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User's Guide and Reference Manual

ESC Model 8816 Data System Controller/Data Logger

For CEM and Ambient Data Acquisition Systems

Software Version 5.40

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Chapter 1
Overview

The ESC Model 8816 Data Logger is a microprocessor-based data acquisition system designed to acquire, process, store, report, and telemeter data in a multi-tasking environment. The ESC Model 8816 is designed around an expansion bus that gives the user great flexibility in configuring the unit with almost any combination of input and output types.

The base unit consists of:

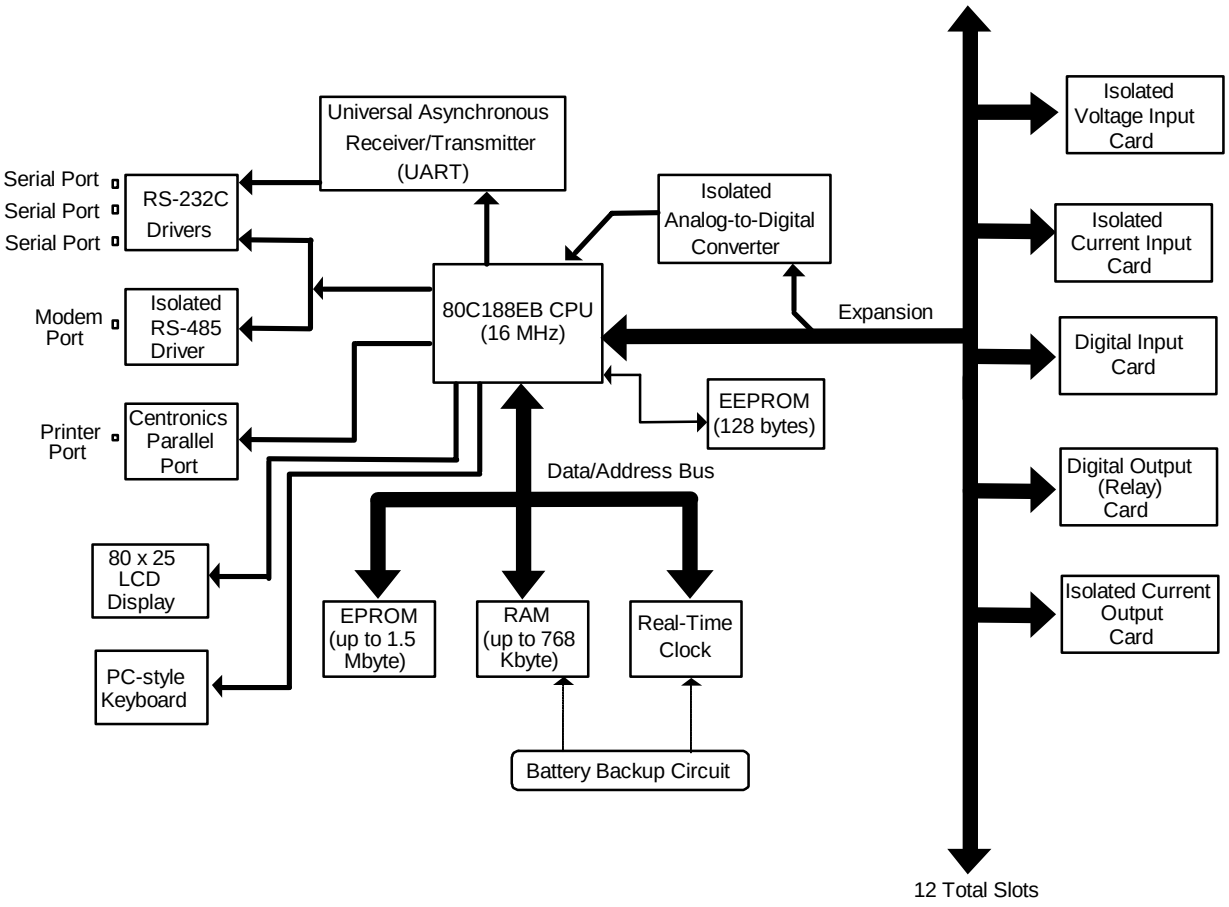
- a motherboard with an 80C188EB CPU running at 16 MHz
- up to 1.5MB of program ROM
- up to 768K of data and configuration RAM
- a real-time clock
- power fail detect circuitry
- battery backup for the RAM and real-time clock
- up to four serial ports (including an option for an isolated RS-485 port)
- an optional parallel port
- an optional full-size LCD display (80 characters x 25 lines) with special function keypad
- an optional full-size personal computer (PC)-style keyboard.

See page 1-2 “ESC Model 8816 Block Diagram.”

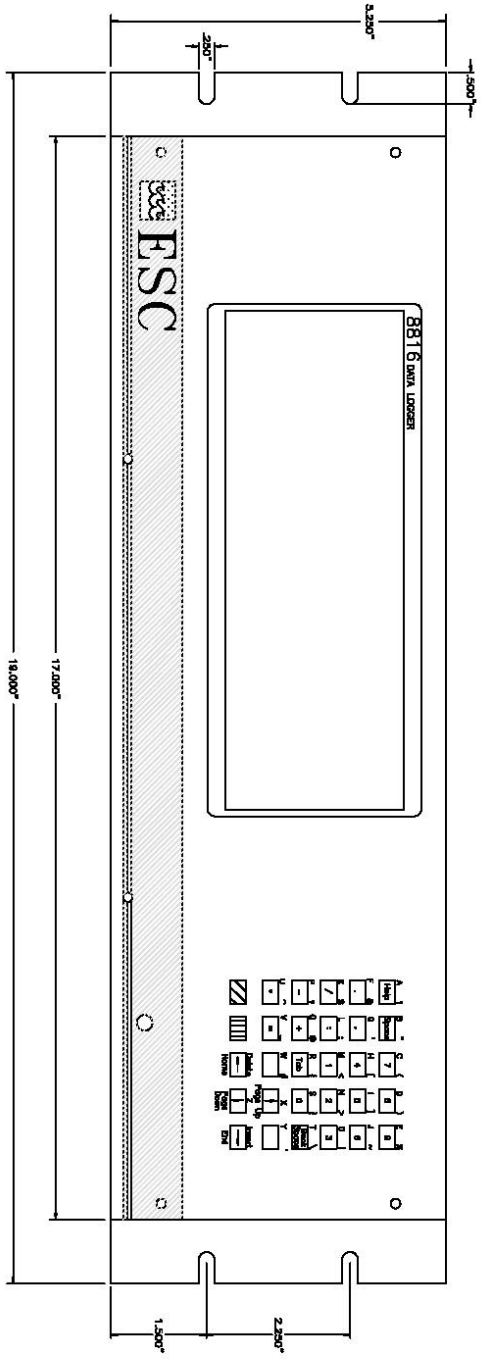
1.1 Features

- User-friendly menu-driven interface with “plain English” prompts.
- Data entry supports arrow and backspace keys and insert and overstrike modes.
- Supports several channel types, including math pack, stream-switching, time-on-line counters, rolling averages, and (optionally) meteorological parameters.
- Simple and complex calibration programs, providing both ease of use and flexibility.
- Full-screen real-time displays of data values.
- Graphical display of data, both real-time and historical (LCD only).
- Flexible alarming system, no limit on number of alarms per channel.
- Six-level password protection with user-configured passwords.
- Data storage configurable for each channel and averaging interval, to allow optimum use of available data storage RAM; also permits “snapshot” storage of one-second readings.
- All configuration may be set via software (no DIP switch configurations required).
- Up to 50 parameters per logger can be monitored.

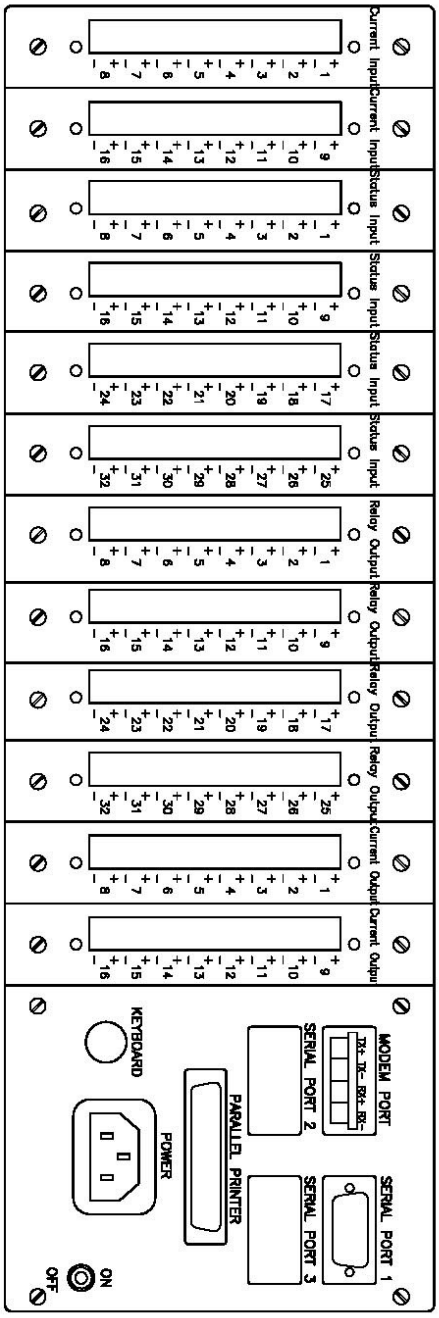
1.2 ESC Model 8816 Block Diagram



1.3 Front View



1.4 Rear View


Current Input
Current Input
Status Input
Status Input
Status Input
Status Input
Relay Output
Relay Output
Relay Output
Relay Output
Current Output
Current Output
KEYBOARD
POWER
PARALLEL PRINTER
SERIAL PORT 2
SERIAL PORT 3
MODEM PORT
SERIAL PORT 1
ON
OFF

1.5 ESC Model 8816 Specifications

Components	Specifications
Dimensions:	17.00w x 5.25h x 14.00d inches (43.2 x 13.4 x 35.6 cm)
Weight:	Less than 15 pounds (6.8 kg)
Mounting:	19-inch rack
Power:	120/220 VAC, 60/50 Hz, less than 30 Watts
Battery Backup:	50 mA-hour rechargeable lithium (30 days minimum)
Operating Temperature Range:	0° C to 40° C
Humidity:	0 to 95% (noncondensing)
Current Inputs:	Isolated, differential 4-20 mA current loops
Resolution:	14-bit
Front-To-Back Accuracy:	± 0.1% full scale at room temperature; ±0.15% full scale over full temperature range
Input Impedance:	~170 ohms
Scan Rate:	32 channels per second
Voltage Inputs:	Isolated, differential with programmable gain amplifier
Resolution:	14-bit
Front-To-Back Accuracy:	± 0.05% full scale at room temperature; ±0.1% full scale over full temperature range
Voltage Ranges:	± 100 mV, ±1 V, ± 5 V, ±10 V full scale
Input Impedance:	> 10 Megaohms
Scan Rate:	32 channels per second
Digital Status Inputs:	Detects contact (relay) closures or voltage-to-ground transitions (to 24 V); optional software debounce available
Isolated Status Inputs:	Detects open-to-voltage transitions (24 V to 120 V, AC or DC); optional software debounce available
Relay Outputs:	Latching-coil relays; rated load: 5 A @ 250 VAC, 5 A @ 30 VDC
Analog Current Outputs:	Isolated 4-20 mA current loops
Resolution:	12-bit
Accuracy:	± 0.5% over operating temperature range
CPU:	80C188EB, 16 MHz
ROM:	Up to 1536K
RAM:	Up to 768K, plus 2 MB optional expansion card
Serial I/O Ports:	One isolated RS-232C or RS-485 port and up to three RS-232C ports
Baud Rates:	300 baud to 19200 baud, software selectable
Data Format:	8-bit word, 1 stop bit, no parity, full-duplex
Parallel Printer Ports:	Centronics port, DB-25 connector (optional)

1.6 Typographic Conventions Used in This Manual

The following table describes the conventions that you will see when reading this manual, and the reason for its use.

Typographic Convention	Explanation
	Whenever you see this graphic of a pointing finger, it indicates an important or critical warning. Pay careful attention to these warnings.
NOTE:	An indented message beginning with the word "note" denote messages that may not tie in with the instructions or explanations, but are important enough for the user to notice.
<Enter> or <Ctrl><N>	The <> signs specify keys on the keyboard. If the key strokes are simultaneous, the keys will be together without a space (e.g., <Ctrl><N>).
hot key (**S)**	A hot key is a letter or number on the keyboard of which you can press to maneuver from menu to menu instead of using the up or down arrows on the keyboard to select a menu item. The hot keys will be provided in parentheses (**S)**.
Home Menu	All menu names will appear in Italics.
Instrument Name: The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).	All field names are spelled exactly as they are in the screens. Field names appear in this manuals as Arial Italic. The field description will be on the next line.

Chapter 2
Description and Installation

The ESC Model 8816 input/output (I/O) cards must be installed in a specific order or the logger may not work properly. They **cannot** be randomly installed. The table below shows the proper order of installing the I/O cards on the main board; refer also to the diagram on page 1-4.

Order	Card Type
1	Current In card (data channels)
2	Voltage In card (data channels)
3	Status In card (digital inputs)
4	Relay Out card (digital outputs)
5	Current Out card (DACs)
6	MET cards

Step 1. The card order assumes a view from the rear of the data logger. Install the cards from lowest "order" cards on the left to highest "order" cards on the right. If a specific type of card is not present, put the next "order" card into that slot.

Step 2. Insert the I/O card into the vacant slot, and press the card down on the riser that is on the main board. The I/O card is correctly in place if the holes match up to the screws.

Be careful to not bend the pins on the card during installation.

Each of the I/O card types contains removable screw-down connectors for easy access when making the wire terminations. The I/O card connectors accept 12-20 gauge solid or stranded wire stripped to 7.5 mm, but 20 gauge stranded wire with solder-tinned ends is recommended. The recommended torque for the connectors is 0.5 N-m (4.5 lbf-in.).

Step 3. After removing or adding I/O cards, you must modify the data logger configuration for the number and type of cards installed. At the System Configuration screen (hot keys C-S from the *Home Menu*), press <Ctrl><U>. Please see page 4-7 "Configuring EEPROM Parameters" for instructions.

Only those with Integrator access will be allowed to modify the EEPROM settings to the correct values.

The logger must be cold-started after changing the data logger configuration screens. Any changes will not take effect until after the logger has been cold-started. See page 16-2 "Cold Start" for details.

2.1 Analog Input Cards

Each analog input card has connections for eight differential voltage inputs or 4-20 mA current-loop inputs (user must provide power for the loop). The software supports four voltage ranges for each channel (independent by channel) for voltage input cards. The ranges are: ±100 mV, ±1 V, ±5 V, and ±10 V full scale. These inputs are scanned at a rate of 32 channels per second.

The analog-to-digital converter then translates the voltage/current reading to digital data for manipulation and storage. The analog-to-digital converter has a resolution of greater than one part in 16,000 (14-bit). A full scale front-to-back accuracy at room temperature is guaranteed at 0.05 percent for the Voltage Input Card and at 0.1 percent for the Current Input Card. A full scale front-to-back accuracy over the full temperature range is guaranteed at 0.1 percent for the Voltage Input Card and at 0.15 percent for the Current Input Card.

To install a voltage input, connect the ground terminal of the signal line to the minus (-) terminal of the numbered input, and connect the signal terminal of the signal line to the plus (+) terminal on the input card.

To install a current loop input, connect the "current in" of the signal line to the plus (+) terminal on the input card, and connect the "current out" terminal of the signal line to the minus (-) terminal.

2.2 Analog Output Cards

The analog output cards provide an individually isolated 4-20 mA signal output and have 12-bit resolution. An accuracy of 0.5 percent is guaranteed over the full temperature range. The ESC Model 8816 provides power for the loop.

The analog output cards are typically used to output the results of a calculation performed by the ESC Model 8816's software such as pollutant emission rates. These outputs can be used to drive strip-chart devices or to provide information to a local distributed control system.

Step 1. To install an analog output, connect the plus (+) and minus (-) terminals of the output to the plus (+) and minus (-) terminals of the required device. The initial output current will be zero mA.

Step 2. Configure the digital-to-analog converter (DAC) in the software to provide a specific output (see Configure Analog Outputs in the *Configuration Menu*).

2.3 Digital Input Cards

2.3.1 *Contact Closure Inputs*

Digital input lines are used to monitor the status of events external to the logger, such as instrument-initiated calibrations, alarms, instrument failure, or the status of a stream-switched system. Each digital input card can read up to eight inputs, which must be either dry contact closures (relays), or DC voltage-to-ground transitions, less than 24 VDC.

The minus (-) terminal must be at the ESC Model 8816's AC ground potential. Current of more than 50 mA flowing into this terminal may cause permanent damage to the ESC Model 8816.

2.3.2 *Isolated Status Inputs*

These inputs have the same functionality as contact closure inputs, but they accept 24 VAC to 120 VAC inputs (also DC).

Step 1. To install a voltage-transition digital input, connect the voltage-transition line to the plus (+) terminal of the digital input.

Step 2. Connect the ground reference line to the minus (-) terminal of the input card.

2.4 Digital Output Cards

Digital outputs allow the ESC Model 8816 to control external events such as calibrations, switching of alarm lights/klaxons, and notifying a distributed control system of an alarm or other event. Each digital output card contains eight relay outputs. Each relay is a latching-coil relay capable of switching up to 5A at 250 VAC or 5A at 30 VDC. The latching-coil feature allows all relays to be on at the same time without putting extra load on the data logger's power supply. It also allows the relay to maintain its on/off status during a power failure.

To install a relay output, connect the two terminals of the plus (+) and minus (-) terminals in any order to the desired load.

If you need a switched voltage, you must supply the voltage via an external power source to one side of the relay.

2.4.1 *Pseudo Digital Input/Output Lines*

The ESC Model 8816 logically considers itself to have more digital inputs (DIs) and digital outputs (DOs) than it physically possesses. The number of these pseudo points is equal to the difference between the greater of the number of physical digital inputs and digital outputs and the maximum number of digital points allowed by the software (eighty-eight). The ESC Model 8816 software considers these additional lines to be jumpered to each other or looped back in the software

For example, if a logger has 24 DIs and 24 DOs, you can actually view and refer to digital inputs and digital outputs 01 through 88 (24 actual lines + 64 pseudo lines). Digital output #25 is considered to be connected to DI#25, DO#26 to DI#26, and so on.

If the number of DI and DO cards in the ESC Model 8816 are not equal, the linked line numbers are skewed. If a logger has 32 DIs but only 24 DOs, the user can actually view 56 (88 max–32 DI's) pseudo lines. The pseudo digital inputs are DI#33-DI#88, and the pseudo digital outputs are DO#25-DO#80. DO#25 is linked to DI#33, DO#26 to DI#34, and so on.

2.5 Meteorological Input Cards

These cards contain signal-conditioning hardware to allow the ESC Model 8816 to accept inputs from most AC-generator or pulse output wind speed (WS) sensors, resistor-pot-type wind direction (WD) sensors, tipping bucket rain gauges, and YSI thermilinear element temperature probes.

To install an AC-generator or pulse-output wind sensor, connect the WS+ and WS- terminals to the wind speed sensor.

To install a resistive wind direction sensor, connect the two ends of the resistive element to the WD+ and WD- terminals and connect the wiper to the WD<- terminal.

To install a tipping bucket rain gauge, connect the tipping contact output to the RFL (rainfall) terminal and the ground contact to the RFL ground terminal.

To install a YSI temperature probe, contact ESC.

2.6 Serial Ports

The ESC Model 8816 is provided with one to four serial ports for interface and printer output. The RS-232 serial ports are Data Terminal Equipment (DTE) devices. Data is transmitted out on pins 2 and received on pins 3 at the DB-9 connectors. The connectors are standard RS-232 serial ports with DB-9 (male) connectors, just as you would find on a PC. The serial port 0, however, may be configured as an isolated RS-485 port. Please review your System Configuration Sheet to determine how each port is set up (hardware and software interface). This sheet also lists default baud rates for each port.

To connect a modem to an RS-232 port, use a DB-9 to DB-25 modem cable provided by ESC or purchased from a local computer store.

To connect a terminal or PC directly to an RS-232 port, use a DB-9 to DB-9 null modem cable provided by ESC or purchased from a local computer store. Be sure to specify "null modem" when interfacing to a terminal or PC directly.

To connect the RS-485 port, use the custom connector or converter box provided by ESC. The terminals are (in order from left to right): TX (transmit) +, TX -, RX (receive) +, and RX -. These terminals should be connected to the rest of the RS-485 network with the correct polarity (+ to +, - to -), but swapping the role of RX and TX. That is, connect the ESC Model 8816's TX+ to the network's RX+, TX- to RX-, and so on. Refer to the diagrams on pages 2-6 and 2-7 for help.

A terminal or PC running terminal emulation software must use a VT100-compatible emulation mode.

2.7 Parallel Port

Parallel Ports allow data, alarm, and other reports to be routed to a standard Centronics printer. The connector is a standard DB-25 female, as you would find on a PC.

Do NOT connect a serial device to this port!

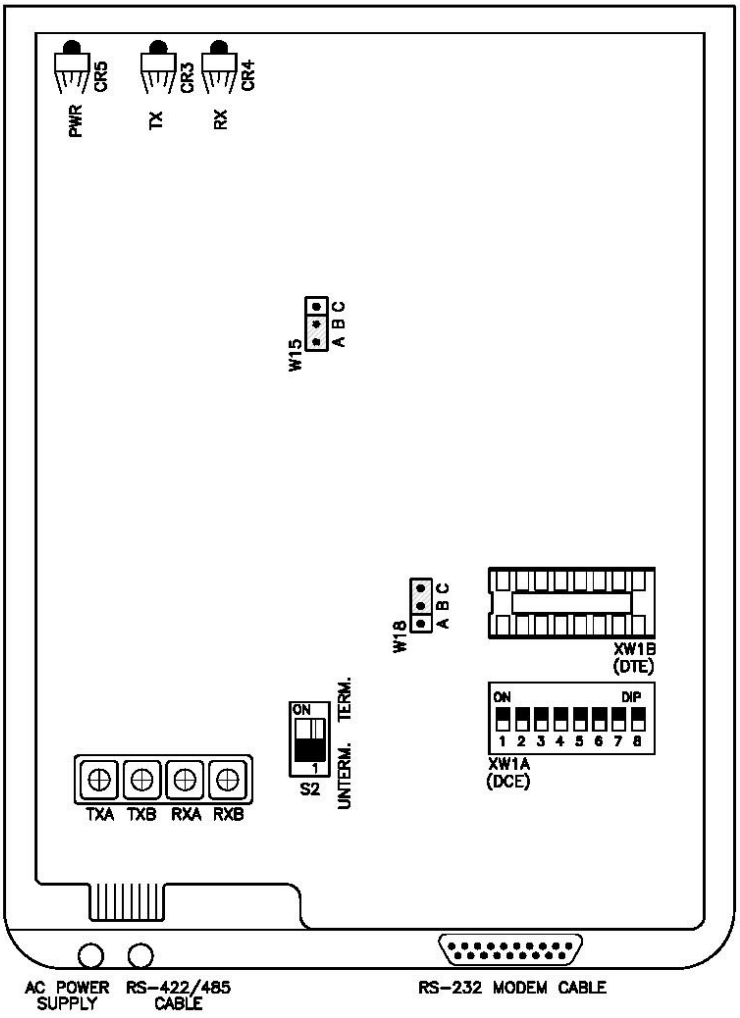
This port should be connected to a Centronics printer via a DB-25 male to Centronics connector cable provided by ESC or available from a local computer store.

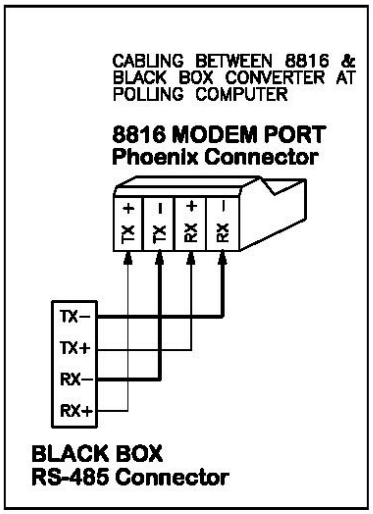
2.8 Keyboard

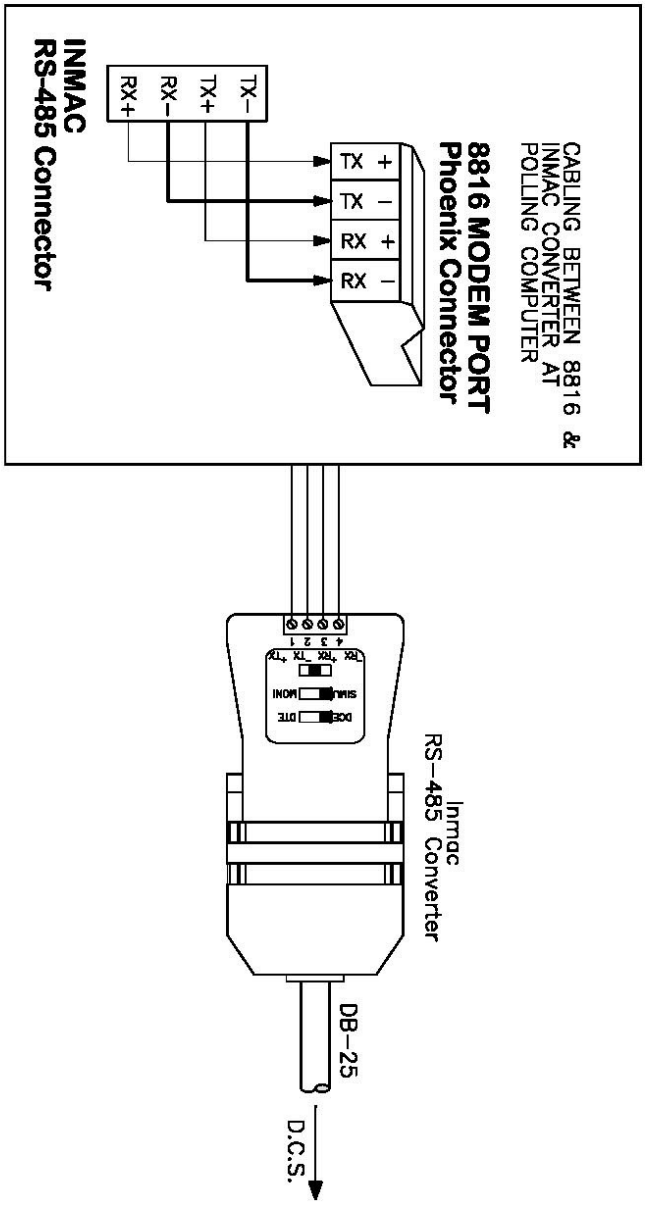
The ESC Model 8816 may contain, as an option, a full-size PC-style keyboard. This feature is used in conjunction with the front-panel LCD display to provide a user-friendly local interface. The software will support the arrow keys, function keys, and many of the other special function keys available (insert, page up, page down).

To install the keyboard, connect the DIN-5 connector from the keyboard to the provided connector on the back of the ESC Model 8816 (near the AC power receptacle). Another connector is available on the front panel under the keypad.

BLACK BOX
232 ◄⟶► 422/485 Converter
Data Only






CABLING BETWEEN 8816 & INMAC CONVERTER AT POLLING COMPUTER
8816 MODEM PORT
Phoenix Connector
TX +
TX –
RX +
RX –
INMAC
RS-485 Connector
TX–
TX+
RX–
RX+
Inmac
RS–485 Converter
DB–25
D.C.S.

2.9 Software Installation Instructions

Equipment Needed:

- ESC Model 8816 Firmware consisting of two (2) EPROM's per logger
- Chip extraction tool or small, flat blade screw driver
- 74ACTQ245 IC (when upgrading from Version 3.xx to 4.03 and above) per logger
- 8-pin EEPROM (If backward path to Version 3.xx is needed) per logger

Step 1. Stop polling of the data logger being upgraded, as well as polling of any other loggers that share the same DAS computer COM port.

Step 2. Make a note of the Logger ID in the upper left hand corner of the logger's LCD display. If the Logger ID is stored in EEPROM, the ID will be restored after installation. Otherwise, the Logger ID must be entered.

Step 3. Turn off AC Power to data logger.

Step 4. Remove the top panel from the data logger. There is one flat blade screw in each corner.

Step 5. If upgrading from firmware version 3.xx to version 5.01+ and the capability to revert back to version 3.xx is desired, follow the sub-steps below, otherwise skip to step 6.

a. Refer to page 2-10 to locate IC U35 noting the proper orientation and position of the notch on the IC. Remove this IC, label it 3.xx if you wish, and store it in a static safe place. This is the EEPROM in which information about the hardware and software options are stored.

b. Replace this IC (U35) with the small 8-pin IC supplied with your upgrade, noting the proper orientation and position of the notch on the IC.

c. Restore AC power to the logger.

d. From the *Home Menu*, login with the integrator access password. Contact ESC if this password is not known.

e. From the *Home Menu*, select *Configuration Menu* (hot key **C**).

f. From the *Configuration Menu*, select *Configure System Parameters* (hot key **S**).

g. Type <Ctrl><R> to edit the RAM copy of the EEPROM.

h. Type <Tab> then <Enter> three (3) times until the EEPROM configuration editor has been exited with the results saved to EEPROM.

i. Turn off AC power to the data logger.

Step 6. Remove the AC power cord from the rear of the logger.

Step 7. Locate IC's U25 and U26 in the corner of the main board. These IC's should be labeled with the firmware name and version number. Refer to page 2-10 if necessary to locate these IC's.

Step 8. Noting the proper orientation and position of the notches on the IC's, remove them from the sockets.

Step 9. Install the supplied upgrade EPROM #0 into the socket for U25 and EPROM #1 into the socket for U26, paying special attention to the proper orientation of the IC's. Once this is done make sure no pins are bent on U25 or U26.

Step 10. Locate IC U32 towards the middle of the board. Refer to page 2-10 if necessary. If this IC is labeled as 74ACTQ245, then this step can be skipped. Logger firmware Version 4.03 and above requires this IC. When replacing a version of firmware earlier than this, the following steps will need to be performed:

a. Locate U32 toward the middle of the main board. Refer to page 2-10 if necessary. Noting the proper orientation and position of the notch on the IC, remove the IC.

b. Replace the 74**H**CT245 (U32) with the supplied 74**A**CTQ245 (20-pin thin IC). U32 must be a 74ACTQ245 if the version of firmware being installed is V4.03 or later.

