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# ESC 8800 DATA LOGGER USER'S MANUAL

## OEPA 8800 Software Version 2.0

Prepared By:

Environmental Systems Corporation
200 Tech Center Drive
Knoxville, TN 37912

October, 1995

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## NOTICE

This manual was written to help you install and operate the ESC 8800 environmental data logger. Our goal was to explain, as completely as possible, how to set up and use the logger with a wide variety of optional equipment and instrument interfaces. Additional information can be found in the reference material section at the end of the manual.

If, for any reason, you require assistance, please contact our technical support department at 1-800-688-7930.

While every effort has been made to insure that the information in this document is complete, accurate, and up-to-date, ESC reserves the right to expand, alter, or clarify the various sections of this manual as necessary.

Environmental Systems Corporation (ESC) makes no warranty and assumes no liability for the correctness of the information contained herein.

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**APPENDICES**

**Appendix A DDT88 Monitor Manual**

**Appendix B YSI Temperature Probes and Their Connection to the 8800**


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# 1.0 INTRODUCTION

## 1.1 General Description

The 8800 data logger is a microprocessor based data acquisition system designed specifically to acquire, process, store and telemeter environmental data. The standard unit consists of a microprocessor (Z180), analog input multiplexer, programmable gain amplifier, analog to digital converter, random access memory (RAM), read only memory (ROM), power supply, and battery backup for the clock and data storage. Optional equipment* includes digital inputs/outputs*, modems* (internal or external), an external RAM storage cartridge*, a cartridge reader*, a keyboard/display*, and printing terminals*. Figure 1.1 shows a simplified block diagram of the 8800 data logger. A brief description of the major data logger components follows.

### 1.1.1 Analog Inputs

The standard 8800 data logger accepts up to 8 differential analog inputs (8 additional analog inputs and two YSI Temperature Probe inputs optional) with four full-scale voltage range choices of ±100mV, ±1V, ±5V, or ±10V. The analog input section is composed of a multiplexer to select the line to be sampled, a programmable gain amplifier for input voltage range selection and a 12 bit analog-to-digital converter.

The analog input multiplexer samples each input line at a rate of approximately once per second. A programmable gain amplifier is then used, which allows each channel to be individually configured in software to one of the four input voltage ranges given above. The analog-to-digital converter then converts the information.

*An Asterisk is used throughout this manual to identify optional equipment.



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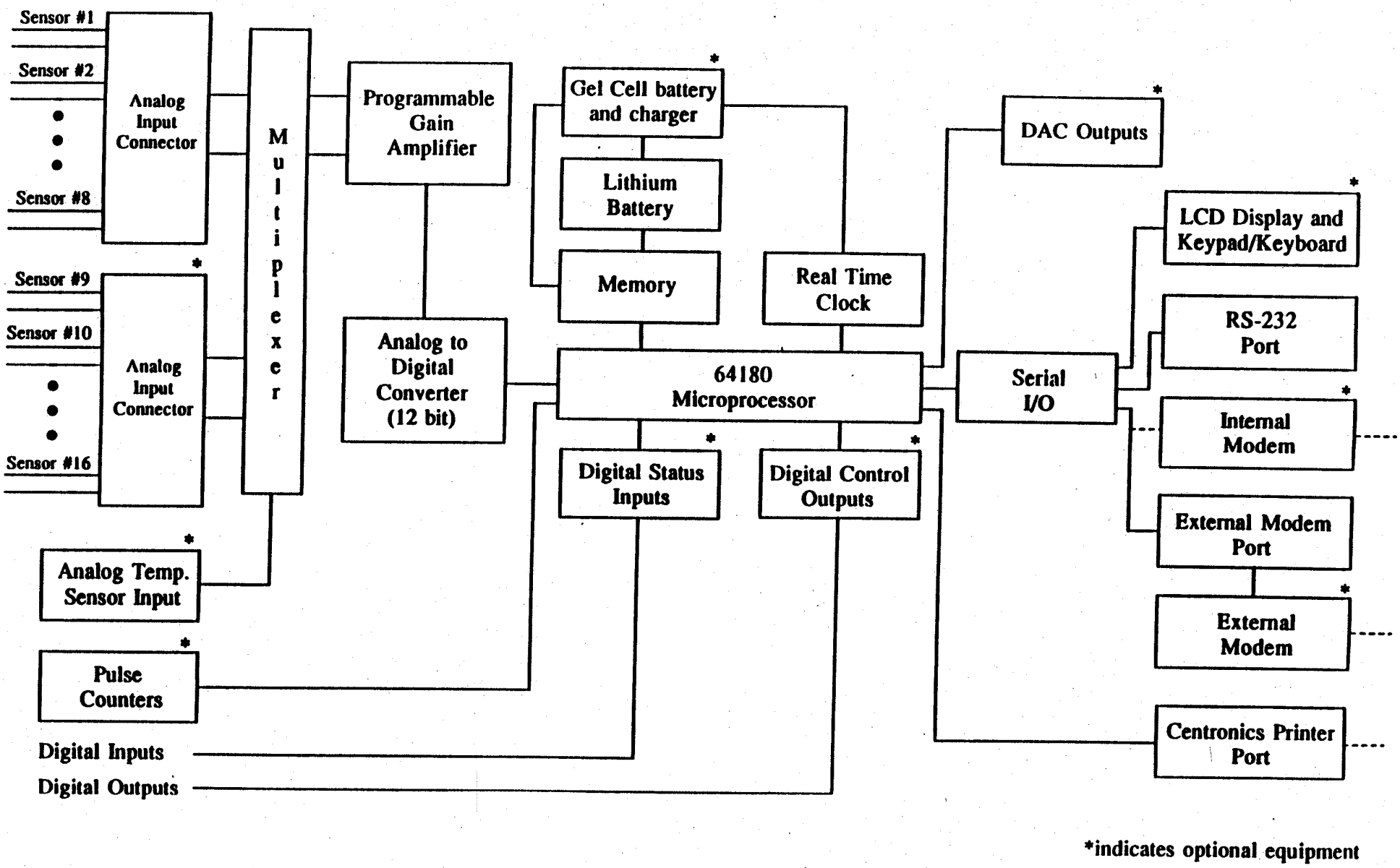



Figure 1.1: 8800 Block Diagram

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The analog inputs are true "differential" type inputs, meaning that the data logger measures the difference in voltage between the positive and negative terminals for each channel. A voltage of up to 11 volts (relative to ground) that is common to both terminals (common_mode voltage such as noise) is cancelled and does not affect the signal voltage.

The analog-to-digital converter (A/D) has a resolution of 12 bits, plus an additional "sign" bit, with a temperature stability better than 25 PPM/C. The use of high quality components throughout the instrument results in a guaranteed accuracy of ±0.1% of the full scale analog input voltage range for all ranges.

### 1.1.2 Real-time Clock

The real-time clock is crystal controlled and the date, hour and minutes are easily set by the operator, both remotely via telephone (with modem*) and locally via keyboard/terminal*. (The year and all leap-year information is controlled by the microprocessor and is stored in CMOS RAM.)

### 1.1.3 Random Access Memory

The standard 8800 data logger is supplied with 44 Kbytes of RAM for operation system use, plus 20 Kbytes of data storage RAM, which is sufficient to store approximately one month of hourly averages for 4 instruments. The data RAM for the 8800 data logger can be expanded to 212 Kbytes* (in 32 Kbyte increments).

Optionally, an external RAM cartridge interface can be supplied, which allows data storage in removable, solid state cartridges. These cartridges are available with memory capacities from 64 to 512 Kbytes. The logger automatically recognizes the installed memory size and addresses it properly, thus making it easy to expand memory as storage needs grow.



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### 1.1.4 Battery Backup

The 8800 data logger offers two forms of battery backup. The first form is the use of a lithium battery to power the RAM and clock circuit during power interruption. This is standard on the 8800 data logger and can power the RAM data and clock for a minimum of 30 total days guaranteed.

The second option includes the standard lithium battery, but also includes an optional gel cell battery with battery charger. The gel cell battery offers charging whereas the lithium battery can not be recharged. The gel cell battery is recommended in any areas where power outages are frequent or extended, which can cause discharging of the lithium battery and lost data.

The gel cell with charger overcomes lost data by recharging after each power outage. The charger operates in two modes; a trickle charge mode is used when a power outage was brief, and a deep charge mode if the outage was severe. This two charge process gives the highest guarantee against data loss.

### 1.1.5 Communication Ports

The standard data logger includes two RS-232C serial ports, as shown in Figure 1.1. One port is labeled External Modem for direct connect to a modem* or computer* for setup and data retrieval. The second port, labelled RS-232, may be connected to a keyboard* or printing terminal* for local interface to the logger. Since the instrument operates in a multi-tasking mode, either (or both) of these ports may be active without interfering with the routine tasks of data collection and storage. Communications with the 8800 data logger is covered in greater detail in Section 2.3.

### 1.1.6 Digital I/O

Both digital status input* lines and digital control output* lines can be provided for the 8800 data logger (in groups of 8 to 16 maximum for both inputs



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and outputs). A typical configuration consists of 8 digital status input lines and 8 digital output control lines. All output control lines are solid-state optically coupled relays capable of switching up to 130 mA. Activation of these digital control ouput lines can occur automatically from data logger software, or on command through one of the RS-232 ports.

Digital input lines are used to monitor the status of events external to the logger (contact closures indicative of instrument calibration cycles, alarms, etc). The status of these lines is monitored continuously by the logger, and can be used to flag or invalidate data, or activate digital output lines.

### 1.1.7 Software

The data logger is supplied complete with operating program stored in non-volatile ROM. It automatically scans the analog inputs at a fixed rate, computes averages of all parameters, performs scaling, stores the data in RAM and transmits it on command to a central facility.

In the event of a power failure and unit shutdown, the operating program will automatically reboot the data logger to the operating configuration software as soon as power is restored. In the meantime, the battery-backed clock and memory will retain all stored data, as well as the time of the power outage for later reporting and analysis.

On start-up, the software automatically initiates a PROM test and reports the results. In addition, a system monitor EPROM can be provided which allows diagnostics to pinpoint hardware errors (see Appendix B, DDT-88 Monitor Manual). The test routines can also be initiated from either of the RS-232C communication ports.



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## 1.2 Specifications

### 1.2.1 Hardware Specifications

| | |
|---|---|
| Dimensions: | 4.5 x 10-1/2 x 20 inches |
| Weight: | Approximately 11 lbs, (27 lbs in shipping container) |
| Mounting: | 19" Rack* or Bench Mount |
| Power: | 120 VAC ± 10% |
| | 60 Hz ± 5 Hz |
| | Less than 50 watts continuous |
| Battery Backup: | 100 mA-Hr standard lithium cell |
| Temperature Range: | 0°C to 50°C (operating and non-operating) |
| Humidity: | 0 to 95% (non-condensing) |
| Analog Inputs: | 8 differential (double-ended) with programmable gain amplifier |
| Resolution: | 12 bits plus sign (1 part in 4096) |
| Accuracy: | ± 0.1% of full-scale |
| Range: | ± 0.1v, ± 1v, ± 5v, ± 10v full scale |
| Input Resistance: | Greater than 10 megohm (input either active or inactive) |
| Common-mode Limit: | Voltages greater than ± 11v relative to analog ground |
| | cannot be measured. |
| Memory: | ROM - 128 K |
| | RAM - 44 K Operational |
| | 20 K Data Storage Memory |
| Data Ports: | RS-232 port (DCE configuration) |
| | Rate - 300 baud default, software programmable |
| | from 300 to 19200 baud |
| | Mode - Full duplex, asynchronous, 8 data bits, 1 stop |
| | bit |



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External Modem port (DTE configuration)

Rate - 300/1200 baud default, software programmable from 300 to 19200 baud

Mode - Full duplex, asynchronous, 8 data bits, 1 stop bit

Optional Equipment:

- Analog Inputs - Expansion to 16 total inputs (double-ended)
- Digital Status Inputs or Control Outputs - Groups of 8 each (2 groups each, max.)
- External Modem
- 1.2 A-Hr rechargeable gel cell battery
- Data RAM Expansion - 32 Kbyte increments to 224 Kbytes max.
- DSC-80 Data Storage Cartridge - 64 Kbyte to 512 Kbyte
- DCR-80 Data Cartridge Reader
- KD-80 Keyboard/Display
- Data Retrieval System
- Digital to Analog Converter Outputs
- Digital Rainfall Counters
- Precision 1.00 Volt Reference Output
- ESC Temperature Sensor Input

### 1.2.2 Software Features

- Interactive (question and answer) initialization procedure
- Three level password protection
- "HELP" command listing
- Fixed averaging period of one hour plus one auxiliary averaging interval (1,2,3,4,5,6,10,12,15,20, or 30 minutes).



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- Ability to store or not store averages, sigmas, percent valid, and range (min. & max. values), for both hourly and auxiliary intervals, for each channel
- Can display raw voltages or engineering units of one or all channels and can continuously update these values
- Can automatically display averages as they are computed
- Automatic generation of messages when the site operator logs on
- Automatic testing of ROM memory on power-up or reset
- Manually initiatable test of all RAM and EPROMS
- Error-checked compacted data communications format (Command/Response mode) for computer transmission to a central computer (via telephone, radio link, or remote milking)
- Formatted report of hourly or auxiliary averages for any data stored in memory
- Automatic display of hourly report once each day can be enabled
- Printer/terminal* can be connected and set to print response to all commands

Additional Stored Information:

- Maintains log of first 20 power-out times
- Maintains log of last 64 edit exceptions
- Maintains log of first 128 input lines that change state
- Maintains log of at least 137 calibrations
- Buffer for up to four 80 character messages from the site operator to the central computer
- Buffer for up to four 80 character messages from the central computer to the operator
- Data flagging based on status input line pattern

Computations:

- Standard deviation of hourly and/or auxiliary average on any channel
- Corrections for wind direction discontinuity



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- The sigma-theta algorithm is corrected for zero crossing to compute sigma on vector or scalar wind direction channels.
- EPA sigma-theta (Yamartino's)

Channel Types:

- Vector wind speed
- Vector wind direction
- Scalar wind speed
- Scalar wind direction
- EPA sigma-theta
- Summation of two channels
- Difference between two channels
- Product of two channels
- Quotient (ratio) of two channels
- Standard gas instrument
- Rainfall (digital or analog input)
- YSI Temperature Probes
- Solar radiation
- Two types of tape sampling
- Sine component (i.e. Vy of vector wind)
- Cosine component (i.e. Vx of vector wind)
- Coefficient of Haze sampling
- Math Pak channel for equation use

Calibrations:

- Individual calibration cycle for each channel
- Choice of three phase calibration (zero, span #1, span #2, recovery) and a calibrator controlled calibration (up to 10 steps)
- Selectable duration of calibration phase lengths



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- Calibration phase order may be varied (in three phase calibration)
- Variable calibration cycle start time
- Alternate weekly calibration program
- Operator initiated calibration cycle
- Instrument initiated calibration monitoring
- Calibration status report
- Calibration data report
- Activation of up to 3 digital output lines for each calibration phase

## 1.3 Warranty Information (Does Not Apply to Lease Arrangements)

ESC warrants the 8800 data logger to be free from defects in material and workmanship. ESC's obligation under the warranty is limited to servicing or adjusting the logger when returned to their offices in Knoxville, Tennessee, for that purpose, and to making repairs at their offices of any part thereof (except batteries), which shall, within one year after delivery, be returned by the original purchaser, and which upon examination shall disclose to ESC's satisfaction to have been defective. If the fault has been caused by misuse, modification or abnormal conditions of operation, repairs will be billed at a normal cost. In this case, if requested, an estimate will be submitted before work is started.



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# 2.0 FAMILIARIZATION

## 2.1 Unpacking & Initial Inspection

This instrument was carefully inspected both mechanically and electrically before shipment. First, confirm that there is no evidence of damage to the exterior of the shipping container. Carefully remove the data logger and optional equipment from the container, and check all parts against the packing list for completeness. Store the container and shipping materials for later re-use should it be necessary to support any damage claims, or to return the instrument to the factory for warranty or repair.

Inspect all components for signs of physical damage. If there is any sign of damage, document your observations (photographs are recommended) and immediately file a claim with the carrier.

Note the instrument model number and serial number, which appear on a tag at the bottom rear of the data logger. This information should be included in any future communication with ESC regarding the instrument.

## 2.2 Panel Layouts

Please take a few moments to familiarize yourself with the following figures and accompanying text. They will be referred to at various points throughout the manual.

### 2.2.1 Front Panel

Figure 2.1 shows the front panel for a standard 8800 data logger, consisting of:

- Keyboard
- LCD Display



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- Data Cartridge Interface
- Contrast Knob

If a DSC-80* memory cartridge interface option is installed the data cartridge may be inserted. If this option is included on your data logger, please note that the cartridge should be installed or removed with the power off, and it can only be installed with the printed side toward the display, as the connector slot is polarized to prevent incorrect insertion.

### 2.2.2 Rear Panel

A typical rear panel for an 8800 data logger (with optional internal modem*) is shown in Figure 2.2. The rear panel may be fully populated with all the connection even if the options for the additional connectors are not implemented in your logger.



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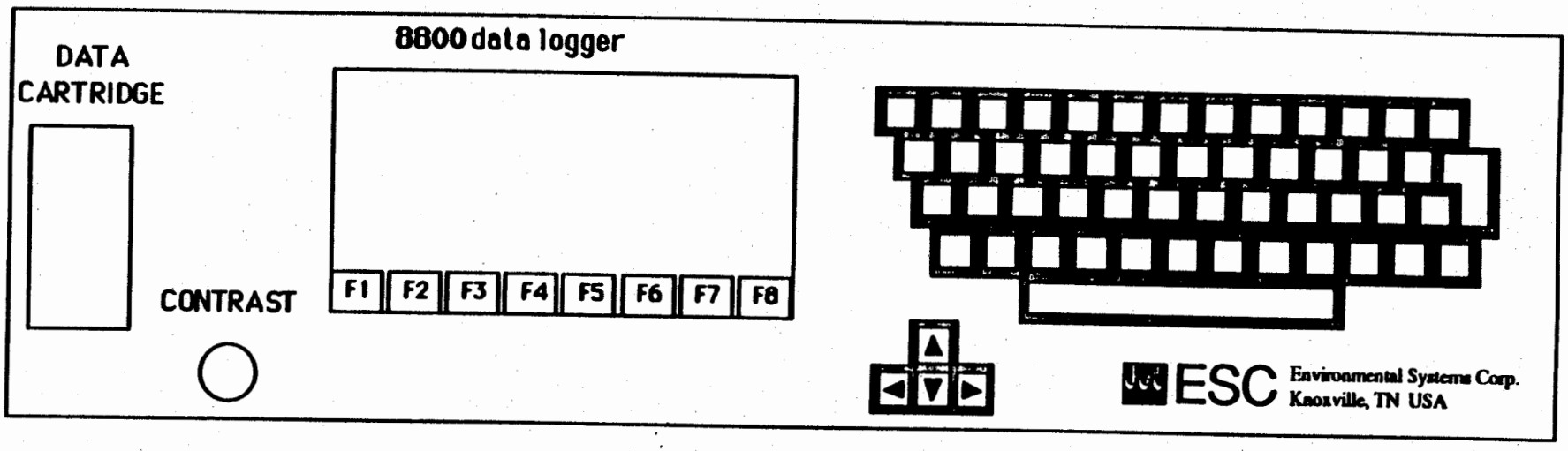



Figure 2.1: 8800 Data Logger Front Panel

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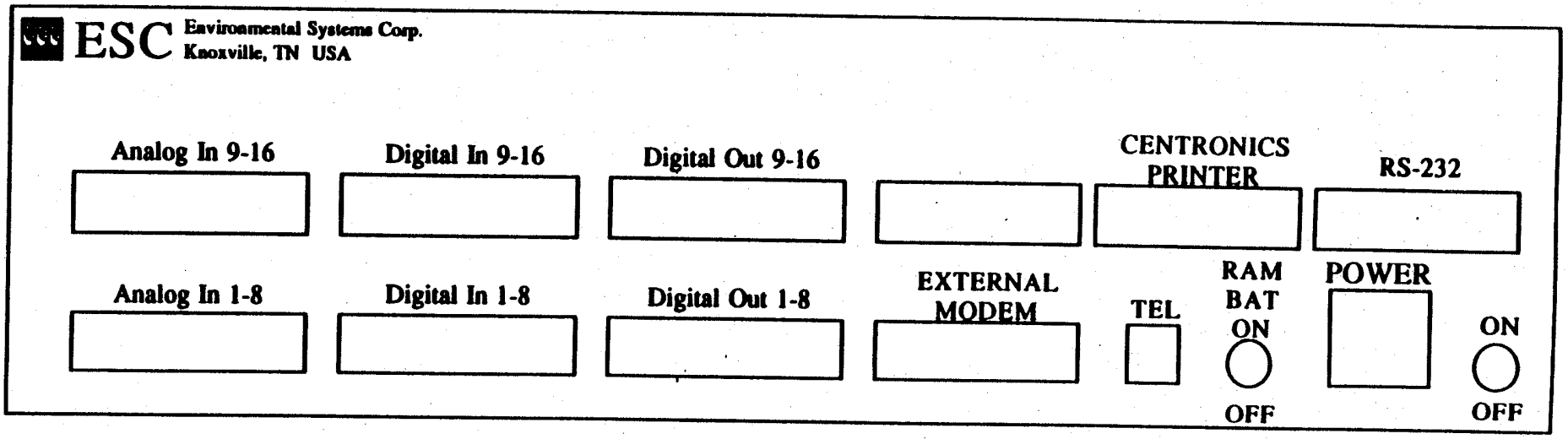



Figure 2.2: 8800 Data Logger Back Panel

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TABLE 2.2

8800 DATA LOGGER REAR PANEL CONFIGURATION

| Designator | Description |
|---|---|
| Analog In - | Connectors for double-sided analog inputs. Normal Configuration of 8 inputs, expandable to 16* with supplementary connector. |
| Digital In - | Connectors for digital inputs for status sensing. Normal configuration of 8, expandable to 16* with supplementary connector. |
| Digital Out - | Connectors for digital ouputs for digital control of external devices. Normal configuration of 8 outputs, expandable to 16* through supplementary connector. |
| DAC Output Connector - | Outputs for the digital-to-analog converters* in the 8800 data logger (not implemented on AMB systems). |
| External Modem Connector - | Serial port connection for an external modem* for remote communication. May be directly connected to a computer for local communication. |
| Centronics Printer - | Allows direct connection to Centronics Printer.* |
| RJ11 connector - | Not used. |
| RAM Battery Switch - | Disconnects the internal battery output to prevent discharge during extended storage periods. This switch must always be "ON" (up position) when the 8800 data logger is in service. |
| Temperature Probe Connector* - | Direct Connection for up to two YSI Temperature Probes* (YSI #44018 or Equivalent) |
| RS-232 connector - | RS-232 serial port connection for local communication. |
| AC power connector - | For connection to 120 VAC, 60 Hz power. |
| Power Switch | |

*Denotes Optional Equipment



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## 2.3 Connecting a Terminal

In order to determine if the 8800 data logger is functioning properly, it is necessary to communicate with the instrument. If an LCD display is not provided a suitable terminal should be used. This section gives instructions for connecting a generic terminal (CRT, PC, etc.) as well as specific instructions for ESC supplied options which may be used as terminals. Read the subsection corresponding to the terminal of your choice, then proceed to Section 2.4 for initial startup information.

### 2.3.1 User Supplied Terminal

A device such as a CRT or personal computer, which operates as a terminal, may be used to communicate with the 8800 Data Logger. The following general information is provided.

1. Connect a suitable null modem cable from the terminal to the "External Modem" port, or connect a straight RS-232 cable to the "RS-232" port (i.e. the "External Modem" port operates in DTE mode and the "RS-232" port operates in DCE mode). The cable must have a male connector on the data logger end. Refer to Figure 2.3, on the next page, for the null modem pin connection information, if necessary. If the External Modem port is to be used for local terminal application, it must first be removed from Command/Response Mode. This mode is used for compact communications with a Central Host and is covered in Section 5.5. The RS-232 port is already configured for local terminal use.
2. Set up the terminal with 300 baud for the RS-232 port, or 300 baud for the External Modem port. The communication parameters are no parity, 8 data bits, 1 stop bit, full duplex asynchronous operation. Refer to the terminal operating manual for specific instructions on configuring your terminal.



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- Type "STAT 38N1E" then the ENTER key to set the status of the communication port. STAT is the Model 102 command that sets the communication parameters, and the data that follows the command contains the parameters. The first number indicates the baud rate with:

| Number | Baud Rate |
|---|---|
| 3 | 300 |
| 4 | 600 |
| 5 | 1200 |
| 6 | 2400 |
| 7 | 4800 |
| 8 | 9600 |
| 9 | 19200 |

  The second number is the number of data bits used during communication, the third entry is the parity indicator, and the forth entry is the number of stop bits. The fifth value is the XON/XOFF protocol control. The 8800 data logger always communicates with 8 data bits, no parity, 1 stop bit, and XON/XOFF enabled. These parameters will never change. The only parameter to vary is the baud rate. For a greater discussion of the communications parameters, refer to the Model 102 handbooks included with the computer.

- Type "TERM" then the ENTER key to enter the terminal emulation mode.
- Along the bottom row of the display will be five words, the fourth from the left will either be "Full" or "Half". If it is "Half", press the F4 key (fourth key from the left along the top row of keys) so that the word reads "Full".
- Press the LABEL key (seventh key from the right along the top row of keys) to remove the labels from the bottom row of the display.
- The Model 102 should now be set correctly to act as a terminal for the 8800 data logger. If problems occur, refer to the Model 102 manual, or contact ESC for additional information.



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### 2.3.3 The HX-40 Display*

The EPSON HX-40 portable computer may be used as a terminal. The RS-232C port is located on the rear of the HX-40 and has a round connector. Connect the appropriate end of the cable supplied to this connector, and the other end to the 8800 data logger rear panel RS-232 port. Connect the AC adapter to the connector on the rear of the HX-40 (if applicable). Slide the power switch, located on the right side, to the on position, and adjust the "View Angle" knob as necessary to change contrast on the LCD display. Depress the CAPS LOCK key on the lower left of the keyboard and note that the "CAPS" LED is illuminated. The display should show a program menu, with the program C: TERM.COM second from the bottom on the left side. Use the arrow keys to position the block cursor over this program and press return. This lists the status of the RS-232C port. It should read: rate = 300, data = 8, stop = 1, parity = none, Xon/Xoff = enable, Si/So = disable. If it reads these values hit return. The HX-40 is now ready for use as a terminal.

If the communication parameters are not as indicated above, hold down the "shift" key and press the PF5 key two times to return to the program menu. Position the block cursor over the A:CONFIG.COM program and press return to enter the configuration program. Press 8 (communication) and follow the procedures until these parameters are set:

| Desired Parameter | Proper Setting |
|---|---|
| Bit Rate = 300 | 8 + return |
| Data Bits = 8 | 2 |
| Parity = none | 3 |
| Stop Bits = 1 | 6 |
| Xon/Xoff enable | 9 |
| Si/So disable | A |

When completed, press the <ESC> key (second from left on top row of function keys) two times to re-enter the menu. Position the block cursor over the C:TERM.COM and press return to re-enter the communication program. The status should now be correct (if not, repeat the above procedure). Hold down the "shift"



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key and press the "PF5" function key to complete the terminal setup. You may wish to refer to the HX-40 instruction manual for additional information.

## 2.4 Initial Startup

If the LCD display is not provided, connect a terminal as indicated in the previous section, we are ready to turn on the 8800 data logger and establish communication with it. Refer to the rear panel configuration diagram in Figure 2.3 as necessary when making the following connections and adjustments:

1. Make certain that the "RAM BATT" switch on the rear panel is in the ON (UP) position, and that the rear panel power switch is in the OFF position.
2. If the 8800 data logger has an optional DSC-80 RAM cartridge, install the cartridge and make sure it is securely seated.
3. Connect one end of the AC power cord to the rear panel connector on the 8800 data logger and the other end to a source of 120 V AC power. Move the rear panel power switch to the ON (UP) position.
4. With the LCD display or terminal connected as described previously, press the "RETURN" or "ENTER" key on the terminal. You should get the prompt *DCN#??>* followed by a flashing cursor, indicating that the data logger is ready to accept commands. If you do not get this response repeat the terminal setup procedures as described in the previous section. Contact ESC if you are still unable to establish communication with the data logger.



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### 2.4.1 The DCN Prompt

The response *DCN#??>* is called the DCN prompt. DCN stands for "data collection node" which is another phrase for a specific data logger used in a data collection network. Throughout this manual you may frequently find the data logger referred to as the "DCN". The DCN prompt indicates that ESC's proprietary software is enabled in the data logger, and that the logger is ready to accept commands. The characters ?? will be replaced by alphanumeric characters which provide a specific identification of this logger (or DCN) as will be shown later in this section.

### 2.4.2 Levels of Security

Before proceeding with further communications, let us first describe the levels of security which are designed into the data logger operating system to prevent unauthorized access to information or settings.

Level 0 ACCESS - At this level, only the command **TIME**, **HELP**, **VERSION**, **LOGIN**, and **SET PASSWORDS** are recognized. Communications through the RS-232 port or the front panel start here, but to use the External Modem port it must first be removed from Command/Response Mode. This mode is used for compact communications with Central Host. Removal from this mode is covered in Section 5.5.

Level 1 LOGIN - Except as indicated above, the command **LOGIN** must be typed in to obtain any data or status information from the data logger, followed by the correct password at the *PASSWORD* prompt. From this level the operator can check status, list channel information and retrieve stored data. However, commands which modify system parameters require a higher (privileged) status. The command response for login sequence is as follows:



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Command: **LOGIN**

System Response: *PASSWORD>* Type LOGIN password (<CR> is default value)

*LOGGED IN*

Level 2 PRIVILEGE - To request privileged status, the command **SET PRIV** is issued, followed by the correct password at the *PASSWORD>* prompt. The commands which require privileged status are indicated by asterisks on the command list given in Section 5.6. The command response sequence is:

Command: **SET PRIV**

System Response: *PASSWORD>* Type PRIV password (<CR> is default value)

*PRIV PERMITTED*

Level 3 PASSWORD KEY - In order to set or alter the LOGIN and SET PRIV passwords, the system password must be entered following the command **SET PASSWORDS**. The system password is embedded in the data logger software at the factory, and communicated verbally only to the system operations manager. The sequence for this command is:

Command: **SET PASSWORDS**

System Response: *LEVEL-3 PASSWORD?* (Type SYSTEM password)

*PRIV PERMITTED*

The logger then requests new PRIV and LOGIN passwords.

To remove LOGIN and PRIVILEGED status, the command **BYE** can be issued at the terminal. This is done automatically if the terminal is disconnected, or the modem answers or hangs up the line.

### 2.4.3 Initial Login & Privilege

At the prompt *DCN#??>* type the command **LOGIN**, followed by the "ENTER" or "RETURN" key. (NOTE: All commands require a carriage return or enter key, indicated by **<CR>**, to activate.) You should get the *PASSWORD>* prompt in return. If you get an *ILLEGAL COMMAND* response instead, check to make sure that the "CAPS



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LOCK" key is activated on your terminal. Remember, the data logger does not accept lower case letters in commands!!

As shipped from ESC, the default login password is a simple carriage return <CR>, so press the "ENTER" or "RETURN" key again at the *PASSWORD>* prompt. You should get the response *LOGGED IN*. If something other than the expected password is entered, the message *LOGIN FAILED!!!* will appear. Check with your system manager to see if the login password has already been established. Upon successful login, you might get an additional message, since messages previously stored in the logger remote operator message buffer are printed out upon login. Certain commands, such as **TIME**, **DATE**, **HELP**, **VERSION**, etc. (see the data logger command list, Section 5.6) are allowed at this level, and you may wish to try some at this point. Privileged commands, however, (such as **SET TIME**, **SET ID**, etc.) are not allowed at this level and will produce an *PRIV VIOLATION* response.

To enter the next level of command access, type the command **SET PRIV** which, like **LOGIN** produces the *PASSWORD>* prompt. Again, as shipped from ESC this password is simple **<CR>**, so press **ENTER** or **RETURN** to get the *PRIV PERMITTED* response. The data logger will now accept all valid commands. (For a list of these commands, type **HELP <CR>**.)

### 2.4.4 Setting Time, Date and ID

Issue the command **TIME <CR>** and observe the response. The data logger operates on a 24 hour clock (military time), so 1:00 pm will be displayed as 13:00:00 (hr:min:sc). Next, issue the command **DATE <CR>** and observe the result. The day of the week is displayed, followed by the date in the form of mo/dd/yr and the Julian day. If the time and/or date are incorrect, issue the command **SET TIME mo/dd/yr hr:min:sc <CR>** exactly in the format shown where mo/dd/yr is the correct date (month/day/year) and hr:min:sc is the correct time (hour:minute:seconds). Re-enter the **TIME** and **DATE** commands to assure that they



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are correct. If not, repeat the above **SET TIME** command. A relative command, **REPEAT TIME**, continuously reports the time from the 8800 data logger real time clock until another key is struck.

Enter the command **ID <CR>** to list the current identification codes and observe the response. You should get the response

*REMOTE ID = ??*

*REPORT ID = ???????????????????? (20 question marks)*

unless identification codes have already been established for the data logger. The REMOTE ID is a 2 character alphanumeric code which identifies the particular data logger for use by a central computer (this code will replace the ?? in the DCN prompt, when established). The REPORT ID is a string of alphanumeric characters and/or punctuation marks up to 20 characters long, which can be used to establish a more detailed description of the location or function of the data logger. This identification code is not used by the central computer except in the heading of formatted data reports. If you are ready, at this time, to set the identification codes, issue the command **SET ID** xx Text <cr>, where "xx" is 2 character alphanumeric and "text" is up to 20 characters, including punctuation. (For example **SET ID** 1A KNOXVILLE, TENNESSEE) the logger will respond with:

*REMOTE ID = 1A*

*REPORT ID = KNOXVILLE, TENNESSEE*

From this point on, you will get the same response at the **ID** <cr> command, and the "xx" value will appear in your DCN prompt (DCN#xx>).

### 2.4.5 Logger Memory Test

If a terminal or the LCD display was not already connected when you turned on the data logger, you may not have yet established communications, and so did not notice the logger "self test" when power was applied to it. Turn the power switch on the data logger to the "OFF" position for a few seconds, then turn it



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back "ON" and note the response on the terminal. Whenever power is applied to the logger, it performs internal diagnostic checks. You should see the response *"ENTERING PROM TEST"* followed by *"AQM MEMORY TEST OK"*, indicating that the tests were performed and the logger memory is responding normally. If you do not get the *"AQM MEMORY TEST OK"* response, contact the ESC service department immediately at (800) 688-7930.

Memory tests can also be initiated, at the privileged level, by typing the command.

**TEST**

The data logger should respond with:

*ENTERING PROM TEST*

*ENTERING RAM TEST* or ENTERING CARTRIDGE TEST

*TESTING 32K RAM*

*TESTING 64K RAM* (Reports in 32K increments to Max. RAM)

*AQM MEMORY TEST OK*

There is one additional response which can appear with the DSC-80 RAM cartridge option, if the logger does not have internal data RAM. The logger will recognize if the memory cartridge is not installed, or fully seated, and will respond with the message *"NO DATA RAM FOUND"* on power up or whenever attempting to read stored data. Initial testing of the data logger is now complete and you may proceed with installation at this point. Alternatively, you may wish to further acquaint yourself with the initialization sequence or other commands now. Refer to Sections 4 and 5 for detailed information on these subjects.



