INDUSTRIAL COMPUTER SOURCE®

Model AOB2-P
Product Manual

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INDUSTRIAL COMPUTER SOURCE®

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FOREWARD

This product manual provides information to install, operate and or program the referenced product(s) manufactured or distributed by Industrial Computer Source. The following pages contain information regarding the warranty and repair policies.

Technical assistance is available at: **1-800-480-0044**.

Manual Errors, Omissions and Bugs: A "Bug Sheet" is included as the last page of this manual. Please use the "Bug Sheet" if you experience any problems with the manual that requires correction.

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September 1997

Chapter 1: Introduction

The AOB2-P is a half-size card that can be installed in short I/O slots of PC/XT/AT class computers. The AOB2-P is designed to be EC Compliant when used in a EC Compliant chassis. It contains two digital-to-analog converters (DAC) and provides two independent analog output channels of 12-bit resolution. Each analog output channel can be configured for ranges of:

0V to +5V

0V to +10V

-5V to +5V

-10V to +10V

4mA to 20mA

Voltage ranges may be setup one of two ways; either by settings on two on-board jumpers or by jumpers at the output connector. The Option Selection section of this manual contains a description of how to make these selections.

Both analog output channels have a double-buffered input for single-step update and each is addressed at its own I/O location. The card is designed for left-justified data format. The analog outputs can be set up to be updated either independently or simultaneously.

Analog Outputs

Resolution

12 bits (0 to 4095 decimal)

Channels

Two

Voltage Output Ranges at 5mA max

0.0 to 5.0 VDC
0.0 to 10.0 VDC.
-5.0 to +5.0 VDC
-10.0 to +10.0 VDC

Current Output Range (with excitation voltage 8-36 VDC)

4 to 20 mA

Digital-to-Analog Converter

AD-7548 monolithic chip, double buffered

Relative Accuracy

±1 LSB (includes nonlinearity)

Monotonicity

Guaranteed over operating temperature range

Settling Time

4 usec to 0.01% for full-scale step input.

Offset Temperature Drift

±1 ppm/ C. typical
±3 ppm/ C. maximum

Gain Temperature Drift

±25 ppm/ C. (with reference)
±5 ppm/ C. (w/ext. ref)

Reference Voltage Input Range

±10V (2 or 4 quadrant)

Reference Input Resistance

7Kohm min., 11 Kohm typical, 20 Kohm max

Data Format

Left-justified, two bytes (4 LSB's, then 8 MSB's)

Power Requirements

+5 VDC @ 75 mA typical, 100 mA max
+12 VDC @ 15 mA typical, 25 mA max
-12 VDC @ 25 mA typical, 35 mA max

Environmental

Operating Temperature Range

0° to +70° C.

Storage Temperature Range

-55° to +125° C.

Humidity

5% to 95% non-condensing.

Weight

4 oz.

Size

5.0" long. Can be used in half- or full-size slot.

Agency Approvals

CE Conformity with:
EU EMC Directive 89/336/EEC
EU Low Voltage Directive 72/23/EEC