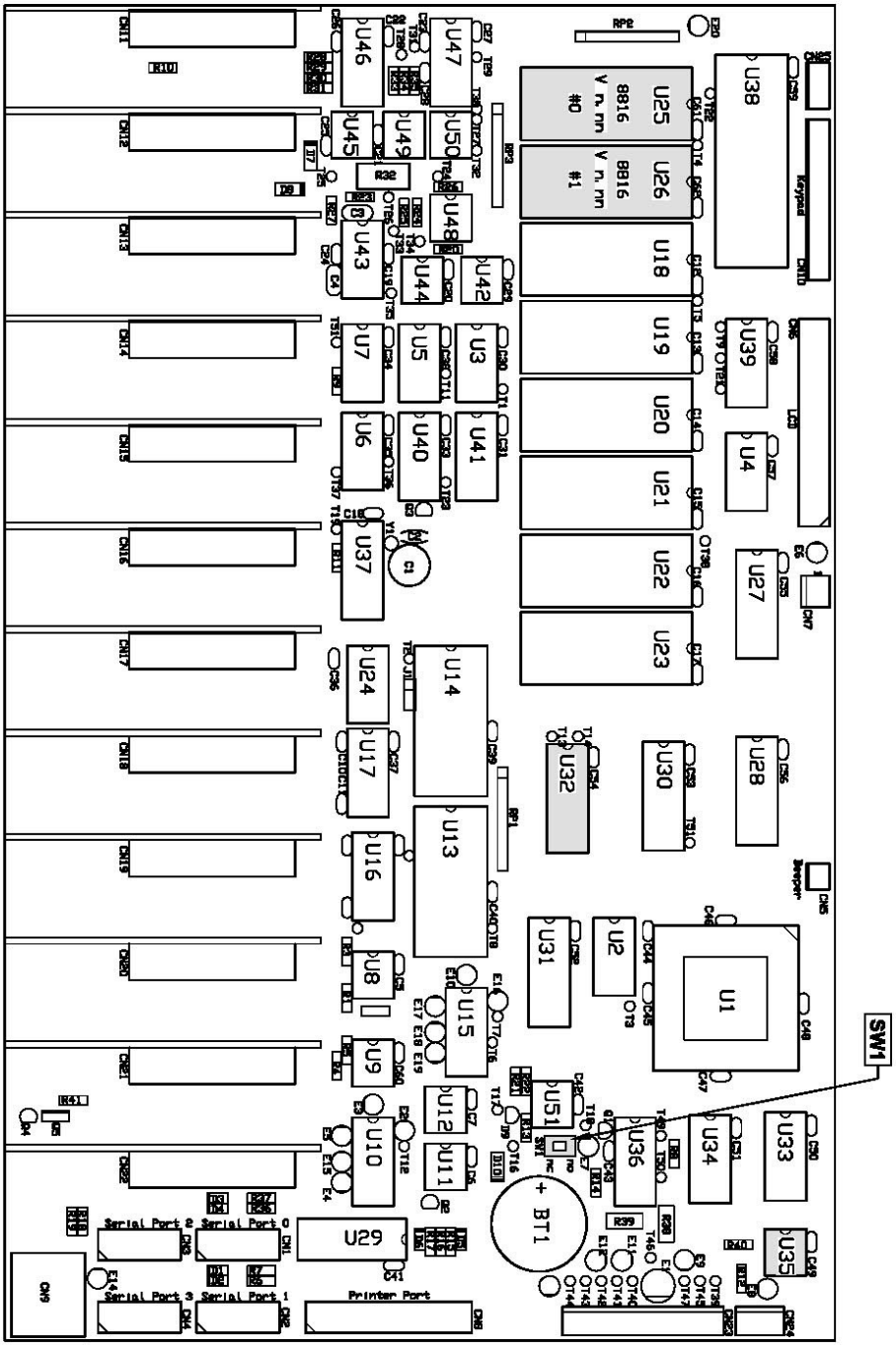
Step 11. Locate SW1 on the right side of the main board. (SW1 is next to battery BT1).

Step 12. With the AC power still off, push and hold down SW1 for one minute.

Step 13. Replace the top panel on the logger.

Step 14. Reinstall the AC power cord to the rear of the logger.

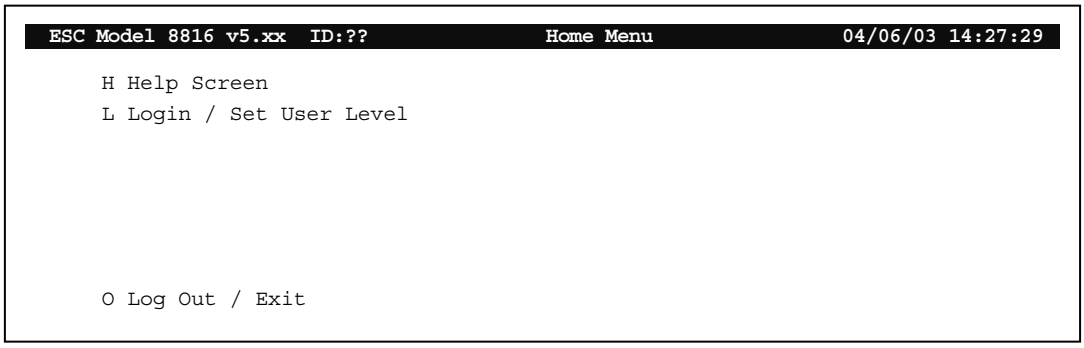
Step 15. Turn on AC power to the logger.


SW1
BT1
Printer Port
Serial Port 0
Serial Port 1
Serial Port 2
Serial Port 3
Keypad
Display

Chapter 3
Startup and Operation

The ESC Model 8816 is started at installation and should stay on thereafter. However, if for some reason it is turned off, flip the toggle switch on the far left side of the back panel to turn on the ESC Model 8816. Following the power-on sequence, the *Home Menu* should appear on the front-panel LCD (or on the attached VT-100 terminal/terminal program):

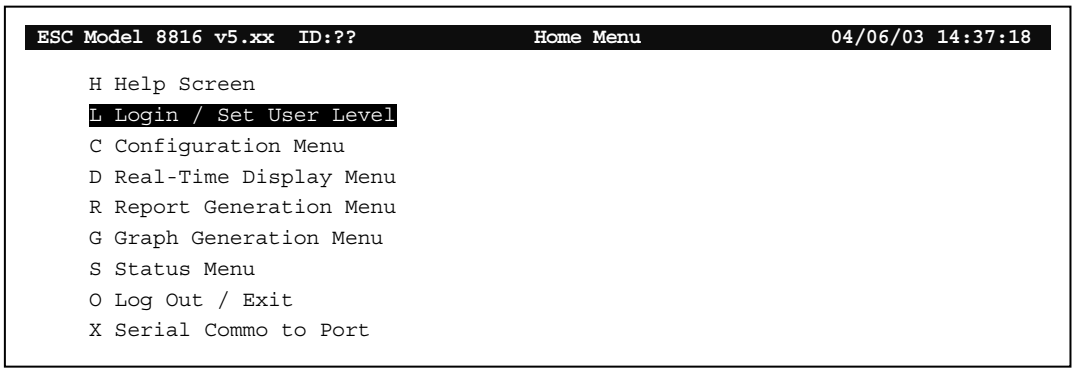
Press <F12> to return to this menu from any point in the menu tree (except from real-time displays, configuration menus, etc.) and only while using the keyboard interface.



The first step in using the ESC Model 8816 for actual data collection is to login at the *Home Menu*. Once a basic understanding of how to use the menu system and how to enter information is grasped, the ESC Model 8816 is ready to use for data collection and other functions.

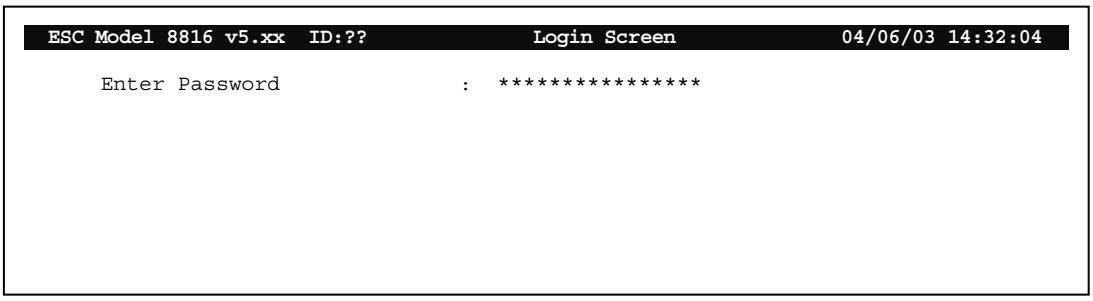
3.1 Logging in to the ESC Model 8816

By entering a login password, you select the user level. Users login under one of six privilege levels. The access level determines which menus or menu selections of the ESC Model 8816 will be accessible. For more information, see page 4-2 “Configuring Passwords.”



Step 1. From the *Home Menu*, use the arrow key to select *Login / Set User Level* (hot key **L**). Press <Enter>.

Step 2. To login, type a password in the *Enter Password* field**.** Press <Enter> to continue or <Esc> to exit. Asterisks (****) will hide the password as it is typed. If the wrong character(s) are typed while entering the password, the backspace key can be used to delete the character(s) and to allow re-entry of the correct character(s). See page 3-6 "Entering Data in Fields" for details.



Step 3. If the password is valid, the *Home Menu* will be displayed when <Enter> is pressed. Otherwise, a message will be displayed at the bottom of the screen indicating that access has been denied.

NOTE: After startup, normal logout, or when the logout time has expired, the user must login before any other features (except the *Help Menu*) can be accessed.

3.2 Log Out/Exit

You can log out to restrict access to the ESC Model 8816. After a user has logged in, the access level may be reset by logging out.

To log out, use the arrow keys to select *Log Out / Exit* (hot key **O**) in the *Home Menu.*

A message will display at the bottom of the screen confirming that the action has taken place (the display remains at the *Home Menu*).

An automatic logout will occur when the ESC Model 8816 has remained idle for a predetermined amount of time. This time is set in the *System Configuration Screen* and can be edited after logging in at the proper level. Please see page 4-4 "Configuring System Parameters" for more information.

3.3 ESC Model 8816 Menu Interface

The ESC Model 8816 uses a menu-driven interface to simplify access to the data logger's powerful and sometimes complex features. The software has been designed for ease of use by operators.

Upon entry to any menu the first selection is highlighted (i.e., displayed in reverse video). The highlighted selection is referred to as the "active selection." Press the <Enter> key to cause the active selection to be invoked. This may result in going to the highlighted submenu to make another selection, displaying a choose list, or performing an action such as configuring a channel or calibration or displaying a graph or real-time data. The active selection can be changed by using the up and down arrow keys to highlight the desired menu selection.

3.3.1 *Function Keys and Keyboard Shortcuts*

You can assign the function keys to a desired function. To assign a function key:

Step 1. Display the desired screen.

Step 2. Press <Shift><X>, where <X> is the desired function key.

Screens that are accessed beyond a choose list in the menu tree cannot be selected for programming to a function key. The default function key assignments are shown in the following table and are active after a cold start of the data logger.

Function Key	Action
<F1>	*Help Menu*
<F2>	Refresh screen
<F3>	*Current Calibration Status*: real-time display of active calibration phases (see page 11-6 "Current Calibration Status")
<F4>	*Current Alarm Status*: displays currently active alarms (see page 11-5 "Viewing Current Alarms")
<F5>	*Real-Time Engineering Units*: real-time display of channel readings with engineering units displayed (see page 8-3 "Display Readings with Units or Flags")
<F6	*Real-Time Engineering Flags*: real-time display of channel readings with flags displayed (see page 8-3 "Display Readings with Units or Flags")
<F7>	*Real-Time Digital Inputs*: displays current open or closed status of digital inputs (see page 8-4 "Continuous Avg Report")
<F8>	*Real-Time Digital Outputs*: displays current open or closed status of digital outputs (see page 8-7 "Display Digital Inputs")
<F9>	*Channel Configuration Menu*: allows the user to enter, modify, and delete channel configurations (see page 5-1 "Channel Configuration")
<F10>	*Cal Configuration Menu*: allows the user to enter, modify, and delete calibration configurations (see page 6-1 "Calibration")
<F11>	*Alarm Configuration Menu*: allows the user to enter, modify, and delete alarm configurations (see page 7-1 "Alarms")
<F12>	*Home Menu*: returns to the top-level menu (see page 3-1 "Startup and Operation")

Global	Action
<Esc> or left arrow key	Exits the current screen, returning to the previous screen. Left arrow can also be used if not in an active edit field.
<Tab>, <End> or <Ctrl><I>	Goes to the bottom of a list; this can be a choose list, a configuration screen, or a menu list.
<Home> or <Ctrl><K>	Goes to the top of a list; this can be a choose list, a configuration screen, or a menu list.
Any hot key	Selects the corresponding feature; see page 3-2 "ESC Model 8816 Menu Interface."
<Ctrl><L>	Displays system log if access level is Configuration or higher, works from any screen except real-time displays. <Ctrl><Q>will toggle between the system log display and the previous display.

In menu listings:	Action
Down arrow key	Moves the highlighted selection box downward through a menu list.
Up arrow key	Moves the highlighted selection box upward through a menu list.
Right arrow key	Selects the highlighted menu item, except for field editing.

In choose lists:	Action
Up, down, right, left arrow keys	Moves the selection highlight through the list (right and left arrows go across columns).
<Ctrl><N>	Goes to the next page if the choose list is longer than one screen.
<Ctrl><P>	Goes to the previous page if the choose list is longer than one screen.
Any unique characters	Type any unique characters of a name in the choose list and the selection highlight will move to that name. <Backspace> will erase the last typed character (highlight moves to name matching the remaining characters, if any). <Ctrl><R>erases all typed characters so you can start over.
<Ctrl><R>	Erases all characters typed.

System Configuration Screen	Action
<Ctrl><E>or <Ctrl><U>	View EEPROM configuration if access is Configuration or higher. Edit EEPROM configuration if access is integrator.
<Ctrl><R>	View EEPROM settings in RAM if access is Configuration or higher. Edit EEPROM settings in RAM if access is Integrator.
<Ctrl><F>	Edit Modbus address table if access is Supervisor or higher.

Channel Configuration Screens	Action
<Ctrl><V>	Edit instantaneous or average validation information
<Ctrl><D>	Edit decimal positioner, rounding precision, Modbus scale factor, Modbus/SIO register number, calibration span value, etc.
<Ctrl><C>	Toggles between two-point and three-point scaling in standard channel configurations
<Ctrl><T>	Shows three-point scaling constants in three-point channel configurations

Calibration Configuration Screens	Action
<Ctrl><O>	Edit output normally open/normally closed settings
<Ctrl><R>	Edit number of runs, interval between runs, startup delay, startup minute, and allow offline OOC checks.

3.3.2 *Hot Keys*

All menu selections have single letters beside them. These letters are "hot keys," and may be used to navigate quickly through menus. For example, to get to the *Configuration Menu*, you press the **C** hot key instead of using the arrow keys to highlight the selection and pressing <Enter>.

Hot keys are designed in such a way that popular sequences may be easily remembered as a few keystrokes. For example, to go to the *Cal Configuration Menu*, the sequence of hot keys is **C-C**; the first **C** takes you to the *Configuration Menu*, and the second **C** selects the *Cal Configuration Menu*.

NOTE: Use the <Esc> key to abort any screen, menu, or operation. The <Esc> key can be used to exit out of sub-menus back to main menus all the way to the Home menu.

See the following table for all hot keys that can be used in the *Home Menu*. For all other hot keys, depending on which menu, see the respective sections in this manual.

Hot Key	Function/Menu	Purpose	See Page
H	Help Screen	Information on navigating menus	3-5
L	Login / Set User Level	Allows access to the logger by user login	3-1
C	*Configuration Menu*	Allows system configuration	4-1 − 7-1
D	*Real-Time Display Menu*	Displays real-time data	8-1
R	*Report Generation Menu*	Displays and prints data	9-1
G	*Graph Generation Menu*	Shows real-time bar graph, historical data graph or trending plot (available on LCD display only)	10-1
S	*Status Menu*	Displays system status, including historical logs	11-1
O	Log Out / Exit	Logs out current user	3-2
X	Serial Commo To Port	Links current interface to another port; typically used to contact analyzers with RS-232 options	3-5

3.4 Help Menu

The *Help Menu* displays information on navigation around the menu system. It is accessed from the *Home Menu* by selecting *Help Screen* (hot key **H**).

```
ESC Model 8816 v5.xx  ID:??              Help Menu              04/06/03 14:41:53

Use arrow keys to highlight a menu item.
Press ENTER to activate a highlighted menu item.
Press "Hotkey" (displayed to left of item) to activate any menu item.
Press ESC to exit menus.
Press ESC (or SPACE when indicated) to exit displays.
Press ESC to cancel an edit and restore previous data.
Press TAB (CTRL-I) or END to go to the end of a list or menu.
Press CTRL-K or HOME to go to the beginning of a list or menu.

   F2= Refresh Screen, Press any other key to exit.
```

To exit the *Help Menu* and return to the *Home Menu*, press <Esc> or the spacebar.

3.5 Serial Communication to Port

The *Serial Commo to Port* selection from the *Home Menu* is used to link the operator interface directly to another ESC Model 8816 serial port. In order to set up direct access to analyzers equipped with RS-232 port options via the ESC Model 8816 operator interface, follow these steps:

Step 1. Use the up and down arrows to select *Serial Commo to Port* (hot key **X**). Press <Enter>. A list of configured terminal ports will display.

Step 2. Select of one of the given ports. The screen will clear, and the operator interface will become a terminal to the device connected to the ESC Model 8816 serial port.

The local echo is initially enabled (i.e., all characters typed at the operator interface are echoed back to the user's display). If the connected device (analyzer, etc.) echoes back characters it receives, this may result in double characters displayed on the operator interface terminal. Use <Ctrl><E>to toggle the local echo state between disabled and enabled.

The alternate character entry is initially disabled (i.e., only characters that can be typed on the attached keypad or keyboard can be sent out to the serial port from the data controller). Use <Ctrl><Y>to toggle the alternate entry state between disabled and enabled. When enabled, alternate characters can be entered in the format \xnn (where nn is a valid hexadecimal value, 00-ff) When a "\" character is entered, it, along with the next three characters entered, will not be sent out the serial port. If the format of the four characters is valid, then the represented hexadecimal value is sent out the serial port instead.

To exit terminal mode and return to the menu interface, press <Ctrl><X>.

3.6 Entering Data in Fields

When the menu system is navigated to an information screen, such as a configuration screen, the information is arranged in fields. A field displays information and accepts typed input from users. When highlighted on the screen, it is the active selection; that is, whatever is typed will appear in the highlighted field.

The following table lists the keys you can use when entering data into fields.

Key Command	Action
<Enter>	Accepts the information in the active field and moves the highlighted selection box downward to the next available field. If a change to a field is unnecessary, press <Enter> to highlight the next available field. Once editing of a data entry field has begun, <Esc> can be used at any time to abort the edit. The data value will remain unchanged from its value before editing.
<Esc>	Exits the edit mode in the active field without saving any changes that have been made.
Down arrow key	Moves the cursor down one line within a multi-line field. If a change to a field is unnecessary, the down arrow can be used to highlight the next available field.
Up arrow key	Moves the cursor up one line within a multi-line field.
Right arrow key	Moves the cursor to the right one character within a field.
Left arrow key	Moves the cursor to the left one character within a field.
Backspace key	Deletes the previous character in the active field.
<Ctrl><O>	Toggles between overstrike and insert modes in the active field. Typing in overstrike mode will overwrite any characters that may already be in the field. Insert mode allows typing without deleting any existing characters.

For example, the first data entry field in the *Config. Dig. Event Program* screen is the *Dig. Event Program Name* field. Upon entry to the screen, this field is highlighted. A new program name can be configured by simply typing the new name and pressing <Enter>. The next field is then highlighted and available for information entry.

```
ESC Model 8816 v5.xx  ID:??       Config. Dig. Event Program       04/06/03 14:48:54

    Dig. Event Program Name      :  DEFPROG
    Starting Time                :  08/07/97 00:00:00
    Repeat Interval              :  12m
    Output Line(s)               :  8,
    Output Duration              :  6m
    Disable During Cal(s)        :  (none)



    FINISHED (Configure Now)

  CTRL-O = Config Relay Outputs
```

3.6.1 *Common Field Definitions*

There are several types of common fields that you will use from screen to screen. The most common types and their allowable formats and ranges are explained in the following field descriptions.

Name:

This is a user-configured label consisting of 1 to 8 characters. Names may consist of any numbers, letters, and the following special characters: % * # + - _ / ( ). This could be for alarms, calibrations, etc.

Channel Name:

This field is the same as the Name field above. An optional site name can be joined to the channel name with a colon (:), for a maximum of 17 characters. The site name may be added to organize channels when one ESC Model 8816 is monitoring the same parameter on multiple stacks (e.g., parameter S02 may be monitored at two sites, BLR1 & BLR2, by using the following channel names: SO2:BLR1, SO2:BLR2).

Report Channel Number:

A number used for ordering channels in the real-time displays. It is also used in systems polled by central computers as a "channel number" designation. Report channel numbers may consist of 1 to 2 digits, 1 through 99.

Date/Time:

Dates are designated as MM/DD/YY. Times may be HH:MM or HH:MM:SS. All hourly time of day information should be entered in military format (e.g., 6:45 PM would be designated as 18:45).

Units:

The engineering units to which the input readings will be scaled (AP, #/MBTU, PPM, etc.).Units can be 1 to 8 characters.

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the base average. The two values must be entered separated by a comma. The average interval can be changed without affecting the number of storage blocks allocated

by entering only the new interval value (e.g., 1m). The average storage can be changed without affecting the interval by entering only the new storage value preceded by a comma (e.g., 1h). Base average validation flag limits may be edited by typing <Ctrl><V>while the cursor is in this field; see page 5-49 "Configuring Average Validation Limits."

Interval and storage values are 1 to 3 digits (0 to 999) with a one-letter designation for the time span: s = seconds, m = minutes, h = hours, d = days. For example, one-minute base averages would be configured as **1m**. All average intervals must either evenly divide into 24 hours (e.g., **5m** is acceptable) or be evenly divisible by 24 hours (e.g., 7d is acceptable).

Average #1 Interval, Storage:

The first half of the field specifies the average #1 interval. This interval must be some integer multiple of the base average interval. The second half of the field specifies the length of the long-term data storage buffer for the average #1. The two values must be entered separated by a comma. The average interval can be changed without affecting the number of storage blocks allocated by entering only the new interval value (e.g., 1m). The average storage can be changed without affecting the interval by entering only the new storage value preceded by a comma (e.g., 1h). Average #1 validation flag limits may be edited by typing <Ctrl><V> while the cursor is in this field; see page 5-49 "Configuring Average Validation Limits." Same format and range as Base Avg. Interval, Storage.

Average #2 Interval, Storage:

The first half of the field specifies the average #2 interval. This interval must be some integer multiple of the base average interval. The second half of the field specifies the length of the long-term data storage buffer for the average #2. The two values must be entered separated by a comma. The average interval can be changed without affecting the number of storage blocks allocated by entering only the new interval value (e.g., 1m). The average storage can be changed without affecting the interval by entering only the new storage value preceded by a comma (e.g., 1h). Average #2 validation flag limits may be edited by typing <Ctrl><V> while the cursor is in this field; see page 5-49 "Configuring Average Validation Limits." Same format and range as Base Avg. Interval, Storage.

NOTE: In regards to the three fields above, the storage time displayed will be equal to or greater than the actual storage time entered. The data storage for an averaging interval is assigned in 1K blocks. The reported storage time will fill all blocks allocated.

Use 40CFR75 Validation (Y/N):

You can indicate Yes, No or Grace Disabled. **Y** causes the channel to validate hourly averages in accordance with the Clean Air Act regulations (see Appendix C). Default=**N**: Averages are validated using a simple percent validity test (see page 4-4 "Configuring System Parameters"). **G** causes the channel to operate exactly as **Y** except that no 8-hour grace period is allowed after a startup. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

It may be desirable to specify a "Boiler Offline" status condition to correctly validate hours during startup and shutdown. See page 5-47 "Data Validation and Flags."

High Input:

This is the maximum current, voltage, hertz or voltage ratio output from the instrument. You can type up to 10 characters.

Mid Input:

This is the mid-range current, voltage, hertz or voltage ratio output from the instrument. It is used for parabolic scaling. Press <Ctrl><C> to toggle between parabolic and linear scaling. You can type up to 10 characters.

Low Input:

This is the minimum current, voltage, hertz or voltage ratio output from the instrument. You can type up to 10 characters.

High Output:

This is the instrument reading in engineering units corresponding to the High Input. You can type up to 10 characters.

Mid Output:

This is the instrument reading in engineering units corresponding to the Mid Input**.** It is used for parabolic scaling. Press <Ctrl><C> to toggle between parabolic and linear scaling. You can type up to 10 characters.

Low Output:

This is the instrument reading in engineering units corresponding to the Low Input. You can type up to 10 characters.

Analog Input Number:

This specifies the actual, physical input line number. **`01`** to **`99`**. When using a Meteorological Input Card, inputs **`Tx`** (YSI temperature input), **`Dx`** (wind direction input), **`Sx`** (wind speed input) or **`Rx`** (rainfall counter input) can be used, where **`x`** is the integer number of the Meteorological Input Card.

Counter Input Channel:

This specifies the actual, physical counter input name from the Meteorological Input Card. This input must be either **`Rx`** (rainfall counter) or **`Sx`** (wind speed input), where **`x`** is the number of the Meteorological Input Card.

Digital Outputs / Output Control Lines:

This specifies the digital output line pattern; patterns can be up to 41 characters long. Both the line number and the status (1=activate, 0=deactivate) should be specified: *n*=**`1`** or **`0`**, where *n* is the line number. Each line number/status pair must be separated by a comma (e.g., 1=1,2=0,3,4). If the status is not designated, the ACTIVE state (=1) is assumed. Digital outputs can be configured as normally open (active closed) or normally closed (active open); see page 4-20 "Configuring Digital Inputs and Outputs." Output line numbers can be 1 to 2 digits (1 to 99).

Digital Input Status Line Patterns:

This specifies the digital input line pattern; patterns can be up to 41 characters long. Both the line number and the status (1=on, 0=off) should be specified: *n*=**`1`** or **`0`**, where *n* is the line number. If the status is not designated, the ON state (=1) is assumed.

- Multiple input line/status pairs can be OR'ed together by separating them with the vertical bar character, |.
- Multiple input line/status pairs can be AND'ed together by separating them with the ampersand character, &.

For example, a closed line number 2 would be designated as `2=1` or `2`. An open line number 3 would be designated as `3=0`. If either line 2 must be closed or line 3 must be open, designate the pattern as `2=1|3=0` or `2|3=0`. If line 2 must be closed and line 3 must be open, designate the pattern as `2=1&3=0` or `2&3=0`. If the AND/OR designators are mixed in one pattern, the entire pattern is forced to the same condition by converting to the first occurrence of & or |.

NOTE: A comma separator (e.g., `1,2=0`) will default to AND unless the entry is in one of the following fields: Instantaneous Channel Validation Status Lines (for B, M, F, V, W, X, Y and Z flags), Stream-Switched Channel On-Line, Merge/Join Channel On-Line, Alarm Input Lines for Ack or Math Pack Constants Alternate Status. In these cases, a comma separator will default as specified in the *Default Dig. Inputs to OR ?* field in the *System Configuration Screen* (see page 4-4).

FINISHED (Configure Now):

In most configuration screens, this is the last field selection. Press <Enter> here to store the configuration into memory. This allows the configuration fields to be changed as many times as necessary until the setup is satisfactory.

NOTE: The <Esc> key may be used to abort the configuration process at any time before selecting *FINISHED (Configure Now)*. Any changes that have been made to the configuration are ignored.

The date/time stamp after this field indicates the last time that the configuration was changed and is only updated when <Enter> is pressed on this field or when the configuration is changed by a central download command.

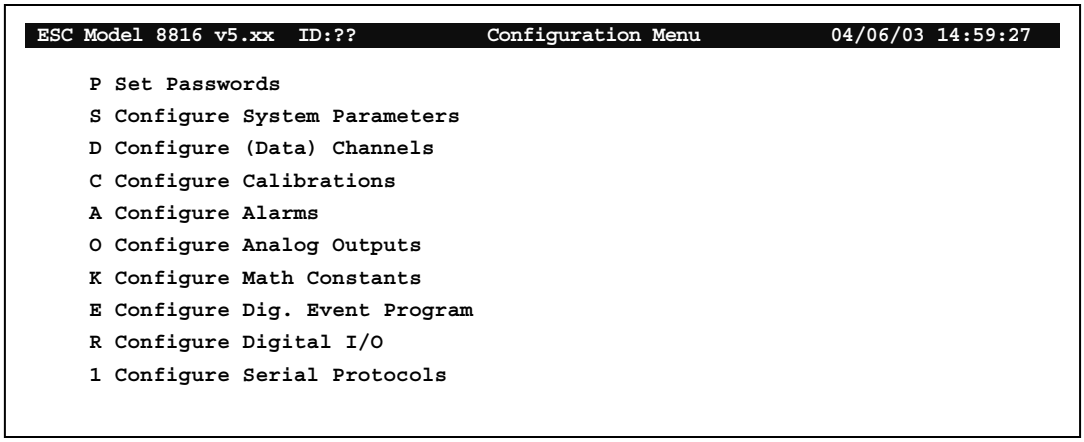
Chapter 4
Logger Configuration

The logger has various system components that can be configured by users. This section and the following three sections explain how to configure the various components of the logger via the *Configuration Menu*.

4.1 Configuration Menu

The *Configuration Menu* accesses all submenus and screens necessary to configure the data logger and all inputs and outputs for operation. Changes and deletions to existing configurations are also accomplished via this menu.

From the *Home Menu*, use the arrow keys to select *Configuration Menu* (hot key **C**):



The path to a configuration screen (with data entry fields) may be direct (e.g., *Configure System Parameters*) or may proceed through one or more submenus with additional choices along the way (e.g., *Configure (Data) Channels).*

4.1.1 *FINISHED (Configure Now) Field*

In most configuration screens, the last item is the *FINISHED (Configure Now)* field. Once you select this field, the configuration will be accepted, and stored into memory. This allows the configuration fields to be changed as many times as necessary until the setup is satisfactory. Once all information for a configuration screen has been entered, the *FINISHED (Configure Now)* selection must be highlighted and <Enter> must be pressed to accept the configuration.

A date/time stamp after this field indicates the last date/time that the configuration was changed.

NOTE: The <Esc> key may be used to abort the configuration process at any time before selecting *FINISHED (Configure Now)*. Any changes that have been made to the configuration are ignored.

4.1.2 *Configuration Items*

A brief description of each *Configuration Menu* item appears in the following table. For more detailed explanations of a particular item, refer to the section noted.

