

Highlights of the WB-WORKMATE

Maximum Speed

200 kHz, Single Channel

200 kHz, Multi-Channel

Maximum Resolution

14 Bits (.006%)

Analog Input Gain Ranges

13 selectable Ranges

All WB-WORKMATEs Feature

16 Single-Ended or 8 Differential Analog Input channels · 13 software selectable gain ranges · Eight Digital I/O lines, user configurable · Input protection to 30 Volts, operating · Low noise sampling mode · Two Analog Output channels · On-board pacer clock · Wide acceptance of sensor devices · On-board counter/timer · Factory guaranteed accuracy for two years from date of purchase

Chapter 1: Introduction to the WorkMate

Thank you for selecting the WB-WORKMATE 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-WORKMATE as an enhancement board that readily mounts in an ISA expansion slot in an IBM PC, or -compatible, computer.

This product's high speed and guaranteed long term stability, make it ideal for speed-critical applications in both the laboratory and harsh industrial environments.

Using the WB-WORKMATE board together with our graphical interface application software (such as WorkBench PC™ for Windows or DOS, 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,

- **Display and log data** to disk for later analysis,
- **Measure temperature, pressure, flow** and most other analog inputs from sensors and instruments,
- **Perform scale, offset, or complex calculations** on a measurement,
- **Monitor and control processes,**
- **Set alarm limits** on any input,
- **Control devices at preset levels** (fans, pumps, heaters, etc.),
- **Control devices from digital input** (e. g., from switches or TTL signals), and

- **Gather data unattended.**

You can use the system interactively, operating controls or modifying your setup 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 WB-WORKMATE board from within a program they design and code for their specific purpose.

EXPANDABILITY A WB-WORKMATE product has eight differential (or 16 single-ended) analog input channels; and you can add one board at a time to your computer, for as many as 15 boards with a total of 120 analog input channels (240 single-ended), 120 digital input/output lines and 30 analog output channels! (*Note that the installation is limited to five boards when using our DOS software.*)

RANGES/ UNITS OF MEASURE The 13 input ranges of the WB-WORKMATE span from ± 50 millivolts through $\pm 5V$, capable of accepting data from almost any sensor. Its high conversion rate also makes the WB-WORKMATE ideal for highspeed measurement in the plant or laboratory.

The WB-WORKMATE together with our software – such as WorkBench PC for Windows or DOS and QuickLog PC – make it easy to specify engineering units (degrees, Volts, milliAmperes, etc.) for measurements, as well as which ranges to use.

(You can measure temperature, for example, by selecting from among 11 different thermocouple types. With our application software, the process simply consists of selecting the type of sensing device from a menu – the driver automatically handles cold junction compensation and linearization.)

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

The system is capable of showing data on the monitor in a variety of formats, including graphical meters. Charts can indicate trends for comparison of actual measurements on several channels, or for setting data points or alarms.

HALF-FLASH CONVERTER Your WB-WORKMATE incorporates Strawberry Tree's unique "Half Flash" converter, greatly improving the board's speed.

In analog to digital conversion, the highest speed designs use what is called a "flash" converter. Flash converters are unique in that they use comparators – one for each bit – to detect whether an analog input signal is higher or lower than a particular reference point. The output of all comparators is encoded by digital logic to then yield the digital output. Because the conversion

takes only as long as it takes for the comparators to detect the input level, conversion rates of greater than 50 nanoseconds are easily achieved.

Despite their speed, flash converters are rarely used in data acquisition products. Because there are as many comparators as there are bits (an 8-bit converter has $2^8 = 256$ comparators!), they are quite expensive to produce.

For the WB-WORKMATE boards, Strawberry Tree developed a unique “half flash” converter which overcomes the expense and complexity of a full flash converter. With the half flash converter, the A/D conversion takes place in two steps: 1) a rough approximation of the digital code is generated, and 2) the approximation is adjusted to the correct value.

While this two step process is slower than the flash converter, it will still yield conversion rates of up to 200kHz. Because of this unique process, the WB-WORKMATE is the best performance/price data acquisition board in the industry!

Features and Configurations

All WB-WORKMATE boards possess these features:

- ANALOG INPUT CHANNELS** The WB-WORKMATE can be set for either eight differential or 16 single-ended analog inputs.
- RESOLUTION SELECTIONS** The resolution of the WB-WORKMATE is selectable in software, ranging from 12 through 14 bits.
- DATA ACQUISITION SPEED** The maximum single-channel and/or multichannel acquisition rate for the WB-WORKMATE is 200kHz.
- RANGES** The WB-WORKMATE features 13 voltage ranges, from $\pm 50\text{mV}$ up to $\pm 5\text{V}$, all selectable individually for each analog input channel.
- SENSORS** Each WB-WORKMATE provides accurate cold junction compensation and linearization for thermocouple devices.
- NOISE REJECTION** The WB-WORKMATE features a "low noise mode" which, when selected in DOS software, can sample at 50 or 60Hz to reject power line frequency noise.
- ACCURACY** We guarantee the factory calibration of the WB-WORKMATE 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.)
- INPUT PROTECTION** Built-in circuitry assures protection of analog input channels for ± 30 Volts operating, or ± 20 Volts non-operating.
- ANALOG OUTPUT CHANNELS** The WB-WORKMATE includes two analog output channels, with a fixed $\pm 5\text{V}$ output range.
- DIGITAL I/O** The WB-WORKMATE features eight digital input/output channels that the user can configure individually to be input or output.
- COUNTER/TIMER** Every WB-WORKMATE board includes a counter/timer for precise timing (for counting pulses or other events) which you can use as a pulse output.
- TERMINAL PANELS** Other available accessories for the WB-WORKMATE include your choice of screw fastener terminal panels for connecting sensors. They include general purpose and thermocouple terminal panels, most of which accept digital opto-isolators.

FOR MORE INFORMATION For more information about the capabilities of your WB-WORKMATE, please see “Product Specifications” in Chapter 3.

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

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

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

WB-WORKMATE SYSTEM REQUIREMENTS Before installing the WB-WORKMATE, 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 ISA slot,
- **Floppy disk drive** and a hard drive.

Software Environment –

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

Chapter 2: Installing the WorkMate

Getting your WB-WORKMATE 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 (see page 2 – 2),
- **Physically insert the board** into a slot of the personal computer (page 2 – 4; and illustration on 2 – 3),
- **Connect a terminal panel to the board** (to attach sensing devices and for digital outputs from the WB-WORKMATE; see page 2 – 4), and
- **Load and start up the software** to be used for the project.

As the scope of this manual focuses on the WB-WORKMATE board, this chapter discusses 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-WORKMATE, 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 Windows or DOS, 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-WORKMATE 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-WORKMATE'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-WORKMATE 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 Windows or DOS, 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 Switch first (refer to "Setting the Board Number Switch" on page 2 – 6), then go on to perform the physical installation.

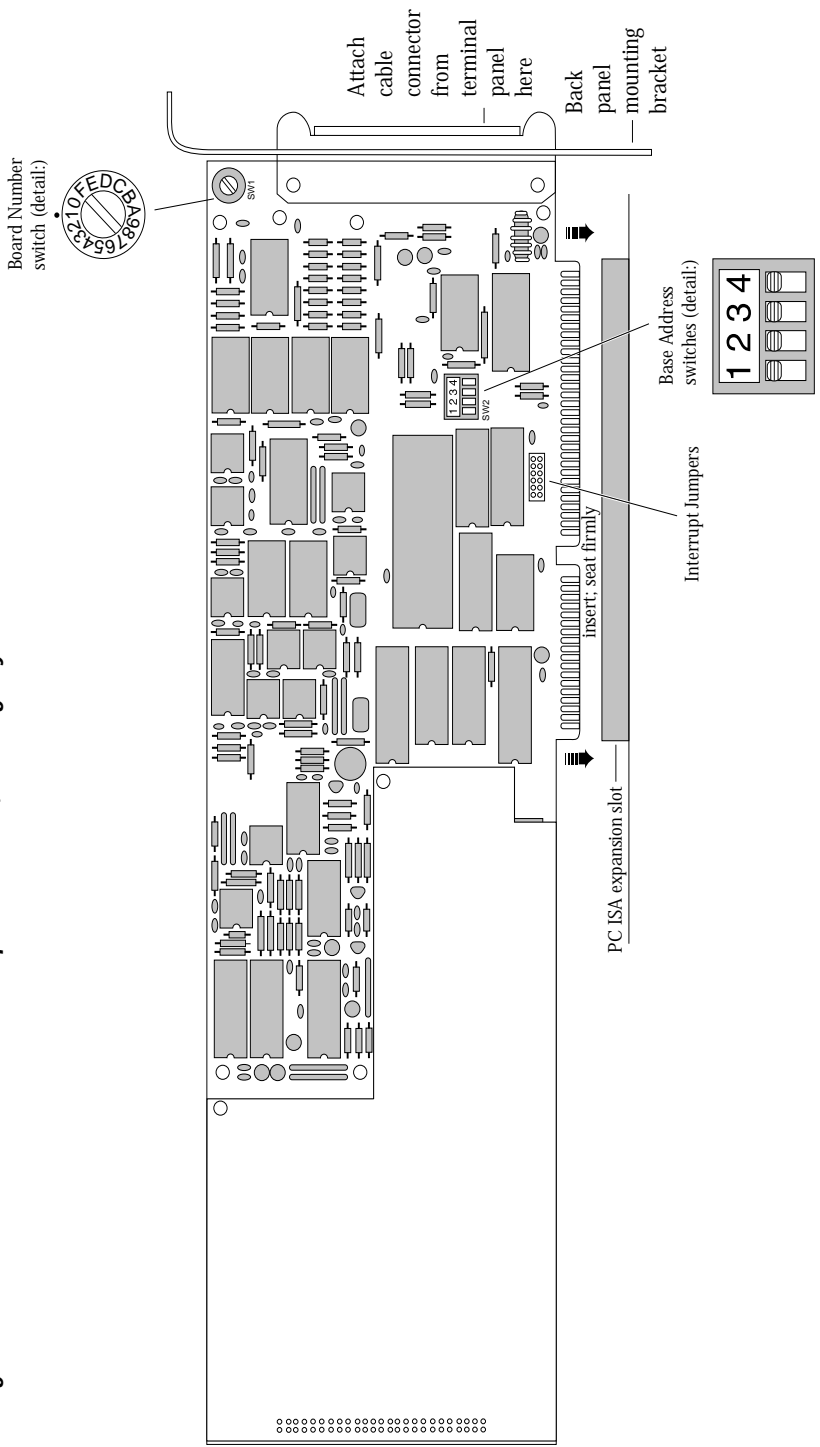
Otherwise, there's no reason to be concerned about the board's switch settings, except in the unlikely event you encounter a problem in getting your product to operate. (If you experience a problem, refer to "Troubleshooting" in Chapter 3).