CE

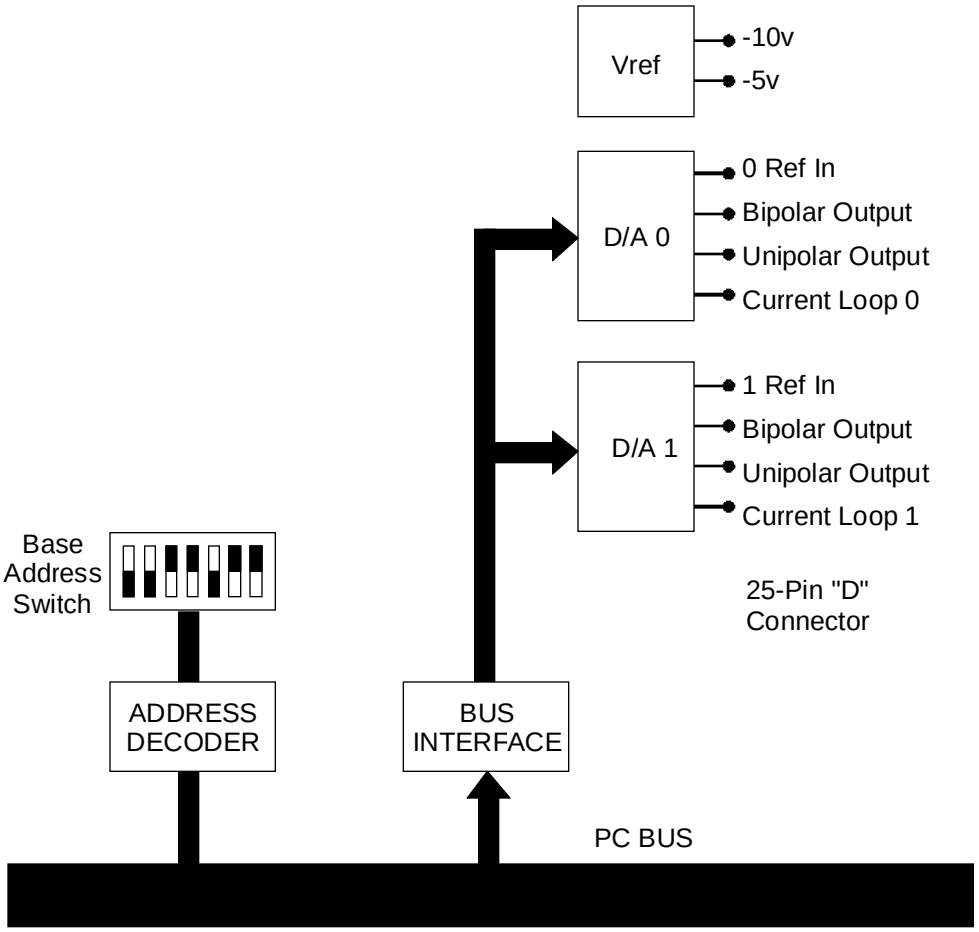


Figure 1: AOB2-P Block Diagram

Chapter 2: Option Selection

Voltage output ranges are determined either by jumper installation at the output connector or by jumper placement as described in the following paragraphs. Also, the method of updating D/A outputs is programmable as described on the next page and in the Programming section of this manual.

Output Ranges

A quick and easy way to select output voltage ranges (either unipolar or bipolar) is to set jumpers S3 (channel #0) and S2 (channel #1). These jumpers are located at the upper left corner of the card when looking at the component side.

Placing those jumpers in the "-5V" position selects the 0 to 5V, the -5V to +5V range, or the 4-20 mA range. The range selected depends on the output pins being connected. See the table below for details.

Placing S3 and S2 to the "-10V" position selects the 0 to 10V or the -10V to +10V range.

An alternative way to select output ranges for each analog output channel is to place jumpers between pins on the I/O connector. The various ranges are selected as follows:

Range		Jumper Between Pins	Output Pin
0 to +5VDC	D/A #0	21 and 22	24
	D/A #1	15 and 16	18
0 to +10VDC	D/A #0	20 and 22	24
	D/A #1	14 and 16	18
±5VDC	D/A #0	21 and 22	23
	D/A #1	15 and 16	17
±10VDC	D/A #0	20 and 22	23
	D/A #1	14 and 16	17
4-20mA	D/A #0	21 and 22	25
	D/A #1	15 and 16	19