Hot Key	To Menu	Configures	See Page
P	**Set Passwords**	System passwords	4-2
S	**Configure System Parameters**	System operating parameters	4-4
D	**Configure (Data) Channels**	Data channels, including equations, data validation flags, etc	5-1
C	**Configure Calibrations**	Calibration programs	6-1
A	**Configure Alarms**	Alarm programs for averages and calibrations	7-1
O	**Configure Analog Outputs**	Digital-to-analog converters (DACs)	4-16
K	**Configure Math Constants**	Math pack constants	5-13
E	**Configure Dig. Event Program**	Digital event programs	4-17
R	**Configure Digital I/O**	Digital I/O labels and activation states	4-20
1	**Configure Serial Protocols**	Generic serial interface tables	4-21

4.2 Configuring Passwords

The *Password Configuration Screen* allows the system passwords to be changed **when logged in at the Supervisor level or higher.** If the sufficient level of access to change passwords has not been attained (i.e., logging in with the passwords Alarm Ack, Login, Privileged or Configuration access), this item will not appear on the *Configuration Menu*. The only passwords that appear are the ones that can be changed with the access level that has been attained.

NOTE: The Integrator password will only appear if the integrator is logged in.

From the *Configuration Menu*, use the up/down arrows to select *Set Passwords* (hot key **P**):

```
ESC Model 8816 v5.xx  ID:??     Password Configuration Screen      04/06/03 15:07:10

     Alarm Ack Password          :  ****************
     Login Password              :  ****************
     Privileged Password         :  ****************
     Configuration Password      :  ****************
     Supervisor Password         :  ****************
```

Step 1. To enter a new password, use the up/down arrows to highlight the password entry to be modified, type the new password, and press <Enter>.

Step 2. Confirm your entry by typing the password again. All typing is masked by asterisks (**), which allows the passwords to be set in a public setting. After confirming, the new password will be active.

Step 3. Exit the menu by configuring the last password, or, of course, via the <Esc> key.

Alarm Ack Password:

Sets the Alarm Acknowledgment access password; entry is active following confirmation of new password. 1 to 16 characters. Default password=**ALARM**.

Login Password:

Sets the Login access password; entry is active following confirmation of new password. 1 to 16 characters. Default password=**LOGIN**.

Privileged Password:

Sets the Privileged access password; entry is active following confirmation of new password. 1 to 16 characters. Default password=**PRIV**.

Configuration Password:

Sets the Configuration access password; entry is active following confirmation of new password. 1 to 16 characters. Default password=**ESCPRIV**.

Supervisor Password:

Sets the Supervisor access password; entry is active following confirmation of new password. 1 to 16 characters. Contact ESC Technical Support for the password.

Integrator Password:

Sets the Integrator access password; entry is active following confirmation of new password. 1 to 16 characters. Contact ESC Technical Support for the password.

4.2.1 *User Levels and Menu Access*

Logging in with one of the six passwords explained in the last section determines the user's access level (i.e., which features are available to the user). See a description for each user access level below:

Alarm Ack Password:

This password allows access to the *Alarm Status/Log Menu* (discussed on page 11-4 "Alarm Status / Log") and a few other features such as average reports and real-time displays. Appendix B shows the alarm level menu separately on page B-3.

Login Password:

This password allows viewing and reporting of data along with access to some of the *Logger Status Menu* features. The non-shaded menu items in Appendix B's menu tree indicate the features that are available at this access level.

Privileged Password:

This password allows the same access as the Login password along with the ability to view configurations, to place channels in/out of maintenance, to mark channels online/offline, and to start/abort calibration programs. The menu tree in Appendix B uses shaded boxes to denote which additional menu items are available at this access level.

Configuration Password:

This password allows the same access as the Privileged password along with the ability to modify configurations and to change digital output states. Appendix B's menu tree uses shaded boxes to indicate which additional menu items are available at this level.

Supervisor Password:

This password allows the same access as the Configuration password along with the ability to perform system diagnostic tests and to configure passwords.

Integrator Password:

This password allows the same access as the Supervisor password along with the ability to change several EEPROM settings.

4.3 Configuring System Parameters

Use the *System Configuration Screen* to modify the data logger system parameters.

From the *Configuration Menu*, select *Configure System Parameters* (hot key **S**):

```
ESC Model 8816 v5.xx  ID:??      System Configuration Screen      08/06/97 15:20:53

     Logger Date                 :  08/06/97
     Logger Time                 :  15:20:50
     Time Zone                   :  EST
     Logger ID Code              :  01
     Station ID Code             :  A05
     Logger Description          :  ESC Model 8816
     Modbus ID Code              :  100
     Baud Rate - Ext. Modem      :  9600
     Baud Rate - Port 1          :  19200
     Baud Rate - Port 2          :  N/A
     Baud Rate - Port 3          :  N/A
     Parallel Port Timeout       :  5s
     Automatic Logout Time       :  10m
     % For Valid Base Avg        :  100
     % For Valid Ext. Avg        :   75
     Debounce Digital Inputs ?   :  N
     Default Dig. Inputs to OR ? :  N
     Math Update Rate            :   1
     Alarm Deadband (% of limit) :  0.0
     Allow Auto Corr if Config'd?:  Y

   CTRL-U = Edit EEPROM Config.
```

All changes will immediately take effect when the <Enter> key is pressed to leave the field, hence the absence of the FINISHED (Configure Now).

Logger Date:

The system date; entry is active as soon as <Enter> is pressed. MM/DD/YY.

Logger Time:

The system time; entry is active as soon as <Enter> is pressed. HH:MM:SS (in military format).

Time Zone:

The time zone (**EST**, **PST**, etc.) that is displayed on the Daily Averages Report and the Daily Calibrations Report; 3 characters maximum.

Logger ID Code:

Unique two-character identification code for this logger.

Station ID Code:

Unique three-character station identification code for this logger that is displayed on the Daily Averages Report and the Daily Calibrations Report.

Logger Description

The description of this logger for user convenience; 26 characters maximum.

Modbus ID Code:

The unique three-digit Modbus identification code, **001-246** only.

Baud Rate -Ext. Modem:

The baud rate for the External Modem Port. **300, 600, 1200, 2400, 4800, 9600** or **19200**

Baud Rate -Port 1:

The baud rate for Serial Port 1. **300, 600, 1200, 2400, 4800, 9600 or 19200**

Baud Rate -Port 2:

The baud rate for Serial Port 2. **300, 600, 1200, 2400, 4800, 9600 or 19200**

Baud Rate -Port 3:

The baud rate for Serial Port 3. **300, 600, 1200, 2400, 4800, 9600 or 19200**

Parallel Port Timeout:

The timeout interval for attempting output to the parallel port. **0** to **60s** (for seconds).

Automatic Logout Time:

The timeout interval of no key input before automatically being logged out. **1m** to **49710d**.

% For Valid Base Avg.

The required percentage (1 to 100) of valid data points during an averaging interval for a base average to be marked as valid. An average that falls below this percentage will be flagged with < to indicate that it is invalid.

Note that the *Average Validation Config.* screen allows setting a validity percentage for each average individually. If used, the individual validity percentage for an average overrides this setting. (The *Average Validation Config.* screen is accessed by typing <Ctrl><V> while the cursor is on one of the average interval fields of a channel configuration screen.)

% For Valid Ext. Avg.

For non-Part 75 channels only. Required percentage (1 to 100) of valid points during an averaging interval for an extended average to be marked as valid. An average that falls below this percentage will be flagged with < to indicate that it is invalid. The average validation setting for an individual average will override this setting, as described in the previous field definition.

Debounce Digital Inputs?

Yes or No. If **Y**, digital inputs must remain in a new state for at least one second before the new state is recognized. If **N**, digital transitions take effect as soon as they are detected.

Default Dig. Inputs to OR?

Yes or No. This flag applies only to digital input fields where an explicit AND or OR pattern has not been entered, i.e. fields where the input line numbers are separated by commas (1,2=0,3). If **N** (the default), the digital inputs are ANDed to determine status. If **Y**, the digital inputs are ORed to determine status. This flag does NOT apply to digital input patterns for calibrations, DI-triggered digital event programs, time on-line counter channels or multi-condition TOL counter channels.

Math Update Rate

The rate at which math equations are evaluated, from once per second to once per 10 seconds. With Integrator access, this value can be increased, which is 1 by default, to reduce CPU load.

Alarm Deadband (% of limit)

Indicates deadband used by high, high-high, low and low-low alarm limits in all channels. Alarm must drop below/above original limit **plus** deadband for alarm condition to go inactive. Alarm deadband is calculated as a percentage of the limit. Up to 10 characters; 0.0 to 99.9%.

Example: High limit for SO2#/MBTU is 1.2. If alarm deadband is 10%, SO2#/MBTU must fall below 1.08 for High alarm condition to go inactive.

Allow Auto Corr if Config'd?

Refer to page 6-18 "Configuring Expected Values." Default=Y.

Use the control keys outlined in the following table to configure the Modbus and EEPROM settings. You can only do this if the appropriate access level has been attained.

System Parameters Configuration Screen	
<Ctrl><E> or <Ctrl><U>	View EEPROM configuration if access is Configuration or higher. Edit EEPROM configuration if access is Integrator.
<Ctrl><R>	View EEPROM settings in RAM if access is Configuration or higher. Edit EEPROM settings in RAM if access is Integrator.
<Ctrl><F>	Edit Modbus register settings if access is Supervisor or higher.

4.3.1 *Configuring EEPROM Parameters*

The EEPROM configuration screens allow the data logger parameters that are stored in memory unaffected by a cold start of the ESC Model 8816 to be modified.

From the *System Configuration Screen*, press <Ctrl><U> if access is Configuration or higher to enter *EEPROM Configuration Menu#1*:

```
ESC Model 8816 v5.xx  ID:??      EEPROM Configuration Menu#1      04/06/03 15:44:03

    Serial Number               :  1234
    EEPROM Size(kbits)          :  1
    Logger ID Code              :  ??
    FeatureMask                 :  0x0901
    LCD (Y/N)                   :  Y
    CPU Speed (Mhz)             :  16
    AC Line Freq. (Hz)          :  60
    Development System (Y/N)    :  N
    PROM1 Size (Mbits)          :  4
    PROM2 Size (Mbits)          :  1
    PROM Speed (ns)             :  120
    Num of RAM Chips            :  6
    Memory Card Type(0=none)    :   0
    Memory Size (Mbytes)        :    0
                                :
    Math Eqn Update Rate        :  1
    Min % for Valid Base Avg    :  100
    Min % for Valid Ext Avg     :  75
    If Cal is in Maint (D/S/N)  :  NORMAL
    Maximize Longterm Storage ? :  N
    Use LTS for Config          :  N
    Key Beep (Y/N)              :  Y
  Next Page = CTRL-N or PGDN
```

Serial Number:

This field is view only at Configuration and Supervisor user access level. This is the unique number identification code for the data logger initially set by ESC.

EEPROM Size (kbits):

This field is view only regardless of user access level. This is the storage size of the EEPROM chip.

Logger ID Code:

Unique two-character identification code for the data logger. This will assign the Logger ID after a cold start. This field can be changed at configuration user access level and above. The actual ID code can be changed in the *System Configuration Screen.*

Feature Mask:

This field is view only regardless of user access level. Software feature activation code set by ESC.

LCD (Y/N):

This field is view only regardless of user access level. Yes or No. **Y** indicates that the LCD screen is present. **N** indicates that the LCD screen is not present.

CPU Speed (Mhz):

This field is view only regardless of user access level. Clock speed of the ESC Model 8816's processor.

AC Line Freq. (Hz):

This field is view only regardless of user access level. The AC frequency of the voltage supplied to the ESC Model 8816.

Development System (Y/N):

This field is view only regardless of user access level. Yes or No. **Y** indicates that development features are activated. **N** indicates normal logger operation.

PROM1 Size (Mbits):

This field is view only regardless of user access level. Storage size of PROM 1.

PROM2 Size (Mbits):

This field is view only regardless of user access level. Storage size of PROM 2.

PROM Speed (ns):

This field is view only regardless of user access level. Access time of the PROMs in the ESC Model 8816.

Num of RAM Chips:

This field is view only regardless of user access level. Number of memory chips in the ESC Model 8816.

Memory Card Type(0=none):

This field is view only regardless of user access level. Type of extended memory card installed in the ESC Model 8816. **0** = No memory card is present. **1** = Unformatted static ram card installed.

Memory Size (Mbytes):

This field is view only regardless of user access level. Total data storage size of the extended memory card installed.

Math Eqn Update Rate:

This field is view only at Configuration and Supervisor user access level. The default rate at which math equations are evaluated after a cold start from once per second to once per 10 seconds. The actual update rate can be changed in the *System Configuration Screen.*

Min % for Valid Base Avg:

This field is view only at Configuration and Supervisor user access level. The default required percentage (1 to 100) of valid data points during averaging interval for a base average to be marked as valid after a cold start. The actual default percentage may be changed in the *System Configuration Screen.*

Min % for Valid Ext Avg:

This field is view only at Configuration and Supervisor user access level. For non-Part 75 only. The default required percentage (1 to 100) of valid points during averaging interval for an extended average to be marked as valid after a cold start. The actual default percentage may be changed in the *System Configuration Screen*.

If Cal is in Maint (D/S/N):

This field is view only at Configuration and Supervisor user access level. D, S, or N.

If **D** (DONTSEND), perform OOC checks, but do not change OOC status of any OOC configured parameter if in maintenance when checked for OOC during any phase, or in maintenance at the end of the sequence. Also, store cal results, but do not send results (for parameters that were in maintenance when checked for OOC) to central when polled.

If **S** (SEND), perform OOC checks, but do not change OOC status of any OOC configured parameter if in maintenance when checked for OOC during any phase, or in maintenance at the end of the sequence. Store all cal results, and send all results to central when polled.

If **N** (NORMAL), process calibrations as in normal operation.

Maximize Longterm Storage?:

This field is view only at Configuration and Supervisor user access level. Yes or No. If **Y**, data values are stored as 3-byte (short) floating-point values, and the data invalid flag (<) and/or the highest priority data flag are stored. If **N**, data values are stored as 4-byte floating-point values, and up to 32 data flags (4 bytes) are stored.

Use LTS for Config:

This field is view only at Configuration and Supervisor user access level. Yes or No. If **Y**, 8 Kbytes of long-term storage will be used as configuration memory. The *System Information* screen will reflect this selection by displaying 8 blocks less in the **Available Data Storage** field.

Key Beep (Y/N):

This field is view only at Configuration and Supervisor user access level. Yes or No. If **Y**, using the front panel keypad on the ESC Model 8816 will generate a beep for each key pressed. If **N**, the keypad will cause no sound to be produced.

To access *EEPROM Configuration Menu#2*, press the Page Down (PGDN) key from the keyboard interface or <Ctrl><N> from any other interface.

```
ESC Model 8816 v5.xx  ID:??      EEPROM Configuration Menu#2       04/06/03 15:47:09

    Max 4-20 mA Inputs          :  16
    Max Voltage Inputs          :  8
    Max Status Inputs           :  32
    Max Relay Outputs           :  16
    Max Current Outputs         :  16
    Max Met Cards               :  1
                                :
    Max External 4-20 mA Inputs :  0
    Max External Voltage Inputs :  0
    Max External Status Inputs  :  0
    Max External Relay Outputs  :  0
    Max External Current Outputs:  0
    Max External 16-bit Counters:  0
                                :
    Modbus ID Code              :  001
    Def.Modbus AddrTbl Start    :  40001
    Def.Modbus InputTbl Start   :  40005
    Def.Modbus OutputTbl Start  :  41005
    ModbusQuietIfNoRegMatch     :  N
    ModbusAddrTabl[0]=          :      5
    ModbusAddrTabl[1]=          :   1005
  Next Page = CTRL-N or PGDN, Prev Page = CTRL-P or PGUP
```

All fields are view only with Configuration and Supervisor user access levels except for the Modbus ID code field.

Max 4-20 mA Inputs:

The number of analog inputs provided by Current In card(s).

Max Voltage Inputs:

The number of analog inputs provided by Voltage In card(s).

Max Status Inputs:

The number of digital inputs provided by Status In card(s).

Max Relay Outputs:

The number of digital outputs provided by Relay Out card(s).

Max Current Outputs:

The number of analog current outputs provided by Current Out card(s).

Max Met Cards:

The number of Meteorological Input Cards in the logger.

Max External 4-20 mA Inputs:

The number of external analog current inputs.

Max External Voltage Inputs:

The number of external analog voltage inputs.

Max External Status Inputs:

The number of external digital inputs.

Max External Relay Outputs:

The number of external digital outputs.

Max External Current Outputs:

The number of external analog current outputs.

Max External 16-bit Counters:

The number of external 16-bit digital counters.

Modbus ID Code:

The default unique three-digit Modbus identification code, **001-246** only. This will assign the Modbus ID after a cold start. The actual Modbus ID code can be changed in the *System Configuration Screen*.

Def. Modbus AddrTbl Start:

The Modbus Address Table start location.

Def. Modbus InputTbl Start:

The Modbus Input Table start location.

Def. Modbus OutputTbl Start:

The Modbus Output Table start location.

ModbusQuietIfNoReg Match:

Yes or No. **N** = Return error message if requested register cannot be found. **Y** = No response if requested register cannot be found.

ModbusAddrTabl[0]=:

User Information field. Value entered is returned as the value of the first register in the Modbus Address Table.

ModbusAddrTabl[1]=:

User Information field. Value entered is returned as the value of the second register in the Modbus Address Table.

To access *EEPROM Configuration Menu#3*, press the Page Down (PGDN) key from the keyboard interface or <Ctrl><N> from any other interface.

```
ESC Model 8816 v5.xx  ID:??      EEPROM Configuration Menu#3       04/06/03 15:48:25

     Port0(COM0) Enable (Y/N)     :  Y
     Port0(COM0) Baud/Bits/Parity:  9600/8/N
     Port0(COM0) Delay (ticks)    :  0
     Port0(COM0) 232/485          :  485
     Port0(COM0) Device Type      :  LLM-RTS
     Port0(COM0) Interface        :  CEN
                                 :
     Port1(COM1) Enable (Y/N)     :  Y
     Port1(COM1) Baud/Bits/Parity:  19200/8/N
     Port1(COM1) Delay (ticks)    :  0
     Port1(COM1) Device Type      :  VT100
     Port1(COM1) Interface        :  CEN
                                 :
     Port2(COM2) Enable (Y/N)     :  N
     Port2(COM2) Baud/Bits/Parity:  1200/8/N
     Port2(COM2) Delay (ticks)    :  0
     Port2(COM2) Device Type      :  DIALUP
     Port2(COM2) Interface        :  CEN

   Next Page = CTRL-N or PGDN, Prev Page = CTRL-P or PGUP
```

All fields are view only with Configuration and Supervisor user access levels.

Port0(COM0) Enable (Y/N):

This field is always "view only" regardless of user access level. Indicates whether this port is enabled. Yes for enabled or No for not enabled.

Port0(COM0) Baud/Bits/Parity:

The default baud rate for the external modem Serial Port 0. **300, 600, 1200, 2400, 4800, 9600, 19200**. Number of data bits and parity are also displayed. A 7-bit data length can be combined with odd or even parity. An 8-bit data length can be combined with odd, even or no parity.

Port0(COM0) Delay (ticks):

The number of delay ticks that the logger waits before transmitting characters. Each tick is $1/64^{th}$ of a second.

Port0(COM0) 232/485:

The type of serial communication port for Serial Port 0.

Port0(COM0) Device Type:

The type of communication device connected to Serial Port 0. Supported device types are: **VT100** (Video terminal – fixed modem control), **DIALUP** (Dial-up modem), **LLM** (Leased-line modem with no modem control), **LLM-RTS** (Leased-line modem with modem control), **PRINTER** (Serial printer) , **DU!TIME** (Video terminal-does not send time updates while in MDI mode).

Port0(COM0) Interface:

The type of communication interface that Serial Port 0 should follow. Supported interface types are **MDI** (Menu driven interface), **CEN** (Central interface), **PRN** (Printer interface), **TERM** (Dumb terminal – VT100), **MB-RTU** (Modbus RTU), **MB-ASCI** (Modbus ASCII), **GSI1** (GSI interface), **GSI2** (Extended GSI interface), **KORAMB1** (Korean Ambient Protocol - in 8800), **KORAMB2** (Korean Ambient Protocol), **KORH20** (Korean Water Quality Protocol), **KORSTAK** (Korean Stack Protocol), **KORPOSC** (Korean Posco Protocol), **KORINCH** (Korean Inchon Protocol), **SANBAR** (Santa Barbara Protocol), **KORULSN** (Korean Ulsan City Protocol), **KORKYKI** (Korean KyungKiDo Protocol), **MB-FLT** (Modbus Floating Point).

Port1(COM1) Enable (Y/N):

This field is always "view only" regardless of user access level. Indicates whether this port is enabled. Yes for enabled or No for not enabled.

Port1(COM1) Baud/Bits/Parity:

The default baud rate for Serial Port 1. **300, 600, 1200, 2400, 4800, 9600, 19200**. Number of data bits and parity are also displayed. A 7-bit data length can be combined with odd or even parity. An 8-bit data length can be combined with odd, even or no parity.

Port1(COM1) Delay (ticks):

This is the number of delay ticks that the logger waits before transmitting characters. Each tick is 1/64th of a second.

Port1(COM1) Device Type:

The type of communication device connected to Serial Port 1. Supported device types are: **VT100** (Video terminal – fixed modem control), **DIALUP** (Dial-up modem), **LLM** (Leased-line modem with no modem control), **LLM-RTS** (Leased-line modem with modem control), **PRINTER** (Serial printer) , **DU!TIME** (Video terminal-does not send time updates while in MDI mode).

Port1(COM1) Interface:

The type of communication interface that Serial Port 1 should follow. Supported interface types are **MDI** (Menu driven interface), **CEN** (Central interface), **PRN** (Printer interface), **TERM** (Dumb terminal – VT100), **MB-RTU** (Modbus RTU), **MB-ASCI** (Modbus ASCII), **GSI1** (GSI interface), **GSI2** (Extended GSI interface), **KORAMB1** (Korean Ambient Protocol - in 8800), **KORAMB2** (Korean Ambient Protocol), **KORH20** (Korean Water Quality Protocol), **KORSTAK** (Korean Stack Protocol), **KORPOSC** (Korean Posco Protocol), **KORINCH** (Korean Inchon Protocol), **SANBAR** (Santa Barbara Protocol), **KORULSN** (Korean Ulsan City Protocol), **KORKYKI** (Korean KyungKiDo Protocol), **MB-FLT** (Modbus Floating Point).

Port2(COM2) Enable (Y/N):

This field is always "view only" regardless of user access level. Indicates whether this port is enabled. Yes for enabled or No for not enabled.

Port2(COM2) Baud/Bits/Parity:

The default baud rate for Serial Port 2. **300, 600, 1200, 2400, 4800, 9600, 19200**. Number of data bits and parity are also displayed. A 7-bit data length can be combined with odd or even parity. An 8-bit data length can be combined with odd, even or no parity.

Port2(COM2) Delay (ticks):

The number of delay ticks that the logger waits before transmitting characters. Each tick is 1/64th of a second.

Port2(COM2) Device Type:

The type of communication device connected to Serial Port 2. Supported device types are: **VT100** (Video terminal – fixed modem control), **DIALUP** (Dial-up modem), **LLM** (Leased-line modem with no modem control), **LLM-RTS** (Leased-line modem with modem control), **PRINTER** (Serial printer) , **DU!TIME** (Video terminal-does not send time updates while in MDI mode).

Port2(COM2) Interface:

The type of communication interface that Serial Port 2 should follow. Supported interface types are **MDI** (Menu driven interface), **CEN** (Central interface), **PRN** (Printer interface), **TERM** (Dumb terminal – VT100), **MB-RTU** (Modbus RTU), **MB-ASCI** (Modbus ASCII), **GSI1** (GSI interface), **GSI2** (Extended GSI interface), **KORAMB1** (Korean Ambient Protocol - in 8800), **KORAMB2** (Korean Ambient Protocol), **KORH20** (Korean Water Quality Protocol), **KORSTAK** (Korean Stack Protocol), **KORPOSC** (Korean Posco Protocol), **KORINCH** (Korean Inchon Protocol), **SANBAR** (Santa Barbara Protocol), **KORULSN** (Korean Ulsan City Protocol), **KORKYKI** (Korean KyungKiDo Protocol), **MB-FLT** (Modbus Floating Point).

To access *EEPROM Configuration Menu#4*, press the Page Down (PGDN) key from the keyboard interface or <Ctrl><N> from any other interface.

```
ESC Model 8816 v5.xx  ID:??      EEPROM Configuration Menu#4       04/06/03 15:49:32

    Port3(COM3) Enable (Y/N)    :  N
    Port3(COM3) Baud/Bits/Parity:  300/8/N
    Port3(COM3) Delay (ticks)   :  0
    Port3(COM3) Device Type     :  DIALUP
    Port3(COM3) Interface       :  CEN
                                :
    Port4(LCD0) Enable (Y/N)    :  Y
    Port4(LCD0) Device Type     :  LCD
    Port4(LCD0) Interface       :  MDI
                                :
    Port5(LPT0) Enable (Y/N)    :  Y
    Port5(LPT0) Delay (ticks)   :  10
    Port5(LPT0) Device Type     :  PRINTER
    Port5(LPT0) Interface       :  PRN
                                :
    Report Printer Port         :  5
    Alarm Printer Port          :  5
                                :
    Finished (Configure Now)      04/06/03 08:52:50
  Prev Page = CTRL-P or PGUP
```

All fields are view only with Configuration and Supervisor user access levels.

Port3(COM3) Enable (Y/N):

This field is always "view only" regardless of user access level. Indicates whether this port is enabled. Yes for enabled or No for not enabled.

Port3(COM3) Baud/Bits/Parity:

The default baud rate for Serial Port 3. **300, 600, 1200, 2400, 4800, 9600, 19200**. Number of data bits and parity are also displayed. A 7-bit data length can be combined with odd or even parity. An 8-bit data length can be combined with odd, even or no parity.

Port3(COM3) Delay (ticks):

The number of delay ticks that the logger waits before transmitting characters. Each tick is 1/64th of a second.

Port3(COM3) Device Type:

The type of communication device connected to Serial Port 3. Supported device types are: **VT100** (Video terminal – fixed modem control), **DIALUP** (Dial-up modem), **LLM** (Leased-line modem with no modem control), **LLM-RTS** (Leased-line modem with modem control), **PRINTER** (Serial printer) , **DU!TIME** (Video terminal-does not send time updates while in MDI mode).

Port3(COM3) Interface:

The type of communication interface that Serial Port 3 should follow. Supported interface types are **MDI** (Menu driven interface), **CEN** (Central interface), **PRN** (Printer interface), **TERM** (Dumb terminal – VT100), **MB-RTU** (Modbus RTU), **MB-ASCI** (Modbus ASCII), **GSI1** (GSI interface), **GSI2** (Extended GSI interface), **KORAMB1** (Korean Ambient Protocol - in 8800), **KORAMB2** (Korean Ambient Protocol), **KORH20** (Korean Water Quality Protocol), **KORSTAK** (Korean Stack Protocol), **KORPOSC** (Korean Posco Protocol), **KORINCH** (Korean Inchon Protocol), **SANBAR** (Santa Barbara Protocol) , **KORULSN** (Korean Ulsan City Protocol), **KORKYKI** (Korean KyungKiDo Protocol), **MB-FLT** (Modbus Floating Point).

Port4(LCD0) Enable:

This field is always "view only" regardless of user access level. Indicates whether this port is enabled. Yes for enabled or No for not enabled.

Port4(LCD0) Device Type:

The type of communication device connected to Port 4 (LCD Port). Supported device type is **LCD**.

Port4(LCD0) Interface:

The type of communication interface that Port 4 should follow. Supported interface type is **MDI** (Menu driven interface).

Port5(LPT0) Enable (Y/N):

This field is always "view only" regardless of user access level. Indicates whether this port is enabled. Yes for enabled or No for not enabled.

Port5(LPT0) Delay (ticks):

The number of delay ticks that the logger waits before transmitting characters. Each tick is 1/64th of a second.

Port5(LPT0) Device Type:

The type of communication device connected to Port 5 (Parallel Port). Supported device type is **PRINTER** (Parallel printer).

Port5(LPT0) Interface:

The type of communication interface that Port 5 should follow. Supported interface type is **PRN** (Printer interface).

Report Printer Port:

The default port for all printer functions. **0-3** for serial ports, and **5** for parallel ports.

Alarm Printer Port:

The default port for all alarm to printer notifications. **0-3** for serial ports, and **5** for parallel ports.

4.4 Configuring Analog Outputs

If the logger is supplied with analog output cards, these outputs can be configured to drive the result of a calculation internal to the ESC Model 8816 Data Logger. Any channel can be used to drive the outputs, so the unit can be used as a simple voltage to current loop converter, if desired (i.e., a current loop output driving the result of a single analog input).

From the *Configuration Menu*, use the up and down arrows to select *Configure Analog Outputs* (hot key **O**). When the choose list of the DAC numbers appears, select a DAC number. The configuration screen will appear:

```
ESC Model 8816 v5.xx  ID:??          Configure DAC Outputs          04/06/03 15:54:35

     DAC Number (not editable)   :  01
     Input Parameter Name        :  (none)
     Averaging Interval          :  0s
     High Input (E.U.s)          :  100
     Low Input (E.U.s)           :  0
     High Output (mA)            :  20
     Low Output (mA)             :  4
     Action When Flagged(I,Z,H,0):  HOLD
     FINISHED (Configure Now)


   CTRL-Z = Clear Settings
```

NOTE: <Ctrl> <Z> resets the analog outputs to the default settings shown here.

Input Parameter Name:

The parameter name whose results are to be used to drive the output.

Averaging Interval:

The average to be used, as well as the analog output's update speed. Interval must match an interval configured in the input parameter. However, **0s** can be used for instantaneous readings. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

High Input:

The high reading in engineering units of the driving input.

Low Input:

The low reading in engineering units of the driving input.

High Output:

The high value of the analog output corresponding to the *High Input* in mA.

Low Output:

The low value of the analog output corresponding to the *Low Input* in mA.

Action When Flagged:

Action to take when the input parameter has been flagged with an error code indicating bad data. **(I) - IGNORE** (continue to output values normally), **(Z) - ZERO** (hold output at 0mA), **(H) - HOLD** (hold output at the last good output setting), or **(0) - LOWVAL** (hold output equal to 0.0 EU). For instantaneous data, this action is taken when one or more of the following flags exists: R, -, +, A, U, O, M, C, B, F, T, D or P. For an average interval, this action is taken when the < flag is present.

A current output can be set to a constant value by setting both the *Low Output* and *High Output* fields to the desired value.

4.5 Configuring Digital Event Programs

This feature allows the user to specify a digital control output event. A digital event program can be either timed or triggered by a digital input.