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 "Board Number Switch Settings" on 2 – 8 in this chapter.

Figure 1. Illustration of WorkMate Data Acquisition Board, Showing Physical Installation –



Physical Board Installation

Installation very simply consists of inserting the board into an open ISA AT 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 Windows software supports as many as 15 WB-WORKMATE boards at one time. Up to five boards can be installed for use with our DOS software.)

TERMINAL PANEL CONNECTIONS When using a terminal panel with the WB-WORKMATE (to connect external devices: sensors and digital input/output) 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-WORKMATE and, at its far end, plugs into a 50 pin connector at the terminal panel. 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.

(Refer to the illustration on page 2 – 3. Also see “Pinouts,” on page 3 – 2 of this manual, for a description of the signals.)

PHYSICAL INSTALLATION *To Install the WB-WORKMATE 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-WORKMATE board having “gold fingers” down and into a twin connector 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-WORKMATE 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 diagram on page 2 – 3.)

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 and to connect sensors to your terminal panel.

Multiple Board Usage – If you are going to use more than one data acquisition board, now it’s time to set each Board Number Switch to an unique number. Follow the steps in the “Setting the Board Number Switch” section in this chapter on page 2 – 6.

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

IMPORTANT! *Setting the Analog Input Mode* – You must set the Analog Input mode in the software before using the WB-WORKMATE. See “Single-Ended vs. Differential Inputs” on page 2 – 10.

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 Board Number Switch

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 switch on a board accomplishes this, as it enables you to set an identifying number for the board (see the illustration on page 2 – 3).

This number determines, among other things, the sequence in which the software reads multiple boards. OMEGA programs can address as many as 15 boards total (but if you are working in DOS, no more than 5 of these boards can be from the high speed family, i.e. WB-WORKMATE or WB-FLASH12 boards).

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

(If you are working in DOS *and* there are also WB-AAI/FAI family boards in your installation, then their Board Numbers need to be at the low end of the number sequence.)

SINGLE BOARD If your system includes just a single data acquisition board, then you don't need to have much concern about the Board Number switch.

When your WB-WORKMATE leaves our manufacturing facility, we set the Board Number switch to 1, and 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 switch 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 Switch –*

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

On the printed circuit board, this is a rotary switch with the label “SW1.”

2. **Make the Setting.** Note that the switch has 16 possible positions: numbers on the detents are 0 through 9 and A through F.

Determine which is to be the First Board. (This is easy, if it is the sole board.) Then turn its dial to 1. Determine which is to be the Second Board, then set its switch to 2. Continue this process until all of the boards have been assigned and set to a unique number.

If you are working in DOS –The software interprets First Board to use *system installation* digital I/O channels 1-8 and analog input channels 1 through 8 (or channels 1 through 16 for single-ended inputs). The program then recognizes the Second Board to use *system installation* digital I/O channels 9-16 and analog input channels 9 through 16 (for differential inputs), or *system installation* analog input channels 17 through 32 (if the inputs are single-ended).

3. **Set All Switches.** Continue to set the switches for all boards in your installation 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.)

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 all of our data acquisition products is 300H (in hexadecimal format).

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-WORKMATE.

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

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

SETTING WB-WORKMATE *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-WORKMATE diagram.

On the printed circuit board itself, this is a block of four DIP switches labeled “SW2.”