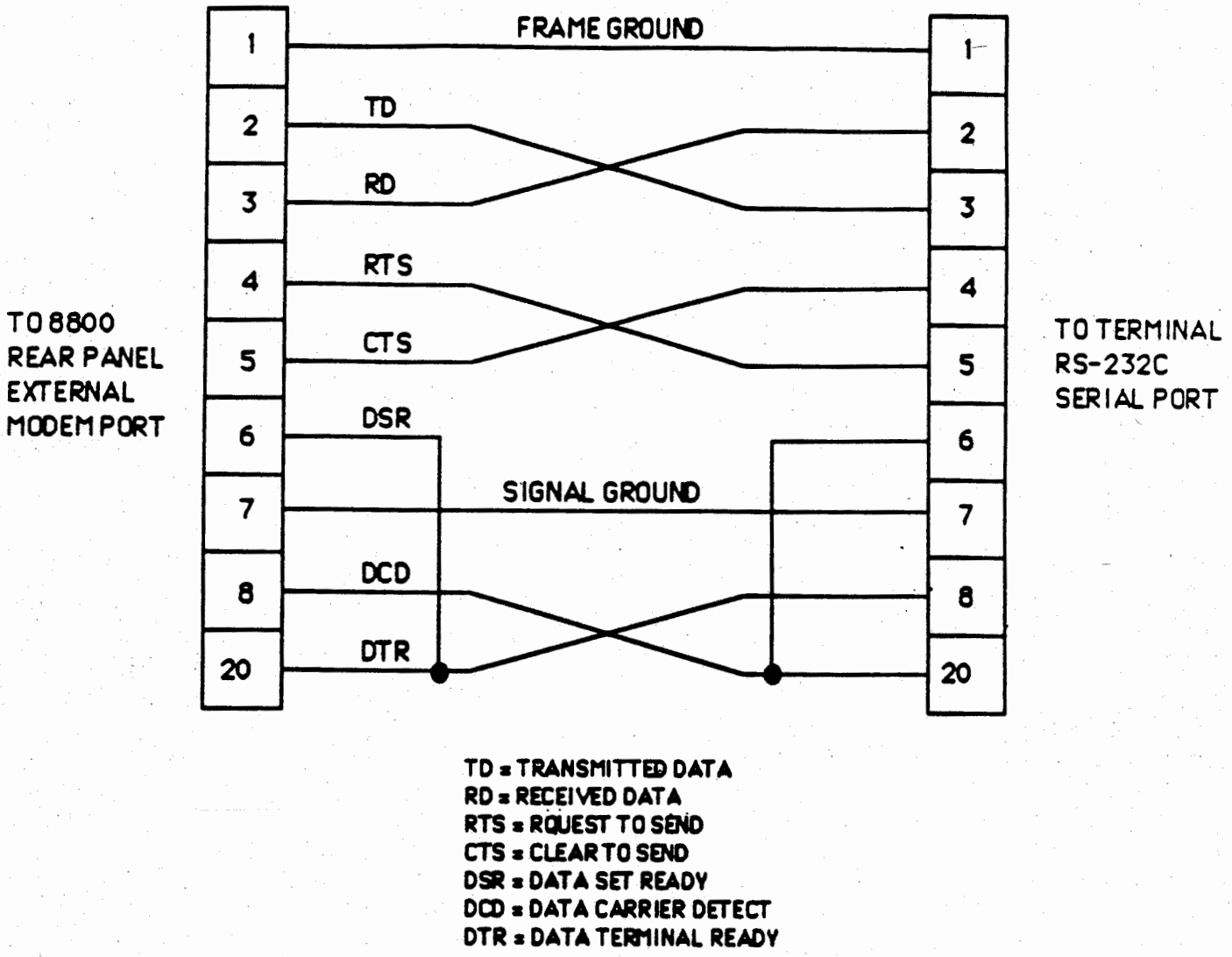
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Since the instrument was calibrated at the factory, it is not necessary to repeat calibration procedures on initial checkout. More extensive testing of the logger internal circuity can also be performed, if desired, with the Dynamic Debugging Tool (covered in Appendix B).

When you have finished your familiarization with the instrument, return the data logger power switch to the "OFF" position and disconnect the AC power cord. Turn off the terminal and disconnect it from the logger. Do not turn off the "RAM BATT" switch on the logger rear panel unless the data logger is to be inactivated for more than one month, as this will erase all data stored in internal RAM as well as your TIME, DATE, and ID settings, and require that they be reset and require that they be cold started (turning the power off with the "RAM Battery" switch off).



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The null modem cable allows two like devices to communicate. Since both the data logger and terminal are operating as data terminal equipment when connected through the "External Modem" port, the appropriate pins must be reversed as shown above.

On the 8800 data logger modem ports , the Hayes Standard for pin 12 control of HS (1200 baud) has been adopted.

Figure 2.3: Null Modem Cable Diagram

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3. Make certain that your terminal has the "CAPS LOCK" key activated, as the data logger will not accept lower case letters in commands.

The examples that follow assume that communication with the 8800 data logger is through the RS-232 port. If communication is set through the External Modem port, then make the correct settings and remove this port from Command/Response Mode (see Section 5.5).

### 2.3.2 The KD-80 Keyboard/Display*

This option uses a Radio Shack Model 102 or Model 100 as a local terminal. Connect the ESC supplied RS-232 cable from the RS-232 port on the rear of the Model 102 to the 8800 data logger port labelled "RS-232". Make sure that the CAPS LOCK key on the lower left of the keyboard is in the ON (down) position and that the NUM key on the lower right is in the OFF (up) position. Connect the AC adapter to the connector on the right side of the Model 102 (if applicable) and slide the power switch to the ON position. If necessary, adjust the "DISP" control to change contrast on the LCD display. If the display shows the prompt "DCN#??>" the configuration has already been set, the terminal is ready to use, and you may proceed to Section 2.4. Otherwise, perform the following procedures to set the terminal configuration.

- Press the recessed RESET button on the rear of the unit. The menu should appear with the current time along the first line of the display.
- Press the "Right-Arrow" key (the third key from the right along the top row of keys) two times to position the box cursor over the word TELCOM on the display, then press the ENTER key to start the TELCOM program.



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# 3.0 INSTALLATION

## 3.1 Environmental Requirements

The data logger will operate satisfactorily over the temperature range of 0° to 50°C, with relative humidities ranging from 0 to 95%, non condensing. It should not be installed outdoors without protection from the elements. A heated, moisture-proof (or moisture controlled) enclosure is recommended. Please contact ESC if there are any questions concerning the operating environment for the 8800 data logger.

## 3.2 Analog Inputs

Before connecting any instrument to the 8800 data logger, make certain that the instrument output voltage is compatible with the analog input range of the data logger. The logger will accept full scale input voltages of ±100mV, ±1V, ±5V, and ±10V. The correct voltage should be selected during the channel initialization procedure (see Section 4.1.2 for more details).

The data logger will correctly read voltages up to 102% of the full scale input, but voltages above this value cannot be read. For example, on the 10 volt scale, an input voltage of 10.2 volts will be properly stored, but 10.3 volts will not be read and will produce a "+" error code.

Overranging (i.e. voltages too high to measure but not too high as to cause damage to the logger) is allowed, up to 2 times the full scale input voltage.

Since the logger analog inputs are "differential", some "common-mode" voltage is allowed (see description, Section 1.1.1, page 1). However, this voltage must not exceed 11 volts with respect to the logger AC ground. In other words, if either the + or - instrument output exceeds 11 volts relative to the data logger AC ground, then the logger will not be able to measure the differential voltage



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accurately, and some type of isolation is required. Contact ESC for additional information.

Instruments with other type outputs (such as 4-20 mA current outputs) must first be connected to a signal converter to give the proper voltage output for the data logger inputs.

To connect instruments to the data logger, use 22 gauge (or larger), twisted-pair, shielded cables. Connect the shield to AC ground at either the instrument or the logger, but not both. On the logger end, remove approximately 3/8" of insulation from the + and - leads, insert the bare wire into the appropriate lug on the screw connector, and tighten the screw. Make sure that the bare wire only (not the insulation) is crimped behind the lug and that the lead is not shorted to the chassis. Note that these connectors are removable.

---

**NOTE:** Refer to Figure 2.2. The connections for channels 1-8 are on the bottom terminal and are marked, from left to right, as +1-, +2-, etc. Channels 9-16 (if applicable) are similarly marked on the top analog terminal.

---

If the instrument has only one voltage output terminal, then connect the negative lead, at the instrument, to analog ground, and proceed as described above at the data logger.

## 3.3 Digital Input/Output

If digital input or output options are supplied with the 8800 Data Logger, they are wired, internal to the logger, to the rear panel connectors marked "Digital In 1-8" (see Figure 2.2).

Digital input lines are active low and are considered digital zero when a 5 volt signal or no connection is made (due to a pull-up resistor and an inverter on the input). The input is considered active, or digital one when 0 volts is



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input to the line (i.e. it is connected to ground). In the example of a contact closure, one side of the closure should be connected to the digital input, and the other side of the closure should be connected to ground. When the contact is open, the digital input reads a digital zero, and when the contact is closed, the input is connected to ground and reads a digital one. Digital output lines are software controlled and are optically isolated solid-state relays, mounted internally and capable of switching up to 130 mA each.

## 3.4 YSI Temperature Probe Inputs

If the YSI Temperature Probe option is included with the 8800 Data Logger, one or two standard YSI Temperature Probes can be directly connected to the 8800 through a special connector on the back panel located right above the RS-232 port. These YSI Temperature Probes can measure temperatures ranging from -30°C to +50°C (-22°F to +122°F) with an accuracy of at least ±0.5°C (±0.9°F). If you do not have this option but wish to have it installed, call ESC for a price quotation. See Appendix B for more specific information on the YSI Temperature Probes and how they are connected to the 8800.

## 3.5 Communications

If the data logger is to be used in a network of remote sites, some method of communication must be established with the central computer. Usually, this involves the use of auto-dial, auto-answer telephone modems. Two modem configurations are offered as options for the 8800 data logger.

External modems provided by ESC will be shipped with the appropriate command set and necessary cabling. User supplied modems must be auto dial, auto answer, asynchronous, Bell 103 compatible @ 300 BPS and/or Bell 212A compatible @ 1200 BPS and must utilize the Hayes "AT" compatible command set. Connections to the external modem are as follows.



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1. Plug one end of the phone cable that came with the modem into the modem phone jack and the other end into the telephone wall jack.
2. Connect an RS-232C cable between the modem and the 8800 data logger rear panel External Modem connector (see Figure 2.2).
3. Connect one end of the modem power adapter into the appropriate connector on the modem and the other end into a source of 120 VAC power. If the 8800 data logger is rack mounted, the auxiliary AC power connector on the logger rear panel (see Figure 2.2) may be used. This completes the hookup of the external modem.

Dedicated line modems are generally specified by the user. Connect the dedicated line modem to the dedicated 4-wire leased line, then follow steps 2-3 above to complete connection to the data logger. If your data logger has not already been configured for leased-line operation, SW1 on the main board DIP switch must be set to "ON" (see Technical Drawings, Section 9).

## 3.6 Installation Completion

After completing sections 3.2 through 3.5, connect a terminal as described in Section 2.3. Next, connect the data logger as described in Section 2.4, turn it on, and check that the time, date and ID have been set correctly (Section 2.4.4). You may now proceed to initialize the data logger input channels as described in the next section.



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# 4.0 INITIALIZATION

This section describes the initialization procedure, which is used to configure each analog input channel according to its function and/or the type of instrument connected to it. The 8800 data logger provides an initialization menu, which identifies each parameter by name, followed by a question mark and default value. If the default value is correct, a simple carriage return advances to the next step. Otherwise, the default value is replaced by typing in the appropriate information, followed by a carriage return.

The command used to initialize any channel is:

**INIT** cc

where cc is the channel number (01 - 20).

The following table lists the possible functions which may be assigned to channel numbers 01-16. Channels 17-20 are reserved for Math Pak use only. Any channel may be a Math Pak channel, but channels 17-20 are Math Pak Channels only.

| Channel Type | Function |
|---|---|
| 1 | Vector Wind Speed |
| 2 | Vector Wind Direction |
| 3 | Scalar Wind Speed |
| 4 | Scalar Wind Direction |
| 5 | Summation (+) |
| 6 | Difference (-) |
| 7 | Product (x) |
| 8 | Quotient (÷) |
| 9 | Standard Gas Instrument |
| A | Rainfall ( |
| B | Precision Temperature from PTS-80B |
| C | Solar Radiation |
| D | Tape Sampler (Type 1) |
| E | Sine |
| F | Cosine |
| G | Tape Sampler (Type 2) |
| M | Math Pak |
| N | Math Pak (non-rolling) |
| S | EPA Sigma |



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**NOTE:** At any time during the initialization, the user can back up to the previous prompt by typing "^" (shift-6) and a carriage return. This feature can be used to back up all the way to the beginning prompt, if desired.

The initialization sequence can be halted at any time by pressing the <ESC> key.

Finally, if the user wants to quickly finish initializing the table and use defaults for the remaining values, type "!" (shift-1) and a carriage return. The remaining prompts and default values will be shown, just like a "LIST" command.

---

Since a standard gas instrument (SO2, CO, NOx, etc.) is the more common entry, as well as the default channel type, its initialization procedure will be described first.

Please note that throughout this section operator commands or responses are in **bold face** type, while data logger responses are *italicized*. Also note that <CR> denotes a carriage return.

## 4.1 Standard Gas Instrument (Channel Type 9)

With both the data logger and terminal operational (as described previously), issue the following command at the DCN prompt:

**INIT** cc

where cc is the number (01 - 16) of an analog channel to which a standard gas instrument is connected. The data logger will respond with

*CHANNEL NAME: ?*

Enter up to 5 alphanumeric characters to identify the instrument, followed by a carriage return; for example

**SO2 <CR>**

the data logger responds with:



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*CHANNEL TYPE: 9?*

Since the default value (9) is of the correct type for a standard gas instrument, enter **<CR>** to continue. The data logger responds with:

*STORE HOURLY AVERAGES: Y?*

Averages are further explained in Section 4.1.1 below.

### 4.1.1 Storing Averages

The data logger can be used to store averages over two time intervals. The first averaging interval is fixed at one hour, while the second (or auxiliary) interval can be selected and/or changed by the operator (see the SET INT command description, section 4.5.1). In addition to the averages, the data logger can calculate and store standard deviations (sigma), percent valid data, and range for the averaging period.

If hourly averages are to be stored, accept the default value (Y) with a carriage return at the data logger response:

*STORE HOURLY AVERAGES: Y?*

The logger will then request the following:

*HOURLY SIGMAS: N?*

*HOURLY % VALID: N?*

*HOURLY RANGE: N?*

HOURLY SIGMA - the standard deviation of the data during the hourly averaging period. Enter **Y <CR>** to store it, or **<CR>** to accept the negative default value.

HOURLY % VALID - the number of scans included in the average as a percentage of the total scans taken (% valid = $\frac{\text{valid scans}}{\text{total scans}} \times 100$).



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**NOTE:** Valid scans are all minute averages not marked with an error code (see error code summary, Section 5.2). Again, the default value is no for this parameter.

---

HOURLY RANGE - the maximum and minimum one minute averages which occurred during the averaging interval. Select **Y <CR>** or the default value **<CR>**.

If hourly averages are not stored, the three previous questions are not asked, since a stored average is necessary to compute sigma, % valid and range.

The data logger then prompts the user for the same information regarding auxiliary averages. The auxiliary averaging period is user selectable to any integer division of 60 minutes, i.e, 1, 2, 3, 4, 5, 6, 10, 12 15 or 30 minutes are acceptable choices (see **SET INT** mm command, Section 4.5.1).

The data logger prompt for auxiliary averages is:

*STORE AUX AVERAGES: N?*

To store auxiliary averages, answer **Y <CR>**, then answer the following questions, just as described above for hourly averages.

*AUX SIGMAS: N?*

*AUX % VALID: N?*

*AUX RANGE: N?*

If auxiliary averages are not to be stored, accept the default value of N, and proceed with the initialization.

### 4.1.2 Units and Scaling

Once averages are configured for the channel, the data logger prompts for information relating to units and scaling. The 8800 data logger prompts relating to units and scaling are:

*CHANNEL UNITS: ?*



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*VOLTS FULL SCALE: 1.000?*

*SLOPE: 100.0?*

*INTERCEPT: 0000?*

*DECIMAL POSITIONER: 0?*

Since these items are interrelated, please read the following information before making any entries.

CHANNEL UNITS - is simply a label, 5 characters or less (i.e, PPM, PPB, MPH, etc.) used in report headings, and does not itself affect the scaling calculation. However, it must be chosen with forethought, in order that the scaled data be correctly reported.

VOLTS FULL SCALE - Must be chosen to match the output voltage of the sensor to the data logger analog input for the channel being initialized. Allowable ranges are 0.1, 1, 5 or 10 volts full scale ($V_{fs}$).

SLOPE - Once the desired units and full scale voltage selections have been made, it is necessary to establish the proper linear relationship between the two, in order that the raw data be scaled correctly. The standard form for such a relationship is given by the straight line equation:

$y = mx + b$, where

y = the scaled data, in engineering units

m = the slope, or scale factor

x = the input voltage fraction, i.e., the input voltage divided by the full scale voltage ($V_{in}/V_{fs}$)

b = the intercept, or point at which the line would cross the "y" axis if plotted. This value offsets the scaled data for those cases where $x \neq 0$ when $y = 0$.

If we represent the engineering units by E, and the voltage fraction by $V_{in}/V_{fs}$, then the equation becomes:

$$E = mV_{in}/V_{fs} + b$$



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The equation for calculating the slope "m" is then:

$$m = \frac{E2 - E1}{(V_2/V_{fs}) - (V_1/V_{fs})}$$

We will present examples of this calculation later in this section.

INTERCEPT - The Y intercept is calculated from the equation

$$b = E1 - m\ (V_1/V_{fs})$$

As can readily be seen from the equation, the intercept b is equal to zero if $E_1$ (the minimum engineering unit) = 0 when $V_1$ (the minimum voltage) = 0.

DECIMAL POSITIONER - The decimal positioner determines the number of decimal places in the stored data. The decimal positioner, together with the choice of units, allows maximum flexibility in the reported data. However, care must be taken in this choice, since the data logger stores a maximum of 4 digits. Any attempt to display more than 4 digits results in the error code 9999E, indicating that a conversion error occurred when data was retrieved from long term memory. For example, suppose the sensor output is 0 to 100, and you choose a decimal positioner of 2. This allows all values from 00.00 to 99.99 to be displayed, but does not allow the full scale value of 100.00 (5 digits).

EXAMPLE CALCULATIONS - In order to compute the proper slope and intercept, two data points, corresponding to $E_1$, $V_1$ and $E_2$, $V_2$ are required. These are normally chosen from the minimum and maximum values, respectively. The following examples illustrate these computations for some typical situations.

Example 1: Ambient Air SO2 analyzer, 0-.5 PPM for 0-1 V output from instrument.

If the data is to be reported in PPM, then select PPM for the CHANNEL UNITS. The VOLTS FULL SCALE selection is 1.000. The data points are $E_1 = V_1 = 0$, and $E_2 = 0.5$, $V_2 = 1$. The slope is then: $m = \frac{.5-0}{(1/1 - 0/1)} = \frac{.5}{1} = .5$

and the intercept b = 0 - .5 (0/1) = 0. Note that for all cases where $E_1$



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and V1 are zero, the intercept is 0 (as explained earlier) and the slope equation simplifies to: $m = E_2 \frac{V_{fs}}{V_2}$

Now, with a decimal position of 4, the data will be reported in the range of .0000 to .5000. If this many decimal points appear cumbersome to handle, there are several options. One option is to reduce the number of decimal points, though this is done at the expense of resolution. For example, the decimal positioner changed to 3, resulting in a range from .000 to .500. However, a voltage input of, say, .555 volts will be reported as .279 PPM, whereas with 4 decimal points it will be reported as .2785 PPM (the logger rounds off the last decimal point). A better choice might be to select different units. As an example, one could choose channel units of PPB. In that case, m = 500, and a decimal positioner of 1 results in reported values ranging from 0.0 to 500.0 PPB.

Example 2: Opacity monitor, 0 - 100% with a 4-20 ma current output (converted to 1-5 volt).

Select PCT for CHANNEL UNITS and 5 for VOLTS FULL SCALE

then $E_1 = 0$, $V_1 = 1$
$E_2 = 100$, $V_2 = 5$

$$m = \frac{100 - 0}{(5/5) - (1/5)} = \frac{100}{4/5} \text{ or } \frac{500}{4} = 125$$

$$b = 0 - 125\ (1/5) = -25$$

If a decimal positioner of 1 is chosen, the data will be reported in the range of 0.0 to 100.0 percent.

Example 3: Temperature sensor, 0°C to 100°C (32°F to 212°F), with voltage output of 0 to 100 mv (.1V).



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If the data is reported in degrees Fahrenheit to report this data in degrees Fahrenheit, we could use DEGF for CHANNEL UNITS. VOLTS FULL SCALE is 0.1. For this case, $E_1 = 32$ at $V_1 = 0$, and $E_2 = 212$ at $V_2 = 0.1$. Then

$$m = \frac{212 - 32}{(.1/.1) - (0/.1)} = 180$$

$$b = 32 - 180\ (0/.1) = 32$$

For a decimal positioner of 1, the data will be reported in the range of 32.0 to 212.0 (to the nearest tenth of a degree fahrenheit).

With these examples in mind, let us now return to the initialization description. The next data logger response is:

*CHANNEL UNITS: ?*

Enter the desired label (i.e. PPM PPB, WDR, etc.) up to 5 characters. This label will appear in report headings.

*VOLTS FULL SCALE: 1.000?*

The four allowable full scale ranges are 0.1. 1, .5 and 10. This setting controls the programmable gain amplifier (PGA).

*SLOPE: 000.0?*

Enter the slope from the equation

$$m = \frac{E2 - E1}{(V_2/V_{fs}) - (V_1/V_{fs})}$$

*INTERCEPT: 0000?*

Enter the y intercept from the equation

$$b = E1 - m\ (V_1/V_{fs})$$

as described in the proceeding explanation.

*DECIMAL POSITIONER: 0?*

Enter the number of decimal places that should be kept for long term data storage. Allowable values range from 0 (no decimal places) to 4.



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**NOTE:** When using the **PRINT** commands to retrieve data from the logger, only those commands which access the long term memory will apply the DECIMAL POSITIONER to the resulting data. These commands are limited to:

**PRINT DAILY (all)**

**PRINT HOUR cc, hr, nn**

**PRINT HOUR cc, mo/dd, hr, nn**

**PRINT AUX cc, hr: mm, nn**

**PRINT AUX cc, mo/dd, hr: mm, nn**

All other print commands retrieve data from temporary storage buffers, and the resulting data is in the form of true 4 digit floating point numbers.

For example, suppose the command **PRINT HOUR cc** returns the latest hourly value of 2.173, a true floating point number, from the temporary buffer. If we ask for this same hourly data tomorrow, using the command

**PRINT HOUR cc, mo/dd, hr, nn**

and our decimal positioner for channel cc is 1, the resulting reported value will be 2.2, which is the value resulting from 2.173 being retrieved from long term memory and applying the decimal positioner of 1 to that value.

### 4.1.3 Data and Alarm Limits

The next series of questions allow the operator to choose limits for acceptable data, i.e, limits beyond which the one minute average will be excluded from hourly or auxiliary averages. They also allow "bad status" flags to be set. The sequence of questions and responses is as follows:

*MAX READING: 9999.?*



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Enter the maximum reading, or accept the default value. Minute averages over this limit will not be included in auxiliary or hourly averages and will be flagged with a "+" error code symbol (see Section 5.2.5 for a listing of error codes).

*MIN READING: -999.0?*

Enter minimum reading, or accept default value. Minute averages under this limit will not be included in auxiliary or hourly averages and will be flagged with a "-" error code symbol.

Please note that MIN and MAX values are not taken during calibration cycles for the channel in calibration. You may wish to read the following more detailed discussion of MIN and MAX values.

---

Additional MIN-MAX Information

An error state is determined for the MAX READING or MIN READING as follows: In the equation

$$y = mx + b$$

y is tested to verify that it is within the limits stated where

m is the slope (entered in initialization)

b is the y-intercept (entered in initialization)

x is the input voltage fraction ($V_{in}/V_{fs}$) as described in Section 4.1.2

Example: If a 0.8 volt signal is applied to the analog input when 1.0 volt full scale is specified, then x = 0.8. If m = 100 and b = 0, then y = 80. As long as y is less than the MAX READING specified and greater than the MIN READING specified, no out-of-range error will occur. Any variable may be negative; negatives are treated as they should be using standard algebraic rules.

The MIN and MAX READING values entered are not related to the minimum-maximum voltage that the analog to digital (A/D) converter can accept. The A/D converter gives a percent full scale reading. The possible measurable full scale ranges are 0.1, 1, 5 and 10 volts. For the 0.1, 1, 5 and 10 volt scales, the full scale



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percent range is ±102%. If the applied voltage is greater than the allowed range for any scan; an overrange error occurs and the minute reading is excluded from the Auxiliary or Hourly Average. All averages in error are tagged with "+" or "-" error codes, depending on whether the overrange was in the positive or negative direction.

---

The MAX RATE OF CHANGE prompt is:

*MAX RATE OF CHANGE: 5000?*

The value entered is the maximum change that can occur between two consecutive minute averages. If the change is greater than this value, the new minute average will not be included in Auxiliary or Hourly averages, and will be flagged with an "R" error code symbol.

Once the MAX and MIN parameters are set, the data logger will prompt for alarm information. Alarm information allows the 8800 data logger to inform other devices when input analog data exceeds certain setable parameters. The data logger perform three actions when in alarm condition (when the parameters are exceeded); they are: (1) to activate one digital output line, (2) to flag data in memory as alarmed, and (3) call through the external modem port to inform a central location. Activation of an output line and making an external call are optional, but alarmed data will always be flagged whenever the parameters are set.

The first prompt on alarm parameters is

*ALARM INTERVAL [N,M,A,H]: N?*

This prompt specifies whether alarming will occur and over what specific averaging interval it will occur. "N" is for no alarming, and if chosen, then the initialization will skip to the *BAD STATUS* prompt. "M" indicates a minute interval, "A" indicates the auxiliary interval, and "H" is an hourly alarm interval. If "M","A", or "H" is chosen, the 8800 will examine data in that



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interval and alarm when it is outside the boundaries set by the remaining parameters.

The 8800 next prompts with

*ALARM LINE: 00?*

which allows the choice of which digital output will be activated on an alarm condition (01-16, or 00 for no alarm line). Whenever a channel is in alarm condition, then the optional output line will be activated.

The next three prompts allow the setting of the alarm parameters used in determining an alarm condition. They are

*ALARM LIMIT HIGH: 9999.?*

*ALARM LIMIT LOW: -9999.?*

*ALARM LIMIT ROC: 9999.?*

These prompts allow the setting of the high and low values and the rate of change on which alarming for that channel will occur. Whenever the engineering value for the channel is greater than the high limit or less than the low limit, or the rate-of-change between successive interval measurements is greater than the rate-of-change limit, then that channel is in alarm condition.

When an alarm parameter is exceeded, the data is flagged to indicated what caused the alarm condition. If the high limit was exceeded, then the data is marked with the "H" error code. An "L" error code indicates that low alarm limit was exceeded, and an "O" is associated with rate-of-change alarms. The alarm conditions are not checked if the data for the interval is invalid (flagged by a higher priority condition). In the case of ROC, this is true for both the current data and the previous interval data.

The third action that the logger may take when in alarm condition is to activate an external modem. This allows for transfer of information concerning the alarm condition to a central location. The four commands used in setting the modem are covered in chapter 5 under Alarm Commands. When the data logger calls,



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it transfers data concerning the alarmed channel(s), in printable ASCII text format.

*BAD STATUS = XXXXXXXX XXXXXXXX?*

This refers to the state of the 16 optional status input lines, where X represents a "don't care" state. If you do not have the digital input option, or don't wish to utilize any input lines with this channel, enter a <CR> and proceed with the next (calibration) section.

To designate a bad status state, enter the desired line number, followed by an equal sign and the desired state. Example: Entering **01=0 <CR>** means a bad status error code will occur if line 1 is a digital 0. Likewise, entering **16=1 <CR>** will result in an error code if line 16 is a digital 1. As each entry is made, the menu presents the latest bad status settings. For example, typing **01=1 <CR>** returns *1XXXXXXX XXXXXXXX*.

If more than one line is specified, a bad status is recorded when any of the specified lines are in that state (OR function). During an analog reading, if any of the optional status input lines match the bit specified in BAD STATUS, that reading will not be averaged into the Auxiliary or Hourly averages, and those averages will be flagged with the bad status error code "B".

### 4.1.4 Calibration Cycles

The 8800 Data Logger has two forms of calibration, 3 step calibration and 10 step calibration. A 10 step calibration allows a dedicated calibrator to specify and control when calibration occurs, and this type of calibration is covered in Section 4.1.5. The 3 step calibration allows either the data logger or an instrument, or both to specify when the different steps of calibration are occurring (assuming that digital inputs and outputs are present). After the BAD STATUS prompt, the data logger begins the calibration setup with:

*CALIBRATION TYPE: N?*



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There are four possible answers for this prompt: "I", "A", "B", and "N" (default value). **I <CR>** is entered for an instrument initiated calibration and leads to the sequence of questions described in Section 4.1.4.1. **A <CR>** is entered for automatic calibration, where the logger initiates the cycle and activates output control line relays to switch the instruments through the calibration. This is described in Section 4.1.4.2. **B <CR>** allows both types of calibration and leads an operator through both the **A** and **I** type calibration.

The final entry, "N" (the default value), provides no 3 step calibration. If **N <CR>** is chosen, then the next prompt of the initialization sequence is given. The prompt is:

*10-STEP CALIBRATION: N?*

which is covered in the next section.

In summary, answer the *CALIBRATION TYPE: N?* question with one of the following entries, and proceed with the indicated section(s).

| ENTRY | FOR | PROCEED WITH |
|---|---|---|
| N | No 3 Step Calibration | 10 STEP CALIBRATION: Y |
| I | Instrument Initiated Calibration | Section 4.1.4.1 |
| A | Automatic Calibration | Section 4.1.4.2 |
| B | Both calibration types | Section 4.1.4.1 & 4.1.4.2 |

### 4.1.4.1 Instrument Initiated Calibration

If "I" is the chosen calibration type, the data logger requests the operator to specify which digital input lines will be used to signal the logger that the connected instrument has entered the Zero, Span 1 and Span 2 phases. Normally, 2 control lines are used for this purpose. We will give an example, where we have chosen to use digital inputs 1 and 2, in the logic sequence given below, to signal the calibration phases.



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| Control Line 01 State | Control Line 02 State | Status |
|---|---|---|
| 0 | 1 | Zero Phase |
| 1 | 0 | Span 1 Phase |
| 1 | 1 | Span 2 Phase |

At the data logger prompt:

*ZERO STATUS = XXXXXXXX XXXXXXXX?*

Enter **01 = 0 <CR>** (For line 01 = logic state 0) followed by:

**02 = 1 <CR>** (For line 02 = logic state 1).

The data logger response is now:

*ZERO STATUS = 01XXXXXX XXXXXXXX?*

This specifies that the data logger will recognize the instrument zero phase when digital input line 01 is high (digital zero), and input line 02 is low (digital 1). When this input pattern is present, data will not be averaged into the Auxiliary or Hourly averages and these averages will be flagged with a calibration status code ("C"). When the pattern is no longer present, the data logger enters the average of the last five one minute averages into its calibration report for ZERO. If one of the "span" mode patterns follows, the logger continues to flag the data with the calibration code "C". Otherwise, it observes the time set for Recovery Mode (see "Recovery Time" description following), again with the status code "C", and goes back on line at the end of the recovery time.

When the Zero Status Lines are properly set, use a carriage return to continue to the next step, which is:

*SPAN1 STATUS = XXXXXXXX XXXXXXXX?*

The description for this phase is similar to that given previously for ZERO STATUS. For the example given, we should enter **01 = 1 <CR>**, followed by **02 = 0 <CR>** and the logger would respond with:

*SPAN1 STATUS = 10XXXXXX XXXXXXXX?*

indicating that a SPAN1 phase will be recognized when input line 01 is low and line 02 is high.



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During this phase, the averages are again flagged with status code ("C") and at the end, the last five minute averages are entered into the calibration report for SPAN1.

With the SPAN1 lines properly set, use a carriage return to continue to:

*SPAN2 STATUS = XXXXXXXX XXXXXXXX?*

For example given, you would enter **01 = 1 <CR>**, followed by **02 = 1 <CR>** and the response:

*SPAN 2 STATUS = 11XXXXXX XXXXXXXX?*

would indicate recognition of a SPAN2 state when both input lines 01 and 02 are low (inputs are active low). The data will be entered into the calibration report for SPAN2.

---

**NOTE:** If only one span phase is required, you can get by with a single digital line where, for example, **01=0 <CR>** could be used for the ZERO phase, and **01=1 <CR>** could be used for the SPAN1 phase. No entries would then be made for SPAN2.

---

After a carriage return from the Span 2 prompt, the next data logger response will be:

*RECOVERY TIME: 05?*

This entry is used to allow time for the instrument to return to stable operation after any of the calibration phase(s) have occurred. The default entry is 05 (five minutes) during which time the logger continues to flag the data with the calibration code "C". Enter a carriage return or a new value, in minutes (03, 08, 10, etc.) followed by a carriage return.

---

**NOTE:** If auto calibration is also used, the recovery time must be the same as that for the auto calibration mode.

---



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The next data logger response is:

*CAL SEQUENCE: Z12?*

this indicates the expected calibration sequence, where Z is zero phase, 1 is span 1 etc. If different from the default value, enter the proper sequence (example 1Z2, etc.). If any phases occur out of order they will be ignored. If XXX is entered as the CAL SEQUENCE the logger will recognize any calibration phase at any time. The final entry for an instrument initiated calibration is:

*EXPECTED SPAN1, SPAN2: .0000, .0000?*

You may enter expected values for SPAN1 and SPAN2 here, if desired. These numbers are only used in the cal alarm, and are only reference numbers with which actual values may be compared on calibration reports.

This completes the instrument initiated calibration. If automatic calibration is also to be performed, proceed with section 4.1.4.2. Otherwise, proceed with 10 step calibration prompt

*10 STEP CALIBRATION: Y?*

to continue the initialization sequence for this channel.

### 4.1.4.2 Automatic Calibration

Automatic calibration is used when the data logger controls the calibration cycle of an instrument connected to it. After an **A <CR>** is entered as the calibration type, the data logger responds with:

*WEEKLY ALT CAL: N?*

During the auto calibration sequence, the logger will cycle the instrument through the calibration phases (Zero, Span1, Span2) by activating appropriate output control lines. In addition, the logger has the capability of activating a different calibration program every seventh day, thus providing a separate "weekly" calibration cycle. If the default value is chosen, then the same set of lines will be activated every day. To chose the alternate "weekly" calibration,



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enter a number from 1 to 7 (followed by <CR>), where 1 indicates Sunday, 2 is Monday, etc. On the specified day of the week, only the alternate set of control lines, times, and cycle order will be used to control calibration.

*AUTO CAL START TIME: 00:00?*

This entry sets the time for the beginning of the auto-calibration cycle. The default time is midnight (00:00). Enter a different time, if desired, in the form hh:mm, were hh is hours in military time (00 to 23) and mm is in minutes.

If power goes down during an auto-cal, calibration will resume when power is returned and will continue for the number of minutes left in the cycle. If power is down at the time an auto-cal should begin that calibration will not take place.

*ZERO LINES: 00, 00, 00?*

This prompt allows up to 3 digital output control lines to be specified for the zero phase of the calibration cycle. Issue a <CR> to accept the default value (no lines), or make an entry in the form 02, 00, 00 <CR> (to use control line 02 only) or 02, 03, 04 <CR> (to use control lines, 02, 03 & 04) etc. The specified output line(s) will turn on during the zero phase (giving a switch closure for the line).

*ZERO DURATION TIME: 05?*

This entry keeps a logical 1 on the line(s) specified in response to the ZERO LINES (& ALT ZERO LINES, if applicable) prompts, for the time specified (in minutes). The default value is 5 minutes (05). During this time, the data is flagged with a "C" status code and excluded from averaging.

*ZERO RESPONSE TIME: 05?*

This entry specifies the number of minute averages (default value is 5) which are to be averaged together to produce the zero value. This entry must be <= the value entered at the ZERO DURATION prompt. IF less than, it occurs at the end of the ZERO DURATION TIME, and can be used to allow the sensor to stabilize before taking averages to be used for the zero value.



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The sequence for setting the line(s) and times for SPAN1 and SPAN2 are identical to those just described for the zero phase and are listed below. Make the appropriate entries as you go through the sequence:

*SPAN1 LINES: 00, 00, 00?*

*SPAN1 DURATION TIME: 05?*

*SPAN1 RESPONSE TIME: 05?*

*SPAN2 LINES: 00, 00, 00?*

*SPAN2 DURATION TIME: 05?*

*SPAN2 RESPONSE TIME: 05?*

---

**NOTE:** If the same output control line is specified in two consecutive phases (i.e. zero, span1, or span1, span2), that output control line will go off for less than one millisecond.

---

Example: SPAN1 LINES: 07

SPAN1 DURATION TIME: 05

SPAN1 RESPONSE TIME: 03

SPAN2 LINES: 07

Output control line 07 will go off only momentarily when control is switched from the SPAN1 line to the SPAN2 line.

The next prompt is:

*RECOVERY TIME: 05?*

This specifies the time, in minutes, from the completion of the calibration until data is again included in averaging. The default value is 5 minutes (05).

From the time the calibration begins (AUTO-CAL START TIME) until the end of the recovery period, all data is excluded from averaging and flagged with calibration code symbol "C".

*CAL SEQUENCE: Z12?*



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This prompt allows the operator to change the calibration sequence. The default value is zero, span1, span2 (Z12). Example: The entry **1Z2 <CR>** results in a Span1, Zero, Span2 sequence.

If a weekly alternate cal day has been selected, the user will now be prompted for the alternate calibration program parameters. The alternate calibration parameters include everything the regular calibration has, except "Auto Cal Start Time".