For example, a digital event program could be described as: Starting at 3 PM on July 6, turn digital outputs 07 and 08 on, leave them on for 14 minutes, and repeat this sequence every other day.

Stream-switching (or time-sharing) is normally controlled by digital event programs which switch a specified output or outputs on a timed basis or via digital input triggers. One approach to configuring a stream-switched system is described on page 14-1 "Application Note - Stream-Switched Channel."

From the *Configuration Menu*, select *Configure Dig. Event Program* (hot key **E**):

```
ESC Model 8816 v5.xx  ID:??       Dig. Event Program Config.       04/06/03 11:21:06

    N New Timed Dig. Event Program
    T New DI-Triggered Dig. Event
    C Change Dig. Event Program
    D Delete Old Dig. Event Program
```

Hot Key	Selection	Purpose
N	*New Timed Dig. Event Program*	Choose this option to enter a new timed digital event program.
T	*New DI-Triggered Dig. Event*	Choose this option to enter a new digital event program that is triggered by digital inputs.
C	*Change Dig. Event Program*	Choose this option to modify an existing digital event program.
D	*Delete Old Dig. Event Program*	Choose this option to delete an existing digital event program.

4.5.1 *Timed Digital Event Programs*

From the *Dig. Event Program Config Menu*, select *New Timed Dig. Event Program* (hot key **N**).

For a timed digital event program, the start time and repeat interval for the digital output(s) event are specified. The configuration screen for a timed digital event program is as follows:

```
ESC Model 8816 v5.xx  ID:??       Config. Dig. Event Program       04/06/03 11:15:00

     Dig. Event Program Name     :  DEFPROG
     Starting Time               :  08/15/97 00:00:00
     Repeat Interval             :  12m
     Output Line(s)              :  8,
     Output Duration             :  6m
     Disable During Cal(s)       :  (none)

     FINISHED (Configure Now)
```

NOTE: Press <Ctrl><O> to configure digital outputs. See page 4-20 "Configuring Digital Output States."

Program Name:

The name that uniquely identifies this digital event program.

Starting Time:

The scheduled execution time of the program. MM/DD/YY HH:MM:SS (in military format).

Repeat Interval:

The time between program executions. **10s** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Output Control Line(s):

The list of the two-digit output control line numbers that should be activated at execution time.

Output Duration:

The length of time that the *Output Control Line(s)* will be activated. After this time, the lines will return to their inactive state. **5s** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Disable During Calibration(s):

The list of calibration program names during which the digital program will update its *Starting Time* but will not activate output lines. This option allows calibrations to override normally programmed probe-switching sequences.

4.5.2 *DI-Triggered Digital Event Programs*

For this type of digital event program, a digital input pattern is specified that will initiate the digital output(s) event. The output lines will remain on in their active state for the specified duration. At the end of this time, the output lines will be deactivated unless the triggering digital input pattern is still true. The configuration screen for a DI-digital event program is as follows:

```
ESC Model 8816 v5.xx  ID:??       Config. Dig.Event Program       04/06/03 11:24:28


    Dig. Event Program Name     :  DEFPROG
    Trigger DI Pattern          :  (none)
    Output Line(s)              :  8,
    Output Duration             :  6m
    Disable During Cal(s)       :  (none)

    FINISHED (Configure Now)

  CTRL-O = Config Relay Outputs
```

NOTE: Press <Ctrl><O> to configure digital outputs. See page 4-20 "Configuring Digital Output States."

Program Name:

The name that uniquely identifies this digital event program.

Trigger DI Pattern:

The digital input line pattern that will trigger the execution of this digital event program. Specify the line number followed by the state (1=on, 0=off); e.g., **`1=1`**|**`2=0`**|**`3=1`**. If more than one line pattern is entered, the inputs will be OR'ed if the patterns are separated by "|" or will be AND'ed if the patterns are separated by "&", or ",".

Output Control Line(s):

The list of the two-digit output control line numbers that should be activated at execution time.

Output Duration:

The length of time that the *Output Control Line(s)* will be activated. After this time, the *Trigger DI Pattern* will again be compared against the state of the digital inputs. If the pattern matches, the lines will remain activated for this duration. If the pattern no longer matches, the lines will return to their inactive state. **`5s`** to **`999 s`**, **`m`**, **`h`**, or **`d`** (for seconds, minutes, hours, or days, respectively).

Disable During Calibration(s):

The list of calibration program names during which the digital program will update its *Starting Time* but will not activate output lines. This option allows calibrations to override normally programmed probe-switching sequences.

4.6 Configuring Digital Inputs and Outputs

From the *Configuration Menu*, select *Configure Digital I/O* (hot key **R**).

Digital I/O Configuration Menu Selections

Hot Key	Function	Purpose
I	*Edit Digital Input Labels*	Choose to assign a label to a digital input line.
O	*Edit Digital Output Labels*	Choose to assign a label to a digital output line..
R	*Configure Norm. Open/Closed*	Choose to assign the default state for the digital outputs.

NOTE: The ESC Model 8816 can logically possess more digital inputs and digital outputs than it physically possesses (up to a maximum of 88). See page 2-3 "Pseudo Digital Input/Output Lines" for details.

Menus for other Digital I/O Features in the ESC Model 8816	See Page
Real-Time Display Menu ⇒ Display Digital Inputs, Display Digital Outputs	8-7, 8-8
Logger Status Menu ⇒ Line Changes Log Menu	11-2

4.6.1 *Editing Digital I/O Labels*

The *Edit Digital Input Labels* and *Edit Digital Output Labels* menus allow the configuration of any digital input or output line with a common, recognizable name.

Step 1. Select *Edit Digital Input Labels* or *Edit Digital Output Labels* menu. A choose list of the digital lines will appear.

Step 2. Use the up/down and left/right arrows to highlight the desired digital line, and press <Enter>.

Step 3. In the screen that appears, type the text for the line label. The label takes effect when the screen is exited (<Esc>). The digital line is then referred to by its number and the configured name wherever it appears in the logger software.

4.6.2 *Configuring Digital Output States*

Use this selection to select the default state of the digital outputs.

From the *Configure Digital I/O* menu, select *Configure Norm. Open/Closed* (hot key **R**). The following screen will appear.

```
ESC Model 8816 v5.xx  ID:??       Configure Digital Outputs        04/06/03 11:28:36

=>Control Output # 01  = NormOpen        Pseudo  Output # 17  = NormOpen
  Control Output # 02  = NormOpen        Pseudo  Output # 18  = NormOpen
  Control Output # 03  = NormOpen        Pseudo  Output # 19  = NormOpen
  Control Output # 04  = NormOpen        Pseudo  Output # 20  = NormOpen
  Control Output # 05  = NormOpen        Pseudo  Output # 21  = NormOpen
  Control Output # 06  = NormOpen        Pseudo  Output # 22  = NormOpen
  Control Output # 07  = NormOpen        Pseudo  Output # 23  = NormOpen
  Control Output # 08  = NormOpen        Pseudo  Output # 24  = NormOpen
  Control Output # 09  = NormOpen        Pseudo  Output # 25  = NormOpen
  Control Output # 10  = NormOpen        Pseudo  Output # 26  = NormOpen
  Control Output # 11  = NormOpen        Pseudo  Output # 27  = NormOpen
  Control Output # 12  = NormOpen        Pseudo  Output # 28  = NormOpen
  Control Output # 13  = NormOpen        Pseudo  Output # 29  = NormOpen
  Control Output # 14  = NormOpen        Pseudo  Output # 30  = NormOpen
  Control Output # 15  = NormOpen        Pseudo  Output # 31  = NormOpen
  Control Output # 16  = NormOpen        Pseudo  Output # 32  = NormOpen

  EXIT=ESC or SPACE, O = NormOpen, C = NormClosed
```

All channels default to Normally Open on cold start. In this state, the relay is open until activated by a calibration, digital event program, or an alarm.

Step 1. Use the up/down and right/left arrow keys or type the two-digit relay number to move the cursor.

Step 2. To change a digital output to Normally Closed (i.e., the relay will remain closed until it is activated, at which point it will open), type **C** when the cursor is pointing to the appropriate output. To switch a line back to Normally Open, type **O**.

Line states can only be reassigned when the output is inactive. If the output is activated, the calibration, digital event program, or alarm must be canceled before its assignment can be changed.

When a digital output's assignment is changed, the relay will switch to the new default (inactive) state. That is, when a relay is changed to Normally Closed, the ESC Model 8816 will close the relay to keep it in the default, inactive state.

4.7 Configuring Serial Protocols

From the *Configuration Menu*, select *Configure Serial Protocols* (hot key **1**).

```
ESC Model 8816 v5.xx  ID:??       Serial Protocol Config Menu      04/06/03 11:31:31

    G Configure GSI Tables
```

The Generic Serial Interface (GSI) is a serial communications interface used by the ESC Model 8816 Data Logger. This interface is used to retrieve data from analyzers, digital control systems, or some other device using one of the RS-232 or RS-485 serial communications ports.

The input functions of this interface include receiving data strings to store values into GSI Channels (see page 5-42 "Generic Serial Interface Channels (Optional)") for data collection and receiving alarm strings to close the ESC Model 8816's relay or pseudo outputs. The output functions of this interface include sending strings from the ESC Model 8816 to an analyzer to execute certain functions, such as calibrations, either on a repeating time-basis or based on a given status input pattern.

Before using the GSI, the Interface type for the serial port to be used for GSI communications must be set to GSI1 or GSI2 in the *EEPROM Configuration Menu* (see page 4-7 "Configuring EEPROM Parameters"). The GSI1 interface type is the original implementation of the GSI and allows for the configuration of Data Parse and Autosend entries. The GSI2 interface type allows for the configuration of all types of GSI entries, which include Data Parse, Autosend, DI-Triggered Send, Alarm and Primer entries.

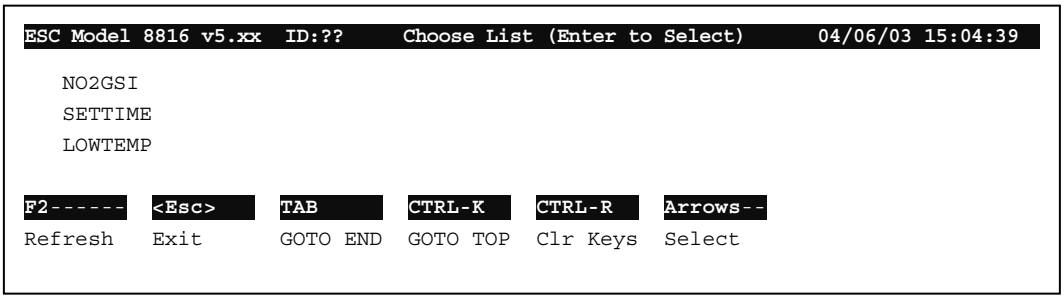
Select *Configure GSI Tables* (hot key **G**) from the *Serial Protocol Config Menu*. The GSI selections will display.

```
ESC Model 8816 v5.xx  ID:??        GSI Configuration Menu        04/06/03 11:31:31

    N New Data Parse Entry
    A New Autosend Entry
    T New DI-Triggerd Send Entry
    L New Alarm Entry
    P New Primer Entry
    C Change Old Configuration
    D Delete Old Configuration
```

Hot Key	Function	Purpose
N	New Data Parse Entry	Defines a parsing program to extract data from a received string of a predefined format
A	New Autosend Entry	Transmits a predefined string at regular intervals
T	New DI-Triggerd Send Entry	Transmits a predefined string based on a digital input
L	New Alarm Entry	Closes an output after receiving a predefined string
P	New Primer Entry	Defines a string that must be received before data is validated in a GSI Channel
C	Change Old Configuration	Modifies an existing GSI table entry
D	Delete Old Configuration	Deletes an existing GSI table entry

4.7.1 *Changing a GSI Table Entry*

Select *Change Old Configuration* (hot key **C**) from the *GSI Configuration Menu*. A list of all configured GSI table entries will display.



Step 1. Use the up/down arrows to select a table entry. Press <Enter> for the highlighted GSI table entry's configuration screen to appear. The selected GSI table entry is copied into memory for editing.

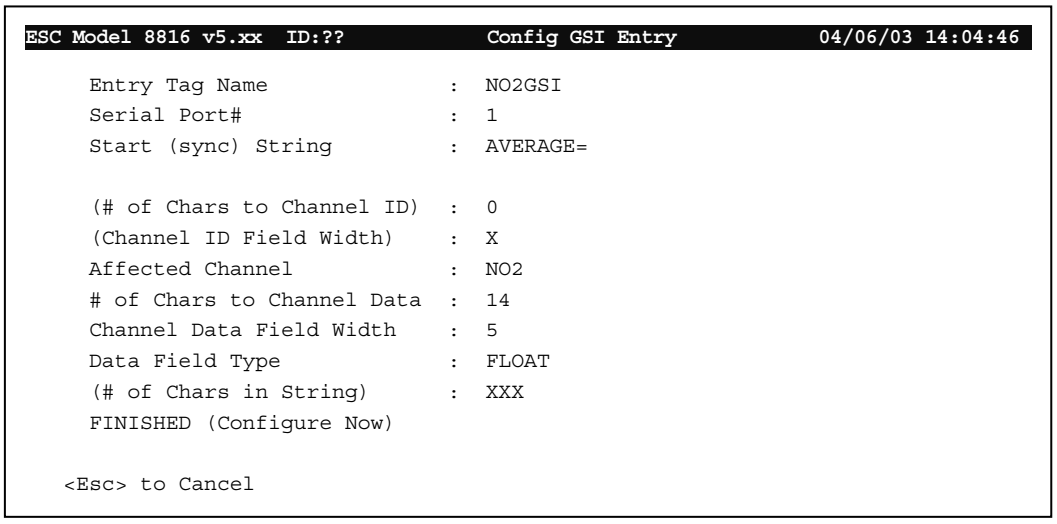
Step 2. Make the desired changes (refer to page 4-23 "Configuring New Data Parse Entries" and page 4-28 "Formatting Strings" for information about configuration fields.). Select *FINISHED (Configure Now)* for the new changes to take effect. If you exit using the <Esc> key, the GSI table entry will not be deleted.

4.7.2 Deleting a GSI Table Entry

Select *Delete Old Configuration* (hot key **D**) from the *GSI Configuration Menu*. A list of all configured GSI table entries will display. Press <Enter> to delete the highlighted GSI table entry. If you exit using the <Esc> key, the entry will not be deleted.

4.7.3 Configuring New Data Parse Entries

A Data Parse Entry defines a parsing program to extract data from a received text string. The string must have a predefined format consisting of a start (sync) section, an optional channel number or identifier section and a transferred data section.



Entry Tag Name:

The label used to identify this GSI Parse Entry.

Serial Port #:

The serial port being used for GSI communications. **0** to **3**.

Start (sync) String:

One or more characters that signal the beginning of the data stream to be parsed (see page 4-28 "Formatting Strings" for more information on formatting strings).

(# of Chars to Channel ID:)

(Optional) The number of characters between the end of the *Start (sync) String* and the beginning of the Channel Identification field. **0** indicates that the first byte after the *Start (sync) String* is the first character of the Channel ID. **0** to **512**.

(Channel ID Field Width:)

(Optional) The number of characters that compose the channel identification (number or name) in the incoming stream. If no Channel ID is expected, the *Channel ID Field Width* must be entered as **0**. (A value of **0** is displayed as **X**.) **0** to **8**.

Affected Channel:

The name of the GSI Channel used to store the data received. If a *Channel ID Field Width* is specified, the Channel ID received must either match the channel number or the channel name of the **Affected Channel** before data is stored. Entering **none** clears the field.

# of Chars to Channel Data:

The number of characters between the end of the *Start (sync) String* and the beginning of the channel data field. **0** indicates that the first byte after the *Start (sync) String* is the first character of the channel data. **0** to **512**.

Channel Data Field Width:

The number of characters that compose the channel data field in the incoming stream. **0** to **32**.

Data Field Type:

The available data types are FLOAT and BINARY WORD. The FLOAT type takes the ASCII text received for the Channel Data and converts it to a number. Valid ASCII characters used in converting to a FLOAT are **+**, **-**, **0** through **9**, and **e** or **E** for exponential notation. If any characters other than white spaces or a trailing ETX (CTRL-C) are present in the field, the value is considered invalid. The BINARY WORD type takes two bytes of data and uses them to represent a 16-bit signed integer allowing values from –32768 to +32768. The *Channel Data Field Width* must be **2** for the Binary Word type.

(# of Chars in String):

(Optional) The number of characters that must be received after the last byte of the *Start (sync) String* before the string is parsed. The configuration of this field allows for more than one *GSI Data Parse Entry* to contain the same *Start (sync) String* and for data to be received for multiple channels from a single GSI string.

NOTE: One parsing program should be configured for each channel to which data is to be transferred.

Example: Autosending Analyzer

Assume an instrument that automatically sends minute averages to the ESC Model 8816 in the following format:

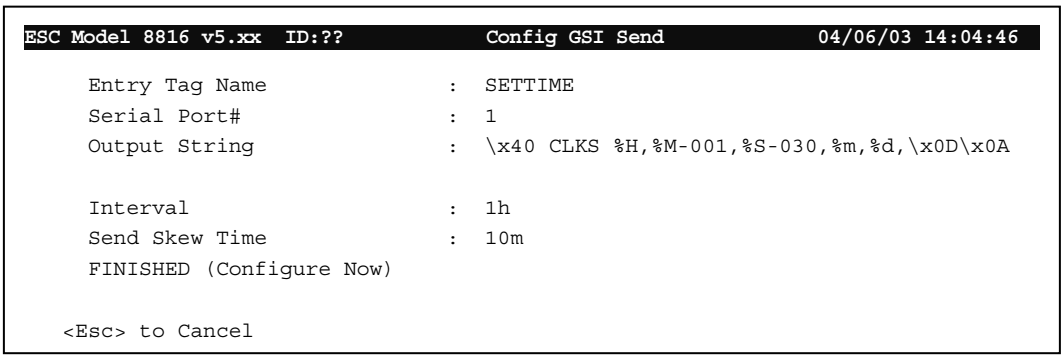
AVERAGE=001m 14:50:03 345.5 14.200

The first value (345.5) is the NO2 reading and it is desired to send it to the NO2 channel in the data logger. The description for the GSI data parse entry would read as follows:

Look for the start string "AVERAGE=". Skip to the next 14 characters "001m 14:50:03 " and then parse the next 5 characters and use the result in the NO2 channel.

4.7.4 *Configuring Autosend Entries*

An Autosend Entry is used to send a string out the GSI Serial Port at a repeated interval.



Entry Tag Name:

The label used to identify this GSI Autosend Entry.

Serial Port #:

The serial port being used for GSI communications. **0** to **3**.

Output String:

The string to be sent out of the GSI port. This string can contain time formatting and time offset characters (see page 4-28 "Formatting Strings" for more information on formatting strings).

Interval:

The repeat interval of this autosend entry.

Send Skew Time:

The time offset at which this entry should be transmitted. A *Send Skew Time* of **0s** will cause the *Output String* to be transmitted at the beginning of each *Interval*. A *Send Skew Time* of **10m**, for example, will cause the *Output String* to be transmitted 10 minutes after the beginning of each *Interval*. The *Send Skew Time* must be less than the *Interval*.

4.7.5 Configuring DI-Triggered Send Entries

A DI-Triggered Send Entry is used to send a string out the GSI Serial Port when a specified set of status input lines matches a specified pattern. The GSI only sends the string once per pattern match. The pattern match must become false and then true once again before the string is resent. This feature prevents the string from being sent multiple times while the input pattern is matched.

```
ESC Model 8816 v5.xx  ID:??      Config GSI2 DI-Triggered Send      04/06/03 14:04:46

     Entry Tag Name              :  SETTIME
     Serial Port#                :  1
     Output String               :  \x40 CLKS %H,%M-001,%S-030,%m,%d,\x0D\x0A

     Interval                    :  1h
     Send Skew Time              :  10m
     FINISHED (Configure Now)

   <Esc> to Cancel
```

Entry Tag Name:

The label used to identify this GSI DI-Triggered Send Entry.

Serial Port #:

The serial port being used for GSI communications. `0` to `3`.

Start Pattern Status Lines:

The digital input pattern that must be matched before transmitting the *Output String*.

Output String:

The string to be sent out of the GSI port. This string can contain time formatting and time offset characters (see page 4-28 "Formatting Strings").

4.7.6 Configuring Alarm Entries

An Alarm Entry is used to control relay outputs upon the reception of a specified string on the GSI Serial Port.

```
ESC Model 8816 v5.xx  ID:??        Config GSI2 Alarm Entry        04/06/03 14:04:46

     Entry Tag Name              :  LOWTEMP
     Serial Port#                :  1
     Alarm String                :  \x0D\x0A         LOW TEMPERATURE

     Output Line(s)              :  8,10=0
     FINISHED (Configure Now)

   <Esc> to Cancel
```

Entry Tag Name:

The label used to identify this GSI Alarm Entry.

Serial Port #:

The serial port being used for GSI communications. **0** to **3**.

Alarm String:

The activation string for this entry (see page 4-28 "Formatting Strings").

Output Lines:

The pattern of digital outputs to be activated and/or deactivated upon reception of the *Alarm String*.

4.7.7 Configuring Primer Entries

A Primer Entry is used to validate or invalidate data based upon the reception of a specified string on the GSI Serial Port. At the beginning of each Primer Duration interval, all of the Affected Data Parse Entries are disabled from accepting valid data. Until the Primer String is received, Affected Data Parse Entries that receive and parse data must mark the received data as invalid. After the Primer String is received, any Affected Data Parse Entries that receive and parse data operate normally, and the received data is valid for averages. For any Affected Data Parse Entries that receive and parse data two or more times after the Primer String is received, all but the first data received is ignored (no data conversion and no affect on validity).

```
ESC Model 8816 v5.xx  ID:??          Config GSI2 Primer Entry        04/06/03 14:04:46

     Primer Tag Name              :  DATAPRIM
     Serial Port#                 :  1
     Primer String                :  \x0D\x0A         %H:%M %m/%d

     Primer Duration              :  1m
     Hold Data Between Updates    :  N
     Affected Data Parse Entries  :  GSISO2,GSICO2,GSINOX,GSIFLOW

     FINISHED (Configure Now)

   <Esc> to Cancel
```

Primer Tag Name:

The label used to identify this GSI Primer Entry.

Serial Port #:

The serial port being used for GSI communications. **0** to **3**.

Primer String:

The string that signals to the *Affected Data Parse Entries* that the following data strings can be parsed for valid data. This string can contain time formatting and time offset characters (see page 4-28 "Formatting Strings").

Primer Duration:

The amount of time after receiving the *Primer String* allowed for *Affected Data Parse Entries* to receive and parse strings containing valid data.

Hold Data Between Updates:

Feature not implemented at this time.

Affected Data Parse Entries:

The list of data parse entry tag names that require the reception of the *Primer String* before receiving and parsing valid data.

4.7.8 *Formatting Strings*

All GSI strings allow the use of **\x*hh***, where ***hh*** is a hexadecimal number from **00** to **FF** representing an ASCII character.

The Output String for the Autosend and DI-Triggered Send Entries and the Primer String for the Primer Entry also allow the data and time to be included in the string. The following special characters are allowed:

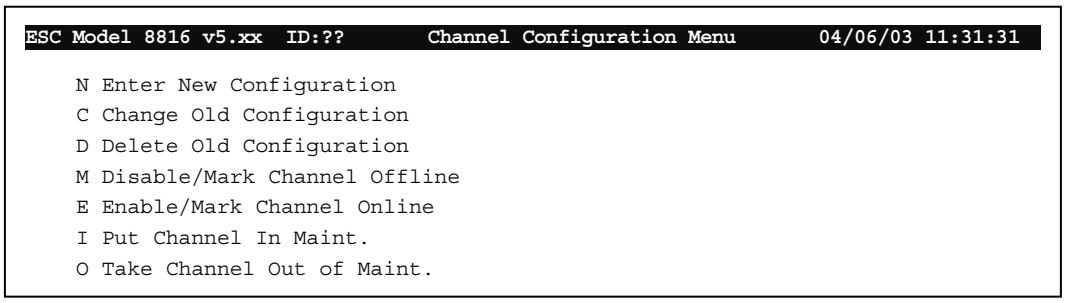
Character	Explanation
%%	Character **%**
%a	Abbreviated weekday name
%A	Full weekday name
%b	Abbreviated month name
%B	Full month name
%c	Date and time
%d[±*nnn*]	Two-digit day of month (**01**-**31**)
%H[±*nnn*]	Two-digit hour (**00**-**23**)
%I	Two-digit hour (**01**-**12**)
%j	Three-digit day of year (**001**-**366**)
%m	Two-digit month as a decimal number (**1**-**12**)
%M[±*nnn*]	Two-digit minute (**00**-**59**)
%p	AM or PM
%S[±*nnn*]	Two-digit second (**00**-**59**)
%U	Two-digit week number where Sunday is the first day of the week (**00**-**53**)
%w	Weekday where **0** is Sunday (**0**-**6**)
%W	Two-digit week number where Monday is the first day of the week (**00**-**53**)
%x	Date
%X	Time
%y	Two-digit year without century (**00**-**99**)
%Y	Year with century
%Z	Time zone name, or no characters if no time zone

For the two-digit second, minute, hour (24-hour), and day, or %S, %M, %H and %d respectively, a three-digit integer can be added or subtracted from the current date and time. For example, if the current date and time is 1/1/92 12:00pm, and an Autosend Entry is configured to output the formatted string "%H:%M+001:%S+030\x0D\x0A", the resulting output is "12:01:30" followed by a line feed and a carriage return.

Chapter 5
Channel Configuration

The *Channel Configuration Menu* allows the user to enter, modify, and delete channel configurations. Channels are also enabled and disabled via this menu and put into and taken out of maintenance mode.

From the *Configuration Menu***,** select *Configure (Data) Channels* (hot key **D**):



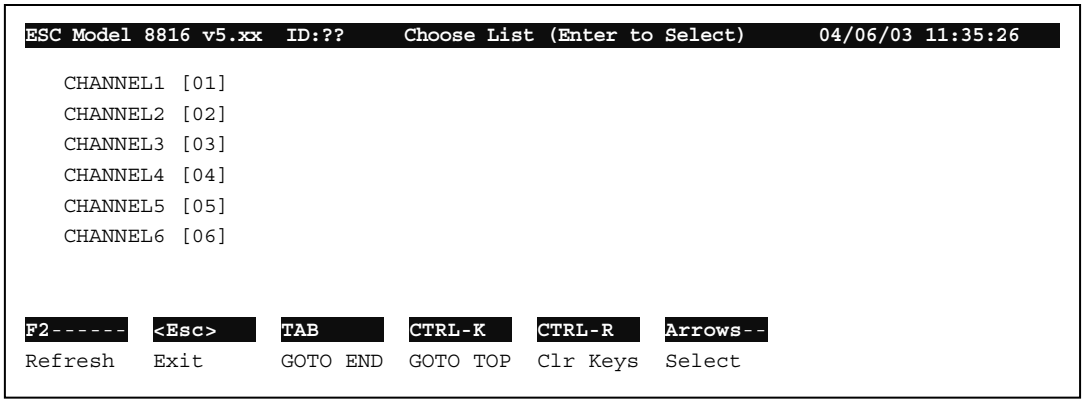
A brief description of each item in the *Channel Configuration Menu* appears in the table below. For more detailed explanations of a particular item, refer to the section noted.

Hot Key	To Option	Purpose	See Page
N	*Enter Old Configuration*	Enters a new channel configuration	5-5
C	*Change Old Configuration*	Modifies an existing channel configuration	5-4
D	*Delete Old Configuration*	Deletes an existing channel configuration	5-2
M	*Disable/Mark Channel Offline*	Disables an existing channel	5-2
E	*Enable/Mark Channel Online*	Enables an existing channel	5-2
I	*Put Channel in Maint.*	Puts a channel into maintenance mode	5-3
O	*Take Channel Out of Maint.*	Takes a channel out of maintenance mode	5-3

Control Keys	Purpose	See Page
<Ctrl><V>	Edit instantaneous or average validation information and percent validity per average	5-48, 5-49
<Ctrl><D>	Configure channel options, such as decimal positioner, round precision, Modbus scale factor and register number, and calibration span value.	5-53
<Ctrl><C>	Toggles between two-point and three-point scaling in standard channel configurations	5-8
<Ctrl><T>	Shows three-point scaling constants in three-point channel configurations (standard channels)	5-8
<Ctrl><A>	Select all channel names in a choose list when enabling/disabling a channel or placing a channel into/out of maintenance.	5-2, 5-3
<Ctrl><D>	Deselect all channel names in a choose list when enabling/disabling a channel or placing a channel into/out of maintenance.	5-2 – 5-3

5.1 Deleting a Channel

Select *Delete Old Configuration* (hot key **D**) from the *Channel Configuration Menu.* A list of existing channels is displayed. Press <Enter> to delete the highlighted channel. Press Y to confirm. Press N, or press <Esc> to exit without deleting a channel.



5.2 Disabling Channels

If you disable a channel, instantaneous readings are invalidated (i.e., any instantaneous data readings taken during the time that the data are flagged are excluded from the averages). To disable a channel, follow these steps:

Step 1. Select *Disable/Mark Channel Offline* (hot key **M**) from the *Channel Configuration Menu.* A list of existing channels will display.

Step 2. The first channel in the list will automatically be highlighted. Select or deselect individual channels by highlighting the desired channel name, and pressing the Spacebar. An indicator (>) will appear next to a selected channel name. If you need to select all channel names, press <Ctrl><A> . If you need to deselect all channel names, press <Ctrl><D>.

Step 3. Press <Enter> to disable the selected channels. Their data readings will be marked with a "D" validation flag. If you want to exit the screen without disabling any channels, press <Esc> to exit.

Take caution not to press the <Enter> key when exiting, or the first channel highlighted in the list will be disabled.

To verify that a channel is disabled, select *Display Readings w/flags* (hot key **F**) from the *Real-Time Display Menu.* A disabled channel will display a "D" flag.

5.3 Enabling Channels

Data for the enabled channel(s) are included in averages if other invalidating conditions do not apply. To enable a channel, follow these steps:

Step 1. Select *Enable/Mark Channel Online* (hot key **E**) from the *Channel Configuration Menu*. A list of existing disabled channels will display. If no channels are disabled, a message indicating this fact will display instead of a list.

Step 2. Select or deselect individual channels by highlighting the desired channel name and pressing the Spacebar. An indicator (>) will appear next to a selected channel name. Press <Ctrl><A> to select all channel names in the list. Press <Ctrl><D> if you need to deselect all channel names in the list.

Step 3. Press <Enter> to enable all selected channels. Their data readings will no longer be marked with a "D" validation flag. If you want to exit the screen without disabling any channels, press <Esc> to exit.