(NOTE: Depending 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.** 300H is the normal base address. It consists of all four DIP switches' being in the “up” 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 “down” position *adds* a value to 300H:

WB-WORKMATE Base Address Switch Additive* Values –

Switch	Position	To 300H Add
1	Down	10H
2	Down	20H
3	Down	40H
4	Down	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-WORKMATE Base Addresses to Avoid –

Value	Switch Positions*				Can Interfere With
	1	2	3	4	
320H	–	U	U	D	<i>Hard disk drive</i>
370H	–	U	D	D	<i>Parallel printer</i>
3C0H	–	D	D	U	<i>Color Monitor</i>
3F0H	–	D	D	D	<i>Floppy disk drive</i>

* U = Up D = Down – = any position

Single-Ended vs. Differential Inputs

In the Single-Ended mode, the WB-WORKMATE has 16 analog input channels, each of which can measure a different voltage relative to ground. There are eight analog input channels available in Differential mode; each channel can measure the difference voltage between the positive and negative inputs.

The WB-WORKMATE is shipped from the factory in Differential Mode. Follow the instructions below if you wish to change this.

SETTING THE ANALOG INPUT MODE IN DOS

To Set the Analog Input Mode (if you are using DOS) –

- 1. Install the Driver Software.** All WB-WORKMATE boards ship with both driver and application software (QuickLog PC or WorkBench PC for Windows or DOS). The driver software resides on both the QuickLog and the WorkBench disk, and will be automatically installed when you run either installation program. (Please consult the appropriate software manual for further information on installation.)
- 2. Run the GFIND Program.** At the DOS prompt, type “GFIND – S.” This will tell the GFIND program to show you the current configuration of all cards in your computer.
- 3. Type the Board Number.** The Analog Input Mode for each WB-WORKMATE in your installation must be set individually.
- 4. Select the Analog Input Mode.** Type “S” for Single-Ended or “D” for Differential mode. To write the changes to the boards’ EEPROMs, you must type “W” after making your selection.
- 5. Quit the Program.** You may now exit the program by typing “Q” at the prompt.

The new settings will be remembered by each board until it is reprogrammed.

MULTIPLE BOARDS IN DOS

When you are using multiple boards in your installation, the software automatically numbers the analog and digital input and output channels in a sequential order, beginning with the channels on Board Number 1.

For example, if you have installed two WB-WORKMATE boards, both set in Differential mode, the software will assign Board 1 analog input channels 1 through 8 and digital I/O channels 1 through 8. Board 2 will be assigned analog input channels 9 to 16

and digital input channels 9 to 16. Because both boards are set in Differential mode, the channel assignment is fairly straightforward.

If your installation includes boards that are set in different modes, however, the channel numbering can be a bit more complicated. The following Channel Locator Chart defines possible analog input channel assignments in multiple (up to 3) board setups:

Channel Locator Chart –

Analog Input Channel Assignments						
Total # Boards	Board 1		Board 2		Board 3	
	Diff.	Single	Diff.	Single	Diff.	Single
1	1 to 8	–	–	–	–	–
1	–	1 to 16	–	–	–	–
2	1 to 8	–	9 to 16	–	–	–
2	1 to 8	–	–	9 to 24	–	–
2	–	1 to 16	17 to 24	–	–	–
2	–	1 to 16	–	17 to 32	–	–
3	1 to 8	–	9 to 16	–	17 to 24	–
3	1 to 8	–	–	9 to 24	25 to 32	–
3	1 to 8	–	9 to 16	–	–	17 to 32
3	1 to 8	–	–	9 to 24	–	25 to 40
3	–	1 to 16	17 to 24	–	25 to 32	–
3	–	1 to 16	–	17 to 32	33 to 40	–
3	–	1 to 16	17 to 24	–	–	25 to 40
3	–	1 to 16	–	17 to 32	–	33 to 48

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-WORKMATE. 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-WORKMATE showing on-board processing (please see page 3-3);
- **Using EDITCAL** to accommodate changes to your installation, (on pages 3-4 to 3-5);
- **Changing hardware interrupts** in order to use programs such as WorkBench PC for Windows (please see page 3-6);
- **Troubleshooting:** some possible problems and solutions after installing, and during operation of the WB-WORKMATE (beginning at page 3-7);
- **Specifications:** complete specifications of the WB-WORKMATE (beginning at page 3-10).