Analog Outputs Update

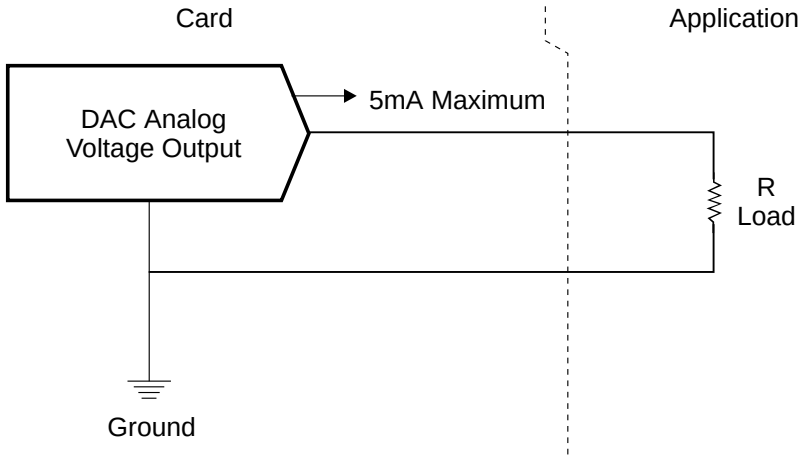
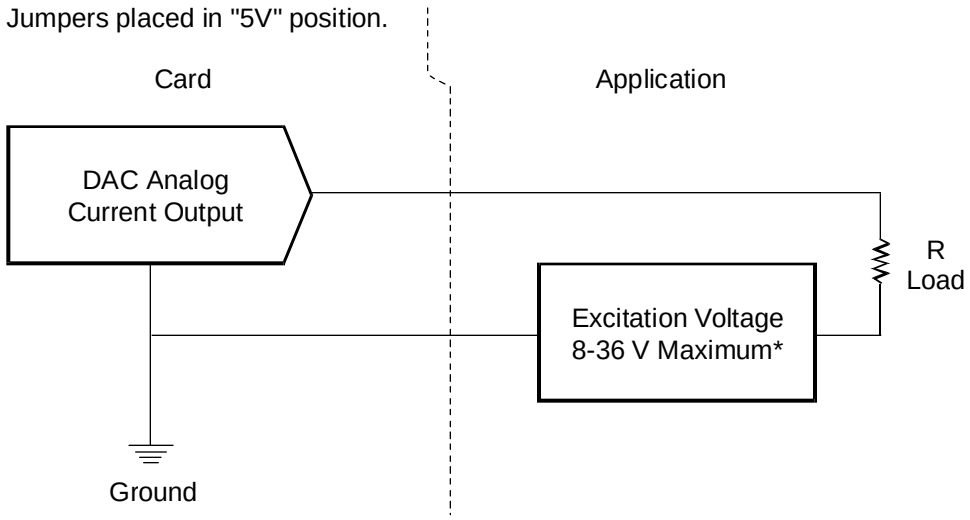


Figure 2: Voltage Output



* Minimum voltage of 8V must be maintained for correct operation.

Figure 3: Current Output

Analog outputs may be updated under program control in either of two ways:

(a) Each D/A output is updated when new data are written to its related high byte base address.

(b) The outputs of both D/A's may be updated simultaneously. This is done by first writing the low and high bytes for D/A 0 to base address +4 and base address +5 respectively and the low byte for D/A 1 to base address +6. Then, when the high byte for D/A 1 is written to base address +7, both D/A outputs are updated.

Refer to the Programming section of this manual for more detail.

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Chapter 3: Installation

Address Selection

The AOB2-P occupies eight consecutive addresses in I/O space. The base or starting address can be selected anywhere within the I/O address range 000-3FF provided that it does not cause an overlap with other functions. If in doubt about what base address to use, the following table lists standard address assignments. Addresses not mentioned in this table are generally available for I/O boards.

CAUTION!

When using D/A circuitry to control a high voltage motor (ie 48VDC or 115/ 230VAC). The D/A board must be isolated from the motor. Leakage currents large enough to damage the D/A board can be induced on the low voltage D/A line at start-up.

Hex Range	Usage
000-1FF	Internal System - Not Usable
200-20F	Game Control
210-217	Expansion Unit
220-24F	Reserved
278-27F	Reserved
2E8-2EF	Serial Port
2F0-2F7	Reserved
300-31F	Asynchronous Communications (secondary)
320-32F	Prototype Card
378-37F	Fixed Disk
380-38C	Printer
3A0-3A9	SDLC Communications
3B0-3BF	Binary Synchronous Communications (primary)
3C0-3CF	Reserved
3DO-3DF	Color/Graphics
3E0-3E7	Reserved
3E8-3EF	Serial Port
3F0-3F7	Diskette
3F8-3FF	Asynchronous Comunications (primary)

The AOB2-P base address is set up by a DIP switch. That switch controls address bits A3 through A9. (Lines A0 through A2 are used on the card to control individual registers. A description of these two lines is in the Programming chapter of this manual.)

To determine how to set these switches for a desired hex-code address, refer to the Address Settings table. If you prefer to determine proper switch settings yourself, first convert the hex-code address to binary form (refer to the Address Values and Switch Settings table). Then, set the corresponding switch to ON for each “0” and set the corresponding switch to OFF for each “1”.