Take caution not to press the <Enter> key when exiting, or the first channel highlighted in the list will be enabled.

5.4 Putting Channels Into Maintenance

If you place a channel in maintenance, instantaneous readings are invalidated (i.e., any instantaneous data readings taken during the time that the data are flagged are excluded from the averages). To put a channel into maintenance, follow these steps:

Step 1. Select *Put Channel In Maint.* (hot key **I**) from the *Channel Configuration Menu*. A list of existing channels will display.

Step 2. Select or deselect individual channels by highlighting the desired channel name and pressing the Spacebar. An indicator (>) will appear next to a selected channel name. Press <Ctrl><A> to select all channel names in the list. Press <Ctrl><D> if you need to deselect all channel names in the list.

Step 3. Press <Enter> to put selected channels into maintenance. Their data readings will be marked with an "M" validation flag. If you want to exit the screen without putting any channels into maintenance, press <Esc> to exit.

Take caution not to press the <Enter> key when exiting, or the first channel highlighted in the list will be put into maintenance.

To verify that a channel is in maintenance, select *Display Readings w/flags* (hot key **F**) from the *Real-Time Display Menu*. A channel in maintenance will display an "M" flag.

5.5 Taking Channels Out of Maintenance

If you take a channel out of maintenance, data for the channel(s) are included in averages if other invalidating conditions do not apply. To take a channel out of maintenance, follow these steps:

Step 1. Select *Take Channel Out Of Maint.* (hot key **O**) from the *Channel Configuration Menu*. A list of existing channels in maintenance will display. If no channels are in maintenance, a message indicating this fact will display instead of a choose list.

Step 2. Select or deselect individual channels by highlighting the desired channel name, and pressing the Spacebar. An indicator (>) will appear next to a selected channel name. Press <Ctrl><A> to select all channel names in the list. Press <Ctrl><D> if you need to deselect all channel names in the list.

Step 3. Press <Enter> to take all selected channels out of maintenance. Their data readings will be no longer be marked with an "M" validation flag. If you want to exit the screen without taking any channels out of maintenance, press <Esc> to exit.

Take caution not to press the <Enter> key when exiting, or the first channel highlighted in the list will be taken out of maintenance.

To verify that a channel is out of maintenance, select *Display Readings w/flags* (hot key **F**) from the *Real-Time Display Menu*. A channel out of maintenance will no longer display an "M" flag.

5.6 Changing a Channel Configuration

To change a channel configuration, select *Change Old Configuration* (hot key **C**) from the *Channel Configuration Menu*. A list of existing channels will display:

```
ESC Model 8816 v5.xx  ID:??     Choose List (Enter to Select)      04/06/03 11:35:26

   CHANNEL1 [01]
   CHANNEL2 [02]
   CHANNEL3 [03]
   CHANNEL4 [04]
   CHANNEL5 [05]
   CHANNEL6 [06]


F2------   <Esc>      TAB        CTRL-K     CTRL-R     Arrows--
Refresh    Exit       GOTO END   GOTO TOP   Clr Keys   Select
```

Press <Enter> for the highlighted channel's configuration screen to appear. The selected channel will be copied into memory for editing. After making changes (see the rest of this section for details), press <Enter> at *FINISHED (Configure Now)* for the changes to take effect. If the configuration screen is exited by pressing the <Esc> key, the changes to the channel configuration will NOT take effect.

NOTE: Each channel and each average in each channel has its own circular storage. The value in the storage field for each average will determine how long data are kept before rolling over. These storage buffers are allocated in discrete 1Kbyte blocks, so even though a storage time of 4d (4 days) may be entered, the ESC Model 8816 rounds up to the next block size. The actual storage time may be reported as 5d, 4h (5 days, 4 hours). In any case, the ESC Model 8816 will store data at least as long as the value configured for storage time.

5.7 Entering New Channel Configurations

Select *Enter New Configuration* (hot key **N**) from the *Channel Configuration Menu*. A list of channel types will display. Eleven channel types are standard; the remainder, shown in italic type, are optional channel types that may or may not have been purchased with the logger.

```
ESC Model 8816 v5.xx  ID:??      Config. Channel- Choose Type      04/06/03 11:39:11

    A Standard Averaging
    M Math Pack
    P Average Math Pack
    R Rolling Averaging
    X Stream-Switched Averaging
    J Merge (Join Streams)
    K Average Merge
    T Time On-Line Counter
    U Multi-Condition TOL Counter
    L Linear Interpolation
    D Digital State Channel
    1 Vector Wind Speed
    2 Vector Wind Direction
    3 Wind Speed Channel
    4 Wind Direction Channel
    5 Sigma-Theta Channel
    6 Linear Sigma Channel
    Z Rainfall Channel
    Q Modbus Channel
    I GSI Channel
    G Tape Sampler Channel
    C General Channel
```

Hot Key	To Option	Purpose	See Page
A	*Standard Averaging*	Standard averaging channel	5-6
M	*Math Pack*	Math pack channel	5-8
P	*Average Math Pack*	Average math pack channel	5-8
R	*Rolling Averaging*	Rolling averaging channel	5-15
X	*Stream-Switched Averaging*	Stream-switched channel	5-16
J	*Merge (Join Streams)*	Joining of two channels' real-time data	5-18
K	*Average Merge*	Merges results at average interval time	5-18
T	*Time On-Line Counter*	Time on-line counter channel	5-21
U	*Multi-Condition TOL Counter*	Multi-condition time on-line counter channel	5-21
L	*Linear Interpolation*	Linear interpolation channel	5-26
D	*Digital State Channel*	Optional digital state channel	5-28
1	*Vector Wind Speed*	Optional vector wind speed channel	5-32
2	*Vector Wind Direction*	Optional vector wind direction channel	5-32
3	*Wind Speed Channel*	Optional (scalar) wind speed channel	5-30
4	*Wind Direction Channel*	Optional (scalar) wind direction channel	5-30
5	*Sigma-Theta Channel*	Optional sigma-theta channel	5-36
6	*Linear Sigma Channel*	Optional linear sigma channel	5-34

Hot Key	To Option	Purpose	See Page
Z	*Rainfall Channel*	Optional rainfall channel	5-38
Q	*Modbus Channel*	Optional Modbus "slave" channel	5-39
I	*GSI Channel*	Optional generic serial interface channel	5-42
G	*Tape Sampler Channel*	Optional tape sampler channel	5-44
C	*General Channel*	Multi-purpose channel	5-46

5.8 Standard Averaging Channels

Standard averaging channels calculate averages from voltage or current inputs for up to three unique averaging intervals.

As each voltage or current input is scanned, it is scaled to the appropriate engineering units (EU) (PPM, %, etc.) according to the user's specifications. Analog inputs may be scaled using either a linear (first-order) or parabolic (second-order) curve-fit to yield the desired engineering units.

The first average, called the "base average," is then calculated as the average of all scans (in EU values) for the prescribed interval. If configured, one or two extended averages are then calculated as the average of several base averages, according to each of the other averages' prescribed intervals. If the base average is considered to be invalid due to calibration or some error, that average is not included in the calculation of the other one or two dependent averages. (See "Appendix C. Clean Air Act Validation" in this manual for extended average calculation details when *Use 40CFR75 Validation (Y/N)* field is set to **Y**.

Select *Standard Averaging* (hot key **A**) from the *Config. Channel- Choose Type* screen. The *Standard Channel Config.* screen will display:

```
ESC Model 8816 v5.xx  ID:??        Standard Channel Config.        04/06/03 11:42:02

    Instrument Name              :  SO2
    Analog Input Number          :  01
    Report Channel Number        :  01
    Volts Full Scale             :  N/A
    High Input                   :  20 mA
    Low Input                    :  0 mA
    High Output (E.U.s)          :  100
    Low Output (E.U.s)           :  0
    Units                        :  %FS
    Base Avg. Interval, Storage  :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    Use 40CFR75 Validation (Y/N):  N
    FINISHED (Configure Now)


  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Analog Input Number:

Specifies the actual, physical input line number. `01` to `99`. When using a Meteorological Input Card, inputs **`Tx`**, **`Dx`**, **`Sx`** or **`Rx`** can be used (**`x`** is the integer number of the Meteorological Input Card).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. `01` to `99`.

Volts Full Scale:

The volts full scale range for the channel. `0.1`, `1.0`, `5.0` or `10.0` volts. Applicable only when the Analog Input Number references a voltage input.

High Input:

The maximum current, voltage, hertz or voltage ratio output from the instrument.

Mid Input:

The mid-range current, voltage, hertz or voltage ratio output from the instrument; used for parabolic scaling. (<Ctrl><C> toggles between parabolic and linear scaling.)

Low Input:

The minimum current, voltage, hertz or voltage ratio output from the instrument.

High Output:

The instrument reading in engineering units corresponding to the High Input.

Mid Output:

The instrument reading in engineering units corresponding to the Mid Input; used for parabolic scaling. (<Ctrl><C> toggles between parabolic and linear scaling.)

Low Output:

The instrument reading in engineering units corresponding to the Low Input.

Units:

The engineering units to which the input readings will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Use 40CFR75 Validation (Y/N):

Yes, No or Grace Disabled. **Y** causes the channel to validate hourly averages in accordance with the Clean Air Act regulations (see Appendix C). Default=**N**: Averages are validated using a simple percent validity test (see page 4-4 "Configuring System Parameters"). **G** causes the channel to operate exactly as **Y** except that no 8-hour grace period is allowed after a startup. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

5.8.1 *Scaling*

Standard channels have the optional capability of parabolic (second-order) scaling. Three points can be entered (low, mid, and high inputs and outputs) that the ESC Model 8816 uses to construct a second-order curve fit. Press <Ctrl><C> in the *Standard Channel Config.* screen to toggle between linear scaling and parabolic scaling (**Mid Input** and **Mid Output** fields appear).

```
ESC Model 8816 v5.xx  ID:??          View Scaling Coeff.          04/06/03 11:46:07

    X^2 Coefficient             :  0.03922
    X Coefficient (slope)       :  6.203
    Offset                      :  -1.242


  <Esc> to exit to chl cfg
```

After toggling to parabolic scaling, press <Ctrl><T> to display the three-point scaling constants, which are based on the regular channel configuration of low/mid/high inputs and outputs.

5.9 Math Pack and Average Math Channels

Math pack channels calculate results according to a user-defined equation. The configured equation can use the results of other channels as operators. This channel type is most often used to correct stack gas readings from dilution probes for the diluent or to calculate emission rates for pollutants in lbs/hour or lbs/mmBtu. Like the standard averaging channel, a math pack channel has a base average and up to two dependent averages.

Average math channels perform a similar function, but the calculation is not computed until the time of the average, and the average is formed from the averages (not the instantaneous readings) of the input channels. Any equation using operators other than addition or subtraction will yield different results using this method.

For the same reason, it is incorrect to compare the average of a regular math pack channel with the averages of its input channels using the equation. The answers will probably differ, based upon the well-known fact that (a+b) × (x+y) does not equal (ax + by).

A system parameter called `Math Update Rate` allows the rate at which equations are evaluated to be configured, from once per second to once per 10 seconds. See page 4-4 "Configuring System Parameters."

```
ESC Model 8816 v5.xx  ID:??       Math Channel Configuration       04/06/03 11:48:15

    Instrument Name             :  TEMP
    Report Channel Number       :  01
    Equation                    :  0=


    Units                       :  #/MBTU
    Base Avg. Interval, Storage :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    Round Constituents (Y/N)    :  N
    Use 40CFR75 Validation (Y/N):  N
    FINISHED (Configure Now)

  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

See page 5-49 "Configuring Average Validation Limits" for information about writing averages to Math Constants.

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. `01` to `99`.

Equation:

The equation to be used to calculate data from this channel; see page 5-11 "Equation Configuration" for details. Up to 255 characters. If using math constants, refer to page 5-13 "Configuring Math Constants."

Units:

The engineering units to which the equation results will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Round Constituents (Y/N):

Yes or No to indicate if the constituents for this calculated average are to be rounded before calculating the average. If Yes, the constituents in the equation will be rounded according to the precision configured in the channel options screen *for the constituent(s)*. If this math channel parameter is to be used in another math channel equation (i.e., it is itself a constituent) and that math channel is to be rounded, use <Ctrl><D> to configure the rounding precision. See also page 5-54 "Implicit Rounding of Values."

Use 40CFR75 Validation (Y/N):

Yes, No or Grace Disabled. **Y** causes the channel to validate hourly averages in accordance with the Clean Air Act regulations (see Appendix C). Default=**N**: Averages are validated using a simple percent validity test (see page 4-4 "Configuring System Parameters"). **G** causes the channel to operate exactly as **Y** except that no 8-hour grace period is allowed after a startup. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

```
ESC Model 8816 v5.xx  ID:??      Average Math Channel Config.      04/06/03 11:48:15

    Instrument Name              :  TEMP
    Report Channel Number        :  01
    Equation                     :  0=



    Units                        :  #/MBTU
    Base Avg. Interval, Storage  :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    Round Constituents (Y/N)     :  N
    Use 40CFR75 OOC (Y/N)        :  N
    FINISHED (Configure Now)


  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

See page 5-49 "Configuring Average Validation Limits" for information about writing averages to Math Constants.

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. **01** to **99**.

Equation:

The equation to be used to calculate data from this channel; see page 5-11 "Equation Configuration" for details. Up to 255 characters. If using math constants, refer to page 5-13 "Configuring Math Constants."

Units:

The engineering units to which the equation results will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the first interval time at which the ESC Model 8816 will evaluate the Equation. This interval must match the Base Average Interval of any constituent channels in the Equation. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the second interval time at which the ESC Model 8816 will evaluate the Equation. This interval must match the Average #1 Interval of any constituent channels in the Equation. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the third interval time at which the ESC Model 8816 will evaluate the Equation. This interval must match the Average #2 Interval of any constituent channels in the Equation. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Round Constituents (Y/N):

Yes or No to indicate if the constituents for this calculated average are to be rounded before calculating the average. If Yes, the constituents in the equation will be rounded according to the precision configured in the channel options screen *for the constituent(s)*. If this math channel parameter is to be used in another math channel equation (i.e., it is itself a constituent) and that math channel is to be rounded, use <Ctrl><D> to configure the rounding precision. See also page 5-54 "Implicit Rounding of Values."

Use 40CFR75 OOC (Y/N):

Yes, No or Grace Disabled. **Y** causes the channel to validate hourly averages in accordance with the Clean Air Act regulations (see Appendix C). Default=**N**: Averages are validated using a simple percent validity test (see page 4-4 "Configuring System Parameters"). **G** causes the channel to operate exactly as **Y** except that no 8-hour grace period is allowed after a startup. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

5.9.1 *Equation Configuration*

In order to define the equation that a math pack channel uses as its input, the equation must be entered just as it would be on a calculator.

In addition to numerals, the following two columns of operators can be used:

Equation Symbol	Explanation	Equation Symbol	Explanation
<channel name>	take reading from an existing channel	SIN()	sine
*	multiply	ASIN()	arc sine

Equation Symbol	Explanation	Equation Symbol	Explanation
/	divide	COS()	cosine
+	add	ACOS()	arc cosine
-	subtract	TAN()	tangent
^	raise to the power	ATAN()	arc tangent
K1...K32	use math pack constant in equation	LOG()	logarithm, base 10
SQRT()	take square root	LN()	natural logarithm
%	modulo	ABS()	absolute value
~	round	EXP()	natural exponent
TRUNC()	truncate	QTRHR()	quarter hour in fractional units
SECMN(SECS)	Number of seconds into the current SECS second interval. If SECS is omitted, the default is 60 seconds (1 min).	MINHR(MINS)	Number of minutes into the currents MINS minute interval. If MINS is omitted, the default is 60 minutes (1 hr).
HRDAY(HRS)	Number of hours into the current HRS hour interval. If HRS is omitted, the default is 24 hours (1 day).	JDAY(DAYS)	Number of days into the current DAYS interval. If DAYS is omitted, the default is the total number of days in the current year.
<	math less than: Format is A < B. If A is less than B, then A is used. Else B is used. A and B can be channel names, math constants, etc.	>	math greater than: Format is A > B. If A is greater than B, then A is used. Else B is used. A and B can be channel names, math constants, etc.
?	math merge channels: Format is (<channel1> ? <channel2>). <channel1> is considered the primary channel and <channel2> is considered the secondary channel. This operation cannot be embedded in another merge (e.g., (S1?S2)?S3.)	#	math optime: Format is A # B. A is the value to normalize. B is the number of divisions in which hour is to be divided (precision). A and B can be channel names, math constants, etc.

Example: A user wishes to average the concentration of SO2 of three ducts into one "stack value," weighed by three flow measurements. The equation might appear as:

```
(SO2A * FLOWA + SO2B * FLOWB + SO2C * FLOWC) / 3.0 =
```

When a channel name is used in an equation, that channel must already exist or the ESC Model 8816 will invalidate the equation entry.

Explicit Rounding in Equations

The format for explicitly rounding values in a math equation is: <*expression*>~<*round_precision*>, where <*expression*> is any valid math pack sequence of values, operators, or operands. The <*expression*> will be rounded to the number of decimal places indicated by <*round_precision*>. The value of <*round_precision*> is interpreted as:

1 = round to the nearest tenth	-1 = round to the nearest ten
2 = round to the nearest hundredth	-2 = round to the nearest hundred
3 = round to the nearest thousandth	-3 = round to the nearest thousand, etc.

The implicit rounding of values is described in page 5-54 "Implicit Rounding of Values."

5.9.2 *Configuring Math Constants*

The *Configure Math Constants* screen allows the user to create up to 32 math constants that can be used throughout the system. These math constants may be used in equations for math pack channels. The intention of math constants is to represent parameters in the system that only periodically change, and this screen is an easy way to update those constants without reconfiguring several math channels.

An option will allow a calibration expected value or result to be written to a math constant; see page 6-18 "Configuring Expected Values." Any of the three averages of a channel (base, average #1, average #2) can also be written to a constant; see page 5-49 "Configuring Average Validation Limits."

Select *Configure Math Constants* (hot key **K**) from the *Configuration Menu*. The following screen is displayed:

```
ESC Model 8816 v5.xx  ID:??        Set Math Pack Constants.        04/06/03 11:50:03

    Constant K1  =                              1
    Constant K2  =                              1
    Constant K3  =                              1
    Constant K4  =                              1
    Constant K5  =                              1
    Constant K6  =                              1
    Constant K7  =                              1
    Constant K8  =                              1
    Constant K9  =                              1
    Constant K10 =                              1
    Constant K11 =                              1
    Constant K12 =                              1
    Constant K13 =                              1
    Constant K14 =                              1
    Constant K15 =                              1
    Constant K16 =                              1

  ESC=Exit. CTRL-A=Alternate Values. CTRL-N=Next Page
```

Press <Ctrl><N> to display the remaining 16 math constants, K17 to K32, in a similar display.

Secondary or tertiary values based on digital inputs can also be defined for the math constants.

These were designed for fuel-switching systems, which must constantly adjust the fuel factor and can provide digital inputs representing the exact fuel loaded.

Place the cursor on the desired math constant, and press <Ctrl><A>. A screen will display with fields for entering the numerical value and digital input status for the secondary and tertiary states:

```
ESC Model 8816 v5.xx  ID:??        Set Constants/Secondary          04/06/03 11:54:06

    Constant # (not editable) :    1
    Primary Value =           :    1800.00000
    Alternate Value#1 =       :    1420.00000
    Alternate Status#1        :    1=0&2
    Alternate Value#2 =       :    0.000000
    Alternate Status#2        :    (none)


  ESC=Exit. CTRL-A=Primary Values
```

When the digital input state does not match the secondary or tertiary status, the primary value (edited on the first screen) is used.

5.9.3 *Configuring Data Validation Flags in Math Channels*

The following table shows how data validation flags are propagated in math pack and average math channels.

Flag Type in Math Pack Channels	Instanta-neous Reading	Base Avg	Avg# 1	Avg# 2
All instant. validation flags on math parameter	Y	Y	Y	Y
V-Z instant. information flags on math parameter	Y	Y	Y	Y
All average validation flags on math parameter (H, h, L, l, J, j, f, c) except G	N	(Y)	(Y)	(Y)
G average validation flag on math parameter	N	Y	((Y))	((Y))
All instantaneous validation flags on constituent	Y	Y	Y	Y
Out-of-control tolerance flag on constituent	Y	Y	Y	Y
V-Z instant. information flags on constituent	Y	Y	Y	Y
All average validation flags on constituent (H, h, L, l, J, j, f, c, G)	N	N	N	N

Flag Type in Average Math Pack Channels	Instantaneous Reading	Base Avg	Avg# 1	Avg# 2
All instant. validation flags on math parameter	Y	Y*	Y*	Y*
V-Z instant. information flags on math parameter	Y	Y	Y	Y
All average validation flags on math parameter (H, h, L, l, J, j, f, c) except G	N	(Y)	(Y)	(Y)
G average validation flag on math parameter	N	Y	((Y))	((Y))
All instantaneous validation flags on constituent	Y	Y	Y	Y
Out-of-control tolerance flag on constituent	Y	Y	Y	Y

Flag Type in Average Math Pack Channels	Instantaneous Reading	Base Avg	Avg# 1	Avg# 2
V-Z instant. information flags on constituent	Y	N	N	N
All average validation flags on constituent (H, h, L, l, J, j, f, c, G)	N	N	N	N

(Y) means yes, but flag is not propagated (only average information configured for *that* average is seen).

((Y)) means yes, but flag is only generated on base average and propagated to extended averages.

* Flag appears but data are not invalidated.

5.10 Rolling Average Channels

Rolling average channels take average values determined by other channels as input, and then calculate rolling averages from them. A rolling average is updated at the same interval as the input average, but is calculated over a length of time equal to the rolling average duration. If, for example, the input average interval is one minute, and the rolling average duration is one hour, then the rolling average channel will store a new data point every minute. This data point will be an average of the last 60 one-minute input averages.

```
ESC Model 8816 v5.xx  ID:??          Rolling Average Config          04/06/03 11:57:33

    Instrument Name              :  TEMP
    Report Channel Number        :  01
    Input Channel                :  (none)
    Input Avg Interval,Storage   :  1m  , 0s
    Units                        :  #/HR
    Rolling Average Duration     :  1h
    Clear at Rolling Interval?   :  N
    Exclude Offline Data?        :  N
    FINISHED (Configure Now)

  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. `01` to `99`.

Input Channel:

The name of the channel to be used as input. Must be a configured channel name.

Input Avg Interval, Storage:

The first half of the field specifies the input channel's average interval from which rolling averages will be calculated. The second half of the field specifies the length of the long-term data storage buffer for the Input Average Interval.

Units:

The engineering units to which the readings will be scaled (AP, #/MBTU, PPM, etc.).

Rolling Average Duration:

Specifies the total length of the rolling average. (Rolling averages are calculated and stored each time a new input average becomes available.) The maximum length of the rolling average stack (Rolling Average Duration ÷ Input Average Interval) is 60.

Clear at Rolling Interval?

Yes or No to specify whether the rolling average buffer should be cleared at the beginning of each Rolling Average Duration. Default=**N**.

Exclude Offline Data?

Yes or No to specify whether offline input data should be excluded from the rolling average calculation. If this is set to **Y** and the input data is offline, the held rolling average value is marked with the offline flag 'F.' Default=**N**.

5.11 Stream-Switched Averaging Channels

Stream-switched channels allow the ESC Model 8816 to monitor one analyzer that is time-shared between two sampling trains. It forms a base average and two extended averages from another channel, accepting data from that input channel only when an online digital input status is met. If this condition is not met, data may be designated as invalid, or the last good reading, base average, extended average, or average over the previous online period may be "held" until the online status condition is met again.

An example of configuring a stream-switched (or time-shared) system between three boilers is given on page 14-1 "Application Note - Stream-Switched Channel."

When stream-switched channels are controlled by digital event programs or calibrated using the automatic calibration programs, the digital program or calibration timing may not line up exactly with the stream-switched channels averaging periods. It is recommended that calibrations and event programs be configured so that they end a few seconds before the start of the next base average.

```
ESC Model 8816 v5.xx  ID:??        Stream-Switched Config.        04/06/03 12:01:26

   Instrument Name              :  TEMP
   Report Channel Number        :  01
   Input Channel                :  (none)
   On-Line Input Status         :  (none)
   Purge Time                   :  0s
   Offline Action (I,R,O,B,1,2):  I
   Units                        :  %FS
   Base Avg. Interval, Storage  :  1m  , 0s
   Average #1 Interval, Storage:  15m , 0s
   Average #2 Interval, Storage:  1h  , 0s
   Use 40CFR75 Validation (Y/N):  N
   FINISHED (Configure Now)

 CTRL-V=Edit Validation. CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. **01** to **99**.

Input Channel:

The name of the channel to be used as input. Must be a configured channel name.

On-Line Input Status:

Specifies the online digital input pattern. Both the line number and the state should be specified (**1**=on, **0**=off); e.g., **2=1**.

Purge Time:

Amount of time to wait after switching from offline to online before taking data again.

Offline Action (I,R,O,B,1,2):

If the online digital input pattern is not met, this designates whether data should be in-validated (**I**) or the last good reading (**R**), the average of the last online period (**O**), the last base average (**B**), the last average #1(**1**), or the last average #2 (**2**) should be "held" until the online status condition is met again.

Units:

The engineering units to which the readings will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Use 40CFR75 Validation (Y/N):

Yes, No or Grace Disabled. **Y** causes the channel to validate hourly averages in accordance with the Clean Air Act regulations (see Appendix C). Default=**N**: Averages are validated using a simple percent validity test (see page 4-4 "Configuring System Parameters"). **G** causes the channel to operate exactly as **Y** except that no 8-hour grace period is allowed after a startup. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

5.12 Merge (Join Streams) and Average Merge Channels

The Merge (Join Streams) channel type allows two channels to be merged into one channel (almost the opposite of a stream-switched channel). The real-time data from two channels are merged and then averaged. This type of channel uses the value of one of two input channels, based on a digital input line status. The *On-Line Input Status* pattern indicates when the primary channel should be used; if the pattern is not observed, the secondary channel's data are used.

The Average Merge channel merges the results of two input channels at the average time, rather than merging real-time data, similar to the Average Math channel.

```
ESC Model 8816 v5.xx  ID:??        Merge/Join Chl Config.        04/06/03 12:03:20

    Instrument Name              :  TEMP
    Report Channel Number        :  01
    Primary Input Channel        :  (none)
    Secondary Input Channel      :  (none)
    On-Line Input Status         :  (none)
    Switch on Invalid?           :  Y
    Switch on Flags              :  (none)
    Purge Time                   :  0s
    Flags from Off-Line Channel  :  (none)
    Units                        :  %FS
    Base Avg. Interval, Storage  :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    Use 40CFR75 Validation (Y/N):  N
    FINISHED (Configure Now)

  CTRL-V=Edit Validation. CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. `01` to `99`.

Primary Input Channel:

The name of the channel to be used as the primary source of data for the merged channel. Must be a configured channel name.

Secondary Input Channel:

The name of the channel to be used as the secondary source of data for the merged channel. Must be a configured channel name.

On-Line Input Status:

(Merge/Join channel only) Specifies the online digital input pattern. Both the line number and the state should be specified (`1`=on, `0`=off); e.g., `2=1`.

Switch on Invalid?:

Yes or No. If **Y**, the merged channel will also revert to taking data from the secondary input channel if readings from the primary input channel become invalid due to a bad status, calibration, etc. (anything that results in the < flag being appended to data).

Switch on Flags:

The list of data flags that selects the secondary channel's data.

Purge Time:

(Merge/Join channel only) Amount of time to wait after switching from offline to online before taking data again.

Flags from Off-Line Channel:

(Merge/Join channel only) The flags that should be passed up to the merged channel from offline channels; data from offline channels will not be used but flags will (e.g., dual range analyzers that pass on the out-of-control flag).

Units:

The engineering units to which the readings will be scaled (e.g., **PPM**).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Use 40CFR75 Validation (Y/N):

Yes, No or Grace Disabled. **Y** causes the channel to validate hourly averages in accordance with the Clean Air Act regulations (see Appendix C). Default=**N**: Averages are validated using a simple percent validity test (see page 4-4 "Configuring System Parameters"). **G** causes the channel to operate exactly as **Y** except that no 8-hour grace period is allowed after a startup. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

```
ESC Model 8816 v5.xx  ID:??        Avg Merge Chl Config.          04/06/03 12:03:20

    Instrument Name              :  TEMP
    Report Channel Number        :  01
    Primary Input Channel        :  (none)
    Secondary Input Channel      :  (none)
    Switch on Invalid?           :  Y
    Switch on Flags              :  (none)
    Units                        :  %FS
    Base Avg. Interval, Storage  :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    Use 40CFR75 OOC (Y/N)        :  N
    FINISHED (Configure Now)


  CTRL-V=Edit Validation. CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. **01** to **99**.

Primary Input Channel:

The name of the channel to be used as the primary source of data for the merged channel. Must be a configured channel name.

Secondary Input Channel:

The name of the channel to be used as the secondary source of data for the merged channel. Must be a configured channel name.

Switch on Invalid?:

Yes or No. If **Y**, the merged channel will also revert to taking data from the secondary input channel if readings from the primary input channel become invalid due to a bad status, calibration, etc. (anything that results in the < flag being appended to data).

Switch on Flags:

The list of data flags that selects the secondary channel's data.

Units:

The engineering units to which the readings will be scaled (e.g., **PPM**).

Base Avg. Interval, Storage:

The first half of the field specifies the first interval time at which the ESC Model 8816 will record data from an Input Channel. This interval must match the Base Average Interval of both the Primary Input Channel and the Secondary Input Channel. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the second interval time at which the ESC Model 8816 will record data from an Input Channel. This interval must match the Average #1 Interval of both the Primary Input Channel and the Secondary Input Channel. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the third interval time at which the ESC Model 8816 will record data from an Input Channel. This interval must match the Average #2 Interval of both the Primary Input Channel and the Secondary Input Channel. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Use 40CFR75 OOC (Y/N):

Yes, No or Grace Disabled. **Y** causes the channel to validate hourly averages in accordance with the Clean Air Act regulations (see also Appendix C). Default=**N**: Averages are validated using a simple percent validity test (see page 4-4 "Configuring System Parameters"). **G** causes the channel to operate exactly as **Y** except that no 8-hour grace period is allowed after a startup. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

5.13 Time On-Line and Multi-Condition Time On-Line Channels

These types of channels provide a method for counting online intervals. Time online (TOL) channels are typically used to monitor boiler or scrubber online times.

Time online channels count the number of base average intervals in which a user-configured digital input online status is met. The total number of base averages that meet this condition is reported in an extended average.

Example: If the base average is one minute and the extended average is one hour, then the hourly average would report the number of minutes that the online status was observed.

Multi-condition TOL channels allow up to three conditions to be specified that must be considered when determining online intervals. The three conditions can be considered together (AND link), so that all conditions must be true to determine an online interval, or they can be considered separately (OR link), so that only one must be true for an online interval to be counted.

A condition can be configured as a digital input line status, a channel/threshold value or a combination of the two. If both are configured, the states of each are OR'ed together to determine the condition status.