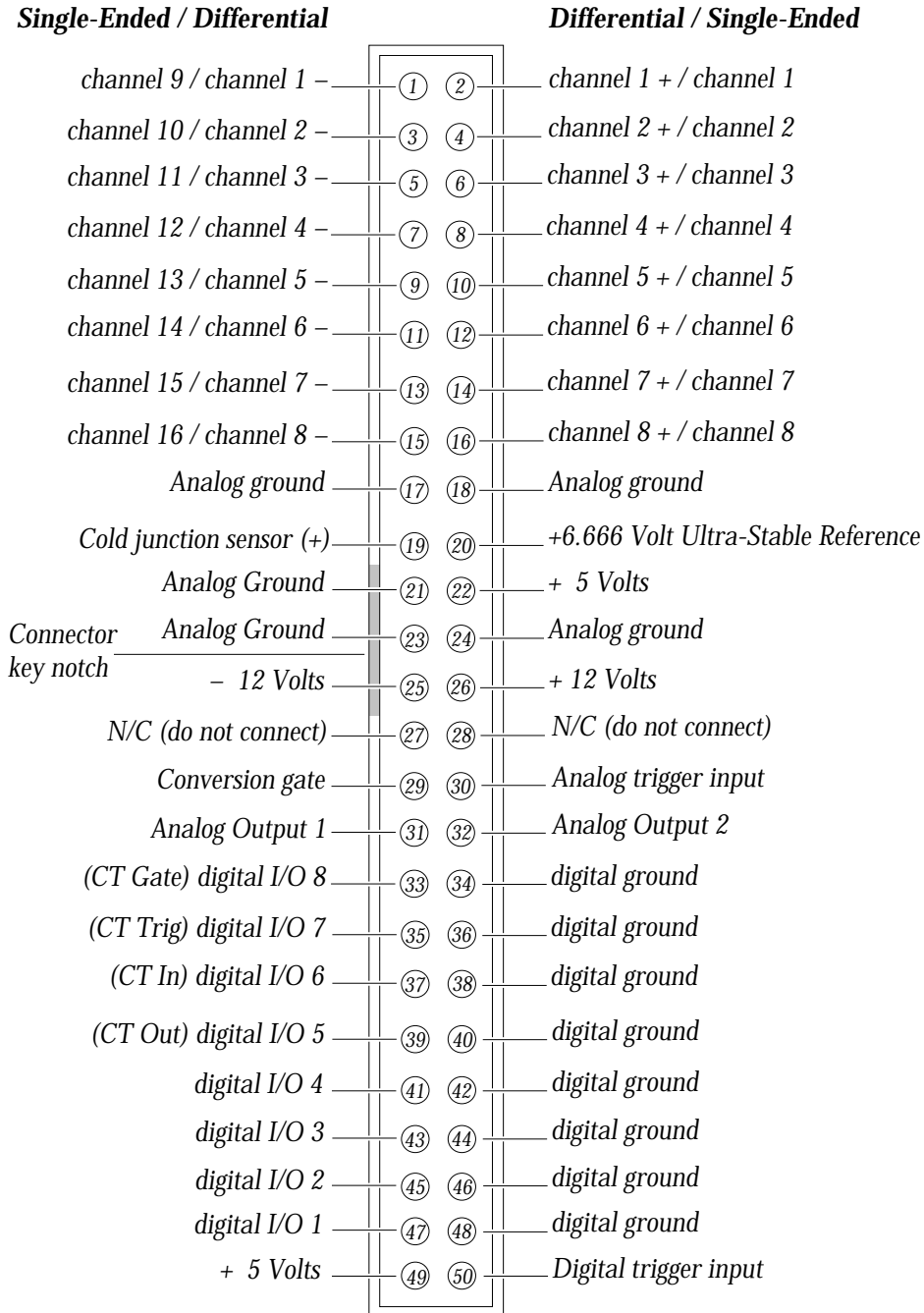
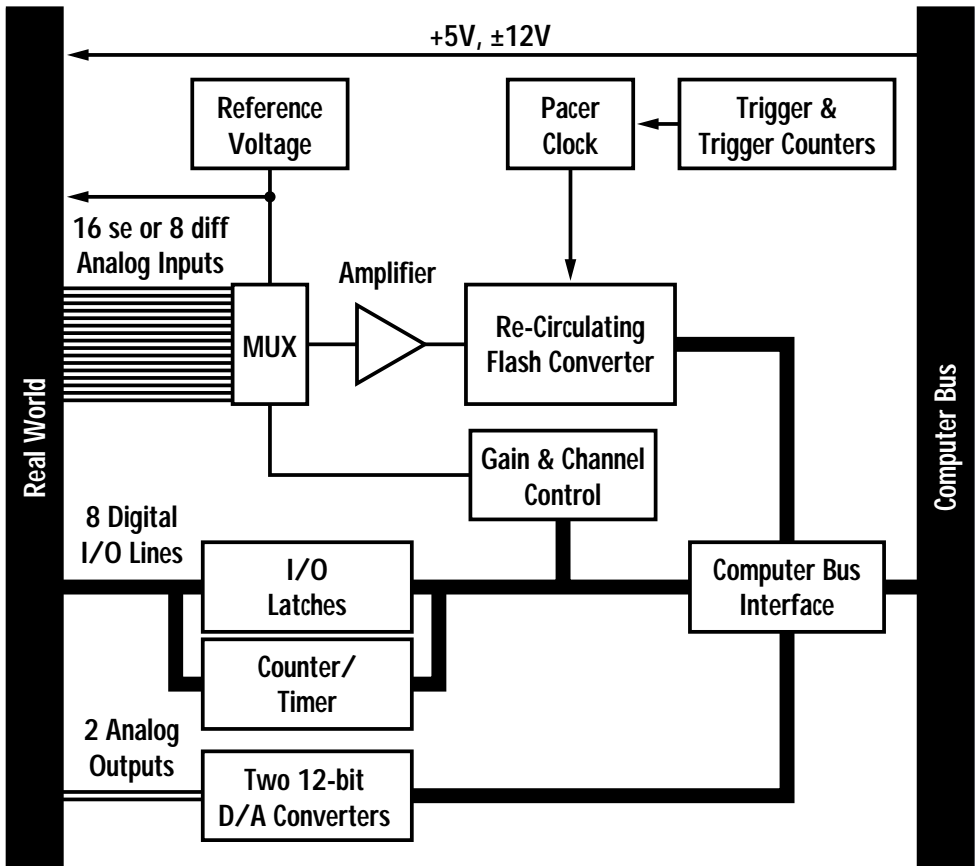
Figure 2. Pinouts of the WorkMate at Back Panel Connector –

