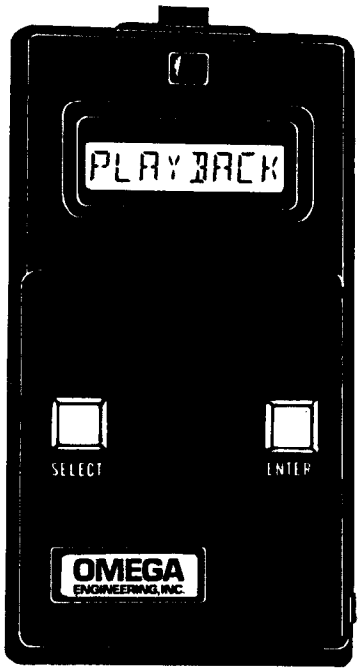
OM160

Portable Intelligent Data Logger



OMEGA®
An OMEGA Technologies Company

Operator's Manual
M669/1092

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

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RETURN REQUESTS / INQUIRIES

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1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems you are having with the product.

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

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SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The OMEGA® OM-160 Portable Intelligent Data Logger is a four channel, adaptive data logger and playback system designed to work with an IBM or IBM-Compatible Personal Computer. The OM-160 Data Logger is used to collect data at a remote site. The recorded data is then stored in the OM-160 Data Logger unit memory and played back at a later time utilizing a Personal Computer driven by the Software Application Program (included).

Each of the two major operations (RECORD and PLAYBACK) utilizes its own menu system, enabling the user to make operational choices. The OM-160 Data Logger Menu utilizes two front panel keys to set up recording conditions, and the Application Software Program utilizes a series of computer-based, interactive CRT screen menus and prompts to set up the conditions for playback and analysis. Figure 1-1 is a block diagram of the system, showing the major functional blocks and the flow between them.

1.2 THE DATA LOGGER

Figure 1-1A illustrates the functions of the OM-160 System for the Display/Recording of data. The OM-160 Data Logger unit must be equipped at the recording site with the appropriate data sensors/transducers and associated Signal Conditioner Modules (refer to paragraph 7.1 Specifications, Table 7-1) at the inputs to each of its four channels. The sensors convert physical and electrical phenomena, such as temperature, pressure, flow, voltage, current, etc. into analog signal equivalents. The Modules accept and convert them to a standard signal level (0 to 2 V, full scale) suitable for input to the OM-160 Data Logger unit.

The data recording conditions are selected with two simple keys (SELECT and ENTER) located on the OM-160's front panel. Recording sessions may be set under a wide range of environmental conditions. Real-time data display is also possible at the data recording site.

The OM-160 incorporates a unique and innovative adaptive system that adjusts to the data it is storing to provide optimum resolution and accuracy for periods up to 100 days. It collects data to memory by automatically adjusting data storage to accommodate the "worst-case" recording environment, essentially eliminating memory capacity as a concern for the user.

The recorder information can be played back as serial data into an IBM (or compatible) Personal Computer (PC) for display and analysis.

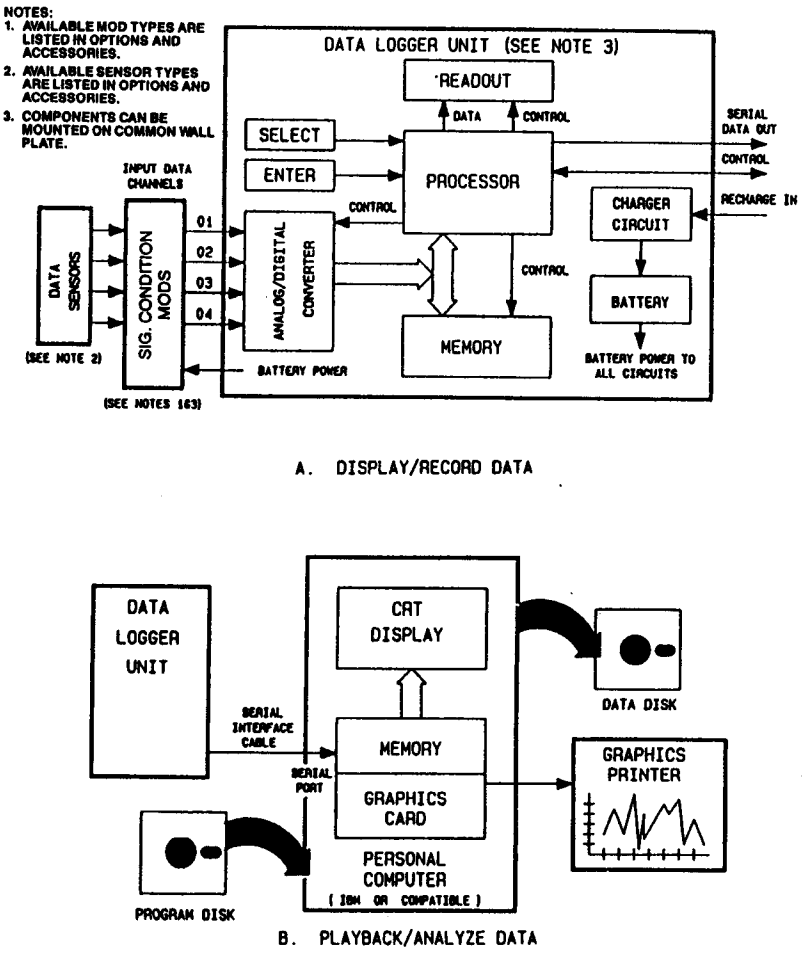


Figure 1-1. Adaptive Data Logger and Playback System, Functional Block Diagram

1.2.1 Adpative Mechanism Process of the OM-160 Data Logger

The OMEGA® OM-160 Data Logger incorporates an adaptive storage process. This process differs from the point storage process in several significant ways. The advantages of the adaptive storage process is that it can continually sample at a high rate even for extremely long recording periods. Efficiencies gained in data compression algorithms allow for high resolution of data reproduction with minimal amounts of memory even for long periods of time; whereas a point for point storage device can only reproduce those points that were present on the data logger when it was sampling data. The adaptive mechanism process allows for information such as minimum and maximum values over the sample period, weighted averages, integrated data presentation and average plotting, thus giving you much more detailed information about the data that would normally fall in between the sample periods of a traditional point storage data logger.

The OM-160 samples data every 650ms regardless of whether the recording period is 10 minutes or 100 days. Mathematical models are set up to represent the data being received with respect to time. Models represent instantaneous values, rate of change and exponential components of the data. Each new sample received on a 650ms basis is compared to these models and the models are updated accordingly. In data collection periods where the data is changing too rapidly to save all of the changes, a window is set up around the data point. Thus, any point falling within the window is considered to satisfy the model. This is best represented by viewing a max/min plot.

The last variable in the equation for data collection is the length of recording time. The OM-160 Data Logger insures that you will not run out of memory prior to the end of the recording length you have set, i.e., 10 min, 1 hour, 100 days, etc. The shorter the record time, the more accurate reproduction you have of the exact wave form and the smaller the min/max boxes will be about the waveform. The OM-160 will attempt to use 98% to 99% of its memory by the end of the recording interval you have set, thus it optimizes its memory over that interval. The memory is also adaptive on a channel by channel basis. That is to say the most active channels will use more memory than channels recording fairly constant data. The internal memory of the data logger is 8K. If this memory is entirely filled, it will require approximately 70K of computer memory to play it back.

1.2.2 Plot Description

Data from the OM-160, when presented on the application software, can be viewed in four distinct ways; Max/Min, Average, Cumulative, and Hystogram.

In the max/min plot there is a plot of the envelope in which all data sampled stayed within. This is the most accurate reproduction of what the data logger has seen regardless of recording time.

In the plot, you will always know the maximum and minimum data point achieved during that stored sample period as they are the real limits seen at the input for that stored record.

The average plot is a computer generated plot representing the most likely signature of the waveform based on the samples presented on a 650ms basis.

The cumulative plot is an incremental summation of data stored with respect to time throughout the recording.

Finally, the hystogram is a weighted average of all samples seen on a 650ms basis within each max/min record.

Recording sessions of data that is very cyclic and predictable will generate max/min, average, and hystogram plots that look very close to being identical.

1.3 PLAYBACK AND ANALYSIS

Figure 1-1B illustrates the major functions of the OM-160 System for the playback, display and analysis of data. The OM-160 Data Logger is connected to the serial port of the PC. Playback of recorded data utilizes the Application Software to drive the PC. Using a system of computer screen menus, statements, and prompts, the user can readily move through all the available selections.

By using the interactive features of the CRT screen, the user can set up the conditions to:

- Transfer and save remotely-collected data from the OM-160 Data Logger to computer memory
- Create, name and describe data files
- Convert the data to graphs
- Plot graphs from raw or processed data
- Change graphs in format, size and position
- Annotate the graphs with text/lables
- Display graphs for review
- Print graphs or lists for reports
- Create compatible files for output to data-based spreadsheets (i.e. Lotus 1-2-3)

1.4 WHAT YOU NEED TO GET STARTED

1. An IBM Personal Computer or compatible system with two double-sided, double-density disk drives and 256K of main memory.

2. A Serial Data Card.

NOTE

Refer to your PC User's/Operator's Manual for operating instructions, disk formatting, etc.

3. A DOS operating system disk (MS-DOS or PC-DOS), revision 2.02 or later.
4. Blank double-sided, double-density disks.
5. The OM-160 Data Logger and appropriate Signal Conditioning Modules.
6. The Master Application Program Disk (supplied with the OM-160).
7. A Graphics Card (Hercules, CGA, EGA or equivalents)
8. Serial Data Transmission Cable (RR-101).
9. RR-120 Battery Recharger.

Each system purchase includes a hand held OM-160 Data Logger unit, a Master Software Application Program disk, and a User's Manual.

A complete operating system also requires transducers or sensors and associated Signal Conditioning Modules (MODs) for each monitored data channel. The types and quantities of MODs and associated transducers/sensors (and accessories) are unique to each installation. The installed system may include a combination of these components. (A typical installation arrangement is described in paragraph 2.2.)

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call the OMEGA Customer Service Department at (203) 359-1660.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 TYPICAL INSTALLATION

Figure 2-1 illustrates the mechanical and electrical assembly for a typical installation. Each site will have its own unique requirements for data collection. The type and quantity of Signal Conditioning Modules and sensors/transducers will vary for each application.

Figure 2-1 illustrates a fully populated RR-200 Wall Mounting Plate (item 1). The OM-160 components may be housed in a RR-205 Tamperproof Enclosure (not shown). The Wall Mounting Plate comes equipped with a spring clip (item 2), two locating buttons (item 3), and a battery clip (item 4). Refer to Figure 2-1 and assemble components on the Wall Mounting Plate in the order specified.

1. Mount the OM-160 Data Logger (item 5) to the Wall Mounting Plate. Locate the OM-160 on the locating buttons; the spring clip will secure the Data Logger in place.
2. Mount one to four Signal Conditioning Modules (item 6) on the mounting plate with two each #4-40x1/4 Flat Head Nylok screws (item 7).

NOTE

Mount the Signal Conditioning Modules in the same order of the Logger unit channel input receptacles to which they are assigned. Make a written record of these assignments for later reference.

3. Connect the Module output cables (item 8) to the input receptacles on the OM-160 Data Logger unit.
4. Mount the RR-130 Battery Pack (item 9) to Wall Mounting Plate (item 1) with the Battery Clip (item 4).
5. Mount the RR-120 Charge Circuit Assembly (item 10) to the Wall Mounting Plate with two each #4-40x5/16 Pan Head Nylock screws (user supplied).
6. Make the Battery Pack/Charge Circuit connections as follows:
   a. Battery Pack cable to connector J3 on Charger Circuit.
   b. Jack from J2 (item 12) on Charge Circuit to receptacle on Data Logger.
7. Connect transducer/sensor leads (item 13) to appropriate Modules.
8. Install assembled Mounting Plate on the wall using two mounting holes (item 14). Refer to site installation plan for plate location.
9. Dress the transducer/sensor leads, and route to appropriate data collection points.

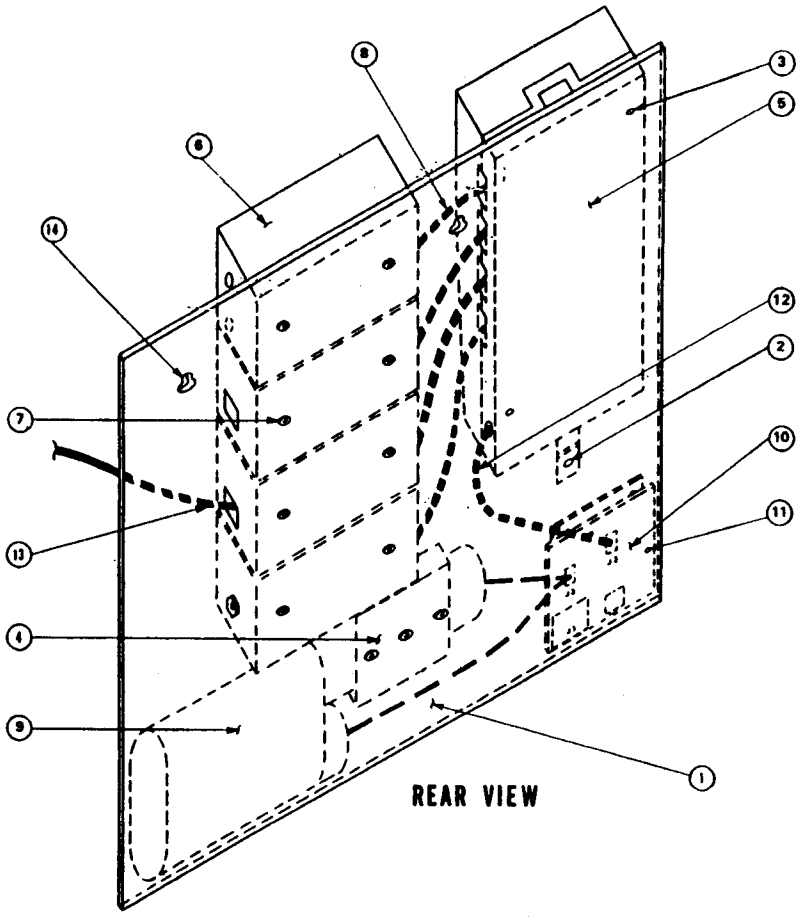


Figure 2-1. Typical Installation Arrangement

SECTION 3 OPERATION OF THE OM-160 DATA LOGGER UNIT

3.1 INTRODUCTION

This section discusses the use of the OM-160 Data Logger unit. The Menu Tree is your operational interface with the Data Logger. The Menu Tree is printed on the back surface of the unit (see Figure 3-1). The unit is set up for operation using two front panel keys (SELECT and ENTER), in conjunction with prompts from an 8-character liquid crystal display (LCD). Understanding the structure of the Menu Tree is essential for operating the Data Logger.

The Menu Tree enables you to:

- Set up the recording session parameters in the DEFINE Mode
- Initiate a data recording session in the RECORD Mode
- Read out status in the DISPLAY Mode
- Initiate the transfer of the recorded data to the computer in the PLAYBACK Mode.

By following the instructions in the given order, you will exercise all of the menu functions for setting up the Data Logger. The SELECT and ENTER keys will permit you to move through the "branches" of the Menu Tree.

This section describes a series of "tree" diagrams. Each diagram relates to a separate level of the Menu Tree hierarchy. First discussed is the Menu Tree itself, followed by the major tree "trunk", its "branches", and subordinate "limbs". The complete series of diagrams (Figure 3-1 through Figure 3-10), and the related descriptions, will give you an understanding of the selection process using the Menu Tree and the two front-panel keys, SELECT and ENTER.

If you accidentally push the wrong key, simply press the SELECT and ENTER keys together to bring you to the "home" position, READY. Then start again.

3.2 THE STRUCTURE OF THE MENU TREE

Examine the Menu Tree chart (see Figure 3-1) printed on the back surface of the OM-160 Data Logger. This chart is a guide to familiarize the user with the major "branches" of the Menu Tree. It shows only the vertical "trunk" (the Main Menu) and its major horizontal "branches". Various vertical and horizontal "limbs" not shown on this chart are discussed further in this section.

NOTE

The settings on the Menu Tree that are printed in red (refer to the chart on the back of the OM-160), must be made before an actual recording session is started.

The following instructions will guide you through each path of the Menu Tree. With the aid of illustrations, we will examine and exercise each path of the Menu Tree separately, using the SELECT and ENTER keys to execute our moves.

The SELECT key generally executes major selections in the vertical direction, while the ENTER key executes major selections in the horizontal direction. Some minor settings are made using both the SELECT and ENTER keys in a coordinated sequence. As you move through the menu, various flashing displays will prompt you to execute a selection with the aid of these two keys.

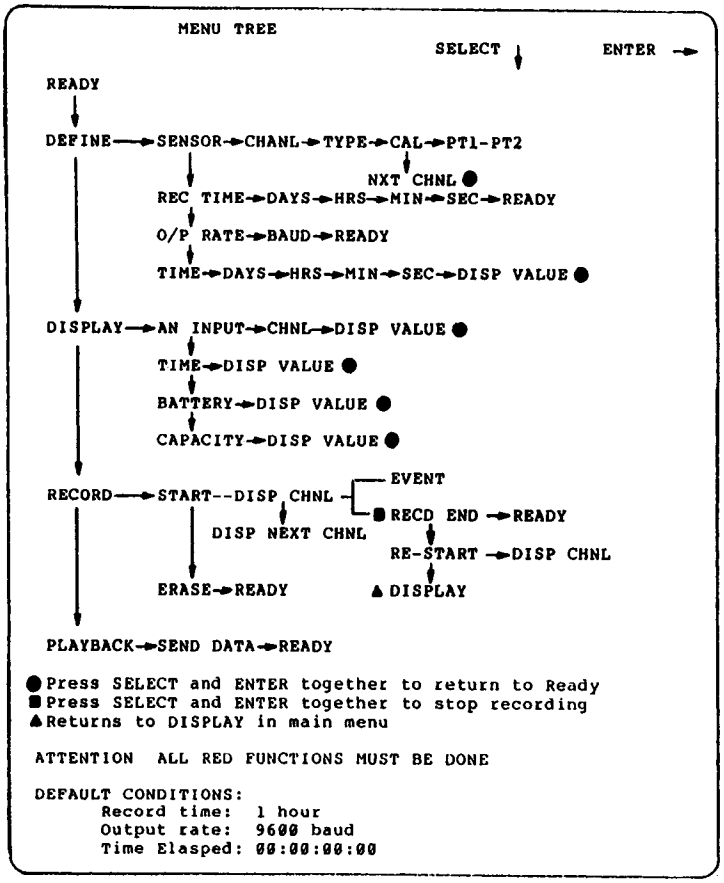


Figure 3-1. The Menu Tree

3.3 TURNING THE POWER ON

The OM-160 Data Logger is powered by an internal rechargeable NI-CAD battery. The internal battery provides the main operating power for the unit during short-term recording sessions. For long-term data collection, a 30 day external battery pack/charger (RR-130) is available. In either recording mode, the internal battery acts as the back-up power source for holding the recorded data in memory during transportation to the computer site for playback.

WARNING
All data is erased from memory when the power is turned off.

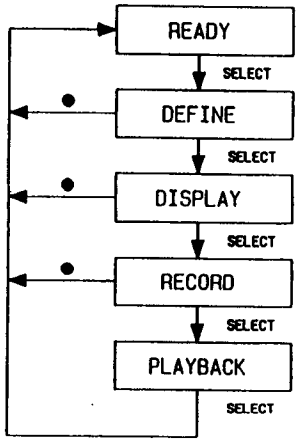
An optional battery charger (RR-120) is available to maintain the charge on the internal and external batteries. Make sure that the OM-160 has a fully charged internal battery before proceeding. Place unit on charge if required.

You can verify battery voltage anytime by entering the DISPLAY Menu and selecting the BATTERY Mode. (Refer to paragraph 3.6.)

Before proceeding, turn on the power to the OM-160. The power switch is located in a recess at the unit's left side. With power on, the readout should show a flashing READY.

3.4 THE MAIN MENU

Figure 3-2 is the selection flow diagram for the Main Menu. Each block defined is a major operating mode of the OM-160 Data Logger unit. As shown in Figure 3-2, READY is the reset (home) position. When the unit is first turned on, the menu opens with a flashing READY displayed in the readout. A flashing READY is your first prompt to further action.



NOTES:
THE ● SYMBOL DENOTES THE PRESSING OF SELECT AND ENTER KEYS TOGETHER. THIS BRINGS YOU TO THE "HOME" POSITION, READY.

