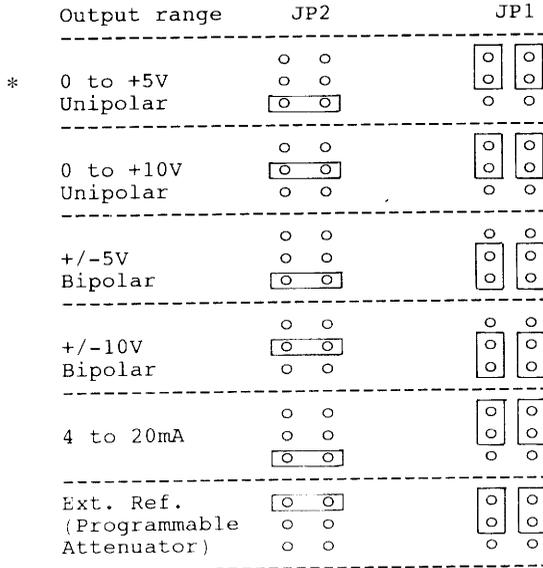
Note :   1.   For programmable attenuator function should, the input
              signal should be connected to the "ref in' pin of CN3
              and CN4.

         2.   *   means factory setting

2.3 Connector Pin Assignment

The PCL-726 is equipped with two 20-pin insulation displacement (mass
Termination) connectors accessible from the rear plate, and two other 20-pin
insulation displacement connectors on-board.   All these connectors can be
connected to the same type of flat cables , or connected to 37-pin D-type
connectors through our PCLK-1050 industrial wiring kit. Please Refer to
Appendix B for the location of each connector.

The following diagrams illustrate the pin assignment of each connector.

Legend :

      V OUT   -   Analog voltage output
      I OUT   -   Analog current output
      REF OUT -   Reference voltage output
      REF IN   -   Voltage reference input
      D/O   -   Digital output
      D/I   -   Digital input
      D.GND   -   Digital and power supply ground
      A.GND   -   Analog ground
      NC   -   No connection

```
Connector 1 (CN1) -  Digital Output


          D/O 0      1    2    D/O 1
          D/O 2      3    4    D/O 3
          D/O 4      5    6    D/O 5
          D/O 6      7    8    D/O 7
          D/O 8      9   10    D/O 9
          D/O 10    11   12    D/O 11
          D/O 12    13   14    D/O 13
          D/O 14    15   16    D/O 15
          D.GND     17   18    D.GND
          +5V       19   20    +12V


Connector 2 (CN2)  - Digital Input


          D/I 0      1    2    D/I 1
          D/I 2      3    4    D/I 3
          D/I 4      5    6    D/I 5
          D/I 6      7    8    D/I 7
          D/I 8      9   10    D/I 9
          D/I 10    11   12    D/I 11
          D/I 12    13   14    D/I 13
          D/I 14    15   16    D/I 15
          D.GND     17   18    D.GND
          +5V       19   20    +12V
```

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```
Connector 3 (CN3) - D/A Output (Ch #1 to Ch #3)


      -5V REF OUT      | 1   2 |  -10V REF OUT
      -5V REF OUT      | 3   4 |  -10V REF OUT
      D/A #1 V OUT     | 5   6 |  D/A #1 I OUT
      D/A #1 REF IN    | 7   8 |  A.GND
      D/A #2 V OUT     | 9  10 |  D/A #2 I OUT
      D/A #2 REF IN    |11  12 |  A.GND
      D/A #3 V OUT     |13  14 |  D/A #3 I OUT
      D/A #3 REF IN    |15  16 |  A.GND
      A.GND            |17  18 |  A.GND
      NC               |19  20 |  NC


Connector 4 (CN4) - D/A Output (Ch #4 to Ch #6)