Figure 3. Block Diagram of WorkMate –



Using EDITCAL

Your WB-WORKMATE 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.)

Instead of employing adjustment potentiometers to calibrate the boards, our technicians test and calibrate each WB-WORKMATE after assembly. That board's unique calibration number values reside on-board, in Electrically Erasable Programmable Read Only Memory – EEPROM – chips.

EDITING CALIBRATION VALUES Though recalibration is seldom necessary (and not recommended unless you have the proper equipment), it may be necessary to edit calibration numbers to accommodate other changes in your data acquisition setup. For DOS users, EDITCAL.EXE (or EDITCAL for short) is the utility program that simplifies the modification of these values. (*EDITCAL can be found on the QuickLog PC disk.*)

THERMOCOUPLES *Thermocouple Terminal Panel Calibration* – Terminal panels suitable for thermocouples have thermal isolation blocks and factory calibration for accurate measurements, as the CCAL number on the label on the panel. CCAL is the value controlling the cold junction compensation temperature.

If you change from one isothermal terminal panel to another, even if they are the same model number, it might be necessary to enter a new calibration number (CCAL). Check the calibration value on the two panels' labels. If they differ (which is likely), use EDITCAL to change the appropriate value to the new figure.

Similarly, if you are experiencing inaccurate measurements with a thermocouple, you can use EDITCAL to adjust the CCAL up or down until the temperature the board reports is correct. (Increasing the CCAL figure by 75 points increases the temperature reading by approximately 1° C.)

For more information, please refer to your terminal panel manual.