The following example illustrates switch selection corresponding to hex 300 (or binary 11 0000 0xxx). The "xxx" represents address lines A0 through A2, used on the card to select individual registers as described in the Programming section of this manual.

Address Settings

	A9	A8	A7	A6	A5	A4	A3
200H	OFF	ON	ON	ON	ON	ON	ON
210H	OFF	ON	ON	ON	ON	OFF	ON
220H	OFF	ON	ON	ON	OFF	ON	ON
300H	OFF	OFF	ON	ON	ON	ON	ON
310H	OFF	OFF	ON	ON	ON	OFF	ON
320H	OFF	OFF	ON	ON	OFF	ON	ON
350H	OFF	OFF	ON	OFF	ON	OFF	ON

Address Values and Switch Settings

Address Line	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
Binary	0	0	1	1	0	0	0	0	0	0	0	0
Hex	3				0				0			
Switch Settings			OFF	OFF	ON	ON	ON	ON	ON			

ON=0 OFF=1

Carefully review the address selection reference table before selecting the card address and then perform the Installation Precheck Procedure to determine if that address is in fact free. If the addresses of two installed items overlap, you will experience unpredictable computer behavior. The following illustration show the location of the switches on the AOB2-P board.

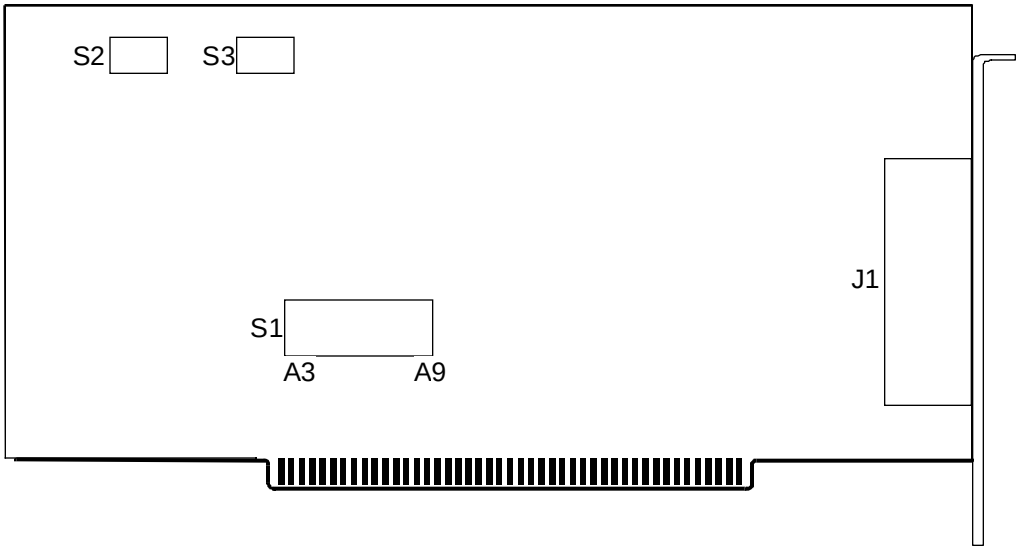

Figure 4: AOB2-P Switch Locations

Installation Procedure

Before installing the card, carefully read the Address Selection and Option Selection sections of this manual and configure the card according to your requirements. Be especially careful with Address Selection. If the addresses of two installed functions overlap, you will experience unpredictable computer behavior.

Installation Precheck Procedure

The precheck procedure is designed to help you determine if the address you have selected for the board is actually free for use. In the following example we are testing for an address of hex 300, but any other address may be substituted.

1. Type DEBUG at the DOS prompt and the press the Enter key. The DOS directory must be in your path statement or you must change to the DOS subdirectory before running this application. The DEBUG "-" prompt is displayed.
2. Type **i 300** at the DEBUG "-" prompt and press the Enter key. This reads I/O address H300. DEBUG returns an **FF** if the address is not currently in use. If a value other than **FF** is returned, the address is being used by another board. Try each desired address until an **FF** is returned. For information about the various functions available through DEBUG, simply type a **?** at the prompt and press the Enter key.
3. Repeat step 2 for the next seven (7) addresses, since the board uses eight (8) consecutive addresses. For example, if **300** checked out, check **301** through **307**. Each of these addresses should also return an **FF**.
4. After you have finished checking each address, type **q** and press the Enter key to exit DEBUG.
5. Turn off the computer in preparation for installing the circuit board. If you haven't already done so, set the address switches in accordance with the directions in the previous section.