Figure 3-2. The Main Menu Selection

Starting at READY, you can now sequence through the major modes by repeatedly pressing the SELECT key. Figure 3-2 shows the direction of movement through the modes. Use the SELECT key and increment the Main Menu as follows:

1. Press SELECT key; the readout shows a flashing DEFINE.
2. Press SELECT key; the readout shows a flashing DISPLAY.
3. Press SELECT key; the readout shows a flashing RECORD.
4. Press SELECT key; the readout shows a flashing PLAYBACK.
5. Press SELECT key; the readout shows a flashing READY.

You have now moved through all the major modes of the OM-160 Data Logger. Note that after step 4, you returned automatically to READY. You should now repeat the sequence through the modes until you are comfortable with the operation at the Main Menu level.

3.5 THE DEFINE MENU

The Define Menu permits you to set up (define) the characteristics and parameters for making a data recording. These are programmed into the OM-160 Data Logger unit with the SELECT and ENTER keys prior to each recording session.

Figure 3-3 is the selection flow diagram for the Define Menu. It shows the direction of movement through the menu. Each block you see is a major selection you can make. You can always reset (go to READY) by pressing the SELECT and ENTER keys together.

You can now start the sequence through the major selections of the Define Menu. Use the SELECT and ENTER keys as directed, and increment the Define Menu as follows:

1. Select DEFINE from the Main Menu; the readout shows a flashing DEFINE.
2. Press ENTER key; the readout shows a flashing SENSOR.
3. Press SELECT key; the readout shows a flashing REC TIME.
4. Press SELECT key; the readout shows a flashing O/P RATE.
5. Press SELECT key; the readout shows a flashing TIME.
6. Press SELECT key; the readout shows a flashing SENSOR.

Note that in step 6 you returned automatically to SENSOR. This permits you to re-cycle through the Define Menu selections. Repeat steps 1 through 6 until you are familiar with the selections available in the Define Menu.

Now we can proceed to examine the Define Menu by looking at each of its selections (sub-menus) SENSOR, REC TIME, O/P RATE, and TIME, individually.

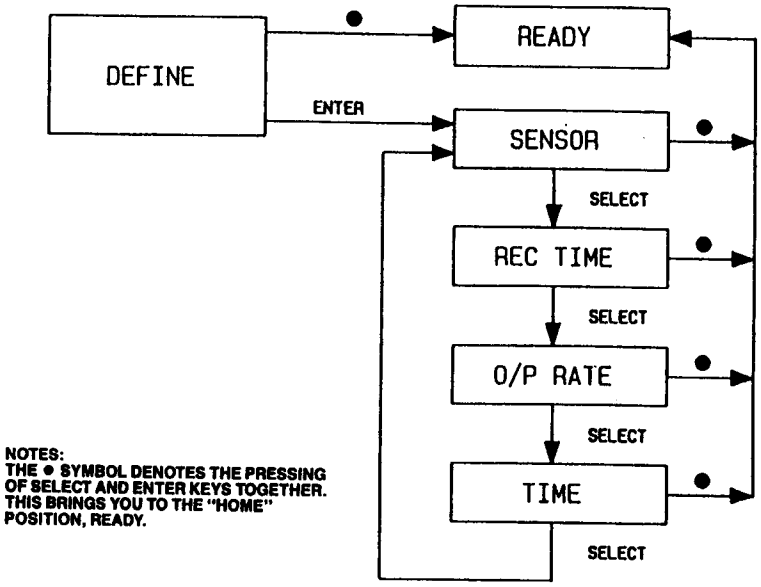


Figure 3-3. The Define Menu Selections

3.5.1 The SENSOR Sub-Menu—Selecting Type of Sensor

Before each recording session, you should enter the sensor type for each active channel (1 through 4). The appropriate sensor characteristics are then selected from a library in the OM-160 Data Logger Memory.

Figure 3-4 is the selection flow diagram for the SENSOR sub-menu. It shows the direction of movement through the menu. Each block you see is a major selection you can make.

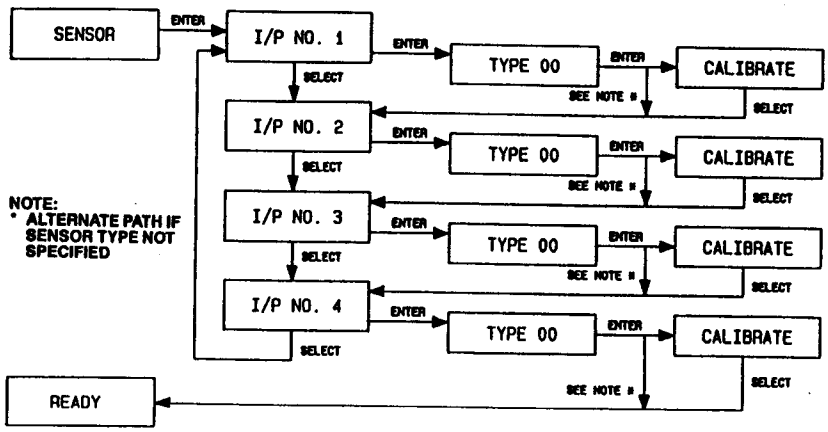


Figure 3-4. SENSOR Sub-Menu Selections

Use the SELECT and ENTER keys as directed, and increment the sub-menu as follows:

1. Select SENSOR from the DEFINE Menu; the readout shows a flashing SENSOR.
2. Press ENTER key; the readout shows a flashing I/P NO. 1.
3. Press SELECT key; the readout shows a flashing I/P NO. 2.
4. Press SELECT key; the readout shows a flashing I/P NO. 3.
5. Press SELECT key; the readout shows a flashing I/P NO. 4.
6. Press SELECT key; the readout shows a flashing I/P NO. 1.

Note that in step 6 you returned automatically to I/P NO 1 (channel no. 1). This permits you to recycle through the channel selections, if desired. Repeat steps 1 through 6 until you are familiar with selecting channels.

We will now proceed to assign a sensor type for each of the four channels, starting with channel no. 1.

NOTE

Only those sensor types listed in paragraph 6.1 Specifications, Table 6-1, are valid entries.

For sensor type selection, use the SELECT and ENTER keys as follows:

1. Press SELECT key until readout shows a flashing I/P NO. 1.
2. Press ENTER key; the readout shows TYPE 00, with the tens digit flashing.
3. Set tens digit (0-9) with SELECT key; confirm tens digit with ENTER key; tens digit stops flashing; units digit flashes.
4. Set units digit (0-9) with SELECT key; confirm with ENTER key; both digits flash.
5. Execute two-digit type selection by pressing ENTER; readout shows flashing CALIBRATE.

NOTE

At this point, you can select either the internal calibration or an external calibration. We will select the internal calibration, as this is the most often used. External calibration is described in paragraph 3.10 through 3.10.2.

6. Accept internal CALIBRATE by pressing SELECT key; readout shows flashing I/P NO. 2.
7. Repeat steps 2 through 6 above for channels 2, 3, and 4.

3.5.2 The REC TIME Sub-Menu—Setting the Record Time

Before each recording session, you may enter the recording time duration of the session in days, hours, minutes, and seconds. If you choose not to set a record session time, the OM-160 Data Logger will default to one hour. Figure 3-5 is the selection flow diagram for the REC TIME sub-menu. It shows the direction of movement through the menu. Each block you see is a selection you must make.

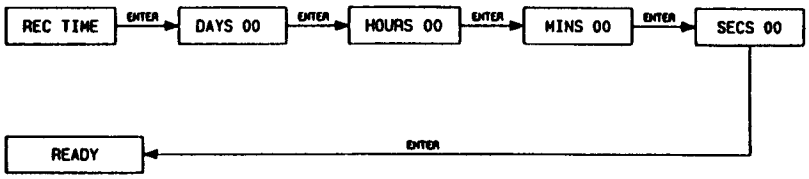


Figure 3-5. REC TIME Sub-Menu Selections

To start the record time setup procedure, use the SELECT and ENTER keys as directed, and increment the sub-menu as follows:

1. Select REC TIME from the DEFINE Menu; the readout shows a flashing REC TIME.
2. Press ENTER key; the readout shows DAYS 00, with the tens digit flashing.
3. Set tens digit (0-9) with SELECT; confirm tens digit with ENTER; tens digit stops flashing; units digit flashes.
4. Set units digit (0-9) with SELECT; confirm with ENTER; both digits flash.
5. Execute two-digit days selection by pressing ENTER; readout shows HOURS 01, with the tens digit flashing.
6. Set tens digit (0-9) with SELECT; confirm tens digit with ENTER; tens digit stops flashing; units digit flashes.
7. Set units digit (0-9) with SELECT; confirm with ENTER; both digits flash.
8. Execute two-digit hours selection by pressing ENTER; readout shows MINS 00, with tens digit flashing.
9. Set tens digit (0-9) with SELECT; confirm tens digit with ENTER; tens digit stops flashing; units digit flashes.
10. Set units digit (0-9) with SELECT; confirm with ENTER; both digits flash.
11. Execute two-digit minutes selection by pressing ENTER; readout shows SECS 00, with tens digit flashing.
12. Set tens digit (0-9) with SELECT; confirm tens digit with ENTER; tens digit stops flashing; units digit flashes.

13. Set units digit (0-9) with SELECT; confirm with ENTER; both digits flash.
14. Execute two-digit seconds selection by pressing ENTER; readout returns to flashing READY.

You have now set the duration of the data recording session in terms of days, hours, minutes, and seconds. Repeat steps 1 through 14 until you are familiar with setting the record time.

3.5.3 O/P RATE Sub-Menu—Setting the Output Data Rate

Before each recording session, you have the option to enter the baud (BD) rate for data transmission to the PC. You can select either 9600 BD, 4800 BD, 1200 BD, or 300 BD. If you do not specify a baud rate, the rate will default to 9600 BD.

Figure 3-6 is the selection flow diagram for the O/P RATE sub-menu. It shows the direction of movement through the menu. Each block you see is a selection you can make.

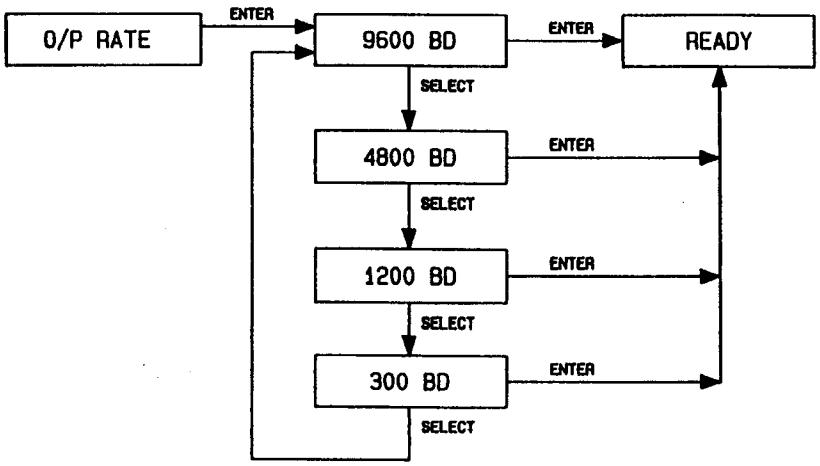


Figure 3-6. O/P RATE Sub-Menu Selections

To start the data rate setup procedure, use the SELECT and ENTER keys as directed, and increment the sub-menu as follows:

1. Select O/P RATE from the DEFINE Menu; the readout shows a flashing O/P RATE.
2. Press ENTER key; the readout shows a flashing 9600 BD.
3. Press SELECT key; the readout shows a flashing 4800 BD.

4. Press SELECT key; the readout shows a flashing 1200 BD.
5. Press SELECT key; the readout shows a flashing 300 BD.
6. Press SELECT key; the readout shows a flashing 9600 BD.

You have now moved through the data rate selections of the O/P RATE sub-menu. In steps 2 through 5 above, if you want to execute your selected data rate, simply press the ENTER key; the readout will show a flashing READY.

NOTE

If you select any data rate other than 9600 BD, you must set the computer to the same rate. Both the OM-160 Data Logger and the Software Application Program default to 9600 BD.

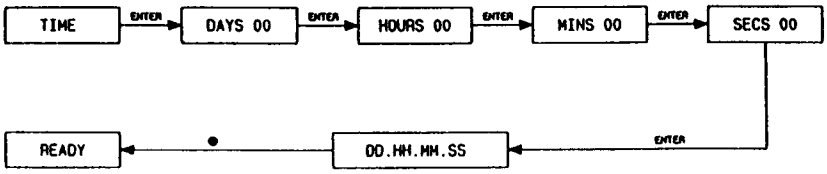
You should now repeat the procedure until you are familiar with the selections available in the O/P RATE sub-menu.

3.5.4 The TIME Sub-Menu—Setting the Time of Day

Before each recording session, you may enter the time of day in hours, minutes, and seconds. This provides the time reference for the internal system clock. Also, a day reference setting is permitted. From the day reference setting, the system clock accumulates day counts over the period of the recording session.

Time is entered as a 24-hour value (military time). The clock functions as a real-time indicator, including the date of the month (up to 31 days); thereafter, it displays elapsed time, for example: 31.23:59:59 goes to 32.00:00:00 .

Figure 3-7 is the selection flow diagram for the TIME sub-menu. It shows the direction of movement through the menu. Each block you see is a selection you can make.



NOTES:
THE ● SYMBOL DENOTES THE PRESSING OF SELECT AND ENTER KEYS TOGETHER. THIS BRINGS YOU TO THE "HOME" POSITION, READY.

Figure 3-7. TIME Sub-Menu Selections

To start the time-of-day setup procedure, use the SELECT and ENTER keys, and increment the sub-menu as follows:

1. Select TIME from the DEFINE Menu; the readout shows a flashing TIME.
2. Press ENTER key; the readout shows DAYS 00, with the tens digit flashing.

NOTE

This setting may be left at "00" if only accumulated days are desired, or it may be set at a specific value for date reference.

3. Set tens digit (0-9) with SELECT; confirm tens digit with ENTER; tens digit stops flashing; units digit flashes.
4. Set units digit (0-9) with SELECT; confirm with ENTER; both digits flash.
5. Execute two-digit days selection by pressing ENTER; readout shows HOURS 00, with the tens digit flashing.
6. Set tens digit (0-9) with SELECT; confirm tens digit with ENTER; tens digit stops flashing; units digit flashes.
7. Set units digit (0-9) with SELECT; confirm with ENTER; both digits flash.
8. Execute two-digit hours selection by pressing ENTER; readout shows MINS 00, with tens digit flashing.
9. Set tens digit (0-9) with SELECT; confirm tens digit with ENTER; tens digit stops flashing; units digit flashes.
10. Set units digit (0-9) with SELECT; confirm with ENTER; both digits flash.
11. Execute two-digit minutes selection by pressing ENTER; readout shows SECS 00, with tens digit flashing.
12. Set tens digit (0-9) with SELECT; confirm tens digit with ENTER; tens digit stops flashing; units digit flashes.
13. Set units digits (0-9) with SELECT; confirm with ENTER; both digits flash.
14. Execute two-digit seconds selection by pressing ENTER; readout shows the selected value: DD.HH.MM.SS (real time or elapsed time).
15. Press SELECT and ENTER keys together; readout shows flashing READY.

You have now set the time-of-day reference for the data recording session in terms of days, hours, minutes, and seconds. The OM-160 Data Logger will automatically increment the time of day as long as power is applied. Repeat steps 1 through 15 until you are familiar with setting the time of day.

3.6 THE DISPLAY MENU

Figure 3-8 is the selection flow diagram for the Display Menu. It shows the direction of movement through the menu. Each block you see is a function you can select for display on the OM-160 readout.

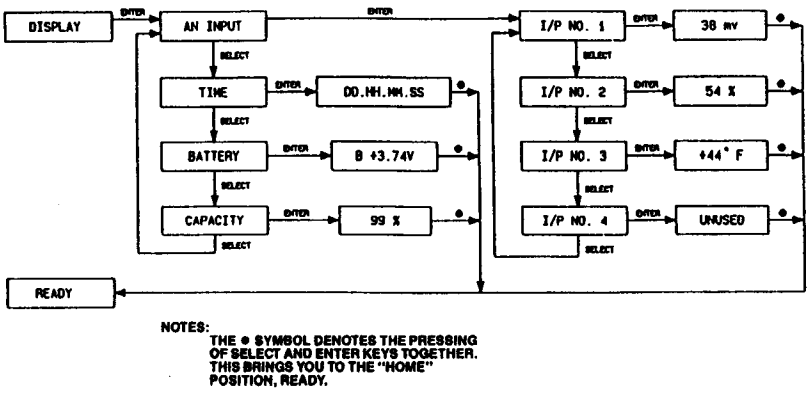


Figure 3-8. The DISPLAY Menu Selections

Use the SELECT and ENTER keys as directed, and increment the Display Menu as follows:

1. Select DISPLAY from the Main Menu; the readout shows a flashing DISPLAY.
2. Press ENTER key; the readout shows a flashing AN INPUT.
3. Press SELECT key; the readout shows a flashing TIME.
4. Press SELECT key; the readout shows a flashing BATTERY.
5. Press SELECT key; the readout shows a flashing CAPACITY.
6. Press SELECT key; the readout shows a flashing AN INPUT.

You have now moved through the four major selections of the Display Menu. Repeat steps 1 through 6 until you are familiar with the selections available in the Display Menu.

We can now proceed to examine the Display Menu by looking at each of its selections (sub-menus), AN INPUT, TIME, BATTERY, and CAPACITY.

3.6.1 AN INPUT—Display the Analog Input

The AN INPUT function allows you to display the real-time value of the input signals. Use the SELECT and ENTER keys as directed, and increment the sub-menu as follows:

1. Select AN INPUT from the DISPLAY Menu; the readout shows a flashing AN INPUT.
2. Press ENTER key; the readout shows a flashing I/P NO. 1.
3. Press SELECT key; the readout shows a flashing I/P NO. 2.
4. Press SELECT key; the readout shows a flashing I/P NO. 3.
5. Press SELECT key; the readout shows a flashing I/P NO. 4.
6. Press SELECT key; the readout shows a flashing I/P NO. 1.

You have now moved through the four channels of the AN INPUT sub-menu. Repeat steps 1 through 6 until you are familiar with data channel selection.

Figure 3-8 shows typical readouts you can expect on the four channels. Note that channel 1 (I/P NO 1) displays a value of 38 mV, representing a millivolt input; channel 2 (I/P NO 2) displays a value of 54%, representing a 4-20 mA current input (on a percent basis); channel 3 (I/P NO 3) displays a value of +44°F, representing a temperature input. The readout, UNUSED, on channel 4 indicates that the channel 4 sensor type was not specified under the Define Menu, thereby making this channel inactive for display purposes.

NOTE

Once a channel value is on display, you must press the SELECT and ENTER keys together to return to READY.

3.6.2 TIME—Display the Time

The TIME function allows you to display the time of day and the accumulated days of a recording session. Refer to Figure 3-8, and make selections as follows:

1. Select TIME from the DISPLAY Menu; the readout shows a flashing TIME.
2. Press ENTER key; the readout shows, in order from left to right, the accumulated days, hours, minutes, seconds.

NOTE

Once the time is on display, you must press the SELECT and ENTER keys together to return to READY.

3.6.3 BATTERY—Display the Battery Charge Status

The BATTERY function allows you to evaluate the charge status of the OM-160 Data Logger battery system by displaying its terminal voltage. Refer to Figure 3-8, and make selections as follows:

1. Select Battery from the DISPLAY Menu; the readout shows a flashing BATTERY.

2. Press ENTER key; the readout shows the terminal voltage of the battery system. A typical value of B +3.74 V is shown.

NOTE

The operable range of the battery is between +3.64 V and +4.20 V. The battery should be charged immediately if it is 3.62 V or less. Once the battery voltage is on display, you must press the SELECT and ENTER keys together to return to READY.

The internal battery is rechargeable through the OUTPUT/RECHARGE receptacle located on the top of the OM-160. Figure 3-9 shows how the battery charger is connected. It takes 16 hours to bring the OM-160 from a 100% discharged condition to a fully-charged condition.

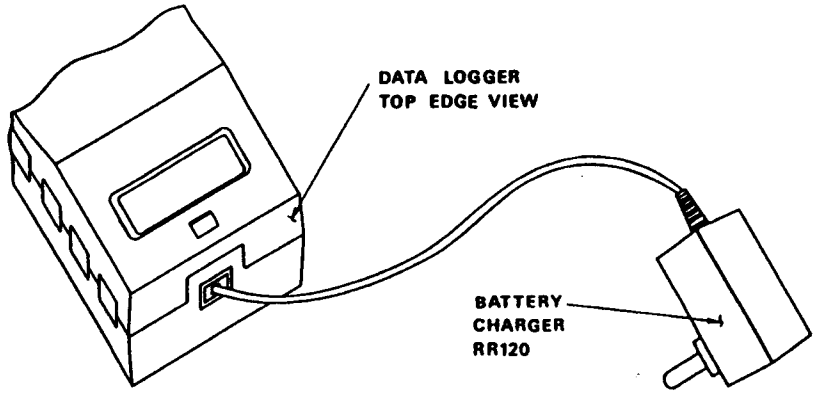


Figure 3-9. Battery Charger Connected to Data Logger Unit

3.6.4 CAPACITY—Display Unused Memory Capacity

The CAPACITY function allows you to display the remaining available memory capacity of the OM-160 Data Logger in percent (from 0 to 100%). Refer to Figure 3-8, and make selections as follows:

1. Select CAPACITY from the DISPLAY Menu; the readout shows a flashing CAPACITY.
2. Press ENTER key; the readout shows the memory capacity. A value between 0 and 100% will be shown, indicating the amount of memory still available for recording.