STARTING EDITCAL IN DOS Make sure the EDITCAL.EXE program file is in the same sub-directory as the OMEGA Engineering, Inc. application programs. 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
-----
CALIBRATION UTILITIES
-----
This program allows for the creation or modification of
calibration data files or hardware EEPROM data on analog
and digital boards. You may create and merge existing
CALIB.DAT or CALOUT.DAT files for multiple boards. You may
update an existing calibration file to add, delete or modify
data. Or you may view or modify EEPROM data or boards.
-----
Do you want to work with calibration data files, view/edit
EEPROM on Analog Connection, highspeed or DATAshuttle boards?
use ← and → keys to choose then press ENTER
DATA FILES  AC EEPROM  HS EEPROM  DS EEPROM  QUIT
Press the F1 Key at anytime for online help

```

**EDITCAL To Select a Function –
SELECTIONS**

1. Use the arrow keys to navigate 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 DATAshuttles' EEPROM.*
 - QUIT** *Ends this EDITCAL session.*
2. Move the arrow keys until the selection you want is flashing.
3. Press **[ENTER]**.

Changing Hardware Interrupts

For users of programs that employ hardware interrupts, the WB-WORKMATE board provides for changing the interrupt number, if necessary.

OMEGA Engineering, Inc. customers using DOS have no requirement for this feature, and do not have to change hardware interrupts.

The illustration of the WB-WORKMATE on page 2 – 3 in Chapter 2 identifies the jumper block. (It is labeled as “interrupt jumpers.”)

By repositioning the jumper, which is a plug, to another socket on the block, you can select another of these interrupts: IRQ2, IRQ4, IRQ5, IRQ6, or IRQ7.

(Remember that on AT computers the IRQ2 selection is actually the IRQ9 line.)

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 switch** is not set to “0.” (Refer to page 2 – 6).
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 – 8).
4. **If there is more than one OMEGA 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.
10. **Replace the Z8536 chip** on the board, or return the product to our Technical Services department for testing.

(Please call our Technical Support line before returning a board – we hope to assist you with your problem via telephone.)

Troubleshooting: Operation

HINTS During operation, it's good practice to short all analog input channels you're not using; to do this, connect + to – to Com.

It's essential to have exactly one ground reference per channel. This single connection to ground makes sure you don't exceed the common mode range of input.

(More than one connection per channel can lead to ground loops, causing errors or erratic readings. Connecting the – to the Com terminal provides a single ground. Your sensor might also provide another ground. If you're not sure that your sensor is grounded, try connecting the – to Com, and not, and see which works best.)

Remember that if speed is not critical, selecting the “low noise mode” in software always provides the best accuracy and resolution with your data acquisition board.

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

Problem: *I read a voltage with my multimeter at the analog input terminals, with nothing connected.*

Action: None. Any voltage between – 12V and + 12V is possible, when nothing is connected.

Problem: *My board reads analog input wrong.*

Action: Try shorting + to – to Com: the board should return a reading around 0V.

Problem: *My board reads the thermocouple as a very negative temperature.*

Action: Verify the connections are secure. Opens read as negative temperature.

Problem: *My board reads thermocouple input wrong.*

Action: Using EDITCAL, confirm that the CCAL number matches the number on the terminal panel's calibration label (see pages 3–4 through 3–5).

(If you need to use a general purpose terminal panel – one that doesn't have a factory CCAL number – with a thermocouple, you can achieve approximate results by entering a

CCAL of 2300. Then change the figure by about 75 points for each degree C. that you want to raise the temperature.)

Problem: *My readings are noisy.*

Action: Try using the low noise mode (see your software manual for more information).

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 switch is not set to "0."

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.

Specifications of the WB-WORKMATE

ANALOG INPUT The WB-WORKMATE has 16 available analog inputs when set to single-ended mode; eight analog inputs are available in differential mode. (See page 2–10 for instructions on setting the Analog Input Mode.)

ACCURACY WB-WORKMATE GENERAL CONDITIONS ACCURACY –

	Unipolar Full Scale Range*	Bipolar Full Scale Range*	Resolution	Accuracy (% of full scale)
VOLTAGE	N/A	$\pm 5V$	2.44mV	$\pm 5mV (.05\%)$
	0 to 5V	$\pm 2.5V$	1.22mV	$\pm 2.5mV (.05\%)$
	0 to 2 V	$\pm 1V$	488 μV	$\pm 1mV (.05\%)$
	0 to 1V	$\pm 500mV$	244 μV	$\pm 0.75mV (.075\%)$
	0 to 500mV	$\pm 250mV$	122 μV	$\pm 0.375mV (.075\%)$
	0 to 200mV	$\pm 100mV$	48.8 μV	$\pm 0.2mV (.1\%)$
	0 to 100mV	$\pm 50mV$	24.4 μV	$\pm 0.1mV (.1\%)$

* Due to automatic calibration, actual maximum and minimum voltage can be 1.5% above or below the stated value.