This completes initialization of the 3 step calibration. Channel initialization continues with 10 step calibration prompts.

### 4.1.5 10-Step Calibration

10-step calibration is designed to allow an external calibrator control of the calibration process. The external calibrator indicates to the 8800 data logger that calibration is **not** in progress by applying a certain value on the digital input lines (called the ambient mask). Whenever the digital inputs do not equal this certain input, the data logger assumes the instruments are in a calibration. Each change in the digital inputs indicates that the calibrator is in a different step of the calibration, up to 10 steps. If, after 10 changes on the digital inputs (10 steps in the calibration), the ambient mask is not present, then a new calibration is assumed to start at step 1.

The initialization prompt for 10-step calibration is:

*10-STEP CALIBRATION: N?*

If 10 step calibration is to be used, then answer **Y <CR>**, and the logger will prompt with

*AMBIENT MASK=XXXXXXXX XXXXXXXX ?*

which allows the input of the ambient mask for indication of a non-calibration state. Whenever the digital inputs equal this ambient mask, the logger will not flag the data with the calibration symbol, and when the digital inputs vary from



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this mask, the logger marks the data as calibration data, and forms a new calibration record. When the digital inputs vary a second time, the logger starts recording a new step in the calibration record and with each change a new step is noted. If ten steps are recorded in the calibration record, and the ambient mask is not present on the digital inputs, a new calibration record is formed. If less than ten steps are taken before the ambient mask is detected on the digital inputs, the record is ended and recovery is entered.

Once the ambient mask is specified, the 8800 data logger will prompt for the averaging interval. This prompt is

*AVERAGING INTERVAL: 05?*

The averaging interval prompt allows the choice of how many of the previous minute averages will be used to calculate the calibration average. This value can be from 00, which would indicate that no average needs to be taken, to 15, which indicates that the last 15 minute averages are to be used for the calculation of the calibration average to be stored in the calibration record.

The next prompt asks for the amount of recovery time to assign to the channel. This allows a certain number of minutes, for an instrument to recover to a valid state for data acquisition. The recovery time begins as soon as the ambient mask is detected on the digital inputs and once complete, the data will no longer be flagged with a calibration indicator for hourly and auxiliary calculations.

This completes 10-step calibration initialization, and the logger will issue the final prompt

*ON LINE: Y?*

Accept the default value to activate the analog line and start data acquisition, or input **N <CR>** for line deactivation. This concludes the channel initialization for the standard gas instrument. Initializations for the other channel types are close parallels to this initialization and are described in the following sections.



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## 4.2 Wind Speed/Wind Direction

The initialization process for these channels begins with the **INIT** cc command, just as for standard gas (Type 9) instruments. After making the **CHANNEL NAME** entry, you must decide whether you want to choose vector or scalar averaging. At the *CHANNEL TYPE: ?* prompt, choose the appropriate channel number from the list in the beginning of section 4.0.

---

**NOTE:** If vector averaging is chosen, the vector wind speed channel (Type 1) must be initialized before the wind direction channel is initialized. The logger will then choose the next available channel for wind direction, and display it with the response:

*WDR CHANNEL NUMBER: cc?*

Where cc is the next available channel number. You may accept the default value, or designate any other non-initialized channel. You will then be led through the same series of questions as described in Section 4.1, such as:

*STORE HOURLY AVERAGES: Y?*

*HOURLY SIGMAS: N?*

*HOURLY % VALID: N?*

*HOURLY RANGE: N?*

Refer to Section 4.1 if you have any difficulty with this sequence.

---

After completing the initialization of a wind speed channel (WSP), the logger will automatically begin the initialization of the corresponding wind direction channel (WDR) if vector WSP was chosen, with the same question and answer sequence as for wind speed.



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## 4.3 Inter-channel Calculations

There are two ways to perform inter-channel calculations on the 8800 data logger. The first is through definition of a specific channel for simple calculations. Six channel types specify simple arithmetic operations to be performed on two previously initiated channels. The second way to perform inter-channel calculations is through the use of Math Pak. Math Pak is used to perform complex calculations by defining equations and setting channels equal to the equations.

Arithmetic channel types will be covered first, in section 4.3.1, and Math Pak will be covered in section 4.3.2.

### 4.3.1 Arithmetic Channel Definition

Channel types 5, 6, 7, 8, E & F (summation, difference, product, quotient, sine and cosine, respectively) specify arithmetic operations to be performed on two previously initiated channels. You may specify any available channel with the INIT cc command to initiate one of these functions. After naming the channel, choose the appropriate function at the prompt:

*CHANNEL TYPE: 9?*

the data logger responds with the questions:

*COMPANION CHANNELS: 01, 02?*

Here, you must choose which two previously initiated channels you want the function to operate on. For example, if you want to add the values (both raw and engineering values) in channel 3 to those in channel 4, then the CHANNEL Type is 5 (summation) and the COMPANION CHANNEL entry is **03, 04 <CR>**.

For sine and cosine channels, the first companion channel is the magnitude and the second is the angle (in degrees). Sine channels (Type E) compute (1st companion channel) * SIN (2nd companion channel), and similarly, cosine channel (Type F) compute (1st companion channel) * COS (2nd companion channel).



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The remaining entries for these channels are as described previously, ending with the questions:

*CHANNEL UNITS: ?, DECIMAL POSITIONER: 0?, and ON-LINE: Y?*

There are no min or max limits on arithmetic channels. If the positive value exceeds 4 digits, 9999 is the result. If a negative value exceeds 4 digits, -9999 is the result.

### 4.3.2 Math Pak

Math Pak is used to perform complex or non-standard inter-channel calculations using basic operators. To use Math Pak, one must first define an equation, then assign the equation to a channel during channel initialization. Equation definition is covered in section 4.3.2.1, and Math Pak channel initialization is covered in section 4.3.2.2.

#### 4.3.2.1 Equation Definition

The first step in the use of Math Pak is the definition of the equation which you wish to assign to a channel. Up to four different equations can be defined and stored.

Math Pak uses the following basic operators: +, -, /, *, LOG(), LN(), EXP(), ABS(), SIN(), COS(), TAN(), ATAN(), SQRT(), and y^x where x is rounded to an integer. Eight levels of implied or explicit parentheses can be used, and an underline character _, precedes negative numbers. The mathematical hierarchy, with 1 being greatest, is:

1) Parentheses
2) Unary function (COS, LN, etc.)
3) y^x
4) multiplication and division (*, and /)
5) addition and subtraction (+, and -)



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The command used to define an equation is "SET EQUATION" and has the following format:

**SET EQUATION # EQU=**

Description: Set Equation is the command

| | |
|---|---|
| # | is the equation number that you are defining |
| EQU | is your equation |
| = | is the end specifier and must be present **without** a space separation from the equation. |

Three example command lines are shown below for reference.

1) **SET EQUATION 1 C01/C02/12.5=**

2) **SET EQUATION 2 EXP(C01/C03)=**

3) **SET EQUATION 2 EXP(C01/C02)*(COS(C04)+COS(C02))=**

In example 1, equation 1 is defined to divide C01 by C02, then divide the result by 12.5 (notice the hierarchy). Example 2 sets equation 2 to take the exponential of C01/C02. Example 3 sets equation 2 to a more complex equation.

Once an equation is set, their are two ways to view it, Algebraic notation, and in Reverse Polish Notation. To view the equation in algebraic notation, type **EQUATION 1 <CR>**, equation 1 will be shown. To see all equations, type 0 for the equation number. For Reverse Polish Notation, type **RPN 1 <CR>**, and equation 1 will be shown in RPN (or the parsed notation).

Now the equation has been defined. To use it, you must assign the equation to a channel during the channel initialization. This is covered in the next section.

### 4.3.2.2 Math Pak Channel

Once an equation is defined, it must be assigned to a channel for use. Once you are in the initialization process, type **M <CR>** for channel type. This is the



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math channel specifier. The initializer will then prompt for the equation number, such as:

*EQUATION NUMBER: 1?*

with equation 1 as the initial default. Enter one or two equation numbers with two channel numbers separated by a comma.

An example of two equations is

*EQUATION NUMBER: 1?* **1,2**

If one equation is used, then no comma is necessary and the initialization is the same in Chapter 2. The second equation is used only when the secondary status is active on the digital input lines. The secondary status is the next prompt and is:

*SECONDARY STATUS: XXXXXXXX XXXXXXXX?*

with no secondary status (all X's) as the default. To change the secondary status, type

**#=D <CR>**

where # is the bit number of the digital input, and D is the digital signal to set it to, either 0, 1, or X. Repeat the **#=D <CR>** command until the bit pattern is as desired.

For example, typing **01=1 <CR>** will return

*SECONDARY STATUS: 1XXXXXXX XXXXXXXX*

Then typing **10=0 <CR>** will return

*SECONDARY STATUS: 1XXXXXXX XOXXXXXX*

One final point to note about the calculation of the channel's value. Handling of Edit Exceptions for an operand is done on an instantaneous basis, not on the minute averages. If any of the operands listed in the channel's equation are edited from a minute average, then the math channel will not use that value in the calculation of the equation and marks the instantaneous value with an error code. Minute averages are calculated as normal.



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Once the secondary status is specified, the initialization procedure is the same as explained in the beginning of Section 4.0.

## 4.4 Other Channels

This section describes the initialization procedure for channel types A, B, C, D, G & T (Rainfall, Temperature, Solar Radiation, Tape Sampler #1, Tape Sampler #2, YSI Temperature Probe respectively).

### 4.4.1 Rainfall Counter

#### 4.4.1.1 Analog Rainfall Channel

The analog rainfall channel can be any one of the analog channels, but an accumulator card with a voltage output must be used. The analog channel is initialized like any other channel with the channel type being type A. The initialization will contain the following prompts:

*CHANNEL NAME: ?*
*CHANNEL TYPE: 9?*
*CHANNEL UNITS: ?*
*VOLTS FULL SCALE: 1.000?*
*SLOPE: 100.0?*
*INTERCEPT: .0000?*
*DECIMAL POSITIONER: 0?*

The slope and intercept prompt have been added so that a READ, REPEAT READ, RAW or REPEAT RAW can be performed on the rainfall channel. The READ and REPEAT READ commands return the actual amount of rain that has fallen since the last hour. This value is calculated by the following equation:

$$\text{TOTAL RAINFALL} = m \frac{\text{Voltage}}{\text{Volts Full Scale}} + b$$

The RAW and REPEAT RAW commands return the exact voltage on the channel.



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#### 4.4.1.2 Pulse Type Rainfall Channel

The pulse type rainfall channel must be initialized as channel number 17 (for CTR1) or 18 (for CTR2). Connecting the "CTR1" or "CTR2" line and DGND on the rear of the data logger registers one count on the digital rainfall channel.

As with the analog channel, the pulse rainfall channel is type A. The prompts are the same with the exception of the volts full scale prompt which is unnecessary with the pulse type rainfall channel.

The pulse type rainfall channel is also able to do the READ and RAW commands. The read command shows the amount of rain that has fallen in the last hour and is calculated by:

TOTAL RAINFALL = m (# of counts since last hour) + b

The RAW command returns the number of counts since the last hour.

#### Rollover for Analog and Digital Rainfall Counters

Rollover is needed to allow the rainfall channel to record more than the full scale reading. A rollover for an analog channel is detected by subtracting the current voltage from the voltage read at the last hour. If the difference is negative by more than 10% of full scale then a rollover counter is incremented. The total rainfall is then calculated by:

TOTAL RAINFALL = (Rollover Count * Volts Full Scale) +
(Current Voltage - Last Hour's Voltage)

This gives a value in volts which is then scaled accordingly. For a digital channel the number of counts is substituted for the voltages.

The check for a rollover is performed once a minute. Because of this, more than one rollover a minute cannot be detected. If a rollover is detected during a minute the value of a READ or a REPEAT READ command will not be correct until the next minute.



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**NOTE:** The rainfall counter is read on the hour and the resulting value is stored in the hourly average for that channel. If power is interrupted, the rainfall counter continues to count contact closures and the total number of closures is recorded at the first hour after power is restored.

### 4.4.2 Temperature, Solar Radiation

Channel type B & C are initialized just as are standard gas instruments (Type 9) except that no span values are entered in the calibration record, if chosen.

### 4.4.3 Tape Sampler #1

When a channel type of "D" is specified, a logical 1 is placed on output control line #8 for 1 second at the hour to advance a tape reel.

The initialization procedure is the same as for a normal channel, but the data is recorded in a different manner. Instead of averaging over the whole hour, the last minute average before the hour is placed in the hourly average. The status code for the "D" channel reflects only the status of the last minute average of the hour. However, the codes for power interruptions ("P"), bad status ("B") and disabled channel ("D") apply for events which occur anytime during the reporting hour. For example, a maximum error ("+") that occurs at 08:15 will not be reported at 09:00, but a power outage at 08:30 will be reported. Further, the average is not flagged with a "C" when calibration occurs, nor with an "R" when a rate of change error occurs.

### 4.4.4 Tape Sampler #2

The "G" type channel is initialized in much the same manner as the "D" type. Except that following the Channel Type prompts, the prompt "USE COH CALULATION"



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N?" will appear if a "Y" is entered then the COH calculation will be used instead of the regular calculation.

When a channel type of "G" is specified, a logical 1 is placed on output control line #7 for approximately five seconds each even clock hour (Example Time: 02:00). After waiting one minute, the data logger takes a one minute average (Example Time: 02:01 to 02:02) and stores this average as the hourly average (Example Time: 02:00). After 118 minutes (Example Time: 03:59 to 04:00) the data logger again takes a one minute average. This difference between the two one minute averages is stored as the odd hour (Example Time: 03:00) average. The difference is taken as the first one minute average minus the second one minute average.

If the COH calculation prompt was answered with a "Y" then the following calculation will be used on the first minute reading and the last minute reading and the result stored as the hour average for the odd hour as above.

$$COH/1000ft = \frac{540}{(\hat{}T)C} \quad LOG \frac{(VSG)}{(V)}$$

where: $\hat{}T$ = 119 min

C = 6.25 L/min or .2207166667009 $ft.^3/min$

Vsg = Reading for 1st minute

V = Read for last minute

This effectively works out to:

$$COH/100ft = 20.55945809 \text{ Log } \frac{(1st \text{ reading})}{(last \text{ reading})}$$

---

**NOTE:** For the COH calculation to be correct slope must = 100 and intercept must = 0.

---



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**NOTE:** The value produced by the COH calculation is stored in long term memory and will appear in print daily and print hour commands that specify date and time. The print hour and set hour commands will output the last reading not the COH result.

### 4.4.5 YSI Temperature Probes

As an option, two standard YSI temperature probes* can be connected directly to the 8800 through a special connector* on the rear panel. To obtain data from temperature probe #1, channel 19 must be initialized, and to obtain data from probe #2, channel 20 must be initialized. No other channels can be used for YSI temperature probes. The "CHANNEL TYPE" for a YSI temperature probe channel is type "T".

The initialization procedure for a YSI temperature probe channel is basically the same as the initialization procedure for a standard gas instrument channel with the following exceptions:

1. The "CHANNEL TYPE" is "T", and
2. The "VOLTS FULL SCALE" prompt is not given because the full scale voltage must stay fixed at 1.0 volts.

* For more information on the YSI Temperature Probes and their connection to the 8800, see Appendix B.



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To obtain a reading in °C with an accuracy of at least ±0.5°C**, the following slope and intercept must be used:

slope, m = -147.13 intercept, b = 95.79

where y = mx + b.

To obtain a reading in °F with an accuracy of at least ±0.9°F**, the following slope and intercept must be used:

slope, m = -264.84 intercept, b = 204.43

where y = mx + b.

## 4.5 Additional Commands

Other commands associated with the initialization process are listed below, followed by a brief description of each.

### 4.5.1 SET INT

**SET INT mm** is used to set or change the auxiliary averaging interval, for all channels, to the time (in minutes) entered for mm. The auxiliary averaging interval must be an integer divisor of 60 minutes, i.e. allowable settings are: 01, 02, 03, 04, 05, 06, 10, 12, 20, and 30 minutes. The data logger response is:

*AUX INTERVAL IS: mm*

Where mm is the value entered with the **SET INT mm** command. The command **SET INT** results in a data logger response of *AUX INTERVAL IS: mm* which simply reports the auxiliary averaging value previously set.

** The accuracies stated above are valid over the temperature range of -30°C to +50°C (-22°F to +122°F). These accuracies include allowances for interchangeability (i.e. differences from probe to probe and logger to logger). For greater accuracies, see Appendix B.



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### 4.5.2 List

**LIST** cc provides a record of the initialization settings for the channel specified in cc. If the wildcard channel description 00 is entered, this command lists the initialization settings for all channels. An example of the response to the LIST command for a specific channel (01 in the example) follows:

```
DCN#KB>LIST 01

CHANNEL NUMBER: 01
CHANNEL NAME: TEST
CHANNEL TYPE: 9
STORE HOURLY AVERAGES: Y
      HOURLY SIGMAS: N
      HOURLY % VALID: N
      HOURLY RANGE: N
STORE AUX AVERAGES: Y
      AUX SIGMAS: N
      AUX % VALID: N
      AUX RANGE: N
CHANNEL UNITS: TEST
VOLTS FULL SCALE:  1.000
SLOPE:  1000.
INTERCEPT:  100.0
DECIMAL POSITIONER: 0
MAX READING:  5000.
MIN READING: -5000.
MAX RATE OF CHANGE:  500.0
ALARM INTERVAL [N,M,A,H]: H
ALARM LINE: 00
ALARM LIMIT HIGH:  1000.
ALARM LIMIT LOW:  1000.
ALARM LIMIT ROC:  1000.
BAD STATUS= 1XXXXXOX XXXXXXXX
CALIBRATION TYPE: I
ZERO STATUS= 1XOXXXXX XXXXXXXX
SPAN1 STATUS= 1X1XXXXX XXXXXXXX
SPAN2 STATUS= 11XXXXXX XXXXXXXX
RECOVERY TIME: 05
CAL SEQUENCE: Z12
EXPECTED SPAN1, SPAN2:  .0000, .0000
10-STEP CALIBRATION: Y
AMBIENT MASK=X11OXXXX XXXXXXXX
AVERAGING INTERVAL: 05
RECOVERY TIME: 05
ON-LINE: Y

DCN#KB>
```



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### 4.5.3 Disable/Enable AVG

The command **DISABLE AVG cc** allows the operator to take a channel "off-line", thus disabling the channel from averaging incoming data, and results in status code symbol "D" for that channel during the disabled period. Use of the wildcard channel number 00 will result in all channels being taken off-line.

The command **ENABLE AVG cc** allows the operator to put back "on-line" a channel (or all channels with wildcard 00) taken off-line with the previous DISABLE AVG command. The program will then resume averaging of the data for the channel(s) specified in cc.

### 4.5.4 Delete

The command **DELETE cc** will delete all initialization entries for the channel indicated in cc. Use of the wildcard channel number 00 will result in the deletion for all channels. If the indicated channel has not been initiated, the data logger responds with:

*NOT IN TABLE!!!*

---

**NOTE:** If a WSP/WDR pair is set up using vector averaging, deleting one will delete the other.

---



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# 5.0 COMMAND DESCRIPTION

This section contains a listing and description of all commands not previously covered. For convenience, the commands are grouped according to function. At the end of the section is a command summary, which provides an alphabetical listing of all commands, their privileged status, and the section and pages where they are described in detail.

Please note that all commands must be entered at the data logger DCN prompt: *DCN#??>*, and must be entered in CAPITAL letters. Also, in this section, operator entered commands are in **BOLD** type, while data logger responses are *italicized*.

## 5.1 General Commands

Commands grouped in this section are related to general information such as time, date, version, messages, etc. These commands are as follows.

### 5.1.1 Command: **HELP**

Response: *The data logger responds with a list of all valid commands.*

Description: A complete listing of the help printout is given at the end in Section 5.7.

### 5.1.2 Command: **VERSION**

Response Example: *ESC V1.01-August 21, 1987*

Description: Returns the version number of the software program for the 8800 data logger, as well as the date of its inception.

### 5.1.3 Command: **SET RING n**

Response: *DCN Prompt*

Description: This command sets the modem to answer the phone on the number of rings specified in n, where n is a number between 1 and 4, and turns the modem speaker off (Does not apply to dedicated line modems).



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A related command is:

Command: **SET RING**

Response: *THE RING COUNT IS: n*

Description: Reports the ring count n set with the SET RING n command. If no count has been set, it reports the default value of 1.

### 5.1.4 Command: **MESSAGE**

Response: ****NO MESSAGES FOR REMOTE****

****NO MESSAGES FOR CENTRAL****

Description: Reports any messages stored in the data logger remote operator message buffer (see R: text command), or the central message buffer (see C: text command). Includes the time and date that the message was entered. If no messages are present, it returns the response shown above.

### 5.1.5 Command: **R: text**

Response: *DCN Prompt*

Description: Loads the remote operator message buffer (R:) with the message entered for "text" (up to 80 characters) for messages from the central computer to the remote (data logger) site. A maximum of 4 messages are stored in a scrolling buffer, i.e., the oldest message is removed when a fifth is added.

Command: **C: text**

Response: *DCN prompt*

Description: Same as for (R:) text, except that the message is from the remote (data logger) site to the central computer (C:) message buffer.

### 5.1.6 Command: **CLEAR MESSAGE**

Response: ****No Messages for Remote****

Description: Clears the data logger remote message buffer (R:) of all messages, but does not affect the central computer (C:) message buffer.



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### 5.1.7 CARTRIDGE Commands

The DSC-80 removable RAM cartridge contains from 32K to 512K of CMOS RAM, protected by a lithium battery. The cartridge allows a user to take data from a remote site without telephone lines.

The user must NEVER REMOVE OR INSERT THE CARTRIDGE WHILE POWER IS ON. Doing so will violate the data logger's warranty, and will cause a loss of data.

A cartridge, like a floppy disk, must be "formatted" before it can be used. To format a cartridge, turn the data logger off, insert the cartridge, and turn it on. From the console port, log in, set to privileged status, and type the command:

**FORMAT CARTRIDGE**

The data logger will format the cartridge, tag the cartridge with the DCN ID, and report the size of RAM available to you.

Whenever the formatted data cartridge is inserted, the data logger automatically recognizes it, and will use it to store data, rather than using its internal memory. It is also possible to copy data from the internal RAM of the data logger to the cartridge, so that any data logged while the cartridge was not inserted is not lost. The command is:

**COPY CARTRIDGE**

The data logger responds with the prompt:

*CARTRIDGE FROM DCN 1A HAS BEEN FOUND.*

*TYPE 'E' TO EXIT, OR DO NOTHING FOR DEFAULT FORMAT AND COPY.*

*COUNTING DOWN (15 SECS)...*

The same prompt is provided whenever a cartridge from a foreign DCN is inserted into the logger.

Typing 'E' tells the data logger to just copy the DCN-ID from the logger to the cartridge without altering the data in the cartridge, while doing



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nothing permits the data logger to format the cartridge and copy the contents of its internal RAM to the cartridge.

---

**NOTE:** Cartridges removed for transport and/or later reading should have the "write protect" switch activated.

If the wrong cartridge is inserted, and power applied, then Don't Panic!! At the prompt 15 seconds is given for the decision. Turn off the logger again and remove the cartridge.

---

5.1.8 Command: **CONSOLE SPEED bbbb**

Response: *CONSOLE BAUD RATE = 1200* (See Note)

Description: This command allows the baud rate of the RS-232 port on the rear panel to be selected, where bbbb is the new baud rate (1200 in this example). Allowable values 300, 1200, 2400, 4800, 9600, and 19200.

The initial default value (RAM battery OFF) 300 baud. The present value may be observed by entering the command **CONSOLE SPEED** without bbbb. The logger responds with the present setting, as in the response example given.

---

**NOTE:** The baud rate of the console must match that of the terminal being used with it. As described in Section 2.3 (Connecting a Terminal) we recommend a terminal speed of 300 baud, to match the console default value. To change values, you must follow this sequence.

1. Establish communications, terminal to logger (baud rates match).
2. Change console speed with above command. You will not see the response shown above, since the terminal and logger now have different baud rates.
3. Re-initialize baud rate of terminal to new value.
4. Re-establish communications (new baud rates match).

We do not recommend use of this command unless you are familiar with the procedures for changing the terminal communication parameters!

---



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5.1.9 Command: **CENTRAL SPEED bbbb,cccc**

Response: *EXTERNAL MODEM LOW SPEED = 300*
*HIGH SPEED = 1200*

Description: This command allows the baud rate of the External Modem port to be set, where bbbb is the low speed of the port, and cccc is the high speed of the port. Allowable values are as described for the **CONSOLE SPEED bb bb** command, except that the 2 entries are allowed for 300/1200 baud. The default value for the External Modem port is 300 baud. ON LS/HS of 300/1200 the modem port is at 1200 baud when pin 12 is brought high by the modem. Again, the command **CENTRAL SPEED**, without the entry bb, reports the present setting in the same format as given in the response example.

---

**NOTE:** Care should be exercised when using this command, as the CENTRAL SPEED must match that of the modem being used with the logger, as well as the central computer modem (if applicable).

---

5.1.10 Command: **SET DST FALL = mm/dd**

Description: This command sets the date of the daylight savings time for fall. At 2:00 AM on this date, the data logger's time will be automatically set back one hour, causing an hour of data to be overwritten.

5.1.11 Command: **SET DST SPRING = mm/dd**

Description: This command sets the date of the daylight savings time for spring. At 2:00 AM on this date, the data logger's time will be automatically set forward one hour, causing a missing hourly average for 2:00.

## 5.2 Data Related Commands

Data stored in the 8800 data logger can be accessed, either locally or remotely, by issuing commands listed in this section. Where applicable, accompanying SET or CLEAR commands are also described here. In addition, commands which activate (or deactivate) certain print commands are listed in the "SET/RESET" Section 5.2.5.



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For those commands containing a cc (for channel number), the use of the wildcard channel number 00 returns the same information for all active analog input channels, unless otherwise indicated.

If the data returned from the commands described in this section have been corrupted for any reason, an error code accompanies the corrupted data. A listing of these error codes and their description is given as follows.

**ERROR CODE SUMMARY**

| Priority | Character | Indication |
|---|---|---|
| 1 | P | Power down during reporting interval. |
| 2 | D | Channel disabled during interval. |
| 3 | B | Bad status condition detected. |
| 4 | C | Channel in a calibration cycle. |
| 5 | + | Channel minute average greater than maximum value. |
| 6 | - | Channel minute average less than minimum value. |
| 7 | R | Rate of change exceeded. |
| 8 | H | High alarm condition. |
| 9 | L | Low alarm condition. |
| 10 | O | Rate of change alarm condition. |
| 11 | (Space) | Indicates no error. |
| - | < | With hour or aux average, indicates that less than 75% of 1-minute averages were available for the average. |
| - | > | With hour or aux average, indicates that 75%-99.9% of 1-minute averages were available for the average. |

PRIORITY EXAMPLE: If a channel has both a "P" and "D" error during the same averaging interval, then the "P" will be reported since it has a higher priority.



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### 5.2.1 POWER

The following commands are related to power outage information.

Command: **LOG POWER**

Response Example: *P 03/18 19:03:07 => 03/18 19:03:21*
*P 03/19 20:41:51 => 03/19 20:51:32*
*P 03/19 22:06:39 => 03/19 22:06:43*

Description: This command lists the times during which power was not available to the data logger. "P" indicates that the power fail has been read by the central computer and is now "purgeable" (see PURGE POWER command). Gives date (03/18) and time (10:03:07) of power off followed by date (03/18) and time (19:03:21) of power back on. Lists first 20 occurrences since last purged by the operator.

Command: **PURGE POWER**

Response: *DCN Prompt*

Description: Clears all power fails, which have been read by the central computer and are flagged with a "P", from the power fail buffer.

Command: **CLEAR POWER**

Response: *DCN Prompt*

Description: Clears the power fail buffer of all power fails.

### 5.2.2 RAW Commands

Command: **RAW cc**

Response Example: *CHAN # 01 = 1.073V*

Description: Reports the analog voltage input reading for the channel specified in cc (01 in the example), or for all channels with cc=00.

Command: **REPEAT RAW cc**

Response Example: *CHAN # 01 = 1.073V*
*CHAN # 01 = 1.074V*
*CHAN # 01 = 1.072V*

Description: Continuously repeats the analog input voltage for the channel specified in cc. The wildcard channel (#00) gives a full screen display of all channels, continually updated. This command allows the terminal to be used as a DVM for adjustments or servicing. Press any key to stop this (or any other REPEAT) command.



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### 5.2.3 READ

The "READ" command is similar to "RAW", except that it displays the value in engineering units. Examples of this command and its responses are as follows.

Command: **READ cc**

Response Example: *CHAN # 01 = 0.029*

Description: Displays the value, in engineering units, calculated according to the latest analog input voltage, slope, and intercept values for the channel specified in cc (01 for this example). If the global channel # 00 is used, it displays the engineering unit values for every channel in the table.

Command: **REPEAT READ cc**

Response Example: *CHAN # 01 = 0.029*
*CHAN # 01 = 0.030*

Description: Continuously repeats the channel value, in engineering units, until another key is struck. The wildcard channel (00) gives a full-page display of all channels, continually updated.

### 5.2.4 PRINT Commands

The following commands report data for various time intervals (minute, hourly, etc.)

#### 5.2.4.1 MINUTE

Command: **PRINT MINUTE cc**

Response Example: *01 1.22C 1.44P*

Description: For the indicated channel (01 in this example) reports latest minute average (1.22) plus previous minute average (1.44) in engineering units (reports same information for all channels with cc=00). Includes error codes (C,P).

Command: **PRINT MAX MINUTE cc**

Response Example: *01 06/06 12:06 1.65*
*01 06/05 11:32 1.82*

Description: Reports the maximum minute averages for the last 2 days. Includes channel no (01), date (06/06) and time (12:06) of the maximum value occurrence. Returns zero's for days where no data was available. Wildcard # 00 reports this data for all channels.



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Command: **PRINT MIN MINUTE cc**

Response Example: *01 06/06 06:32 1.01*
*01 06/05 05:47 1.02*

Description: Reports the same information as the PRINT MAX MINUTE command, except for minimum, rather than maximum, values. Wildcard channel 00 reports minimum values for all channels.

Command: **REPEAT MINUTE 00**

Description: This command gives a full-page display of the last minute average for all channels, updated every minute. It may be exited by pressing any key.

Command: **PRINT EXCEPT cc**

Response Example: *01 08/06 12:30 1.22C 1.44P*
*01 08/06 12:29 1.44P 1.00P*

Description: This command returns all minute averages, for the channel specified in cc, (01 in this example) which contain error codes (errors or values exceeding max, min, rate of change limits, etc.). Response is similar to that for PRINT MINUTE, except that the dates (08/06) and times (12:30, 12:29( of the exceptions are included. Returns this information for all channels with wildcard #00. Returns a DCN prompt if no exceptions occurred.

Command: **CLEAR EXCEPT**

Response Example: *DCN Prompt*

Description: This command clears the error exception buffer for all channels.

### 5.2.4.2 AUX

Command: **PRINT AUX cc**

Response Example: *01 06/04 09:45 1.223 C*

Description: Returns the latest average (1.223) for channel (01) over the auxiliary averaging period. Includes data (06/04) and time (09:45), where time is the beginning of the auxiliary averaging interval. Error codes are included, if applicable. Reports this data for all channels with cc=00.

Command: **PRINT AUX cc,hr:mm,nn**

Response Example: *01 06/04 09:45 1.22*
*01 06/04 09:50 1:01 C*
*01 06/04 09:55 1.11 P*



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Description: Returns auxiliary averages for the indicated channel (01), beginning at the time specified in hr:mm (09:45) and including the number of averages specified in nn (03), where nn is a number from 01 to 99. Includes date (06/04) and error codes (C,P). Wildcard # 00 is allowed only if nn is omitted.

Command: **PRINT AUX cc,mo/dd hr:mm,nn**

Response Example: *01 06/03 08:00 1.16*
*01 06/03 08:05 1.21*
*01 06/03 08:10 1.19*

Description: Returns same information as the previous command, but for <u>any</u> day specified in mo/dd. Wildcard # 00 is allowed if nn is omitted.

Command: **PRINT MAX AUX cc**

Response Example: *01 06/06 12:00 1.657*
*01 06/05 11:30 1.725*

Description: Reports the maximum auxiliary averages for the last 2 days. Includes channel (01), date (06/06) and time (12:00) of the maximum value occurrence. Returns zeros for days where no data was available. Wildcard channel #00 reports this data for all channels.

Command: **REPEAT AUX 00**

Description: This command gives a full-page display of the last auxiliary average for all channels, updating every aux interval. It may be exited by pressing any key.

### 5.2.4.3 <u>Hour</u>

Command: **PRINT HOUR cc**

Response Example: *01 06/03 13:00 59 1.012B> .0000*

Description: Returns information for the most recent hourly average including channel (01), date (06/03), time (13:00), number of 1 minute averages included (59), hourly average with error codes (1.012B>), and standard deviation (.0000). Wildcard channel # 00 reports this information for all channels.

Command: **PRINT HOUR cc,hr,nn**

Response Example: *01 06/04 12:00 1.00*
*01 06/04 13:00 1.02P*

Description: Reports hourly averages, for the present day only, beginning at the hour specified in hr (12:00) and extending for the number of hours specified in nn (02), where nn is a number from 01 to 12. Includes channel (01), date (06/04), and error



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code information (P). If enabled, sigma, % valid and range are also printed. Wildcard # 00 may be used if nn is omitted.

Command: **PRINT HOUR cc,mo/dd hr,nn**

Response Example: *01 05/06 12:00 1.21C*
*01 05/06 13:00 1.15*

Description: Returns same information as previous command, but for any day specified in mo/dd (05/06).

Command: **REPEAT HOUR 00**

Description: This command gives a full-page display of the last hourly average for all channels, updating every hour. It may be exited by pressing any key.

### 5.2.4.4 DAILY

Command: **DAILY AVERAGE cc**

Response Example: *01 123.4 09 HOURS*

Description: Reports the average thus far (123.4) for the present day, for the channel specified in cc (01). The number of valid hours are shown (09), where "valid hours" are those for which 75% or more of the minute averages are valid (i.e., do not contain error codes). Wildcard channel #00 reports this data for all channels.

A formatted daily report, similar to that shown in the example on the next page, can be obtained from the 8800 data logger. This allows the 8800 data logger to operate in a "stand alone" configuration without the use of a central computer system. The commands affecting this report are as follows:

Command: **PRINT DAILY**

Response: *Formatted Daily Report (see example)*

Description: Produces a daily summary, of hourly averages for all channels, for the preceeding 24 hour period.

Command: **PRINT DAILY mo/dd**

Response: *Formatted Daily Report*

Description: Same as for PRINT DAILY except for the day specified in mo/dd, beginning with hr 00 and ending with hr 23.



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Command: **PRINT DAILY mo/dd hr**

Response: *Formatted Daily Report*

Description: Same report as PRINT DAILY, but for the day specified in mo/dd, beginning at the hour specified in hr, and extending for 24 hours.

**SAMPLE DAILY REPORT**

DAILY SUMMARY 10/08/86 11:00 DAY=281 ESC DEMO

| CHANNEL: | 01 | 02 | 03 | 04 | 05 |
|---|---|---|---|---|---|
| NAME: | SO2 | NO | NO2 | NOX | WS |
| UNITS: | PPB | PPB | PPB | PPB | MPH |
| VOLTS FS: | 5.000 | 10.00 | 10.00 | 10.00 | 1.000 |
| SLOPE: | 500.0 | 500.0 | 500.0 | 500.00 | 1000 |
| INTERCEPT: | .0000 | .0000 | .0000 | .0000 | .0000 |
| 10/08 11 | 23. | 31. | 3. | 2. | 2.6 |
| 10/08 12 | 22. | 33. | 9. | 12. | 2.8 |
| 10/08 13 | 12. | 36. | 29. | 66. | 4.0 |
| 10/08 14 | 21. | 33. | 31. | 64. | 3.5 |
| 10/08 15 | 21. | 19. | 21. | 31. | 0.4 |
| 10/08 16 | 24. | 22. | 13. | 15. | 1.2 |
| 10/08 17 | 23. | 32. | 7. | 6. | 2.6 |
| 10/08 18 | 23. | 36. | 2. | 0. | 1.6 |
| 10/08 19 | 22. | 29. | 3. | 2. | 0.2 |
| 10/08 20 | 19. | 32. | 4. | 2. | 7.6 |
| 10/08 21 | 22. | 26. | 2. | 0. | 10.7 |
| 10/08 22 | 23. | 30. | 3. | 1. | 11.5 |
| 10/08 23 | 21. | 32. | 2. | 0. | 2.7 |
| 10/09 00 | -2.C> | -2.C> | -2.C> | 0.> | 0.7 |
| 10/09 01 | 0.C> | 0.C< | 0.C< | 0.C< | 6.3 |
| 10/09 02 | 3.C< | -2.C< | 3.C> | 1.C> | 7.7 |
| 10/09 03 | 18. | 2. | 3. | 1. | 8.8 |
| 10/09 04 | 22. | 2. | 3. | 1. | 4.2 |
| 10/09 05 | 28. | 32. | 4. | 2. | 2.1 |
| 10/09 06 | 22. | 30. | 4. | 2. | 3.7 |
| 10/09 07 | 21. | 22. | 3. | 2. | 3.9 |
| 10/09 08 | 30. | 24. | 3. | 2. | 1.0 |
| 10/09 09 | 26. | 29. | 3. | 3. | 2.3 |
| 10/09 10 | 28. | 31. | 3. | 2. | 3.0 |



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Command: **PRINT DAILY mo/dd hr,nn**

Response: *Formatted Daily Summary Report*

Description: Same report as previous, but extends for nn hours beginning with the hour specified in hr,nn is any value from 01 to 24.