NOTE

Once the memory capacity is on display, you must press the SELECT and ENTER keys together to return to READY.

3.7 THE RECORD MENU

The Record Menu permits you to start, event mark, end, interrupt, display, re-start, and erase data recordings. Figure 3-10 is the selection flow diagram for the Record Menu. It shows the direction of movement through the menu using the SELECT and ENTER keys. Each block you see is a record function you can select. The symbols are described as they apply in these procedures.

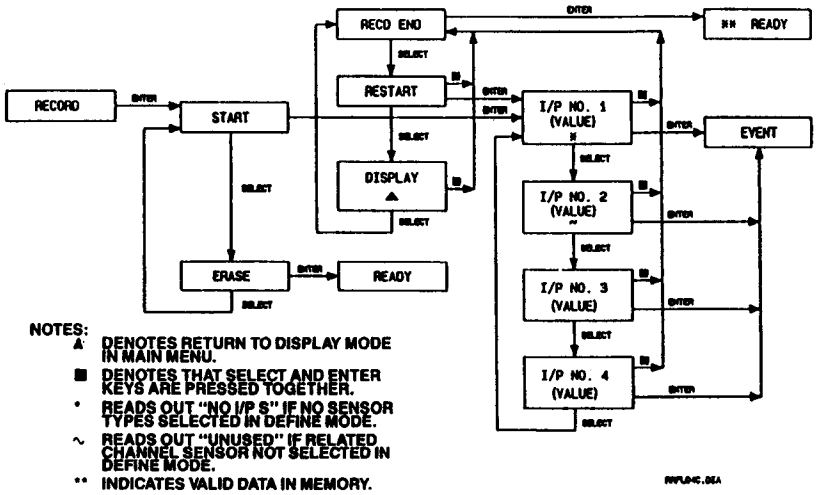


Figure 3-10. The RECORD Menu Selections

There are six functions that may be selected via the Record Menu: start, display, event marking, record ending, re-start, and erase. Each function is demonstrated in turn, in paragraphs 3.7.1 through 3.7.7. It is suggested that you follow the procedure in the given order for best results.

3.7.1 Starting the Record Session

Before starting a recording session, take note of the printed Menu Tree on the back of the OM-160. The settings you see printed in red must be made before you can make a recording.

NOTE

SPECIFY THE SENSOR TYPE: If you fail to specify at least one channel sensor type, the readout will show a flashing NO I/P S, which indicates that no input sensor has been defined. Therefore, you will not be able to record.

If you want to re-define a channel from active status to inactive, simply define the sensor type as TYPE 00.

For this exercise, the minimum requirement is that you specify the sensor type for at least one channel. For demonstration purposes, let's specify sensor Type 15 (MOD-15, thermocouple, −4181 to +2500°F) for channel 1. To do this, you must return to the DEFINE Menu and follow the instructions given in paragraph 3.5.1.

NOTE

Before starting a record session, make sure that the battery is fully charged.

To start a record session, use the SELECT and ENTER keys as directed, and increment the menu as follows:

1. Select RECORD from the Main Menu; the readout shows a flashing RECORD.
2. Press ENTER key; the readout shows a flashing START.
3. Press ENTER key; the readout shows a flashing R (Record) and value.

You have now started to record the data on channel 1. If you had specified sensor types for channels 2 through 4, they also would be recording now.

WARNING

Once you start a record session, DO NOT power down the OM-160 Data Logger until you finish playback, or YOU WILL LOSE YOUR RECORDED DATA AND YOUR DEFINE SETTINGS FROM MEMORY. The power switch is recessed to avoid this possibility.

3.7.2 Displaying Channel Values While Recording

To view the data being recorded on each of the four channels, proceed as follows:

NOTE

Steps 1-4 below assume that you have started a record session as previously described.

1. Press the SELECT key; the readout shows a steady-state UNUSED on I/P NO 2 (channel 2).
2. Press the SELECT key; the readout shows a steady-state UNUSED on I/P NO 3 (channel 3).
3. Press the SELECT key; the readout shows a steady-state UNUSED on I/P NO 4 (channel 4).
4. Press the SELECT key; the readout shows a flashing indication of a changing value on I/P NO 1 (channel 1), as previously described in paragraph 3.7.1.

You have now moved through all four channels of the value display mode. Repeat steps 1 through 4 until you are familiar with the sequence.

3.7.3 Placing an Event Marker on Recording

To place an event marker on the recorded data, press the ENTER key; the readout will momentarily show EVENT, then return to the channel display value. If you were recording all four channels, the event marker would be simultaneously placed on each channel.

You can now choose to either interrupt or end the recording session.

3.7.4 Interrupting the Record Session

At this point, you are still in the record session; the readout displays a channel value. To interrupt the record session, press the SELECT and ENTER keys together; the readout shows a flashing RECD END. From this point in the menu, you can re-start the recording session, enter the DISPLAY Mode, or end the recording session.

3.7.5 Re-Starting the Record Session

You can re-start a session when the readout shows a flashing RECD END, by simply pressing the SELECT key. The readout now shows a flashing RE-START. Pressing the ENTER key re-starts the session.

3.7.6 Return to the Display Mode

The RE-START Mode has an added feature which permits you to return to the Main Menu DISPLAY Mode while a recording is interrupted. This mode permits you to display the system status of AN INPUT, TIME, BATTERY, and CAPACITY. You can return to DISPLAY by pressing the SELECT key; the readout shows a flashing DISPLAY. You can now use the DISPLAY Menu as previously described by pressing the ENTER key.

NOTE

To return from the DISPLAY Mode, press the SELECT and ENTER keys together. You will then return to a flashing RECD END. See Figure 3-10 for the path.

3.7.7 Ending the Record Session

Proceed as follows:

1. Simultaneously press the SELECT and ENTER keys together; the readout shows a flashing RECD END.

   NOTE

   The square-shaped symbol on Figure 3-10 shows the points on the Record Menu where the recording may be terminated by pressing the SELECT and ENTER keys together.

2. Press the ENTER key; the readout will show a flashing * *READY. The double asterisk in the display indicates that data is stored in memory.

You have now terminated the recording session on all channels. You cannot re-start the recording from this point. The session is over. The only way to re-start is to initiate a new record session by returning to the RECORD Mode. All previously defined parameters will apply to the new session, as long as power has not been turned off. Remember, if you start another record session, you will now have two sessions in memory.

3.7.8 Erasing Recorded Data

At any time, you can erase recorded data without losing the DEFINE settings. To erase recorded data, proceed as follows:

1. Select RECORD from the Main Menu; the readout shows a flashing RECORD.
2. Press ENTER key; the readout shows a flashing START.
3. Press the SELECT key; the readout shows a flashing ERASE.
4. Press ENTER key; the data is erased and readout shows a flashing READY.
5. Verify that data has been erased by checking memory capacity; it should indicate 100%.

3.8 TYPICAL DATA RECORDING SESSION

A description of a typical long-term recording session is provided here. It is assumed that you have read, and understand, the structure of the Menu Tree, as previously described.

The requirements for this session are to record the measurements of: temperature, pressure, and flow for a period of 30 days.

3.8.1 Preliminary Setup

The required OM-160 system components and sensors are shown properly interconnected in Figure 3-11. Operate the system so that the Battery Charger (RR-120) is connected to a 120 Vac power source for the period of the record session. Connect the Charger (RR-120) to the Battery Pack/ Recharge Circuit (RR-130), and set the charge switch to TRICKLE. Connect the charger plug to the OM-160 Data Logger receptacle. Connect the Signal Conditioning Modules and sensors as shown.

NOTE

If the system is to be operated at a remote location (without AC power), the batteries must be charged for 20 hours prior to beginning the RECORD session. Connect RR-120 to RR-130, and set the charge switch on RR-130 to FAST. Connect the charger plug to the OM-160's receptacle. This will charge both the external battery pack and the internal batteries of the OM-160. When the 20-hour charge is complete, set the charge switch on the RR-130 to TRICKLE, and disconnect recharger RR-120.

Turn the OM-160 power switch to ON, select the DEFINE Mode, and proceed with OM-160 settings, described in paragraphs 3.8.2 through 3.8.8.

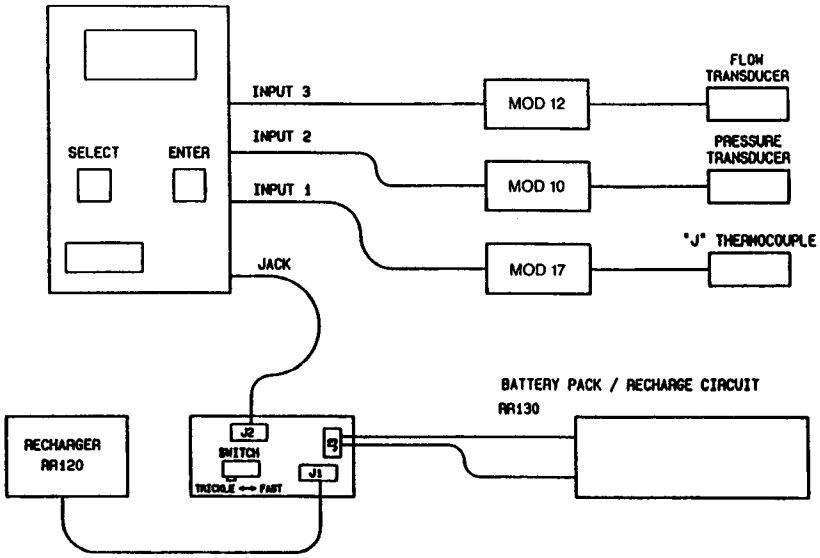


Figure 3-11. Interconnections For a Typical Long Term Record Session

3.8.2 Specify Sensors for Channels 1 Through 4

NOTE

The CALIBRATE function below may be either from the internal or an external source.

- DEFINE–SENSOR–I/P NO 1–TYPE 17–CALIBRATE
- I/P NO 2–TYPE 10–CALIBRATE
- I/P NO 3–TYPE 12–CALIBRATE
- I/P NO 4–(UNUSED)–RETURN TO READY

3.8.3 Set Up the Recording Time

- DEFINE–REC TIME–DAYS 30–HOURS 00–MIN 00–SEC 00–READY

3.8.4 Set Up the Time of Day

If elapsed time is an appropriate measurement for the session, it is not necessary to enter (define) the time of day. If real time is required, set the time of day as previously described in paragraph 3.5.4.

3.8.5 Verify Channel Inputs

Verify each channel input to assure that it is acting according to its characteristics. Select the DISPLAY Mode, AN INPUT sub-menu. You must return to READY after viewing each channel input value. Return to READY by pressing the SELECT and ENTER keys together.

3.8.6 Check Remaining Available Memory

Make a check of available OM-160 Data Logger memory for the planned session. Check memory while in the DISPLAY Mode, by selecting the CAPACITY sub-menu.

NOTE

For each new record session, you may wish to use the full memory capacity. Only then can you take advantage of the maximum STORE capability of the Data Logger. It is acceptable, however, to record with less than 100% of memory available.

3.8.7 Start the Record Session

NOTE

If you need to erase data in memory, do it now.

Select the RECORD Mode, and proceed as follows:

RECORD–ENTER–START–ENTER (AN INPUT VALUE)–SELECT

NOTE

You have now commenced a record session. An event may be marked manually on all active channels by pressing the ENTER key.

- I/P NO 2 (AN INPUT VALUE)–SELECT
- I/P NO 3 (AN INPUT VALUE)–SELECT
- I/P NO 4 (UNUSED)–SELECT

At any time during the recording session, you may view the status of elapsed TIME, BATTERY charge, and CAPACITY of remaining memory. The record session will be interrupted for the duration of this viewing time. The record session may be resumed by initiating RE-START.

3.8.8 Terminate the Record Session

At the end of the recording, the session is terminated by executing a RECD END, as follows:

1. Press the SELECT and ENTER keys together; the readout shows a flashing RECD END.
2. Press the ENTER key; the readout shows a flashing **READY. The double asterisk indicates that data is in memory.

WARNING

DO NOT power down the Data Logger until you finish playback, or YOU WILL LOSE YOUR RECORDED DATA AND YOUR DEFINE SETTINGS FROM MEMORY! Also, make sure that the Battery Charge is sufficient to retain data in memory until it is transferred to your PC. If internal battery discharges below 3.62 V, re-charge it immediately.

The OM-160 Data Logger may now be transported to the computer site. Disconnect the Battery Pack (RR-130) from the OM-160. Disconnect all channel input cables, and dismount the unit from the wall plate.

A record session that would record data for one to several hours, could use the same system components as shown in Figure 2-11, except for Modules and sensors.

3.8.9 I/O Port Pin Assignment

PIN	FUNCTION	TO PC, 25 PIN
1	"Select" Button	
2	Ground	7
3	DTR	20
4	Data	3
5	+V Charger Input	
6	"Enter" Button	4.7k → 2

NOTE

To drive the ENTER and SELECT functions remotely, pulses must be at least 20ms long and spaced more than 20ms apart, triggered on the leading edge. These connections are made directly into a CMOS circuitry and should not exceed 3VDC.

If the requirements were to record a short term session of two RTD channels, one event relay, and one pluse counter for a period of eight hours, the minimum necessary OM-160 System components are shown in Figure 3-14. The battery voltage in the Data Logger should be checked to insure that the batteries are suffieciently charged. If not, connect the Battery Charger (RR-120) into the I/O receptacle at the top of the Data Logger. Charge the batteries for 16 hours prior to test.

3.9 THE PLAYBACK MENU

In a typical work situation, the OM-160 Data Logger is physically removed from the data collection site and transported to a computer site while still under battery power. It is then cable-connected to the Personal Computer for the Playback operational phase through a serial I/O Port on the computer.

The Playback Menu permits you to transfer your recorded data from the OM-160 Data Logger to your PC. Playback permits all recording sessions to be loaded into computer memory in the form of raw data for filing, review, analysis, and printout.

The Playback operation of the OM-160 is coordinated between the Data Logger and the Personal Computer, driven by the Software Application Program. Figure 3-12 shows a block diagram of the Playback function.

Figure 3-12. Playback Selection

3.9.1 Connections for Playback

As previously described, we must interconnect the OM-160 Data Logger with the Personal Computer to demonstrate the software portion of the playback function. This is an appropriate point in the discussion to make the connection. Refer to Figure 3-13, and connect the Computer Serial Interface Cable (RR-101) between the Data Logger port, "OUTPUT/RECHARGE" and the computer serial I/O port. You can now proceed to Section 4, Installing the Software Application Program.

3.9.2 Starting Playback

You can now start playback. Use the SELECT and ENTER keys as required, and increment the menu as follows:

1. Select PLAYBACK from the Main Menu; the readout shows a flashing PLAYBACK.
2. Press ENTER key; the readout shows a steady-state PLAYBACK (stops flashing).
3. When computer acknowledges data transmission, the display on the Data Logger begins to ripple indicating that data is being transmitted.
4. Display returns to READY upon completing playback.

You have now performed the procedure for sending the collected data in the OM-160 memory to the PC. If the computer is not connected, the OM-160 will stay in a "wait" condition (readout shows a steady-state PLAYBACK).

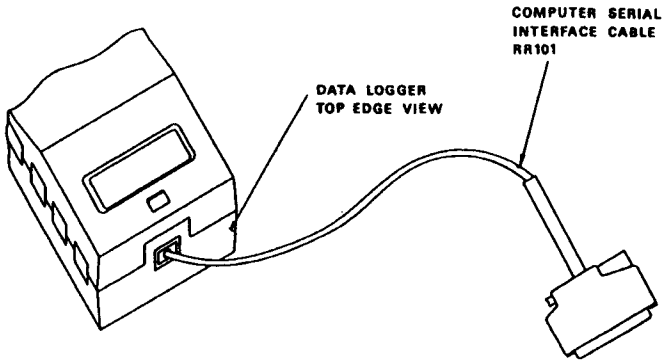


Figure 3-13. Connections For Playback

3.10 TYPICAL EXTERNAL CALIBRATION PROCEDURES

There may be two reasons for performing an external calibration. The first is to insure that the OM-160 is set by two known calibration standards if this is normal operating procedure. The second is to set a range that represents functional values rather than actual sensor values. Figure 3-14 shows the setup for a typical external calibration procedure.

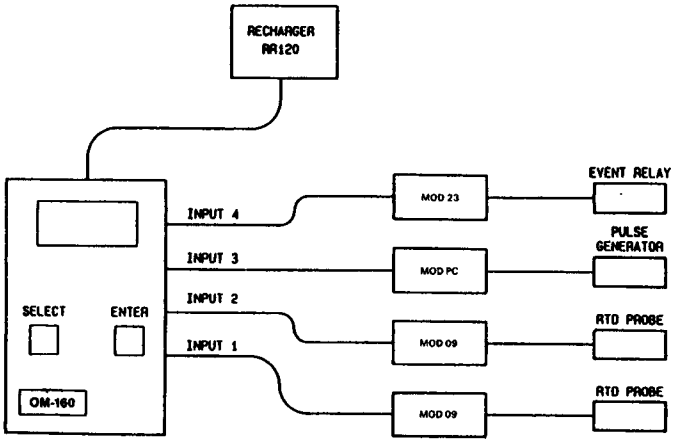


Figure 3-14. Setup For External Calibration

3.10.1 Two-Point Calibration

External calibration requires that the transducer/sensor be the source of the standard input into the system (i.e., a thermistor probe in an ice bath for POINT 1 setting of calibration, and the thermistor probe in boiling water for POINT 2 setting of calibration.) The same procedure applies for voltage standards or current standards. It should be noted that reversing the input standards for POINT 1 and POINT 2 are acceptable to the OM-160 Data Logger.

The external calibration is performed in the following manner. Define the sensor I/P No required and the TYPE required. When CALIBRATE is displayed on the LCD, press the ENTER key; POINT 1 will be displayed. Allow reading of the first reference input to be displayed on the LCD prefixed by a flashing C (CALIBRATE). When the reference input is stable, press the ENTER key again. The display will then read P1 followed by a fixed reading of the input reference. Using the SELECT and ENTER keys, set the fixed reading to the actual reference input. When this is entered, the LCD will display POINT 2. The display will then show some input reading preceded by a flashing C. The second reference should be input before proceeding. When this input reference is stabilized, press the ENTER key; the display will show P2 followed by a fixed reading of this input reference. Using the SELECT and ENTER keys, set the fixed reading to the actual input reference. When this is entered, the OM-160 Data Logger will advance to the next input to be defined or to READY if I/P NO 4 was last defined.

3.10.2 Changing the Data Logger Scale

External calibration for the purpose of setting a range that represents a functional scale rather than an actual sensor value is done in the same manner as setting calibration to known standards, except values are selected and entered that represent the functional scale. A typical example is a measurement of pressure using a transducer having a range of 20 psi to 200 psi and an output of 4 to 20 mA. This transducer would be used with a Module Type 10 (MOD-10) plugged into the Data Logger. The OM-160 will display 4 to 20 mA as 0 to 100%. The external calibration is performed in the following manner.

Define the SENSOR I/P NO required and define TYPE 10. When CALIBRATE is displayed on the LCD, press the ENTER key; POINT 1 will be displayed. Set input from the transducer to be 4 mA (20 psi). The display should show a flashing C followed by a reading of +0.0%. Press the ENTER key and the display should read P1 +000.0. Using the SELECT and ENTER keys, set the fixed reading to +020.0 and enter this value. Set input from the transducer to be 20 mA (200 psi). The display should show a flashing C followed by a reading of +100.0%. Press the ENTER key and the display should read P2 +100.0.

Using the SELECT and ENTER keys, set the fixed reading to +200.0 and enter this value. When this is entered, the Data Logger will return to the next input to be defined or to READY. The values entered will DISPLAY and RECORD as 20% to 200% for an input of 4 to 20 mA. When this RECORD is graphed using the Application Software, the range displayed will be 20 to 200%, relating to the actual functional psi measurement that was recorded. Further Applications Software will allow changing the scale units from % to psi for the final true representation of the measurement recorded.

3.10.3 Analog Input Connector Configuration

Refer to Section 8.5 for details.

3.10.4 Single Point Calibration

The single point calibration feature may be used in those instances when it is necessary to offset the data logger by a constant value. This may be required if the sensor used is known to have some constant error; or if it is desired that the data logger agrees with the readings of some other device in the system.