General Conditions – 12-bit (0.024%) resolution, after automatic self-calibration. From 15°C to 35°C at the interface board. Source resistance less than 1k Ohms. Includes linearity, drift, offset, and calibration errors.



WB-WORKMATE RTD ACCURACY –

We do not recommend using the WB-WORKMATE for RTD or strain gauge measurements. The reference voltage does not supply enough current to accurately support these type of measurements.

WB-WORKMATE THERMOCOUPLE ACCURACY –

Type	Range (°C.)	12-Bit Resolution (°C)	14-Bit Resolution (°C)	Accuracy (°C.)
J	-100 to 880	0.6	0.15	± 3
	-210 to -100	1.0	0.25	± 6
K	-75 to 1370	0.6	0.15	± 3
	-260 to -75	0.8 to 8	0.2 to 2	± 4 to 35
E	0 to 1000	0.4	0.1	± 2.5
	-200 to 0	0.5 to 1	0.125 to 0.25	± 5
	-270 to -200	1 to 6	0.25 to 1.5	± 5 to 30
T	0 to 400	0.6	0.15	± 3
	-200 to 0	0.6 to 1	0.15 to 0.25	± 3 to 6
	-270 to -200	1 to 6	0.25 to 1.5	± 6 to 30
S	0 to 300	3 to 5	0.75 to 1.25	20
	300 to 1770	2 to 3	0.5 to 0.75	12
R	0 to 200	3 to 5	0.75 to 1.25	20
	200 to 1770	2 to 3	0.5 to 0.75	12
B	200 to 400	6 to 12	1.5 to 3.0	50
	400 to 800	3 to 6	0.75 to 1.5	25
	800 to 1820	2 to 3	0.5 to 0.75	13
G	25 to 200	3 to 12	0.75 to 3	50
	200 to 2315	2 to 3	0.5 to 0.75	15
D	-20 to 2315	1.7 to 3	0.4 to 0.75	12
C	-20 to 2315	1.5 to 3	0.38 to 0.75	12
N	-100 to 200	0.8 to 1.3	0.2 to 0.3	± 5
	200 to 1300	0.8	0.2	± 3

Thermocouple Conditions – Same as General Conditions. Does not include the accuracy of the thermocouple itself (cold junction error must be added in; cold junction compensation with T21 terminal panel only; please see your terminal panel manual's specifications for cold junction compensation error). Accuracy is approximate because resolution varies with temperature.

Thermocouples use the 50 mV range. For inputs below -5 mV (below approximately -100 degrees C.) use the +/-25 mV range. For the best resolution use the 50 mV range above -5 mV.

INPUT IMPEDANCE All analog inputs have an impedance rating of $>100\text{g}\Omega$.

NOISE REJECTION CMRR – Conditions for Common Mode Rejection Ratio (CMRR): DC to 1k Hz, common mode input. This specification applies even when one or more nonmeasured channels exceeds the operating common mode range.

WB-WORKMATE NOISE REJECTION –

Unipolar Range	Bipolar Range	CMRR	Typical Internal Noise* (RMS)
N/A	$\pm 5V$	$> 86 \text{ dB}$	$150 \mu V$
0 to 5V	$\pm 2.5V$	$> 86 \text{ dB}$	$100 \mu V$
0 to 2 V	$\pm 1V$	$> 86 \text{ dB}$	$100 \mu V$
0 to 1V	$\pm 500\text{mV}$	$> 92 \text{ dB}$	$50 \mu V$
0 to 500mV	$\pm 250\text{mV}$	$> 98 \text{ dB}$	$25 \mu V$
0 to 200mV	$\pm 100\text{mV}$	$> 98 \text{ dB}$	$20 \mu V$
0 to 100mV	$\pm 50\text{mV}$	$> 98 \text{ dB}$	$10 \mu V$

* Low noise mode.

COMMON MODE RANGE No input may exceed ± 10.5 Volts.

INPUT PROTECTION *Operating* – ± 30 Volts, maximum.

Nonoperating – ± 20 Volts, maximum.

RESOLUTION/SCAN RATE Selectable in software:

WB-WORKMATE RESOLUTION AND SCAN RATE* –

Resolution	Scan Rate (Single Channel)	Scan Rate (Multiple Channels)
low noise mode: 0.006 %	50 or 60 Hz	50 or 60 Hz
14 bits: 0.006 %	50 kHz	50 kHz
13 bits: 0.012 %	100 kHz	100 kHz
12 bits: 0.024 %	200 kHz	200 kHz

* Burst mode with DOS software. Rates with Windows software or continuous sampling will be lower.

NOTE: The multiple channel scan rate depends on the computer speed, minimum of 100kHz on PC AT. Divide the rate by 4 for 13-bit resolution and by 16 for 14-bit resolution; scan rate is settled to 0.25%. Rate is never less than 40kHz at 13 bits or 20kHz at 14 bits.

Scan Rate – Scan rate is the rate in Hertz (or, samples per second) to read data into memory, including the time it takes to switch channels and ranges. To calculate the total scan time for all channels, divide the rate by the number of channels.

(After placing a burst of data into memory, and depending on your computer and software, the system requires additional processing time before the data are available to you, or before you can collect more data.)

DIGITAL I/O CHANNELS The WB-WORKMATE has 8 digital I/O lines, with each line individually selectable as input or output. Inputs are 5 Volt TTL-compatible.

Their outputs are also 5 Volt TTL-compatible, or high voltage open collector on the terminal panel.

(Please see the specifications in your terminal panel owner's manual.)

COUNTER/TIMER The WB-WORKMATE has one on-board 16-bit counter/timer with a 2 MHz internal clock. The counter timer is connected to Digital I/O lines 5 through 8.

ANALOG OUTPUT There are two analog outputs available on the WB-WORKMATE.

WB-WORKMATE ANALOG OUTPUT ACCURACY –

Output Voltage	Voltage Resolution	Accuracy (% of full scale)
$\pm 5V$	1.22mV	$\pm 7mV(.07\%)$

General Conditions – 12-bit (0.024%) resolution. Includes linearity, offset, and initial calibration.

Output Protection – May be shorted to any voltage within $\pm 12V$.

Output Impedance – $<0.5\Omega$.

Output Current – $\pm 5mA$ minimum.

Temperature Drift – $<0.004\%$ per degree Celsius, maximum.

PHYSICAL DIMENSIONS The WB-WORKMATE is a full-size PC board measuring 13.0" by 4.2" (33.0cm by 10.7cm).

GENERAL CONDITIONS **Auxiliary Power Output** – +5v, +12V, or -12V, direct from the computer's power supply, unfused. It is not to exceed 1A.

Reference Voltage Output – 6.667V, $\pm 1\%$; 1k Ω output impedance.

Operating Temperature Ambient – 0 to 50 degrees Celsius.

Power Consumption – 8.8W