```
ESC Model 8816 v5.xx  ID:??          Time On-Line Config.          04/06/03 12:05:04

    Instrument Name             :  TEMP
    Report Channel Number       :  01
    On-Line Input Status        :  (none)
    TOL Output Control Line     :  (none)
    Require Full Base Int(Y/N)? :  N
    Units                       :  MINS
    Base Avg. Interval, Storage :  1m  , 0s
    Average #1 Interval, Storage:  1h  , 0s
    Average #2 Interval, Storage:  15m , 0s
    FINISHED (Configure Now)


CTRL-V=Edit Avg. Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. **01** to **99**.

On-Line Input Status:

Specifies the online digital input pattern. Both the line number and the state should be specified (**1**=on, **0**=off); e.g., **2=1**.

TOL Output Control Line:

Optional specification of an output line pattern to be activated or deactivated when the On-Line Input Status is met.

NOTE: If this pattern is changed while the TOL channel is active, the "old" pattern does not reset.

Require Full Base Int(Y/N)?:

Yes or No to require that, to be considered online, the On-Line Input Status must be met for the full Base Average Interval. Default=**N**.

Units:

The engineering units to which the readings will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will instantaneously check for a digital input pattern matching the On-Line Input Status. The result stored for this interval will always be either "0" or "1". The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the totaling interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the totaling interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

```
ESC Model 8816 v5.xx  ID:??     Multi-Conditional TOL Config.      04/06/03 12:06:33

    Instrument Name              :  TEMP
    Report Channel Number        :  01
    COND-A Input Status          :  (none)
    COND-A Input Channel         :  (none)
    COND-A Threshold Type/Value  :  (none)
    COND-A/B Link (AND/OR)       :  OR
    COND-B Input Status          :  (none)
    COND-B Input Channel         :  (none)
    COND-B Threshold Type/Value  :  (none)
    COND-B/C Link (AND/OR)       :  OR
    COND-C Input Status          :  (none)
    COND-C Input Channel         :  (none)
    COND-C Threshold Type/Value  :  (none)
    TOL Output Control Line      :  (none)
    Require Full Base Int(Y/N)?  :  N
    Units                        :  MINS
    Base Avg. Interval, Storage  :  1m  , 0s
    Average #1 Interval, Storage:  1h  , 0s
    Average #2 Interval, Storage:  15m , 0s
    FINISHED (Configure Now)


  CTRL-V=Edit Avg. Validation, CTRL-D=Config. Channel Options
```

The configuration of a multi-condition TOL channel is the same as for a time online channel, with the addition of some fields in place of the one *On-Line Input Status*. Note that if a condition is not specified, it is considered false. In this case (when a condition is **not** used), it should be linked to the other states with **OR**.

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. **01** to **99**.

COND-A Input Status:

Specifies the online digital input pattern for the first condition. Both the line number and the state should be specified (**1**=on, **0**=off); e.g., **2=1**.

COND-A Input Channel:

The name of the channel to be checked for the first condition. Must be a configured channel name.

COND-A Threshold Type/Value:

Specifies the COND-A Input Channel's threshold in the format **>Value**, **<Value**, or **=Value**, where Value is numeric data.

COND A/B Link (AND/OR):

Indicates whether the first and second conditions should be considered together (AND) or separately (OR) to determine online intervals. Default=**OR**: one of conditions A or B must meet the specified status.

COND-B Input Status:

Specifies the online digital input pattern for the second condition. Both the two-digit line number and the state should be specified (**1**=on, **0**=off); e.g., **02=1**.

COND-B Input Channel:

The name of the channel to be checked for the second condition. Must be a configured channel name.

COND-B Threshold Type/Value:

Specifies the COND-B Input Channel's threshold in the format **>Value**, **<Value**, or **=Value**, where Value is numeric data.

COND B/C Link (AND/OR):

Indicates whether the second and third conditions should be considered together (AND) or separately (OR) to determine online intervals. Default=**OR**: one of conditions B or C must meet the specified status.

COND-C Input Status:

Specifies the online digital input pattern for the third condition. Both the two-digit line number and the state should be specified (**1**=on, **0**=off); e.g., **02=1**.

COND-C Input Channel:

The name of the channel to be checked for the third condition. Must be a configured channel name.

COND-C Threshold Type/Value:

Specifies the COND-C Input Channel's threshold in the format **>Value**, **<Value**, or **=Value**, where Value is numeric data.

TOL Output Control Line:

Optional specification of an output line pattern to be activated or deactivated when the On-Line Input Status is met.

NOTE: If this pattern is changed while the TOL channel is active, the "old" pattern does not reset.

Require Full Base Int(Y/N)?:

Yes or No to require that, to be considered online, the On-Line Input Status must be met for the full Base Average Interval. Default=**N**.

Units:

The engineering units to which the readings will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will instantaneously check for a digital input pattern matching the On-Line Input Status. The result stored for this interval will always be either "0" or "1". The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the totaling interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the totaling interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

5.14 Linear Interpolation Channels

The linear interpolation channel is designed to meet the alarming requirements of Appendix E to 40CFR75. Appendix E systems require that the measured value of certain parameters (e.g., O2) be within a certain range of test values. The estimated value is calculated by linear interpolation between test points, correlating it to an input parameter (typically heat input).

The number of correlated input parameters is limited to six (6), which is suitable for most applications.

```
ESC Model 8816 v5.xx  ID:??        Linear Interp. Config.        04/06/03 12:08:06

    Instrument Name              :  TEMP
    Report Channel Number        :  01
    Input Channel                :  (none)
    # of Points/Runs             :  2
    Input,Output[0]              :  0          ,0
    Input,Output[1]              :  1000       ,1000
    Input,Output[2]              :  0          ,0
    Input,Output[3]              :  0          ,0
    Input,Output[4]              :  0          ,0
    Input,Output[5]              :  0          ,0
    Units                        :  %FS
    Base Avg. Interval, Storage  :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    Use 40CFR75 Validation (Y/N):  N
    FINISHED (Configure Now)


  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Channel Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. `01` to `99`.

Input Channel:

The name of the channel to be used as input. Must be a configured channel name.

Number of Points/Runs:

The number of points or runs to apply to the interpolation; the number of input/output ("x,y coordinates") to calculate.

Input,Output[0]:

First input value ("x coordinate") to be correlated versus the output value ("y coordinate"); usually `0,0`. Math constants (`K1-K32`) are allowed for either value.

Input,Output[1]:

Second input value ("x coordinate") to be correlated versus the output value ("y coordinate"). Math constants (**K1-K32**) are allowed for either value.

Input,Output[2]:

Third input value ("x coordinate") to be correlated versus the output value ("y coordinate"). Math constants (**K1-K32**) are allowed for either value.

Input,Output[3]:

Fourth input value ("x coordinate") to be correlated versus the output value ("y coordinate"). Math constants (**K1-K32**) are allowed for either value.

Input,Output[4]:

Fifth input value ("x coordinate") to be correlated versus the output value ("y coordinate"). Math constants (**K1-K32**) are allowed for either value.

Input,Output[5]:

Sixth input value ("x coordinate") to be correlated versus the output value ("y coordinate"). Math constants (**K1-K32**) are allowed for either value.

Units:

The engineering units to which the readings will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Use 40CFR75 Validation (Y/N):

Yes, No or Grace Disabled. **Y** causes the channel to validate hourly averages in accordance with the Clean Air Act regulations (see Appendix C). Default=**N**: Averages are validated using a simple percent validity test (see page 4-4 "Configuring System Parameters"). **G** causes the channel to operate exactly as **Y** except that no 8-hour grace period is allowed after a startup. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

Validation limits, percent validity, and decimal positioner are configured as for standard channels.

5.15 Digital State Channels (Optional)

A digital state channel monitors four digital input lines and their online statuses over the base average, much like the time online channel. However, rather than counting instances of online or offline status, the four channels' statuses are grouped together and represented as numeric data. At each averaging interval, a four-digit number is stored, each digit being "0" (for offline) or "1" (for online), with the first digital input line status in the 1's place, the second digital input line status in the 10's place, etc.. Once the data are stored in numerical format, they can be used to drive analog outputs, trigger alarms, and so forth.

```
ESC Model 8816 v5.xx  ID:??        Digital Channel Config.        04/06/03 13:26:44

    Instrument Name              :  TEMP
    Report Channel Number        :  01
    Line #1                      :  00
    Line #2                      :  00
    Line #3                      :  00
    Line #4                      :  00
    Require Full Int (Y/N)?      :  N
    Units                        :  STATE
    Base Avg. Interval, Storage  :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    FINISHED (Configure Now)

  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. `01` to `99`.

Line #1:

The digital input number for the first digital input line (whose results will appear in the 1's place). `00` to `99`.

Line #2:

The digital input number for the second digital input line (whose results will appear in the 10's place). `00` to `99`.

Line #3:

The digital input number for the third digital input line (whose results will appear in the 100's place). `00` to `99`.

Line #4:

The digital input number for the fourth digital input line (whose results will appear in the 1000's place). `00` to `99`.

Require Full Int (Y/N)?:

Yes or No to require that, to be counted as online (=1), the digital input line must be on for the full Base Average Interval.

Units:

The engineering units to which the data will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will instantaneously check each specified digital input. The result stored for this interval will always be either "0" or "1" for each field of the pattern. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

5.16 Scalar Wind Speed and Wind Direction Channels (Optional)

The ESC Model 8816 supports wind speed (WSP) and wind direction (WDR) channels, in both scalar and vector form (see page 5-32 "Vector Wind Speed and Wind Direction Channels (Optional)"). Zero crossovers and 0 - 540° instruments are supported.

```
ESC Model 8816 v5.xx  ID:??          Wind Channel Config.          04/06/03 13:30:30

    Instrument Name              :  WSP1
    Report Channel Number        :  01
    Analog Input Number          :  01
    Volts Full Scale             :  N/A
    High Input                   :  20 mA
    Low Input                    :  0 mA
    High Output (E.U.s)          :  100
    Low Output (E.U.s)           :  0
    Units                        :  MPH
    Base Avg. Interval, Storage  :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    FINISHED (Configure Now)

  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. **01** to **99**.

Analog Input Number:

Specifies the actual, physical input line number. **01** to **99**. When using a Meteorological Input Card, inputs **Tx**, **Dx**, **Sx** or **Rx** can be used (**x** is the integer number of the Meteorological Input Card).

Volts Full Scale:

The volts full scale range for the channel. **0.1**, **1.0**, **5.0**, or **10.0** volts. Applicable only when the Analog Input Number references a voltage input.

High Input:

The maximum current, voltage, hertz or voltage ratio output from the instrument.

Low Input:

The minimum current, voltage, hertz or voltage ratio output from the instrument.

High Output (E.U.s):

The instrument reading in engineering units corresponding to the High Input.

Low Output (E.U.s):

The instrument reading in engineering units corresponding to the Low Input.

Units:

The engineering units to which the input readings will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Scalar equations for base averages where N is the number of instantaneous samples included in the base average interval:

$$WSP_B = \left(\frac{\sum_{i=1}^{N} WSP_i}{N} \right)$$

$$WDR_B = \arctan\left(\frac{\sum_{i=1}^{N} \sin WDR_i}{\sum_{i=1}^{N} \cos WDR_i} \right)$$

Scalar equations for extended averages where M is the number of base averages included in the extended average interval:

$$WSP_E = \left(\frac{\sum_{j=1}^{M} WSP_{Bj}}{M} \right)$$

$$WDR_E = \arctan\left(\frac{\sum_{j=1}^{M} \sin WDR_{Bj}}{\sum_{j=1}^{M} \cos WDR_{Bj}} \right)$$

5.17 Vector Wind Speed and Wind Direction Channels (Optional)

The ESC Model 8816 supports wind speed (WSP) and wind direction (WDR) channels, in both scalar (see page 5-30 "Scalar Wind Speed and Wind Direction Channels (Optional)") and vector form. Zero crossovers and 0 - 540° instruments are supported.

```
ESC Model 8816 v5.xx  ID:01        Vector Wind Config Screen        04/06/03 15:00:55

    Instrument Name             :  VWS1
    Report Channel Number       :  01
    WDR Input Number            :  01
    WDR Volts Full Scale        :  N/A
    WDR High Input              :  20 mA
    WDR Low Input               :  0 mA
    WDR High Output (E.U.s)     :  100
    WDR Low Output (E.U.s)      :  0
    WSP Input Number            :  01
    WSP Volts Full Scale        :  N/A
    WSP High Input              :  20 mA
    WSP Low Input               :  0 mA
    WSP High Output (E.U.s)     :  100
    WSP Low Output (E.U.s)      :  0
    Units                       :  MPH
    Base Avg. Interval, Storage :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    FINISHED (Configure Now)

  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. **01** to **99**.

WDR Input Number:

Specifies the actual, physical input line number. **01** to **99**. When using a Meteorological Input Card, inputs **Tx**, **Dx**, **Sx** or **Rx** can be used (**x** is the integer number of the Meteorological Input Card).

WDR Volts Full Scale:

The volts full scale range for the channel. **0.1**, **1.0**, **5.0**, or **10.0** volts. Applicable only when the WDR Input Number references a voltage input.

WDR High Input:

The maximum current, voltage, hertz or voltage ratio output from the instrument.

WDR Low Input:

The minimum current, voltage, hertz or voltage ratio output from the instrument.

WDR High Output (E.U.s):

The instrument reading in engineering units corresponding to the High Input.

WDR Low Output (E.U.s):

The instrument reading in engineering units corresponding to the Low Input.

WSP Input Number:

Specifies the actual, physical input line number. **01** to **99**. When using a Meteorological Input Card, inputs **Tx**, **Dx**, **Sx** or **Rx** can be used (**x** is the integer number of the Meteorological Input Card).

WSP Volts Full Scale:

The volts full scale range for the channel. **0.1**, **1.0**, **5.0**, or **10.0** volts. Applicable only when the WSP Input Number references a voltage input.

WSP High Input:

The maximum current, voltage, hertz or voltage ratio output from the instrument.

WSP Low Input:

The minimum current, voltage, hertz or voltage ratio output from the instrument.

WSP High Output (E.U.s):

The instrument reading in engineering units corresponding to the High Input.

WSP Low Output (E.U.s):

The instrument reading in engineering units corresponding to the Low Input.

Units:

The engineering units to which the input readings will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Vector equations for base averages where N is the number of instantaneous samples included in the base average interval:

$$VWSP_B = \sqrt{\left(\frac{\sum_{i=1}^{N} WSP_i * \cos WDR_i}{N}\right)^2 + \left(\frac{\sum_{i=1}^{N} WSP_i * \sin WDR_i}{N}\right)^2}$$

$$VWDR_B = \arctan\left(\frac{\sum_{i=1}^{N} WSP_i * \sin WDR_i}{\sum_{i=1}^{N} WSP_i * \cos WDR_i}\right)$$

Vector equations for extended averages where N is the number of instantaneous samples included in the base average interval and M is the number of base averages included in the extended average interval:

$$VWSP_E = \sqrt{\left(\frac{\sum_{j=1}^{M}\left(\frac{\sum_{i=1}^{N} WSP_i * \cos WDR_i}{N}\right)}{M}\right)^2 + \left(\frac{\sum_{j=1}^{M}\left(\frac{\sum_{i=1}^{N} WSP_i * \sin WDR_i}{N}\right)}{M}\right)^2}$$

$$VWDR_E = \arctan\left(\frac{\sum_{j=1}^{M}\left(\sum_{i=1}^{N} WSP_i * \sin WDR_i\right)}{\sum_{j=1}^{M}\left(\sum_{i=1}^{N} WSP_i * \cos WDR_i\right)}\right)$$

5.18 Linear Sigma Channels

The linear sigma channel type takes data from an analog input to calculate a standard deviation/mathematical sigma on three averaging intervals. The base and extended intervals all calculate their averages using instantaneous data, i.e. the extended averages have no dependency on the base average.

```
ESC Model 8816 v5.xx  ID:??          Sigma Channel Config.          04/06/03 13:40:58

    Instrument Name              :  LSIGMA
    Report Channel Number        :  01
    Analog Input Number          :  01
    Volts Full Scale             :  N/A
    High Input                   :  20 mA
    Low Input                    :  0 mA
    High Output (E.U.s)          :  100
    Low Output (E.U.s)           :  0
    Units                        :  MPH
    Base Avg. Interval, Storage  :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    FINISHED (Configure Now)

  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. `01` to `99`.

Analog Input Number:

Specifies the actual, physical input line number. `01` to `99`. When using a Meteorological Input Card, inputs `Tx`, `Dx`, `Sx` or `Rx` can be used (`x` is the integer number of the Meteorological Input Card).

Volts Full Scale:

The volts full scale range for the channel. `0.1`, `1.0`, `5.0`, or `10.0` volts. Applicable only when the Analog Input Number references a voltage input.

High Input:

The maximum current, voltage, hertz or voltage ratio output from the instrument.

Low Input:

The minimum current, voltage, hertz or voltage ratio output from the instrument.

High Output (E.U.s):

The instrument reading in engineering units corresponding to the High Input.

Low Output (E.U.s):

The instrument reading in engineering units corresponding to the Low Input.

Units:

The engineering units to which the input readings will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the first interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the second interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the third interval over which the ESC Model 8816 will average instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Linear Sigma equation for all averaging intervals where N is the number of instantaneous samples in the averaging interval.

$$SIGMA = \sqrt{\left(\frac{\sum_{i=1}^{N} AI_i^2}{N} - \left(\frac{\sum_{i=1}^{N} AI_i}{N} \right)^2 \right)}$$

5.19 Sigma-Theta Channels

The ESC Model 8816 can calculate the sigma-theta of an initialized wind direction input. The ESC Model 8816 uses the EPA-approved Yamartino single-pass algorithm and has software protection against zero sigma "blowup" caused by small rounding errors.

```
ESC Model 8816 v5.xx  ID:??      Sigma-Theta Channel Config.       04/06/03 13:44:01

    Instrument Name             :  STCH
    Report Channel Number       :  01
    WDR Analog Input Number     :  01
    WDR Volts Full Scale        :  N/A
    WDR High Input              :  20 mA
    WDR Low Input               :  0 mA
    WDR High Output (E.U.s)     :  100
    WDR Low Output (E.U.s)      :  0
    Units                       :  DEG
    Sigma-Theta Avg Interval    :  15m , 0s
    RMS Average Interval        :  1h  , 0s
    FINISHED (Configure Now)


  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. **01** to **99**.

WDR Analog Input Number:

Specifies the actual, physical input line number. **01** to **99**. When using a Meteorological Input Card, inputs **Tx**, **Dx**, **Sx** or **Rx** can be used (**x** is the integer number of the Meteorological Input Card).

WDR Volts Full Scale:

The volts full scale range for the channel. **0.1**, **1.0**, **5.0**, or **10.0** volts. Applicable only when the WDR Input Number references a voltage input.

WDR High Input:

The maximum current, voltage, hertz or voltage ratio output from the instrument.

WDR Low Input:

The minimum current, voltage, hertz or voltage ratio output from the instrument.

WDR High Output (E.U.s):

The instrument reading in engineering units corresponding to the High Input.

WDR Low Output (E.U.s):

The instrument reading in engineering units corresponding to the Low Input.

Units:

The engineering units to which the input readings will be scaled (AP, #/MBTU, PPM, etc.).

Sigma-Theta Avg Interval:

The first half of the field specifies the interval over which the ESC Model 8816 will calculate the Sigma-Theta Average from instantaneous readings. The second half of the field specifies the length of the long-term data storage buffer for the Sigma-Theta Average.

RMS Average Interval:

The first half of the field specifies the Root Mean Square (geometric mean) average interval calculated for the Sigma-Theta averages. This interval must be some integer multiple less than or equal to 60 of the Sigma-Theta Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the RMS Average.

The following shows the Sigma-Theta equation where N is the number of instantaneous samples in the Sigma-Theta Average Interval.

$$ETA = \sqrt{\left(1 - \left(\left(\frac{\sum_{i=1}^{N} \sin WDR_i}{N}\right)^2 + \left(\frac{\sum_{i=1}^{N} \cos WDR_i}{N}\right)^2\right)\right)}$$

$$SIGMA - THETA = \arcsin(ETA) * (1.0 + 0.1547 * ETA^3)$$

The following shows the RMS equation where M is the number of Sigma-Theta averages in the RMS Average Interval.

$$RMS = \sqrt{\frac{\sum_{i=1}^{M} (SIGMA - THETA_i)^2}{M}}$$

5.20 Rainfall Channels (Optional)

If the ESC Model 8816 is purchased with the appropriate meteorological hardware card, this optional channel type is available. Rainfall channels are used to count or total the number of pulses received during the averaging interval and to scale them to engineering units, typically inches of rain per hour.

```
ESC Model 8816 v5.xx  ID:??        Rainfall Channel Config.       04/06/03 13:46:44

    Instrument Name              :  PRECIP
    Counter Input Channel        :  R1
    Report Channel Number        :  01
    Counter Input (Counts)       :  1
    Channel Output (E.U.s)       :  0.1
    Units                        :  INCHES
    Base Avg. Interval, Storage  :  1h  , 0s
    Average #1 Interval, Storage:  8h  , 0s
    Average #2 Interval, Storage:  1d  , 0s
    FINISHED (Configure Now)

  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Counter Input Channel:

Rx or **Sx**, where **x** is the integer number of the Meteorological Input Card.

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. **01** to **99**.

Counter Input (Counts):

The number, or count, of pulses that will equal one engineering unit.

Channel Output (E.U.s):

The instrument reading in engineering units corresponding to the Counter Input.

Units:

The engineering units to which the readings will be scaled (inches, in, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the first interval over which the ESC Model 8816 will total readings. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the totaling interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the totaling interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Rainfall equation for base averages where N is the number of instantaneous samples included in the Base Average Interval and Rx is the number of pulses on the rainfall input of the meteorological input card.

$$RAIN_B = \sum_{i=1}^{N} Rx_i$$

Rainfall equation for extended averages where M is the number of base averages included in the extended average interval.

$$RAIN_E = \sum_{j=1}^{M} RAIN_{Bj}$$

5.21 Modbus Channels (Optional)

The Modbus channel type is used to take data from a distributed control system over a Modbus link.

To enter a Modbus scale factor and register number, press <CTRL><D> in the Channel Configuration screen (see page 13-1 "Application Note - Modbus Interface").

5.21.1 *Modbus Setup Configuration*

Step 1. Check the system information screen to see if Modbus channels are available on your system. From the Home Menu, select Status Menu (hot key **S**), then System Information (hot key **I**). For additional information, contact ESC if Modbus is not enabled.

Step 2. Configure a serial port interface with the proper Modbus Interface. See page 4-7 "Configuring EEPROM Parameters". You must cold start the data logger for changes to take effect.

Step 3. Edit the Modbus ID. See page 4-4 "Configuring System Parameters." (The Modbus ID can be stored in the EEPROM).

Step 4. Edit the Modbus address table (requires Supervisor level access or higher) at the System Configuration Screen, press <CTRL><F>. (The Modbus table can be stored in the EEPROM.)

```
ESC Model 8816 v5.xx  ID:??       Serial/MODBUS Chl Config.       04/06/03 13:50:08

    Instrument Name             :  TEMP
    Report Channel Number       :  01
    Hold Data Between Updates   :  Y
    Units                       :  PPM
    Base Avg. Interval, Storage :  1m  , 0s
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 0s
    Use 40CFR75 Validation (Y/N):  N
    FINISHED (Configure Now)

  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. `01` to `99`.

Hold Data Between Updates:

Yes or No. If you want to use the last value received until the next one arrives, configure Yes.

Units:

The engineering units to which the readings will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will average instantaneous readings. **NOTE**: The Modbus master (the DCS) must update the ESC Model 8816's register at a frequency greater than the base average interval or subsequent base averages will be invalidated ("B" flag) unless the field Hold Data Between Updates is set to Yes. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Use 40CFR75 Validation (Y/N):

Yes, No or Grace Disabled. **`Y`** causes the channel to validate hourly averages in accordance with the Clean Air Act regulations (see also Appendix C).

Default=**N**: Averages are validated using a simple percent validity test (see page 4-4 "Configuring System Parameters"). **G** causes the channel to operate exactly as **Y** except that no 8-hour grace period is allowed after a startup. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

Modbus channels get their inputs from registers internal to the ESC Model 8816. These registers may be written across a serial port configured as a Modbus interface. Because the ESC Model 8816 is a Modbus "slave," it is the responsibility of the Modbus "master" (the distributed control system) to update the ESC Model 8816's register at a frequency greater than the base average interval. Otherwise, a communication failure will cause the next base average to be invalidated unless the field Hold Data Between Updates is set to Yes.

5.21.2 *Modbus Scaling Factor*

The Modbus scaling factor is used to convert numeric data to integers for placement in Modbus input/output registers. The scaling factor will be used to scale data as follows:

Modbus register integer = Eng. units × Scaling factor.

Press <Ctrl><D> in any channel configuration screen to display the following screen.

```
ESC Model 8816 v5.xx  ID:??        Config. Channel Options        04/06/03 13:53:49

    Name (not editable)          :  TEMP
    Chl Number (not editable)    :  01
    Decimal Positioner           :  00
    MODBUS Scale Factor          :      0.0100
    MODBUS/SIO Register #        :  01
    Span for Cal Err             :  (not set)
    Round Precision              :  (none)

  ESC to return to chl config
```

Example: A NOx channel is configured to have a value from 0 - 30 ppm. The highest positive value that can be returned in a Modbus RTU register is 32767. If the scaling factor is set to 0.001, the NOx value would be sent with three decimal places worth of information. Therefore, values of 0 - 30000 in the Modbus register would correspond to NOx values of 0.000 to 30.000 ppm.

5.21.3 *Modbus/SIO Register Number*

The data from this channel will be mapped to this Modbus register number. The Modbus register number will default to the channel number. Care must taken when configuring these registers; **the ESC Model 8816 will <u>not</u> check to see if an index is already being used!**

See page 13-1 "Application Note - Modbus Interface" for more details.

5.22 Generic Serial Interface Channels (Optional)

The Generic Serial Interface (GSI) is a serial communications interface used by the ESC Model 8816 Data Logger. This interface is used to retrieve data from analyzers, digital control systems, or some other device using one of the RS-232 or RS-485 serial communications ports.

The input functions of this interface include receiving data strings to store values into GSI Channels for data collection. (See page 4-21 "Configuring Serial Protocols" for more information.)

The GSI channel type is used to store the data collected via the Generic Serial Interface.

```
ESC Model 8816 v5.xx  ID:??       Serial/MODBUS Chl Config.       04/06/03 13:50:08

    Instrument Name              :  SO2PPM
    Report Channel Number        :  01
    Hold Data Between Updates    :  N
    Units                        :  PPM
    Base Avg. Interval, Storage  :  1m  , 9h 35m
    Average #1 Interval, Storage:  15m , 0s
    Average #2 Interval, Storage:  1h  , 14d 9h
    Use 40CFR75 Validation (Y/N):  N
    FINISHED (Configure Now)

  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. `01` to `99`.

Hold Data Between Updates:

Yes or No. If you want to use the last value received until the next one arrives, configure Yes.

Units:

The engineering units to which the readings will be scaled (AP, #/MBTU, PPM, etc.).

Base Avg. Interval, Storage:

The first half of the field specifies the interval over which the ESC Model 8816 will average instantaneous readings.

NOTE: The Generic Serial Interface attempts to update readings every five seconds. If data streams will not be received at this rate, the *Percent for valid average* (see page 5-49 "Configuring Average Validation Limits") value must be adjusted in order to validate the base average. The second half of the field specifies the length of the long-term data storage buffer for the Base Average.

Average #1 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #1. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #1.

Average #2 Interval, Storage:

The first half of the field specifies the averaging interval for the Average #2. This interval must be some integer multiple of the Base Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the Average #2.

Use 40CFR75 Validation (Y/N):

Yes, No or Grace Disabled. **Y** causes the channel to validate hourly averages in accordance with the Clean Air Act regulations (see also Appendix C). Default=**N**: Averages are validated using a simple percent validity test (see page 4-4 "Configuring System Parameters"). **G** causes the channel to operate exactly as **Y** except that no 8-hour grace period is allowed after a startup. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

5.23 Tape Sampler Channels (Optional)

Tape sampler channels take two one-minute averages every two hours and store the difference or the COH (coefficient of haze; see calculation at end of this section) between each minute average. As shown below, each even clock hour, the configured output control line is activated for the selected period of time (*Output Duration*). The logger takes a one-minute average (the second minute of the hour) and stores the minute average as the hourly average on the even-numbered hour. After 119 minutes, the data logger again takes a one-minute average and stores the difference or the COH of the two one-minute averages at the odd hour.

```
ESC Model 8816 v5.xx  ID:??       Tape Sampler Channel Cfg.        04/06/03 14:08:08

    Instrument Name             :  TEST1
    Analog Input Number         :  01
    Report Channel Number       :  01
    Volts Full Scale            :  N/A
    High Input                  :  20 mA
    Low Input                   :  0 mA
    High Output (E.U.s)         :  100
    Low Output (E.U.s)          :  0
    Units                       :  COH
    Storage Time                :  0s
    Output Line                 :  (none)
    Starting Time               :  08/14/97 16:00:00
    Output Duration             :  4s
    COH Factor                  :  20.55945809
    FINISHED (Configure Now)


  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Analog Input Number:

Specifies the actual, physical input line number. **`01`** to **`99`**. When using a Meteorological Input Card, inputs **Tx**, **Dx**, **Sx** or **Rx** can be used (**`x`** is the integer number of the Meteorological Input Card).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. **`01`** to **`99`**.

Volts Full Scale:

The volts full scale range for the channel. **`0.1`**, **`1.0`**, **`5.0`**, or **`10.0`** volts. Applicable only when the Analog Input Number references a voltage input.

High Input:

The maximum current, voltage, hertz or voltage ratio output from the instrument.

Low Input:

The minimum current, voltage, hertz or voltage ratio output from the instrument.

High Output:

The instrument reading in engineering units corresponding to the High Input.

Low Output:

The instrument reading in engineering units corresponding to the Low Input.

Units:

The engineering units to which the input readings will be scaled (AP, #/MBTU, PPM, etc.).

Storage Time:

The length of the long-term data storage buffer for averages.

Output Line:

The digital output line which will be activated each even clock hour.

Starting Time:

The date and time to start the tape sampling; will always move to the next even-numbered hour. *dd/mm/yy hh:mm:ss*.

Output Duration:

The amount of time to keep the Output Line activated.