      D/A #4 V OUT     | 1   2 |  D/A #4 I OUT
      D/A #4 REF IN    | 3   4 |  A.GND
      D/A #5 V OUT     | 5   6 |  D/A #5 I OUT
      D/A #5 REF IN    | 7   8 |  A.GND
      D/A #6 V OUT     | 9  10 |  D/A #6 I OUT
      D/A #6 REF       |11  12 |  A.GND
      A.GND            |13  14 |  A.GND
      D.GND            |15  16 |  D.GND
      +5V              |17  18 |  +5V
      +12V             |19  20 |  +12v
```

2.2. Hardware Installation

Installing the card in your computer

1.   Turn the computer off Turn the power off to any peripheral devices
     (such as printers and monitors).

2.   Disconnect the power cord and any other cables from the back of
     the computer. Turn the system unit so the back of the unit faces
     you.

3.   Remove the system unit cover. (refer to your computer users guide
     if necessary).

4.   Locate the expansion slots at the rear of the unit and choose any
     unused slot.

5.   Remove the screw that secures the expansion slot cover to the
      system unit (save the screw to secure the interface card retaining
      bracket).

6.   Carefully grasp the upper edge of the PCL-726 card. Align the
      hole in the retaining bracket with the hole on top of the
      expansion slot, and align the gold striped edge connector with the
      expansion slot socket. Press the board firmly into the socket.

7.   Replace the screw in the expansion slot retaining bracket.

8.   Attach necessary accessories, e.g., 20 pin flat cable or connector
      adapter, to the interface card based on your application
      requirements.

9.   Replace the system unit cover. Connect the cables you removed in
       step 2. Turn the computer power on.

The hardware installation is now completed, proceed to install the software
driver.

2.5. Software Installation

A floppy diskette containing utility software is included with each PCL-726 to
minimize your application programming work and support the PCL-726
calibration. The utility programs include :

1.   Testing program.

2.   Demonstration programs.

3.   Calibration program.

It is strongly recommended that you make a working copy from the master
copy diskette and save the master copy in safe place. You may use the **DOS
COPY** or **DISKCOPY** commands to copy the diskette files to another floppy
disk or use the **COPY** command to *copy* the files to a hard disk. Refer to your
MS-DOS users manual for details of how to make backup copies of your

make backup copies of your diskettes.

Since the operation of the calibration program will be covered in Appendix D, we will only explain the functions of these program files.

* **TEST726.EXE**   : The object of the test program is to test the PCL-726 functions easily by the user. The test functions consist of D/A voltage output, D/A current loop output, digital output and digital input.

* **DEM0726A.BAS**   : This demonstration program provides an example of writing I/O ports to program D/A #1 to generate +3V at unipolar mode and than programs D/A #2 to generate -3V at bipolar mode. Additionally, there are also some explanations about how to program a current output of 10mA on D/A #3

* **DEM0726B.BAS**   : This demonstration program provides an example that programs D/A #1 to D/A #6 to generate a voltage waveform rising from -5V to +5V and then a drop from +5V to -5V at bipolar mode.