Command: **SET DAILY hr:mm**

Response: *DCN Prompt*

Description: Enables an automatic printout of the daily report, at the time indicated in hr:mm, and repeating daily until disabled.

Command: **SET DAILY X**

Response: *DCN Prompt*

Description: Disables automatic printout enabled with the proceeding command.

Command: **SET DAILY**

Response: *00:10*

Description: Reports the time that the automatic daily report will print, as determined by the SET DAILY hr:mm command (00:10 for this example).

### 5.2.4.5 SET/RESET Commands

The commands described in this section are used to enable or disable automatic printout of Hourly, Auxiliary, Minute, Calibration or Exception data. The commands and their descriptions are as follows:

Command: **SET HOUR/RESET HOUR**

Description: Enables/Disables automatic printout of hourly averages (at the end of every hour) for all channels. Print format is as described for the PRINT HOUR cc command.

Command: **SET AUX/RESET AUX**

Description: Enables/Disables automatic printout of auxiliary averages at the end of every auxiliary averaging interval. If both SET HOUR and SET AUX are on, the auxiliary averages are printed below the hourly averages for comparison. Format is as described for PRINT AUX cc command.



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Command: **SET MIN/RESET MIN**

Description: Enables/Disables automatic printout of minute averages, for all channels, at the minute mark. Format is as described for the PRINT MINUTE cc command.

Command: **SET CAL/RESET CAL**

Description: Enables/Disables automatic printout of the calibration data for every calibration cycle (except operator initiated single-phase calibration). Data is printed after completion of the calibration cycle recovery time. Format is as described for the PRINT CAL cc command (see Section 5.3).

Command: **SET EXCEPT/RESET EXCEPT**

Description: Enables/Disables automatic printout of any error codes that occurred, during the proceeding minute (except for calibration error codes c). Printout is for all channels. Format is as described for the PRINT EXCEPT cc command.

Command: **RESET ALL**

Description: Resets (Turns off) all five of the printing options described in this section.

Command: **STATUS**

Response:

| *HOUR* | *AUX* | *MIN* | *CAL* | *EXCEPT* |
|---|---|---|---|---|
| *ON* | *OFF* | *OFF* | *ON* | *OFF* |

Description: Displays the state (ON or OFF) of the SET HOUR, SET AUX, SET MIN, SET CAL and SET EXCEPT commands.

### 5.2.4.6 Printer Commands

Command: **PRINTER ON**

Response: *Printer is on line*
*Printer is off line*
*Printer is not responding please check*

Description: This command enables echo printer of the console output to a Centronics compatible parallel printer. When issued any output to the console port or input from the console port will be printed on the printer. The command responds with the printer status which is self explanatory. Caution: In the specific instance that the printer is hooked up and turned off the data logger cannot determine this fact and will respond with "Printer is on line" in all other situations it will respond properly.



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Command: **PRINTER OFF**

Response: *DCN Prompt*

Description: This command disables echo printing. The parallel printer port has been tested and works properly with Epson's FAX series of printers. Use of other parallel printers may require a software modification for proper operation.

## 5.3 Calibration Commands

As explained during the initialization procedures (Section 4.1.4), the data logger can be configured to automatically control calibration cycles, or to monitor the status of instrument initiated calibrations.

In addition, the operator may manually control the calibration phases with the commands described in this section. Following is a list of calibration related commands.

Command: **ENABLE CAL cc**

Response: *DCN Prompt*

Description: Enables the auto-cal feature for the channel specified in cc (for all channels if cc=00). Does not start the cycle. It begins when the auto-cal start time (set in the channel initialization) is reached.

Command: **DISABLE CAL cc**

Response: *DCN Prompt*

Description: Allows the operator to disable the auto-cal feature for the channel specified in cc (for all channels if cc=00). This command does **not** abort an auto-calibration cycle already in progress.

Command: **CAL STAT cc**

Response Example:

| *CHAN* | *ZERO* | *SPAN1* | *SPAN2* | *RECOVERY* | *ORDER* | |
|---|---|---|---|---|---|---|
| *01* | *15* | *10* | *02* | *05* | *21Z* | *AUTO-CAL SPAN2* |

Description: Provides information on the status of the auto-cal sequence for the channel specified in cc (for all channels if cc=00). Gives time remaining in its zero, span1, span2, and recovery phases, the calibration order (21Z) and the present status (presently in span2 of auto-cycle for this example). Returns all zeros if the channel is not presently in a calibration cycle. This command also gives the status of a 10-step calibration.



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Command: **PRINT CAL**

Response Example:

| *CALIBRATION DATA* | | | | | |
|---|---|---|---|---|---|
| *CHANNEL* | *DATE* | *TIME* | *ZERO* | *SPAN1* | *SPAN2* |
| *01* | *03/16* | *22:09* | *0.013* | *50.75* | *100.1* |

Description: Reports the first three steps of calibration data from the most recent calibration cycle for all channels. Data is in the form indicated in the sample response. To conserve space, only one channel is shown in the response example.

Command: **PRINT CAL cc**

Response Example: *Same response format as PRINT CAL.*

Description: Prints the first three steps of all calibration data (from longterm storage) for the channel specified in cc (for all channels if cc=00). Report format is the same as for PRINT CAL.

Command: **PRINT CAL cc,mo/dd**

Response Example: *Same response format as PRINT CAL.*

Description: Reports the first three steps of all calibration data for the channel specified in cc (for all channels if cc=00) for the day specified in mo/dd. Format same as PRINT CAL.

Command: **PRINT XCAL**

Response Example:

| *CC* | *DATE* | *TIME* | *01* | *02* | *03* | *04* | *05* | *06* | *07* | *08* | *09* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *10* | *04/06* | *10:37* | *246.0* | *378.1* | *271.9* | | | | | | |

Description: Reports data from only the most recent calibration cycle for all channels. Data is in the form indicated in the sample response. To conserve space, only one channel is shown in the response example.

Command: **PRINT XCAL cc**

Response Example: *Same response format as PRINT XCAL.*

Description: Prints all steps of (including 3-step) calibration data (from longterm storage) for the channel specified in cc (for all channels if cc=00). Report format is the same as for PRINT CAL.

Command: **PRINT XCAL cc,mo/dd**

Response Example: *Same response format as PRINT XCAL.*

Description: Reports all steps of calibration data for the channel specified in cc (for all channels if cc=00) for the day specified in mo/dd. Format same as PRINT CAL.



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Command: **START CAL cc**

Response: *DCN Prompt*

Description: Manually initiates a calibration cycle for channel specified in cc, provided that channel has been enabled for auto calibration (see ENABLE CAL cc). Wildcard channel #00 is not permitted with this command. Times for each phase and digital output control lines are as specified during initialization. This command will not affect a calibration cycle already in progress.

Command: **START ZERO cc,mm**

Response: *DCN Prompt or CAL IN PROGRESS if calibration was already in progress*

Description: This command allows the operator to manually initiate the zero phase of a calibration cycle for the channel specified in cc (wildcard number 00 not permitted). The channel specified will remain in that phase for the number of minutes specified in mm, will proceed to the recovery phase for the period specified in the initialization, and will then return to collecting data. It will also switch on the output control line associated with that phase, and switch it off again after mm has elapsed. During this time, and the associated recovery time, data is omitted from hourly and auxiliary averages, and those averages are flagged with the calibration error code (C). This command can be terminated at any time with the ABORT CAL cc command.

Command: **START SPAN1 cc,mm**

Response: *DCN Prompt OR CAL IN PROGRESS IF CALIBRATION WAS ALREADY IN PROGRESS*

Description: The description for this command is the same as for START ZERO, except that it initiates the SPAN1 phase instead.

Command: **START SPAN2 cc,mm**

Response: *DCN Prompt OR CAL IN PROGRESS IF CALIBRATION WAS ALREADY IN PROGRESS*

Description: Same as above, except that it initiates the SPAN2 phase.

Command: **ABORT CAL cc**

Response: *DCN Prompt*

Description: Terminates any auto or manually initiated calibration for the channel specified in cc (for all channels if cc=00). It does not terminate an instrument-initiated calibration or a 10-step calibration, however, since such a calibration is under instrument, rather than data logger, control.



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Command: **PURGE CAL**

Response: *DCN Prompt*

Description: When the central computer retrieves a calibration, that calibration is flagged with a "P" to indicate that the record is now purgeable. The command PURGE CAL deletes all calibration records thus marked. (3-step and 10-step)

Command: **CLEAR CAL**

Response: *DCN Prompt*

Description: This command deletes all calibration records, whether or not they have been flagged as purgeable.

## 5.4 Digital I/O Commands

In addition to the set-up of digital lines during the initialization process (see Section 4) there are several commands which can be used to read or alter the status of these lines. These commands are as follows:

Command: **SWITCH ON ss**

Response: *DCN prompt*

Description: This command is used to manually turn on the digital output control line specified in ss (where ss = 01 to 16). This command overrides all automatic and initialization settings.

Command: **SWITCH OFF ss**

Response: *DCN prompt*

Description: Manually turns off the digital output control line specified in SS. This is a complementary command to SWITCH ON.

Command: **SENSE IN ss**

Response Example: *INPUT LINE # 05=0*

Description: Reports the state (0 or 1) of the input status line specified in ss (01 to 16). Use of wildcard #00 reports the status of all 16 input status lines.

Command: **SENSE OUT ss**

Response Example: *OUTPUT LINE #02=1*

Description: Reports the state (0 or 1) of the digital output control line specified in ss (01 to 16). Wildcard # 00 reports the status of all 16 output control lines.



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Command: **LOG INPUTS**

Response Example: *06/24 14:30:27 INPUT LINE #08 0 => 1*
*06/24 14:38:32 INPUT LINE #08 1 => 0*
*06/24 19:15:55 INPUT LINE #08 0 => 1*

Description: Reports the digital input line transitions that have occurred since the operator last requested this information. Reports the date (06/24), time of transition (14:30:27), line #(08) and the transition made (0 => 1 is from "off" to "on", 1 => 0 is from "on" to "off).

Command: **CLEAR INPUTS**

Response: *DCN prompt*

Description: Clears the journal of digital input line transition described for the LOG INPUTS command.

### 5.4.5 Digital Program Commands

The digital program feature allows the user to turn on or off one or more digital output lines for a specified duration, not to exceed 45 days, at a specified time. The program may also be repeated at a given interval that does not exceed 99 days. The commands(4) to set up the digital programs are given below. There is a maximum of 9 (1-9) digital programs that can be initialized. On power fails the start time of the digital program will be recalculated if the logger time is greater than the start time. If the power fail is greater than 100 days then the start time will not be recalculated by the data logger. It is up to the user to reset the start time if this occurs.

Command: **SET PROG START** n JJJ HH:MM:SS<cr>

Response: (example)
*PROGRAM #1*
*STARTING AT 12:00:00 ON 150*
*LINE XXXXXXXX XXXXXX01 FOR 00 DAYS AND 01:15 HOURS/MINS REPEATING EVERY 007 DAYS AND 00:00:00 HOURS/MINS/SECS*

Description: This command allows the user to enter the starting time (julian days, hours, minutes, and seconds) for a digital program. This start time cannot exceed the current logger time by more than 90 days.

where:

n = program number
JJJ = julian date
HH = hours
MM = minutes
SS = seconds

EXAMPLE:

**SET PROG START** 1 127 12:30:15<cr>



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This setting tells the logger to start program 1 on 5/7 (5/6 if a leap year) at 30 minutes and 15 seconds past noon.

**SET PROG START** n<cr>

This allows the user to look at the program without changing any of the parameters.

Command: **SET PROG LINE/DUR** n XXXXXXXX XXXXXXXX JJ HH:MM<cr>

Response: (example)
*PROGRAM #1*
*STARTING AT 12:00:00 on 150*
*LINE XXXXXXXX XXXXXX01 FOR 00 DAYS AND 01:15 HOURS/MINS/SECS*
*REPEATING EVERY 007 DAYS AND 00:00:00 HOURS/MINS/SECS*

Description: This command allows the user to enter digital output line mask (XXXXXXXX XXXXXXXX) and a duration time (days,hours,minutes, and seconds). The mask allows up to 16 digital output lines to be turned on or off. The duration must not exceed 45 days.

where:

| | |
|---|---|
| n | = program number |
| X...X | = digital output lines |
| JJ | = number of days |
| HH | = hours |
| MM | = minutes |
| SS | = seconds |

EXAMPLE:

**SET PROG LINE/DUR** 1 XXXXXXXX 11110000 00 01:00:30<cr>

This setting tells the logger to turn off lines 13-16, turn on lines 9-12 and leave lines 1-8 alone when program 1 is started. This program will run for 1 hour and 30 seconds. When the program is stopped, the active lines will be inverted, i.e. the 1's will become 0's and the 0's will become 1's.

**SET PROG LINE/DUR** n<cr>

This allows the user to look at the program without changing any of the parameters.

Command: **SET PROG REPEAT** N JJJ HH:MM:SS<cr>

Response: (example)
*PROGRAM #1*
*STARTING AT 12:00:00 ON 150*
*LINE XXXXXXXX XXXXXX01 FOR 00 DAYS and 01:15 HOURS/MINS REPEATING EVERY 007 DAYS AND 00:00:00 HOURS/MINS/SECS*

Description: This command allows the user to set up an interval time (days, hours, minutes and seconds) at which to repeat the program (up to one full year).



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where:

n = program number
JJJ = number of days
HH = hours
MM = minutes
SS = seconds

EXAMPLE:

**SET PROG REPEAT** 1 001 12:30:00<cr>

This setting tells the logger to repeat digital program #1 on a 1 day 12 hour and 30 minute interval time. When the program is started, the start time is incremented by the repeat time in order to get the next correct starting time.

**SET PROG REPEAT** n<cr>

This allows the user to look at the program without changing any of the parameters.

Command: **DELETE PROG** n<cr>

Response: DCN prompt

Description: This command allows the user to delete a digital program. When this command is executed, the default values will be loaded into the program. If the program is in progress when this command is executed, the active lines of the mask will be inverted just like they are with the SET PROG LINE/DUR command.

where:

n = program number

EXAMPLE:

**DELETE PROG** 1<cr>

This deletes digital program #1.

## 5.5 Analog DAC Outputs*

DAC outputs are available on the 8800 data logger for interfacing with analog recording equipment such as strip chart drivers. DAC outputs allow voltage equivalents (between 0 and 10 V) for channel values to be output for storage and further use. The 8800 data logger has four DAC outputs all of which can be used concurrently.

Section 5.4.2.1 covers the command for using the DAC's, and Section 5.4.2.2 covers the DAC hardware and specifications.



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### 5.5.1 DAC Commands

The command to set up and use a DAC is

**DAC # cc ty cond fullscale**

where # is the number of the DAC to be used

cc is the analog channel to watch

ty is the type of data to watch

IV - Instantaneous

MA - Minute Average

AA - Auxiliary Average

AS - Auxiliary Average

HA - Hourly Average

HS - Hourly Sigma

condition is ALL for all values to be recorded, VALID for only valid data values to be output. FULLSCALE is the fullscale value of the receiving device. An example of the command line is:

**DAC 1 03 IV ALL 100.0 <cr>**

This command will initialize a DAC driver to output to DAC 1 all the instantaneous values from channel 3.

Two commands are associated with the DACs on the 8800. They are

**DAC # ZERO <cr>**

**DAC # SPAN <cr>**

DAC # Zero is used to force a DAC output to 0 V and DAC # SPAN forces the DAC output to the fullscale voltage. # represents the number of the DAC to command (1-4).



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5.5.2 DAC Hardware (See Appendix A for 4-20 mA output.)

The back panel for the 8800 data logger is shown in Chapter 2, Figure 2.2. The connector for DAC outputs is shown just above the external modem connector near the center of the back panel. The pinout for the connector is shown and is

DGND - digital ground

CTR1 - control 1

CTR2 - control 2

DAC1 - DAC output 1

DAC2 - DAC output 2

DAC3 - DAC output 3

DAC4 - DAC output 4

1.000V - precision 1.000v output

AGND - analog ground

The DAC circuits for the 8800 data logger are AD 7248 12 bit DAC chips. The connection of the AD7248's is shown in Figure 2.2 with the connector and the precision 1.000 V reference also shown. The specifications for the DAC outputs are:

| | |
|---|---|
| Resolution | 12 bits |
| Relative Accuracy | ±1 LSB |
| Range | 0 V to 10 V fs |
| Short-Circuit Current | 40 mA |
| Output Voltage Settling Time | 10 uS |
| Output Voltage Slew Rate | 2 V/uS |



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## 5.6 Alarm Commands

These commands set parameters for the alarm call out procedure.

---

**NOTE:** The commands in this section are not available if the data logger has been configured for leased-line operation (i.e., if DIP SW1 is set to "ON".

---

Command: **SET PHONE1 XXXXXXXXX**

Response: *Phone Number One = T6156887900, 349*

Description: This command allows entry or examination of phone number one. If a carriage return is entered after "SETPHONE1" then the current value of phone number one is displayed. Up to 33 characters may be entered to replace the current phone number one. Valid characters are numbers, letters excluding "A" and the comma. T or P may be entered to indicate that following numbers should be Tone or Pulse dialed respectively. A comma will cause a delay of about one second, when inserted into the string to be dialed, multiple commas may be used. Other characters such as dashes and spaces will be ignored.

Command: **SET PHONE2 XXXXXXXX...**

Response: *Phone Number Two - T6156887900, 341*

Description: As for Phone1.

Command: **SET REDIAL ss**

Response: *Redial Trys = ss*

Description: This command allows setting of the number of times to retry a phone number before ceasing to dial that number and moving on to the next number or exiting.

Valid values: S = 00 to 09

If set to 00 then no dial out of alarm will occur. If no entry current value is displayed.

Command: **SET CARRIER WAIT ss**

Response: *Carrier Wait Time = ss seconds*

Description: This command sets the interval which the data logger will wait for the modem to receive a carrier and report it. If this time is exceeded then the 8800 assumes no connection and proceeds to dial out the next attempt. If no value is entered then the current value is displayed.



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## 5.7 Remote Command Use

In addition to using commands from a local terminal, these same commands may be issued remotely. To do so requires that the operator dial up the modem of the 8800 data logger and type the following sequence on the remote terminal

<ESC>"ID"AQM

where <ESC> is the terminal "escape" or "altmode" key and "ID" is the DCN id. The 8800 data logger will then respond just as if the terminal were connected to the operator port, and all of the commands previously described may be used. Thus, averages, calibration data, daily reports, etc. may be obtained remotely. It is even possible to set up the analog channels (or alter them) using the initialization sequences previously described.

A second, more efficient method of communication is described in Section 6, (Command Response Strings). This is also the method used in the ESC remote data acquisition package (RAQS).

## 5.8 Command List

The following is the help listing available on the 8800 data logger. Typing the command **HELP** and the following listing will occur.

*LOGIN*
*SET PRIV*
*SET PASSWORDS*
*BYE*
*ID*
*SET ID x text*
*TIME*
*REPEAT TIME*
*DATE*
*SET TIME mo/da/yr hr:mi:sc*
*SET DST SPRING mm/dd*
*SET DST FALL mm/dd*

*HELP*
*VERSION*

*CENTRAL SPEED low,high*
*CONSOLE SPEED nnnn*
*SET RING n*



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```
SET INT mm [roll nn]
INIT cc
LIST cc
DELETE cc
SET EQUATION C EGN =
RPN c
RAW cc
REPEAT RAW cc
READ cc
REPEAT READ cc
ENABLE AVG cc
DISABLE AVG cc
PRINT MINUTE cc
PRINT MINUTE OO
PRINT MAX MINUTE cc
PRINT MIN MINUTE cc
PRINT MAX AUX cc
PRINT AUX cc,mo/dd hr:mm,nn
REPEAT AUX OO
REPEAT HOUR OO
PRINT HOUR cc,mo/dd hr,nn
PRINT DAILY mo/dd hr,nn
PRINTER OFF
PRINTER ON
PRINT EXCEPT cc
CLEAR EXCEPT
LOG POWER
PURGE POWER
CLEAR POWER


ENABLE CAL cc
DISABLE CAL cc
START CAL cc
START ZERO cc,mm
START SPAN1 cc,mm
START SPAN2 cc,mm
CAL STAT cc
ABORT CAL cc
PRINT CAL cc,mo/da
PRINT XCAL cc,mo/da
PURGE CAL
CLEAR CAl

SET DAILY hr:mi
<RE>SET AUX
<RE>SET HOUR
<RE>SET MIN
<RE>SET CAL
<RE>SET EXCEPT
STATUS
RESET ALL

SENSE IN ss
SENSE OUT ss
```



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```
SWITCH ON ss
SWITCH OFF ss
LOG INPUTS
CLEAR INPUTS

SET PHONE1 (up to 33 characters)
SET PHONE2 (up to 33 characters)
SET REDIAL ss
SET CARRIER WAIT ss
R:text
C:text
MESSAGE
CLEAR MESSAGE
DAC n cc ty cond fullscale
SET PROG START n jjj hh:mm:ss
SET PROG LINE/DUR n XXXXXXXX XXXXXXXX jj hh:mm:ss
SET PROG REPEAT n jjj hh:mm:ss
DELETE PROG n

COPY CARTRIDGE
FORMAT CARTRIDGE
```

The following is an alphabetical listing of all valid 8800 data logger commands, with an indication of their privileged states, as well as the section and pages(s) where you can find a detailed explanation of each.



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FIGURE 5.1

COMMAND LIST

| COMMAND | P | SECTION | PAGE |
|---|---|---|---|
| ABORT CAL cc | | 5.3 | 5-17 |
| BYE | | 2.4.2 | 2-13 |
| C:TEXT | | 5.1.5 | 5-2 |
| CAL STAT cc | | 5.3 | 5-15 |
| CENTRAL SPEED bb,cc | * | 5.1.9 | 5-5 |
| CLEAR CAL | * | 5.3 | 5-18 |
| CLEAR EXCEPT cc | * | 5.2.4.1 | 5-9 |
| CLEAR INPUTS | * | 5.4 | 5-19 |
| CLEAR MESSAGE | | 5.1.6 | 5-2 |
| CLEAR POWER | * | 5.2.1 | 5-7 |
| CONSOLE SPEED bb | * | 5.1.8 | 5-4 |
| COPY CARTRIDGE | | 5.1.7 | 5-3 |
| DAC | | 5.5 | 5-20 |
| DAILY AVERAGE cc | | 5.2.4.4 | 5-11 |
| DATE | | 2.4.4 | 2-14 |
| DELETE cc | * | 4.5.4 | 4-33 |
| DELETE PROG n | | | |
| DISABLE AVG cc | * | 4.5.3 | 4-32 |
| DISABLE CAL cc | * | 5.3 | 5-15 |
| ENABLE AVG cc | * | 4.5.3 | 4-32 |
| ENABLE CAL cc | * | 5.3 | 5-15 |
| EQUATION # | | 4.3.2.1 | 4-25 |
| FORMAT CARTRIDGE | | 5.1.7 | 5-3 |
| HELP | | 5.1.1 | 5-1 |
| ID | | 2.4.4 | 2-15 |
| INIT cc | * | 4.0 | 4-1 |
| LIST cc | | 4.5.2 | 4-31 |
| LOGIN | | 2.4.2 | 2-13 |
| LOG INPUTS | | 5.4 | 5-19 |
| LOG POWER | | 5.2.1 | 5-7 |
| MESSAGE | | 5.1.4 | 5-2 |
| PRINT AUX cc | | 5.2.4.2 | 5-9 |
| PRINT AUX cc,hr:mm,nn | | 5.2.4.2 | 5-9 |
| PRINT AUX cc,mo/dd,hr:mm,nn | | 5.2.4.2 | 5-10 |
| PRINT CAL | | 5.3 | 5-16 |
| PRINT CAL cc | | 5.3 | 5-16 |
| PRINT CAL cc,mo/dd | | 5.3 | 5-16 |
| PRINT DAILY | | 5.2.4.4 | 5-11 |
| PRINT DAILY mo/dd | | 5.2.4.4 | 5-11 |
| PRINT DAILY mo/dd hr | | 5.2.4.4 | 5-12 |
| PRINT DAILY mo/dd hr,nn | | 5.2.4.4 | 5-13 |
| PRINT EXCEPT cc | | 5.2.4.1 | 5-9 |
| PRINT HOUR cc | | 5.2.4.3 | 5-10 |
| PRINT HOUR cc,hr,nn | | 5.2.4.3 | 5-10 |
| PRINT HOUR cc,mo/dd hr,nn | | 5.2.4.3 | 5-11 |
| PRINT MAX AUX cc | | 5.2.4.2 | 5-10 |
| PRINT MAX MINUTE cc | | 5.2.4.1 | 5-8 |
| PRINT MIN MINUTE cc | | 5.2.4.1 | 5-9 |
| PRINT MINUTE cc | | 5.2.4.1 | 5-8 |



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FIGURE 5.1 CONTINUED

COMMAND LIST

| COMMAND | P | SECTION | PAGE |
|---|---|---|---|
| PRINT XCAL | | 5.3 | 5-16 |
| PRINT XCAL cc | | 5.3 | 5-16 |
| PRINT XCAL cc,mo/dd | | 5.3 | 5-16 |
| PRINTER OFF | | 5.2.4.6 | 5-15 |
| PRINTER ON | | 5.2.4.6 | 5-14 |
| PURGE CAL | | 5.3 | 5-18 |
| PURGE POWER | | 5.2.1 | 5-7 |
| R:TEXT | | 5.1.5 | 5-2 |
| RAW cc | | 5.2.2 | 5-7 |
| READ cc | | 5.2.3 | 5-8 |
| REPEAT AUX OO | | 5.2.4.2 | 5-10 |
| REPEAT HOUR OO | | 5.2.4.3 | 5-11 |
| REPEAT MINUTE OO | | 5.2.4.1 | 5-9 |
| REPEAT RAW cc | | 5.2.2 | 5-7 |
| REPEAT READ cc | | 5.2.3 | 5-8 |
| REPEAT TIME | | 2.4.4 | 2-15 |
| RESET ALL | * | 5.2.4.5 | 5-14 |
| RESET AUX | * | 5.2.4.5 | 5-13 |
| RESET CAL | * | 5.2.4.5 | 5-14 |
| RESET EXCEPT | * | 5.2.4.5 | 5-14 |
| RESET HOUR | * | 5.2.4.5 | 5-13 |
| RESET MIN | * | 5.2.4.5 | 5-14 |
| RPN # | | 4.3.2.1 | 4-25 |
| SENSE IN ss | | 5.4 | 5-18 |
| SENSE OUT ss | | 5.4 | 5-18 |
| SET AUX | * | 5.2.4.5 | 5-13 |
| SET CAL | * | 5.2.4.5 | 5-14 |
| SET CARRIER WAIT SS | * | 5.5 | 5-23 |
| SET DAILY | * | 5.2.4.4 | 5-13 |
| SET DAILY hr:mm | * | 5.2.4.4 | 5-13 |
| SET DAILY x | * | 5.2.4.4 | 5-13 |
| SET DST FALL = mm/dd | * | 5.1.10 | 5-5 |
| SET DST SPRING = mm/dd | | | 5-5 |
| SET EQUATION # EQU = | * | 4.3.2.1 | 4-25 |
| SET EXCEPT | * | 5.2.4.5 | 5-14 |
| SET HOUR | * | 5.2.4.5 | 5-13 |
| SET ID xx text | * | 2.4.4 | 2-15 |
| SET INT | | 4.5.1 | 4-31 |
| SET INT mm | * | 4.5.1 | 4-31 |
| SET MIN | * | 5.2.4.5 | 5-14 |
| SET PASSWORDS | | 2.4.2 | 2-13 |
| SET PHONE1 number | * | 5.6 | 5-22 |
| SET PHONE2 number | * | 5.6 | 5-23 |
| SET PRIV | | 2.4.2 | 2-13 |
| SET PROG LINE/DUR n | | 5.4 | 5-19 |
| SET PROG REPEAT n | | | |
| SET PROG START n | | | |
| SET REDIAL ss | | 5.5 | 5-23 |
| SET RING | | 5.1.3 | 5-2 |
| SET RING n | * | 5.1.3 | 5-1 |
| SET TIME mo/dd/yr hr:min:ss | * | 2.4.4 | 2-14 |



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FIGURE 5.1 CONTINUED

COMMAND LIST

| COMMAND | P | SECTION | PAGE |
|---|---|---|---|
| START CAL cc | | 5.3 | 5-17 |
| START SPAN1 cc,mm | | 5.3 | 5-17 |
| START SPAN2 cc,mm | | 5.3 | 5-17 |
| START ZERO cc,mm | | 5.3 | 5-17 |
| STATUS | | 5.2.4.5 | 5-14 |
| SWITCH OFF ss | * | 5.4 | 5-18 |
| SWITCH ON ss | * | 5.4 | 5-18 |
| TEST | * | 2.4.5 | 2-16 |
| TIME | | 2.4.4 | 2-14 |
| VERSION | | 5.1.2 | 5-1 |



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# 6.0 COMMAND/RESPONSE STRINGS

The 8800 data logger can be controlled from a central computer via dial-up telephone lines, using an asynchronous modem. The command/response strings used eliminate all unnecessary spaces, colons, line feeds, etc., and thereby result in more efficient communications. The central computer and data logger communicate via packets in the following form:

@ D R R R . . . . . C$

where @ precedes the packet and $ terminates it.

D denotes the ID of the AQM addressed or responding (two characters)
R is a command or response (multiple commands/response may be sent)
C is a set of four CHECKSUM and CRC check characters

A command/response (R) takes the form:

!XXXXX . . . . X&

where ! precedes the command and & terminates it.

The first character (X) denotes the type of command/response. For example, 1 denotes the command code for sending stored averages.

Detailed listings of command strings for the 8800 data logger are given in the following pages. An explanation of the letter codes is given with the following listings of commands and responses. The second character (C) in the command code is for use by the central system and can be any ASCII character. The remote has a unique response format for each type of command.

The CHECKSUM and CRC characters are computed in the following manner: The CHECKSUM is the algebraic sum of all the ASCII characters in the packet starting with the "@" and including those characters prior to the check characters. The



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CRC is the "exclusive-or" of these characters. The two 8-bit results are then converted into four printable ASCII characters and added to the communication string before the final "$".

To return to the central mode, type "@" when attached through the MODEM port.



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## COMMAND/RESPONSE CODES
## DATA TRANSMISSION

| Command Code | Response Code | Corresponding Operator Command |
|---|---|---|
| 0 | 0 | PRINT EXCEPT |
| 1 | 1 | PRINT HOUR |
| 2 | 2 | SENSE IN |
| 3 | NONE | SET AUX |
| 4 | 4 | PRINT CAL |
| 5 | 5 | PRINT AUX |
| 6 | 6 | PRINT MINUTE |
| 7 | NONE | INIT |
| 8 | NONE | INIT |
| B | NONE | SET TIME |
| C | NONE | DELETE |
| D | D | LOG INPUTS |
| E | E | LOG POWER |
| F | NONE | SET EQUATION |
| G | NONE | DAC |
| H | NONE | INIT |
| J | J | MESSAGE |
| K | NONE | STORE MESSAGE |
| L | L | TIME |
| M | NONE | INIT |
| N | NONE | SET PHONE 1 |
| O | O | PRINT X CAL |
| P | NONE | INIT |
| Q | NONE | DIGITAL |
| R | NONE | SET PROGRAM |
| S | NONE | SWITCH ON/OFF |

### AQM RESPONSE

| | |
|---|---|
| 0 | Send edit exceptions to Central |
| 1 | Send hourly averages |
| 2 | Send current input line status |
| 3 | Set AUX Interval |
| 4 | Send calibration readings |
| 5 | Send AUX averages and sigmas |
| 6 | Send latest one-minute averages |
| 7 | Update table entry |
| 8 | Update instrument-initiated calibration table |
| 9 | Update alarm table |
| B | Update the AQM clock |
| C | Delete an instrument from the AQM table |
| D | Send changes in input line status |
| E | Send Power Fail information |



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| | |
|---|---|
| H | Update an instrument's auto-calibration table |
| J | Send DCN's central message buffer |
| K | Update the DCN's operator message buffer |
| L | |
| M | Update multiple alarm table |
| N | Update alarm dial out parameters |
| O | Send 10 step cal data to central |
| P | Set calibrator status |
| Q | |
| R | |
| S | |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 6 |

Message Function:

To prompt Remote to send any edit exceptions which have occurred.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| O<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number* | Integer | 2 |
| & | Command Terminator | Alpha | 1 |

*A wildcard ("00") command clears the edit exceptions when acknowledged



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Response String | Number of Characters: 20 |

Message Function:

To send edit exceptions to Central.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Response Initiator | Alpha | 1 |
| O<C> | Response Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <HH> | Hour of Exception | Integer | 2 |
| <MM> | Minute of Exception | Integer | 2 |
| <RRRR> | Latest Reading | Integer | 4 |
| <S> | Status of Latest Reading | Alpha | 1 |
| <LLLL> | Previous Reading | Integer | 4 |
| <L> | Status of Previous Reading | Alpha | 1 |
| & | Response Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 11 |

Message Function:

To prompt Remote to send stored hourly averages and sigmas.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| 1<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <DDD> | Julian Day of Average | Integer | 3 |
| <HH> | Hour of Average | Integer | 2 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Response String | Number of Characters: 17 - 34 |

Message Function:

To send stored hourly averages to Central.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Response Initiator | Alpha | 1 |
| 1<C> | Response Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <DDD> | Julian Day of Average | Integer | 3 |
| <HH> | Hour of Average | Integer | 2 |
| <AVG> | Average + Status | Alpha | 6 |
| <SIGMA>* | Sigma + Status | Alpha | 6* |
| <%>* | Percent Valid | Integer | 3* |
| <RANGE>* | Range (min + max) | Integer | 8* |
| & | Response Terminator | Alpha | 1 |

*Not included if not stored for this channel



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 4 |

Message Function:

Request current input line status.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| 2<C> | Command Code | Alpha | 2 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Response String | Number of Characters: 20 |

Message Function:

To send current input line status to Central.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Response Initiator | Alpha | 1 |
| 2<C> | Response Code | Alpha | 2 |
| <00..0> | Line Status (1 or 0) | Integer | 16 |
| & | Response Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 6 |

Message Function:

To set the auxiliary averaging interval.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| 3<C> | Command Code | Alpha | 2 |
| <NN> | Auxiliary Averaging Interval | Integer | 2 |
| & | Command Terminator | Alpha | 1 |
| | <NN> - 01<br>02<br>03<br>04<br>05<br>06<br>10<br>12<br>15<br>20<br>30<br>60 | | |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 8 |

Message Function:

To prompt Remote to send the first three steps of calibration data.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| 4<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number* | Integer | 2 |
| & | Command Terminator | Alpha | 1 |

*A wildcard ("00") command clears the calibrations when acknowledged



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Response String | Number of Characters: 25 |

Message Function:

To send the first three steps of calibration data to Central.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Response Initiator | Alpha | 1 |
| 4<C> | Response Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <DDD> | Julian Day of Start Time | Integer | 3 |
| <HH> | Hour of Start Time | Integer | 2 |
| <MM> | Minute of Start Time | Integer | 2 |
| <ZZZZ> | Average During ZERO | Integer | 4 |
| <SSS1> | Average During SPAN1 | Integer | 4 |
| <SSS2> | Average During SPAN2 | Integer | 4 |
| & | Response Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 13 |

Message Function:

To prompt Remote to send auxiliary averages.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| 5<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 3 |
| <DDD> | Julian Day of Average | Integer | 3 |
| <HH> | Hour of Average | Integer | 2 |
| <MM> | Minute of Average | Integer | 2 |
| & | Response Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Response String | Number of Characters: 19 - 36 |

Message Function:

To send stored auxiliary averages to Central.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Response Initiator | Alpha | 1 |
| 5<C> | Response Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <DDD> | Julian Day of Average | Integer | 3 |
| <HH> | Hour of Average | Integer | 2 |
| <MM> | Minute of Average | Integer | 2 |
| <AVG> | Average + Status | Alpha | 6 |
| <SIGMA>* | Sigma + Status | Alpha | 6* |
| <%>* | Percent Valid | Integer | 3* |
| <RANGE>* | Range (min + max) | Integer | 8* |
| & | Response Code | Alpha | 1 |

*Not included if not stored for this channel



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 6 |

Message Function:

To prompt Remote to send the latest one minute average.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| 6<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Response String | Number of Characters: 11 |

Message Function:

To send the latest one minute average to Central.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Response Initiator | Alpha | 1 |
| 6<C> | Response Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <AAAA> | Latest One Minute Average | Integer | 4 |
| <S> | Status of One Minute Average | Alpha | 1 |
| & | Response Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 101 |

Message Function:

To update an instrument table entry.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| 7<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <T> | Channel Type | Alpha | 1 |
| <NNNNN> | Channel Name | Alpha | 5 |
| <CCCC> | Companion Channel | Integer | 4 |
| <V> | Vector Flag | Alpha | 1 |
| <R> | RMS Hourly Sigma Flag | Alpha | 1 |
| <HA> | Store Hourly Average Flag | Alpha | 1 |
| <HS> | Store Hourly Sigma Flag | Alpha | 1 |
| <HV> | Store Hourly %Valid Flag | Alpha | 1 |
| <HR> | Store Houly Range Flag | Alpha | 1 |
| <AA> | Store Auxiliary Average Flag | Alpha | 1 |
| <AS> | Store Auxiliary Sigma Flag | Alpha | 1 |
| <AV> | Store Auxiliary %Valid Flag | Alpha | 1 |
| <AR> | Store Auxiliary Range Flag | Alpha | 1 |
| <UUUUU> | Channel Units | Alpha | 5 |
| <P> | Decimal Postioner | Integer | 1 |
| <X..X> | Bad Status | Alpha | 16 |
| <VFSC> | Volts Full Scale | Floating | 6 |
| <SSSS> | Slope | Floating | 6 |
| <IIII> | Intercept | Floating | 6 |
| <MAXX> | Maximum Valid Reading | Floating | 6 |
| <MINN> | Minimum Valid Reading | Floating | 6 |
| <RAOC> | Rate of Change | Floating | 6 |
| <A> | Averaging Enable Flag | Alpha | 1 |
| <C> | Calibration Type ('A,'B,'I) | Alpha | 1 |
| <COH> | Coeffecient of Haze Flag | Alpha | 1 |
| <UNUSED> | Unused Bytes* | Alpha | 14 |
| & | Command Terminator | Alpha | 1 |

*In Math Pack channel with secondary equation, the first two bytes are the coded 16 bit status mask, while the next two bytes are the 16-bit don't care mask. The remaining 10 bytes can be blanks or zeros.



