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Highlights of the WB-AVO

Analog Output Channels

8: WB-AVO-8

2: WB-AVO-2

Analog Output Resolution

12 bits (.024%)

Maximum Output Rate

130 kHz

Both Models of the WB-AVO Feature

Three voltage output ranges, one current output range

*Eight Digital I/O lines, user configurable · Factory
guaranteed accuracy for two years from date of purchase*

Chapter 1: Introduction to the ACAO

Thank you for selecting the WB-AVO for your project!

Our primary objective is to provide you with data acquisition systems that are easy to install, operate, and maintain. We also strive to furnish the performance you need at the lowest overall cost. The benefits for you are increased productivity, data you can count on, and, of course, meeting your budget.

We manufacture the WB-AVO as an enhancement board that readily mounts in an expansion slot in an IBM PC, or -compatible, computer.

This product's guaranteed long term stability make it ideal both for the laboratory and for harsh industrial environments.

Using the WB-AVO together with our graphical interface application software (such as WorkBench™ PC for DOS or Windows, or QuickLog™ PC), you can easily and very quickly implement a broad spectrum of research and commercial tasks, in a wide variety of settings. You can, for example,

- **Ramp, hold, or step** analog outputs,
- **Control processes** with proportional or on/off control,
- **Set alarm** on any digital input,
- **Control devices at preset levels** (fans, pumps, heaters, etc.),
- **Control devices from digital input** (e. g., from switches or TTL signals), and
- **Control processes unattended.**

You can use the system interactively, operating controls or modifying your set-up while the system is running.

DEVELOPMENT SYSTEM

People who decide, on the other hand, to write their own software (rather than using an off-the-shelf application) can employ the Analog Connection

Development System™ hardware driver to address all features of the board from within a program they design and code for their specific purpose.

EXPANDABILITY The WB-AVO has either two or eight analog output channels and eight digital input/output lines; and you can add one board at a time to your computer, for as many as 15 boards with a total of 120 analog output channels and 120 digital I/Os! In addition, separate analog input cards may be used with the same software.

**RANGES/
UNITS OF OUTPUT** The WB-AVO features switch-selectable ranges of 0-10V, 0-5V, or $\pm 5V$ for voltage output, and 4-20mA for current output. Self-calibration and self-diagnostics are built into the board to ensure that the output is always accurate.

**DATA
PRESENTATION** The combination of our hardware and application software (WorkBench PC for DOS or Windows or QuickLog PC) enables both the display of data on the screen, and the logging of data to disk for later analysis.

Features and Configurations

ANALOG OUTPUT CHANNELS The WB-AVO-12-2 has two output channels, while the WB-AVO-12-8 allows for up to eight analog outputs.

RESOLUTION The WB-AVO is capable of attaining 12-bit resolution (that is, .024% of signal).

DATA ACQUISITION SPEED The WB-AVO is capable of attaining a data acquisition speed of 130 kHz, depending on the software being used. The maximum data acquisition rate supported by our software for the WB-AVO is 1 kHz.

ACCURACY We guarantee the factory calibration of the boards for a period of two years from the date of purchase. (If it is ever necessary, the user can recalibrate the board with precision through the use of software utilities we provide with every product.)

DIGITAL I/O The WB-AVO features 8 digital input/output channels that the user can configure individually to be input or output.

TERMINAL PANEL An available accessory for the WB-AVO is the WB-T31 general purpose terminal panel, which includes terminals for eight analog outputs and eight digital I/Os.

FOR MORE INFORMATION For more information about the capabilities of your data acquisition board, please see the “Product Specifications” in this chapter.

For instructions on controlling the board with our interface software (such as WorkBench PC for DOS or Windows or QuickLog PC), refer to that particular software manual.

To learn more about data acquisition and process control in general, and how to use the Analog Connection systems together to accomplish everyday tasks, consult our *Applications* manual.

And, last but not least, if you’re creating your own program to address the board for a custom purpose, please see the *Analog Connection Development System* manual.

SYSTEM REQUIREMENTS Before installing the board, make sure the computer system fulfills these minimum requirements:

Hardware –

- **IBM PC XT, AT, (or higher), or -compatible**, with at least 640k system RAM and full-size slot for WB-AVO-8 or half-size slot for WB-AVO-2
- **Floppy disk drive** and a hard drive.

Software Environment –

- **DOS 3.0** (or higher, depending on the application software),
- **Application software** (WorkBench PC for DOS or Windows, QuickLog PC, the Analog Connection Development System, or other compatible proprietary software; please see your software manual for directions for using it with the WB-AVO).

Chapter 2: Installing the WB-AVO

Getting your WB-AVO data acquisition and process control board up and running is a straightforward process; you only need to

- **Verify the board's switch settings** that control board identity and system addressing of OMEGA products,
- **Physically insert the board** into a slot of the personal computer,
- **Set the voltage/current switches** to suit the measurement you are making,
- **Connect a terminal panel to the board**, and
- **Load and start up the software** to be used for the project.

As the scope of this manual focuses on the WB-AVO board, this chapter discusses the board's switch settings, and the physical insertion of the board.

Please see your terminal panel manual for full instructions regarding its attachment to the WB-AVO, as well as for how to connect sensors to the panel.

Guidelines for loading the software, and for starting up, depend on the application program you are going to use (such as our WorkBench PC for DOS or Windows, or QuickLog PC, or a package by a third party developer who has our authorization).

The program you are going to use with the WB-AVO might even be unique and proprietary, a product of your organization. (The Analog Connection Development System is a powerful set of utilities making it possible for software engineers to design and develop their own programs to exploit the WB-AVO's many features.)

In any event, please refer to the software provider's installation manual, or user guide, for specific information on how to load and run the particular program.

Troubleshooting – If you have any difficulty getting your board to work, refer to the “Troubleshooting” section in Chapter 3.