 * **CALB726.BAS**   : This calibration program provides a procedure to calibrate the voltage and current output of each D/A channels. The program will guide the user to adjust the variable resistors to get the best accuracy of the outputs.

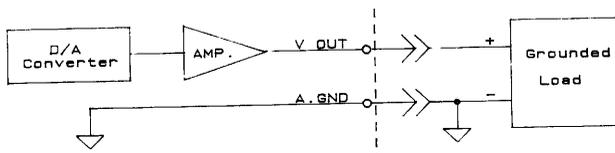## 3. SIGNAL CONNECTION

3.1. Introduction

Correct signal connection is one of the most important steps to assure your application system will send and receive data correctly. Since most data acquisition applications involve voltage measurement, correct signal connection will avoid costly damage to your equipment. This section provides some useful information on signal connection in different types of data acquisition applications.
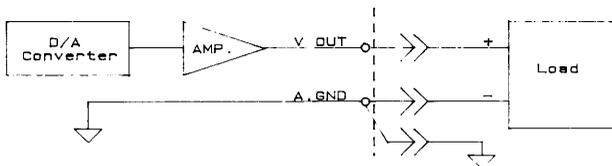
3.2. Voltage Output Connection

The PCL-726 supports 6 channels of D/A voltage output. There is only one output signal wire for each channel. The voltage is referred to the common ground. It is fairly simple to connect a voltage output channel to a floating load. A standard wiring diagram is illustrated below :

PCL-726 Side   External Side
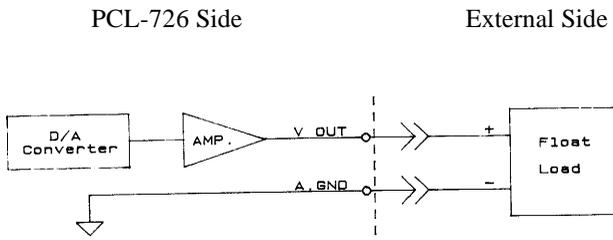
For grounded load, the signal should be connected as:

For some differential input loads, an external ground wire is needed and the signal connection is recommended as following:

### 3.3. 4 to 20mA Current Output Connection

The PCL-726 provides 6 channels of 4 to 20mA current output. The current loop output utilizes the 0 to 5V(unipolar) voltage output as the driving source and a current drive circuit consists of a power FET, reverse protection diode and a constant current source. The voltage bias of this current output should be within 8 to 36 volts to insure correct operation. A 24 volt power supply is ideal for this application. The PCL-726 also provides internal 12 volt power source for current loop by user's selection. There are three ways of connecting: a grounded load with a floating supply, a floating load with a grounded power supply, a floating load with internal 12 volt supply. The connections are shown below:
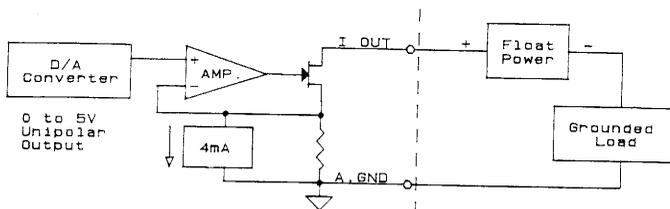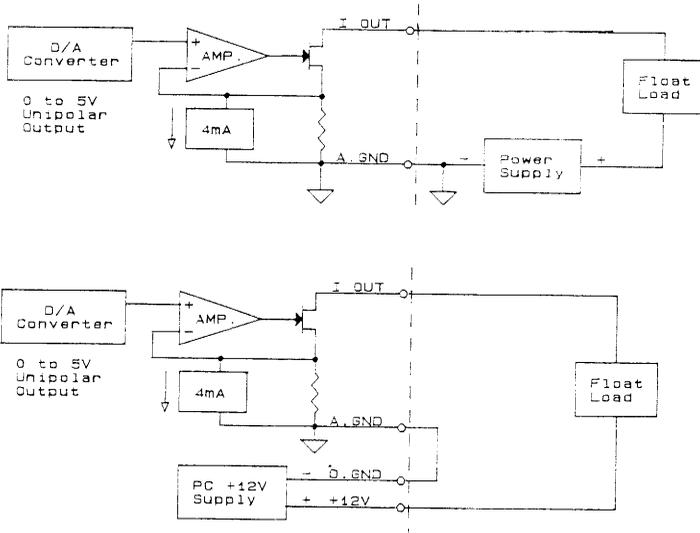
1.3. Programmable Attennuator Connection

A variety of D/A operations can be supported by your PCL-726.   For example, the PCL-726 can function as a digital attenuator by inputing variable AC or DC references, or can be used to generate arbitrary waveform outputs. The connection is
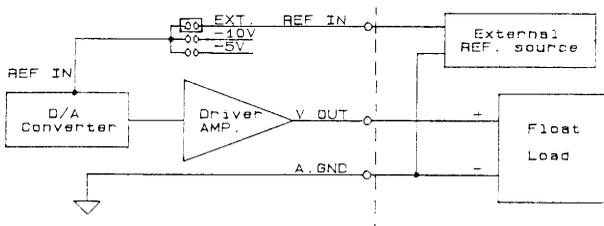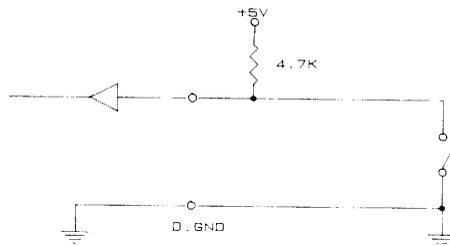
3.5. Digital Signal Connection

The PCL-726 has 16 digital input and 16 digital output channels. The digital I/O levels are TTL compatible. To transmit or receive digital signal to/from other TTL devices, the connection is :

TTL Devices
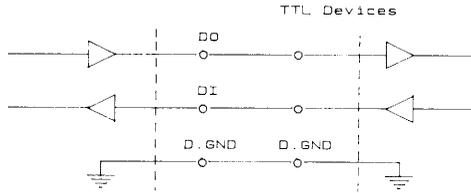
To receive an **OPEN/SHORT** signal from a switch or relay, a pull up resistor must be added to ensure the high level when open.

4. REGISTER STRUCTURE AND FORMAT

4.1. Introduction

The PCL-726 requires 16 consecutive addresses in I/O space. The most important issue in programming the PCL-726 is understanding the meaning of the 16 registers addressable from the selected I/O port base address. A summary map of the functions of each address and the data format of each register are given in the following sections.

3.2. I/O Port Address Map

The following table provides the location of each register and driver relative to the base address, and its usage.

Legend :