Installing the card

To install the card:

1. Turn off computer power.
2. Remove the computer cover.
3. Remove the blank I/O backplate.
4. Select the base address on the card.
5. Install the card in an I/O expansion slot.
6. Install the I/O cable.
7. Inspect for proper fit of the card and cables, tighten screws.

How to remain CE Compliant

In order for machines to remain CE compliant, only CE compliant parts may be used. To keep a chassis compliant it must contain only compliant cards, and for cards to remain compliant they must be used in compliant chassis. Any modifications made to the equipment may affect the CE compliance standards and should not be done unless approved in writing by Industrial Computer Source.

The Model AOB2-P is designed to be CE Compliant when used in an CE compliant chassis. Maintaining CE Compliance also requires proper cabling and termination techniques. The user is advised to follow proper cabling techniques from sensor to interface to ensure a complete CE Compliant system. Industrial Computer Source does not offer engineering services for designing cabling or termination systems. Although Industrial Computer Source offers accessory cables and termination panels, it is the user's responsibility to ensure they are installed with proper shielding to maintain CE Compliance.

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Chapter 4: Programming

The AOB2-P card uses eight consecutive I/O addresses. The I/O address map is as follows:

Address	Write	Comment
Base + 0	AO 0 Low Byte	
Base + 1	AO 0 High Byte	Updates output of D/A 0
Base + 2	AO 1 Low Byte	
Base + 3	AO 1 High Byte	Oupdates output of D/A 1
Base + 4	AO 0 Low Byte	Data to buffer only
Base + 5	AO 0 High Byte	Data to buffer only
Base + 6	AO 1 Low Byte	Data to buffer only
Base + 7	AO 1 High Byte	Updates both D/A outputs

Note that, if you wish to update both D/A's simultaneously, you can do so by using Base Address +4 through Base Address +7.

Data are written to the D/A in left-justified, binary format.

B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	X	X	X	X
High Byte												Low Byte			

Data Format

Byte	D7	D6	D5	D4	D3	D2	D1	D0
Low	B12	B11	B10	B9	X	X	X	X
High	B8	B7	B6	B5	B4	B3	B2	B1

For UNIPOLAR ranges: For Unipolar ranges, data are in true binary form.

0000 0000 0000 = ZERO
1000 0000 0000 = 1/2 SCALE
1111 1111 1111 = FULL SCALE

MSB or B12 B1 or LSB

For BIPOLAR ranges: For Bipolar ranges, data are in complementary offset binary form.

0000 0000 0000 = + FULL SCALE
1000 0000 0000 = ZERO
1111 1111 1111 = - FULL SCALE

To output an analog value with 12-bit resolution, a corresponding decimal number N between 0 and 4095 is calculated.

N / 4095 = V(out) / V(full scale)

Then the number is split between high and low bytes, as follows:

```
N = N *16
H% = INT (N / 256)
L% = N - (H% * 256)
```

Next the data are written to the selected analog output channel. (See I/O Address Map.) In this example, we will assume analog output 0 (AO 0).

```
OUT (BASE + 0), L%
OUT (BASE + 1), H%
```

For simplicity, it was assumed that the simultaneous-update capability of AOB2-P was not used.

The following sample code performs the following functions.

1. Outputs 0V to both channels simultaneously.
2. Raises each channel independently.
3. Outputs 10V to both channels simultaneously.

The following is the sample BASIC code for the AOB2.

```
BASEADDR%=&H300                 'Set the base address to hex 300.
N=0*(4096/10)                   'N=Vout*(full scale count/full scale volt)
HIGHBYTE%=((N AND &HFF0)/16)    'Shift right 4 bits to isolate the high byte.
LOWBYTE%=((N AND &H00F)*16)     'Shift left 4 bits to isolate the low byte.
OUT BASEADDR% +4, LOWBYTE%      'Load data to the buffer.
OUT BASEADDR% +5, HIGHBYTE%     'Load data to the buffer.
OUT BASEADDR% +6, LOWBYTE%      'Load data to buffer.
OUT BASEADDR% +7, HIGHBYTE%     'Update both D/A 0 'and D/A 1
                                simultaneously.
```

Peek and Poke Driver for Windows 95/NT

This driver allows developers to write Win32 programs which access hardware I/O ports and physical memory. This should allow easier testing of hardware components since they can be accessed without the use of a specific driver.