Verifying WB-AVO Switch Settings

SINGLE BOARD When you purchase a data acquisition board new from our company, the product's switch settings already are correct to operate a *single* board with our software (WorkBench PC for DOS or Windows, QuickLog PC, the Analog Connection Development System, and all others).

This means the factory switch settings are right for the purpose of using only one board, and you can skip the task of confirming them. You can go directly to the "Physical Board Installation" section on page 2 – 4 in this chapter, and begin to follow the steps there.

MULTIPLE BOARDS If you are using more than one board at a time, set the individual boards' Board Number Switches first (refer to "Setting the Board Number Switches" on page 2 – 8), then go on to perform the physical installation.

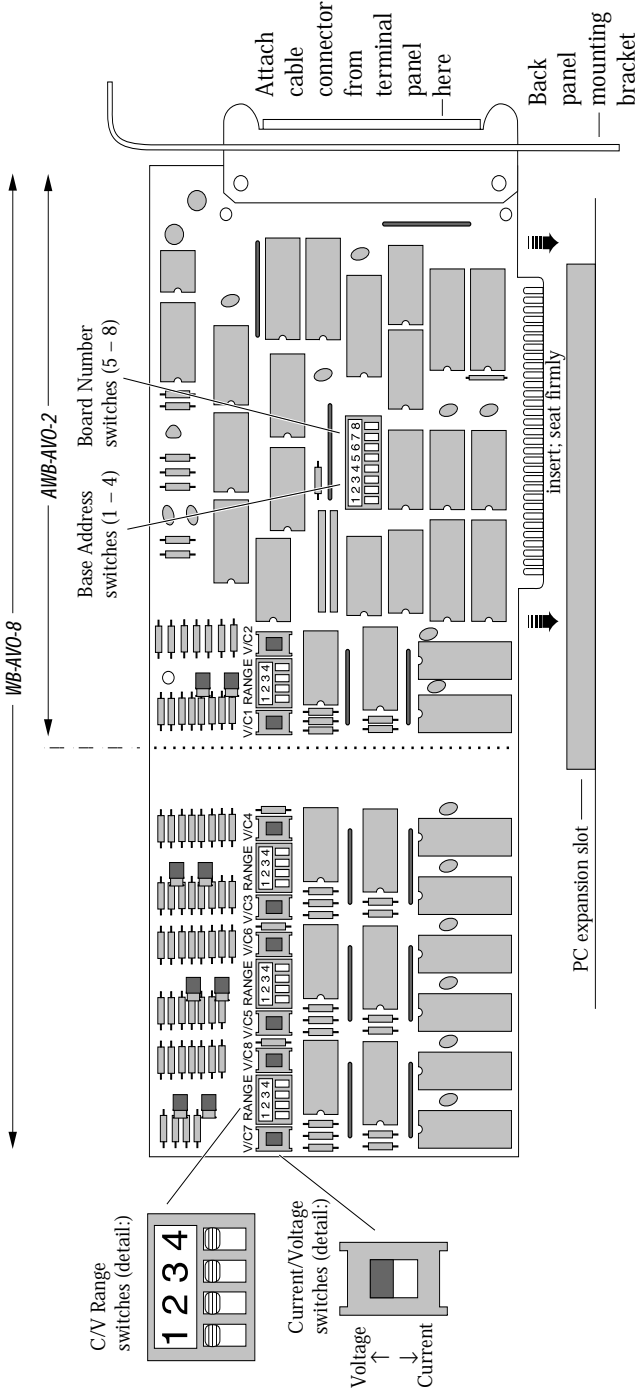
Otherwise, there's no reason to be concerned about the board's switch settings, except in the unlikely event you encounter a problem in getting your product to operate. (If you experience a problem, refer to "Troubleshooting," in Chapter 3).

PREVIOUSLY IN USE If, on the other hand, your board has been in use previously in another computer, or if your company uses its own proprietary software, the present switch positions might differ from the factory settings.

If your company uses such a program, making changes to factory switch settings might be necessary to accommodate it. Please consult the administrator of your internal system, or the provider of third party software, to determine their recommendations for any unusual switch setting.

To check and restore the factory values, please read "Setting the Board Number Switches" on 2 – 8 in this chapter.

Illustration of WB-AVO Data Acquisition Board, Showing Physical Installation –



Physical Board Installation

Installation very simply consists of inserting the board into an open peripheral (expansion) slot inside your computer.

(There are, for example, five available slots in the IBM PC, and eight in the IBM XT or AT. IBM and other companies sell expansion chassis that can accept even more analog cards. Our software supports as many as 15 boards at one time.)

TERMINAL PANEL CONNECTIONS When using a terminal panel with the WB-AVO you are going to be using a single ribbon cable from the terminal panel. This cable plugs into a 50 pin connector at the back panel of the WB-AVO and, at its far end, plugs into a 50 pin connector at the terminal panel.

(Refer to the illustration on page 2 – 3; always check to confirm that the attachment of the cables is according to the diagram.)

Each 50 pin cable connector has a key on one side that mates with a socket on the device; be sure to observe polarity when attaching.

PHYSICAL INSTALLATION *To Install the WB-AVO Board –*

- 1. TURN THE COMPUTER OFF!** Never remove the cover of the computer without first turning its power switch to the “off” position.
- 2. Open the Computer** Remove the cover of the computer. (If appropriate, refer to your computer's owner's manual for more information about removing the cover and installing enhancement boards.)
- 3. Ground Yourself** While holding the board, before installing it, touch the metal chassis of the computer to discharge any static electricity that might be on the surface of your body.

This is important, as static electricity can damage electronic parts. (Likewise, if you ever remove the board from the computer, always store it in its protective shipping bag.)
- 4. Remove the Dust Cover** At the back panel of the computer, unscrew and remove the narrow dust cover plate that is directly behind the expansion slot you want to use. (Keep this screw handy.)