In the first case, single point calibration can be employed to correct for the error the sensor by offsetting the data logger by the amount of the error at a given reference point.

An example of the second case would be where temperature is being recorded on a system where a temperature controller is also being used. If it were required, the data logger could be offset so that its readings matched those of the controller by using point calibration to change the data logger display to agree with the controller.

The single-point calibration is performed as follows:

1. Define the sensor I/P No. and TYPE required.
2. When "CALIBRATE" is displayed, press the ENTER key. POINT 1 will flash momentarily, followed by a flashing C and some value for the particular sensor being used.
3. When the reading has stabilized, press ENTER. The display will read P1, and a value (i.e. P1 + 0.185). The sign will be flashing indicating that it is the character to be changed or accessed first.
4. Use the SELECT key to change this value, digit by digit. The ENTER key will allow acceptance of each digit and advancement to the next digit. The flashing digit is the one that will be changed by the SELECT key.
5. After the display has been corrected to correct the offset or bring the display into agreement, digits will flash. If any further changes are needed, press SELECT to change the value digit by digit again or press ENTER to accept the value.
6. The display will then read POINT 2.
7. Press SELECT to complete single-point calibration and go on to define the next I/P No.

3.10.5 Data Logger Display Messages

INVALID — This message appears in the display during the external calibration process when the two calibration points selected are too close together for proper calculation or if the scale selected represents a change that is either greater than two times the original or less than one half of the original. For example, MOD-10 has a predetermined scale of 0-100%, any recalibration above 200 or below 50 for full scale values will cause an invalid message to appear.

NO STORE — This message appears in the display of the Data Logger during an active recording session if 100% of the memory is used. All data in memory is valid. No new data is accepted beyond that point in time. To retrieve the data in memory proceed to Section 3.8.8, terminating the Recording Session.

NO I/P S — This message appears in the record mode when a recording session is attempted with no input sensor types defined for any channel. To start a valid recording session, at least one channel must have a defined sensor type. See the paragraph 3.5 Define Menu.

UNUSED — This message appears in both the record mode and the display mode whenever an inactive channel is called up to be displayed.

CAL FAIL — This message will be displayed upon power up if the microprocessor within the Data Logger is unable to complete its internal calibration. This could be a result of a low battery or a defective component. Recharge the unit, and if the message appears after a full recharge, contact the OMEGA Customer Service Department at (203) 359-1660.

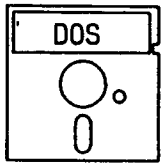
SECTION 4 INSTALLING THE SOFTWARE APPLICATION PROGRAM

The information contained in this section is provided primarily to guide you in getting the Software Application Program up and running for both two-drive and hard-disk computer systems. For best results, it is recommended that you follow the procedures in the order of their presentation.

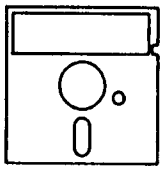
4.1 MAKING A BACK-UP COPY OF THE SOFTWARE MASTER DISK

All data stored on disks are subject to inadvertent loss from various incontrollable and unpredictable causes. The loss of your application program is, therefore, always a possibility. The best protection against such a loss is to make a back-up copy of your MASTER DISK right away.

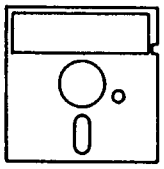
The back-up copy you make here will be used to create a self-booting Software WORKING DISK to operate a two-drive system. You will also use this disk to permanently install the Software Application Program onto a hard-disk system. The procedure below describes how to make an exact duplicate of your Software Application Program MASTER DISK for these purposes.



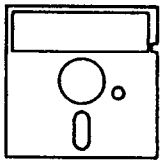
A DOS (Disk Operating System) Disk—MS DOS or PC DOS



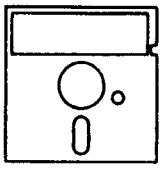
The Software Application Program Disk



A double-sided, double-density blank disk to make a Software Application Program DATA DISK for storing data in a two-drive system



A double-sided, double-density blank disk to make a self-booting Software Application Program WORKING DISK



A double-sided, double-density blank disk to make a back-up copy of the Software Application Program MASTER DISK

Figure 4-1. What You Need for Installation

Refer to Figure 4-1 and select one of the double-sided, double-density blank disks, and proceed with duplication, as follows:

1. Insert your DOS Disk into drive A:, and close the drive door. "Boot" the system.
2. At the A Prompt (A>), type: **diskcopy a: b:**
3. Press the Return key.
4. Remove the DOS disk from drive A:, and insert the Software MASTER DISK in its place. Insert a blank disk in drive B:. Close the drive doors. Press any key.
5. When DOS asks if you want to make any more copies, type: **n**. When DOS displays the A> again, the duplication of your MASTER DISK is complete.
6. Remove the MASTER DISK from drive A:, and store it away in a safe place.
7. Remove the disk from drive B: and lable the disk, Software Application Program BACK-UP DISK.

4.2 INSTALLING THE SOFTWARE APPLICATION PROGRAM FOR A TWO-DRIVE SYSTEM

There are two tasks which must be performed as part of the two-drive system installation procedure. Most important, you must make the Software Application Program "self-booting". This will permit you to load the Software directly without time consuming preliminary steps. Figure 4-1 shows the disks you will need. Perform these tasks in the following order:

1. Make a self-booting Software Application Program WORKING DISK (refer to paragraph 4.2.1).
2. Make a data disk from a blank disk (refer to paragraph 4.2.2).

In a two-drive system, you can choose either to operate entirely from your Software Application Program WORKING DISK, or place your data on a separate data disk. A separate data disk offers the advantage of increased storage space for your data, and independent mobility of your files.

4.2.1 Make a Self-Booting Software Application Program Working Disk

For this purpose, we will use one of the double-density, double-sided blank disks. To be self-booting and fully operable, this blank disk must have the following files installed on it:

1. The COMMAND.COM file from your DOS disk.
2. All files from your Software Application BACK-UP Disk.

Select one of your blank disks, and proceed with installation, as follows:

1. Insert your DOS Disk into drive A:, and close the drive door. "Boot" the system.
2. At the A>, type: **format b:/s**
3. Press the Return key.

4. Follow the DOS instructions displayed on the screen. Insert new blank disk in drive B. When DOS asks if you want to format another disk, type: **n**. When DOS displays the A> again, the formatting of your blank disk is complete, and the COMMAND.COM file is installed.
5. Remove the DOS disk from drive A, and insert your Software Application BACK-UP Disk in its place.
6. At the A>, type: **copy a:*.* b:**
7. Press the Return key.
8. When DOS displays the A> again, the installation of the Application Program files has been completed.
9. Remove the BACK-UP Disk from drive A, and store it out of the way in a safe place.
10. Remove the disk from drive B: and lable it Software Application Program WORKING DISK.

4.2.2 Making a Data Disk

You will need a separate Data Disk to store the raw or processed data you generate in the course of operating the Software Application Program using a two-drive system. The data disk must be formatted before you can use it.

Select one of your double-sided, double-density blank disks, and proceed with the formatting as follows:

1. With the DOS Disk in drive A, insert a blank, double-sided, double-density disk into drive B. Close the drive door.
2. At the A>, type: **format b:**
3. Press the Return key.
4. Follow the DOS instructions displayed on the screen. When DOS asks if you want to format another disk, type: **n**. When DOS displays the A> again, the formatting of your blank disk is complete.
5. Remove the disk from drive B, and lable it, Software Application Program DATA DISK.
6. This will be the disk you use each time you wish to save your raw or processed data.

4.3 INSTALLING THE SOFTWARE APPLICATION PROGRAM ON A HARD-DISK SYSTEM

The Applications Program may be installed on either the A drive or the hard-disk drive. Refer to paragraphs 4.3.1 and 4.3.2.

The Software Application Program Disk has a special system configuration file called CONFIG.SYS. If you already have a file with this name on your hard disk, then you may wish to install the Software Application Program on a floppy and execute this program from the A drive. If you still choose to install the Software on the hard disk, then you must have a program like EDLIN (supplied with DOS) to append the text in CONFIG.SYS to your existing CONFIG.SYSD.

4.3.1 Installation on Drive A

1. Boot up your system and insert a blank disk in drive A. Make sure your DOS files, such as FORMAT.COM are available on the hard disk. Type: **format a:/s** and press Return.
2. Remove the floppy from drive A: and insert the BACK-UP DISK in drive A. Type: **copy a:*.* b:** and follow the prompts from DOS.
3. The floppy disk that is created is your Application Software WORKING DISK. Remove this disk and lable it accordingly.

4.3.2 Installation in Drive C

1. Boot up the system and make sure you are at the root directory. Type: **CD** and press Return.
2. Insert the BACKUP DISK in drive A. Type: **copy a:config.sys c:** and press Return.
3. You should create a subdirectory for the Software program files to be placed in, on the hard disk. At the C> type: **md\ directoryname** and press Return. The directory name can be anything appropriate.
4. Now copy all the files from the BACKUP DISK into this new subdirectory. Type: **copy a:*.* c:\ directoryname** and press Return.

4.4 GETTING STARTED—LOADING THE COMPUTER

The loading procedures provided in paragraphs 4.4.1 and 4.4.2 are for two-drive and hard-disk systems, respectively.

4.4.1 Loading the Software Application Program for a Two-Drive System

In a two-drive system, you can choose either to operate entirely from your WORKING DISK, or place your data on a separate DATA DISK. A separate data disk offers the advantage of increased storage space for your data, and independent mobility of your files.

Load the Software Application Program as follows:

1. Obtain your WORKING DISK, and insert it into drive A.
2. Turn on power to the computer and all peripheral equipment. After a few seconds, the red lamp on drive A will light, followed by a screen request to enter the current date.
3. Type the date in the numerical format: **10-24-85** (month-day-year)

   NOTE

   It is advisable to enter the current date each time you "boot" the computer, as this date is automatically imprinted on the data and graphs you will produce.
4. Press the Return key on your PC keyboard. After the date, you will be requested to enter the current time.
5. Type the current time in the 24-hour format. For example: 3PM is the 15th hour. Type: **15:00:00** (hours:minutes:seconds).

6. Press the Return key. The screen will display the author of your Disk Operating System, version, and the copyright. After the message, you will see: A>. This is the "A Prompt", indicating that the computer will now accept your instructions.

NOTE

If you are running the Software Application Program for the first time, proceed to Section 6, Using the Install Program, before continuing.

7. At the A> type: **pronto**
8. Press the Return key.
9. The drive A indicator lights, followed shortly by the Software Application Program credits screen.
10. Strike any key. The program opens to the Main Menu. Follow screen instructions and prompts to further access the program functions.

4.4.2 Loading Software for a Hard-Disk System

Load the Software Application Program as follows:

1. Turn on power to the computer and all peripheral equipment. After a few seconds, the red lamp on drive C will light, followed by a screen request to enter the current date.

NOTE

It is advisable to enter the current date each time you "boot" the computer, as this date is automatically imprinted on the data and graphs you will produce.

2. Type the date in the numerical format: **10-24-85** (month-day-year)
3. Press the Return key on your PC keyboard. After the date, you will be requested to enter the current time.
4. Type the current time in the 24-hour format. For example, 3PM is the 15th hour. Type: **15:00:00** (hours:minutes:seconds).
5. Press the Return key. The screen will display the author of your Disk Operating System, version, and the copyright. After the message you will see: C>. This is the "C Prompt", indicating that the computer will now accept your instructions.

NOTE

If you are running the Software Application Program for the first time, proceed to Section 6, Using the Install Program, before continuing.

6. At the C>, type: **pronto**
7. Press the Return key.
8. The drive C: indicator lights, followed shortly by the Software Application Program credits screen.
9. Strike any key. The program opens to the Main Menu. Follow screen instructions and prompts to further access the Software Application Program functions.

4.5 THE SOFTWARE APPLICATION MASTER DISK DIRECTORY

Table 4-1 lists the directory files of the Software Application Program by name and purpose of use.

TABLE 4-1
SOFTWARE APPLICATION PROGRAM FILE DIRECTORY

FILE NAME	PURPOSE
GRAFPAR.DAT	Graph Information Data
PRONTO.EXE	Application Display Program
PRONTO.CNF	Configuration File
INSTALL.EXE	Configuration Program
CONFIG.SYS	Special System Configuration
DEMOII.LOG	A Sample File of Recorded Data

SECTION 5 INTRODUCTION TO THE SOFTWARE APPLICATION PROGRAM MENU SYSTEM

5.1 GENERAL

It is the special Software Application Program which gives the OM-160 system its powerful repertoire of operational features. The Software Application Program is contained on a Master Disk, supplied with the OM-160.

After supervising the transfer of recorded data from the OM-160's memory, the Software Application Program literally transforms the concentrated data into an expanded variety of graphic presentations for immediate CRT screen review/analysis and/or printout, or saves it on disk for later access.

The Software Application Program permits you to use an IBM or IBM-compatible personal computer to:

- Transfer and save remotely collected data from the OM-160 to computer memory
- Create, name, and describe data files
- Convert the data to graphs
- Plot graphs from raw or processed data
- Change graphs in format, size, and position
- Annotate the graphs with text/labels
- Window in and amplify sections of a graph
- Print out graphs or lists for reports
- Create compatible files for output to data base spreadsheets (i.e. Lotus 1-2-3)

To properly understand, access, and utilize the above listed capabilities of your OM-160, it is essential that you become familiar with the Software Application Program, and the system of screen menus it produces.

5.2 THE SOFTWARE MENU SYSTEM

The Software Application Program provides a series of interactive screen menus designed to be your operational interface with the computer-based features of your OM-160.

With a working knowledge of the menu system, you will be able to access the numerous data processing capabilities of the Software Application Program.

This section is organized around the two major functions of the Software Application Program:

1. The Playback/Quick Review Functions
2. The Analysis Functions

The chart in Figure 5-3 depicts the paths through the menu system for the Playback/Quick Review Function. The chart in Figure 5-6 depicts the paths through the menu system for the Analyze Function. Each block on the charts represents a separate task which may be performed. The interconnecting lines show the key you must strike to execute each of the tasks. The accompanying text provides an overview discussion of these charts, describing the path through the tasks, and the actions necessary to execute them.

NOTE

It is recommended that you now load your Software Application Program into the PC, and follow the descriptions. This will give you some valuable "hands-on" experience.

5.3 THE MAIN MENU—YOUR KEY TO ACCESS

As previously described, after loading the Application Software into the computer by typing PRONTO and pressing return, the first screen you will see is the Title Screen, which prompts you to: "Strike any key to continue...". The lower left side of the screen shows you the version of software that you have and the graphics card that the Software Application Program was installed to work with. Example: Rev. 2.10 CGA means that it is software version 2.10 and it is set up to work with a CGA (Color Graphics Adaptor). Refer to Section 6, using the Install Program to match the Software Application Program to your graphics card.

When you strike any key you will bring up the Main Menu. Figure 5-1 shows the Main Menu. This is the first point of decision in the program. As you can see, the Main Menu presents four options from which you may choose:

5.3.1 The F1 Function Key

By striking the F1 key at this point in the program, you can QUIT (exit) the program to return to DOS. Throughout the program, the F1 key will always return you to either the Main Menu or GO BACK to the previous screen.

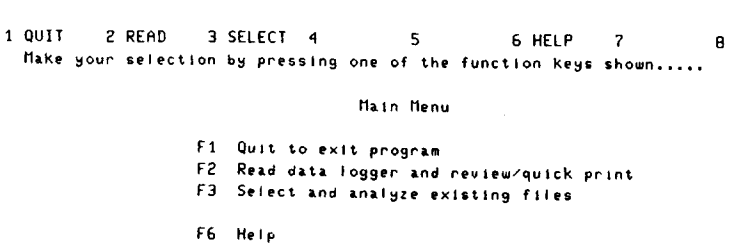


Figure 5-1. The Main Menu

5.3.2 The F2 Function Key

By striking the F2 key at this point in the program, you will enter the menu path to the PLAYBACK/QUICK REVIEW Functions of the program. This path of menu screens is discussed, with references to Figure 5-3 through 5-5.

5.3.3 The F3 Function Key

By striking the F3 key at this point in the program, you will enter the menu path to the ANALYSIS functions of the program. This path of menu screens is discussed, with references to Figure 5-6, thru 5.13.

5.3.4 The F6 Function Key

By striking the F6 key at this point in the program, you will enter the HELP screen. This screen provides instructions on the use of the function keys. It defines the keys (F1 through F8), and instructs you how to select from the choices, how to execute your selection, and how to interpret and recognize defaults and highlighted screen text. Further down the chart of Figure 4-3, the F6 key calls for a different HELP screen to aid in the playback task.

```
1 QUIT    2 READ    3 SELECT  4         5         6 HELP    7         8
  Make your selection by pressing one of the function keys shown.....

                                  Main Menu

                     F1  Quit to exit program
                     F2  Read data logger and review/quick print
                     F3  Select and analyze existing files

                     F6  Help

The function keys (F1 to F8) are shown above.  They are used to move you around
the program.  Use of these function keys is described by their labels (like
'QUIT' above), and will move you on either to the next menu (like 'READ') or
to an alternate function.  <F1> will always get you back to where you were.

You will often be required to make a choice, and a list of alternatives will be
shown with the default choice marked . (If you do not see any difference
in this text, then adjust the contrast and brightness until you do).
To change the selection, press the <SPACEBAR> until you reach the correct
choice.  Then to accept the marked choice, press <RETURN>.
Other keys are used, in particular, for entering/editing text or numbers,
and will be described as usual in the instructions at the top of the screen.

Your first four choices are shown above.
```

Figure 5-2. The Help Screen

5.4 THE PLAYBACK/QUICK REVIEW FUNCTIONS

The following is a step-by-step procedure that will take you through down loading the data from the OM-160 to the PC, creating a file, and plotting the data on the screen and the printer. Refer to Figure 5-3 during this procedure.

5.4.1 Playback Procedure

1. From the Main Menu, select Read Data Logger and Review/Quick Print by pressing F2.
2. Connect the OM-160 Data Logger to the serial port of the computer using interface cable RR-101 as described in Paragraph 3.9.1, Connections for Playback.
3. From the READY display on the OM-160, press the SELECT key until PLAYBACK is on the Display.
4. Press F2 on the PC to prepare for playback.
5. Press the ENTER key on the OM-160.
6. Playback immediately begins under computer control. The message "recorder logged on" appears on the screen and a flashing asterisk indicates that data is being transmitted. The OM-160 will automatically return to READY upon completion of playback. The computer will display a Recording Session Summary screen as shown in Figure 5-4.

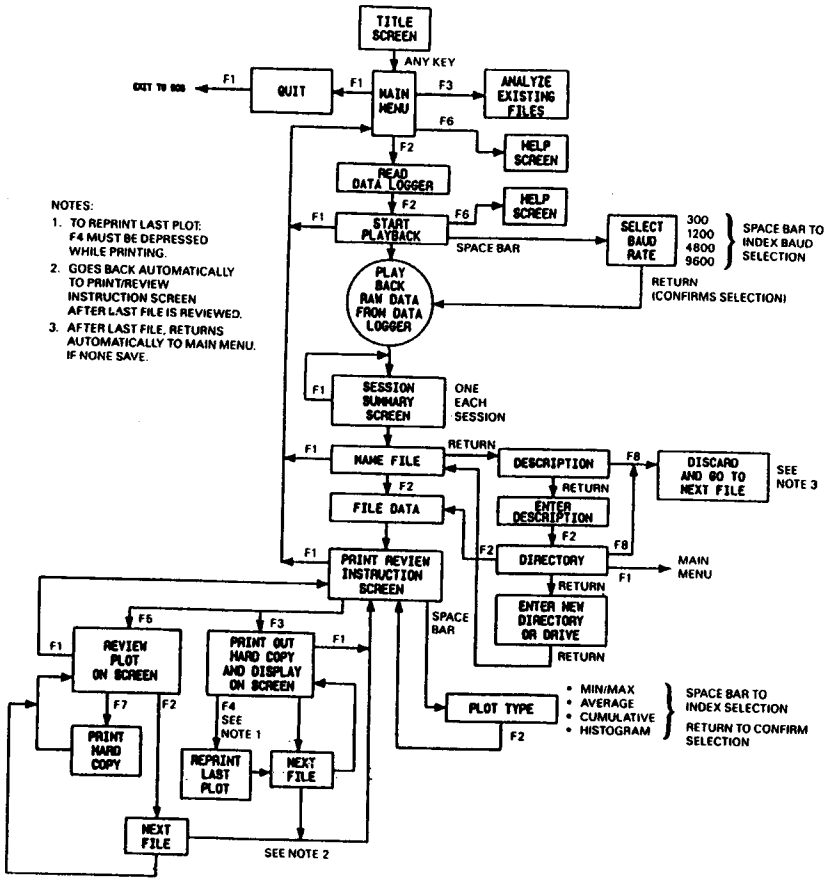


Figure 5-3. The Playback/Quick Review Functions Overall Flow Chart

```
1GO BACK  2 ACCEPT  3         4         5         6         7         8 DISCARD
<SPACEBAR> to index selection.            <RETURN> to confirm selection.
<F1> for main menu.  <F2> to store data.  <F8> to discard it.

                        Session File Specification
Session   1 of   1       File   1 of   2        Channel 1        Type 15
             dd:hh:mm:ss
  Started at   6:11:57:39
  Ended at     6:12:57:56

Enter the name of the file in which you wish to store the data. If you have
already done this for the first file you may accept the default entries shown.

Drive/Directory                          c:
Filename                                 sample11
Description
In this space you can type in detailed information about the recording session
such as reason for recording, transducers used, location of recording.
```

Figure 5-4. Session Summary Screen

5.4.2 The Session File Specifications

The information displayed here indicates the number of recording sessions the OM-160 transmitted and the session the computer is working with. The number of files that can be created and the file the computer is working with are also shown.