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 54 |

Message Function:

To load and instrument's manual-calibration table.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| 8<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <XX...X> | ZERO Status (X, 1, or 0) | Alpha | 16 |
| <YY...Y> | SPAN1 Status (X, 1, or 0) | Alpha | 16 |
| <ZZ...Z> | SPAN2 Status (X, 1, or 0) | Alpha | 16 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 16 |

Message Function:

To update Remote's time.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| B<C> | Command Code | Alpha | 2 |
| <YY> | Year | Integer | 2 |
| <MM> | Month | Integer | 2 |
| <DD> | Day | Integer | 2 |
| <HH> | Hour | Integer | 2 |
| <NN> | Minute | Integer | 2 |
| <SS> | Second | Integer | 2 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 6 |

Message Function:

To delete an entry from the instrument tables.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| C<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 6 |

Message Function:

To prompt the Remote to send status changes in input line status.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| D<C> | Command Code | Alpha | 2 |
| <NN> | Line Number* | Integer | 2 |
| & | Command Terminator | Alpha | 1 |

*A wildcard ("00") command clears the status inputs when acknowledged



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Response String | Number of Characters: 16 |

Message Function:

To send status changes in input line status.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Response Initiator | Alpha | 1 |
| D<C> | Response Code | Alpha | 2 |
| <NN> | Line Number | Integer | 2 |
| <JJJ> | Julian Day of Change | Integer | 3 |
| <HR> | Hour of Change | Integer | 2 |
| <MN> | Minute of Change | Integer | 2 |
| <SS> | Second of Change | Integer | 2 |
| <S> | Status Number<br>0 if off<br>1 if on | Integer | 1 |
| & | Response Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 4 |

Message Function:

To prompt the remote to send power status.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| E<C> | Command Code* | Alpha | 2 |
| & | Command Terminator | Alpha | 1 |

*This command clears the power fails when acknowledged



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Response String | Number of Characters: 28 |

Message Function:

To send power information.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Response Initiator | Alpha | 1 |
| E<C> | Response Code | Alpha | 2 |
| <MM> | Month Down | Integer | 2 |
| <DD> | Day Down | Integer | 2 |
| <YY> | Year Down | Integer | 2 |
| <HR> | Hour Down | Integer | 2 |
| <MN> | Minute Down | Integer | 2 |
| <SS> | Second Down | Integer | 2 |
| <MM> | Month Up | Integer | 2 |
| <DD> | Day Up | Integer | 2 |
| <YY> | Year Up | Integer | 2 |
| <HR> | Hour Up | Integer | 2 |
| <MN> | Minute Up | Integer | 2 |
| <SS> | Second Up | Integer | 2 |
| & | Response Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 4 |

Message Function:

Load Math Equation

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| F<C> | Command Code* | Alpha | 2 |
| N | Equation Number | Integer | 1 |
| <TT...> | Equation Text | Alpha | 80 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | July 1990 |
| Message Type: Command String | Number of Characters: 16 |

Message Function:

Load DAC Output Parameters for Central.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| G<C> | Command Code | Alpha | 2 |
| <N> | DAC Number | Integer | 1 |
| <CC> | Channel Number/Zero/Span | Alpha | 2 |
| <TT> | Data Type | Alpha | 2 |
| <NV> | All/Valid Flag | Alpha | 1 |
| <FS> | Full Scale Range | Alpha | 6 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 104 |

Message Function:

To update an instrument's auto-cal table.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| H<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <Z12> | Cal Order | Alpha | 3 |
| <SPG1> | SPAN1 Gas | Floating | 6 |
| <SPG2> | SPAN2 Gas | Floating | 6 |
| <SSSS> | Slope | Floating | 6 |
| <IIII> | Intercept | Floating | 6 |
| <ZL> | ZERO Lines | Integer | 6 |
| <AZL> | Alternate ZERO Lines | Integer | 6 |
| <ZT> | ZERO Time | Integer | 2 |
| <ZRT> | ZERO Response Time | Integer | 2 |
| <PL> | SPAN1 Lines | Integer | 6 |
| <APL> | Alternate SPAN1 Lines | Integer | 6 |
| <PT> | SPAN1 Time | Integer | 2 |
| <PRT> | SPAN1 Response Time | Integer | 2 |
| <SL> | SPAN2 Lines | Integer | 6 |
| <ASL> | Alternate SPAN2 Lines | Integer | 6 |
| <ST> | SPAN2 Time | Integer | 2 |
| <SRT> | SPAN2 Response Time | Integer | 2 |
| <RT> | Recovery time | Integer | 2 |
| <AUTO> | Auto-Cal Start Time | Integer | 4 |
| <D> | Day of Alternate Cal | Integer | 1 |
| <C> | Auto-Cal Enabled Flag | Alpha | 1 |
| <AZT> | Alternate Zero Time | Integer | 2 |
| <AZRT> | Alternate Zero Response Time | Integer | 2 |
| <APT> | Alternate SPAN1 Time | Integer | 2 |
| <APRT> | Alternate SPAN1 Response Time | Integer | 2 |
| <AST> | Alternate SPAN2 Time | Integer | 2 |
| <ASRT> | Alternate SPAN2 Response Time | Integer | 2 |
| <ART> | Alternate Recovery Time | Integer | 2 |
| <UNUSED> | Unused Byte | Alpha | 1 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 4 |

Message Function:

To prompt remote for central messages.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| J<C> | Command Code* | Alpha | 2 |
| & | Command Terminator | Alpha | 1 |

*This command clears the message when acknowledged



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Response String | Number of Characters: M + 4 |

Message Function:

To send one Central message to Central.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Response Initiator | Alpha | 1 |
| J<C> | Response Code | Alpha | 2 |
| <M...M> | Message | Alpha | M |
| & | Response Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 84 |

Message Function:

To update the operator message buffer.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| K<C> | Command Code | Alpha | 2 |
| <M...MM> | Message (80 Characters) | Alpha | 80 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command Code | Number of Characters: 4 |

Message Function:

To prompt remote to send current time.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| L<C> | Command Code | Alpha | 2 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | June 1990 |
| Message Type: Command String | Number of Characters: 13 |
| Message Function: | |

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| LL | Command Code | Alpha | 2 |
| <JJJ> | Julian Date | Integer | 3 |
| <HH> | Hours | Integer | 2 |
| <MM> | Minutes | Integer | 2 |
| <SS> | Seconds | Integer | 2 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 27 |

Message Function:

To update a mulitple alarm table.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| M<C> | Command Code | Alpha | |
| <NN> | Instrument Number** | Integer | |
| <AI> | Alarm Interval* | Alpha | |
| <ALN> | Alarm Line | Integer | |
| <AH> | Alarm Limit High | Floating | |
| <AL> | Alarm Limit Low | Floating | |
| <AR> | Alarm Limit Rate of Change | Floating | |
| & | Command Terminator | Alpha | 1 |

*The valid values for this entry are N, M, A, or H.

**This command may not be made global. Its use is restricted to previously defined channels.



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 73 |

Message Function:

To update the alarm dial-out parameters.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| N<C> | Command Code | Alpha | 2 |
| <P1> | Alarm PHONE1* | Alpha | 33 |
| <P2> | Alarm PHONE2* | Alpha | 33 |
| <RE> | Number of Retries | Integer | 1 |
| <WC> | Number of Seconds of Carrier-Wait | Integer | 2 |
| & | Command Terminator | Alpha | 1 |

*This entry must be left justified and the full 33 bytes used (i.e. use blank filling). This may contain no interval spaces (use a "-" instead of space) and the phone commands can not contain the letter A.



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 6 |

Message Function:

To prompt Remote to send calibrator-controlled calibration data.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| O<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number* | Integer | 2 |
| & | Command Terminator | Alpha | 1 |

*A wildcard ("00") command will delete the calibration data if acknowledged



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Response String | Number of Characters: 27 - 55 |

Message Function:

To send calibration data to Central.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Response Initiator | Alpha | 1 |
| O<C> | Response Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <DDD> | Julian Day of Start Time | Integer | 3 |
| <HH> | Hour of Start Time | Integer | 2 |
| <MN> | Minute of Start Time | Integer | 2 |
| <XX> | Number of Steps* | Integer | 2 |
| <SSS1> | First Step** | Integer | 4 |
| <SSS2> | Second Step** | Integer | 4 |
| . | . | . | . |
| . | . | . | . |
| . | . | . | . |
| <SSS10> | Tenth Step** | Integer | 4 |
| & | Response Terminator | Alpha | 1 |

*not equal to 0
**data is multiplied by 10^DP



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| Project | Date |
|---|---|
| 8800 Series | January 1989 |
| Message Type: Command String | Number of Characters: 26 |

Message Function:

To set the calibrator-controlled status for an instrument.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| P<C> | Command Code | Alpha | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <X...X> | Ambient Status Mask | Alpha | 16 |
| <YY> | Number of Minutes to Average Per Step | Integer | 2 |
| <ZZ> | Recovery Time | Integer | 2 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | July 1990 |
| Message Type: Response String | Number of Characters: 23 |

Message Function:

Load digital state settings.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| Q<C> | Command Code | Alpha | 2 |
| <N> | Digital State # | Integer | 1 |
| <X...X> | Digital Input Pattern | Alpha | 16 |
| <LL> | Output Control Line | Integer | 2 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | July 1990 |
| Message Type: Command String | Number of Characters: 47 |

Message Function:

Load digital event program from Central.

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| R<C> | Command Code | Alpha | 2 |
| <N> | Digital Program Number | Integer | 1 |
| <JJJ> | Starting Julian Day | Integer | 3 |
| <HH> | Starting Hour | Integer | 2 |
| <MM> | Starting Minute | Integer | 2 |
| <SS> | Starting Second | Integer | 2 |
| <X...X> | Digital Control Line #'s | Alpha | 16 |
| <JJ> | Program Duration (Days) | Integer | 2 |
| <HH> | Program Duration (Hours) | Integer | 2 |
| <MM> | Program Duration (Minutes) | Integer | 2 |
| <SS> | Program Duration (Seconds) | Integer | 2 |
| <JJJ> | Incremental Days | Integer | 3 |
| <HH> | Incremental Hours | Integer | 2 |
| <MM> | Incremental Minutes | Integer | 2 |
| <SS> | Incremental Seconds | Integer | 2 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series | July 1990 |
| Message Type: Command String | Number of Characters: 7 |

Message Function:

Switch digital output control line (on/off).

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| S<C> | Command code | Alpha | 2 |
| <NN> | Line Number (01...16) | Integer | 2 |
| <S> | New Status (1=on, 0=off) | Integer | 1 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series - OEPA | September 3, 1991 |
| Message Type: Command String | Number of Characters: 69 |

Message Function:

To update an intrument table entry (this is the 8000 string)

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| 7<C> | Command code | Integer | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <T> | Channel Type (Instrument or Function) | Alpha | 1 |
| <NNNNN> | Channel Name | Alpha | 5 |
| <CCCC> | Companion Channels | Integer | 4 |
| <V> | Vector Flag | Alpha | 1 |
| <HA> | Store Hourly Average Flag | Alpha | 1 |
| <HS> | Store Hourly Sigma Flag | Alpha | 1 |
| <AA> | Store Aux Average Flag | Alpha | 1 |
| <AS> | Store Aux Sigma Flag | Alpha | 1 |
| <UUUUU> | Channel Units | Alpha | 5 |
| <P> | Decimal Positioner | Integer | 1 |
| <X..X> | Bad Status | Alpha | 16 |
| <VFSC> | Volts Full Scale X 10 | Integer | 4 |
| <SSSS> | Slope | Integer | 4 |
| <IIII> | Intercept | Integer | 4 |
| <MAXX> | Maximum Valid Reading | Integer | 4 |
| <MINN> | Minimum Valid Reading | Integer | 4 |
| <RAOC> | Rate of Change | Integer | 4 |
| <A> | Averaging Enabled Flag | Alpha | 1 |
| <C> | Auto-Cal Enabled Flag | Alpha | 1 |
| & | Command Terminator | Alpha | 1 |



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| Project | Date |
|---|---|
| 8800 Series - OEPA | September 3, 1991 |
| Message Type: Command String | Number of Characters: 51 |

Message Function:

To update an instrument's auto cal table (this is the 8000 string)

| Code | Description | Type | Size |
|---|---|---|---|
| ! | Command Initiator | Alpha | 1 |
| H<C> | Command Code | Integer | 2 |
| <NN> | Instrument Number | Integer | 2 |
| <Z12> | Cal Order | Alpha | 3 |
| <SPG1> | Span1 Gas | Integer | 4 |
| <SPG2> | Span2 Gas | Integer | 4 |
| <SSSS> | Slope | Integer | 4 |
| <IIII> | Intercept | Integer | 4 |
| <ZL> | Zero Lines | Integer | 4 |
| <ZT> | Zero Time | Integer | 2 |
| <PL> | Span1 Lines | Integer | 4 |
| <PL> | Span1 Time | Integer | 2 |
| <PL> | Span2 Lines | Integer | 4 |
| <PL> | Span2 Time | Integer | 2 |
| <RT> | Recover Time | Integer | 2 |
| <AUTO> | Auto-Cal Start Time | Integer | 4 |
| <D> | Day of Alternate Cal | Integer | 1 |
| <C> | Auto-Cal Enabled Flag | Alpha | 1 |
| & | Command Terminator | Alpha | 1 |



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7.1.3 Check voltages of power reset circuitry (Ref. drawing 109-1000-C). If the voltages on the board are correct (i.e. 5 V on pin 14 of 14 pin chips), pin 1 of U55 should be low (>0.8 V). If not correct, adjust R57 or replace U55.

7.2 No Prompt When <CR> Key Struck

7.2.1 Make very sure of the following:

- Connected terminal is working correctly.
- Flat ribbon cable is connected as correctly and no breaks or shorts exist.
- Terminal transmits characters on Pin-2 and receives characters on Pin-3. That is, the terminal must be set as data terminal equipment (DTE).
- Terminal is set for 8-bits, no parity, 1 stop-bit, asynchronous communication, no local echo. See Section 2.3 for baud rate settings.

If in doubt, try the terminal with a separate 8800 that is known to be working correctly.

7.2.2 Turn the power switch off for 30 seconds then back on. If the self-diagnostic check and prompt are printed and the 8800 now responds to <CR>, then the software was locked-up. This may happen on rare occasions (power glitches, etc.), but if it happens on more than one data logger, or twice on the same data logger, then ESC should be notified or the power conditioning circuitry should be verified for proper operation (See Section 7.1.3).

7.2.3 If the diagnostic check is printed, but the logger still does not respond to a <CR>, then recheck the cable and terminal before continuing debug at Section 7.2.9.



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7.2.4 If the diagnostics check message is not printed, check the cable and terminal once again before proceeding. If everything seems O.K., perform a cold-start on the data logger as follows:

- Turn off power with the switch.
- Disable the RAM battery with the toggle switch found on the rear panel.
- Re-enable the RAM battery.
- Turn on power.

If this restores operation, ESC should be notified as to the circumstances of this condition.

7.2.5 If still no diagnostic check message is printed, then one of two approaches should be attempted. If the diagnostics EPROM (DDT) is available, then it should be installed according to the directions in the DDT manual. If DDT will not run or if it is not available, then continue debug at Section 7.2.6. If DDT does run, then perform all of the tests as outlined in the DDT manual to try to pin point the problem. If no problem is found with DDT, then the EPROMs are bad and should be replaced or a more subtle problem exists and the 8800 should be returned to ESC for repair.

7.2.6 With the original EPROMs installed, probe Pin-1 of U-55 on the RMC (Ref drawing 109-1000-C). It should be low (<0.8V). Temporarily short between Pin-1 of CN-15 and Pin-2 of CN-15. The collector of Q9 should go low (<0.8V) and return high when the short is removed. If this point still does not go high when Pins 1 and 2 of CN-15 are shorted, check Pin-3 and 4 of U-9 (clock frequency of 6.144 MHZ) for proper operation.



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7.2.7 The following frequencies should be found on the indicated pins. If not, call ESC for further debugging information.

- CPU Clock - 6.144 MHz, U9-Pin 3 and Pin-4
- KEY Clock - 1.536 MHz, U27-Pin 3
- A/D Clock - 122.88 kHz, U28-Pin 22, U27-Pin 10
- REAL TIME INTERRUPT CLOCK - 32.768 kHz U17-Pin 16 and 17
- SYSTEM OSCILLATOR - 3.072 MHz, U27-Pin 1 and 4

7.2.8 The following pins should be active (toggling from high to low at some indeterminate frequency).

- U9-Pins: 14-33, 37-44

If one or more of these pins are inactive (stay high or low) then call ESC for further debugging information.

7.2.9 If a second working 8800 is available, then try swapping the following chips one or two at a time between the two loggers. Power down the logger under test including the battery, before swapping a chip, then turn the power on again after the new chip has been installed; waiting for diagnostic check message to be printed each time. Be very careful about inserting chips in the proper orientation and in the correct socket. Also, be sure that all of the pins are inserted correctly, being careful not be bend the pins.

- U19
- U18
- U9
- U28
- U17
- All EPROMs (usually U12, U13)

  All RAMs (usually U1-U3)



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7.2.10 If the data logger still doesn't operate correctly, then it should be returned to ESC for repair.

## 7.3 Does Not Respond to "HELP" Command

If the 8800 responds to a <CR> with a prompt, but does not respond to commands (such as "HELP") correctly, then check the terminal and cable as in Section 7.2. If the data logger responds to a <CR> with a prompt, then it is probably working correctly.

## 7.4 Fails Self Test

If the EPROM or RAM test fails then contact ESC for replacement parts and instructions on how to install them.

## 7.5 Loses or Corrupts Data on Power Fail

7.5.1 The 880 data logger is designed to operate under poor power conditions without corrupting data, however, under extreme conditions the data logger may lose part or all of its data.

7.5.2 To restore the operation, the data logger should be cold-started as described in Section 7.2.4. If the logger now appears to function normally, then it should be placed back into service. If it seems to malfunction systematically, then follow the debugging steps below.

7.5.3 With the power on, verify the D.C. voltages as in Sections 7.1.1, 7.1.2 and 7.1.3. If any of these voltages are not correct, follow the debugging procedures in Section 7.1. before returning here.



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7.5.4 With the power switch off, but with the RAM battery switch on, verify the following voltages:

- CN-14, Pin 2 $\geq$ 2.0 If not, continue with Section 7.5.5

7.5.5 Remove the battery and measure its terminal voltage. If it measures 2.5 V or more, then check the RAM battery switch, and the wiring harness for continuity. If it measures below 2.5 V, then the Lithium battery battery has been discharged, and should be replaced.

## 7.6 Modem Won't Communicate

7.6.1 Check continuity of phone cables and connectors.

7.6.2 Turn the power off to the modem by turning the power "off" to the logger.

7.6.3 Restore power after a few seconds delay. If the problem is not resolved, then the modem should be replaced.

7.6.4 If the problem re-occurs, then the problem is most likely the modem.

## 7.7 Lithium Battery Replacement

The Lithium battery supplied with the ESC 8800 data logger is used for continued power of the CMOS RAM and Clock circuit in the event of power interruption. ESC suggests that the Lithium battery be replaced on a yearly basis to facilitate safe collection and storage of data in the logger.



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## 7.8 Suggested Spare Parts List

| ESC PART NO. | SPEC | DESCRIPTION | QUANTITY | RMC-80 DESIGNATIONS |
|---|---|---|---|---|
| | 1488 | Quad Line Driver | 2 | U19 |
| | 1489 | Quad Line Receiver | 2 | U18 |
| | MSM6212 | Real Time Clock | 1 | U17 |
| | 64180 | CPU | 1 | U9 |
| CUSTOM | EPROMS | | 1 set | U12 and U13 |
| | 62256P | 32 x 8k RAM | 3 | U1 - U3 |
| 007-0132 | ICL7109CPL | A/D Converter | 1 | U2 |
| | AD625 | Instrumentation AMP | 1 | U48 |
| | DG221 | | 1 | U25 |
| 007-0134 | MAX358 | Multiplexer | 2 | U21, U22 |
| | DG259 | | 1 | U24 |
| 48-0009 | | Lithium 3 V Battery | 1 | |
| | OMRON G4S-114D-US -24VDC | 24 V Relays | 4 | |
| | UDS 2022648 | Internal Leased Line Modem | 1 | |
| | Densitron CM4434BG4C20T | 4 x 20 LCD Display | 1 | |

Most other chips are standard TTL-type chips that are usually available from stock at any local electronic supply house.



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# 7.0 TROUBLESHOOTING

This section is provided for use by electronic technicians to troubleshoot the 8800 data logger. Circuit diagrams and component layouts referred to in this section may be found in Section 9 (Technical Drawings). Standard Electronic Debug equipment is necessary to follow these procedures (e.g. DVM, oscilloscope). Further troubleshooting of the data logger can be accomplished with the optional ESC Dynamic Debug Tool, if available.

If questions arise, contact the ESC Service Department at 1-800-688-7930 for additional information.

## 7.1 Logger Does Not Power Up

7.1.1 Check for D.C. voltages on CN-13 of RMC (Ref. drawing 109-1000-C).

Pin 1 = GND

Pin 2 = +5.12V ±2%

Pin 3 = VCH 18-26 VAC 1/2 Wave Rectified

Pin 4 = VBL +15V, ±5%

Pin 5 = +15 ±5%

Pin 6 = -15V ±5%

Pin 7 = NC

If voltages check, logger should still operate. Continue debug at Section 7.1.3.

7.1.2 Disconnect CN-13 from the RMC and check power output readings. Output voltages should be the same as for 7.1. If readings do not check, the power supply is defective.



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7.1.3 Check voltages of power reset circuitry (Ref. drawing 109-1000-C). If the voltages on the board are correct (i.e. 5 V on pin 14 of 14 pin chips), pin 1 of U55 should be low (>0.8 V). If not correct, adjust R57 or replace U55.

## 7.2 No Prompt When <CR> Key Struck

7.2.1 Make very sure of the following:

- Connected terminal is working correctly.
- Flat ribbon cable is connected as correctly and no breaks or shorts exist.
- Terminal transmits characters on Pin-2 and receives characters on Pin-3. That is, the terminal must be set as data terminal equipment (DTE).
- Terminal is set for 8-bits, no parity, 1 stop-bit, asynchronous communication, no local echo. See Section 2.3 for baud rate settings.

If in doubt, try the terminal with a separate 8800 that is known to be working correctly.

7.2.2 Turn the power switch off for 30 seconds then back on. If the self-diagnostic check and prompt are printed and the 8800 now responds to <CR>, then the software was locked-up. This may happen on rare occasions (power glitches, etc.), but if it happens on more than one data logger, or twice on the same data logger, then ESC should be notified or the power conditioning circuitry should be verified for proper operation (See Section 7.1.3).

7.2.3 If the diagnostic check is printed, but the logger still does not respond to a <CR>, then recheck the cable and terminal before continuing debug at Section 7.2.9.



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7.2.4 If the diagnostics check message is not printed, check the cable and terminal once again before proceeding. If everything seems O.K., perform a cold-start on the data logger as follows:

- Turn off power with the switch.
- Disable the RAM battery with the toggle switch found on the rear panel.
- Re-enable the RAM battery.
- Turn on power.

If this restores operation, ESC should be notified as to the circumstances of this condition.

7.2.5 If still no diagnostic check message is printed, then one of two approaches should be attempted. If the diagnostics EPROM (DDT) is available, then it should be installed according to the directions in the DDT manual. If DDT will not run or if it is not available, then continue debug at Section 7.2.6. If DDT does run, then perform all of the tests as outlined in the DDT manual to try to pin point the problem. If no problem is found with DDT, then the EPROMs are bad and should be replaced or a more subtle problem exists and the 8800 should be returned to ESC for repair.

7.2.6 With the original EPROMs installed, probe Pin-1 of U-55 on the RMC (Ref drawing 109-1000-C). It should be low (<0.8V). Temporarily short between Pin-1 of CN-15 and Pin-2 of CN-15. The collector of Q9 should go low (<0.8V) and return high when the short is removed. If this point still does not go high when Pins 1 and 2 of CN-15 are shorted, check Pin-3 and 4 of U-9 (clock frequency of 6.144 MHZ) for proper operation.



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7.2.7 The following frequencies should be found on the indicated pins. If not, call ESC for further debugging information.

- CPU Clock - 6.144 MHz, U9-Pin 3 and Pin-4
- KEY Clock - 1.536 MHz, U27-Pin 3
- A/D Clock - 122.88 kHz, U28-Pin 22, U27-Pin 10
- REAL TIME INTERRUPT CLOCK - 32.768 kHz U17-Pin 16 and 17
- SYSTEM OSCILLATOR - 3.072 MHz, U27-Pin 1 and 4

7.2.8 The following pins should be active (toggling from high to low at some indeterminate frequency).

- U9-Pins: 14-33, 37-44

If one or more of these pins are inactive (stay high or low) then call ESC for further debugging information.

7.2.9 If a second working 8800 is available, then try swapping the following chips one or two at a time between the two loggers. Power down the logger under test including the battery, before swapping a chip, then turn the power on again after the new chip has been installed; waiting for diagnostic check message to be printed each time. Be very careful about inserting chips in the proper orientation and in the correct socket. Also, be sure that all of the pins are inserted correctly, being careful not be bend the pins.

- U19
- U18
- U9
- U28
- U17
- All EPROMs (usually U12, U13)

  All RAMs (usually U1-U3)



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7.2.10 If the data logger still doesn't operate correctly, then it should be returned to ESC for repair.

## 7.3 Does Not Respond to "HELP" Command

If the 8800 responds to a <CR> with a prompt, but does not respond to commands (such as "HELP") correctly, then check the terminal and cable as in Section 7.2. If the data logger responds to a <CR> with a prompt, then it is probably working correctly.

## 7.4 Fails Self Test

If the EPROM or RAM test fails then contact ESC for replacement parts and instructions on how to install them.

## 7.5 Loses or Corrupts Data on Power Fail

7.5.1 The 880 data logger is designed to operate under poor power conditions without corrupting data, however, under extreme conditions the data logger may lose part or all of its data.

7.5.2 To restore the operation, the data logger should be cold-started as described in Section 7.2.4. If the logger now appears to function normally, then it should be placed back into service. If it seems to malfunction systematically, then follow the debugging steps below.

7.5.3 With the power on, verify the D.C. voltages as in Sections 7.1.1, 7.1.2 and 7.1.3. If any of these voltages are not correct, follow the debugging procedures in Section 7.1. before returning here.



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7.5.4 With the power switch off, but with the RAM battery switch on, verify the following voltages:

- CN-14, Pin 2 $\geq$ 2.0 If not, continue with Section 7.5.5

7.5.5 Remove the battery and measure its terminal voltage. If it measures 2.5 V or more, then check the RAM battery switch, and the wiring harness for continuity. If it measures below 2.5 V, then the Lithium battery battery has been discharged, and should be replaced.

## 7.6 Modem Won't Communicate

7.6.1 Check continuity of phone cables and connectors.

7.6.2 Turn the power off to the modem by turning the power "off" to the logger.

7.6.3 Restore power after a few seconds delay. If the problem is not resolved, then the modem should be replaced.

7.6.4 If the problem re-occurs, then the problem is most likely the modem.

## 7.7 Lithium Battery Replacement

The Lithium battery supplied with the ESC 8800 data logger is used for continued power of the CMOS RAM and Clock circuit in the event of power interruption. ESC suggests that the Lithium battery be replaced on a yearly basis to facilitate safe collection and storage of data in the logger.



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## 7.8 Suggested Spare Parts List

| ESC PART NO. | SPEC | DESCRIPTION | QUANTITY | RMC-80 DESIGNATIONS |
|---|---|---|---|---|
| | 1488 | Quad Line Driver | 2 | U19 |
| | 1489 | Quad Line Receiver | 2 | U18 |
| | MSM6212 | Real Time Clock | 1 | U17 |
| | 64180 | CPU | 1 | U9 |
| CUSTOM | EPROMS | | 1 set | U12 and U13 |
| | 62256P | 32 x 8k RAM | 3 | U1 - U3 |
| 007-0132 | ICL7109CPL | A/D Converter | 1 | U2 |
| | AD625 | Instrumentation AMP | 1 | U48 |
| | DG221 | | 1 | U25 |
| 007-0134 | MAX358 | Multiplexer | 2 | U21, U22 |
| | DG259 | | 1 | U24 |
| 48-0009 | | Lithium 3 V Battery | 1 | |
| | OMRON G4S-114D-US -24VDC | 24 V Relays | 4 | |
| | UDS 2022648 | Internal Leased Line Modem | 1 | |
| | Densitron CM4434BG4C20T | 4 x 20 LCD Display | 1 | |

Most other chips are standard TTL-type chips that are usually available from stock at any local electronic supply house.



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# 8.0 MATERIALS LIST



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8800 DATA LOGGER CONFIGURATION AND OPTIONS

SHT NO. 1 OF 7

| OPTIONS | DESCRIPTION | PROCEDURE |
|---|---|---|
| A3 | THIRD 32K RAM | ADD U3 TO MAIN BOARD |
| A4 | FOURTH 32K RAM | ADD U4 TO MAIN BOARD |
| A5 | FIFTH 32K RAM | ADD U5 TO MAIN BOARD |
| A6 | SIXTH 32K RAM | ADD U6 TO MAIN BOARD |
| A7 | SEVENTH 32K RAM | ADD U7 TO MAIN BOARD |
| A8 | EIGHTH 32K RAM | ADD U8 TO MAIN BOARD |
| | | CUT J3-1 TO J3-2 - MAIN BOARD |
| | | JUMP J3-2 TO J3-3 - MAIN BOARD |
| | | CANNOT BE SPECIFIED WITH OPTION C |
| B1 | FIRST 8 DIGITAL IN | ADD U38 TO MAIN BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| B2 | SECOND 8 DIGITAL IN | ADD U6 TO EXP BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |

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## 8800 DATA LOGGER CONFIGURATION AND OPTIONS

SHT NO. 2 OF 7

| OPTIONS | DESCRIPTION | PROCEDURE |
|---|---|---|
| C | CARTRIDGE INTERFACE | CUT ACCESS HOLE IN FRONT PANEL |
| | | ADD SUBASSEMBLY TO CHASSIS |
| | | PLUG CABLE INTO U8 OF MAIN BOARD |
| | | CANNOT BE SPECIFIED WITH OPTION A8 |
| | | |
| D1R | FIRST 8 RELAY OUT | ADD U29 TO MAIN BOARD |
| | | ADD PVA2352 TO U30-U37 ON MAIN BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | CANNOT BE SPECIFIED WITH D1C OR C1T |
| | | |
| D1C | FIRST 8 CONTACT OUT | ADD U29 TO MAIN BOARD |
| | | ADD CONTACT CLOSURE MODULES (109-1100) |
| | | TO U30-U37 ON MAIN BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | CANNOT BE SPECIFIED WITH D1R OR D1T |
| | | |
| D1T | FIRST 8 TTL OUT | ADD U29 TO MAIN BOARD |
| | | ADD TTL MODULES (109-1110) TO U30-U37 |
| | | ON MAIN BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | CANNOT BE SPECIFIED WITH D1R OR D1C |
| | | |
| | | |
| | | |

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## 8800 DATA LOGGER CONFIGURATION AND OPTIONS

SHT NO. 3 OF 7

| OPTIONS | DESCRIPTION | PROCEDURE |
|---|---|---|
| D2R | SECOND 8 RELAY OUT | ADD U7 TO EXP BOARD |
| | | ADD PVA2352 TO U8-U15 ON EXP BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 |
| | | CANNOT BE SPECIFIED WITH D2C OR D2T |
| | | |
| D2C | SECOND 8 CONTACT OUT | ADD U7 TO EXP BOARD |
| | | ADD CONTACT CLOSURE MODULES (109-1100) |
| | | TO U8-U15 ON EXP BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |
| | | CANNOT BE SPECIFIED WITH D2R OR D2T |
| | | |
| D2T | SECOND 8 TTL OUT | ADD U7 TO EXP BOARD |
| | | ADD TTL MODULES (109-1110) TO U8-U15 ON |
| | | EXP BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |
| | | CANNOT BE SPECIFIED WITH D2R OR D2C |
| | | |
| E1 | PLAIN FRONT PANEL | ADD PLAIN FRONT PANEL (109-2310) TO |
| | | CHASSIS |
| | | CANNOT BE SPECIFIED WITH E2 |
| | | |

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## 8800 DATA LOGGER CONFIGURATION AND OPTIONS

SHT NO. 4 OF 7

| OPTIONS | DESCRIPTION | PROCEDURE |
|---|---|---|
| E2 | 8 X 40 LCD FRONT PANEL | ADD KEYBOARD FRONT PANEL (109-2300) TO |
| | | CHASSIS |
| | | ADD DISPLAY |
| | | BACK LIGHT INVERTER |
| | | CONTRAST POT. ETC., TO CHASSIS |
| | | CANNOT BE SPECIFIED WITH E1 |
| | | |
| E3 | WASHINGTON TYPE FRONT PANEL | ADD KEYBOARD FRONT PANEL (109-2300) TO |
| | | CHASSIS |
| | | ADD DISPLAY (109-2302 |
| | | CONTRAST POT. ECT., TO CHASSIS |
| | | CANNOT BE SPECIFIED WITH E1 OR E2 |
| | | |
| F1 | BASIC REAR PANEL | ADD BASIC REAR PANEL (109-2400) TO |
| | | CHASSIS |
| | | CANNOT BE SPECIFIED WITH F2 OR F3 |
| | | |
| F2 | EXPANDED REAR PANEL | ADD EXPANDED REAR PANEL (109-2410) AND |
| | | EXP BOARD (109-3000) TO CHASSIS |
| | | CANNOT BE SPECIFIED WITH F1 OR F3 |
| | | |
| F3 | TEMPERATURE REAR PANEL | ADD TEMPERATURE REAR PANEL (109-2310) |
| | | AND EXP BOARD TO CHASSIS |
| | | CANNOT BE SPECIFIED WITH F1 OR F2 |

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8800 DATA LOGGER CONFIGURATION AND OPTIONS