5. **Insert the Board** Push the edge of the WB-AVO board having “gold fingers” down and into the expansion slot (socket) on the chassis so that the contacts align with the socket, then plug it in by pushing the board straight down.
6. **Fasten the Board to the Chassis** Install the “left over” screw from step 4. Place it in the original hole, through the WB-AVO board’s bracket, so that it fastens the top of the bracket to the computer’s back panel.
7. **Connect the Cable to Board and Terminal Panel** Plug the cable into the data acquisition board, and the connector on its far end into the socket on the terminal panel (please refer to your terminal panel’s manual, if you are unsure about the correct position).

**CAUTION**

Incorrect installation of these cables can damage the data acquisition board or the terminal panel. If you are uncertain about proper placement, please see “Terminal Panel Connections” at the beginning of this discussion, and inspect the diagrams on page 2 – 3 and 3 – 2.)

Setting the Voltage/Current Switches

The analog output channels of the WB-AVO (two on the WB-AVO-2 and eight on the WB-AVO-8) can be set to output in either voltage or current. There are five possible range settings – four voltage and one current – for each channel. These voltage/current ranges are set with series of switches on the hardware.

SETTING THE SWITCHES *To Set the Voltage/Current Switches –*

- 1. Locate the Switches** With the cover of your computer removed, examine the illustration on page 2 – 3 in this chapter and find the “Voltage/Current Switches” and “V/C Range Switches” on the WB-AVO.

On the printed circuit board itself, the Voltage/Current is a single switch labeled “V/C”. The V/C Range is of a block of four DIP switches labeled “Range.”

Note that there are three switches for each analog output channel: one large V/C Switch (labeled V/C1 for Channel One, V/C2 for Channel Two, etc.) to set the output for voltage or current and two small DIP switches to set the voltage range.

- 2. Set the V/C Switches** Determine whether the output for each channel is to be a voltage or current.

For voltage output, you must turn the V/C Switch up; leave it down for a current output.

Set the V/C Switch for each channel accordingly.

- 3. Set the V/C Ranges for each channel** Note that the range switches for Channels One and Two are on the same switch module. Switches 1 and 2 select the ranges for Channel One, while 3 and 4 set the ranges for Channel Two.

(For WB-AVO-8 boards, Channels Three and Four are paired similarly, as are Channels Five and Six and Seven and Eight.)

The first range switch for each channel (Switch 1 or 3) selects unipolar or bipolar voltage outputs. Down selects unipolar; up will output bipolar.

The second range switch (Switch 2 or 4) will determine whether the output will be 5 or 10 Volts. An up setting selects 5 volts; down is 10 volts.

Note that the range switches do not effect current outputs. If you set a channel for current, it will automatically output in the 4-20mA range.

See the tables below for detailed V/C switch settings.

V/C Switch Settings for Analog Output Channels –

Range	V/C Switch Position ¹	V/C Range Switch Positions ²	
		Switch 1/3	Switch 2/4
0 to 10V	U	D	D
0 to 5V	U	D	U
±5V	U	U	U
±10V*	U	U	D
4 to 20mA	D	–	–

1. U = Up D = Down

2. Switches 1 and 3 set the voltage ranges for Channels 1,3,5 and 7. Switches 2 and 4 set the ranges for Channels 2,4,6 and 8.

* Selecting the ±10V range is an error condition. This range can be used, but the output is not in ±10V. Output ranges from -10V at 20% to +10V at 100% of full scale. It does not go below approximately -11V at 16%.

NEXT STEPS *Single Board Usage* – If you intend to run with a single data acquisition board in your system, you are now ready to install your application software.

Multiple Board Usage – If you are going to use more than one data acquisition board, now it's time to set each board's Board Number Switches to an unique number. Follow the steps in the "Setting the Board Number Switches" section in this chapter on page 2 – 8.

Installing the Software – For information on loading and configuring our WorkBench PC for DOS or Windows or QuickLog PC please refer to the user guide for that application package.

Installing the Terminal Panels – To learn how to connect experiments to the terminal panel see your terminal panel owner's manual, or our *Applications* manual (which discusses data acquisition and control in general and provides examples of uses for the products).

Setting the Board Number Switches

MULTIPLE BOARDS When you are using multiple boards in your installation, each board needs to have an identity for the software to recognize it as an “individual.”

The Board Number Switches on a board accomplish this, as they enable you to set an identifying number for the board.

This number determines, among other things, the sequence in which the software reads multiple boards (the software programs can address as many as 15 boards).

When using more than one WB Family product in your installation, every board's Board Number Switches need to have a different number setting, and all settings are to be in number sequence (1, 2, 3, for example, if you are using three boards).

(If there are also WB-FLASH12 or WB-WORKMATE boards in your installation, then their Board Numbers need to be at the high end of the number sequence.)

SINGLE BOARD If your system includes just a single data acquisition board, then you don't need to be concerned with the Board Number Switches.

When your WB-AVO leaves our manufacturing facility, the Board Number switches are set to 1. This is the setting we recommend for most purposes when you are using only one board in your installation.

DISABLING BOARDS If you want to disable the board, for any reason, set its Board Number Switches to 0. (This is handy if you want to use fewer boards for a while: that way you don't have to remove them from the computer.)

SETTING THE SWITCH *To Set the Board Number Switches –*

1. Locate the Switches With the cover of your computer removed, examine the illustration on page 2 – 3 in this chapter and find the “Board Number Switches” on the WB-AVO.

On the printed circuit board itself, these are located within a block of eight DIP switches; switches 5 through 8 represent the Board Number.