Next, the channel number of the current session and the sensor type is displayed.

Finally, the starting and ending recording time for the file is displayed.

5.4.3 Entering the File Name and Description

1. At the cursor, enter the file name to be used for data storage. An 8-digit field has been set aside for this purpose. Locations 7 and 8 of this field are automatically assigned numbers representing the session and file, respectively. For example: DEMO23 indicates a file named "DEMO" that is the second recorded session, and the third file (channel) of that session. These numbers will automatically increment as each new session and file becomes active. To overwrite these numbers, press the <Ins> key to toggle the overwrite mode.
2. Description — This function is available to enter text information about the file such as sensor location, reason for the recording, etc. To access the description field, press the <spacebar> until it is highlighted, then press the <return> key. Immediately a lined field 80 characters by 8 lines will appear. After entering the desired text, press the <return> key and then the <F2> key to accept it and save it with the file.
3. Select the directory/disk drive or subdirectory in which you wish to file the data. Do this by pressing <return> when DRIVE/DIRECTORY is highlighted. Enter the drive name (for example: b: or C:\ data) and press return.

4. Press F2 to save file or F8 to discard the data, and go on to the next file.
5. After the last file has been acted upon, the Review/Quick Print screen will appear. A typical screen is shown in Figure 5-5.

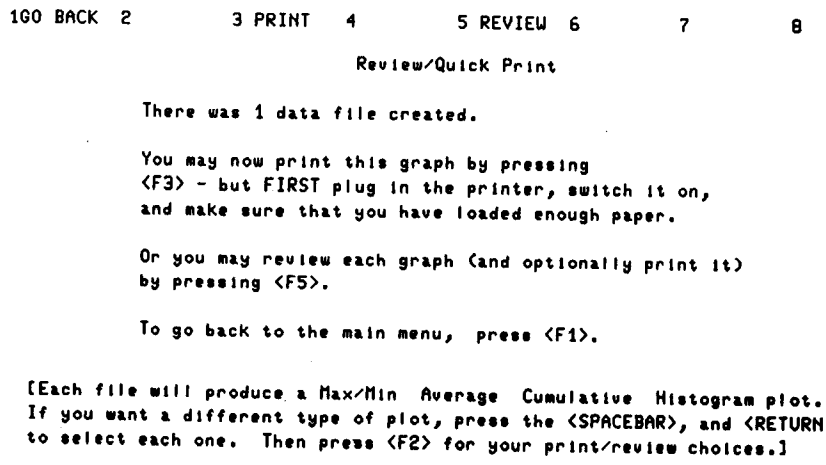


Figure 5-5. The Review/Quick Print Screen

5.4.4 Review/Quick Print

The Review/Quick Print screen gives you three options.

1. Print (F3)—This option brings each file stored during this playback onto the screen, and prints it automatically. Each file appears in sequence. You only press the F3 key once; all files display and print automatically.

   NOTE

   This option requires that your printer be connected to the computer.

2. Review (F5)—This option allows you to view each file on the screen, and print it if desired, by pressing F7 (PRTSCRN). Pressing F2 at this point will bring up the next file. After the last file has been presented, you will automatically return to the Summary Screen by pressing F2.
3. Plot Type (SPACE BAR)—Pressing the space bar allows you to define how the plot will appear. The options here are: Min/Max, Average, Cumulative and Histogram. Selection is made using the space bar. The Return key confirms the selection. More than one selection can be made here. For example, you may want to display Min/Max and Average at the same time. Pressing F2 brings you back to your choices of PRINT (F3) or REVIEW (F5). This choice of graph type should be made before printing has started as selected by F3 or F5. For examples of graph types, refer to Paragraph 6.6.2.

This completes the PLAYBACK/QUICK REVIEW Functions of the Software Application Program. Press F1 to go back to the Main Menu.

5.5 THE ANALYSIS FUNCTIONS

The following is a step-by-step procedure to: select files for analysis, define general graph conditions, define individual graph parameters, and plot graphs. Refer to Figure 5-6 during this procedure. This function is used to review files previously stored.

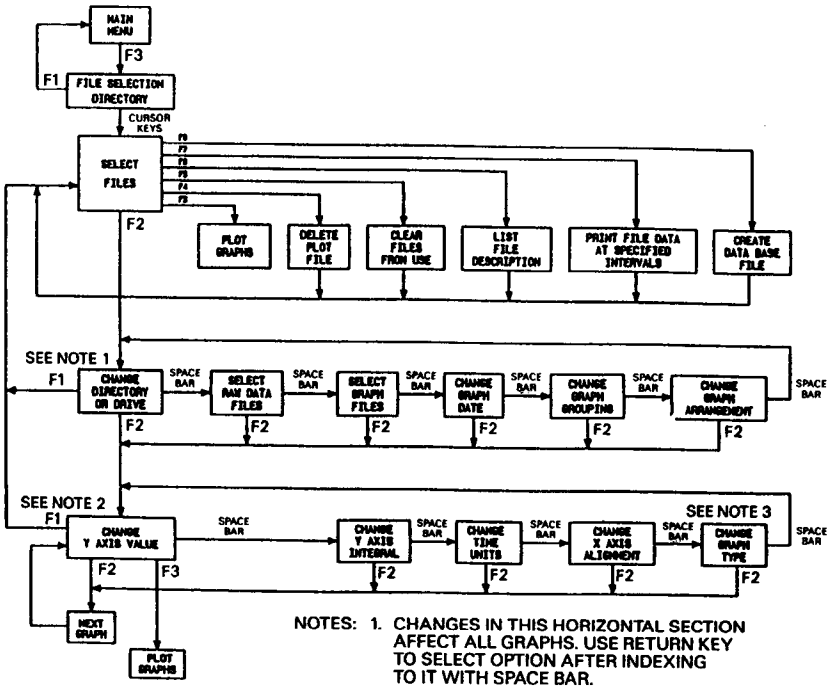


Figure 5-6. The Analysis Functions, Overall Flow Chart

1. From the Main Menu, press F3 to Select and Analyze Existing Files. The File Directory screen will appear. Figure 5-7.
2. If the file(s) you desire to work with is on a different directory or drive, press F2. DIRECTORY/DRIVE will now be highlighted. Press Return to change directory. If the file is on the default directory, proceed to step 4.

```
1GO BACK  2 ACCEPT  3  PLOT   4 DELETE  5 RESTORE 6 DETAILS 7  LIST   8DATABASE
Use cursor keys to select file(s).  <RETURN> to confirm selection.
<F1> for main menu. <F2> to define graphs or change directory.
                              File Directory
                  LINMON11.LOG    DISPLAY1.LOG    FURN211.LOG     DEMO11.LOG
  CORETEMP.LOG    RUN11.LOG       DISPLAY2.LOG    ARMY11.LOG      PROCESS1.LOG
  GRN11.LOG       GREEN11.LOG     PROCESS2.LOG    GREEN12.LOG     RHPROBE.LOG
  RHPROB11.LOG    SHOW.LOG        SAMPLE11.LOG    SAMPL211.LOG    ACPOD21.LOG
  RELPWR21.LOG    MA420.LOG       AUGUST11.LOG    RH11.LOG        ACPOD11.LOG
  BURN11.LOG      MAR311.LOG      CARDEF21.LOG    BURNRK11.LOG    WTRHTR11.LOG
  FURN3206.LOG    TEMP11.LOG      ACTEST11.LOG    ACTEST12.LOG    AIR21.LOG
  SPEED21.LOG     WSPD11.LOG      POD13MV.LOG     HOME11.LOG      TACH11.LOG
  TACH21.LOG      ST20011.LOG     ST20012.LOG     ST20013.LOG     ST20014.LOG
  ACVOLT11.LOG    ACAMPS12.LOG    SHOW2.GRA       DEMO11.GRA      SEPARATE.GRA

The default DRIVE/DIRECTORY is c:, and graphs will be plotted
using the RAW DATA (.LOG) FILES:


and also the PRE-STORED (.GRA) FILES:


The DATE used is 05-21-87.  The chosen .LOG files will be GROUPED INTO GRAPHS
separately, by transducer or all together.  These graphs, and the .GRA files
above, will be ARRANGED ON THE SCREEN stacked or scattered.
```

Figure 5-7. The File Directory Screen

The Software Application Program creates two types of working files, .LOG and .GRA. The .LOG is sent to the computer from the OM-160. The pre-stored (.GRA) files represent new files created and saved by the operator and are derived from the .LOG files.

A third file type is created if text strings are added to any graph. These are identified as .$TX and appear on disk only. They do not appear in the file directory.

The .LOG and .GRA files can be called up for review and analysis using steps 4 through 16 which follow. The text string files are overlays which come up automatically when its graph file is called up.

In all cases the .GRA file must be on the same drive/directory as its associated .LOG file to function properly. If you erase a .LOG file its supporting .GRA and text string files will not be usable.

3. Enter the file or directory name, and press Return.
4. Use the cursor keys to select the file(s) and the return key to confirm the selections of all files to be used. Maximum selection is 9 files at any one time.
5. Press F3 to plot all graphs on the screen. Press F2 to change general default information such as drive, date, graph group, and graph arrangement.
6. Pressing F2 here will again highlight DIRECTORY/DRIVE. Press the Space Bar until DATE is highlighted. To change the date shown, press return. Enter the new date, and press return again.

7. GROUPED INTO GRAPHS will now be highlighted. If more than one file has been selected, you should press the space bar to access one of the options: separately, by transducer, or all together. The space bar indexes through the options and the return key confirms the selection.

   The default group is: separately

8. After pressing Return, ARRANGED ON THE SCREEN will now be highlighted. Pressing the space bar will allow you to change the arrangement. Your choices are: stacked or scattered. Selection is made by the space bar. Confirmation is made by pressing return.

   The default arrangement is: scattered

9. You have now cycled through all the general graph definitions and DIRECTORY/DRIVE is again highlighted.
10. You may now plot the selected file(s) using F3 or define each graph further using F2 to bring up the graph definition screen. See Figure 5-8.

5.5.1 Graph Definition

The Graph Definition screen depicts configuration and lable information about each graph. This information can be altered from the keyboard by pressing the <spacebar> until the desired function is highlighted, then press the <return> key. Information can then be entered from the keyboard for lables or the <spacebar> can select alternate choices for time units, alignment, or graph type. Press the <return> key when editing is complete.

The graph type allows more than one choice. Example: a graph could be displayed as Max/Min and Average all at the same time. The active choice(s) will be highlighted.

When all the necessary changes are complete, press the F2 key to accept the new information and go on to the next file (if more than one is in use). After all the files have been reviewed, press the F3 key to plot the data using the new definitions.

```
1GO BACK  2 ACCEPT  3  PLOT   4          5          6          7          8
<SPACEBAR> to index selection.              <RETURN> to confirm selection.
<F1> to re-select files.  <F2> to define next graph.  <F3> to plot.

                              Graph Definition
Graph Number
    1 of 1       Value on y-axis        Label: Temperature     Units: Deg C
                 Integral on y-axis     Label: Heat            Units:
                 Time Units             Weeks, Days, Hours, Mins or Secs
                 Alignment              None, Start, Week, Day or Hour
                 Graph Types

                       c:CORETEMP     Max/Min  Average  Cumulative  Histogram
```

Figure 5-8. The Graph Definition Screen

5.5.2 Graph Utilities Available

Now that the general conditions have been defined for all graphs and specific information has been entered for individual graphs, the graph(s) appear on the screen as previously stated by pressing F3 (PLOT). Figure 5-9 shows a typical screen presentation of one graph and the available functions and utilities.

Three important utilites available are the Zoom, Text, and Graph options. When the plot first appears on the screen, the Zoom function will be highlighted. To execute this utility, press <return>. To select the Text or Graph utilities, simply press the <spacebar> until the desired utility is highlighted, then press <return> to execute your selection.

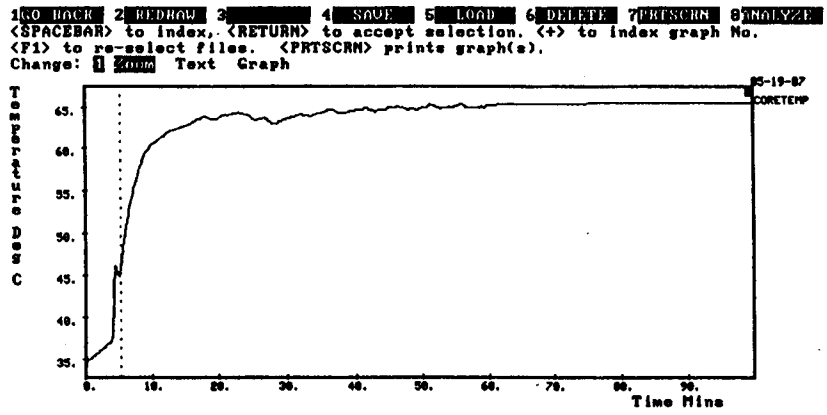


Figure 5-9. Plot Utilities

5.5.3 Zoom Utility

This utility allows a portion of any graph to be windowed into and amplified for better resolution.

1. Select Zoom as outlined above; your choice will be "Window" or "Original". Window allows a selection of a section of a graph for review. Original allows replot of the original graph.
2. Select Window with the <spacebar> and invoke it with the <return> key.
3. The words LEFT TOP RIGHT BOTTOM will appear on the screen above the graph. See Figure 5-10. LEFT will be highlighted. The highlighted position is the active cursor position for framing in the desired section of the graph to be windowed.
4. Use the <spacebar> to activate the desired cursor. Use the appropriate arrow key (left, right, up or down arrow) to move that cursor. The longer the arrow key is held down, the faster the cursor moves.

5. Exact framing locations can also be achieved by pressing the < = > key and entering the numeric value of the location on the amplitude or time axis desired. Press the <return> key to move the frame line to the new location on the graph.
6. When all sides have been framed in, press the <return> key to replot the graph in its amplified form. Scaling will be updated automatically.
7. The Zoom function can be applied as many times as desired. The Software Application Program will indicate when it is no longer practical to window in any further.

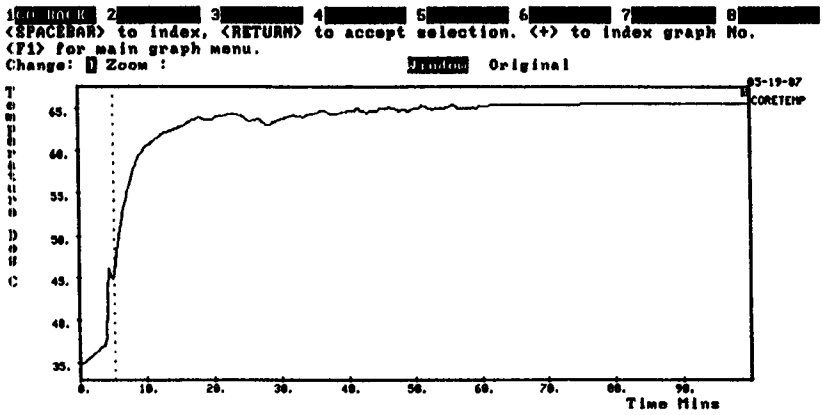


Figure 5-10. Zoom Utility

5.5.4 Text Utility

This Utility allows alphanumeric information to be placed on any plot.

1. Select the TEXT utility by highlighting it with the <spacebar> and pressing the <return> key.
2. Select New with the <spacebar> and press <return>. A text cursor will appear above the graph as shown in Figure 5-11.
3. The keyboard can now be used to enter text data up to 40 characters in length for placement on the graph.
4. Press the <return> key to accept the text and activate the positioning cursor. A mouse-like figure will now appear on the screen.
5. Move the mouse to the desired location using the cursor keys. The arrowhead on the mouse will be the location of the first letter in the character string.
6. Press the <return> key to place the text on the graph.
7. The process may be repeated as often as desired, placing as many text strings on the plot as necessary.

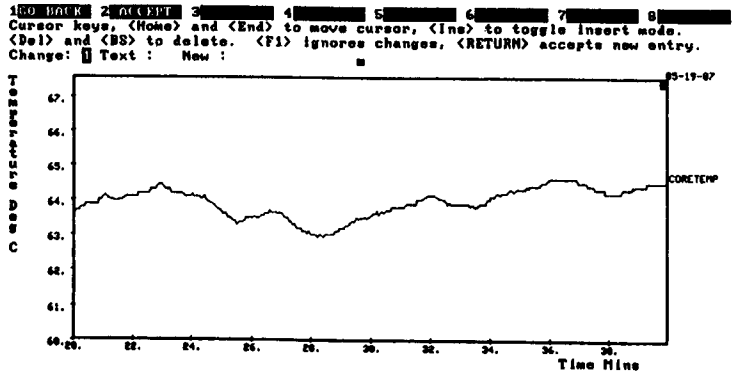


Figure 5-11. Text Utility

5.5.5 Graph Utility

This utility is used to move, change the size, or duplicate a graph. It also allows two graphs to be joined together at any point on the time axis. Use the <spacebar> and <return> keys to select and implement these functions within the graph utility. The graph utility is selected in the same manner as the zoom and text utility. Figure 5-12 shows the results of several of these functions.

Move — In this mode the cursors will move the graph (if it is smaller than full size) anywhere on screen.

Size — In this mode any graph can be changed in size by using the cursor keys.

Duplicate — This mode allows a second graph to be called up on screen identical to the active graph you are working with. This is useful when it is desirable to window in and amplify a section of a graph as well as view the entire graph. The two graphs will appear side-by-side or one on top of the other depending on the graph arrangement selected (scattered or stacked).

Join — This mode allows two or more graphs on screen to be joined together at any point on the time axis of one of the graphs. The join point is selected by the cursor keys.

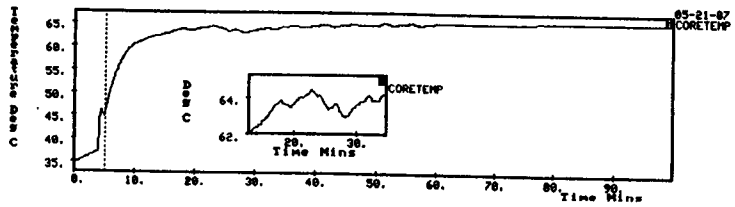


Figure 5-12. Graph Utilities—Duplicate, Size, Move, and Zoom

5.6 GRAPH COMMANDS

Redraw (F2)
This command initiates a redraw of the graph(s) on screen. It is useful when mistakes need to be corrected in editing the graph(s).

Save Command (F4)
The Software Application Program allows a library of plots to be created from the raw data received by the data logger. Each of these new plots can be saved to disk by pressing F5 while the desired plot is on screen and the Save command is active as indicated by its appearance on top or the screen in the command line. When this command is invoked, you will be asked for a file name. The present name will appear at the active cursor. The Software will automatically append a .GRA to the file name; therefore, it is not necessary to change the name if only one revised file is created. These new files can be recalled from the file directory at any time for use.

Load (F5)
This command allows another file to be called up on screen by typing in the file name when prompted after pressing F5.

Delete (F6)
This command is most useful to delete files that are no longer needed. It is best initiated from the file directory screen. When the file directory is on screen, select the file to be deleted using the <spacebar> and <return> keys. Note, if you delete a .LOG file, its associated .GRA files will not be usable.

Print Screen Command (F7)
This command allows the graph and text that are on screen to be sent to the printer. This command may be invoked any time it appears on the command line at the top of the screen. A printer with graphics capability must be connected and on to use this function. The printer must also comply with the configuration set up in the install program. See Section 6.

Analyze (F8)
This command allows detailed information about the graph or sections of a graph to be displayed.

This information includes:

- Specific value of X
- Specific value of Y
- Minimum value in a framed area
- Maximum value in a framed area
- Mean value in a framed area
- Integral of a plot in a framed area
- Time duration in a framed area.

Once these calculations are accomplished by the Software Application Program, the results can then be printed on the graph by pressing the Write command (F5) and positioning it with the mouse as in the text utility.