It should be noted that this driver will give application level access to areas of the hardware and memory which can quite easily crash the operating system or even corrupt data. Care needs to be taken to only access known memory or I/O ports.

Using The Library

There are two libraries that can be used to ease use of the Peek and Poke driver. They are pplib95.lib and pplibnt.lib. They are used for Windows 95 and Windows NT respectively. These libraries provide I/O routines familiar to those who have used Microsoft compilers in the past.

To use a library, add pplib95.lib or pplibnt.lib to your link, whichever is appropriate for the target OS. Include pplib95.h or pplibnt.h in the C/C++ file you will be accessing the functions from. These libraries are compatible with all Microsoft compilers. NOTE: These libraries are not thread safe.

The following is a list of the functions provided by the library.

Function	Description
BOOL ics_pp_open (void)	Opens the Peek and Poke driver. Returns TRUE if successful. This must be called before any calls are made to the other library functions.
void ics_pp_close (void)	Closes the driver. Should be called before the application exits.
void *ics_pp_make_pointer (int page, int length)	This function is used to allow access to a particular region of physical memory by a Win32 application. page is the starting page of the physical memory. length is the size of the region in pages. For example, for a pointer to a region of physical memory starting at 0xA0000 and 64k long: void *ptr = ics_pp_make_pointer (0xA0, 0x10); The pointer can then be treated as a standard C/C++ pointer. NOTE: Be sure to release this memory region back to the system with a call to ics_pp_release_pointer. (See Below.)
void ics_pp_release_pointer (void *address, int length)	This function is used to release a memory mapping made with ics_pp_make_pointer. It is important to release such pointers back to the system. Failure to do so could affect the way the system runs even after the application has exited. address is the address that was returned by the ics_pp_make_pointer function. length is the size of the mapped region in pages.
int _outp (USHORT port, int data) USHORT _outpw (USHORT port, USHORT data) ULONG _outpl (USHORT port, ULONG data)	These functions output data to the given port. Use _outp for byte width, _outpw for word width, and _outpl for double word width.
Int _inp (USHORT port) USHORT _inpw (USHORT port) ULONG _inpl (USHORT port)	These functions return data input from the given port. Use _inp for byte width, _inpw for word width, and _inpl for double word width.

PeekPoke Driver for Windows NT Installation

This driver allows developers to write WinNT programs which access hardware I/O ports and physical memory.

Installing the Windows NT PeekPoke Driver

Under Windows NT 3.51:

- From the Program Manager, click on File->Run.
- Type a:\setup and press OK.

From Windows NT 4.0

- From the Start Menu, select Run.
- Type a:\setup and press OK.

The InstallShield installer will initialize and run. Follow the on-screen instructions. You will need to provide one piece of information:

- The destination path for the driver files.

When the files are transferred, you will be asked if you want to reboot the computer. The drivers will not work until after a reboot.

PeekPoke Driver for Windows 95 Installation

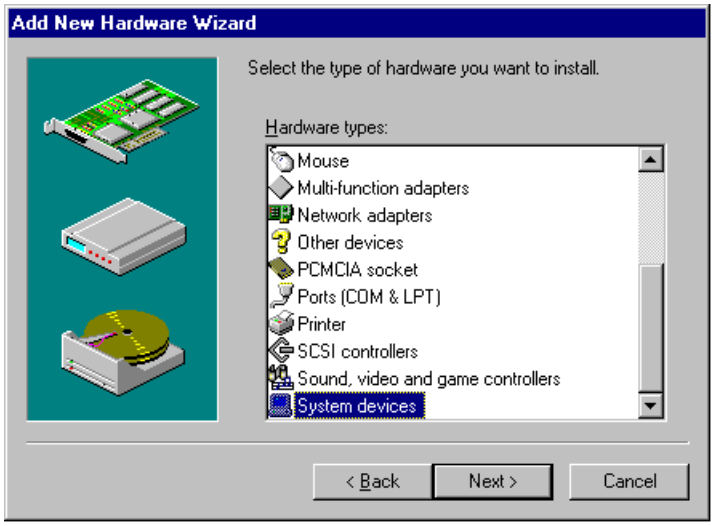
This driver allows developers to write Win95 programs which access hardware I/O ports and physical memory.