2. Make the Setting Note that the four switches have 16 possible setting combinations.

Determine which is to be the First Board. (This is easy, if it is

the sole board.) Then set the switches for Board Number 1. (See the table below for board number settings.)

The software interprets Board 1 to use *system installation* digital I/O channels 1 - 8 and analog output channels 1 through 8 (if it's an WB-AVO-8), or *system installation* analog output channels 1 through 2 (if it's an WB-AVO-2).

Determine which is to be the Second Board, then set the switches for Board Number 2.

The program then recognizes Board 2 to use *system installation* digital I/O channels 9 - 16 and analog output channels 9 to 16 (for an WB-AVO-8) or 3 - 4 (for an WB-AVO-2).

3. **Set All Switches** Continue to set the switches for all installed boards to unique numerical values in an unbroken sequence.

(As various models of our boards use different kinds of switches, please see their operator's manuals for an explanation of how to set switches.)

WB-AVO Board Number Switch Settings –

Board Number	Switch Positions*			
	5	6	7	8
0 (disabled)	D	D	D	D
1	U	D	D	D
2	D	U	D	D
3	U	U	D	D
4	D	D	U	D
5	U	D	U	D
6	D	U	U	D
7	U	U	U	D
8	D	D	D	U
9	U	D	D	U
10	D	U	D	U
11	U	U	D	U
12	D	D	U	U
13	U	D	U	U
14	D	U	U	U
15	U	U	U	U

* U = Up D = Down

Setting the Base Address

The Base Address determines the logical system address where the personal computer expects to find all data acquisition boards. Base Addresses must be the same on all boards.

The factory setting for the WB-AVO products is B00H (in hexadecimal format); the analog input boards in the WB family have a base address of 300H. The two digits "00" must be the same for all WB family products.

It is rarely necessary, but if you have difficulty getting the board to work you can change these switches to values different from the factory settings. (Another device in your PC, for example, might be trying to use the same Base Address.)

Indications of this are: if the program reports it cannot find your board, or if it reports fewer boards than you really have, or if another board starts to work improperly after you install the WB-AVO.

These problems indicate interference with another board using the same base address as the WB-AVO product.

Remedy the problem by changing the switches of all WB-AVO boards to an address that has no conflict. (If you have boards other than WB-AVOs in your system, please refer to their operator's manuals for instructions.)

SETTING WB-AVO BASE ADDRESS *To Set the Base Address –*

- 1. *Locate the Address Switches*** Remove the cover of your computer over the data acquisition board, and find the location of the Base Address switches. Refer to the board illustration on page 2 – 3 in this chapter and find "Base Address Switches" on the WB-AVO diagram.

On the printed circuit board itself, these are located within a block of eight DIP switches; switches 1 through 4 represent the base address.

(NOTE: Depending on the space available in your installation, it might be necessary to remove the board to reach the Base Address Switches. If so, please follow the same precautions as in "Physical Installation" on page 2 – 4 in this chapter.)

2. **Change the Setting** B00H is the normal base address. It consists of all four DIP switches being in the “down” position (when the board is sitting in the computer’s expansion slot).

The DIP switches have the labels “1” through “4.” Sliding a switch to the “up” position adds a value to B00H:

WB-AVO Base Address Switch Additive* Values –

Switch	Position	To 300H Add
1	Up	10H
2	Up	20H
3	Up	40H
4	Up	80H

* As the switches are additive, your sliding Switches 1 and 4 down, for example, is going to add 10H and 80H to the 300H, equalling 390H.

If you are having a problem with Base Address, we recommend first trying 340H as an alternative to the factory setting of 300H.



CAUTION

Values to Avoid – There are several Base Address values you need to avoid, that we know can cause interference with other devices in some PC installations:

WB-AVO Base Addresses to Avoid –

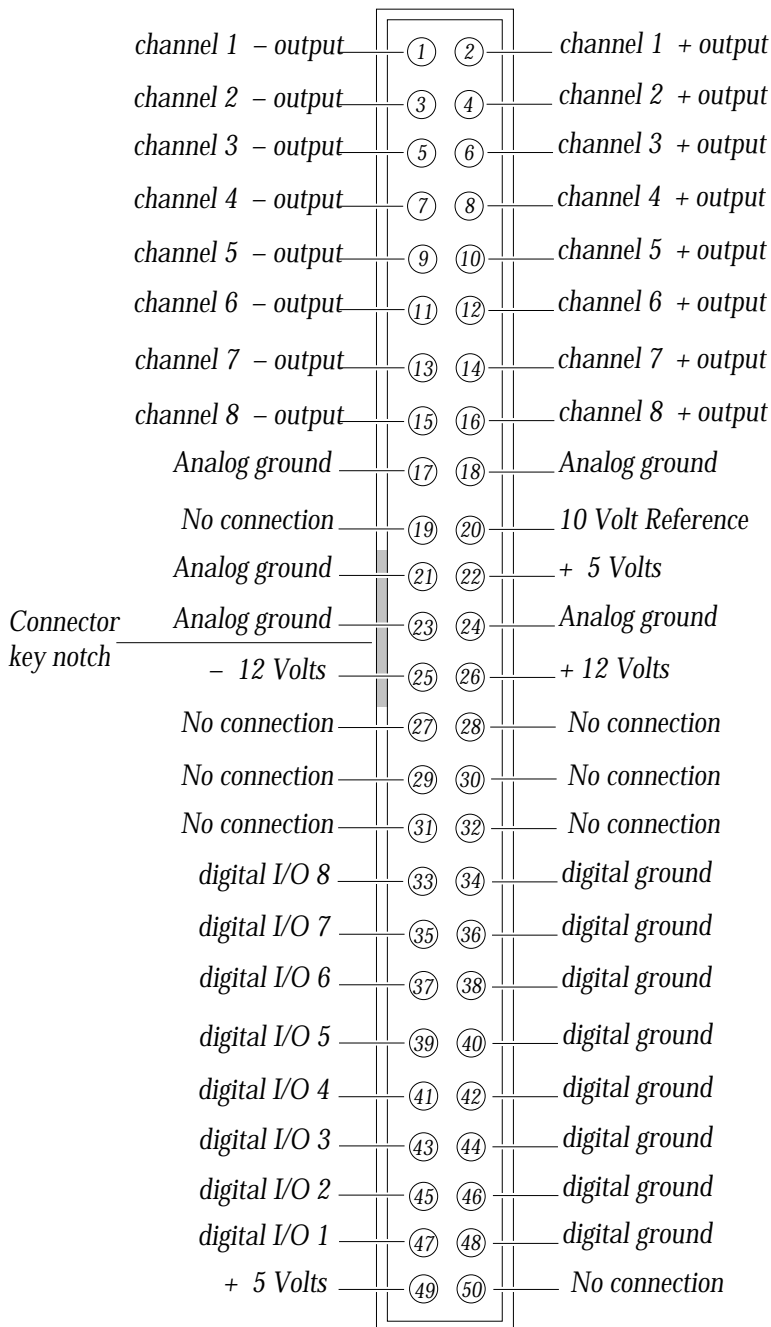
Value	Switch Positions*				Can Interfere With
	1	2	3	4	
B20H	U	D	U	U	Hard disk drive
B70H	D	D	D	U	Parallel printer
BB0H	D	D	U	D	Monochrome display
BD0H	D	U	D	D	Graphics adaptor
BF0H	D	D	D	D	Floppy disk drive