COH Factor:

Coefficient of haze factor: enter `0.0` to store the difference (first minute average minus second minute average); enter any other positive value to calculate the difference according to the formula shown below.

$COH/1000ft = 540/(\Delta T)C*LOG(Avg1/Avg2)$

where

ΔT	=	119 minutes,
C	=	6.25 L/min or 0.2207166667009ft^3/minute,
Avg1	=	first average reading, and
Avg2	=	second average reading.

This yields:

$COH/1000ft = 540/(119)\ 0.2207166667009 * LOG(Avg1/Avg2)$

$COH/1000ft = 20.55945809 * LOG(Avg1/Avg2)$

where COH constant = 20.55945809.

5.24 General Channel (Optional)

The General Channel is used for evaluation of data in six different channel types. The Maximum, Minimum, and Accumulative types will evaluate maximum, minimum, and accumulative (summation) values respectively from the Input Channel over the General Value Duration. The Percent Complete type reports the amount of data from the Input Channel that is valid over the duration specified. The Number of Runs type specifies the number of input values from the Input Channel over the duration specified. The Number of Valid Runs type specifies the number of valid input values from the Input Channel over the duration specified.

```
ESC Model 8816 v5.xx  ID:01          General Channel Config          04/06/03 15:34:44

    Instrument Name              :  TEMP
    Report Channel Number        :  01
    Input Channel                :  (none)
    Input Average Interval       :  1m
    Units                        :  %FS
    Data Channel Type            :  MAXIMUM
    Reset Input Status Pattern   :  (none)
    General Val Duration,Storage:  1h  , 0s
    Ignore Input Channel Flag(s):  (none)
    FINISHED (Configure Now)


  CTRL-V=Edit Validation, CTRL-D=Config. Channel Options
```

Instrument Name:

The label used to identify this channel. May consist of a parameter name and site name separated with a colon (:).

Report Channel Number:

A number used for ordering channels in the real-time displays; also used in systems polled by central computers as a "channel number" designation. `01` to `99`.

Input Channel:

The name of the channel to be used as the source of data. Must be a configured channel name.

Input Average Interval:

One of the Input Channel's averaging intervals or 0s for instantaneous data.

Units:

The engineering units to which the readings will be scaled (AP, #/MBTU, PPM, etc.).

Data Channel Type:

`MAXIMUM`, **`MINIMUM`**, **`ACCUM`** for Accumulation, **`PCNTCMP`** for Percent Complete, **`NRUNS`** for Number of Runs or **`NVRUNS`** for Number of Valid Runs.

Reset Input Pattern Status:

The input status which will generate a reset to the General Channel based on the Data Channel Type at the next Input Average Interval.

General Val Duration,Storage:

The first half of the field specifies the duration to collect the data over the Input Average Interval. The second half of the field specifies the length of the long-term data storage buffer for the General Value Duration.

Ignore Input Channel Flag(s):

The flags to ignore when verifying the validity of the current data point. This field is only valid for the MINIMUM, MAXIMUM and ACCUM Data Channel Type. For any other Data Channel Type, this field will remain (none) and cannot be changed.

5.25 Data Validation and Flags

Data validation refers to two concepts:

- a determination of whether or not an hourly average is a valid average; this is determined by regulations or by a percentage.
- certain conditions and value limits that can invalidate data (i.e., the data will not be included in averages). This validation information is configured and checked on an instantaneous basis and on each averaging interval. (Each base and extended average interval can have validation limits specified, although these are generally attached only to the base average.)

5.25.1 *Valid Average Determination*

In the channel configuration field, the field, *Use 40CFR75 Validation (Y/N)*, allows a choice between a simple percent validity test or the validation required by 40CFR75, the Federal Clean Air Act regulations. This validation determines whether or not an hourly average is a *valid* hourly average.

- The Clean Air Act requires that a valid hourly average consists of four data points equally spaced around the hour (see also Appendix C). *Use 40CFR75 Validation (Y/N)* is configured as "**`Y`**" or "**`G`**".
- The percentage validity test divides the number of readings by the averaging period and multiplies that result by 100; the default validity percent is 75. Any average that is less than the percentage is deemed invalid (flagged with <). The number used for the averaging period is 100% of the potential readings; for example, 60 minutes for hourly average intervals and 60 seconds for minute averages. If there were 45 readings taken for a **`01h`** averaging period, the result would be 75% (45 ÷ 60 x 100).

Use 40CFR75 Validation (Y/N) is configured as "**`N`**" and the percentage is configured:

- To apply the percent validation globally (to every average), the *Percent for Valid Base Avg* and *Percent for Valid Ext. Avg* fields are configured in the *System Configuration Screen* (see page 4-4 "Configuring System Parameters").
- To configure percent validation on a per-channel, per-average basis, place the cursor in the desired average field, and press <Ctrl><V>. The *Percent for Valid Base Avg* field is configured. This overrides the global percent validation for that channel's average interval.

5.25.2 *Configuring Instantaneous Validation Limits*

To configure instantaneous validation information, place the cursor in any field (except an interval or storage field), and press <Ctrl><V>. Only conditions related to digital inputs and limits that invalidate data are configured and checked on an instantaneous basis.

```
ESC Model 8816 v5.xx  ID:??        Inst. Validation Config.        04/06/03 14:12:00

    Bad Status Lines (B)         :  (none)
    Maintenance Status Lines (M):  (none)
    Boiler Offline Status (F)    :  (none)
    Maximum Reading Limit (+)    :  1E+10
    Minimum Reading Limit (-)    :  -1E+10
    Rate of Change Limit (R)     :  1E+10
    Digital Info Status #1 (V)   :  (none)
    Digital Info Status #2 (W)   :  (none)
    Digital Info Status #3 (X)   :  (none)
    Digital Info Status #4 (Y)   :  (none)
    Digital Info Status #5 (Z)   :  (none)

  <Esc> to return to chl config
```

Bad Status Lines (B):

Digital Input Pattern which indicates Bad Status for the parameter. The 'B' flag will be present with the data when the pattern in this field is true.

Maintenance Status Lines (M):

Digital Input Pattern which indicates that the parameter is in Maintenance. The 'M' flag will be present with the data when this field is true.

Boiler Offline Status (F):

Digital Input Pattern which indicates that the Boiler that this parameter is associated with is Offline. The 'F' flag will be present with the data when this field is true.

Maximum Reading Limit (+):

Numerical value; if reading is equal to or exceeds this value, the '+' flag will be present with the data.

Minimum Reading Limit (-):

Numerical value; if reading is equal to or less than this value, the '-' flag will be present with the data.

Rate of Change Limit (R):

Numerical value; if difference between the previous reading and the current reading is equal to or exceeds this value, the 'R' flag will be present with the data.

Digital Info Status #1 (V):

Digital Input Pattern which indicates that Status#1 is true. The 'V' flag will be present with the data when the pattern in this field is true.

Digital Info Status #2 (W):

Digital Input Pattern which indicates that Status#2 is true. The 'W' flag will be present with the data when the pattern in this field is true.

Digital Info Status #3 (X):

Digital Input Pattern which indicates that Status#3 is true. The 'X' flag will be present with the data when the pattern in this field is true.

Digital Info Status #4 (Y):

Digital Input Pattern which indicates that Status#4 is true. The 'Y' flag will be present with the data when the pattern in this field is true.

Digital Info Status #5 (Z):

Digital Input Pattern which indicates that Status#5 is true. The 'Z' flag will be present with the data when the pattern in this field is true.

5.25.3 *Configuring Average Validation Limits*

To configure average validation information, place the cursor in an interval or storage field, and press <Ctrl><V>. All validations related to averages are configured and checked on each averaging interval.

```
ESC Model 8816 v5.xx  ID:??       Average Validation Config.       04/06/03 14:14:28

     High-High Alarm Limit (H)    :  1E+10
     High Alarm Limit      (h)    :  1E+10
     Low Alarm Limit       (l)    :  -1E+10
     Low-Low Alarm Limit   (L)    :  -1E+10
     High ROC Alarm Limit  (J)    :  1E+10
     Low ROC Alarm Limit   (j)    :  1E+10
     Floor Limit           (f)    :  -1E+10
     Floor Value                  :  0
     Ceiling Limit         (c)    :  1E+10
     Ceiling Value                :  0

     Percent for valid average    :  Default (100)
     Average to Math Constant     :  (none)

  <Esc> to return to chl config
```

NOTE: See also Appendix A, section A.7.

High-High Alarm Limit (H):

Numerical value; if average is equal to or exceeds this value, the 'H' flag will be present with the data.

High Alarm Limit (h):

Numerical value; if average is equal to or exceeds this value, the 'h' flag will be present with the data.

Low Alarm Limit (l):

Numerical value; if average is equal to or less than this value, the 'l' flag will be present with the data.

Low-Low Alarm Limit (L):

Numerical value; if average is equal to or less than this value, the 'L' flag will be present with the data.

High ROC Alarm Limit (J):

Numerical value; if the absolute value of the difference between the previous average and the current average is equal to or exceeds this value, the 'J' flag will be present with the data.

Low ROC Alarm Limit (j):

Numerical value; if the absolute value of the difference between the previous average and the current average is equal to or exceeds this value, the 'j' flag will be present with the data.

Floor Limit (f):

Numerical value; if average is equal to or less than this value, the 'f' flag will be present with the data.

Floor Value:

Numerical value; if average is equal to or less than the Floor Limit value, the average will be replaced by this value.

Ceiling Limit (c):

Numerical value; if average is equal to or exceeds this value, the 'c' flag will be present with the data. The Passed Ceiling Limit flag 'G' will also be present with the data (unless the Invalid Data flag '<' is present) and, unlike the 'c' flag, will be passed on to the extended averages. If this limit is configured and the Analog Overrange flag 'O' is present with no other invalidating flags, then the Invalid Data flag '<' is cleared (if it is present), and the 'c' and 'G' and '>' (Incomplete Data) flags will be present with the data.

Ceiling Value:

Numerical value; if average is equal to or exceeds the Ceiling Limit value, the average will be replaced by this value.

Percent for valid average:

Required percentage (`1` to `100`) of valid data points during averaging interval for this average to be marked as valid. An average that falls below this percentage will be flagged with < to indicate that it is invalid. This field will override the setting in the *System Configuration Screen* as described on page 4-4 "Configuring System Parameters".

Average to Math Constant:

The Math Constant (`K1-K32`) in which to write this average at the completion of each averaging interval. Entering "none" in this field will clear the Math Constant. **Note:** The average must be valid before it is written to the specified math constant.

5.25.4 *Data Flags*

The ESC Model 8816 stores data flags along with the numerical average in long-term storage. These data flags describe error conditions or alarms that took place during the averaging interval. The validation process described above allows the user to set up certain limits and conditions under which data can be flagged for informational purposes, invalidated, or both.

Control Keys for any Channel Configuration Screen	
<Ctrl><V>	In interval or storage fields to enter/edit validation limits on averages.
<Ctrl><V>	In any *other* field to enter/edit validation limits on instantaneous readings.

Validation-type flags indicate data that were not included in averaging (invalidated). Validation flags are sent with averages when a central computer system polls the logger. Alarm and information flags indicate data that were used in averaging; these flags can be used for alarm purposes and reporting at the logger.

The flags and conditions in the following table are listed in order of priority.

Data not included in average:

Validation Flag	Condition	Type
P	Power Failure	Validation
D	Channel Disabled (marked off-line)	Validation
T, t	Out-of-Control Tolerance Exceeded (calibration data)	Validation
F, p	Boiler Offline	Validation
B	Bad Status Detected	Validation
C	Calibration	Validation
M	Maintenance	Validation
O	Analog Overrange	Validation
U	Analog Underrange	Validation
A	Arithmetic Error (math calculation error)	Validation
+	Maximum Exceeded	Validation
-	Minimum Exceeded	Validation
R	Rate of Change Limit Exceeded	Validation

Data included in average:

Alarm & Info Flags	Condition	Type
H	High-High Alarm Limit Exceeded	Alarm
h	High Alarm Limit Exceeded	Alarm
L	Low-Low Alarm Limit Exceeded	Alarm
l	Low Alarm Limit Exceeded	Alarm
J	High Rate of Change Alarm Limit Exceeded	Alarm
j	Low Rate of Change Alarm Limit Exceeded	Alarm
f	Floor Limit Exceeded	Information
c	Ceiling Limit Exceeded	Information
G	Passed Ceiling Limit	Information
V	Digital Information Status #1 Detected	Information

Alarm & Info Flags	Condition	Type
W	Digital Information Status #2 Detected	Information
X	Digital Information Status #3 Detected	Information
Y	Digital Information Status #4 Detected	Information
Z	Digital Information Status #5 Detected	Information

>	Some missing data, but meets requirement for valid average	Data Capture
<	Does not meet requirement for valid average	Data Capture
<blank>	No missing data	Data Capture

Out-of-Control Flags

The out-of-control tolerance flags will be appended to any data whose calibration exceeded the configured out-of-control limit. The uppercase 'T' flag indicates that data were out-of-control during the interval, and the interval was invalid. The lowercase 't' flag indicates that data were out-of-control, but the interval was still valid. Subsequent data for that channel is marked with a 'T' until a calibration is performed that falls within the out-of-control limits. The out-of-control tolerance is configured in the *Expected Value Configuration* screen of a Calibration Configuration. For more information about how the logger handles OOC conditions, see page 6-6 "Handling Out-of-Control Calibrations."

Boiler Offline Flags

The boiler offline flags can be used to invalidate data during non-operating hours. These flags will prevent the ESC Model 8816 from averaging in zeroes during non-operating periods; their use is crucial to correctly calculate emission rates during partial operating hours for 40 CFR Part 75. The capital 'F' indicates a whole hour offline; the lowercase 'p' indicates a partial hour offline.

The digital input pattern that triggers the boiler offline flag is entered at the Instantaneous Validation Configuration screen (see page 5-48 "Configuring Instantaneous Validation Limits"). This DI pattern is usually the opposite of the time-on-line channel's digital input pattern (entered at the *On-Line Input Status* field), especially if the time-on-line signal is a single digital input line. If the time-on-line signal is multiple lines, consider whether the lines are AND'ed or OR'ed together; note that the boiler offline flag uses the global *Default Dig. Inputs to OR?* switch configured in the *System Configuration Screen* (unless the | or & designators are used).

Floor Limit Flag

The Floor Limit/Value feature addresses the situation of averages lower than allowed. It allows a value to be set for each averaging interval (minute, hour, etc.). If the average falls below the Floor Limit, then the average is flagged with an 'f', and the average is replaced with the Floor Value. The defaults for this feature render it inactive. The Floor Value propagates to average math and average merge channels and to further extended averages in regular math channels, stream-switched channels, merged channels, and so on. However, the Floor Limit flag 'f' is only present on the average on which it is generated. The Floor Limit is evaluated before any

other average validation check, so that if the Floor Value is used, all other validation checks are made against the stored data (floor) value.

Ceiling Limit Flag

The Ceiling Limit/Value feature addresses the situation of averages higher than allowed. It allows a value to be set for each averaging interval (minute, hour, etc.). If the average rises above the Ceiling Limit, then the average is flagged with a 'c', and the average is replaced with the Ceiling Value. If this is a base average and the Invalid Data flag '<' is not present, then the average is also flagged with the Passed Ceiling Limit flag 'G'. The defaults for this feature render it inactive. If this limit is configured and the Analog Overrange flag 'O' is present on the data with no other invalidating flags, then the Invalid Data flag '<' is cleared (if it is present), and the 'c' and 'G' and '>' (Incomplete Data) flags will be present with the data. The Ceiling Value propagates to average math and average merge channels and to further extended averages in regular math channels, stream-switched channels, merged channels, and so on. However, the Ceiling Limit flag 'c' is only present on the average on which it is generated. The Passed Ceiling Limit flag 'G' is propagated on to the extended averages of the channel. The Ceiling Limit is evaluated before any other average validation check, except the Floor Limit, so that if the Ceiling Value is used, all other validation checks are made against the stored data (ceiling) value.

5.26 Channel Options

To use the decimal positioner, Modbus information, rounding precision, and the span value in calibration error calculations that will be configured, press <Ctrl><D> in any channel configuration screen.

```
ESC Model 8816 v5.xx  ID:??        Config. Channel Options        04/06/03 14:17:09

    Name (not editable)          :  TEMP
    Chl Number (not editable)    :  01
    Decimal Positioner           :  00
    MODBUS Scale Factor          :      0.0100
    MODBUS/SIO Register #        :  01
    Span for Cal Err             :  (not set)
    Round Precision              :  (none)

  ESC to return to chl config
```

5.26.1 *Decimal Positioner*

The decimal positioner is used to convert floating point numbers to integers for communications compatibility with 8800 loggers. Press <Ctrl><D> in any channel configuration screen to designate the number of places to the right of the decimal. **0** to **7**.

5.26.2 *Modbus Scaling Factor*

The Modbus scaling factor is used to convert numeric data to integers for placement in Modbus input/output registers. Each channel may be assigned a scaling factor for this conversion; typing <Ctrl><D> at the channel configuration screen allows the factor that will be used to scale data to be entered as follows:

Modbus register integer = Value in engineering units × scaling factor.

The default scaling factor is 0.01.

5.26.3 *Modbus/SIO Register Number*

Press <Ctrl><D> to map data from this channel to the Modbus register number entered here; this is the *starting* register number. The Modbus register number will default to the channel number.

Take caution; the ESC Model 8816 will not check to see if an index is already being used!

NOTE: For more information about the ESC Model 8816's Modbus interface and Modbus channels, see page 5-39 "Modbus Channels (Optional)" and page 13-1 "Application Note - Modbus Interface."

5.26.4 *Span Value for Calibration Error*

Press <Ctrl><D> at a channel configuration screen to allow the span value to be used in calibration error calculations to be configured. The table in "Calibration Error Calculation" on page 6-5 shows how the span value would be used, with and without rounding.

5.26.5 *Implicit Rounding of Values*

Rounding of values can be accomplished in two ways—explicitly by using the rounding operand in a math pack equation (see page 5-11 "Equation Configuration"), or implicitly as described here.

Step 1. At the Math Channel configuration screen in the *Round Constituents (Y/N)* field, select Yes for any constituent parameters in the math channel equation to be rounded to the precision configured at the *Config. Channel Options* screen for the constituent(s).

Step 2. Check the *Config. Channel Options* screen for the *Round Precision* field. This field accepts values from 9 to -9, such that a positive *n* entry rounds *n* number of places to the right of the decimal and a negative *n* entry rounds *n* number of places to the left of the decimal. For example,

-1 = round to the nearest ten, -2 = round to the nearest hundred,

1 = round to the nearest tenth, 2 = round to the nearest hundredth.

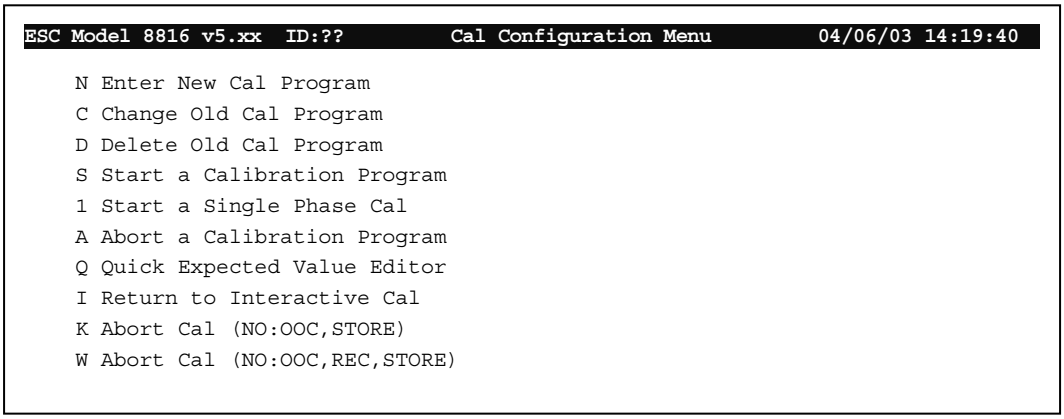
The rounded constituent values are then used in the equation to arrive at the math channel's values. If the math channel is itself a constituent to another math channel, and Round Constituents is enabled in the second math channel, then a Round Precision must be configured at the first *Config. Channel Options* screen.

Chapter 6
Calibration

Up to 64 calibration sequences may be maintained in the ESC Model 8816 logger (if adequate configuration memory is available). The “types” of calibrations, simple and complex, are broken down by how the programs are initiated and controlled.

The simplified calibrations, automatic and externally controlled zero/span, are intended to handle a majority of zero/span calibration sequences. The complex calibrations provide the user with a great deal of flexibility to handle unusual or long (more than two points) calibration sequences.

When *Configure Calibrations* (hot key **C**) is selected from the *Configuration Menu*, the following screen is displayed:



A brief description of each *Cal Configuration Menu* item appears in the table below. For more detailed explanations of a particular item, refer to the section noted.

Hot Key	To Option	Purpose	See Page
N	*Enter New Cal Program*	Enters a new calibration sequence	6-4
C	*Change Old Cal Program*	Changes an existing calibration sequence	6-4
D	*Delete Old Cal Program*	Deletes an existing calibration sequence	6-4
S	*Start a Calibration Program*	Starts a calibration sequence manually	6-2
1	*Start a Single Phase Cal*	Manually runs one phase of a calibration	6-3
A	*Abort a Calibration Program*	Ends a calibration sequence manually	6-3
Q	*Quick Expected Value Editor*	Edits expected values for existing calibrations	6-2
I	*Return to Interactive Cal*	Accesses the interactive calibration screen	6-2
K	*Abort Cal (NO:OOC, STORE)*	Ends a calibration sequence with control	6-3
W	*Abort Cal (NO:OOC, REC, STORE)*	Ends a calibration sequence with control	6-4

Control Keys	Purpose	See Page
<Ctrl><O>	Edit output normally open/normally closed settings	5-48, 5-49
<Ctrl><R>	Edit number of runs and interval between each run for a phase and other information	5-53

A Note About Storing Calibrations

Before logger version 4.03, an 8-KB fixed calibration buffer stored all calibrations. The maximum number of calibrations stored depended on the number of calibration sequences configured, the number of parameters for which data was stored, etc. If a large number of calibrations were configured or if a calibration ran more often than others, the total calibration storage could be limited.

In version 4.03 and later, the storage system for calibrations acts more like the long-term data storage for average data. Each calibration has its own storage area and can be a variable size. The minimum number of calibration records to be stored for each calibration sequence can now be configured (*Minimum # Cal Records Stored* in calibration configuration screens). This change can also provide additional configuration space by allowing the original 8K storage buffer to be moved from long-term storage to configuration memory for channels, calibrations, etc. This can only be done, however, if the total number of calibration sequences is less than the number of storage blocks left in the pre-v4.03 configuration. (This memory switchover is done via EEPROM configuration as explained on page 4-7 "Configuring EEPROM Parameters;" contact ESC or the system integrator.)

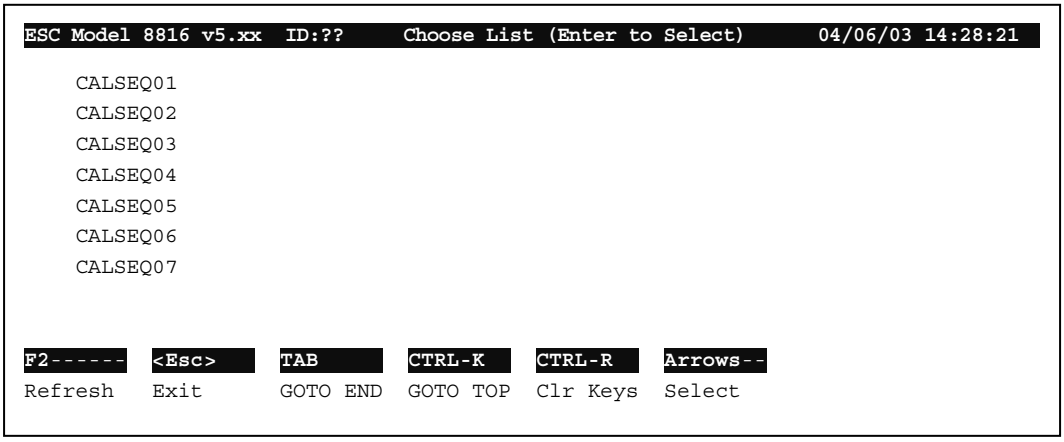
To maintain upward compatibility, the ESC Model 8816 will by default add the original 8K buffer to the long-term storage area, increasing the long-term storage area from 384K to 392K. New calibration programs will by default use 1K of long-term storage for their calibration data storage area. Thus, as long as the configuration loaded has less than 8 calibration programs, no changes are necessary (because data storage will still have at least the original 384K).

If, however, the configuration uses more than 8 calibration sequences, it will use up some of the original 384K of data storage and a configuration that has little or no long-term storage blocks left over could now run out of room. Thus, if the number of calibration programs downloaded in excess of 8 is more than the number of long-term storage blocks remaining in the pre-v4.03 configuration, the long-term data storage on some channels must be shortened. That is, if (number of cals - 8) < (number of storage blocks left), there will not be a problem.

An EEPROM switch affects whether or not calibrations are stored and how they affect the out-of-control status if a parameter is in maintenance; see page 4-7 "Configuring EEPROM Parameters."

6.1 Starting Calibration Programs

Select *Start a Calibration Program* (hot key **S**) from the *Cal Configuration Menu*. A list of all configured calibration programs will display.



Press <Enter> to cause the highlighted calibration program to begin, or press <Esc> to exit without starting a calibration. Instrument-controlled calibrations cannot be started with this menu selection.

Manually starting a calibration will not affect any scheduled calibrations. Also, if a calibration was scheduled to run during the manual start, it will be rescheduled to the next even-numbered interval.

6.1.1 *Running a Single Phase of a Calibration*

When Start a Single Phase Cal (hot key **1**) is selected from the *Cal Configuration Menu*. A list of all configured calibration programs is displayed. Press <Enter> to display a list of phases for the highlighted calibration. Press <Enter> again to display the *Single Phase Setup* screen for the highlighted phase. The *Phase Duration* can then be changed before selecting *Start Single Cal (NOW)* to begin running the calibration phase. At the completion of the phase, the recovery period will take place before normal data acquisition resumes.

6.2 Aborting Calibration Programs (Normal)

When the login access is at Privileged level or higher, calibration sequences can be aborted. Select **Abort a Calibration Program** (hot key **A**) from the *Cal Configuration Menu*. A list of all configured calibration programs will display. Press <Enter> to stop the highlighted calibration program if it is currently running, or press <Esc> to exit without stopping a calibration. The complete recovery phase is executed, and the results are stored. Partially completed parameters that have OOC limits configured for at least one phase are marked as OOC. Instrument-controlled calibrations cannot be stopped with this menu selection.

6.2.1 *Controlling Abort Actions (NO:OOC, STORE)*

When the login access is at Integrator level, calibration sequences can be aborted with control over the actions taken. Select *Abort Cal (NO:OOC,STORE)* (hot key **K**) from the *Cal Configuration Menu*. A list of all configured calibration programs will display. Press <Enter> to stop the highlighted calibration program if it is currently running, or press <Esc> to exit without stopping a calibration. The complete recovery phase is executed, but the results are NOT stored. Partially completed parameters that have OOC limits configured for at least one phase are NOT marked as OOC. Instrument-controlled calibrations cannot be stopped with this menu selection.

6.2.2 *Controlling Abort Actions (NO:OOC, REC, STORE)*

When the login access is at Integrator level, calibration sequences can be aborted with control over the actions taken. Select *Abort Cal (NO:OOC,REC,STORE)* (hot key **W**) from the *Cal Configuration Menu*. A list of all configured calibration programs will display. Press <Enter> to stop the highlighted calibration program if it is currently running, or press <Esc> to exit without stopping a calibration. The complete recovery phase is NOT executed, and the results are NOT stored. Partially completed parameters that have OOC limits configured for at least one phase are NOT marked as OOC. Instrument-controlled calibrations cannot be stopped with this menu selection.

6.3 Changing a Calibration Program

Select *Change Old Cal Program* (hot key **C**) from the *Cal Configuration Menu*. A list of all configured calibration programs will display. Press <Enter> to copy the highlighted calibration program into memory for editing. The program's configuration screen will display. After any changes are made (see page 6-4 "Configuring Calibration Programs" for details about configuration), select *FINISHED (Configure Now)* for the new changes to take effect. If you exit the configuration screen using the <Esc> key, the calibration program changes will not take effect.

6.4 Deleting a Calibration Program

Select *Delete Old Cal Program* (hot key **D**) from the *Cal Configuration Menu.* A list of all configured calibration programs will display. Press <Enter> to delete the highlighted calibration program, or press <Esc> to exit without deleting.

6.5 Configuring Calibration Programs

Select *Enter New Cal Program* (hot key **N**) from the *Cal Configuration Menu*. A list of all available calibration program types will display:

```
ESC Model 8816 v5.xx  ID:??       Config. Cal - Choose Type       04/06/03 14:29:53

    1 Automatic Zero-Span
    2 Instrument Controlled Z-S
    A Automatic Cal
    I Instrument Controlled Cal
    E Externally Initiated Cal
    U User Initiated Cal
    L User Init w/Confirming DI
    M Interactive (Menu) Cal
```

The first two selections, automatic and instrument controlled zero/span, can handle a majority of zero/span calibration sequences. The last six selections are the "complex calibrations" that provide the user with a great deal of flexibility to handle unusual or long (more than two points) calibration sequences.

Simple Calibration Types

Hot Key	Selection
1	*Automatic Zero-Span*
2	*Instrument Controlled Z-S*

Complex Calibration Types

Hot Key	Selection
A	*Automatic Cal*
I	*Instrument Controlled Cal*
E	*Externally Initiated Cal*
U	*User Initiated Cal*
L	*User Init w/Confirming DI*
M	*Interactive (Menu) Cal*

Configuration of complex calibrations uses several screens, the first to specify base information about the calibration and additional screens for each phase of the calibration (up to 16 phases). Once the base information is provided, calibration phases can be added, deleted or modified.

6.5.1 *Affected Channels*

Each calibration has affected channels. Data from these channels are flagged with a 'C' and therefore are not used for averages while the calibration sequence is running. In complex calibrations, each calibration phase has one or more data channels specified, a subset of the affected channels. When a phase runs, a data point is taken for each parameter in the manner prescribed by the phase information.

6.5.2 *Expected Values*

For each parameter (channel) and each phase, an expected value can be entered. This value is typically a calibration gas bottle value, known as gas permtube (GPT) output.

Expected values must be updated every time a calibration gas bottle is changed.

Expected values can be configured in two ways: at the calibration configuration screen (by selecting the *Edit Expected Value* field) or by selecting *Quick Expected Value Editor* (hot key Q) from the *Cal Configuration Menu*. Refer to page 6-18 "Configuring Expected Values" and page 6-20 "Quick Expected Value Editor," respectively, for details about both methods.