The result can also be sent to a printer and not the graph by pressing the Print command (F6).

5.7 OTHER COMMANDS

The following commands are additional features of the Software Application Program that are available from the file directory screen:

Restore (F5)

This command is used when you are finished working with a file and wish to deactivate it before calling up other files. It is necessary to push this key twice if the file is on the .GRA line or once if it is on the .LOG line.

Details (F6)

This command allows the description of any file to be called up on the screen. The description is that information which is entered during the down loading process. The <spacebar> and <return> keys are used to select and activate the file choice.

List (F7)

To print out a listing of data points for a file, press F7 after it has been selected from the file directory screen using the <spacebar> and <return> keys.

The Software Application Program will indicate the total number of seconds in the file and pick a value (in seconds) it suggest as optimum for the print interval.

To use another interval, simply type it in at the active cursor to overwrite the value shown and press the <return> key.

You will be prompted to insure that your printer is connected and is turned on. Press the <return> key to start the print out. Figure 5-13 shows a typical print out.

NOTE

This option requires a printer to be attached to the computer.

DISPLAY1.LOG

Sensor type 15 (Thermocouple Type K).

Calendar	Value	Average	Max	Min	Events
16: 8:24:28	69.9949	70.7232	72	69	0
16: 8:24:38	70.1312	70.1968	72	69	0
16: 8:24:48	70.0490	69.9044	71	70	0
16: 8:24:58	70.0082	70.2979	71	69	0
16: 8:25: 8	69.9237	69.9204	71	69	0
16: 8:25:18	69.4525	69.7391	71	69	0
16: 8:25:28	71	70.0804	71	69	0
16: 8:25:38	69.6067	69.7118	72	69	0
16: 8:25:48	70.5306	73.5403	80	69	0
16: 8:25:58	70.9404	70.9758	80	70	0
16: 8:26: 8	77.0372	70.0404	80	77	0
16: 8:26:18	75.8627	76.4870	78	75	0
16: 8:26:28	74.9047	75.3077	77	74	0
16: 8:26:38	74.3174	74.5989	75	73.6130	0
16: 8:26:48	73.4177	73.9108	74.6130	73	0

Figure 5-13. The List Command

Database (F8)

This command creates an ASCII file with a .PRN suffix that can be imported by other software such as spreadsheet and database products like Lotus 1-2-3 and dBASEIII.

This command works in a similar way to the list command in that the operator will be shown the total time (in seconds) in the file and be asked to decide on a reporting interval.

Select the desired file by highlighting it with the <spacebar> and activating it with the <return> key.

Press F8. Use the default interval selected by the Software Application Program or overwrite it with the desired value and press <return>.

The Software will show the file name with a .PRN suffix, change it if necessary or accept it with the <return> key.

The data will then be filed on the active disk or subdirectory. Figure 5-14 shows the protocol for the data.

```
9358, 9300, 60, "N", 22.3152, 22.1479, 30, 20, 1.0000
```

Figure 5-14. Database Protocol

The first number represents the time in seconds.

The second number represents the cumulative interval.

For example, if the interval selected was 60 seconds, the numbers that would appear in this column of the database would be 60, 120, 180, etc.

The third number represents the interval.

The fourth data field contains the letter N or S. This indicates a normal record or a record that contained a temporary stop.

The fifth field represents Value. This is the data used to develop the average plot.

The sixth field is Average. This is an average of all the one second values in the interval.

The seventh field represents Maximum. This is the highest point the data reached during that interval.

The eighth field is Minimum. This represents the lowest point the data reached during the interval.

The seventh and eighth fields together represent the Max/Min plot in the Software Application Program.

The ninth field represents the number of manual events entered from the data logger EVENT key during the recording session for that interval.

SECTION 6 USING THE INSTALL PROGRAM

6.1 INTRODUCTION

This program is used in conjunction with the Software Application Program, and will allow you to set up the Software to work with most printers and video display cards by simply scrolling through a few screens of instruction. The Software is configured for a default condition using a specific printer and graphics card as listed in the Software Defaults section below.

The Software Application Program defaults can be easily modified by this program. If your peripheral equipment and software defaults match the requirements listed below, you will not need to run the Install Program.

6.2 SOFTWARE DEFAULTS

The Software Application Program contains the following defaults as shipped by OMEGA:

Graphics Display---------- Hercules Monochrome
Printer---------- Epson
Playback Port---------- Com 1
Graph Type---------- Average
Graph Grouping---------- Separately
Graph Arrangement---------- Scattered

For the user with requirements different from the defaults stated, the Install program will quickly and easily guide you through a set of screen instructions. By just pressing a few keys, you can easily modify the Software default conditions to your own set of defaults.

To run the Install program, type INSTALL and press Return. Make sure that the disk to be used is not write protected. The Main Menu (see Figure 6-1) should now appear on the screen.

6.3 MAIN MENU

The Main Menu is subdivided into four distinct sections, with a help screen added to aid in the decision making process. The major selections are shown in Figure 6-1.

MAIN MENU

Select video display
Set printer configuration
Set Software defaults
Set sensor parameters
Help screen
Exit this program

Figure 6-1. The Main Menu

Each of these sections will be described in detail. Illustrations show each screen as it is displayed on the Personal Computer (PC), along with a visual picture of what the individual choices look like.

To enter into one of the four major sections of the Main Menu, just place the highlighted cursor on that option and press return. Pressing the spacebar or cursor key will enable you to scroll through the table of options available. The selection that you chose will be highlighted; to accept that choice just press the return key.

To leave a particular section of the menu directory and return to the top level screen, use the Exit this Function command. This will return you to the Main Menu.

6.4 SELECT VIDEO DISPLAY

To select the Video Display, from the Main Menu, place the highlighted cursor (using the spacebar) on that choice and press return. The Video Display Choice will appear (see Figure 6-2) showing the options available within the Video Display section.

VIDEO DISPLAY CHOICES

Hercules Monochrome
IBM CGA (Color)
IBM EGA (4 Colors, 64K)
IBM EGA (16 Colors, 128K)
AT&T 6300
IBM CGA (B/W, LCD)
Exit this function

Figure 6-2. Video Display Selection

The default option that is configured with the Software Application Program is the Hercules Monochrome display. If your PC has a different video display card (and it matches one of the options), just scroll through this screen until the cursor highlights the proper display, then press the return key. Once selection is completed, you will return automatically to the Main Menu.

NOTE

Other Video Display cards can be used if they emulate one of the choices outlined in this section. Refer to your graphics card manual to determine compatability.

A brief description about each Video Display card will be given. Refer back to your video display card user's manual for more detailed information.

Hercules Monochrome
This is the Software Application Program default display. Resolution: 720 Horizontal by 348 Vertical.

IBM CGA (Color)
IBM or compatible CGA (Color Graphics Adaptor) card. Resolution: 640 Horizontal by 200 Vertical.

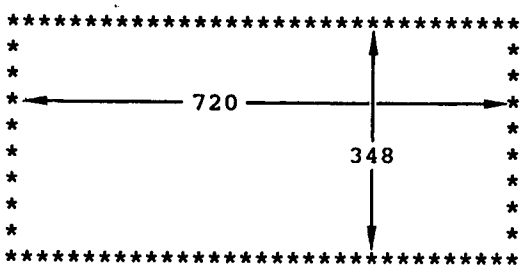
IBM EGA (4 Colors, 64K)
IBM or compatible EGA (Enhanced Color Adaptor) card. Resolution: 640 Horizontal by 350 Vertical.

IBM EGA (16 Colors, 128K)
IBM or compatible EGA (Enhanced Color Adaptor) card. Resolution: 640 Horizontal by 350 Vertical.

AT&T 6300
Internal display built-in. Resolution: 640 Horizontal by 400 Vertical.

IBM CGA (B/W, LCD)
IBM or compatible CGA (Color Graphic Adaptor) card. This display (non-color) is usually found on portable and laptop PC's along with systems that have composite monochrome monitors. Resolution: 640 Horizontal by 200 Vertical.

EXAMPLE: Resolution description
Hercules Monochrome (720 horizontal by 348 vertical).



6.5 SET PRINTER CONFIGURATION

To select the Printer Configuration from the Main Menu, place the highlighted cursor (using the spacebar) on that choice and press return. The Printer Choice screen will appear (see Figure 6-3) showing the options available within the Printer section.

A brief description about each printer option will be given. Refer to your Printer user's manual for more detailed information.

PRINTER CHOICES

Epson/compatible printer
Gulton Superplot 80
User defined type
Exit this function

Figure 6-3. Printer Selection

When selecting either the Epson or Gulton Super 80 printer choices, the configuration is implemented and no further input is needed. If you want to define a different printer type, select the User Defined Type option, and change the codes as necessary to match your printer. See Figure 6-4. The printer configuration that will be displayed is that of the last defined choice.

Paragraphs 6.5.1 through 6.5.8 describe the categories on the Printer configuration screen.

USER DEFINED TYPE

Printer Name	Epson/Epson compatible type printer	HP Laser Jet Series 2
Printer Type	1	2
Number of Dots	8	8
Top Bit Number	7	7
Set Up Sequence	1B,33,18	1B,2A,72,30,41
Graphics Prefix	12,0E,1B,4C,D0,02	1B,2A,62,31,30,31,57
Graphics Suffix	0D,0A	
Restore Sequence	1B,32,0F	1B,2A,72,42,0C

Exit This Function

Figure 6-4. User Defined Printer

6.5.1 Printer Name

The printer name is for reference only. A 40 character field is provided for you to type in a reference.

6.5.2 Printer Type

There are two built-in printer defaults. Type 1 is Epson/Epson compatible type printer (vertical dot matrix); and Type 2 is Gulton Superplot 80 (horizontal dot thermal). Enter the type that matches your printer.

6.5.3 Number of Dots

This corresponds to the number of dots on the printer mechanism.

6.5.4 Top Bit Number

This number represents the numerical position assignment of the top bit. For example, a print head having eight dots and having the number 1 assigned to the top dot means it is assigned the lowest numbered bit.

EXAMPLE:

Horizontal Head	Vertical Head
1 2 3 4 5 6 7 8	8•
• • • • • • • •	7•
	6•
	5•
	4•
	3•
	2•
	1•

NOTE

For the set up sequence through to the restore sequence, a few basic rules need to be adhered to. Notice from Figure 6-4 that only Hex codes (0-F) are allowed, no ASCII codes. Commas are the acceptable way of separating the two-bit Hex codes. If you incorrectly enter the printer sequence, a help message will be displayed onto the screen mentioning that either a comma was forgotten or a hex byte was left out. A line may be left blank if input is not necessary for the printer configuration set up. A maximum of 20 characters is allowed in these fields.

6.5.5 Set Up Sequence

The set up sequence is used to set up the printer for hard copy output. The first two Hex numbers represents the control code for graphics mode. The third Hex number represents inch line spacing and is the numerator in the formula n/216.

6.5.6 Graphics Prefix

This code is sent once before the first byte of dot line data. The dot line is set for 720 dots. This is the default regardless of what type of display is used. The first Hex number cancels compressed printing. The second selects expanded mode. The next for Hex numbers selects low speed double-density graphics mode.

6.5.7 Graphics Suffix

This code is sent after the last byte of dot line data and represents carriage return, line feed respectively.

The two sequences, Graphics Prefix/Graphics Suffix, are sent to the printer for each line until the screen is finished being printed.

6.5.8 Restore Sequence

This is the reverse of the setup sequence. This sequence will restore the configuration that the printer was previously set at before running the Software Application Program. Hex characters 1 and 2 execute line spacing. The third character selects the desired printing mode, such as compressed mode.

The specific codes to be used will depend on the printer in use. Refer to the graphics section of your manual for details.

6.6 SET THE SOFTWARE DEFAULTS

To select the Software Application Program Defaults from the Main Menu, place the highlighted cursor (using the spacebar) on that choice and press return. The Software Defaults screen will appear. Figure 6-5 shows the options available within the Software Defaults section.

The Software Default choices help you decide which disk drive to save a file on, what graph type to plot, how the plots are to be grouped, and the proper arrangement on the screen and printer.

The following is the Software Defaults for version 1.2 or later:

Graph Type ---------- Average
Graph Grouping ---------- Separately
Graph Arrangement ---------- Scattered
Playback Port ---------- Com 1

These are only the predetermined defaults for the software. By going briefly through the Install Program, the defaults can be redefined to your own unique setup.

SOFTWARE DEFAULT CHOICES

Drive/Directory	none specified
Graph Type	Max/Min Average Cumulative Histogram
Graph Grouping	Separately By transducer All together
Graph Arrangement	Stacked Scattered
Playback Port	COM1 COM2
Exit This Function	

Figure 6-5. Software Defaults

6.6.1 Drive/Directory

The drive directory comes up in a default state showing none specified. The options available are either to set the directory to describe a floppy disk drive (A or B) or to set the default drive to be the hard disk (C). The Software will automatically default to the drive that you boot up from, if none specified.

EXAMPLE: Drive/Directory Sintax
Drive. A: , C:
Drive and Subdirectory. C: Data

6.6.2 Graph Types

The options here consist of setting up the plot to be displayed in one of four modes; Max/Min, Average, Cumulative, and Histogram. Figure 6-6 shows a data file graphed in each of the four modes.

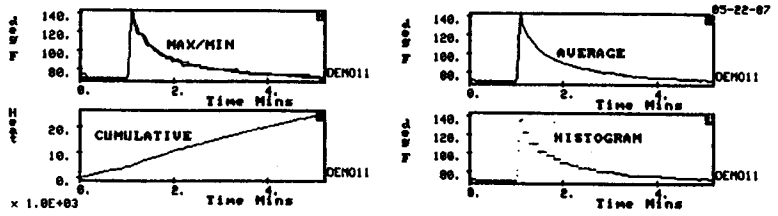


Figure 6-6. Graph Types

6.6.3 Graph Grouping

Graphs can be grouped into one of three distinct displays:

— **Separately**, in which each file is plotted on an individual graph (see Figure 6-7).

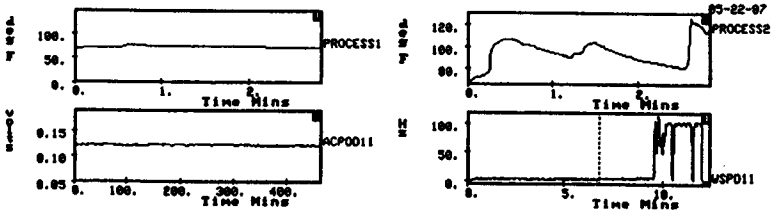


Figure 6-7. Graph Grouping — Separately

— **All Together,** in which all the files are plotted jointly onto one graph (see Figure 6-8).

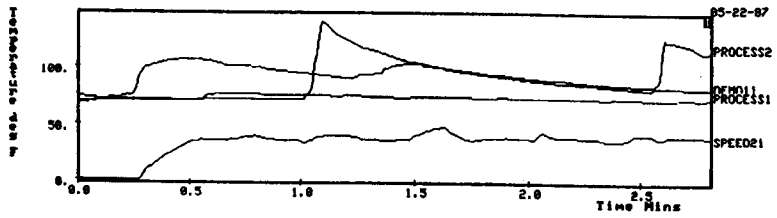


Figure 6-8. Graph Grouping — All Together

— **By Transducer,** in which files that have the same MOD (input module) type are plotted together. Figure 6-9 shows an example of how files will look for the EXAMPLE below.

EXAMPLE: Graph Grouping

If you plot 4 files defined as follows: 2 sensors MOD type 16, 1 sensor MOD type 12, and 1 sensor MOD type 13, you will have three distinct plots that will be grouped by MOD type.

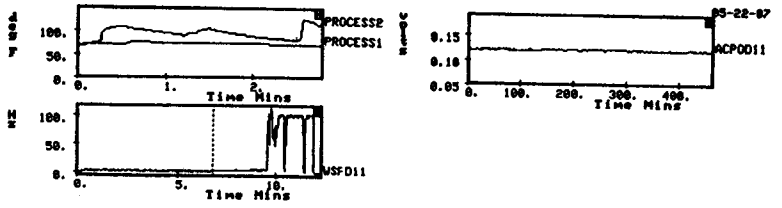


Figure 6-9. Graph Grouping — By Transducer

6.6.4 Graph Arrangement

The files can be graphed into two different arrangements, stacked and scattered. The choice of which format to use to view a file is based solely upon your preference. Figures 6-10a and 6-10b show the two options. Generally the scattered arrangement would be used when the amplitude axis is most important. The stacked option is used when more than one plot must be compared with respect to time.

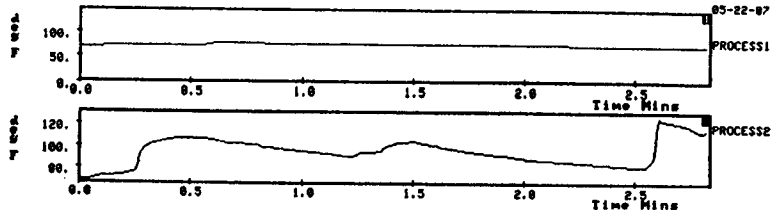


Figure 6-10a. Graph Arrangement — Stacked

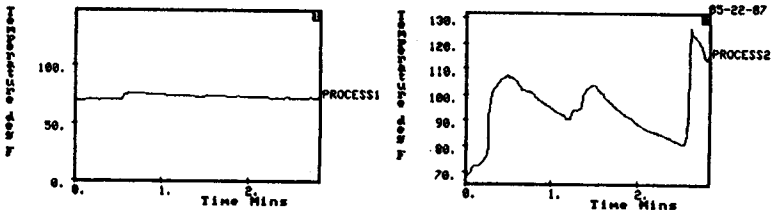


Figure 6-10b. Graph Arrangement — Scattered

6.6.5 Playback Port

The default condition of the playback port is COM1 (communications port 1). If you want to change the default to COM2, it can easily be changed by pressing the spacebar until the playback port is highlighted, then press return to enter this selection. Select COM2 with the spacebar and press return.

6.7 SET SENSOR PARAMETERS

To select the Set Sensor Parameters, from the Main Menu, place the highlighted cursor (using the spacebar) on that choice and press return. The following screen will appear (see Figures 6-11 and 6-12) showing the options available within the Sensor Parameters.

When the decision is made to modify this section, you will notice the screen assembled into two distinct parts. The first part (see Figure 6-11) will show the screen, asking for a two digit number representing the sensor type to be entered. This corresponds to the MOD number used in the data collection process.

Sensor Parameters
Type 00

Figure 6-11. Sensor Type

The needed reply is to enter the type of sensor display to modify. By entering either a 1 or 2 digit code representing the sensor type desired followed by the return key, the second half of the screen appears along with the sensor types entered. The choice of only typing in a single digit such as a 4 or 04 is acceptable. The system will interpret the number accordingly. The screen is now shown in full detail. Figure 6-12 shows a sample screen with Type 11 enabled to show some real data.

Normally sensor displays for the temperature MODS (Types 02 through 09 and 15 through 19) would not be changed. This option, however, is very useful for the general purpose MODS (Type 10 through 13 and 23 through 27), in that engineering units can be represented on the graph in lieu of voltage, current or pulse inputs. That is, pressure in pounds per square inch (PSI) can be displayed rather than 4-20 mA or 0 to 100%.

NOTE
Once modified, this becomes the new default for the MOD type.

Sensor Parameters
Type 11

Sensor Name	Current 0 to 100 mA
Decimal Places on ADL	0 1 2 3 4
Integration Time Base	Hours Minutes Seconds
Value Label	Current
Value Units	mA
Integral Label	Charge
Integral Units	Clumbs
Change Another Sensor	
Exit This Function	

Figure 6-12. Sensor Parameters

6.7.1 Sensor Name

The sensor name is the predetermined name given to each type of sensor. Actual names are used for all existing MOD (input modules) that are supported by the Software Application Program, such as MOD-13 voltage, and MOD-03 thermistor. All new user defined types can be named as you deem necessary.

6.7.2 Decimal Places on the OM-160

This is most easily described by example. It is used in 2 ways; first to make a graph display agree with the data logger display, or second to multiply the display by factors of 10.

EXAMPLE: Decimal Places on the OM-160

The OM-160 is being used with a MOD-13 (0 to 2 VDC). Inspection of the LCD display shows that the numeric value is given to THREE decimal places, 0.000. Scaling can be achieved by changing the decimal places to the right of the decimal—see Table 6-1.

TABLE 6-1

DECIMAL PLACES	DISPLAY
0	0000
1	000.0
2	00.00
3	0.000
4	.0000

To establish other sensor types that are not defined in your version of Software, you can set up the decimal places to agree with the display on the OM-160 Data Logger.

6.7.3 Integration Time Base

This section will allow the file to be delineated in one of the following time formats, hours, minutes, or seconds.

6.7.4 Value Label

This is used to describe the phenomena being measured, such as pressure, flow, or distance. The Value Label can be set to your particular requirements and can be up to 15 characters in length.