* U = Up D = Down

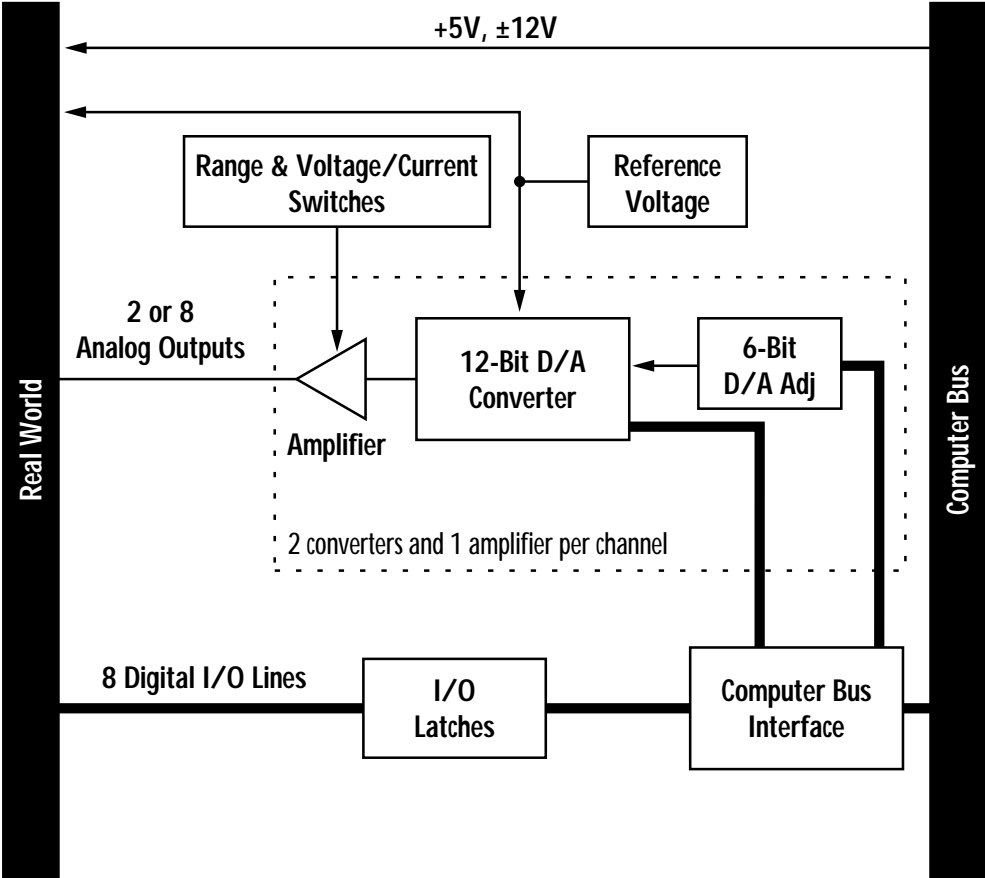
Chapter 3: Technical Notes

Although operations in this chapter are seldom necessary during everyday data acquisition, you might want to refer to them at certain times during operation of the WB-AVO. They are

- **Pinouts** (at the board's connectors, in the event you want to connect analog or digital signals directly, without using a terminal panel; please refer to page 3 – 2);
- **Block diagram** of the WB-AVO showing on-board processing (please see page 3 – 3);
- **Recalibration** of all WB-AVO on-board references to bring the accuracy of the product to factory specifications (see page 3 – 4);
- **Editing calibration** files to accommodate changes to your installation, or to restore missing files (on page 3 – 5),
- **Troubleshooting**: some possible problems and solutions after installing, and during operation of the WB-AVO (beginning at page 3 – 11).

Board Pinouts for the WB-AVO –

Block Diagram of the WB-AVO (All Models) –



Recalibration

Your WB-AVO uses an exclusive calibration technology to achieve great stability, requiring no adjustment for years. (As a reflection of this, we guarantee the factory tolerances for two years from the date of purchase.)

FACTORY METHODS Instead of employing adjustment potentiometers to calibrate the board, our technicians test and calibrate each WB-AVO after assembly. They then enter that board's unique calibration number values into a disk file that you receive with the product (CALOUT.DAT, for analog output channels; we also print the same numbers on a label on the back of the board itself).