SHT NO. 5 OF 7

| OPTIONS | DESCRIPTION | PROCEDURE |
|---|---|---|
| F4 | ST. OF WASHINGTON TYPE REAR PANEL | ADD REAR PANEL (109-2430) TO CHASSIS |
| | | CANNOT BE SPECIFIED WITH F1,F2, OR F3 |
| G | INTERNAL 300/1200 MODEM | ADD U41, U42, AND U43 TO MAIN BOARD |
| H | GEL-CELL | ADD U49 AND U50 TO MAIN BOARD |
| | | ADD GEL-CELL AND BRACKET TO CHASSIS |
| I | WATCHDOG TIMER | ADD U47 TO MAIN BOARD |
| J1 | FIRST 8 EXTRA TTL OUT | ADD U44 TO MAIN BOARD |
| J2 | SECOND 8 EXTRA TTL OUT | ADD U18, SOCKET, AND CN7 TO EXP BOARD |
| | | REQUIRES OPTION F2 OR F3 |
| K | CENTRONICS PORT | ADD U16, U17, AND SOCKETS TO EXP BOARD |
| | | ADD PRINTER CABLE TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |
| L | EXTRA DIP SWITCHES | ADD U17, SOCKET, RP6, AND SW1 TO EXP |
| | | BOARD |
| | | REQUIRES OPTION F2 OR F3 |

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## 8800 DATA LOGGER CONFIGURATION AND OPTIONS

SHT NO. 6 OF 7

| OPTIONS | DESCRIPTION | PROCEDURE |
|---|---|---|
| M1 | FIRST EVENT COUNTER | ADD U19,U20, SOCKETS R1 TO EXP BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |
| | | |
| M2 | SECOND EVENT COUNTER | ADD U22, U23, SOCKETS R2 TO EXP BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |
| | | |
| N1 | FIRST DAC | ADD U23, U28, SOCKETS C2, C3, R3 TO EXP |
| | | BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |
| | | |
| N2 | SECOND DAC | ADD U23, U29, SOCKETS, C4, C5, R4 TO EXP |
| | | BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |
| | | |
| N3 | THIRD DAC | ADD U26, U28, SOCKETS, C7, C8, R5 TO EXP |
| | | BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |
| | | |
| | | |

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## 8800 DATA LOGGER CONFIGURATION AND OPTIONS

SHT NO. 7 OF 7

| OPTIONS | DESCRIPTION | PROCEDURE |
|---|---|---|
| N4 | FOURTH DAC | ADD U27, U28, SOCKETS, C1,C6,R6 TO EXP |
| | | BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |
| | | |
| P | PRECISION VOLTAGE | ADD U21 AND SOCKET D9, D10 TO EXP BOARD |
| | | ADD PHOENIX CONNECTOR TO CHASSIS |
| | | REQUIRES OPTION F2 OR F3 |
| | | |
| Q1 | FIRST TEMPERATURE PROBE | ADD U29, U30, SOCKETS, R7,R8, & CN8 TO |
| | | EXP BOARD |
| | | ADD TEMP. PROBE TO CHASSIS |
| | | REQUIRES OPTION F3 |
| | | |
| Q2 | SECOND TEMPERATURE PROBE | ADD U29, U30, SOCKETS, R9,R10, & CN8 TO |
| | | EXP BOARD |
| | | ADD TEMP. PROBE TO CHASSIS |
| | | REQUIRES OPTION F3 |
| | | |
| R1 | 19" RACK MOUNT | ADD HOLES TO TOP PANEL AND ATTACH RACK |
| | | MOUNT |
| | | |
| R2 | 19" RACK MOUNT WITH RACK SLIDES | |
| S | 220 VAC INPUT OPTION | |

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E.S.C. PART LIST — SHT NO.1 OF 2

TITLE: 8800 DATA LOGGER — PART NO.: 109-0000 — CURRENT ECO:90-051-01

| PART NO. | DESCRIPTION | PART NO. | DESCRIPTION |
|---|---|---|---|
| 109-0000 | 8800 DATA LOGGER | 109-2316 | FRONT PANEL BRACE OPTION E2 & E3 |
| 109-0001 | CHASSIS SUBASSEMBLY | 109-2400 | BASIC REAR PANEL SUBASSY. OPTION F1 |
| 109-0100 | BOTTOM PANEL SUBASSEMBLY | 109-2401 | BASIC REAR PANEL OPTION F1 |
| 109-0101 | BOTTOM PANEL | 109-2410 | EXPANDED REAR PANEL SUBASSY. OPTION F2 |
| 109-0200 | COVER SUBASSEMBLY | 109-2411 | EXPANDED REAR PANEL OPTION F2 |
| 109-0201 | RACK MOUNT PANEL | 109-2420 | EXPANSION REAR PANEL SUB./TEMP.CONN. OPT. F3 |
| 109-1000 | 8800 MAIN P.C. BOARD SUBASSEMBLY | 109-2421 | EXPANSION REAR PANEL OPTION F3 |
| 109-1001 | 8800 MAIN P.C. BOARD | 109-2430 | ST. OF WASHINGTON REAR PANEL SUBASSY. OPT.F4 |
| 109-1100 | TRANSISTOR CONTACT CLOSURE OUTPUT MODULE SUB. | 109-2431 | STATE OF WASHINGTON REAR PANEL OPTION F4 |
| 109-1110 | TTL OUTPUT MODULE SUBASSEMLBY | 109-2500 | 8800 WIRING ASSEMBLIES |
| 109-1200 | 8K/32K PLD | 109-2501 | CONTRAST POT WIRING ASSEMBLY OPTION E2 |
| 109-2300 | KEYBOARD FRONT PANEL SUBASSY. OPTION E2 | 109-2502 | BACK LIGHT INVERTER WIRING |
| 109-2301 | KEYBOARD FRONT PANEL | 109-2503 | PC BOARD INTERCONNECT |
| 109-2302 | 8 X 40 LCD SUBASSEMBLY | 109-2504 | REAR PORT RS 232 |
| 109-2303 | DISPLAY RIBBON CABLE SUBASSEMBLY | 109-2505 | MEMORY CARTRIDGE INTERFACE CABLE |
| 109-2310 | PLAIN FRONT PANEL SUBASSEMBLY | 109-2506 | DISPLAY RIBBON CABLE ASSEMBLY |
| 109-2311 | PLAIN FRONT PANEL | 109-2507 | OPTIONAL FRONT OPERATOR PORT CABLE SUBASSY. |
| 109-2312 | KEYBOARD FRONT PANEL SUBASSEMBLY - OPTION E3 | 109-3000 | EXPANSION P.C. BOARD SUBASSEMBLY |
| 109-2313 | KEYBOARD FRONT PANEL | 109-3001 | EXPANSION P.C. BOARD |
| 109-2314 | STATE OF WASHINGTON DISPLAY ADAPTER SUBASSY. | 109-3100 | WASHINGTON EXPANSION BOARD SUBASSEMBLY |
| 109-2315 | STATE OF WASHINGTON DISPLAY ADAPTER PC CARD | 109-3101 | WASHINGTON EXPANSION BOARD |

PREPARED: PWE DATE: 09/01/88 CHKD: LER DATE: 12/07/88 APPROVE: LER DATE: 12/07/88 REV: 88-357-01

REV:89-160-01 REV:89-188-01 REV:89-298-04 REV: 90-051-01 REV: REV: REV: REV:



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E.S.C. PART LIST — SHT NO.2 OF 2

TITLE: 8800 DATA LOGGER — PART NO.: 109-0000 — CURRENT ECO:90-051-01

| PART NO. | DESCRIPTION | PART NO. | DESCRIPTION |
|---|---|---|---|
| 109-4000 | A.C. POWER SUPPLY P.C. BOARD SUBASSEMBLY | | |
| 109-4001 | A.C. POWER SUPPLY P.C. BOARD | | |
| 109-4010 | 220 VOLTS AC POWER SUPPLY WIRING | | |
| 109-4100 | DC TO DC POWER SUPPLY SUBASSEMBLY | | |
| 109-4101 | DC TO DC POWER SUPPLY PC BOARD | | |
| 109-5000 | CARTRIDGE SUBASSEMBLY | | |
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| REV:89-160-01 | REV:89-188-01 | REV:89-298-04 | REV: 90-051-01 | REV: | REV: | REV: | REV: |



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## BILL OF (SUB) ASSEMBLIES

TITLE: 8800 DATA LOGGER (SUB) ASSY. NO.: 109-0000-39 SHT NO. 1 OF 1

| (SUB) ASSEMBLY NO. | DESCRIPTION | #REQ | #TOT | #REC |
|---|---|---|---|---|
| 109-0001 | CHASSIS SUBASSEMBLY | 1 | | |
| 109-0100 | BOTTOM PANEL SUBASSEMBLY | 1 | | |
| 109-0200 | COVER SUBASSEMBLY | 1 | | |
| 109-1000 | 8800 MAIN P.C. BOARD SUBASSEMBLY | 1 | | |
| 109-1100 | TRANSISTOR CONTACT CLOSURE OUTPUT MODULE SUBASSEMBLY | 1 | | |
| 109-1110 | TTL OUTPUT MODULE SUBASSEMBLY | 1 | | |
| 109-2300 | KEYBOARD FRONT PANEL SUBASSEMBLY OPTION E2 | 1 | | |
| 109-2302 | 8 X 40 LCD SUBASSEMBLY | 1 | | |
| 109-2310 | PLAIN FRONT PANEL SUBASSEMBLY | 1 | | |
| 109-2400 | BASIC REAR PANEL SUBASSEMBLY OPTION F1 | 1 | | |
| 109-2410 | EXPANDED REAR PANEL SUBASSEMBLY OPTION F2 | 1 | | |
| 109-2420 | EXPANSION REAR PANEL SUBASSEMBLY/TEMPERATURE CONN. OPTION F3 | 1 | | |
| 109-2500 | 8800 WIRING ASSEMBLIES | 1 | | |
| 109-2507 | OPTIONAL FRONT OPERATOR PORT CABLE SUBASSEMBLY | 1 | | |
| 109-3000 | EXPANSION P.C. BOARD SUBASSEMBLY | 1 | | |
| 109-3100 | WASHINGTON EXPANSION BOARD SUBASSEMBLY | 1 | | |
| 109-4000 | A.C. POWER SUPPLY P.C. BOARD SUBASSEMBLY | 1 | | |
| 109-4100 | DC TO DC POWER SUPPLY SUBASSEMBLY | 1 | | |
| 109-5000 | CARTRIDGE SUBASSEMBLY | 1 | | |
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PREPARED: PWE DATE: 01-12-89 CHKD: LER DATE:01-12-89 APPROVE: LER DATE:01-12-89 REV.: 89-298-05 REV.:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 4

TITLE: CHASSIS SUBASSEMBLY PART NO.: 109-0001 CURRENT ECO:90-080-06

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | STD | 109-0100 | | BOTTOM PANEL SUBASSEMBLY | 1 | | | | |
| 2 | STD | 109-0200 | | COVER SUBASSEMBLY | 1 | | | | |
| 3 | STD | 109-1000 | | MAIN BOARD SUBASSEMBLY | 1 | | | | |
| 4 | STD | 109-4000 | | POWER SUPPLY SUBASSEMBLY | 1 | | | | |
| 5 | STD | | AMP #640430-8 | 8 PIN CONNECTOR | 1 | | | | |
| 6 | B1 | 038-0020 | PHOENIX #FRONT-MSTB 1.5/13- ST-5.08 | 13 PIN TERMINATION PLUG | 1 | | | | |
| 7 | B2 | 038-0020 | PHOENIX #FRONT-MSTB 1.5/13- ST-5.08 | 13 PIN TERMINATION PLUG | 1 | | | | |
| 8 | C | 109-5000 | | CARTRIDGE SUBASSEMBLY | 1 | | | | |
| 9 | DIR | 038-0021 | PHOENIX #FRONT-MSTB 1.5/16- ST-5.08 | 16 PIN TERMINATION PLUG | 1 | | | | |
| 10 | DIC | 038-0021 | PHOENIX #FRONT-MSTB 1.5/16- ST-5.08 | 16 PIN TERMINATION PLUG | 1 | | | | |
| 11 | DIT | 038-0021 | PHOENIX #FRONT-MSTB 1.5/16- ST-5.08 | 16 PIN TERMINATION PLUG | 1 | | | | |
| 12 | D2R | 038-0021 | PHOENIX #FRONT-MSTB 1.5/16- ST-5.08 | 16 PIN TERMINATION PLUG | 1 | | | | |
| 13 | D2C | 038-0021 | PHOENIX #FRONT-MSTB 1.5/16- ST-5.08 | 16 PIN TERMINATION PLUG | 1 | | | | |
| 14 | D2T | 038-0021 | PHOENIX #FRONT-MSTB 1.5/16- ST-5.08 | 16 PIN TERMINATION PLUG | 1 | | | | |

PREPARED: PWE DATE: 01/06/89 CHKD: LER DATE: 01/12/89 APPROVE: LER DATE: 01/12/89 REV: 89-166-01

REV:89-347-01 REV:90-080-06 REV: REV: REV: REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.2 OF 4

TITLE: CHASSIS SUBASSEMBLY PART NO.: 109-0001 CURRENT ECO:90-080-06

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 15 | E1 | 109-2310 | | PLAIN FRONT PANEL SUBASSEMBLY | 1 | | | | |
| 16 | E2 | 109-2300 | | KEYBOARD FRONT PANEL SUBASSEMBLY | 1 | | | | |
| 17 | H | | AMP #640440-2 | 2 PIN CONNECTOR | 1 | | | | |
| 18 | F1 | 109-2400 | | BASIC REAR PANEL SUBASSEMBLY | 1 | | | | |
| 19 | STD | 038-0022 | PHOENIX #FRONT-MSTB 1.5/18-ST-5.08 | 18 PIN TERMINATION PLUG | 1 | | | | |
| 20 | F2 | 038-0022 | PHOENIX #FRONT-MSTB 1.5/18-ST-5.08 | 18 PIN TERMINATION PLUG | 1 | | | | |
| 21 | F3 | 038-0022 | PHOENIX #FRONT-MSTB 1.5/18-ST-5.08 | 18 PIN TERMINATION PLUG | 1 | | | | |
| 22 | F2 | 109-2410 | | EXPANDED REAR PANEL SUBASSEMBLY | 1 | | | | |
| 23 | F2 | 109-3000 | | EXPANSION BOARD SUBASSEMBLY | 1 | | | | |
| 24 | F3 | 109-2420 | | EXPANSION REAR PANEL SUBASSEMBLY/TEMPERATURE CONN. OPTION F3 | 1 | | | | |
| 25 | F3 | 109-3000 | | EXPANSION BOARD SUBASSEMBLY | 1 | | | | |
| 26 | H | 048-0008 | YUASA NP1.2-6 OR PANASONIC #LCR6V1.3P | 6V GEL-CELL BATTERY | 1 | | | | |
| 27 | H | | ALPHA #1855/19 | 22 GUAGE STRANDED WIRE VIOLET W/WHITE STRIPE | 4" | | | | |
| 28 | H | | ALPHA #1855/19 | 22 GAUGE STRANDED WIRE WHITE | 4" | | | | |
| 29 | H | 103-2252 | | BATTERY BRACKET | 1 | | | | |

PREPARED: PWE DATE: 01/06/89 CHKD: LER DATE: 01/12/89 APPROVE: LER DATE: 01/12/89 REV: 89-166-01

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E.S.C. BILL OF MATERIALS SHT NO.3 OF 4

TITLE: CHASSIS SUBASSEMBLY PART NO.: 109-0001 CURRENT ECO:90-080-06

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 30 | M1 | 038-0019 | PHOENIX #FRONT-MSTB 1.5/9- ST-5.08 | 9 PIN TERMINATION PLUG | 1 | | | | |
| 31 | M2 | 038-0019 | PHOENIX #FRONT-MSTB 1.5/9- ST-5.08 | 9 PIN TERMINATION PLUG | 1 | | | | |
| 32 | N1 | 038-0019 | PHOENIX #FRONT-MSTB 1.5/9- ST-5.08 | 9 PIN TERMINATION PLUG | 1 | | | | |
| 33 | N2 | 038-0019 | PHOENIX #FRONT-MSTB 1.5/9- ST-5.08 | 9 PIN TERMINATION PLUG | 1 | | | | |
| 34 | N3 | 038-0019 | PHOENIX #FRONT-MSTB 1.5/9- ST-5.08 | 9 PIN TERMINATION PLUG | 1 | | | | |
| 35 | N4 | 038-0019 | PHOENIX #FRONT-MSTB 1.5/9- ST-5.08 | 9 PIN TERMINATION PLUG | 1 | | | | |
| 36 | P | 038-0019 | PHOENIX #FRONT-MSTB 1.5/9- ST-5.08 | 9 PIN TERMINATION PLUG | 1 | | | | |
| 37 | STD | 052-0030 | BUCKEYE #MP-40008-5 | TILT STAND | 1 | | | | |
| 38 | STD | | BUCKEYE #MP-1100 | ROUND RUBBER FEET | 2 | | | | |
| 39 | E2 | 109-2300 | | KEYBOARD FRONT PANEL SUBASSEMBLY | 1 | | | | |
| 40 | STD | 109-2310 | | PLAIN FRONT PANEL SUBASSEMBLY | 1 | | | | |
| 41 | F1 | 109-2400 | | BASIC REAR PANEL SUBASSEMBLY | 1 | | | | |
| 42 | | 109-3100 | | WAHSINGTON EXPANSION BOARD SUBASSEMBLY | 1 | | | | |
| 43 | | 109-4100 | | DC TO DC POWER SUPPLY SUBASSEMBLY | 1 | | | | |

PREPARED: PWE DATE: 01/06/89 CHKD: LER DATE: 01/12/89 APPROVE: LER DATE: 01/12/89 REV: 89-166-01

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E.S.C. BILL OF MATERIALS SHT NO.4 OF 4

TITLE: CHASSIS SUBASSEMBLY PART NO.: 109-0001 CURRENT ECO:90-080-06

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | QREQ | QTOT | QORD | QREC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 44 | H | | 6-32 X 1 1/8" | PAN HEAD MACHINE SCREW | 3 | | | | |
| 45 | H | | RICHCO #HS6X8 | 1" SPACER | 3 | | | | |
| 46 | H | | 6-32 | ESNA HEX NUT | 3 | | | | |
| 47 | H | | 6-32 X 3/8 | PAN HEAD MACHINE SCREW | 2 | | | | |
| 48 | H | | #6 | LOCK WASHER | 2 | | | | |
| 49 | STD | | KEYSTONE #1813 | 6-32 X 5/8 THREADED STANDOFF | 13 | | | | |
| 50 | F1 | | KEYSTONE #8422 | 6-32 X 1-1/2 MALE/FEMALE STANDOFF | 6 | | | | |
| 51 | STD | | 6-32 X 5/16 | PAN HEAD MACHINE SCREW | 17 | | | | |
| 52 | STD | | #6 | LOCK WASHER | 17 | | | | |
| 53 | F1 | | 6-32 X 5/16 | PAN HEAD MACHINE SCREW | 6 | | | | |
| 54 | STD | | 8-32 | ESNA HEX NUT | 3 | | | | |
| 55 | STD | | 8-32 X 3/8 | PAN HEAD MACHINE SCREW | 3 | | | | |
| 56 | STD | | PEM #S-632-3-CI | 6-32 SELF CLINCHING NUT | 4 | | | | |
| 57 | STD | | PEM #S-832-3-CI | 8-32 SELF CLINCHING NUT | 3 | | | | |
| 58 | STD | | SIMMONS #87149 | HOLE PLUGS (NOT USED IF OPTION C SPECIFIED) | 2 | | | | |
| 59 | E2 | | AMP #61173-1 | SOCKET CONNECTOR | 2 | | | | |
| 60 | | 058-0040 | ALCO #KN-500-B 1/8 | BLACK KNOB WITH MARKER LINE & 1/8" SHAFT | 1 | | | | |
| 61 | STD | 036-0001 | BELDEN #17250 | 18 GAUGE - 3 WIRE POWER CORD | 1 | | | | |
| 62 | | 109-2316 | | FRONT PANEL BRACE OPTION E2 AND E3 | 1 | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

PREPARED: PWE DATE: 01/06/89 CHKD: LER DATE: 01/12/89 APPROVE: LER DATE: 01/12/89 REV: 89-166-01

REV:89-347-01 REV:90-080-06 REV: REV: REV: REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.1 OF 9

TITLE: 8800 MAIN P.C. BOARD SUBASSEMBLY PART NO.: 109-1000 CURRENT ECO:90-080-07

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | STD | 044-0010 | AMP #640463-3 OR TELTEC ZT-8B (ARC) | 8 PIN IC SOCKET | 12 | | | | |
| 2 | | 043-0010 | SAMTEC #SS-132-62 | 10 PIN SOCKET STRIP (QTY. PER POSITION NOT EACH) | 20 | | | | |
| 3 | STD | 044-0011 | AMP #2-640357-3 OR TELTEC ZT-14B (ARC) | 14 PIN IC SOCKET | 4 | | | | |
| 4 | STD | 044-0012 | AMP #2-640358-3 OR TELTEC ZT-16B (ARC) | 16 PIN IC SOCKET | 10 | | | | |
| 5 | STD | 044-0017 | AMP #2-640359-3 TELTEC ZT-18B (ARC) | 18 PIN IC SOCKET | 2 | | | | |
| 6 | STD | 044-0018 | AMP #2640464-3 OR TELTEC ZT-20B (ARC) | 20 PIN IC SOCKET | 7 | | | | |
| 7 | STD | 044-0020 | AMP #2-640361-3 OR TELTEC ZT-24B (ARC) | 24 PIN NARROW PROFILE IC SOCKET | 1 | | | | |
| 8 | STD | 044-0021 | AMP #2-640362-3 OR TELTEC ZT-28B (ARC) | 28 PIN NARROW PROFILE IC SOCKET | 11 | | | | |
| 9 | STD | 044-0022 | AMP #2-640379-3 OR TELTEC ZT-40B (ARC) | 40 PIN NARROW PROFILE IC SOCKET | 2 | | | | |
| 10 | STD | 044-0026 | TELTEC #ZT-PLCC-68-T | 68 PIN PLCC SOCKET | 1 | | | | |
| 11 | STD | 037-0052 | KEYSTONE #106 | BATTERY HOLDER | 1 | | | | |
| 12 | STD | 109-1001 | | 8800 MAIN P.C. BOARD | 1 | | | | |

PREPARED: PWE DATE: 09/06/88 CHKD: LER DATE: 12/06/88 APPROVE: LER DATE: 12/07/88 REV: 89-080-01

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E.S.C. BILL OF MATERIALS SHT NO.2 OF 9

TITLE: 8800 MAIN P.C. BOARD SUBASSEMBLY PART NO.: 109-1000 CURRENT ECO:90-080-07

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| # | | | | SPECIFY WHEN NEEDED | | | | | |
| BT-1 | STD | 048-0009 | PANASONIC #BR2032 | 3V LITHIUM BATTERY | 1 | | | | |
| C1,C2 | | | CERAMIC DISC | 20pF | 2 | | | | |
| C10,C11 | | | ELECTROLYTIC CAPACITOR, RADIAL | 10uF @ 35V | 2 | | | | |
| C12 | | | ELECTROLYTIC CAPACITOR, RADIAL | 100uF @ 25V | 1 | | | | |
| C13-C17 | | | ELECTROLYTIC CAPACITOR, RADIAL | 10uF @ 35V | 5 | | | | |
| C18 | | | ELECTROLYTIC CAPACITOR, RADIAL | 10ufd @ 50V | 1 | | | | |
| C19-C67 | | | CERAMIC DISC, 0.1 SPACING | 0.1uF, 50V MONO | 49 | | | | |
| C3,C9 | STD | 018-0002 | ERIE #538-011B-7-25 | 7-25pF VARIABLE CAPACITOR | 2 | | | | |
| C4,C8 | | | CERAMIC DISC | 82pF | 2 | | | | |
| C5 | STD | 017-0001 | SPRAGUE #196D105X9035HA1 | 1uF TANTALUM CAPACITOR | 1 | | | | |
| C6 | | | CERAMIC DISC, 0.1" SPACING | 0.1uF, 50V MONO | 1 | | | | |
| C68,C69 | | | ELECTROLYTIC CAPACITOR, RADIAL | 10uF @ 35V | 2 | | | | |
| C7 | STD | 017-0003 | CORNELL DUBBER #WCR-05-P1-10 | 0.1uF POLYCARBONATE CAPACITOR | 1 | | | | |
| | | | OR TRW #463UW-.1-50V-10% | | | | | | |
| C70 | | | RAM CARTRIDGE FIX 5% | .1ufd | 1 | | | | |
| CN-1 | STD | 039-0031 | AMPHENOL #117-DB-25SA | 25 PIN RIGHT ANGLE D CONNECTOR | 1 | | | | |
| CN-11 | STD | 043-0003 | TELTEC ZT-S40-S | SINGLE ROW BERG STIK (40 POSITIONS) | 19 | | | | |
| CN-13 | | | AMP #640456-7 | 7 PIN HEADER | 1 | | | | |
| CN-3 | STD | 039-0036 | PHOENIX MSTBA 1.5/18-G-5.08 | 18 POSITION TERMINAL BLOCK | 1 | | | | |
| CN-4 | STD | 039-0035 | PHOENIX MSTBA 1.5/16-G-5.08 | 16 POSITION TERMINAL BLOCK | 1 | | | | |

PREPARED: PWE DATE: 09/06/88 CHKD: LER DATE: 12/06/88 APPROVE: LER DATE: 12/07/88 REV: 89-080-01

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E.S.C. BILL OF MATERIALS SHT NO.3 OF 9

TITLE: 8800 MAIN P.C. BOARD SUBASSEMBLY PART NO.: 109-1000 CURRENT ECO:90-080-07

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| CN-5 | STD | 039-0034 | PHOENIX MSTBA 1.5/13-G-5.08 | 13 POSITION TERMINAL BLOCK | 1 | | | | |
| CN-6 | STD | 043-0003 | TELTEC #ZT-S40-4 | SINGLE ROW BERG STIK (40 POSITIONS) | 8 | | | | |
| CN-7 | STD | 039-0030 | BERG #66011-001 | RJ11C PHONE JACK | 1 | | | | |
| CN-8 | STD | 039-0014 | 3M #3428-2003 | 20 PIN HEADER | 1 | | | | |
| CN14,CN15 | | | AMP #640456-2 | 2 PIN HEADER | 2 | | | | |
| CN2,CN12 | STD | 039-0018 | 3M #3429-6003 | 26 PIN HEADER | 2 | | | | |
| CN9,CN10 | | | AMP #640456-2 | 2 PIN HEADER | 2 | | | | |
| D1-D8 | * | 007-0180 | GENERAL SEMICONDUCTOR #SA170CA | 170V TRANZORB | 8 | | | | |
| D11 | STD | 001-0003 | IN270 OR BAT 41 | GERMANIUM DIODE | 1 | | | | |
| D12,D13 | STD | 001-0004 | IN5817 | DIODE | 2 | | | | |
| D14-D16 | | | IN4002 | DIODE | 3 | | | | |
| D17 | | | IN4002 | DIODE | 1 | | | | |
| D9,D10 | | | IN4002 | DIODE | 2 | | | | |
| Q1-Q6,Q9 | | | 2N3904 | NPN TRANSISTOR | 7 | | | | |
| Q7 | | | 2N3906 | PNP TRANSISTOR | 1 | | | | |
| Q8 | | | 2N6124 | PNP POWER TRANSISTOR | 1 | | | | |
| R1,R2,R3 | | | CARBON - 5% - 1/4 w | 33.0K OHM | 3 | | | | |
| R11,R12 | | | METAL - 1% - 1/8 w | 20M | 2 | | | | |
| R13,R14 | | | CARBON - 5% - 1/4 w | 20K | 2 | | | | |
| R15 | | | CARBON - 5% - 1/4 w | 100 OHM | 1 | | | | |
| R16,R17 | | | METAL FILM - 1% 1/8 w | 10K OHM | 2 | | | | |

PREPARED: PWE DATE: 09/06/88 CHKD: LER DATE: 12/06/88 APPROVE: LER DATE: 12/07/88 REV: 89-080-01

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E.S.C. BILL OF MATERIALS SHT NO.4 OF 9

TITLE: 8800 MAIN P.C. BOARD SUBASSEMBLY PART NO:: 109-1000 CURRENT ECO:90-080-07

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| R18,R42 | | | METAL FILM - 1% - 1/8 w | 18.2K | 2 | | | | |
| R19 | | | METAL FILM - 1% - 1/8 w | 127K | 1 | | | | |
| R20 | | | METAL FILM - 1% - 1/8 w | 237K | 1 | | | | |
| R21,R54 | | | METAL FILM - 1% - 1/8 w | 100K | 2 | | | | |
| R22 | | | METAL FILM - 1% - 1/8 w | 169K | 1 | | | | |
| R23,R41 | | | METAL FILM - 1% - 1/8 w | 10K | 2 | | | | |
| R24-R26 | STD | 013-0010 | I.R.C. CM55-T10 | MATCHED TO 0.02% + OR - 5 PPM/TC 20,180,1800- | 1 | | | | |
| | | | | OHM 1% | | | | | |
| R27 | | | METAL FILM - 1% - 1/8 w | 35.7K | 1 | | | | |
| R28 | | | METAL FILM - 1% - 1/8 w | 8.25K | 1 | | | | |
| R29 | | | METAL FILM - 1% - 1/8 w | 150 K | 1 | | | | |
| R30 | | | METAL FILM - 1% - 1/8 w | 200K | 1 | | | | |
| R31 | | | METAL FILM - 1% - 1/8 w | 604 OHM | 1 | | | | |
| R32,R43 | | | CARBON - 5% - 1/4 w | 10K | 2 | | | | |
| R33,R36 | | | CARBON - 5% - 1/4 w | 20K OHM | 2 | | | | |
| R35 | | | CARBON - 5% - 1/4 w | 20K OHM | 1 | | | | |
| R37 | | | CARBON - 5% - 1/4 w | 100K | 1 | | | | |
| R38 | | | CARBON - 5% - 1/4 w | 1M | 1 | | | | |
| R39 | | | CARBON - 5% - 1/4 w | 51K | 1 | | | | |
| R4 | | | CARBON - 5% - 1/4 w | 10K | 1 | | | | |
| R40 | | | METAL FILM - 1% - 1/8 w | 2.49K | 1 | | | | |

PREPARED: PWE DATE: 09/06/88 CHKD: LER DATE: 12/06/88 APPROVE: LER DATE: 12/07/88 REV: 89-080-01

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E.S.C. BILL OF MATERIALS SHT NO.5 OF 9

TITLE: 8800 MAIN P.C. BOARD SUBASSEMBLY PART NO.: 109-1000 CURRENT ECO:90-080-07

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| R44 | | | METAL FILM - 1% - 1/8 w | 9.31K | 1 | | | | |
| R45 | | | METAL FILM - 1% - 1/8 w | 3.32K | 1 | | | | |
| R46 | | | CARBON - 5% - 1/4 w | 100K | 1 | | | | |
| R47 | | | CARBON - 5% - 1/4 w | 10K | 1 | | | | |
| R48 | | | CARBON - 5% - 1/4 w | 20K | 1 | | | | |
| R49 | | | CARBON - 5% - 1/4 w | 1.5K | 1 | | | | |
| R5,R34 | | | CARBON - 5% - 1/4 w | 20K OHM | 1 | | | | |
| R50 | | | CARBON - 5% - 1/4 w | 10 OHM | 1 | | | | |
| R51 | | | METAL FILM - 1% - 1/8 w | 2M | 1 | | | | |
| R52 | | | METAL FILM - 1% - 1/8 w | 1M | 1 | | | | |
| R53 | | | CARBON - 5% - 1/4 w | 330 OHM | 1 | | | | |
| R55 | | | METAL FILM - 1% - 1/8 w | 20M | 1 | | | | |
| R56 | | | METAL FILM - 1% - 1/8 w | 332K | 1 | | | | |
| R57 | STD | 014-0001 | BOURNS #3299W-1-503 | 50K TRIM POT | 1 | | | | |
| R58 | | | CARBON - 5% - 1/4 w | 20K OHM | 1 | | | | |
| R59 | | | CARBON - 5% - 1/4 w | 20K OHM | 1 | | | | |
| R6,R8-R10 | | | CARBON - 5% - 1/4 w | 20K | 4 | | | | |
| R60 | | | CARBON - 5% - 1/4 w | 1M | 1 | | | | |
| R61 | | | CARBON - 5% - 1/4 w | 100K OHM | 1 | | | | |
| R62,R64 | | | CARBON - 5% - 1/4 w | 100K OHM | 2 | | | | |
| R63 | | | CARBON - 5% - 1/4 w | 2M OHM | 1 | | | | |

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E.S.C. BILL OF MATERIALS SHT NO.6 OF 9

TITLE: 8800 MAIN P.C. BOARD SUBASSEMBLY PART NO.: 109-1000 CURRENT ECO:90-080-07

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| R65 | | | COMMON MADE FIX 1% | 5 OHM | 1 | | | | |
| R66 | STD | 014-0026 | BOURN 3299W-1-100 | 10 OHM TRIM POT | 1 | | | | |
| R67 | | | RAM CARTRIDGE FIX 5% | 100K OHM | 1 | | | | |
| R7 | | | CARBON - 5% - 1/4 w | 2.7K | 1 | | | | |
| RP-1,RP-2 | STD | 015-0011 | BOURNS #4608X-102-561 | 560 OHM ISOLATED RESISTOR PACK | 2 | | | | |
| RP-3,RP-4 | STD | 015-0012 | BOURNS #4608X-102-473 | 47K ISOLATED RESISTOR PACK | 2 | | | | |
| RP-5,RP-6 | STD | 015-0003 | BOURNS #4310R-101-153 | 15K PULL-UP RESISTOR PACK | 2 | | | | |
| RP-7 | STD | 015-0014 | BOURNS #LC800220016 | 2K PULL-UP RESISTOR PACK | 1 | | | | |
| SW-1 | STD | 031-0028 | AMP #435640-5 | 8 POSITION DIP SWITCH | 1 | | | | |
| SW-2 | STD | 031-0053 | NKK #M2022S2A2G45 | DPDT TOGGLE SWITCH | 1 | | | | |
| U1,U2 | STD | 007-0156 | NEC #43256C-15L | 32K X 8 STATIC RAM | 2 | | | | |
| U10 | STD | 109-1200 | T.I. TICPAL 16L8-55CJL | PROGRAMMED LOGIC DEVICE (PLD), (PROGRAM #8K/ | 1 | | | | |
| | | | | 32 K-P | | | | | |
| U11 | STD | 007-0165 | 74HC138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U12,U13 | STD | 007-0159 | TMS27C2562JL | 32K X 8 EPROM | 2 | | | | |
| U14,U15 | STD | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 2 | | | | |
| U16 | STD | 007-0167 | 74HCT245 | OCTAL BI-DIRECTIONAL BUFFER | 1 | | | | |
| U17 | STD | 007-0163 | OKI #MSM6242BRS | REAL TIME CLOCK | 1 | | | | |
| U18 | STD | 007-0168 | NATIONAL 14C89AN | RS-232 RECEIVER | 1 | | | | |
| U19 | STD | 007-0169 | NATIONAL #14C88N | RS-232 DRIVER | 1 | | | | |
| U20 | STD | 007-0170 | 74HCT04 | HEX INVERTER | 1 | | | | |

PREPARED: PWE DATE: 09/06/88 CHKD: LER DATE: 12/06/88 APPROVE: LER DATE: 12/07/88 REV: 89-080-01

REV:89-095-01 REV:89-164-03 REV:90-012-01 REV: 90-080-07 REV: REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.7 OF 9

TITLE: 8800 MAIN P.C. BOARD SUBASSEMBLY PART NO.: 109-1000 CURRENT ECO:90-080-07

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| U21,U22 | STD | 007-0161 | MAXIM #MAX358CPE | 8 TO 1 ANALOG MUX | 2 | | | | |
| U23 | STD | 007-0171 | NATIONAL LF444CN | QUAD OP-AMP | 1 | | | | |
| U24 | | 007-0172 | SILICONIX D6529CJ | DUAL 4 TO 1 ANALOG MUX | 1 | | | | |
| U25 | STD | 007-0173 | SILICONIX D6221CJ | QUAD ANALOG SWITCH | 1 | | | | |
| U26 | STD | 007-0174 | ANALOG DEVICES AD588AD | +10.000V VOLTAGE REFERENCE | 1 | | | | |
| U27 | STD | 007-0175 | 74HCT390 | DUAL DECADE COUNTER | 1 | | | | |
| U28 | STD | 007-0132 | INTERCIL ICL7109CPL | 12 BIT INTEGRATING A/D | 1 | | | | |
| U29 | D1R | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U29 | D1C | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U29 | D1T | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U29 | STD | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U3 | A3 | 007-0156 | NEC #43256C-15L | 32K X 8 STATIC RAM | 1 | | | | |
| U30-U37 | D1R | 032-0011 | CRYDOM PVA2352 | OPTICALLY ISOLATED SOLID STATE RELAYS | 8 | | | | |
| U30-U37 | D1C | 109-1100 | | CONTACT CLOSURE MODULE | 8 | | | | |
| U30-U37 | D1T | 109-1110 | | TTL OUTPUT MODULE | 8 | | | | |
| U30-U37 | STD | 032-0011 | CRYDOM PVA2352 | OPTICALLY ISOLATED SOLID STATE RELAYS | 8 | | | | |
| U38 | B1 | 007-0176 | 74HCT541 | OCTAL TRI-STATE BUFFER | 1 | | | | |
| U38 | STD | 007-0176 | 74HCT541 | OCTAL TRI-STATE BUFFER | 1 | | | | |
| U39 | STD | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U4 | A4 | 007-0156 | NEC #43256C-15L | 32K X 8 STATIC RAM | 1 | | | | |
| U40 | STD | 007-0176 | 74HCT541 | OCTAL TRI-STATE BUFFER | 1 | | | | |