6.7.5 Value Units

This is used to describe the engineering units that apply to the measurement, such as PSI, GPM, or FT. The Value Units can be set to your particular requirements and can be up to 5 characters in length.

6.7.6 Integral Label

This is used to describe the integrated value such as flow rate, volume, etc. The Integral Label can be set to your particular requirements and can be up to 15 characters in length.

6.7.7 Integral Units

This is used to describe the engineering units for the integral value such as Gl/sc or cu ft. The Integral Units can be set to your particular requirements and can be up to 5 characters in length.

NOTE

All or none of the labels/units can be used to described a particular file.

6.8 CHANGE ANOTHER SENSOR

After all the parameters for a specific sensor are set, you may want to modify an additional sensor parameter. By pressing the return key when the flashing cursor is on this option, you will be returned to the same setup screen as when you first entered this section of the program. Go through the set up parameters previously discussed and then exit this function to complete this setup.

6.9 HELP SCREEN

The Help Screen (see Figure 6-13) is a short description of the options available for each section of the program. If you need more detailed information about the screen options, consult this manual under the proper section.

```
   This program will allow you to set up Pronto to work with the particular
graphics display card and printer you are using. You can also change the
default choices that will normally be presented in the different areas of
Pronto. You will be asked to index your choice using the spacebar or the
cursor keys and then select it by pressing return. You may then be required
to make another choice in the same way or by typing it in from the keyboard.
You may also exit without changing anything.
   Following is the list of choices that may be selected in the Main Menu.

1. Select video display - A list of display types will be presented. Select
     the one that matches the display card Pronto will be used with.

2. Set printer configuration - Select the printer that will be used with
     Pronto from the list or fill in the information for a user defined type.

3. Set Pronto defaults  - The defaults in Pronto such as the file directory
     graph type or arrangement and playback port may be modified here.

4. Set sensor parameters - The graph annotations used for each sensor type
     may be checked or changed here.

          >--------- Press <return> to end ---------<
```

Figure 6-13. Help Screen

6.10 EXIT THIS PROGRAM

All modified changes are temporarily saved as you exit each function. Upon exiting the program, all changes are permanently saved. Once this option is selected, your PC will exit the Install Program and return to DOS (disk operating system), evident by the drive letter followed by a prompt symbol (>), such as (C> _).

You have now prepared the Software to function exactly as your needs require, tailored to your specific computer and printer. To begin using the power of the Adaptive Data Logger Graphics Applications Software, simply type 'Pronto' and press return. The clearly outlined presentation on the screen will guide you every step of the way. Also refer to Sections 4 and 5 of the User's manual for more details.

SECTION 7 SPECIFICATIONS

NUMBER OF CHANNELS:	Four data channels 1, 2, and 3 are analog and digital; 4 is analog only
INPUT SENSORS:	Refer to Table 7-1
SAMPLE RATE:	654 ms
STORAGE RATE:	Automatically adapted to suit recording period and the dynamics of the signal.
INPUT CONNECTIONS:	4 (6 pin modular jacks)
INPUT IMPEDANCE:	10^{12} ohms
INPUT RANGE:	0-2 Vdc, ±3 Vdc max.
SENSITIVITY:	0.5 mV
RESOLUTION:	±0.5% mV
EXCITATION (unregulated):	3.5 Vdc ±0.5V @ 2.5 mA
(filtered):	3.5 Vdc ±0.5 V @ 1.5 mA for sensor power
COMMON MODE:	65 dB TYPICAL
REAL-TIME CLOCK:	Operator programmable—displays in day, hour, minute, second format
RECORDING TIME:	Programmable from 10 minutes to 100 days
DISPLAY:	8-character alphanumeric LCD. Functions include: analog inputs (as a meter), time, remaining memory capacity, battery voltage, sensor definition, and calibration points
PROGRAMMING:	Menu driven by 2 front-panel keys; selects options; enters parameters such as sensor definition, calibration, channels, record time, real time, display data, record data, erase data, event mark, and playback data rate.
OUTPUT:	RS-232C with programmable baud rates of 300, 1200, 4800, and 9600
POWER:	3.9 Vdc via 3 AA size rechargable Ni-Cad batteries; operation time between recharging depends on the number of active channels.
ENVIRONMENTAL CONDITIONS:	Operating temperature: −10° to +60°C; storage temperature: −20° to +70°C; relative humidity: 2 to 90% non-condensing
DIMENSIONS:	L: 5.71" (145 mm) x W: 3.15" (80 mm) x D: 1.18" (30 mm)
WEIGHT:	10 oz (260 grams)
SOFTWARE:	Application software included to down load raw data on IBM (or compatible) Personal Computers; allows for display and analysis of data and hard copy print out.
FCC APPROVAL:	Meets Class A paragraph 15, subpart J

TABLE 7-1
SIGNAL CONDITIONING MODULES

MODEL	INPUT TYPE	Frequency Response	Resolution
MOD-02	Thermistor: -50°C to 150°C		
MOD-03/31	Thermistor: -40°C to 110°C / -40°F to 230°F		
MOD-04/15	Thermocouple Type K: -250°C to 1370°C / -420°F to 2500°F		
MOD-05/16	Thermocouple Type J: -210°C to 750°C / -330°F to 1380°F		
MOD-06	Thermocouple Type J: 0°C to 400°C		
MOD-18/19	Thermocouple Type T: -200°C to 400°C / -320°F to 750°F		
MOD-30	Thermocouple Type E: 0°F to 1600°F		
MOD-07/17	RTD: -200°C to 850°C / -328°F to 1560°F		
MOD-08/09	RTD: -200°C to 260°C / -328°F to 500°F		
MOD-10	DC Current: 4 to 20mA		
MOD-11	DC Current: 0 to 100mA		
MOD-21	AC Current: 0 to 1000A (1,000:1)		
MOD-21A*	AC Current: 0 to 1000A (1,000:5)		
MOD-21B*	AC Current: 0 to 1000A (10,000:1)		
MOD-12	DC Voltage: 0 to 100mV		
MOD-12B	DC Voltage: -80 to 100mV		
MOD-13/14	DC Voltage: 0 to 2V / 0 to 2000mV		
MOD-13B	DC Voltage: ±1 volt		
MOD-20	AC Voltage: 0 to 600V		
MOD-22*	AC Power: 0 to 200KW (VA)		
MOD-23	Event Switch Closure: 0 to 48VDC (200 events min.)		
MOD-29/03*	Humidity/Temperature: 0 to 100% RH / 0°C to 50°C (32°F to 122°F (this MOD includes sensing elements)		
MOD-PC-24	Pulse Counting (rate and RPM): 0 to 100Hz	210 sec	0.01 Hz
MOD-PC-25	Pulse Counting (rate and RPM): 0 to 1K Hz	35 sec	0.1 Hz
MOD-PC-26	Pulse Counting (rate and RPM): 0 to 10K Hz	650msec	1 Hz
MOD-PC-27	Pulse Counting (rate and RPM): 0 to 50K Hz	650msec	10 Hz
MOD-PC-28*	Pulse Counting (rate and RPM): 0 to 20,000 RPM	650msec	1 RPM

* SPECIAL OPTION - CONSULT SALES DEPARTMENT

NOTE

Where you see MOD-X/Y, (for example, MOD-03/31), this identifies the software ranges that can be used for that module.

SECTION 8 ACCESSORIES

MODEL	DESCRIPTION
RR-100	Input Connector Kit (Package of 10)
RR-101M	6 ft. Computer Interface Cable—Serial (Male Connector)
RR-101F	6 ft. Computer Interface Cable—Serial (Female Connector)
RR-102	Liquid Tight feed through connector (for use with RR-205)
RR-103*	Input Cable Assembly, 4 ft (cable comes terminated with OM-160 mating connector on one end and unterminated at other end)
RR-104*	I/O Cable Assembly, 4 ft (cable comes terminated with OM-160 mating connector on one end and unterminated at other end)
RR-105	Clamp-on Current Transformer, for use with MOD-21) Range: 2 to 150A AC
RR-106	Clamp-on Current Transformer, for use with MOD-21) Range: 4 to 400 A AC
RR-120A	Battery Charger (120V)
RR-120B*	Battery Charger (220V)
RR-130	30 Day Rechargeable Battery Pack
RR-200	Wall Mounting Plate
RR-205	Tamperproof Enclosure
RR-210	Weatherproof Enclosure
* SPECIAL OPTION—CONSULT SALES DEPARTMENT	

8.1 RR-130 30-DAY RECHARGEABLE BATTERY PACK

The OMEGA® RR-130 Rechargeable Battery Pack is comprised of three components: a recharger circuit assembly, an interface cable to the OM-160 Data Logger, and a 4 Volt 9 AH sealed rechargeable battery. These are identified in Figure 8-1 as items 1, 2, and 3, respectively. Figure 8-1 illustrates the proper hook-up of the recharger system.

The recharger assembly is designed to be used in either of two optional configurations: Option 1—as a complete recharger system; and Option 2—direct hook-up from the 30-day battery to the OM-160 Data Logger.

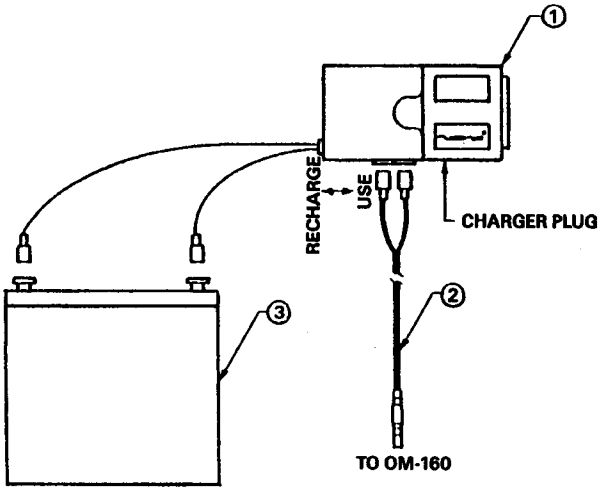


Figure 8-1. RR-130 Components and Proper Hook-Up of the RR-130 Recharger System

8.1.1 Option 1—Complete Recharger System

Connect the red and black leads, coming from the charger module to the battery. Observe color coding (black wire to black terminal and red wire to the red terminal).

Next, connect the power cable to the charger module and the OM-160 Data Logger as follows. The connect-on terminals are designed to fit over the lugs on the side of the battery charger. Observe polarity here by connecting the wire with the white tracer to the positive terminal, and the plain black wire to the negative terminal. Then, connect the power plug into the power receptacle on the lower right side of the OM-160 Data Logger.

To operate from this configuration, with a fully charged battery, place the slide switch on the side of the charger module to the USE position. If the battery is fully charged, you will have a minimum of 30 days of operation of the OM-160.

To recharge both the RR-130 batteries and the internal batteries of the OM-160, plug the RR-120 Recharger module into the module jack on the charger module. Plug the RR-120 into a wall socket of 120VAC/60Hz and move the switch on the charger module to the RECHARGE position. In this configuration, a fully discharged Data Logger and external battery can be charged to full capacity in 27 to 30 hours. It is also possible to operate the OM-160 while recharging. The switch should be returned to the USE position after a full charge has taken place.

8.1.2 OPTION 2 - DIRECT HOOK-UP FROM 30-DAY BATTERY TO OM-160 DATA LOGGER

With a fully charged battery, connect the power cable directly to the battery, observing polarity by connecting the wire with the white tracer to the red terminal of the battery and the plain black wire to the black terminal. Then connect the power plug into the receptacle on the side of the OM-160 Data Logger. The operator now has a 30-day operational system directly between the battery and the OM-160. This may be more convenient in those applications where space is limited.

The operational period of the data logger with a fully charged battery is dependent upon the number and type of signal conditioning MODs in use. Tables 8-1 and 8-2 will provide the necessary data to derive the operational period for your application. Recharge the extended battery as described in Section 8.1.1.

EXAMPLE 1: Data Logger with 1 Thermistor MOD in use

	Current Draw
Data Logger	8.0 mA
Thermistor MOD 03/31	1.0 mA
TOTAL DRAW	9.0 mA

Operational time expected is 41.67 days

Calculation:

$$\frac{\text{Battery Capacity}}{\text{Current Draw}} = \frac{9000\ \text{mA/Hr}}{9\ \text{mA}} = 1000\ \text{Hr} = 41.7\ \text{days}$$

EXAMPLE 2: Data Logger with 1DC Volts MOD and 1 RTD MOD

	Current Draw
Data Logger	8.0 mA
Voltage MOD 13	0.0 mA
RTD MOD 07/17	5.5 mA
TOTAL DRAW	13.5 mA

Operational time expected is 27.78 days

Calculation: $\frac{9000\ \text{mA Hrs}}{13.5\ \text{mA}} = 667\ \text{hours} = 27.8\ \text{days}$

EXAMPLE 3: Data Logger with 4 Thermocouple MODs in use

	Current Draw	Total
Data Logger	8.0 mA	8.0 mA
4 Thermocouple MODs	5.0 mA each	20.0 mA
Total		28.0 mA

Operational time expected is 13.39 days

Calculation: $\frac{9000 \text{ mA hrs}}{28 \text{ mA}} = 321 \text{ hrs} = 13.5 \text{ days}$

TABLE 8-1
COMPONENT CURRENT DRAW

ITEM	INPUT TYPE	CURRENT DRAW
OM-160	Data Logger	8.0 mA
MOD 02	Thermistor	0.5 mA
MOD 03	Thermistor	1.0 mA
MOD 04/15	K Thermocouple	5.0 mA
MOD 05/16	J Thermocouple	5.0 mA
MOD 06	J Thermocouple	5.0 mA
MOD 07/17	RTD	5.5 mA
MOD 08/09	RTD	5.5 mA
MOD 10	4-20 mA	0.0 mA
MOD 11	0–100 mA	0.0 mA
MOD 12	0–100mV	5.0 mA
MOD 12B	-80 to +100mV	5.0 mA
MOD 13/14	0-2V/2000mV	0.0 mA
MOD 13B	-1 to +1V	5.0 mA
MOD 20	0–600ACV	5.5 mA
MOD 21/21A	0–1000 Amps AC	5.5 mA
MOD 23	Event	1.0 mA
MOD PC	Pulse Count	0.0 mA
MOD 29/03	RH	2.0 mA
MOD 30	E thermocouple	5.0 mA

TABLE 8-2
BATTERY OPERATIONAL LIFE

CURRENT DRAW mA	OPERATIONAL Hours	PERIOD Days
8	1125.0	46.9
9	1000.0	41.7
10	900.0	37.5
11	818.2	34.1
12	750.0	31.3
13	692.3	28.8
14	642.9	26.8
15	600.0	25.0
16	562.5	23.4
17	529.4	22.1
18	500.0	20.8
19	473.7	19.7
20	450.0	18.8
21	428.6	17.9
22	409.1	17.0
23	391.3	16.3
24	375.0	15.6
25	360.0	15.0
26	346.2	14.4
27	333.3	13.9
28	321.4	13.4
29	310.3	12.9
30	300.0	12.5

8.2 RR-200 WALL MOUNTING PLATE

The RR-200 Wall Mounting Plate has been designed to incorporate the OM-160, up to four (4) Signal Conditioning Modules (MODS), and the RR-130 30-day Rechargeable Battery Pack and Recharger. This assembly can then be mounted to any structure. It can also be housed in either RR-205 Tamperproof Enclosure, or the RR-210 Weatherproof Enclosure. Both of these enclosures have the necessary mounting supports for the RR-200.

To install the battery pack:

1. Loosen the two phillips-head screws (do not remove), and slide the bracket up and away from the screws.

2. Place the bracket over the battery with the battery terminals facing toward the bracket.

3. Place the battery and the bracket back on the Wall Mounting Plate. Slide down over the screws and fasten the screws down to the Plate.

NOTE

The battery terminal should be facing away from the Wall Mounting Plate.

To install the OM-160 Data Logger:

1. Attach the OM-160 above the battery using the velcro pad.

NOTE

One velcro strip is attached to the Wall Mounting Plate already. The mating pad is also attached.

2. Remove the mating pad from the Plate.

3. Remove the release paper from the pad and attach the velcro pad to the backside of the OM-160.

NOTE

Attach this pad to the OM-160 so that the top edge of the Data Logger does not extend above the top of the Wall Mounting Plate.

To attach the Signal Conditioning Modules (MODS):

Up to four (4) MODS and one recharge module can be mounted to the Wall Mounting Plate. These MODS are mounted from the backside of the Plate using 4-40 x 1/4" flat-head screws. Clearance holes are provided in the Plate for this purpose. The data MODS are mounted to the right side of the OM-160. The recharger is mounted to the right side of the battery. The number and types of MODS will vary according to application.

This completes the mounting of the OM-160 and its accessories to the Wall Mounting Plate. This entire assembly can now be mounted to any structure using either the tear drop holes in the top left and right corners of the Plate, or the clearance holes in the bottom left and right corners of the Plate. Also the four clearance holes, adjacent to the holes just described, are used when mounting the Plate to the Tamperproof (RR-205) or Weatherproof (RR-210) Enclosure.

8.3 RR-205 TAMPERPROOF ENCLOSURE

The RR-205 Tamperproof Enclosure is designed for those applications where the OM-160, its MODS (Signal Conditioning Modules), and battery pack (if used), need to be protected from unauthorized access.

The Tamperproof Enclosure itself is a NEMA-1 type enclosure. It comes with a quarter-turn screwdriver lock on the front panel and a 1-1/8" hole in the bottom panel to facilitate all cabling to and from the system.

The following items are supplied loosely inside the enclosure:

1. **Menu Label** (identical to the one on the back of the OM-160), which can be conveniently placed anywhere on the inside cover to assist the operator in programming the OM-160 Data Logger.

2. A **lock** (included) can be installed on the front cover to prevent access to the inside of the box.

3. **Mounting screws** for attaching the RR-200 Wall Mounting Plate to the inside of the cabinet.

Additionally, there are four clearance holes on the back panel of the Tamperproof Enclosure. These holes are to facilitate mounting the Enclosure to a flat surface.

To attach the RR-200 Wall Mounting Plate to the RR-205 Tamperproof Enclosure:

1. Secure the Tamperproof Enclosure to the wall or structure where it is to be used.

2. Insert the RR-200 Wall Mounting Plate into the Tamperproof Enclosure by first installing the left side of the plate into the box toward the hinged side of the Enclosure. Then drop in the right side of the Wall Mounting Plate and line up the four mounting holes with the threaded studs on the inside of the housing.

3. Secure the Wall Mounting Plate to the inside of the Enclosure with the four fasteners enclosed in the package.

4. The system is now ready for installation of cables through the access holes on the bottom of the Enclosure.

8.4 RR-210 WEATHERPROOF ENCLOSURE

The RR-210 Weatherproof Enclosure is a NEMA-4 type enclosure, suitable for outdoor applications where the OM-160 Data Logger would be subject to harsh environmental conditions, such as rainfall, snow, sleet, etc. It is also ideal for those indoor/outdoor applications where the equipment is hosed down with water on a periodic basis.

The following items are supplied, loosely, inside the Enclosure:

1. **Stick On Menu Label.** This is identical to the menu label supplied on the back of the OM-160. It can be mounted anywhere on the inside of the enclosure. Its purpose is to assist the operator in programming the OM-160 itself.

2. **Water-Tight Rubber Caps.** The bottom of the enclosure is equipped with four feed-through holes that are 1-1/8" in diameter. These holes facilitate cabling to and from the OM-160 Data Logger system. The weather-tight feed-through caps can be installed in these holes when they are not used. There are four supplied.

3. **Locking Hasp.** A hasp is supplied that can be mounted to the front panel to facilitate the use of a padlock to prevent unauthorized access to the system. This will require that holes be drilled.

4. **Hold-Down Bracket.** The Weatherproof Enclosure comes with six screw-down hold-down brackets to insure the weather-tight seal of the hinged door. One of these brackets is installed before shipment. The five remaining brackets and mounting screws are supplied loosely.

5. **Wall Mounting Plate Screws.** There are four screws supplied loosely which facilitate the mounting of the RR-200 Wall Mounting Plate to the threaded studs inside the Weatherproof Enclosure.

Installation of the Weatherproof Enclosure:

1. There are four clearance holes in the base of the Weatherproof Enclosure. These holes facilitate mounting the case to the wall or structure to be used for mounting the system. Hardware for this mounting is not supplied.

2. Once the Weatherproof Enclosure has been mounted in its position, the RR-200 Wall Mounting Plate can be installed by first tipping the left side of the Wall Mounting Plate (once the OM-160 Data Logger accessories have been installed) into the case and then dropping in the right side. Next, align the mounting holes in the base of the Weatherproof Enclosure.