Whenever you use our software with the board thereafter, the programs read the factory's calibration numbers from the disk file, and automatically make minor compensations for real-world conditions (for instance, high external temperatures that marginally affect calibration).

RECALIBRATION Under normal conditions, no full recalibration of the WB-AVO is necessary.

(If you ever suspect that your WB-AVO is out of tolerance, please call Technical Support for advice. If it requires recalibration, we can perform the work for you at our facility using the same high accuracy test equipment we use during the manufacturing quality assurance process.)

A Note About RECAL.EXE – One of the utility programs we distribute on the QuickLog PC disk, RECAL.EXE, is for the purpose of completely recalibrating our data acquisition boards. This software, however, is only suitable for use in a comprehensive hardware lab, and requires sophisticated test equipment.

(Successful use of RECAL.EXE requires, for example, a precision DC voltage supply, as well as a digital volt meter having .005% accuracy.)

Only if your organization is proficient in such techniques, and only if you have the necessary equipment, do we encourage you to proceed with recalibration (and please contact our Technical Support Department for guidelines).

For most customers, we recommend returning the board to our Technical Services Department, instead.

Editing Calibration Files

Depending on your usage of the WB-AVO, your work might require a more common involvement with calibration: modifying values in the calibration file on disk.

This can be essential to accommodate occasional changes in your data acquisition setup.

It's necessary to edit calibration numbers (using EDITCAL.EXE, the software utility we distribute with the WB-AVO, on the QuickLog PC disk) whenever you

- **Reconstruct CALOUT.DAT** if this disk file, which holds factory calibration numbers, is lost (the software tries to read these files upon startup); or
- **Change the quantity of boards** in your installation; that is, when you add data acquisition boards to, or remove them from your computer system.

CALOUT.DAT The CALOUT.DAT file maintains analog output channel calibration figures for all WB-AVO boards in the installation.

CALOUT.DAT is a simple text file containing lines of numbers, or values.

(Another calibration file, CALIB.DAT, contains the analog input channel numbers for all Analog Connection (WB_AAI/FAI, WB-ASC, or WB-ASC16) boards in the installation, and their thermocouple terminal panels. For more information on CALIB.DAT, see the owner's manual for any of the Analog Connection boards).

(Regarding DATAshuttles, WB-FLASH12 boards and WB-WORKMATE boards: If your installation also includes any of these products, remember that they handle calibration values differently from the WB-AVO or Analog Connection boards. Their calibration figures reside on-board, in Electrically Erasable Programmable Read Only Memory – EEPROM – chips, rather than in disk files. As a result, their calibration numbers do not appear in either CALOUT.DAT or CALIB.DAT).

EDITCAL UTILITY EDITCAL.EXE (or EDITCAL, for short) is the utility program that simplifies the modification of values in CALOUT.DAT.

(Instructions for using the program are on page 3 – 9 in this manual; but please continue to read this discussion, which describes

the format of the calibration file, before starting. Also note that it is possible, although more difficult, to modify numbers in the disk calibration files with a text editor. We recommend using EDITCAL.)



CAUTION If a calibration file's numbers are inaccurate or missing, this means the calibration of the cards is going to be in error. When you edit these files, take care to enter the numbers accurately.

RECONSTRUCTING CALIBRATION FILES *Reconstructing CALOUT.DAT* – EDITCAL provides the capacity to reconstruct the calibration file for WB-AVO boards if the file happens to be lost entirely.

(If you still have the original distribution disk you can, of course, restore the original factory calibration numbers from disk).

As the CAL NO label on every WB-AVO board shows that individual board's values, it is a straightforward task to enter the figures into new calibration disk files through the use of EDITCAL. (The CAL NO label can be found on the back of the WB-AVO board; the calibration values are listed right after the serial number.)

MULTIPLE BOARDS/PANELS *Changing the Quantity of Boards* – A single CALOUT.DAT file maintains calibration numbers for *all* WB-AVO boards in your system.

When adding an additional WB-AVO board to the computer installation, it is essential to use EDITCAL to “merge” its numbers into the existing calibration disk files.

In like manner, if you remove an WB-AVO from the system, you need to run EDITCAL, removing that device's calibration numbers from the file.

Calibration File Format

ANALOG OUTPUT CALIBRATION FILE The file CALOUT.DAT contains analog output channel calibration numbers for all WB-AVO boards.

CALIB.DAT Format – The file CALOUT.DAT looks like this:

Content of CALIB.DAT –

	LINE	DATA	MEANING
HEADER	1	ANALOG OUTPUT CALIBRATION	(identifier)
	2	0	
GROUP A	3	1000,1,2,3,4	Analog output board 1's serial number, then its WCAL, XCAL, YCAL, ZCAL values*; next, analog output board 2's serial number, and its WCAL, XCAL, YCAL, ZCAL values*, et al
	4	1001,1,2,3,4	
	(and so many boards in your installation that have analog output channels)		
GROUP B	n	# RANGES 01,23,11,20	After the #: Range settings for each and every analog output channel on board 1; next, range settings for each and every analog output channel on board 2, et al
	n	12,03,21,02	
	(and so many boards in your installation that have analog output channels)		
GROUP C	n	@ CAL VALUES 8,36,42,32,40,40,34,35,38	After the @: cal values – the number of AO channels, followed by calibration values for each analog output channel on board 1; next, calibration values for each analog output channel on board 2, et al
	n	8,22,23,24,25,26,27,28,29	
	(and so many boards in your installation that have analog output channels)		

* If your present CALOUT.DAT file is unusable, find WCAL, XCAL, YCAL, and ZCAL numbers on your board's CAL NO label, and enter the values according to the format in this table.

CALOUT.DAT NOTES The third line in the file has the serial number followed by WCAL, XCAL, YCAL, and ZCAL for the first analog output card.