Installing the Windows 95 PeekPoke Driver

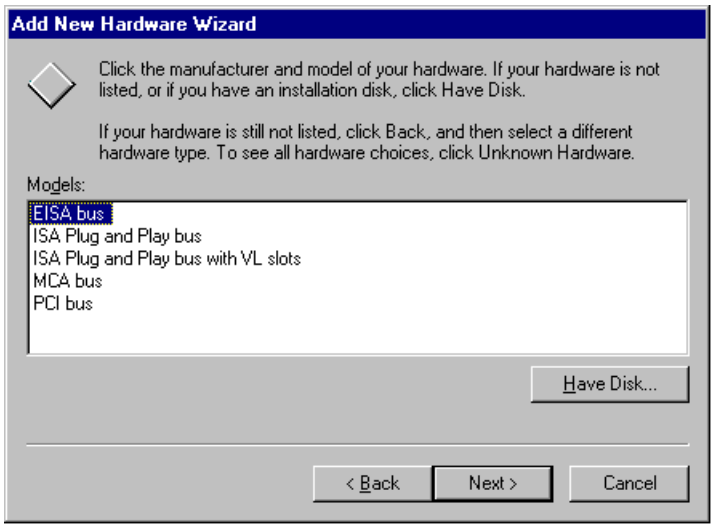
- From the Start Menu, select Settings->Control Panel.
- From the Control Panel, select Add New Hardware.

- Click the Next button.

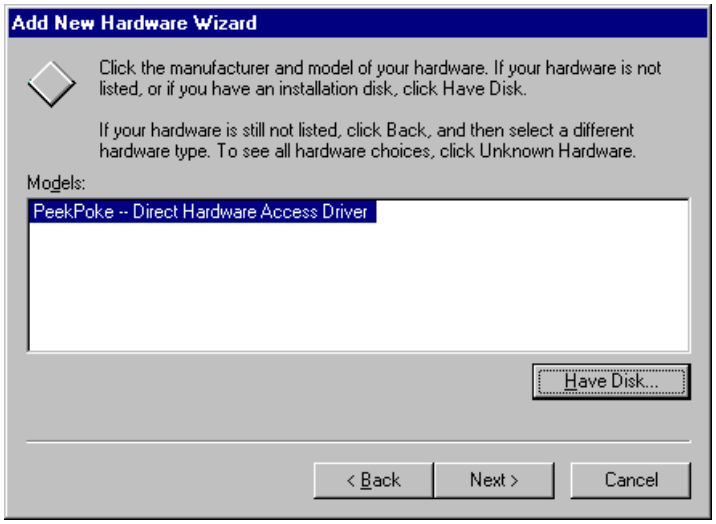
- Answer “No” to the question, “Do you want Windows to search for you new hardware?”
- Press the Next button.



- Scroll the hardware types list down and select the “System devices” type.
- Press the Next button.



- Press the Have Disk button.
- Insert your disk labeled “Windows 95 PeekPoke Driver Disk.”
- Make sure “A:\” is selected as the source.
- Press OK.



- The model "PeekPoke – Direct Hardware Access Driver" should be selected in the Models box.
- Press the Next button.
- Windows 95 will copy the driver's files onto your system.
- Press the Finish button.
- At this point, you will need to shutdown and reboot your machine for the changes to take effect.

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Chapter 5: Calibration

Periodic calibration of the AOB2-P card is recommended if it is used in extreme environmental conditions. The AOB2-P uses very stable components but vibration, or high-low temperature cycles might result in slight analog output errors.

Factory calibration and periodic calibration of the card includes adjustment of the internal reference voltage unless you are using an external reference voltage.

To calibrate the AOB2-P card, run the setup program **SETAOB2.EXE** and follow the screen prompts. No attempt at calibration should be made in noisy locations or with a noisy calibration setup.

Note: The current output ranges apply only for 5V excitation.