```
D/A  -   Analog output
D/O  -   Digital output
D/I  -    Digital input
D/I  -    Digital input
R    -   Read operation on that byte
W    -   Write operation on that byte

Address   R/W           Usage
------------------------------------------------
BASE + O   W    D/A oh #1 high byte data (bit 0-3)
BASE + 1   W    D/A oh #1 low byte data
BASE + 2   W    D/A oh #2 high byte data (bit 0-3)
BASE + 3   W    D/A oh #2 low byte data
BASE + 4   W    D/A oh #3 high byte data (bit 0-3)
BASE + 5   W    D/A oh #3 low byte data
BASE + 6   W    D/A oh #4 high byte data (bit 0-3)
BASE + 7   W    D/A oh #4 low byte data
BASE + 8   W    D/A oh #5 high byte data (bit 0-3)
BASE + 9   W    D/A oh #5 low byte data
BASE + 10  W    D/A oh #6 high byte data (bit 0-3)
BASE + 11  W    D/A oh #6 low byte data
BASE + 12  W    D/O oh 8-15
BASE + 13  W    D/O oh 0-7
BASE + 14  R    D/I oh 8-15
BASE + 15  R    D/I oh 0-7
```

4.3 D/A Output Registers

The D/A output registers are write registers using address BASE +0 to Base +11.

Data Format :

```
BASE + O (2,4,6,8,10)    D7   D6   D5   D4   D3   D2   D1   DO

D/A # 1  (2,3,4,5,6)     X    X    X    X    DA11 DA10 DA9  DA8
High byte

BASE + 1 (3,5,7,9,11)    D7   D6   D5   D4   D3   D2   D1   DO

D/A # 1 (2,3,4,5,6)      DA7  DA6  DA5  DA4  DA3  DA2  DA1  DAO
Low byte
```

LEGEND :

DA11 to DAO - Digital to analog data. DA0 is the least significant byte
(LSB) and DAZ1 is the most significant byte (MSB) of
the D/A data.

X   - Don't care

The D/A circuit utilizes a double buffer technique to eliminate the transient stage between the writing operations of high byte and low byte data. The high byte data (only the lower 4 bits are significant) must be written first and it is then latched into a latch for temporary storage and does not change the analog output. While the low byte is being sent, the high byte data reaches the D/A converter at the same time as the low byte data.

NOTE : THE HIGH BYTE DATA MUST BE SENT FIRST.

4.4. Digital I/O Registers

The PCL-726 offers 16 digital input channels and 16 digital output channels. The digital input channels use the I/O address BASE +14 and BASE +15. The digital output channels use the I/O address BASE +12 and BASE +13. The data format of each port is as following :

Data Format :

	D7	D6	D5	D4	D3	D2	D1	DO
BASE + 12								
D/O high byte	DO15	DO14	DO13	DO12	DO11	DO10	DO9	DO8
BASE + 13	D7	D6	D5	D4	D3	D2	D1	DO
D/O low byte	DO7	DO6	DO5	DO4	DO3	DO2	DO1	DOO
BASE + 14	D7	D6	D5	D4	D3	D2	D1	DO
D/I high byte	DI15	DI14	DI13	DI12	DI11	DI10	DI9	DI8
BASE + 15	D7	D6	D5	D4	D3	D2	D1	DO
D/I low byte	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DIO

LEGEND :

DO15 to DO0 - Digital output data. DO7 to DO0 is the low byte data and DO15 to DO7 is the high byte data (MSB) of the digital output port.

DT15 to DIO - Digital input data. D17 to DI0 is the low byte data and DI15 to DI7 is the high byte data (MSB) of the digital input port.

5. APPLICATION

5.1. D/A Applications

The PCL-726 provides 6 D/A channels which use double buffered 12 bit multiplying D/A converters. The D/A registers are write registers using address BASE +O to BASE +11.

When programming the D/A channels, please note that the most significant byte (high byte data) should be sent first. It is then temporarily held by a register in the D/A and not released to the D/A converter. After the least significant byte (low byte data) is written, the low byte and high byte are added and passed to the D/A converter at the same time. This double buffering process protects the D/A data integrity through a single step update.

The PCL-726 provides an internal precision fixed -5V reference. If this voltage is used as D/A input reference, the D/A output range will be 0 to +5V. You may select other external DC or AC sources as the D/A reference inputs. The maximum reference voltage is +/-10V and the maximum D/A output range is +/- 10V.

Connector CN3 and CN4 support all D/A signal connections. The pin assignment of these connectors is described in Section 2.3. Section 3.2. and 3.3. cover the DIA signal connections and gives an illustration of a wiring diagram.

The PCL-726 D/A functions can be performed in the way by writing I/O instructions to the registers directly. A commonly used D/A application is clearly illustrated in the demonstration program on your diskette. The demonstration program, DEM0726A.BAS, on the PCL-726 software diskette provides a complete explanation of programming either a single D/A channel or more D/A channels.

The following program examples written in BASIC show how to program D/A channel #1 to generate a voltage of +3V.