WCAL, XCAL, YCAL, and ZCAL are the gain calibration numbers for analog output channels for Analog Connection family products. They correspond to the 0-5V, 0-10V, $\pm 5V$, and 4-20mA ranges, respectively.

A second analog output card has its serial number and calibration numbers on the next line, and so on.

Following the “# ranges” sign are range settings. (These ordinarily result from calibrations of the WB-AVO when you start up the Analog Connection programs.)

Following the “@” sign are the fine tuning calibration values that result from a recalculation taking place every time you use Analog Connection software. (There is no need to put numbers here. As with the range settings, the software is going to update them.) The values are in sequence, one for each channel, one line for each card.

Reconstructing A Lost Calibration File

In the event the calibration file CALOUT.DAT becomes corrupt, or is missing, it's first necessary to reconstruct a replacement text file before running EDITCAL. Use any text editor to create a new file, giving it the appropriate name (CALOUT.DAT).

Enter this text on the first line in the file:

ANALOG OUTPUT CALIBRATION

and then press **[ENTER]** ten times, to establish a total of 11 lines in the file. Save the file to the same subdirectory as your other OMEGA Engineering, Inc. programs.

Now you can use EDITCAL to read and restore the calibration numbers by using its **UPDATE** menu selection (please see "Using EDITCAL").

Using EDITCAL

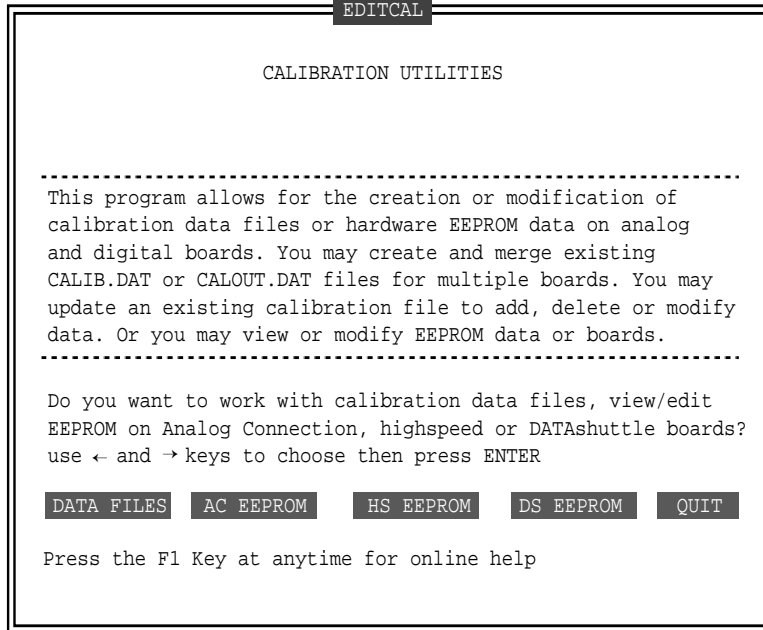
Although the preceding tables might give the impression that editing calibration files is highly complex, the EDITCAL utility makes the task relatively easy.

STARTING EDITCAL Make sure the EDITCAL.EXE program file is in the same subdirectory as the OMEGA Engineering, Inc. application programs and the CALOUT.DAT file.

Load the EDITCAL.EXE program from the keyboard:

To Start Up EDITCAL.EXE –

1. At the DOS prompt, enter **EDITCAL**, then press the **[ENTER]** key. (This invokes the utility.)

EDITCAL Main Menu**EDITCAL TO SELECT A FUNCTION – SELECTIONS**

1. Use the arrow keys to navigate back and forth among these menu selections:
 - DATA FILES** *To merge calibration files supplied from the factory into a single file for systems that have multiple boards, or to update existing calibration files.*
 - AC EEPROM** *To view or modify calibration data on Analog Connection boards that have non-volatile on-board EEPROMS.*
 - HS EEPROMS** *To view or modify calibration data on high speed boards EEPROM, such as WB-WORKMATE or WB-FLASH12.*
 - DS EEPROMS** *To view or modify calibration data on DATAshuttle EEPROM.*
 - QUIT** *Ends this EDITCAL session.*
2. Move the arrow keys until **DATA FILES** is flashing.
3. Press **[ENTER]**.
4. Move the arrow keys until the selection you want is flashing.
5. Press **[ENTER]**.

Troubleshooting: Installation

If you experience difficulty in getting your data acquisition board up and running, please check to see that the installation is according to the descriptions in Chapter 2.

If the software reports a board failure, or that it cannot find a board, then try these remedies:

- 1. Confirm that the board is seated properly** in the PC expansion slot (reseat it, if necessary; see the illustration on page 2 – 3).
- 2. Verify the Board Number Switches** are *not* set to “0.” (Refer to page 2 – 8).
- 3. Use a different Base Address.** It is possible that another device in your installation is trying to use the same Base Address (please see the explanation on page 2 – 10).
- 4. If there is more than one data acquisition board in your installation,** make sure they all have the *same* Base Address, but *different* Board Numbers.
- 5. Install the board in another open slot** in the PC (follow the instructions on page 2 – 4).
- 6. Remove other devices** from expansion slots in your PC to check whether or not they are conflicting with your data acquisition board.
- 7. If possible, install the board in another computer** to verify its correct operation.
- 8. Verify that the software is up to date** (a version compatible with the board you are using. Contact us, or your software provider).
- 9. Remove other terminate and stay resident (TSR)** programs from your system’s AUTOEXEC.BAT file, temporarily.

Troubleshooting: Operation

OPERATING Qs AND As Here are mini “case studies” of difficulties, along with some easy solutions:

Problem: *After changing the switch settings on my board from voltage to current or to different voltage ranges, my outputs are inaccurate.*

Action: If you change any switch settings on the board, you must update the software as well. To do so, go back to DOS and rerun the GFIND command with the -c parameter.