3. With the four mounting screws supplied, secure the Wall Mounting Plate to the back of the Enclosure.

4. Install the weather-tight caps in the clearance holes in the base of the Enclosure for those holes that are going to be used. The remaining holes, which will be used for input and output cabling, should contain weather-tight feed-through connectors. These holes also facilitate the mounting of 3/4" conduit. Once these connectors have been mounted, all cabling can then be fed to and from the OM-160 Data Logger System.

5. Program the OM-160 and start the recorder session per instructions in the Operator's Manual.

6. Close the cover and secure tightly with the six hold-down clamps supplied.

7. Padlock the system with the hasp supplied, if desired.

NOTE

If the hasp is to be used, read the installation instructions supplied with the hasp itself, and proceed accordingly. This completes installation.

8.5 RR-100 INPUT CONNECTOR KIT

Refer to Figure 8-2.

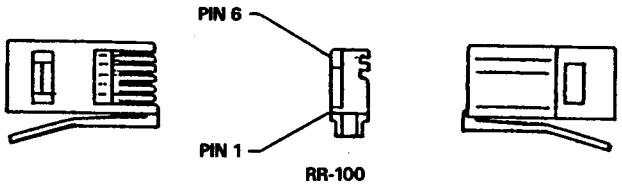


Figure 8-2. RR-100 Input Connector

CONNECTION END VIEW	
PIN #	**FUNCTION**
6	Power for Amplifier (V_{POWER})
5	Sensor Excitation (V_{SIG})
4	+ Signal Input
3	Signal Ground
2	Pulse Count Input (CH1-3)
1	Power Ground

The description of pin 1 through 6 of the RR-100 Input Connector is as follows:

PIN	DESCRIPTION
1	Power common for amplifier power return. No channel to channel isolation. Pin 1 on all channels tied together.
2	3VDC maximum input unprotected. Used for pulse counting (rate) as a digital input. Only available on channels 1, 2 and 3.
3	Signal common. Clean return for sensor excitation. No channel to channel isolation. Pin 3 on all four channels are tied together.
4	Positive signal input to Data Logger from sensor or amplifier. Span is 0-2VDC unprotected. The absolute maximum input is %3VDC.

CAUTION

Damage to the Data Logger may result if Maximum input is exceeded (refer to Step 4).

5	Unregulated 3.5%0.5VDC at 1.5mA maximum for use where clean power is required to excite sensors such as thermistors, RTD, etc.
6	Unregulated 3.5%1.5VDC for external amplifier. This is a pulsed signal with a duty cycle of 200ms on and 450ms off, typical. Current not to exceed 2.5mA.

NOTE

Recommend Belden Cable #RI-47851 (six conductor #26 AWG Keyboard Cable).

SECTION 9 BIPOLAR MOD CALIBRATION, AND CLAMP-ON CURRENT TRANSFORMERS

BIPOLAR MOD CALIBRATION

MOD TYPE: 12B
RANGE: -80 to 100mV DC

1. Plug MOD into appropriate channel and turn on the OM-160.
2. Select DEFINE mode from Data Logger menu and press "ENTER"; SENSOR is now flashing.
3. Press "ENTER". Use SELECT key to indicate channel.
4. Press "ENTER". Type 00 is now flashing.
5. Via the SELECT and ENTER keys, program in type 12 and press "ENTER" to get calibrate into the display (refer to Section 6.7 for more information on the sensor type selection).
6. Place the CAL switch, located on the DATA MOD, to CAL1 (refer to Figure 9-1).
7. Press "ENTER". POINT 1 will flash momentarily, followed by a value.
8. Press "ENTER". The display should now read P1 + 000.0MV ± a few millivolts with the plus sign flashing.
9. Using the SELECT key to change the display that is flashing and the ENTER key to accept the display, correct the display to now read P1 - 80.0MV. With all digits flashing, press "ENTER".
10. POINT 2 will now flash, momentarily, followed by a value.
11. Place the CAL switch on the data MOD to CAL2 (see Figure 9-1). The display will now read P2 + 061.7MV ± a few tenths of a millivolt. Press "ENTER".
12. Using the "SELECT" and "ENTER" keys, correct the display to read P2 + 031.4MV. Press the "ENTER" key with all digits flashing and the next channel will show in the display.
13. Press both "ENTER" and "SELECT" key simultaneously. READY will flash.

You have now completed the 2-point calibration for the MOD Type 12B. Your Data Logger and OM-160 software will display a scale of -80.0 to +100.0mV DC.

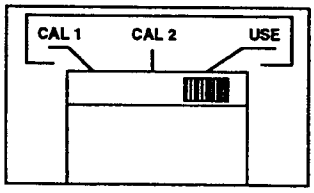


Figure 9-1. MOD Calibration Switch

BIPOLAR MOD CALIBRATION

MOD TYPE: 13B
RANGE: ±1.0 Volt

1. Plug MOD into appropriate channel and turn on OM-160.
2. Select DEFINE mode from Data Logger menu and press "ENTER"; SENSOR is now flashing.
3. Press "ENTER". Now use the "SELECT" key to index to the channel in use.
4. Press "ENTER"; type 00 will now be flashing.
5. Use the SELECT and ENTER keys to program the OM-160 to type 13.
6. Press the "ENTER" key to get 'CALIBRATE' into the display (refer to Section 2 for more information on this procedure if necessary).
7. Place the CAL switch located on the rear of the MOD to CAL1 (refer to Figure 9-1).
8. Press "ENTER"; POINT 1 will flash momentarily, followed by a value.
9. Press "ENTER"; the display should read P1 + 0.000V (± a few millivolts) with the plus sign flashing.
10. Using the SELECT key to change the display and the ENTER key to accept the display digit by digit, correct the display to read P1 — 1.000V. When all digits are flashing, press "ENTER".
11. Now POINT 2 will flash momentarily followed by a value. Place the CAL switch to CAL 2. Press "ENTER"; display will now read P2 +1.235V. (± a few millivolts).
12. Using the "SELECT" and "ENTER" keys as in step 10, change the display to read P2 +0.235V. Press "ENTER" when all the digits are flashing to accept this new calibration.
13. Press both "ENTER" and "SELECT" key simultaneously. Ready will flash.

This completes the 2 point calibration of MOD 13B. Your OMEGA OM-160 Data Logger and application software will display a scale of -1.000 to +1.000 Volts DC. You should place the switch on the MOD to the USE position. The system is then ready to accept data within that voltage range.

MOD 29/03 OPERATING INSTRUCTIONS

SET UP

MOD 29/03 is a combination relative humidity and temperature sensing probe. All MOD electronics are incorporated within the housing of the probe itself. This probe comes equipped for direct plug-in to the OMEGA OM-160 data logger. Any of the four channels may be used for either temperature or humidity measurement.

To select humidity measurement, select Sensor Type 29 in the setup mode.

To select the temperature measurement, select Sensor Type 03 in the setup mode of the data logger.

PROBE CARE

This probe is designed for use in breathable atmospheres of survivable temperatures and pressures. For prolonged life avoid chemicals which are harmful to Chromium or Cellulose Acetate. Polluted, smokey, dusty or other hostile environments may require frequent probe re-calibration.

If dusting is necessary, use clean oil-free air to gently blow particles from the sensing elements.

Allow adequate air flow around the probe but avoid drafts and windy areas.

Prevent rapidly fluctuating temperatures by avoiding heating and cooling sources such as direct sunlight, etc.

When taking hand-held reading, hold the probe away from your body and wave it gently through the air.

****

MOD 29/03 RE-CALIBRATION PROCEDURE

GENERAL

MOD 29/03 is factory pre-calibrated and under normal operating conditions will not require re-calibration for at least one year.

EQUIPMENT NEEDED

- stabilized hydrated salt solutions of:
  reagent grade LiCl (lithium chloride)
  reagent grade NaCl (sodium chloride)
- Jewelers screwdriver
- 0.281" die-cut pressure sensitive labels

PROCEDURE

Before calibration, refer to "Secondary Humidity Standard Using Saturated Salt Solutions". Allow probe to stabilize at the same temperature as the salts before proceeding with the calibration. The area where calibration is done must be free of drafts and sources of uneven temperature such as radiators, sunny areas, air conditioning ducts, etc.

1. Carefully place the probe in the NaCl bottle (75% RH). Take care not to let the solution touch the probe.
2. Allow to stabilize for one (1) hour and adjust the wet trimmer (probe center) to read 75.8% RH.* For temperatures other than 25°C, adjust for the corrected RH reading from Table 1.
3. Immerse the probe in the LiCl bottle (12% RH). Take care not to let the solution touch the probe.
4. Allow to stabilize for one (1) hour and adjust the dry trimmer (probe's cable end) to read 12.0% RH. * For temperatures other than 25°C, adjust for the corrected RH reading from Table 1.
5. Repeat steps 1 through 4 until desired accuracy is reached.

* NOTE: The trimmer located nearest the probe's sensor end factory set and should not be adjusted.

TABLE 1

SALT	°C	20	25	30	35
NaCl	%RH	75.5	75.8	75.6	75.5
LiCl	%RH	12.4	12.0	11.8	11.7

DO NOT CALIBRATE BELOW 20°C

****

SECONDARY HUMIDITY STANDARD USING SATURATED SALT SOLUTIONS

Creating a primary standard source of known, constant, humidity involves mixing of completely saturated gases with perfectly dry gases in accurate ratios at known temperatures, and pressures. For day to day humidity calibration, this method involves such painstaking techniques and is so prone to possible error that it is not practical for general use in calibration of humidity sensors.

Secondary standards using saturated salt solutions are used in industry almost exclusively. When properly constructed and maintained, a salt solution will give excellent repeatability over long periods of time. Deviations of no more than ±1.5% RH from the NIST results can be expected with a simply constructed device. The following rules must be satisfied.

1. Use distilled water.
2. The salt must be chemically pure.
3. The air in the container should be stirred with a tiny fan (motor must be outside the vessel).
4. The solution area must be as large as possible compared to the vapor space above.
5. Use a glass vessel, don't stir the salt with a material that could be attacked by the salt being used. No accidental contamination of any kind including airborne should be permitted.
6. Vapor and solution must be at the same temperature. Use an insulated enclosure if necessary. Allow plenty of time for stabilization after the sensor is inserted.
7. Vessel cover assembly should be very tight but not hermetic.

MIXING THE SALT

Create a "slush" by adding distilled water to the crystals stirring constantly. The slush should have an excess of undissolved crystals but with no crystals protruding above the surface. Crystals on the side of the vessel should be scraped down into the slush. These dry crystals will reduce the equilibrium humidity the same as if they were protruding above the surface of the slush.

Heat is created when water is added to some of the salts. It will take at least 24 hours for the generator to stabilize at its characteristic humidity. Monitoring the humidity during this period will indicate when stabilization finally occurs.

The equilibrium relative humidity for some useful salt solutions is tabulated below:

(FOR REFERENCE ONLY)

COMMERCIALLY PURE SALT	FORMULA	EQUILIBRIUM RELATIVE HUMIDITY 68 F (20 °C)	77 F (25 °C)	86 F (30 °C)
Potassium Acetate	$KC_2H_3O_2$	23.3	22.7	22.0
Magnesium Chloride	$MgCl_2 . 6H_2O$	33.6	33.2	32.8
Potassium Carbonate	$K_2CO_3 . 2H_2O$	44.0	43.8	43.5
Magnesium Nitrate	$Mg(NO_3)_2 . 6H_2O$	54.9	53.4	52.0
Sodium Nitrate	$NaNO_2$	65.3	64.3	63.3
Sodium Chloride	NaCl	76.5	75.8	75.6
Ammonium Sulfate	$(NH_4)_2SO_4$	80.6	80.3	80.0

Kits for construction of secondary humidity standards are available from OMEGA Engineering.

SPECIFICATIONS

GENERAL

STORAGE TEMPERATURE:	-20 to +70°C
OPERATING TEMPERATURE:	-10 to 60°C
OPERATING HUMIDITY:	2 to 98% non-condensing
EXCITATION VOLTAGE:	3.9VDC nominal
CURRENT DRAW:	600 microamperes nominal
DIMENSIONS:	0.5"Dia. x 7.75"L
CABLE LENGTH:	12 foot standard

HUMIDITY SENSOR TYPE 29 (12)

MEASUREMENT RANGE:	0 to 100% relative humidity
NON-LINEARITY:	<2%
HYSTERESIS:	<1%
STABILITY:	±2% per year (calibrate yearly)
RESPONSE TIME:	<1 second for a step change of 45 to 95% RH (to 63% of deviation at constant temperature)
SENSOR TYPE:	Thin film capacitive

TEMPERATURE SENSOR TYPE 03

MEASUREMENT RANGE:	-10 to 60°C
TOLERANCE:	±0.25°C
STABILITY:	±0.2°C per year
RESPONSE TIME:	0.6 seconds (to 63% of deviation)
SENSOR TYPE:	Thermistor 2252Ω @ 25°C

RR-105

CLAMP-ON CURRENT TRANSFORMER

IMPORTANT
READ THIS ENTIRE INSTRUCTION SHEET BEFORE ATTEMPTING TO USE THE CLAMP-ON CURRENT TRANSFORMER.

DESCRIPTION

The AC Clamp-on Mini Current Transformer RR-105 is designed to operate with the OMEGA OM-160 equipped with MOD Type 21.

THEORY OF OPERATION

The RR-105 is a clamp-on probe designed to extend the current measurement range of the OMEGA OM-160 to 150A. Electrically, the probe is a 1000 turn coil and is equivalent to a transformer's secondary winding. The current-carrying conductor serves as the primary when inserted into the probe jaws. Current from the primary is coupled to the secondary, attenuated 1000:1, and used to drive the input of the MOD 21.

When taking measurements, the current carrying conductor is not broken and remains electrically isolated from the MOD's input terminals.

METER READINGS

When the RR-105 is connected to the OMEGA OM-160 through MOD 21 and clamped around a single current carrying conductor, the data logger will provide a direct current reading.

When measuring current in an AC line cord, the jaws should be clamped around only one conductor. If the jaws are clamped around both conductors, the currents will cancel and produce a zero reading. If the current transformer is clamped around two wires carrying current in the same direction, the sum of the two currents will be read. Reversing one of the wires causes the difference to be read. For increased sensitivity, one or more loops can be wrapped around the probe. Sensitivity is increased by the number of loops.

LOW LEVEL CURRENT MEASUREMENTS

The RR-105 is specified to measure primary currents of 2A or greater. Primary currents less than 2A will produce meter readings that are below the true value. Low level currents below 2A can be measured by looping the primary wires through the jaws so that the sum of the current through the jaws is greater than 2A. The actual current can be calculated by taking the meter reading and dividing it by the number of turns looped through the jaws.

For example: To measure a current of 300mA (0.3A), form a loop of 10 turns. Clamp the jaws around all 10 turns. The meter reading will be 3A. To calculate the correct value, divide this reading by the number of turns (in this case 10).

OPERATION

To operate the RR-105:

1. Select sensor type 21 in the data logger setup.
2. Clamp the probe around the desired current-carrying conductor. Make sure that the jaws are tightly clamped.
3. Start your recording session.

CLEANING

Use a soft cloth dampened in a mild solution of detergent and water to clean the RR-105. Do not use solvents unless absolutely necessary. A light coating of dripless oil on the jaw surfaces will prevent corrosion.

SPECIFICATIONS

CURRENT RANGE:	2A to 150A
ACCURACY:	±2%, 10 to 150A, 50/60 Hz, secondary terminated into a 1Ω shunt. ±8%, 2 to 10A, 50/60 Hz, terminated into a 10Ω shunt.
FREQUENCY RANGE:	48 Hz to 10k Hz

SPECIFICATIONS (Cont'd)

ACCURACY OUTSIDE THE 50 TO 60 Hz RANGE:	±3%, 10 to 150A, 48 Hz to 10k Hz, secondary terminated into a 1Ω shunt. ±9%, 2 to 10A, 48 Hz to 10k Hz, secondary terminated into a 10Ω shunt.
DIVISION RATIO:	1000:1
WORKING VOLTAGE:	600 VAC rms maximum
DIELECTRIC WITHSTANDING VOLTAGE:	3kVrms
MAXIMUM CONDUCTOR SIZE:	0.45"

RR-106

CLAMP-ON AC CURRENT TRANSFORMER -

IMPORTANT
READ THIS ENTIRE INSTRUCTION SHEET BEFORE ATTEMPTING TO USE THE AC CLAMP-ON CURRENT PROBE.

DESCRIPTION

The AC Clamp-on Current Probe Model RR-106 is designed to operate with the OMEGA OM-160 equipped with MOD Type 21.

THEORY OF OPERATION

The RR-106 AC Current Probe is a clamp-on probe designed to extend the current measurement range of the OMEGA OM-160 to 400A rms. Electrically, the probe is a 1000 turn coil and is equivalent to a transformer's secondary winding. The current-carrying conductor serves as the primary when inserted into the transformer jaws. Current from the primary is coupled to the secondary, attenuated 1000:1, and used to drive the input of MOD 21.

When taking a measurement, the current-carrying conductor is not broken and remains electrically isolated from the MOD's input terminals.

METER READINGS

When the RR-106 Clamp-on AC Current Probe is connected to the OMEGA OM-160 through MOD 21 and clamped around a single current-carrying conductor, the data logger will provide a direct current reading in amperes.

When measuring current in an AC line cord, the jaws should be clamped around only one conductor. If the jaws are clamped around both conductors, the currents will cancel and produce a zero reading. If the current transformer is clamped around two wires carrying current in the same direction, the sum of the two currents will be read. Reversing one of the wires causes the difference to be read. For increased sensitivity, one or more loops can be wrapped around the probe. Sensitivity is increased by the number of loops.

LOW LEVEL CURRENT MEASUREMENTS

The RR-106 is specified to measure primary currents of 4A or greater. Primary currents less than 4A will produce meter readings which are below the true value. Low level currents below 4A can be measured by looping the primary wires through the jaws so that the sum of the current through the jaws is greater than 4A. The actual current can be calculated by taking the data logger reading and dividing it by the number of turns looped through the jaws.

For example: To measure a current of 500mA (0.5A), form a loop of 10 turns. Clamp the jaws of the RR-106 around all 10 turns. The meter reading will be 5A which corresponds to a primary current of 500mA.

OPERATION

To operate the RR-106

1. Select MOD Type 21 in the data logger setup.
2. Clamp the probe around the desired current-carrying conductor. Make sure that the jaws are tightly clamped.
3. Start your recording session.

CLEANING

Use a soft cloth dampened in a mild solution of detergent and water to clean the RR-106. Do not use solvents unless absolutely necessary. A light coating of dripless oil on the jaw surfaces will prevent corrosion.

SPECIFICATIONS

CURRENT RANGE:	4A to 400A rms (max)
FREQUENCY RANGE:	48 Hz to 1000 Hz
DIVISION RATIO:	1000 to 1
ACCURACY:	±3% + 0.4A (4 to 400A, 48 to 1000 Hz) Conductor centered on the jaw alignment marks. Output terminated to have a burden voltage of 400 mV maximum. Specification valued from 0 to 50°C at 0 to 85% RH, 35 to 50°C at 0 to 70% RH.
MAXIMUM OPERATING VOLTAGE:	660 VAC/rms
DIELECTRIC WITHSTANDING VOLTAGE:	4000V at 60 Hz
OPERATING TEMPERATURE:	-10 to +60°C
STORAGE TEMPERATURE:	-40 to +60°C
OUTPUT CONNECTIONS:	1.5 meter cable terminated with 2 banana plugs with safety design

RANGE	MOD	RESOLUTION	DISPLAY UNITS
-200 to 850°C	07	1°C	°C
-330 to 1560°F	17	1°F	°F
-200 to 260°C	08	0.1°C	°C
-300 to 500°F	18	0.1°F	°F

SENSOR TYPE: 100 ohms Platinum at 25°C
DIN std 43760
Alpha = 0.00385

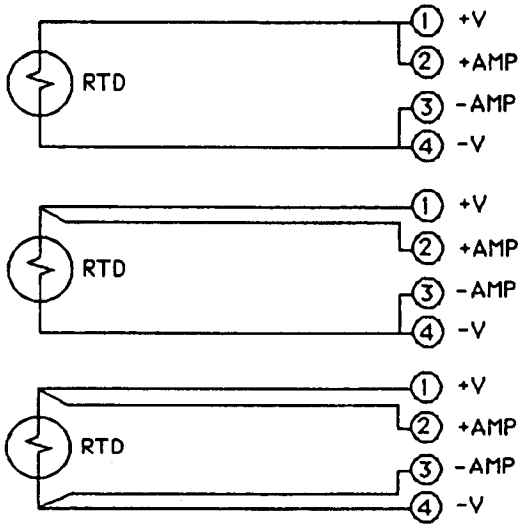
MOD ACCURACY: 0.3% of full scale (all)

ISOLATION: None

RTD EXCITATION: 3.5v ± 0.5V at 1.5mA

INPUT CONNECTOR: Miniature 4 wire plug, TA4F provided

Pin assignment - looking into MOD



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