PREPARED: PWE DATE: 09/06/88 CHKD: LER DATE: 12/06/88 APPROVE: LER DATE: 12/07/88 REV: 89-080-01

REV:89-095-01 REV:89-164-03 REV:90-012-01 REV: 90-080-07 REV: REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.8 OF 9

TITLE: 8800 MAIN P.C. BOARD SUBASSEMBLY PART NO.: 109-1000 CURRENT ECO:90-080-07

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| U41 | 6 | 007-0181 | SIERRA SEMI SC11007CN | MODEM CONTROLLER | 1 | | | | |
| U42 | 6 | 007-0182 | SIERRA SEMI SC11004CN | 300/1200 BAUD MODEM | 1 | | | | |
| U43 | 6 | 007-0183 | DALLAS SEMICONDUCTOR DS6112 | DATA ACCESS ARRANGEMENT (DAA) | 1 | | | | |
| U44 | J1 | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U44 | STD | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U45 | E2 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U46 | E2 | 007-0160 | TOSHIBA TMP82C79P-2 | KEYBOARD CONTROLLER | 1 | | | | |
| U47 | STD | 007-0184 | DALLAS SEMI DS1232 | WATCHDOG TIMER | 1 | | | | |
| U48 | STD | 007-0177 | ANALOG DEVICES AD625AD | INSTRUMENTATION AMPLIFIER | 1 | | | | |
| U49 | H | 007-0185 | NATIONAL LM358N | DUAL OP-AMP | 1 | | | | |
| U5 | A5 | 007-0156 | NEC #43256C-15L | 32K X 8 STATIC RAM | 1 | | | | |
| U50 | H | 008-0027 | MAXIM MAX663CPA | ADJUSTABLE REGULATOR | 1 | | | | |
| U51 | STD | 008-0020 | NATIONAL LM78L05ACZ | +5V REGULATOR | 1 | | | | |
| U52 | STD | 008-0021 | MOTOROLA 78L12ACP | +12V REGULATOR | 1 | | | | |
| U53,U56 | STD | 008-0022 | MOTOROLA 79L05ACP | -5V REGULATOR | 2 | | | | |
| U54 | STD | 008-0023 | MOTOROLA 79L12ACP | -12V REGULATOR | 1 | | | | |
| U55 | STD | 007-0178 | MAXIM ICL7665CPA OR INTERSIL | VOLTAGE DETECTOR | 1 | | | | |
| | | | #ICL7665SCPA | | | | | | |
| U6 | A6 | 007-0156 | NEC #UDP43256-15L | 32K X 8 STATIC RAM | 1 | | | | |
| U7 | A7 | 007-0156 | NEC #UDP43256-15L | 32K X 8 STATIC RAM | 1 | | | | |
| U8 | A8 | 007-0156 | NEC #UDP43256-15L | 32 X 8 STATIC RAM | 1 | | | | |

PREPARED: PWE DATE: 09/06/88 CHKD: LER DATE: 12/06/88 APPROVE: LER DATE: 12/07/88 REV: 89-080-01

REV:89-095-01 REV:89-164-03 REV:90-012-01 REV: 90-080-07 REV: REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.9 OF 9

TITLE: 8800 MAIN P.C. BOARD SUBASSEMBLY PART NO.: 109-1000 CURRENT ECO:90-080-07

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| U9 | STD | 007-0179 | ZILOG #Z80180-06VSC | CPU | 1 | | | | |
| Y-1 | STD | 027-0005 | NDK #NDK061P OR FOX #061 | CRYSTAL 6.144 MHZ | 1 | | | | |
| Y-2 | STD | 027-0001 | NDK #MX-38 | CRYSTAL 32.768KHZ | 1 | | | | |
| Y-3 | STD | 027-0004 | SARONIX #NYP073-20 | CRYSTAL 7.3728MHZ | 1 | | | | |

PREPARED: PWE DATE: 09/06/88 CHKD: LER DATE: 12/06/88 APPROVE: LER DATE: 12/07/88 REV: 89-080-01

REV:89-095-01 REV:89-164-03 REV:90-012-01 REV: 90-080-07 REV: REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: TRANSISTOR CONTACT CLOSURE OUTPUT MODULE SUB.PART NO.: 109-1100

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | SAMTEC #LCP-308-T | 8 PIN DIP ADAPTER PLUG | 1 | | | | |
| 2 | | | | SOLID 22 GAUGE WIRE | 5" | | | | |
| Q1 | | | 2N3904 | NPN TRANSISTOR | 1 | | | | |
| R1 | | | CARBON - 5% - 1\4 w | 1K | 1 | | | | |

PREPARED: PWE DATE: 09/01/88 CHKD: LER DATE: 12/7/88 APPROVE: LER DATE: 12/7/88 REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: TTL OUTPUT MODULE SUBASSEMLBY PART NO.: 109-1110

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | SAMTEC #LCP-308-T | 8 PIN DIP ADAPTER PLUGS | 1 | | | | |
| 2 | | | | 22 GAUGE SOLID WIRE | 2" | | | | |

PREPARED: PWE DATE: 09/01/88 CHKD: LER DATE: 12/7/88 APPROVE: REL DATE: 12/7/88 REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: KEYBOARD FRONT PANEL SUBASSY. OPTION E2 PART NO.: 109-2300 CURRENT ECO:89-348-01

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 109-2301 | | KEYBOARD FRONT PANEL | 1 | | | | |
| 2 | | 109-2302 | EPSON #E6-2402S-ER | 8 X 40 LINE LCD DISPLAY | 1 | | | | |
| 3 | | | ALCO #KT-500B-1/8 | KNOB | 1 | | | | |
| 4 | | | AMP #1-480319-0 | 2 POSTION PIN HOUSING | 1 | | | | |
| 5 | | | AMP #61174-1 | PINS | 2 | | | | |
| 6 | | | 4-40 ESNA | HEX NUT | 4 | | | | |
| 7 | | 109-2501 | | CONTRAST POT WIRING ASSEMBLY | 1 | | | | |

PREPARED: PWE DATE: 01/03/89 CHKD: LER DATE: 01/12/89 APPROVE: LER DATE: 01/12/89 REV: 89-348-01

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: 8 X 40 LCD SUBASSEMBLY PART NO.: 109-2302 CURRENT ECO:90-030-01

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | EPSON #EG-2402S-ER | 8 LINE X 40 CHARACTER LCD DISPLAY (BLUE) | 1 | | | | |
| 2 | | | ALPHA #1855/19-2 | 22 GA. MULTI-STRAND WIRE BLACK | 2" | | | | |
| 3 | | | AMP #1480319-0 | 2 PIN IN-LINE PIN HOUSING | 1 | | | | |
| 4 | | | AMP #61174-1 | MALE CRIMP-ON AMP PINS | 2 | | | | |
| 5 | | 109-2303 | | DISPLAY RIBBON CABLE | 1 | | | | |

PREPARED: PWE DATE: 09/01/88 CHKD: LER DATE: 12/07/88 APPROVE: LER DATE: 12/07/88 REV: 90-030-01

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: DISPLAY RIBBON CABLE SUBASSEMBLY PART NO.: 109-2303

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 039-0039 | 3M #3920-0000T | 20 POSITION PCB CONNECTOR | 1 | | | | |
| 2 | | 037-0007 | 3M #3421-6000 | 20 POSITION SOCKET CONNECTOR | 1 | | | | |
| 3 | | 036-0016 | BELDEN #9L28020-H100 | 20 CONDUCTOR RIBBON CABLE | 5.5" | | | | |

PREPARED: PWE DATE: 02/21/89 CHKD: LER DATE: 02/21/89 APPROVE: LER DATE: 02/21/89 REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: BASIC REAR PANEL SUBASSY. OPTION F1 PART NO.: 109-2400

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 109-2401 | | BASIC REAR PANEL | 1 | | | | |
| 2 | | 109-2504 | | REAR PORT RS 232 | 1 | | | | |
| 3 | | | 4-40 X 1/2" | PAN HEAD MACHINE SCREW | 2 | | | | |
| 4 | | | 4-40 | ESNA HEX NUT | 2 | | | | |

PREPARED: PWE DATE: 01/03/89 CHKD: LER DATE: 01/06/89 APPROVE: LER DATE: 01/06/89 REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: EXPANDED REAR PANEL SUBASSY. OPTION F2 PART NO.: 109-2410

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 109-2411 | | EXPANDED REAR PANEL | 1 | | | | |
| 2 | | 109-2504 | | REAR PORT RS 232 | 1 | | | | |
| 3 | | | 4-40 X 1/2 | PAN HEAD MACHINE SCREW | 2 | | | | |
| 4 | | | 4-40 | ESNA HEX NUT | 2 | | | | |

PREPARED: PWE DATE: 01/03/89 CHKD: LEK DATE: 1/6/89 APPROVE: LEK DATE: 1/6/89 REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: EXPANSION REAR PANEL SUB./TEMP.CONN. OPT. F3 PART NO.: 109-2420

| DESIGNAT. | OPT: | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC. | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 109-2421 | | EXPANSION REAR PANEL SUBASSEMBLY WITH TEMP. CONNECTOR | 1 | | | | |
| 2 | | 109-2504 | | REAR PORT RS 232 | 1 | | | | |
| 3 | Q1 | | AMP #205841-1 | PANEL MOUNT CIRCULAR CONNECTOR | 1 | | | | |
| 4 | Q2 | | AMP #205841-1 | PANEL MOUNT CIRCULAR CONNECTOR | 1 | | | | |
| 5 | Q1 | | AMP #66570-3 | GOLD PINS FOR CIRCULAR CONNECTOR | 3 | | | | |
| 6 | Q2 | | AMP #66570-3 | GOLD PINS FOR CIRCULAR CONNECTOR | 3 | | | | |
| 7 | Q1 | | ALPHA #1855/19-5 | 22 GAUGE STRANDED WIRE YELLOW | 8" | | | | |
| 8 | Q2 | | ALPHA #1855/19-5 | 22 GAUGE STRANDED WIRE YELLOW | 8" | | | | |
| 9 | Q1 | | ALPHA #1855/19-1 | 22 GAUGE STRANDED WIRE YELLOW/WHITE STRIPE | 8" | | | | |
| 10 | Q2 | | ALPHA #1855/19-1 | 22 GAUGE STRANDED WIRE YELLOW/WHITE STRIPE | 8" | | | | |
| 11 | Q1 | | ALPHA #1855/19-1 | 22 GAUGE STRANDED WIRE WHITE | 8" | | | | |
| 12 | Q2 | | ALPHA #1855/19-1 | 22 GAUGE STRANDED WIRE WHITE | 8" | | | | |
| 13 | Q1 | | AMP #640440-6 | 6 PIN CONNECTOR | 1 | | | | |
| 14 | Q2 | | AMP #640440-6 | 6 PIN CONNECTOR | 1 | | | | |
| 15 | Q1 | | AMP #66504-8 | GOLD SOCKETS FOR CIRCULAR CONNECTOR | 3 | | | | |
| 16 | Q2 | | AMP #66504-8 | GOLD SOCKETS FOR CIRCULAR CONNECTOR | 3 | | | | |
| 17 | | | 4-40 X 1/2 | PAN HEAD MACHINE SCREW | 6 | | | | |
| 18 | | | 4-40 | ESNA HEX NUT | 6 | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

PREPARED: PWE DATE: 01/03/89 CHKD: LER DATE: 1/6/89 APPROVE: KE2 DATE: 1/6/89 REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: CONTRAST POT WIRING ASSEMBLY OPTION E2 PART NO.: 109-2501 CURRENT ECO:89-080-02

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 014-0027 | CLAROSTAT #RV6NAYSD252A | 2500 OHM PANEL MOUNT POT | 1 | | | | |
| 2 | | | AMP #640440-2 | 2 PIN CONNECTOR | 1 | | | | |
| 3 | | | ALPHA #1855/19-2 | 22 GAUGE STRANDED WIRE BLACK | 12" | | | | |

PREPARED: PWE DATE: 01/03/89 CHKD: LER DATE: 01/05/89 APPROVE: LER DATE: 01/05/89 REV: 89-080-02

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: BACK LIGHT INVERTER WIRING PART NO.: 109-2502

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 009-0012 | ENDICOTT RESEARCH GROUP | BACKLIGHT INVERTER | 1 | | | | |
| | | | #LPS12-1-2 | | | | | | |
| 2 | | | AMP #640440-2 | 2 PIN CONNECTOR | 1 | | | | |
| 3 | | | AMP #480318-0 | 2 PIN IN-LINE CONNECTOR | 1 | | | | |
| 4 | | | AMP #60620-1 | PINS | 2 | | | | |
| 5 | | | ALPHA #1855/19-8 | 22 GAUGE STRANDED WIRE ORANGE | 3' | | | | |
| 6 | | | ALPHA #1855/19-1 | 22 GAUGE STRANDED WIRE WHITE | 3' | | | | |
| 7 | | | ALPHA #1855/19-2 | 22 GAUGE STRANDED WIRE BLACK | 3' | | | | |

PREPARED: PWE DATE: 02/21/89 CHKD: LER DATE: 02/21/89 APPROVE: LER DATE: 02/21/89 REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: PC BOARD INTERCONNECT PART NO.: 109-2503

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 037-0012 | 3M #3399-6000 | 26 PIN RIBBON CABLE CONNECTOR | 2 | | | | |
| 2 | | 036-0013 | 3M #3302-26 | 26 CONDUCTOR RIBBON CABLE | 6" | | | | |

PREPARED: PWE DATE: 01/03/89 CHKD: LER DATE: 1/15/89 APPROVE: LEC DATE: 1/15/89 REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: REAR PORT RS 232 PART NO.: 109-2504

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 038-0009 | ROBINSON NUGENT #IDDC-25S-T6 | 25 PIN SOCKET DELTA CONNECTOR | 1 | | | | |
| 2 | | 036-0013 | 3M #3302-26 | 26 CONDUCTOR RIBBON CABLE | 6' | | | | |
| 3 | | 037-0012 | 3M #3399-6000 | 26 PIN RIBBON CABLE CONNECTOR | 1 | | | | |

PREPARED: PWE DATE: 02/21/89 CHKD: LER DATE: 2/21/89 APPROVE: REL DATE: 2/21/89 REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: OPTIONAL FRONT OPERATOR PORT CABLE SUBASSY. PART NO.: 109-2507

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 038-0009 | ROBINSON NUGENT #IDDC-25S-TG | 25 PIN SOCKET DELTA CONNECTOR | 1 | | | | |
| 2 | | 036-0013 | 3M #3302-26 | 26 CONDUCTOR RIBBON CABLE | 6' | | | | |
| 3 | | 037-0012 | 3M #3399-6000 | 26 PIN RIBBON CABLE CONNECTOR | 1 | | | | |

PREPARED: PWE DATE: 10/25/89 CHKD: LEC DATE: 11/20/89 APPROVE: LEC DATE: 11/20/89 REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 5

TITLE: EXPANSION P.C. BOARD SUBASSEMBLY PART NO.: 109-3000 CURRENT ECO:90-061-01

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | STD | 109-3001 | | EXPANSION PC BOARD | 1 | | | | |
| 2 | STD | 044-0010 | AMP 8640463-3 OR TELTEC ZT-8B | 8 PIN SOCKET | 10 | | | | |
| | | | (ARC) | | | | | | |
| 3 | STD | 044-0012 | AMP 82-640358-3 OR TELTEC | 16 PIN SOCKET | 5 | | | | |
| | | | ZT-16B (ARC) | | | | | | |
| 4 | Q1 | 044-0017 | AMP 82-640359-3 OR TELTEC | 18 PIN SOCKET | 1 | | | | |
| | | | ZT-18B (ARC) | | | | | | |
| 5 | STD | 044-0018 | AMP 82-640464-3 OR TELTEC | 20 PIN SOCKET | 14 | | | | |
| | | | ZT-20B | | | | | | |
| #NOTE | | | | SPECIFY WHEN NEEDED | | | | | |
| C1,C2,C4 | STD | | ELECTROLYTIC CAPACITOR | 10uf | 3 | | | | |
| C13-C39 | STD | | CERAMIC CAPACITOR | 0.1uF | 27 | | | | |
| C3,C5,C6 | STD | | CERAMIC CAPACITOR | 0.1uF | 3 | | | | |
| C40 | STD | | CERAMIC CAPACITOR | 0.1uF | 1 | | | | |
| C41,C42 | STD | | ELECTROLYTIC CAPACITOR | 1uF | 2 | | | | |
| C7 | STD | | ELECTROLYTIC CAPACITOR | 10uf | 1 | | | | |
| C8 | STD | | CERAMIC CAPACITOR | 0.1uF | 1 | | | | |
| C9-C12 | STD | | ELECTROLYTIC CAPACITOR | 10uf | 4 | | | | |
| CN1 | STD | 039-0036 | PHOENIX #MSTBA 1.5/10-G-5.08 | 10 POSITION CONNECTOR | 1 | | | | |
| CN2 | STD | 039-0034 | PHOENIX #MSTBA 1.5/13-G-5.08 | 13 POSITION CONNECTOR | 1 | | | | |
| CN3 | STD | 039-0035 | PHOENIX #MSTBA 1.5/16-G-5.08 | 16 POSITION CONNECTOR | 1 | | | | |

PREPARED: PWE DATE: 08/31/88 CHKD: LER DATE: 12/07/88 APPROVE: LER DATE: 12/07/88 REV: 89-005-01

REV:89-080-04 REV:89-166-02 REV:90-018-01 REV: 90-051-02 REV:90-061-01 REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.2 OF 5

TITLE: EXPANSION P.C. BOARD SUBASSEMBLY PART NO.: 109-3000 CURRENT ECO:90-061-01

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| CN4 | STD | 039-0033 | PHOENIX #MSTBA 1.5/9-G-5.08 | 9 POSITION CONNECTOR | 1 | | | | |
| CN5 | STD | 039-0032 | 3M #3593-5002 | 26 PIN R/A CONNECTOR | 1 | | | | |
| CN6 | STD | 037-0012 | 3M #3399-6000 | 26 PIN RIBBON SOCKET | 1 | | | | |
| CN7 | J2 | 043-0003 | TELTEC ZT-540-S | SINGLE ROW BERGSTICK (36 POSITION) QTY. REQ. | 8 | | | | |
| | | | | IS POSITION NOT EACH) | | | | | |
| CN8 | Q1 | | AMP #640440-6 | 6 PIN CONNECTOR | 1 | | | | |
| D1-D8 | D2R | 007-0180 | GENERAL SEMICONDUCTOR #SA170CA | TRANZORB | 8 | | | | |
| D1-D8 | D2C | 007-0180 | GENERAL SEMICONDUCTOR #SA170CA | TRANZORB | 8 | | | | |
| D1-D8 | D2T | 007-0180 | GENERAL SEMICONDUCTOR #SA170CA | TRANZORB | 8 | | | | |
| D11 | M1 | 007-0180 | GENERAL SEMICONDUCTOR #SA170CA | TRANZORB | 1 | | | | |
| D12 | M2 | 007-0180 | GENERAL SEMICONDUCTOR #SA170CA | TRANZORB | 1 | | | | |
| D13,D14 | STD | | IN4002 | DIODE | 2 | | | | |
| D9,D10 | STD | | IN4002 | DIODE | 2 | | | | |
| R1-R6 | STD | | CARBON - 5% - 1/4w | 100K | 6 | | | | |
| R11,R12 | STD | | CARBON - 5% - 1/4w | 47K | 2 | | | | |
| R13,R14 | STD | | METAL - 1% - 1/8 w | 10K | 2 | | | | |
| R7,R8 | STD | 013-0011 | YSI #44303 | 0.1% METAL, 30PPM, 18.70K AND 35.25K | 1SET | | | | |
| R9,R10 | STD | 013-0011 | YSI #44303 | 0.1% METAL, 30PPM, 18.70K AND 35.25K | 1SET | | | | |
| RP1,RP2 | STD | 015-0011 | BOURNS #4608X-102-561 OR | ISOLATED RESISTOR PACK, 560 OHM | 2 | | | | |
| | | | LC800256006 | | | | | | |
| RP3,RP4 | STD | 015-0012 | BOURNS #4608X-102-473 OR | ISOLATED RESISTOR PACK, 47K | 2 | | | | |
| | | | LC800247026 | | | | | | |

PREPARED: PWE DATE: 08/31/88 CHKD: LER DATE: 12/07/88 APPROVE: LER DATE: 12/07/88 REV: 89-005-01

REV:89-080-04 REV:89-166-02 REV:90-018-01 REV: 90-051-02 REV:90-061-01 REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.3 OF 5

TITLE: EXPANSION P.C. BOARD SUBASSEMBLY PART NO.: 109-3000 CURRENT ECO:90-061-01

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| RP5,RP6 | STD | 015-0003 | BOURNS #4310-101-153 OR | PULL-UP RESISTOR PACK, 15K | 2 | | | | |
| | | | LC000110036 | | | | | | |
| RP7-RP10 | | | BOURNS #4608X-102-102 | ISOLATED RESISTOR PACK - 8 PIN | 4 | | | | |
| SW1 | L | 031-0028 | AMP #435640-5 | 8 POSITION DIP SWITCH | 1 | | | | |
| U1 | B2 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U1 | K | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U1 | L | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U1 | M1 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U1 | M2 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U1 | N1 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U1 | N2 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U1 | N3 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U1 | N4 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U16 | K | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U17 | K,L | 007-0176 | 74HCT541 | OCTAL BUFFER | 1 | | | | |
| U18 | J2 | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U19,U20 | M1 | 007-0186 | 74HC593 | 8 BIT COUNTER WITH TRI-STATE OUTPUT | 2 | | | | |
| U2 | STD | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U21 | P | 007-0188 | AD517JH | OP-AMP | 1 | | | | |
| U22,U23 | M2 | 007-0186 | 74HC593 | 8 BIT COUNTER WITH TRI-STATE OUTPUT | 2 | | | | |
| U24 | N1 | 007-0187 | AD7248JN | 12 BIT D/A CONVERTER | 1 | | | | |

PREPARED: PWE DATE: 08/31/88 CHKD: LER DATE: 12/07/88 APPROVE: LER DATE: 12/07/88 REV: 89-005-01

| REV:89-080-04 | REV:89-166-02 | REV:90-018-01 | REV: 90-051-02 | REV:90-061-01 | REV: | REV: | REV: |
|---|---|---|---|---|---|---|---|



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E.S.C. BILL OF MATERIALS SHT NO.4 OF 5

TITLE: EXPANSION P.C. BOARD SUBASSEMBLY PART NO.: 109-3000 CURRENT ECO:90-061-01

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| U25 | N2 | 007-0187 | AD7248JN | 12 BIT D/A CONVERTER | 1 | | | | |
| U26 | N3 | 007-0187 | AD7248JN | 12 BIT D/A CONVERTER | 1 | | | | |
| U27 | N4 | 007-0187 | AD7248JN | 12 BIT D/A CONVERTER | 1 | | | | |
| U28 | N1 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U28 | N2 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U28 | N3 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U28 | N4 | 007-0157 | 74HCT138 | 3 TO 8 LINE DECODER | 1 | | | | |
| U29 | Q1 | 007-0188 | AD517JH | OP-AMP | 1 | | | | |
| U29 | Q2 | 007-0188 | AD517JH | OP-AMP | 1 | | | | |
| U3,U4 | STD | 007-0161 | MAXIM #MAX358L8CPE | DUAL 8 TO 1 ANALOG MUX | 2 | | | | |
| U30 | Q1 | 007-0172 | SILICONIX #D6529CJ | DUAL 4 TO 1 ANALOG MUX | 1 | | | | |
| U30 | Q2 | 007-0172 | SILICONIX #D6529CJ | DUAL 4 TO 1 ANALOG MUX | 1 | | | | |
| U31 | | | 74HC14 | SCHMITT TRIGGERED HEX INVERTER | 1 | | | | |
| U5 | STD | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U6 | B2 | 007-0176 | 74HCT541 | OCTAL BUFFER | 1 | | | | |
| U7 | D2R | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U7 | D2C | 007-0166 | 74HCT574 | OCTAL LATCH | 1 | | | | |
| U7 | D2T | 007-0166 | 74HJCT574 | OCTAL LATCH | 1 | | | | |
| U8-U15 | D2R | 032-0011 | CRYDOM #PVA2352 | OPTICALLY ISOLATED SOLID STATE RELAY | 8 | | | | |
| U8-U15 | D2C | 109-1100 | | CONTACT CLOSURE PUTPUT MODULE | 8 | | | | |
| U8-U15 | D2T | 109-1110 | | TTL OUTPUT MODULE | 8 | | | | |

PREPARED: PWE DATE: 08/31/88 CHKD: LER DATE: 12/07/88 APPROVE: LER DATE: 12/07/88 REV: 89-005-01

REV:89-080-04 REV:89-166-02 REV:90-018-01 REV: 90-051-02 REV:90-061-01 REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.5 OF 5

TITLE: EXPANSION P.C. BOARD SUBASSEMBLY PART NO.: 109-3000 CURRENT ECO:90-061-01

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| Z1-Z18 | | | PANASONIC #ERZ-C05DK180 | ZENER | 18 | | | | |
| Z19-Z26 | | | PANASONIC #ERZ-C14DK241U | ZENER | 8 | | | | |

PREPARED: PWE DATE: 08/31/88 CHKD: LER DATE: 12/07/88 APPROVE: LER DATE: 12/07/88 REV: 89-005-01

REV:89-080-04 REV:89-166-02 REV:90-018-01 REV: 90-051-02 REV:90-061-01 REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.1 OF 2

TITLE: WASHINGTON EXPANSION BOARD SUBASSEMBLY PART NO.: 109-3100

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 037-0006 | 3M #3421-6000 | 20 PIN RIBBON CONNECTOR | 3 | | | | |
| 2 | | | | 20 CONDUCTOR RIBBON CABLE | 24" | | | | |
| 3 | | | DIGIKEY #525M-ND | 25 PIN CONNECTOR | 1 | | | | |
| 4 | | 038-0010 | WINCHESTER #49-1125P | 25 PIN DELTA CONNECTOR | 1 | | | | |
| 5 | | 036-0013 | 3M #3302-26 | 26 CONDUCTOR RIBBON CABLE | 9" | | | | |
| 6 | | | AMP #640440-7 | 7 PIN HEADER CONNECTOR | 2 | | | | |
| 7 | | | AMP #207090-5 | DB-25 VERTICAL PC MOUNT | 1 | | | | |
| 8 | | | DIGIKEY #H9091 | RJ11 PLUGS | 4 | | | | |
| 9 | | | DIGIKEY #H0041 | 4 CONDUCTOR TELEPHONE CABLE | 4" | | | | |
| 10 | | 007-0014 | 74LS00 | 14 PIN DIP | 1 | | | | |
| C1-C5 | | | ELECTROLYTIC CAPACITOR | 22uf, 50V | 5 | | | | |
| C6 | | | ELECTROLYTIC CAPACITOR | .1uf | 1 | | | | |
| CN1 | | | PHOENIX MSTBA 1.5/8-G-5.08 | 8 CONTACT CONNECTOR | 1 | | | | |
| CN11 | | | AMP #640456-2 | 2 PIN HEADER | 1 | | | | |
| CN2 | | 039-0031 | AMPHENOL #117-DB-25SA | DB-25 FEMALE RIGHT ANGLE PC MOUNT | 1 | | | | |
| CN3,4 | | 039-0030 | BERG #66011-001 | RJ11 RIGHT ANGLE PC MOUNT | 2 | | | | |
| CN5 | | 039-0040 | 3M #3926-0000T | 26 PIN TERMINATOR | 1 | | | | |
| CN6,CN8 | | 039-0039 | 3M #3920-0000T | 20 PIN TERMINATOR | 2 | | | | |
| CN7,10 | | | AMP #640456-7 | 7 PIN HEADER | 2 | | | | |
| CN9 | | 039-0014 | 3M #3428-2003 | 20 PIN HEADER SOCKET | 1 | | | | |
| D1-D6 | | | IN4004 | DIODES | 6 | | | | |

PREPARED: PWE DATE: 03/07/88 CHKD: LER DATE: 5/24/89 APPROVE: REL DATE: 5/26/89 REV:

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E.S.C. BILL OF MATERIALS SHT NO.2 OF 2

TITLE: WASHINGTON EXPANSION BOARD SUBASSEMBLY PART NO.: 109-3100

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| D7-D8 | | | IN4002 | DIODES | 2 | | | | |
| Q1-4 | | | 2N3904 | NPN TRANSISTORS | 4 | | | | |
| Q5 | | | 78M12 | +12V REGULATOR | 1 | | | | |
| Q6 | | | 79M12 | -12V REGULATOR | 1 | | | | |
| Q7 | | | 2N3906 | TRANSISTORS | 1 | | | | |
| R1-R4 | | | CARBON - 5% - 1/4 w | 1.2K | 4 | | | | |
| R5,R6 | | | CARBON - 5% - 1/4 w | 10K | 2 | | | | |
| R7 | | | CARBON - 5% - 1/4 w | 1.5K | 1 | | | | |
| R8 | | | CARBON - 5% - 1/4 w | 620 OHM | 1 | | | | |
| R9 | | | CARBON - 5% - 1/4 w | 10K OHM | 1 | | | | |
| RY1-4 | | | OMRAN LC1H-US, DIGIKEY | 24 VDC COIL SPDT RELAY | 4 | | | | |
| | | | #2407-ND | | | | | | |
| U1 | | 044-0011 | AMP #2-640357-3 | 14 PIN IC SOCKET | 1 | | | | |

PREPARED: PWE DATE: 03/07/88 CHKD: DATE: / / APPROVE: DATE: / / REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 2

TITLE: A.C. POWER SUPPLY P.C. BOARD SUBASSEMBLY PART NO.: 109-4000 CURRENT ECO:90-080-09

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 109-4001 | | A.C. POWER SUPPLY P.C. BOARD | 1 | | | | |
| 2 | | | LITTLEFUSE #102071 | FUSE CLIPS | 2 | | | | |
| 3 | | | THERMALLOY #6073B OR | TO-220 HEATSINK | 1 | | | | |
| | | | AAVID #5073B | | | | | | |
| 4 | | | ALPHA #1855/19-1 | 22 GA. MULTI-STRAND WIRE WHITE | 6" | | | | |
| 5 | | | ALPHA #1855/19-3 | 22 GA. MULTI-STRAND WIRE RED | 6" | | | | |
| 6 | | | ALPHA #1855/19-6 | 22 GA. MULTI-STRAND WIRE BLUE | 6" | | | | |
| 7 | | | ALPHA #1855/19-4 | 22 GA. MULTI-STRAND WIRE GREEN | 6" | | | | |
| 8 | | | ALPHA #1855/19-8 | 22 GA. MULTI-STRAND WIRE ORANGE | 6" | | | | |
| 9 | | | ALPHA #1855/19-7 | 22 GA. MULTI-STRAND WIRE BROWN | 6" | | | | |
| 10 | | | 4-40 X 1/4" | PAN HEAD MACHINE SCREW | 1 | | | | |
| 11 | | | 4-40 | HEX NUT | 1 | | | | |
| 12 | | | #4 | LOCKWASHER | 1 | | | | |
| 13 | STD | 020-0004 | STANCOR #P8750 | TRANSFORMER 117 VAC SUPPLY | 1 | | | | |
| 14 | | 020-0005 | STANCOR #P8696 | TRANSFORMER 230 VAC SUPPLY | 1 | | | | |
| C1-C4 | STD | 017-0004 | SPRAGUE #80D272P035HA5 | 2700uF, 35V ELECTROLYTIC CAPACITOR | 4 | | | | |
| CN1 | STD | 037-0053 | SWITCHCRAFT #EAC-303 | P.C. MOUNT A.C. RECEPTICAL | 1 | | | | |
| CN2 | | | AMP #640388-8 | 8 PIN 0.156" HEADER | 1 | | | | |
| CN3 | | | AMP #640440-7 | 7 POSITION CLOSED END HOUSING | 1 | | | | |
| D1,D2 | | 007-0180 | GENERAL SEMI #SA170CA | 170V TRANZORB | 2 | | | | |
| D3-D14 | | | IN4002 | GENERAL PURPOSE DIODE | 12 | | | | |

PREPARED: PWE DATE: 01/12/89 CHKD: LER DATE: 01/12/89 APPROVE: LER DATE: 01/12/89 REV: 89-115-01

| REV: | REV: | REV: | REV: | REV: | REV: |
|---|---|---|---|---|---|
| 89-166-03 | 89-311-01 | 90-080-09 | | | |



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E.S.C. BILL OF MATERIALS SHT NO.2 OF 2

TITLE: A.C. POWER SUPPLY P.C. BOARD SUBASSEMBLY PART NO.: 109-4000 CURRENT ECO:90-080-09

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| FU1 | | | | 1A SLO-BLO FUSE | 1 | | | | |
| Q1 | | 008-0024 | MOTOROLA MC78M05CT | +5V REGULATOR | 1 | | | | |
| Q2 | | 008-0025 | MOTOROLA MC78M15CT | +15V REGULATOR | 1 | | | | |
| Q3 | | 008-0026 | MOTOROLA MC79M15CT | -15V REGULATOR | 1 | | | | |
| SW1 | | 031-0054 | ALCO #MTA-106D-VRA OR | SPDT P.C. MOUNT SWITCH | 1 | | | | |
| | | | NKK #M2012SS2W45 | | | | | | |

PREPARED: PWE DATE: 01/12/89 CHKD: LER DATE: 01/12/89 APPROVE: LER DATE: 01/12/89 REV: 89-115-01

REV:89-166-03 REV:89-311-01 REV:90-080-09 REV: REV: REV: REV: REV:



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E.S.C. BILL OF MATERIALS SHT NO.1 OF 2

TITLE: DC TO DC POWER SUPPLY SUBASSEMBLY PART NO.: 109-4100

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | ALPHA #1855/19-1 | 22 GAUGE MULTI-STRAND WIRE WHITE | 6" | | | | |
| 2 | | | ALPHA #1855/19-3 | 22 GAUGE MULTI-STRAND WIRE RED | 6" | | | | |
| 3 | | | ALPHA #1855/19-6 | 22 GAUGE MULTI-STRAND WIRE BLUE | 6" | | | | |
| 4 | | | ALPHA #1855/19-4 | 22 GAUGE MULTI-STRAND WIRE GREEN | 6" | | | | |
| 5 | | | ALPHA #1855/19-8 | 22 GAUGE MULTI-STRAND WIRE ORANGE | 6" | | | | |
| 6 | | | ALPHA #1855/19-7 | 22 GAUGE MULTI-STRAND WIRE BROWN | 6" | | | | |
| 7 | | | ALPHA #1855/19- | 22 GAUGE MULTI-STRAND WIRE YELLOW | 6" | | | | |
| 8 | | | LITTLEFUSE #102071 | FUSE CLIPS | 2 | | | | |
| 9 | | | THERMALLOY #6073B | HEAT SINK | 1 | | | | |
| C1,C3 | | | ELECTROLYTIC CAPACITOR, RADIAL 0.1" SPACING, 25V | 100uF | 2 | | | | |
| C10,C13 | | | ELECTROLYTIC CAPACITOR, RADIAL 0.1" SPACING, 25V | 100uF | 2 | | | | |
| C12 | | | CERAMIC DISC | 75pF | 1 | | | | |
| C14,C16 | | | CERAMIC DISC, 0.1" SPACING | 0.1uF, 50V MONO | 2 | | | | |
| C15 | | | ELECTROLYTIC CAPACITOR, RADIAL 0.1" SPACING, 25V | 100uF | 1 | | | | |
| C2 | | | CERAMIC DISC | 27pF | 1 | | | | |
| C4,C6 | | | CERAMIC DISC, 0.1" SPACING | 0.1uF, 50V MONO | 2 | | | | |
| C5,C9 | | | ELECTROLYTIC CAPACITOR, RADIAL 0.1" SPACING, 25V | 100uF | 2 | | | | |

PREPARED: PWE DATE: 09/30/88 CHKD: LEL DATE: 12/7/88 APPROVE: LEL DATE: 12/7/88 REV:

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E.S.C. BILL OF MATERIALS SHT NO.2 OF 2

TITLE: DC TO DC POWER SUPPLY SUBASSEMBLY PART NO.: 109-4100

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| C7 | | | CERAMIC DISK | 82pF | 1 | | | | |
| C8,C11 | | | CERAMIC DISK, 0.1" SPACING | 0.1uF, 50V MONO | 2 | | | | |
| CN1 | | | SWITCHCRAFT #712A | DC POWER CONNECTOR | 1 | | | | |
| CN2 | | | AMP #640440-7 | 7 POSITION CLOSED END HOUSING | 1 | | | | |
| D1 | | | 1N4744A | 15V ZENER, 5% | 1 | | | | |
| D2,D3,D4 | | | 1N5817 | SCHOTTKY DIODE | 3 | | | | |
| D5 | | | 1N4002 | DIODE | 1 | | | | |
| FU1 | | | | 1A FUSE | 1 | | | | |
| L1,L2,L3 | | | DALE #TE2-03-TA 1MH 2% | INDUCTOR | 3 | | | | |
| Q1 | | | ZN3904 | NPN TRANSISTOR | 1 | | | | |
| R1 | | | METAL FILM - 1% - 1/8 w | 150K | 1 | | | | |
| R2 | | | METAL FILM - 1% - 1/8 w | 14.3K | 1 | | | | |
| R3 | | | METAL FILM - 1% - 1/8 w | 604K | 1 | | | | |
| R4 | | | METAL FILM - 1% - 1/8 w | 49.9K | 1 | | | | |
| R5 | | | CARBON - 5% - 1/4 w | 1K | 1 | | | | |
| R6 | | | METAL FILM - 1% - 1/8 w | 402K | 1 | | | | |
| R7 | | | METAL FILM - 1% - 1/8 w | 100K | 1 | | | | |
| SW1 | | | MKK #M2012SS2W45 | SPDT SWITCH, R/A | 1 | | | | |
| U1 | | | MOTOROLA #MC78M05CT | +5V REGULATOR | 1 | | | | |
| U2 | | | MAXIM #MAX630CPA | STEP-UP SWITCHING REGULATOR | 1 | | | | |
| U3,U4 | | | MAXIM #MAX634CPA | INVERTING SWITCHING REGULATOR | 2 | | | | |

PREPARED: PWE DATE: 09/30/88 CHKD: DATE: / / APPROVE: DATE: / / REV:

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E.S.C. BILL OF MATERIALS SHT NO.1 OF 1

TITLE: CARTRIDGE SUBASSEMBLY PART NO.: 109-5000

| DESIGNAT. | OPT | PART NO. | SPECIFICATIONS | DESCRIPTION | #REQ | #TOT | #ORD | #REC | PRICE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 109-2505 | | MEMORY CARTRIDGE INTERFACE CABLE (DRAWING) | 1 | | | | |
| 2 | | 038-0017 | AMP #746616-2 | 28 POSITION DIP PLUG | 1 | | | | |
| 3 | | 039-0029 | AMP #499188-4 | 15 DUAL POSITION CARD EDGE CONNECTOR | 1 | | | | |
| 4 | | 036-0009 | 3M #3302-34 | 34 CONDUCTOR RIBBON CABLE | 8" | | | | |
| 5 | | 109-5001 | | MEMORY CARTRIDGE BRACKET | 1 | | | | |

PREPARED: PWE DATE: 02/21/89 CHKD: LER DATE: 2/21/89 APPROVE: LER DATE: 2/21/89 REV:

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# 9.0 TECHNICAL DRAWINGS



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# LIST OF 8800 DATA LOGGER TECHNICAL FIGURES

| | | |
|---|---|---|
| 1. | CPU.DWG | CPU and main digital components. |
| 2. | ANALOG.DWG | Analog circuits on main board |
| 3. | EXP.DWG | Expansion board schematic |
| 4. | DACS.DWG | DAC hardware schematic |
| 5. | CHARGER.DWG | Battery charrger schematic |
| 6. | POWER.DWG | Power supply schematic |
| 7. | AC TRANSFORMER WIRING | |
| 8. | POWER SUP. OUTPUT WIRING | |
| 9. | 8800 MAIN BOARD SUBASS | |
| 10. | EXPANSION BOARD SUBASS | |



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# APPENDIX A

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TIN 89-1070

# DDT88 MONITOR MANUAL

Version 1.06

April 24, 1989

Environmental Systems Corporation
200 Tech Center Drive
Knoxville, TN 37912

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# 1.0 INTRODUCTION

The DDT88 monitor consists of 17 test programs which can be used to verify the operation of the major hardware components in the ESC Model 8800 data logger. These programs are the same test routines that the ESC Technical Services Department uses during initial verification of the logger hardware as well as during trouble shooting. An experienced technician should be able to test the operation of the unit and identify any faulty components.