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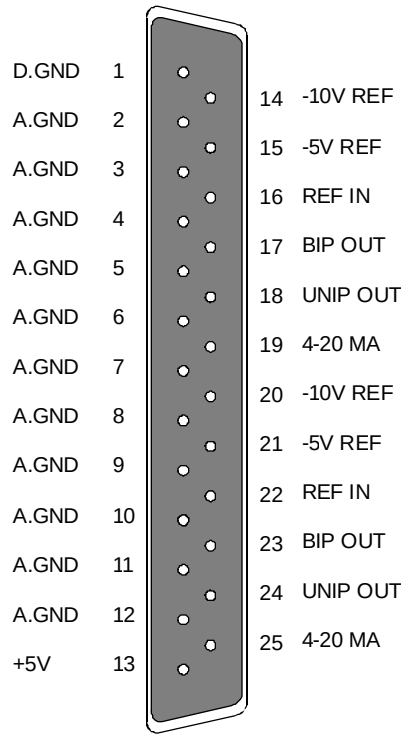
Chapter 6: Connector Pin Assignments

The analog outputs are accessible via a female 25-pin D type connector that extends through the back of the computer case and a DB25P solder cup plug may be used to make connections. Usually only three or four wires are required (D/A outputs and ground) and multiwire flat cable is not necessary. Output range selection is performed by either jumpering pins on the plug body or by on-board switch selection as described in the Option Selection section of this manual. Pin assignments are as follows:

NOTE: The figure on the right shows how pins are numbered on D type connectors.

Pin	Name	Function
1	D. GND	Digital Ground
2	A. GND	Analog Ground
3	A. GND	Analog Ground
4	A. GND	Analog Ground
5	A. GND	Analog Ground
6	A. GND	Analog Ground
7	A. GND	Analog Ground
8	A. GND	Analog Ground
9	A. GND	Analog Ground
10	A. GND	Analog Ground
11	A. GND	Analog Ground
12	A. GND	Analog Ground
13	+5V	Power Supply +5V, from Computer
14	-10V REF	-10V Reference for D/A
15	-5V REF	-5V Referenc from D/A
16	REF IN	D/A #1 Reference Voltage Output
17	BIP OUT	Bipolar Analog Output, Channel 1
18	UNIP OUT	Unipolar Analog Ouput Channel 1
19	4-20 MA	Current Output, Channel 1
20	-10V REF	-10V Reference for D/A
21	-5V REF	-5V Reference for D/A
22	REF IN	D/A #0 Reference Output
23	BIP OUT	Bipolar Analog Output, Channel 0
24	UNIP OUT	Unipolar Analog Output, Channel 0
25	4-20MA	Current Output, Channel 0



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Declaration of Conformity

(according to ISO/IEC Guide 22 and EN 45014)

INDUSTRIAL COMPUTER SOURCE®

6260 Sequence Drive
San Diego, CA 92121-4371
(800) 523-2320

declares, that the product:

AOB2-P

to which this declaration relates, meets the essential health and safety requirements and is in conformity with the relevant EU Directives listed below:

EU EMC Directive 89/336/EEC
EU Low Voltage Directive 72/23/EEC

using the relevant section of the following EU standards and other normative documents:

EN 50081-1:1992 Emissions, Generic Requirements.
-EN 55022 Measurement of radio interference charateristics of information technology equipment.

EN 50082-2:1995 Immunity, Generic Requirements.
-EN 61000-4-2 Immunity to Electrostatic Discharge.
-ENV 50140 Immunity for radiated RF electromagnetic fields.

EN 50082-1:1992 Immunity, Generic Requirements.
-IEC 801-3:1984 Immunity for radiated electromagnetic fields.
-IEC 801-4:1988 Immunity for AC and I/O lines, fast transient common mode.
-IEC 65A/77B Immunity for AC lines, transients, common, and differential mode.

EN 60950:1992 Safety of Information Technology Equipment.

September 17, 1997
San Diego, CA

Mr. Steven R. Peltier
President & Chief Executive Officer

Information supporting this declaration is contained in the applicable Technical Construction file available from:

INDUSTRIAL COMPUTER SOURCE EUROPE®

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91961 COURTABOEUF Cedex

BUG REPORT

While we have tried to assure this manual is error free, it is a fact of life that works of man have errors. We request you to detail any errors you find on this BUG REPORT and return it to us. We will correct the errors/problems and send you a new manual as soon as available. Please return to:

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Manual Revision: **00431-007-4B**

Please list the page numbers and errors found. Thank you!