```
10    ' Figure out the values of the low and high bytes.
20    ' The jumper is set to -5V reference and unipolar
30    ' and the D/A range is OV to +5V.
```

```
40    V = 3.0
50    X% = (V/5*4096)
60    ' X% = (V/5*2048)+2048 for bipolar -5V to +5V
70    IF X%>4095 OR X%<O THEN PRINT "OVERFLOW !!!" : END
80    HI% = X% / 256
90    LO% = X% MOD 256
100   ' Write the value into registers
110   OUT &H2C0+0, HI% : OUT &H2CO+1, LO%
120   END
```

3.3. Digital Input and Output

The PCL-726 provides 16 digital input channels and 16 digital output channels. It is fairly straight forward to program the digital input and output channels. Attention should be paid to the pin assignments of connectors CN1 (digital output) and CN2 (digital input).

A reading operation on any of the D/I ports will read in the value of the 8 corresponding digital input channels. To access the D/I ports in BASIC, use the following statement:

VALUE = INP (ADDRESS)

Where ADDRESS is BASE+14 (high byte) or BASE+1S (low byte).

A writing operation to any of the D/() ports will set the desired value of the 8 corresponding digital output channels. To access the D/O ports in BASIC, use the statement shown below:

OUT ADDRESS, VALUE

Where ADDRESS is BASE+12 (high byte) or BASE+13 (low byte).

APPENDIX A. BLOCK DIAGRAM

PCL-725 BLOCK DIAGRAM

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APPENDIX B. CONNECTOR, SWITCH AND VR LOCATIONS
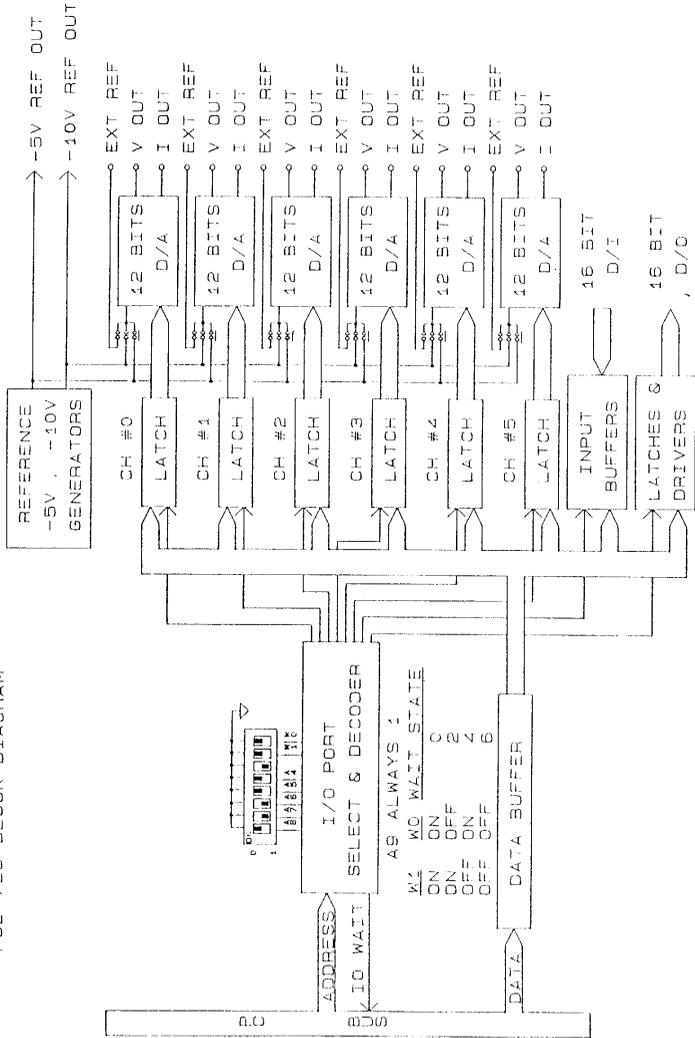
APPENDIX C. PC I/O PORT ADDRESS MAP

I/O Address Range (Hex) Function

I/O Address Range (Hex)	Function
000-1FF	Base system
200	Reserved
201	Came control
202-277	Reserved
278-27F	Second printer port
280-2F7	Reserved
2F8-2FF	COM2
300-377	Reserved
3713-37F	First printer port
380-3AF	Reserved
3BO-3BF	Mono Disp/Print adapter
3CO-3CF	Reserved
3DO-3DF	Color/Graphics
3EO-3EF	Reserved
3FO-3F7	Floppy disk drive
3F8-3FF	COM1

APPENDIX D. CALIBRATION

In the application of data acquisition and control, it is important to constantly calibrate your measurement device to maintain its accuracy. A calibration program, CALB726.BAS, is provided on the PCL-726 software diskette to assist your calibration work.

D.1. VR Assignment

There are 28 variable resistors (VR) on the PCL-726 to allow you making accurate adjustment on D/A channels. The location of each VR is indicated in Appendix B. Connector, Switch and VR Locations. There are 6 sets of VR1, VR2, and VR3 for the adjustment of 6 D/A channels respectively. The functions of the VR's are listed below:

VR1 : D/A gain adjustment for each channel
VR2 : D/A unipolar offset adjustment for each channel
VR3 : D/A bipolar offset adjustment for each channel
VR4 : -10V reference voltage adjustment for D/A Ch #4 to Ch #6
VR5 : -5V reference voltage adjustment for D/A Ch #4 to Ch #6
VR6 : -10V reference voltage adjustment for D/A Ch #1 to Ch #3
VR7 : -5V reference voltage adjustment for D/A Ch #1 to Ch #3
CHI : Ch #1 current offset *adjustment* (4 mA)
CH2 : Ch #2 current offset adjustment (4 mA)
CH3 : Ch #3 current offset adjustment (4 mA)
CH4 : Ch #4 current offset adjustment (4 mA)
CH5 : Ch #5 current offset adjustment (4 mA)
CH6 : Ch #6 current offset adjustment (4 mA)

D.2. D/A Calibration

The calibration program is written in BASIC language. To use it, simply load the program into BASIC and run the program. The default I/O port address setting in the program is hex 2C0. If address hex 2C0 had been occupied by another device, you may either replace that device with the PCL-716 on address hex 2C0 or modify the address setting in the calibration program. It is strongly recommended that do not change

the program unless you thoroughly understand the PCL-726 calibration program.

Once the calibration program has been loaded and executed, it used the graphic display and prompts to guide you through the calibration process.

In addition to the calibration program, it is necessary to have a 5 1/2 digit multimeter to perform the calibration. A slot extension card will make your access to the VR's easier. The PC-LabCARD product PCL-755A (Slot Extension Card) is an ideal product to support the slot extension.

A standard procedure to calibrate the PCL-726 card is illustrated below:

Step 1 : Calibrate REFERENCE VOLTAGE SOURCES including -10V
           REFI (Ch #4 - Ch #6), -5V REFI (Ch #4 Ch #6), -10V REF2
           (Ch #1 - Ch #3) and -5V REF2 (Ch #1 - Ch #3). < VR4-VR7 >

Step 2 : Adjust D/A voltage output OFFSET of unipolar mode.
           < < Adjust VR2 of each channel > >

Step 3 : Adjust D/A voltage output GAIN of unipolar mode.
           < < Adjust VR1 of each channel > >

Step 4 : Adjust D/A precision 4mA constant current.
           < < Adjust VR named "CHI" to "CH6" > >

Step 5 : Adjust D/A voltage output OFFSET of bipolar mode.
           < < Adjust VR3 of each channel > >

Note: The voltage output GAIN of bipolar mode depends on the GAIN
              of unipolar mode, so it is not necessary to be adjusted. The current
              gain depends on a precise fixed resistor and does not need
              adjustment.