DDT88 is contained on one 32K EPROM (27C256) and operates only in the memory map that is contained in the Programmable Logic Device (PLD) labeled "8K/32K-P".



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## 2.0 INSTALLATION AND STARTUP

The DDT88 monitor is contained in one 32K EPROM chip which replaces the first of the operating program EPROMs (i.e.- #0). Once the chip is installed, the data logger will no longer execute the normal data acquisition software but will instead allow the user to perform several diagnostic test procedures that may be used to verify the operation of the hardware or to isolate a failure. The tests only check the hardware of the logger and will not find problems that are associated with the data logger software (operating program).

To install DDT88 follow the steps below:

1. Turn AC power off; disconnect the AC power cord.
2. Turn off the RAM battery switch (located on the rear panel).
3. Remove the cover of the 8800 by removing the four screws.
4. Remove the IC from socket U12 and replace with DDT88.
5. Note the label on the chip installed in U10. If it is not "8K/32K-P" then this chip must be replaced to run DDT88.
6. Reconnect AC power cord and switch on the RAM battery.



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DDT88 requires the use of a serial terminal connected to the OPERATOR PORT of the 8800 data logger. For 8800s with a full keyboard/display front panel, this port is located on the rear panel. For 8800s with the limited keypad/display or with no built-in display, the OPERATOR PORT is on the front panel.

The operator should connect a straight ribbon cable between the OPERATOR PORT and the serial port of any ASCII terminal. The A/D test (T5) uses standard ANSI escape sequences to position the cursor for its full-screen display. To run this test successfully, the operator terminal should be "ANSI compatible"; the other tests should run on any terminal. The operator terminal should be configured as 8-bits, no parity, one stop bit and at any one of the following baud rates: 300, 600, 1200, 2400, 4800, 9600, or 19200.

The first time that the monitor is powered up (cold-started) it enters an automatic baud-rate search. This allows terminals with different baud-rates to be connected. After turning the power switch on, type an upper case "U" on the terminal every (approximately) one half second until the "DDT> " prompt appears. If the prompt does not appear after seven "U"s have been typed, wait two or three seconds then try again. After the prompt appears, the baud-rate will be "locked in" until a cold-start (AC power off with the RAM battery disconnected or switched off) occurs.



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above section is 0.5°C over the range -30°C to +50°C. However, it is possible to increase the accuracy to about 0.3°C through the calibration method described below.

Equipment needed for calibration:

1) Two accurate temperature standards (such as an ice bath and a Gallium cell),
2) The YSI temperature probe you will be using in the field,
3) The data logger to which the temp. probe mentioned above will be connected (the temperature probe must be connected to the same input to which it will be connected in regular use.),
4) A terminal to communicate with the data logger.

Calibration Procedure:

1) Establish communication with the data logger (see section 2.4 of this manual.
2) Connect the YSI temperature probe to temperature probe input you intend to use in the field (see section above in this appendix for connection to data logger).
3) Initialize the corresponding YSI temperature probe channel as described in section 4.4.5 of this manual.
4) Insert the temperature probe in one of the temperature standards and issue the command "REPEAT READ" (section 5.2.3) for the channel initialized and observe the reading. The reading should be within 0.5° C of the standard. If it is not, re-check the connection and the channel initialization and try again.
5) Issue the command "REPEAT RAW" (section 5.2.2) for the channel initialized and record the reading (in volts) for each temperature standard.
6) Using the slope and intercept equations described in section 4.1.2 calculate a new slope and intercept from the temperatures and corresponding voltages obtained in step 5.
7) Reinitialize the YSI temperature probe channel using the new slope and intercept.

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This calibration method will increase the guaranteed accuracy from 0.5°C to about 0.3°C (about 0.5°F). This increased accuracy, however, is only valid for a particular temperature probe connected to a particular input on a particular data logger. If the temperature probe, the probe input, or the data logger are changed, then the guaranteed accuracy reverts to 0.5°C, and the calibration procedure must be performed again to regain the increased accuracy.

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# 3.0 TEST PROCEDURES

## 3.1 Memory Tests

### 3.1.1 Extensive Memory Tests (T1 and T11)

The DDT88 memory test is a test of RAM (Random Access Memory). The test checks each location of memory 256 times to verify proper operation of each memory chip (U1 through U8). It also verifies that only one chip is selected at any one time within the range of the test area. The test can be performed in any one of four ways, depending on the format that is used to start the test. The tests are: a complete check of all memory, a complete check of only a range of memory, a repeating check of all memory, and a repeating check of only a range of memory. For a complete check of RAM the format is:

```
DDT> T1<CR>

ROOT=       0000 - 1FFF
WORKSPACE=  2000 - 2374
FIXED RAM=  2375 - 7FFF
BRANCHES=   8000 - EFFF
BANKS=      F000 - FFFF
nn (HEX) BANKS FOUND
```

Where "nn" is the number of 4K byte banks that were found by the test program. The ROOT and the BRANCHES are areas used by the operating program for PROM (sockets U12 and U13). The WORKSPACE is the area of the RAM chip installed in U1 that DDT88 uses to store its operating parameters and is not tested. The FIXED RAM area is the remaining part of the RAM chip in U1 that is used to store most of the variables for the data collection program.



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The BANKS are the 4K segments of RAM that are swapped into the logical address space one at a time and are used by the data collection program to store its long-term data. The number of BANKS found will be dependent on the number of RAM chips installed. The banks are numbered as follows:

| BANK NUMBER (HEX) | SOCKET |
|---|---|
| 00..07 | U2 |
| 08..0F | U3 |
| 10..17 | U4 |
| 18..1F | U5 |
| 20..27 | U6 |
| 28..2F | U7 |
| 30..37 | U8 |

The test proceeds by performing the memory test for the WORKSPACE then for each of the BANKS found. A pass number is printed for each pattern that is written to the memory. This test takes about 2 1/2 minutes to check the WORKSPACE and about 25 seconds to check each BANK. If the test detects a problem, an error message will be printed indicating the bad memory location and the test pattern that failed. The test may be aborted by typing the <ESC> key on the terminal.

The second form of this command maybe entered to test only a certain range of memory locations:

DDT> T1,ssss,eeee<CR>

The test will proceed with checking the locations between the starting address (ssss) and the ending addresses (eeee) specified. If any of the range of the test area is in the BANKS area then all of the banks will be tested. The test will skip the ROOT, WORKSPACE, and BRANCHES areas of the logical address space.



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Either of the forms of the memory test may be placed in a "repeating" mode by replacing the "T1" with a "T11" in the formats above. In this mode, when the end of the test is reached, the program loops back and starts the test again. The test will continue until an error is detected or until the test is aborted by typing the <ESC> key. If an error is found, the error message will be continuously printed to the serial port until an <ESC> is typed. This allows the operator to disconnect the terminal after starting the continuous test and then return later to check if any error had occurred (and if so, at what address it had occurred).

### 3.1.2 Quick Memory Test (D)

The quick memory test "D" is a less extensive memory test than "T1" but has two advantages over "T1". The first is that it is faster; "D" only checks four bit patterns (00, 55, AA, and FF) in each memory location instead of 256 patterns and it does not check for RAM that may be decoded at multiple addresses. The second advantage is that it checks for RAM in all of the chip sockets; the RAM does not have to be contiguous.

The format of the command and its response is:

```
DDT> D<CR>

STARTING MEMORY TEST AT 002375
-----!-------!
MEMORY FAILURE BEGINNING AT 010000
-------!-------!-------!-------!-------!-------!-------!
MEMORY OK BEGINNING AT 040000
--
END OF RAM TEST AT 41FFF
```



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The addresses printed in the test are the PHYSICAL addresses of the RAM chips (in HEX). The test starts after the DDT88 workspace (002000..002374) and continues upward in memory byte by byte until a memory failure is detected (printing a "-" for every 4K bytes checked and a "!" at every 32K chip boundary). The address of the start of the memory failure is printed and the RAM checked every 4K until a good memory location is found. The test continues until the end of RAM is reached. The chip sockets are decoded in the physical address space as follows:

| Physical Address | Socket |
|---|---|
| 002000..007FFF | LAST 24K OF U1 |
| 008000..00FFFF | U2 |
| 010000..017FFF | U3 |
| 018000..01FFFF | U4 |
| 020000..027FFF | U5 |
| 028000..02FFFF | U6 |
| 030000..037FFF | U7 |
| 038000..03FFFF | U8 |
| 040000..041FFF | FIRST 8K OF U1 |

### 3.1.3 Fill and Verify (F and V)

The "F" command allows the operator to fill all or part of RAM with a specified bit pattern. The "V" command can then be used to verify that a particular pattern exists in a range of memory. This test can be used to verify that the battery backup is working correctly for all RAMs by filling them with a pattern, removing the AC power for some time, restoring the power, then verifying the pattern. The procedure is as follows:



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```
DDT> Fpp<CR>

ROOT=       0000 - 1FFF
WORKSPACE=  2000 - 2374
FIXED RAM=  2375 - 7FFF
BRANCHES=   8000 - EFFF
BANKS=      F000 - FFFF
nn (HEX) BANKS FOUND
```

Where "nn" is the number of 4K byte banks that were found and "pp" is the pattern to be filled. The power may now be remove and restored. To verify the pattern:

```
DDT> Vpp<CR>

ROOT=       0000 - 1FFF
WORKSPACE=  2000 - 2374
FIXED RAM=  2375 - 7FFF
BRANCHES=   8000 - EFFF
BANKS=      F000 - FFFF
nn (HEX) BANKS FOUND

VERIFY O.K.
```

An error message will be printed if any of the bytes in RAM does not contain the specified pattern. The "F" command will default to filling the pattern "55" if no pattern is specified, and the "V" command will verify the last pattern filled by the "F" command if no pattern is specified. To fill or verify only a section of RAM use the following format:

```
DDT> Fssss,eeee,pp
```

Where "ssss" is the starting address and "eeee" is the ending address. If the section to be filled or verified is in the BANK area, this format will only fill or verify the BANK currently swapped into memory.



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## 3.2 Real Time Clock Tests

### 3.2.1 Clock Frequency Test (T2)

The clock frequency test is a procedure that configures the real-time clock to output its time-base frequency on the interrupt line where it can be measured and adjusted. The format of the command is:

```
DDT> T2<CR>

CLOCK FREQUENCY TEST---

CONNECT COUNTER TO TP-14.
ADJUST C3 SO THAT THE PERIOD IS 15.6250 mS

DDT>
```

This frequency (64Hz) will be available on the test point until one of the other clock tests (T3 or T4) are executed. The accuracy of the period is directly related to the long-term accuracy of the real-time clock.

### 3.2.2 Clock Display Test

The clock display test is used to set the real-time clock and to verify its proper operation. This test is not interrupt driven (see Clock Interrupt Test - T4) so that the operation of the clock chip itself can be verified. The test allows the users three possibilities for setting the clock time before the test begins. To display the clock time without setting it use:

```
DDT> T3<CR>

CLOCK DISPLAY TEST--

DO YOU WANT TO SET THE TIME? [Y OR N] > N

Wed, 26-Apr-89 09:23:15
```



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The time will be continuously updated on the same line until any key is typed on the operator terminal. To set a default time of 12/31/89 23:58:58 use:

```
DDT> T3<CR>

CLOCK DISPLAY TEST--

DO YOU WANT TO SET THE TIME? [Y OR N] > <CR>

ENTER [MM,DD,YY] > <CR>

Sat, 31-Dec-89 23:58:58
```

To set a specific time use:

```
DDT> T3<CR>

CLOCK DISPLAY TEST--

DO YOU WANT TO SET THE TIME? [Y OR N] > Y

ENTER [MM,DD,YY] > 04,25,89<CR>
ENTER [HH,MM,SS] > 09,32,45<CR>

Tue, 25-Apr-89 09:32:45
```

The day of the week is calculated by the software and loaded to the clock automatically. For the default time, December 31, 1989 is actually on a Sunday but Saturday is loaded to allow the operator to quickly verify that the clock rolls over correctly from the last day of the week to the first.

### 3.2.3 Clock Interrupt Test

The clock interrupt test is similar to the clock display test in that it can be used to set the real-time clock and to verify its proper operation. However, this test is interrupt driven so that the operation of the entire clock system can be verified.



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Like the clock display test, this test allows the users three possibilities for setting the clock time before the test begins. To display the clock time without setting it use:

```
DDT> T4<CR>

CLOCK DISPLAY TEST--

DO YOU WANT TO SET THE TIME? [Y OR N] > N

Wed, 26-Apr-89 09:23:15
Wed, 26-Apr-89 09:23:16
Wed, 26-Apr-89 09:23:17
```

The time will be continuously updated on successive lines until the <ESC> key is typed on the operator terminal. To set a default time of 12/31/89 23:58:58 use:

```
DDT> T4<CR>

CLOCK DISPLAY TEST--

DO YOU WANT TO SET THE TIME? [Y OR N] > <CR>

ENTER [MM,DD,YY] > <CR>

Sat, 31-Dec-89 23:58:58
Sat, 31-Dec-89 23:58:59
Sat, 31-Dec-89 23:59:00
```

To set a specific time use:

```
DDT> T4<CR>

CLOCK DISPLAY TEST--

DO YOU WANT TO SET THE TIME? [Y OR N] > Y

ENTER [MM,DD,YY] > 04,25,89<CR>
ENTER [HH,MM,SS] > 09,32,45<CR>

Tue, 25-Apr-89 09:32:45
Tue, 25-Apr-89 09:32:45
Tue, 25-Apr-89 09:32:45
```



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The day of the week is calculated by the software and loaded to the clock automatically. For the default time, December 31, 1989 is actually on a Sunday but Saturday is loaded to allow the operator to quickly verify that the clock rolls over correctly from the last day of the week to the first. This test has one other advantage over the clock display test; it computes the time that the clock **should** display and compares it to the actual time read from the clock. If the "software clock" and the hardware clock do not agree, the test will abort and print a message stating the discrepancy. The error message will be printed repeatedly until an <ESC> key is typed.



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## 3.3 Analog to Digital Converter Tests

### 3.3.1 Full Screen Display Test (T5)

The A/D full screen display test can be used with an ANSI-compatible terminal to continuously update the value of one or more of the 16 analog input channels. The test also prints the results of the automatic zero and span conversions that are used to scale the raw data from the analog channels into voltages. The test can be invoked by using one of three formats. To display all 16 channels use:

DDT> T5<CR>

To display only channels 1 to nn (decimal) use:

DDT> T5,n<CR>

To display channels nn to xx (decimal) use:

DDT> T5,nn,xx<CR>

The test can be terminated by typing an <ESC>. Over range data will be displayed as asterisks.



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An example display is:

13

| | | ZERO | +SPAN | -SPAN |
|---|---|---|---|---|
| (H) | 10.V: | -5.000 | 3806. | -3817. |
| (I) | 5.0V: | -7.000 | 3822. | -3838. |
| (J) | 1.0V: | -22.00 | 3784. | -3828. |
| (K) | 0.1V: | -180.0 | 3607. | -3969. |

| CHAN | SCALE | RAW | VOLTAGE | %FS | |
|---|---|---|---|---|---|
| 01 | 10VFS | -6.000 | -.0026 | -.0262 | 01 (1) |
| 02 | 10VFS | -6.000 | -.0026 | -.0262 | 02 (2) |
| 03 | 10VFS | -5.000 | .0000 | .0000 | 03 (3) |
| 04 | 10VFS | -6.000 | -.0026 | -.0262 | 04 (4) |
| 05 | 10VFS | -5.000 | .0000 | .0000 | 05 (5) |
| 06 | 10VFS | -6.000 | -.0026 | -.0262 | 06 (6) |
| 07 | 10VFS | -6.000 | -.0026 | -.0262 | 07 (7) |
| 08 | 10VFS | -6.000 | -.0026 | -.0262 | 08 (8) |
| 09 | 10VFS | -6.000 | -.0026 | -.0262 | 09 (9) |
| 10 | 10VFS | -6.000 | -.0026 | -.0262 | 10 (A) |
| 11 | 10VFS | -5.000 | .0000 | .0000 | 11 (B) |
| 12 | 10VFS | -6.000 | -.0026 | -.0262 | 12 (C) |
| 13 | 10VFS | -5.000 | .0000 | .0000 | 13 (D) |
| 14 | 10VFS | -6.000 | -.0026 | -.0262 | 14 (E) |
| 15 | 10VFS | -6.000 | -.0026 | -.0262 | 15 (F) |
| 16 | 10VFS | -6.000 | -.0026 | -.0262 | 16 (G) |

The upper table of the display shows the raw counts read from the A/D during the auto zero, positive span, and negative span phases for each of the four gain scales. The number in the upper left corner is a counter that is incremented on each conversion to show that the display is being updated. For each channel, the raw counts from the A/D is printed as well as the corrected percent full scale and the corrected voltage. The gain scale for each channel may be changed individually by typing the letter in parentheses on the far right of that channel's row. The scale will toggle from 10V to 5V to 1V to 0.1V then back to 10V. To change all channels to a particular gain, press one of the four keys in parentheses to the left of the auto zero/span table.



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### 3.3.2 Single Channel Test (A)

This test displays and continuously updates the raw counts read from the A/D for a particular analog channel or for the auto zero, positive span, or negative span. The test does not perform the auto zero/span conversions that are performed during the full screen display test. Only one channel and one gain are selected by the input analog multiplexers. The A/D is continuously read and the results are displayed. The format for the command is:

```
DDT> Acc<CR>
```

Where "cc" is the channel (decimal) to be displayed. Select cc= 00 to display the auto zero channel, cc= 17 for the positive span, and cc= 18 to display the negative span. An example display is:

```
DDT> A08<CR>

01= '1'          09= '9'          ZERO= '0'
02= '2'          10= 'A'         +SPAN= 'S'
03= '3'          11= 'B'         -SPAN= 'M'
04= '4'          12= 'C'
05= '5'          13= 'D'         10VFS= 'H'
06= '6'          14= 'E'          5VFS= 'I'
07= '7'          15= 'F'          1VFS= 'J'
08= '8'          16= 'G'        0.1VFS= 'K'

*CHAN: 08        GAIN: 10VFS      COUNTS= -4.000
```

While the display is being updated, the asterisk will flash on and off. To change the selected channel while the test is in progress, press the key in quotes to the right of the channel to be displayed. The gain scale can be changed by pressing one of the four keys in quotes to the right of the desired gain. The test is terminated by typing an <ESC>.



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## 3.4 Serial Port Tests

### 3.4.1 Serial Loopback Test (T6)

The serial loopback test requires a special test cable to fully test the two serial ports on the 8800 data logger. However, a partial test may be performed with the use of a straight ribbon cable. The test is divided into two parts and may be performed in one of three modes. The first part of the test is a verification of the three modem control lines (RTS, CTS, and HS) available on CN1 (See Drawing 109-1000). The second part is the transmission of the printable ASCII characters form the OPERATOR PORT to the EXTERNAL MODEM port and vice-versa. The failure of the modem control line test does not prevent the transmission test from being performed.

A partial test of the serial ports can be performed using only a straight ribbon cable. This test will verify communication of all of the printable ASCII characters at all transmission rates between 300 and 19200 baud but it will not test the modem control lines on the EXTERNAL MODEM port. To start the test, connect the operator terminal to the OPERATOR PORT (as before), leave the EXTERNAL MODEM port disconnected, and type the following:

```
DDT> T6<CR>
ENTERING SERIAL LOOP-BACK TEST...
CTS TEST FAILED!
CONNECT TEST CABLE NOW, <ESC> TO QUIT.
```



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The modem control line test failed because the lines were not looped back using the special test cable. At this point, disconnect the cable from the OPERATOR PORT and connect a straight ribbon cable (MALE to MALE) between the OPERATOR PORT and the CN1. After the connection is made, wait for at least 30 seconds for the test to execute, then disconnect the ribbon cable and reconnect the operator terminal to the OPERATOR PORT. The results of the character loopback test will be continuously printed to the screen. If nothing is printed, then a failure of one of the ports or in the ribbon cable prevented the test from being started.

The same test with the special test cable connected should pass the modem control line test and proceed to the character loopback test. With the special test cable, the operator terminal will display invalid characters when the baud rate of the test does not match the baud rate of the operator terminal. However, the baud rate of the OPERATOR PORT will be reset to its previous speed when the test ends and the results are printed.

The serial loopback test can be executed in two additional modes. When invoked by:

DDT> T6,1<CR>

the character loopback portion of the test is repeated continuously until an error is detected. When invoked by:

DDT> T6,2<CR>

the character loopback portion of the test is repeated continuously at the baud rate of the console (only) until an error is detected.



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### 3.4.2 Baud Rate Test (T10)

This test allows the verification of the baud rate clocks for the serial ports. The clock frequency available for measurement is 16 times the baud rate clock. To test the OPERATOR PORT baud rate, use the command:

```
DDT> T10<CR>

ENTERING CONSOLE BAUD RATE TEST...
MEASURE FREQUENCY ON R3.

BAUD= 19200.    (307.200 KHZ)<BREAK>
BAUD= 9600.     (153.600 KHZ)<BREAK>
BAUD= 4800.     ( 76.800 KHZ)<BREAK>
BAUD= 2400.     ( 38.400 KHZ)<BREAK>
BAUD= 1200.     ( 19.200 KHZ)<BREAK>
BAUD= 600.      (  9.600 KHZ)<BREAK>
BAUD= 300.      (  4.800 KHZ)<BREAK>

DDT>
```

The expected frequency to be measured is indicated in parentheses for each baud rate shown. The <BREAK> key is used to move to the next baud rate. To test the EXTERNAL MODEM baud rate, use the command:

```
DDT> T10,1<CR>

ENTERING EXTERNAL MODEM BAUD RATE TEST...
MEASURE FREQUENCY ON R2.

BAUD= 19200.    (307.200 KHZ)<BREAK>
BAUD= 9600.     (153.600 KHZ)<BREAK>
BAUD= 4800.     ( 76.800 KHZ)<BREAK>
BAUD= 2400.     ( 38.400 KHZ)<BREAK>
BAUD= 1200.     ( 19.200 KHZ)<BREAK>
BAUD= 600.      (  9.600 KHZ)<BREAK>
BAUD= 300.      (  4.800 KHZ)<BREAK>

DDT>
```



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## 3.5 Parallel Port Tests (T7 and T12)

The parallel port tests verify the operation of the digital output relays and the digital input lines (in groups of eight at a time). These tests expect a special cable to be installed which loops the digital outputs back to the digital inputs (first output to first input, etc.). 256 bit patterns are written to the output lines and verified on the input lines. The test allows the flexibility to write to either of the two output ports (main board= DIGITAL OUT 1-8, expansion board= DIGITAL OUT 9-16) and to loop the results to either of the two input ports (main board= DIGITAL IN 1-8, expansion board= DIGITAL IN 9-16). In addition, the test allows the operator the option of specifying the delay (in milliseconds) between the time that the output pattern is written and the time the input pattern is read (to allow for mechanical relay bounce) and the ability to mask off one or more relays to prevent them from being tested. The format of the command to test the main board outputs and inputs is:

```
DDT> T7,1<CR>
PIO TEST, OUTPUT= MAIN, INPUT= MAIN
TEST PASSED.
DDT>
```

To test the expansion board outputs and the expansion board inputs:

```
DDT> T7,2<CR>
PIO TEST, OUTPUT= EXP, INPUT= EXP
TEST PASSED.
DDT>
```



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To test the main board outputs and the expansion board inputs:

```
DDT> T7,3<CR>
PIO TEST, OUTPUT= MAIN, INPUT= EXP
TEST PASSED.
DDT>
```

To test the expansion board outputs and the main board inputs:

```
DDT> T7,4<CR>
PIO TEST, OUTPUT= EXP, INPUT= MAIN
TEST PASSED.
DDT>
```

The parallel port command may be used to exercise (rather than test) the outputs. In this mode, the outputs are cycled as in the test commands but the inputs are not read. The exercise continues until an <ESC> is typed.

To exercise the main board outputs:

```
DDT> T7,5<CR>
PIO TEST, EXERCISING MAIN OUTPUTS
TEST PASSED.
DDT>
```

To exercise the expansion board outputs:

```
DDT> T7,6<CR>
PIO TEST, EXERCISING EXP OUTPUTS
TEST PASSED.
DDT>
```



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An optional delay time between the writing of the test pattern and the reading of the inputs can be appended to the end of any of the above commands (the default delay time is 16. milliseconds). The delay is in milliseconds and is a HEX number between 01 and FF (255). For example, to test the main board outputs and the main board inputs allowing a delay of 100. milliseconds (64 HEX) between the write and the read:

```
DDT> T7,1,64<CR>
PIO TEST, OUTPUT= MAIN, INPUT= MAIN
TEST PASSED.
DDT>
```

An optional bit mask can be added to any of the test commands by preceding the port number with a HEX mask that specifies the output relays that are NOT to be tested (the user must type four digits for the second parameter of the command: T7,mmpp). For example, to test only relays 9 and 10 (bits 0 and 1 on the expansion board output port):

```
DDT> T7,FC02<CR>
PIO TEST, OUTPUT= EXP, INPUT= EXP
TEST PASSED.
DDT>
```

A delay time may also be appended to the end of this form of the command.

Any of the forms of the parallel port test can be made to repeat by substituting a "T12" for the "T7" in the command line.



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## 3.8 Keyboard Test (T8)

The keyboard test supports both the full 54-key ASCII "QWERTY" membrane keyboard and the 20-key keypad. The test can be used in two modes; the first echoes any keystroke to the operator terminal, and the second prompts the operator to press a particular key and verifies the result. To echo the keystrokes from the 54-key keyboard:

```
DDT> T8,1<CR>

ENTERING KEYBOARD TEST --
<F6>
<LEFT>
Q
A
Z
```

To exit this mode, type any key on the operator terminal. To echo keystrokes from the 20-key keypad:

```
DDT> T8,3<CR>

ENTERING KEYBOARD TEST --
<INS>
0
5
<MIN>
```

To invoke the key sequence test for the 54-key keyboard:

```
DDT> T8,2<CR>

ENTERING KEYBOARD TEST --
REQUESTED KEY: <F1>    KEY PRESSED: <F1>
REQUESTED KEY: <F2>    KEY PRESSED: <F2>
REQUESTED KEY: <F3>    KEY PRESSED: <F3>
REQUESTED KEY: <F4>    KEY PRESSED: <F4>
.
.
.
```



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To invoke the key sequence test for the 20-key keypad:

```
DDT> T8,4<CR>

ENTERING KEYBOARD TEST --
REQUESTED KEY: <INS>   KEY PRESSED: <INS>
REQUESTED KEY: <MENU>  KEY PRESSED: <MENU>
REQUESTED KEY: 7       KEY PRESSED: 7
REQUESTED KEY: 8       KEY PRESSED: 8
.
.
.
```



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## 3.7 LCD Display Test (T9)

The LCD display test supports both the 8 line by 40 character display (on the 54-key membrane keyboard front panel) and the 4 line by 20 character display (on the front panel with the 20-key keypad). To test the 8x40 display:

```
DDT> T9,1<CR>

SCREEN SHOULD BE CLEAR...
<ESC> TO EXIT, <CR> TO CONTINUE.<CR>

SCREEN SHOULD BE FILLED...
<ESC> TO EXIT, <CR> TO CONTINUE.<CR>

SCREEN SHOULD DISPLAY ALL CHARACTERS...
<ESC> TO EXIT, <CR> TO CONTINUE.<CR>

SCREEN SHOULD SCROLL ALL CHARACTERS...
<ESC> TO EXIT.<ESC>

DDT>
```

When the display is "CLEAR", all pixels should be off. When the display is "FILLED", all pixels should be on. To test the 4x20 display:

```
DDT> T9,2<CR>

SCREEN SHOULD BE CLEAR...
<ESC> TO EXIT, <CR> TO CONTINUE.<CR>

SCREEN SHOULD BE FILLED...
<ESC> TO EXIT, <CR> TO CONTINUE.<CR>

SCREEN SHOULD DISPLAY ALL CHARACTERS...
<ESC> TO EXIT, <CR> TO CONTINUE.<CR>

SCREEN SHOULD SCROLL ALL CHARACTERS...
<ESC> TO EXIT.<ESC>

DDT>
```



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## 3.8 On-board Modem Test (0)

The test of the on-board modem allows the user to issue commands and receive responses from the modem chip in Hayes compatible format. The modem may be set for 300 baud or 1200 baud operation (independent of the operator terminal baud rate). For 1200 baud operation:

```
DDT> 0<CR>
ATZ
OK
ATS0=1
OK
ATDT9,615/688-7900<CR>
CONNECT
+++
OK
ATH
OK
<ESC>

DDT>
```

The test software automatically sends the "ATZ" and "ATS0=1" when the test is first invoked. An <ESC> terminates the test. For 300 baud operation:

```
DDT> 01<CR>
ATZ
OK
ATS0=1
OK
ATDT9,615/688-7900<CR>
CONNECT
+++
OK
ATH
OK
<ESC>

DDT>
```



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## 4.1 View/Change Memory Command (M)

The "M" command allows the operator to view and/or change the contents of any memory location. To start the command, type "M" followed by the HEX address to be examined (up to 4 digits):

```
DDT> M3A1F<CR>
3A1F 63 _
```

The memory address followed by its data will be printed. As shown below, typing a <CR> will display the next memory location, a HEX value followed by a <CR> will write the value to the memory location, an up-arrow (^) will display the previous location, and a period (.) will terminate the command and return to the DDT> prompt.

```
DDT> M3A1F<CR>
3A1F 63 <CR>
3A20 1B <CR>
3A21 43 77<CR>
3A22 C9 ^
3A21 77 <CR>
3A22 C9 .

DDT>
```



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## 4.2 Read/Write I/O Port Command (P)

The I/O port command has the same format and uses the same characters to move to the next and previous port as the "M" command described above. An example:

```
DDT> P38<CR>
38 28 <CR>        (Port 38= CBR, Common Base Register)
39 5B <CR>        (Port 39= BBR, Bank Base Register)
3A F8 .           (Port 3A= CBAR, Common/Bank Area Register)

DDT>
```

The three ports listed are the three ports in the 64180's Memory Management Unit.

## 4.3 Version Command (X)

This command prints the current version of DDT88:

```
DDT> X<CR>

DDT88 - V1.06, APRIL 21, 1989

DDT>
```



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APPENDIX B

# YSI TEMPERATURE PROBES

# AND

# THEIR CONNECTION TO THE 8800

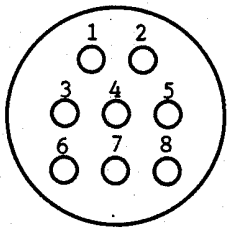
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## YSI Temperature Probes

As mentioned in section 4.4.5 of this manual, 2 standard YSI Temperature Probes can be directly connected to the 8800 through a special connector on the back panel. If you have this option you should find this special connector right above the RS-232 port on the back panel of the data logger. If you do not have this option but wish to have it installed, call ESC for a price quotation.

The YSI temperature probe's thermolinear element part number is YSI #44018 (one can choose different probe styles with the same thermolinear element). This thermolinear element consists of 2 thermistors. One measures 6K @ 25°C and the other measures 30K @ 25°C. The supporting circuitry in the data logger was designed for use with the thermolinear element described above, therefore, it or its equivalent must be used.

Below is a diagram describing how the temperature probes are wired to the 8 pin AMP connector.




AMP 205838-1

| | Pin | Connection | Description |
|---|---|---|---|
| Temp. Probe #1 | 1 | Common | Element Common |
| | 2 | T1 | 6K Thermistor Lead |
| | 3 | T2 | 30K Thermistor Lead |
| Temp. Probe #2 | 4 | Common | Element Common |
| | 5 | T1 | 6K Thermistor Lead |
| | 6 | T2 | 30K Thermistor Lead |
| | 7 | NC | No Connection |
| | 8 | NC | No Connection |

## Increased Accuracy Procedure

The guaranteed accuracy for the YSI temperature probe described in the

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# USER'S MANUAL
# ESC 8800 DATA LOGGER

# OEPA 8800 SOFTWARE
# VERSION 2.0

TIN 91-1129.1
September 1991

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TIN 91-1129
Revision 1

# ESC 8800 DATA LOGGER USER'S MANUAL

## OEPA 8800 Software Version 2.0

Prepared By:

Environmental Systems Corporation
200 Tech Center Drive
Knoxville, TN 37912

February, 1995

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