Problem: *I get a “Reference Error” message when I run GFIND.*

Action: This error occurs when the traces labeled F1 and F2 (found on the bottom right of the board) are burnt. In these cases, you must replace the burnt traces with a 1Amp maximum resistor fuse.

Problem: *At start-up, I get a “Cannot Calibrate – check for short” message.*

Action: This error message occurs primarily when the channel in question is set to voltage. During start-up, calibration is performed on the board if the -c parameter is used with the GFIND command. Voltage calibration can only be completed if nothing is connected to the terminal panel. If there is a connection, you will usually receive this error.

To correct this error, you can remove any connections to the terminal panel. Alternatively, you can rerun the GFIND command without the -c parameter.

Problem: *At start-up, I get a “Cannot Calibrate – check for open” message.*

Action: This error message occurs primarily when the channel in question is set to current. During start-up, calibration is performed on the board if the -c parameter is used with the GFIND command. For current calibration to take place, the +12V terminal must be connected to the +ve terminal of the channel in question. If this connection is not made, you will usually receive this error.

Ensuring this terminal connection will usually get rid of this message. Alternatively, you can rerun the GFIND command without the -c parameter.

Problem: *My board used to work, but now the software cannot find it, or reports an error.*

Action: Check to make sure the Board Number Switches are not set to "0."

Problem: *When my software starts, the outputs of the board momentarily go to full scale.*

Action: If the GFIND program is run with the -c parameter, the WB-AVO board will be calibrated by sending full scale outputs. Removing the -c will prevent this from happening at a slight loss of accuracy.

IF YOU NEED CUSTOMER SUPPORT ***What to do before calling technical support, to help us serve you better:***

1. Have the part numbers of your boards and terminal panels ready.
2. Have the type and version number of the software you're using.
3. Have your computer's type, model, and the version of the operating system.

Product Specifications

ANALOG OUTPUTS The WB-AVO-2 features two analog outputs; the WB-AVO-8 includes eight analog output channels.

ANALOG OUTPUT RANGES The ACAO can output either voltage or current. Selectable voltage ranges include 0–5V, 0–10V, and $\pm 5V$; current is output in the 4–20mA range only.

RESOLUTION The WB-AVO can operate with resolution of up to 12 bits.

SPEED The WB-AVO has a maximum output rate of 130kHz on a standard IBM PC running at 4.77MHz (rates are somewhat faster in faster computers).

For the multi-channel output rate, divide the maximum 130kHz rate by the number of channels using an assembly language program.

MAXIMUM/ MINIMUM OUTPUT *In Voltage Output Mode –*

- Output Current: $\pm 15\text{mA}$ minimum
- Output Protection: May be shorted to any voltage between +12 and -12V
- Output Impedance: $<0.1\Omega$

In Current Output Mode –

- Maximum Output Voltage: +50V
- Minimum Output Voltage: +2.6V
- Output may be shorted to any voltage between 0 and +50 volts

ACCURACY *WB-AVO GENERAL CONDITIONS ACCURACY –*

Range	Absolute Accuracy	Maximum Offset
0 to 10V	0.02%	0.01%
0 to 5V	0.02%	0.02%
$\pm 5V$	0.07%	0.06%
4 to 20 mA	0.15%	0.04%

Relative accuracy for all ranges is a maximum of 0.01%.

There is a 0.01% maximum linearity for all ranges, guaranteed monotonic. The differential linearity is a maximum of 0.01%.

STABILITY In Voltage Output Mode –

- *Temperature Drift:*
With self-calibration is 0.002% / °C maximum
Without self calibration is 0.008% / °C maximum
- *Response time to 0.01% accuracy:*
Small step is 2.5µs
5V step is 20µs
10V step is 35µs

In Current Output Mode –

- *Temperature Drift:*
With self-calibration is 0.006% / °C maximum
Without self calibration is 0.015% / °C maximum
- *Response time to 0.01% accuracy:*
Small step is 2.5µs
16mA step is 10µs

DIGITAL I/O CHANNELS The WB-AVO has eight digital I/O lines, with each line individually selectable as input or output. These channels are TTL- and MOS- compatible as they come out of the board.

Their outputs sinks are open collector and are 3 milliAmperes; as inputs they draw 5 milliAmperes when low. (Please see the specifications in your terminal panel owner's manual for open collector output.)

AUXILIARY POWER OUTPUT **AUXILIARY POWER OUTPUT FOR THE WB-AVO –**

<i>Voltage</i>	<i>Maximum Current</i>
+10V	15mA
+12V	200mA
+5V	100mA
-12V	200mA

Power, except for 10 volts, is supplied directly from the computer power supply. The +10V supply draws its current from the +12V supply.

10 Volt Reference –

- Output Current: 15mA maximum
- Initial Accuracy: 9.9 to 10.1 volts
- Temperature Drift: 0.0008% / °C maximum
- Drift with time: 0.003% / 1000 hours

GENERAL CONDITIONS **General Specifications of the WB-AVO–**

- Operating Temperature Ambient: 0 to 50°C
- Board Dimensions:
The WB-AVO-2 is 4.2" x 5.25" (11.8 x 14.7 cm)
The WB-AVO-8 is 4.2" x 9.5" (11.8 x 14.7 cm)
- The supply current consumed by the WB-AVO varies according to number of analog output channels as well as voltage settings. (See table below for variations.)

WB-AVO POWER CONSUMPTION–

Voltage	Supply Current Consumed by	
	WB-AVO-2:	WB-AVO-8:
+5V	320mA	320mA
+12V	40mA	65mA
-12V	15mA	15mA
Total	2.6 Watts	2.9 Watts

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