6.5.3 *Calibration Error Calculation*

Three methods are available to determine a parameter's calibration error. The option of rounding results when calculating calibration error is also available. The three methods, with and without rounding, are shown in the following table:

Method	Rounding	Error Calculation Used
Standard	Off	(ABS(Actual - Expected) * 100) / Span
Difference	Off	ABS(Actual - Expected)
Linearity	Off	(ABS(Actual - Expected) * 100) / Expected
Standard	On	((ABS(Actual~RP - Expected~RP) * 100) / Span~3)~1
Difference	On	ABS(Actual~RP - Expected~RP)
Linearity	On	((ABS(Actual~RP - Expected~RP) * 100) / Expected~RP)~1

NOTE: ABS = absolute value
Actual = actual calibration result for the parameter
Expected = configured expected value for the parameter
Span = configured calibration span value for the parameter
~ = rounding operand (*a*~*b* means *a* rounded to *b* places)
RP = configured rounding precision for the parameter

Configuration of calibration error information involves the following:

Expected values	Edit Expected Values field in phase configuration screens
Span	***Span for Cal Err*** in the *Config. Channel Options* screen (<Ctrl><D> in channel configuration screen)
RP	***Round Precision*** in the *Config. Channel Options* screen (<Ctrl><D> in channel configuration screen)

6.5.4 *Handling Out-of-Control Calibrations*

Every calibration sequence can be configured to check for out-of-control (OOC) calibration data. If any calibration data point exceeds the configured out-of-control limit, it and all subsequent data points will be flagged with a 'T' (or 't' if valid hour OOC) validation flag. For more information about OOC flags, see page 5-51 "Data Flags."

Once out-of-control, all subsequent calibrations are checked for out-of-control status until the next good calibration, one that falls within the OOC tolerance limits, is received.

Configuration of OOC checking at the logger involves the following:

- **Out-of-control tolerance limits** – In the *Phase Configuration* screen, access the *Expected Value Configuration* screen by selecting the Edit Expected Values field. The OOC Drift Tolerance field can be configured here.

NOTE: If this OOC limit is not set or is removed, the calibration sequence cannot put a parameter back in control.

- **Recovery when OOC** – *No Recovery if OOC Drift?* = **`N`** in the *Expected Value Configuration* screen (via *Phase Configuration* screen). If **`Y`**, the calibration sequence will stop without recovery controls (switching relays off) when a parameter goes OOC.

- **OOC checks on offline parameters** – *Allow OFFLINE OOC Check?* = **`Y`** in the *Advanced Cal Options* screen of the calibration configuration.
- **Generate alarm when OOC** – *Alarm on Out of Control?* = **`Y`** in the *Alarm Configuration* screen.

NOTES:

- A calibration sequence that does not have OOC limits set cannot affect the OOC status of a channel. For instance, if a channel is OOC and then the OOC limits are removed, the calibration sequence cannot put the parameter back in control.
- Calibrations that occur during a boiler offline period ('F' flag) cannot affect the OOC status of a channel (unless the *Allow OFFLINE OOC Check?* option is **`Y`**).

Normal Operations

At the end of each phase, each parameter that is configured with an OOC limit for at least one phase and that is not currently offline is checked for OOC status by comparing the calibration error against the OOC limit. If the result exceeds the configured OOC limit, then the parameter is marked OOC and the OOC alarm calibration flag is set.

Note that the option *Allow OFFLINE OOC Check?* in the *Advanced Cal Options* screen can allow for OOC checks even if the parameter is offline.

At the end of the entire calibration sequence, the calibration results are stored (unless *Store Result in Cal Record?* in the *Expected Value Configuration* screen is "N".)

Automatic Out-of-Control

All parameters that are configured with an OOC limit for at least one calibration phase will be automatically marked out-of-control if (a) they are online and (b) they have not passed an online calibration in 26 hours and the *Use 40CFR75 Validation (Y/N)* flag in the channel configuration is set to "Y".

The only exception to this rule is the 8-hour "grace period" following startup of a parameter. The startup grace period occurs when a parameter transitions from being totally offline during one hour to being online for any time in the next hour. If the 26-hour window expires during the 8-hour grace period, the parameter is not marked OOC until the end of the grace period. This allows users additional time to perform an online calibration and avoid going automatically OOC. Note, however, that additional startups that occur during an 8-hour grace period do *not* rescind or extend the grace period. For related information about automatically triggering calibrations following a startup, see the next section about Advanced Cal Options.

By setting the *Use 40CFR75 Validation (Y/N)* flag to "G", a channel operates identically to a channel with the *Use 40CFR75 Validation (Y/N)* flag set to "Y" except that the grace period is disabled. If an off-line condition begins less than 26 hours after a good calibration and extends past the 26-hour calibration window, the channel is marked with a "T" flag (OOC) immediately after the next on-line condition begins.

6.5.5 *Advanced Options for Automatic Cals*

Press <Ctrl><R> in the calibration configuration screen to configure advanced features. These advanced options (except for *Keep Other Cals in Startup?* and *Allow OFFLINE OOC Check?*) are only available for calibrations that are automatic, user-initiated or externally initiated.

```
ESC Model 8816 v5.18  ID:??          Advanced Cal Options          04/06/03 14:31:51

    Name of Cal     (can't edit):  TEMP
    Startup Delay                :  0s
    Startup Minute (00-59)       :  0
    Keep Other Cals in Startup?  :  N
    Allow OFFLINE OOC Check?     :  N
    Number of Runs               :  0
    Interval Between Runs        :  0s


  Type <Esc> to exit
```

Startup Delay:

An interval of time to delay calibrations after the boiler starts up (e.g., 004h, 030m). The Startup Delay and Startup Minute must be configured for any calibration sequences that should run automatically during the "grace period" after unit startups. A Startup Delay of 0s disables the startup calibration.

Startup Minute (00-59):

The clock minute to begin calibrations after the startup delay time period has elapsed. Entering a minute of 99 sets the Startup Minute to (none), and the startup calibration begins immediately after the Startup Delay time.

Keep Other Cals in Startup?

Yes or No. If (Y)es, any other calibration scheduled to run during startup with one or more of the same affected parameters runs as scheduled even after this calibration is completed. If (N)o, any other calibration scheduled to run during startup with one or more of the same affected parameters is cancelled.

Allow OFFLINE OOC Check?:

Yes or No. Normally, if a parameter is offline, it is marked as such at the end of each calibration phase and at the end of each sequence. Each parameter that is configured with an out-of-control limit is checked for OOC status at the end of each phase unless it has been marked offline. To allow OOC checks while the parameter is offline, this field must be configured as (Y)es; the offline status is ignored and the parameter is checked for OOC status.

Number of Runs:

The number of runs of each calibration that should be made.

Interval Between Runs:

The amount of time that should elapse between the start time of each run of a calibration.

Startup Delay/Startup Minute for Calibrations

Automatic calibrations, user-initiated calibrations, and externally initiated calibrations can be configured to automatically trigger after a calibration startup condition.

A calibration startup condition occurs when one or more parameters, configured with OOC limits for at least one phase of the calibration, transition from being totally offline during one hour to being online at any (averaging) time in the next hour. (This is similar, but not identical, to the 8-hour grace period following startups described above.)

In the *Advanced Cal Options* screen, the *Startup Delay* is the amount of time that must expire following a startup before the calibration is triggered. A *Startup Delay* of 0s disables the startup calibration. The *Startup Minute (00-59)* is the exact minute of the hour to begin the calibration. The calibration automatically begins at the first occurrence of the startup minute following the expiration of the startup delay.

A calibration is scheduled to automatically trigger when at least one of its OOC-configured parameters transitions into the startup state. However, this only occurs if the calibration has not already been scheduled for triggering. Also, a calibration is triggered at its startup time only if all OOC-configured parameters that are in the calibration startup state are online. Otherwise, the calibration is scheduled to trigger at the startup minute of the next hour. For a 40CFR75 type parameter, a configured startup calibration is always scheduled at the first online condition after a completely offline clock-hour. However, if the calibration completes successfully, no additional startup calibrations are scheduled during the 8-hour startup period. Although this method does not utilize the 26-hour calibration window to the fullest, it does prevent unexpected data loss under conditions that are common to combustion turbines. It also reduces the number of calibrations performed for a unit that comes up and down multiple times during a day.

If a calibration has not executed by the time the startup condition expires on all of its OOC-configured parameters, then the calibration is canceled and rescheduled for normal operation. Note also that if such a calibration executes for any other reason (e.g., started from the menu or externally initiated), then its startup condition is canceled. Automatic calibrations are blocked from execution as long as they are scheduled as a startup calibration; they can, however, be started from the menu.

6.6 Automatic Zero/Span

This calibration is initiated by the data logger's internal clock and typically repeats every 24 hours. Two data points are taken: a zero point and a span point. Each phase controls a calibrator or solenoids via digital output lines. Each phase can switch several output lines. Each phase has a prescribed duration that specifies how long the lines are to be switched on, and a response time that specifies how long data are to be averaged at the end of each phase to form the data for that phase.

```
ESC Model 8816 v5.xx  ID:??        Auto Zero/Span Cal Cfg        04/06/03 14:33:30

    Name of Cal Sequence        :  TEMP
    Starting Time               :  08/14/97 23:00:00
    Interval                    :  1d
    Affected/Data Channels      :  (none)









    Minimum # Cal Records Stored:  1
    Zero Output Control Lines   :  1,2=0,
    Zero Phase Data Time        :  0s
    Zero Phase Duration         :  5s
    Edit Zero Expected Values   :
    Span Output Control Lines   :  1=0,2,
    Span Phase Data Time        :  0s
    Span Phase Duration         :  5s
    Edit Span Expected Values   :
    Recovery Time               :  5m
    FINISHED (Configure Now)

  CTRL-R = Advanced Options,  CTRL-O = Config Relay Outputs
```

Name of Cal Sequence:

The label used to identify this calibration program.

Starting Time:

The month, day, and time that the logger should begin this calibration sequence. MM/DD/YY HH:MM:SS.

Interval:

How often this calibration sequence should repeat; usually every 24 hours (1d). Interval must evenly divide into 24 hours. **0** to **999** **s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Affected Data Channels:

The channels that will be affected by the introduction of calibration gas; these will be flagged during calibration. Any configured channel name or ALL for all configured channels. Up to 255 characters.

No. of Cal Records Stored:

The minimum number of calibration records that can be stored for this particular calibration sequence. The default depends on the number of parameters affected. Refer to *A Note About Storing Calibrations* in "Calibration" on page 6-1.

Zero Output Control Lines:

A list of the 2-digit output line numbers and their states that will control the zero phase of calibration.

Zero Phase Data Time:

How long data are to be averaged at the end of the zero phase to form the data for zero calibration. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively). Must be equal to or greater than 5 seconds.

Zero Phase Duration:

How long the lines are to be switched on for the zero phase of calibration; must be greater than or equal to the Zero Phase Data Time. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively). Must be equal to or greater than 5 seconds.

Edit Zero Expected Values:

Press <Enter> at this field to edit expected values for the zero phase of this calibration program. See page 6-18 "Configuring Expected Values." (Use the down arrow to skip the expected values editor.)

Span Output Control Lines:

A list of the 2-digit output line numbers and their states that will control the span phase of calibration.

Span Phase Data Time:

How long data are to be averaged at the end of the span phase to form the data for span calibration. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively). Must be equal to or greater than 5 seconds.

Span Phase Duration:

How long the lines are to be switched on for the span phase of calibration; must be greater than or equal to the Span Phase Data Time. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively). Must be equal to or greater than 5 seconds.

Edit Span Expected Values:

Press <Enter> at this field to edit expected values for the span phase of this calibration program. See page 6-18 "Configuring Expected Values." Use the down arrow to skip the expected values editor.)

Recovery Time:

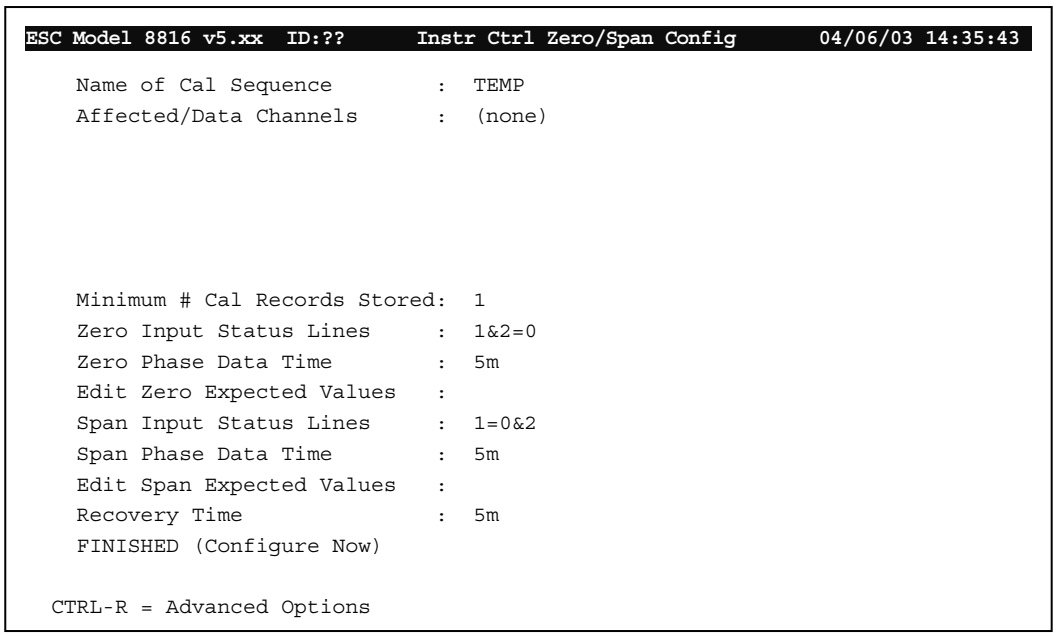
The time required to purge the calibration gases; a delay before normal sampling and averaging begins again. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively). Setting the recovery time to zero (**0s**) will skip any recovery control (switching relays off) and time delay before normal operation resumes.

6.7 Instrument Controlled Zero/Span

This calibration is initiated by events external to the data logger (typically an automatic calibrator). An instrument-controlled calibration cannot be manually started or stopped.

The data logger senses the zero and span states through its digital input lines. Two data points are taken: a zero point and a span point. For each phase, the data logger must be told which inputs are to be watched and whether an on or off state for each input defines the beginning of the phase. When the data logger senses the exact specified input pattern, it recognizes the zero or span state.

Each phase has a response time that specifies how long data are to be averaged at the end of each phase to form the data for that phase. A recovery time specifies the time required to purge out the calibration gases after the zero and span phases have switched off, providing a delay before normal sampling and averaging begins.



Name of Cal Sequence:

The label used to identify this calibration program.

Affected Data Channels:

The channels that will be affected by the introduction of calibration gas; these will be flagged during calibration. Any configured channel name or ALL for all configured channels. Up to 255 characters.

No. of Cal Records Stored:

The minimum number of calibration records that can be stored for this particular calibration sequence. The default depends on the number of parameters affected. Refer to "*A Note About Storing Calibrations*" in "Calibration" on page 6-1.

Zero Input Status Lines:

A list of the input lines and their on/off states that signal the beginning of the zero phase of calibration. Both the line number and the state should be specified (**1**=on, **0**=off); the "=1" is assumed and will not be shown (e.g., if you enter **1=1&2=0**, it will display as **1&2=0**).

Zero Phase Data Time:

How long data are to be averaged at the end of the zero phase to form the data for zero calibration. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Edit Zero Expected Values:

Press <Enter> at this field to edit expected values for the zero phase of this calibration program. See page 6-18 "Configuring Expected Values." (Use the down arrow to skip the expected values editor.)

Span Input Status Lines:

A list of the input lines and their on/off states that signal the beginning of the span phase of calibration. Both the line number and the state should be specified (**1**=on, **0**=off); the "=1" is assumed and will not be shown (e.g., **1=0&2** for 1=0 and 2=1).

Span Phase Data Time:

How long data are to be averaged at the end of the span phase to form the data for span calibration. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Edit Span Expected Values:

Press <Enter> at this field to edit expected values for the span phase of this calibration program. See page 6-18 "Configuring Expected Values." (Use the down arrow to skip the expected values editor.)

Recovery Time:

The time required to purge the calibration gases; a delay before normal sampling and averaging begins again. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively). Setting the recovery time to zero (**0s**) will skip any recovery control (switching relays off) and time delay before normal operation resumes.

6.8 Complex Calibrations

6.8.1 *Automatic Calibration*

This calibration, like the Automatic Zero/Span, is initiated by the data logger's internal clock and is repeated on a preset interval. Thus, the starting time and interval (repeat) time must be configured.

For each phase, the user must designate which control lines are to be turned on or off, the duration of the switch, and the response time.

6.8.2 *Instrument Controlled Calibration*

This calibration, like the Instrument Controlled Zero/Span, is initiated and controlled by external equipment, and the current state is sensed via digital inputs. (An instrument-controlled calibration cannot be manually started or stopped.) The user enters a list of phases, but these phases may occur in any order.

For each phase, the user must designate the pattern of digital input lines that defines the state and the response time for each phase (seconds, minutes, or hours).

6.8.3 *Externally Initiated Calibration*

This calibration is similar to the Automatic Calibration, but instead of specifying a start time, the user specifies one or more digital inputs (and their status: 1=on, 0=off) that are used to notify the ESC Model 8816 that the calibration should begin. The calibration's timing, control, and phase configuration is the same as for Automatic Calibration.

6.8.4 *User-Initiated Calibration*

This calibration is similar to the Automatic Calibration, but there is no automatic start time or repeat time. The calibration begins when *Start a Calibration Program* (hot key **S**) is selected from the *Cal Configuration Menu*. The timing, control, and phase configuration is the same as for an Automatic Calibration.

6.8.5 *User-Initiated Calibration with Confirming Digital Input*

This user-initiated calibration type looks for digital inputs to confirm the end of a phase. The calibration is aborted if the configured digital input line pattern is not observed.

6.8.6 *Interactive (Menu) Calibration*

In this calibration type, the user controls calibration data acquisition via a menu interface. This calibration type is often used for highly manual procedures such as testing opacity instruments against standard filters (see page 6-21 "Performing an Interactive Calibration").

6.9 Configuring Complex Calibrations

The complex calibrations require the same configuration information, with some extra fields for automatic and externally initiated calibration types.

```
ESC Model 8816 v5.xx  ID:??        Automatic (A) Cal Cfg.        04/06/03 14:38:31

    Name of Cal Sequence        :  TEMP
    Starting Time               :  04/06/03 23:00:00
    Interval                    :  1d
    Affected Channels           :  (none)









    Minimum # Cal Records Stored:  1
    MODIFY PHASE                :
    ADD PHASE                   :
    DELETE PHASE                :
    Recovery Time               :  5m
    FINISHED (Configure Now)
```

Name of Cal Sequence:

The label used to identify this calibration program.

Starting Time:

[Automatic only] The month, day, and time that the logger should begin this calibration sequence. MM/DD/YY HH:MM:SS

Interval:

[Automatic only] How often this calibration sequence should repeat; usually every 24 hours (1d). Smaller intervals must evenly divide into 24 hours. **0** to **999** **s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Affected Channels:

The channels that will be affected by the introduction of calibration gas; these will be flagged during calibration. Any configured channel name or ALL for all configured channels.

No. of Cal Records Stored:

The minimum number of calibration records that can be stored for this particular calibration sequence. The default depends on the number of parameters affected. Refer to *"A Note About Storing Calibrations"* in "Calibration." on page 6-1.

Start Pattern Status Lines:

[Externally Initiated only] A list of the input lines and their on/off states that signal the beginning of calibration. Both the line number and the state should be specified (**1**=on, **0**=off); e.g., **2=1**.

MODIFY PHASE:

Pressing <Enter> at this field brings up a choose list from which the phase to modify is selected. See "Configuring Phases of a Complex Calibration" below for an explanation of how phases are configured.

ADD PHASE:

Pressing <Enter> at this field brings up a choose list of existing phases along with the option END. Pressing the <Enter> key with a phase name highlighted causes the new phase to be placed before the selected phase and accesses the *Phase Configuration Screen*. Pressing the <Enter> key with the END selection highlighted causes the new phase to be the final phase of the calibration and accesses the *Phase Configuration Screen*. See "Configuring Phases of a Complex Calibration" below for an explanation of how phases are configured.

DELETE PHASE:

Pressing <Enter> at this field brings up a choose list from which the phase to delete is selected. Press <Enter> to confirm deletion or <Esc> to exit without deleting.

Recovery Time:

The time required to purge the calibration gases; a delay before normal sampling and averaging begins again. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively). Setting the recovery time to zero (**0s**) will skip recovery control (switching relays off) and time delay before normal operation resumes.

6.9.1 *Configuring Phases of a Complex Calibration*

Depending on the type of complex calibration, the phase configuration screen will contain the following fields. Some calibration types will not display all of these fields in their phase configuration.

```
ESC Model 8816 v5.xx  ID:??       Phase Configuration Screen       04/06/03 14:41:42

   Name of Cal (not editable)  :  CALSEQ#1
   Name of Phase               :  TEMP01
   Data Channels               :  (none)




   Output Control Lines        :  1,2=0,3=0,
   Phase Data Time             :  0s
   Phase Duration              :  5s
   Edit Expected Values        :


  <Esc> to return to cal config
```

Name of Cal

The calibration sequence name of which this phase is a part.

Name of Phase:

The label used to identify this phase of the calibration program.

Data Channels:

A subset of the affected channels; when this phase runs, a data point will be taken for each parameter. Defaults to the same channels as designated in the Affected/Data Channels field in the calibration configuration screen. Up to 255 characters.

Output Control Lines:

[All except Instrument Controlled] A list of the 2-digit output line numbers and their states that will control this phase of calibration.

Phase Data Time:

How long data are to be averaged at the end of this phase to form the data. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Phase Duration:

[All except Instrument Controlled] How long the lines are to be switched on for this phase of calibration; must be greater than or equal to the Phase Data Time. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Edit Expected Values:

Press <Enter> at this field to edit expected values for the zero phase of this calibration program. See page 6-18 "Configuring Expected Values."

Input Status Lines:

[Instrument Controlled only] A list of the input lines and their on/off states that signal the beginning of this phase of an instrument controlled calibration. Both the line number and the state should be specified (**1**=on, **0**=off); e.g., **2=1**.

Confirming Status Inputs:

[User Init w/Confirming DI only] For user-initiated calibrations with confirming digital inputs, list the digital input line pattern that confirms the end of this phase (may or may not be configured for each phase). Both the line number and the on/off state should be specified (**1**=on, **0**=off); e.g., **2=1**. If the confirming pattern is configured for a phase, the phase ends when the pattern is observed or after the Phase Duration time has expired. If the configured digital inputs are not observed by the end of the phase duration, the calibration is aborted.

6.10 Configuring Expected Values

The expected values in a calibration configuration can be edited by selecting the *Edit Expected Values* field. After the list of configured channels is displayed, press <Enter> for the following screen to appear for the highlighted channel:

```
ESC Model 8816 v5.xx  ID:??      Expected Value Configuration      04/06/03 14:44:47

    Name of Cal (not editable)  :  CALSEQ#1
    Name of Phase (not editable):  ZERO
    Channel Name (not editable) :  TEMP
    Expected Value              :  0
    Tracer/ID Code (0000-9999)  :  0000
    Use EV For Automatic Correct?  N
    Write EV to Math Constant   :  (none)
    Write Result to Math Constant  (none)
    Warning Drift Tolerance     :  (not set)
    OOC Drift Tolerance         :  (not set)
    No Recovery If Warning Drift?  N
    No Recovery If OOC Drift?   :  N
    Store Result in Cal Record? :  Y
    Use Rounded Results?        :  N
    Method of Error Calc.(S,D,L):  D


  ESC to return to Phase Config
```

Press <Esc> to return to the choose list of channels to edit additional expected values. Press <Esc> again to return to the *Calibration Configuration* screen.

Name of Cal

A non-interactive field displaying the calibration sequence name.

Name of Phase:

A non-interactive field identifying this phase of the calibration program.

Channel Name:

A non-interactive field used to display which channel the expected value editor is working on.

Expected Value:

The expected value of the calibration channel for the selected phase, in engineering units. Up to 10 characters. The expected value can be one of the following:

- the actual numerical value (bottle value),
- a Math Constant (**K1**-**K32**),
- the result of a previous phase (phase name), or
- the product of a numerical value or a Math Constant and the result of a previous phase.

For example, the expected value can be specified as **45.0**, **K1**, **ZERO**, **ZERO*45**, or **ZERO*K1**. For multiplication entries, the phase name must be the first operand.

Tracer ID Code (0000-9999):

The identification code attached to each data point, usually corresponding to serial numbers on calibration gas bottles or filters.

Use EV For Automatic Correct?:

A flag (Y or N) indicating whether the ESC Model 8816 should **automatically** recalculate scaling constants for this channel based on calibration results. If the flag is enabled for the parameter for one phase, a zero adjust is performed. If the flag is enabled for two phases, a linear rescaling is performed. If the flag is enabled (Y) for three phases, a three-point parabolic curve fit is performed. Only standard and rolling average channels may be rescaled. The "Allow Auto Corr if Config'd?" flag must also be set to (Y)es in the System Configuration Screen (see page 4-4 "Configuring System Parameters."

NOTE: Few checks for "reasonability" are done on the data, so a bad calibration (e.g., running out of span gas) could cause irrevocable loss of accuracy.

Write EV to Math Constant:

The user may specify that the expected value for this channel and phase be recorded as one of the thirty-two math constants (**K1**-**K32**).

Write Result to Math Constant:

The user may specify that the results for this channel and phase be recorded as one of the thirty-two math constants (**K1**-**K32**).

Warning Drift Tolerance:

The maximum amount that each calibration result is allowed to differ from the expected value (in engineering units if the *Method of Error Calc. (S,D,L)* flag is set to "D" or in percentage if the flag is set to "S" or "L"). For example, if the *Method of Error Calc. (S,D,L)* field is set to "D" and the expected value = 900 and this limit = 50, then the calibration drift can span 850-950 before a calibration alarm is triggered (see page 7-3 "Average Alarms"). Up to 19 characters. Drift tolerances can be a numerical value, a Math Constant, the result of a previous phase, the product of a numerical value or Math Constant and the result of a previous phase, the expected value (**EXPVALUE**), or the product of the expected value and a Math Constant (**EXPVALUE*K*n**); see Expected Value definition above. May also use the **<** character to indicate that a variance less than or equal to the tolerance is an alarm condition.

OOC Drift Tolerance:

The maximum value of a calibration result (in engineering units if the "Method of Error Calc. (S,D,L)" flag is set to "D" or in percentage if the flag is set to "S" or "L") for determining out-of-control status. If a calibration exceeds this value, the data will be flagged with a T to indicate that it is out-of-control. Up to 19 characters. Drift tolerances can be a numerical value, a Math Constant, the result of a previous phase, the product of a numerical value or Math Constant and the result of a previous phase, the expected value (**EXPVALUE**), or the product of the expected value and a Math Constant (**EXPVALUE*K*n**); see Expected Value definition above. May also use the **<** character to indicate that a variance less than or equal to the tolerance is an out-of-control condition.

No Recovery If Warning Drift?

Yes or No to indicate if the calibration sequence should stop without the recovery control (switching relays off) if the Cal Alarm Drift Tolerance limits are exceeded.

No Recovery If OOC Drift?

Yes or No to indicate if the calibration sequence should stop without the recovery control (switching relays off) if the Out-of-Control Drift Tolerance limits are exceeded.

Store Result in Cal Record?

Yes or No to store the data point in the calibration record. Normally Y, the user may choose that this data point *not* be stored in the calibration record. This feature may be used when a parameter is in the calibration for correction or write to math pack purposes, but should not be included in calibration records (i.e., if the parameter is not required by regulations to be calibrated).

Use Rounded Results:

Yes or No to round the calibration results when calculating calibration error. If Yes, values will be rounded to the precision configured in the advanced options screen of the parameter's channel configuration. Results will not be stored as rounded numbers. See page 6-5 "Calibration Error Calculation."

Method of Error Calc. (S,D,L):

The method to be used for calculating calibration error: **S**=standard, **D**=difference, and **L**=linearity. The table in "Calibration Error Calculation" on page 6-5 shows the methods with and without rounding.

6.11 Quick Expected Value Editor

This utility allows the expected values only to be quickly edited, up to 40 parameter/phase combinations for a single calibration. Calibration expected values may be updated while calibrations are in progress.

Select *Quick Expected Value Editor* (hot key **Q**) from the *Cal Configuration Menu*. A list of all the configured calibrations will display. Use the up/down arrow keys to highlight a calibration. Press <Enter> for a list of calibration phases and associated data parameters to appear for the highlighted calibration:

```
ESC Model 8816 v5.xx  ID:??          Edit Expected Values          04/06/03 14:50:37

     ZERO/S02                     :  0
     ZERO/NOX                     :  0
     ZERO/C02                     :  0
     SPAN1/S02                    :  210.3
     SPAN1/NOX                    :  433.5
     SPAN1/CO2                    :  11.8
     SPAN2/S02                    :  451.7
     SPAN2/NOX                    :  894.3
     SPAN2/C02                    :  18.7

     EXIT (Configure Now)

   Type <Esc> to abort
```

The first screen can only contain up to 20 expected values, but a second screen of the same size is available if necessary. The total number of data parameters in all phases must be less than or equal to 40 or not all parameters will be accessible by this editor (i.e., up to 20 parameters in a zero/span calibration, 13 parameters in a three-point calibration, etc.). Press <Ctrl><N> to select next page or <Ctrl><P> to select previous page. Use the up/down arrows to select a calibration phase. Press <Esc> to abort.

6.12 Performing an Interactive Calibration

This calibration type uses a menu interface to control data acquisition and to move from one calibration phase to another.

Select *Start A Calibration Program* (hot key **S**) from the *Cal Configuration Men.* Select the name of the interactive calibration program. Only one interactive calibration may be active at a time. A special menu displays to the user the active calibration and phase, and whether data acquisition is active or inactive:

```
ESC Model 8816 v5.xx  ID:??        Interactive Calibration        04/06/03 14:54:09

    Cal Sequence                :  MENUCAL
    Currently Active Phase      :  ZERO
    Data Acquisition is         :  OFF
    START Data Acquisition
    Display Readings
    Display Cal Status
    STOP Data, Go To Next Phase
    Edit Expected Values
    Abort Cal Entirely
```

The special menu selections are used to start and stop data acquisition.

After stepping through all the phases, the calibration program enters a preset recovery period, then returns to normal sampling. While in recovery, the *Interactive Calibration* screen cannot be displayed.

Cal Sequence:

A non-interactive field displaying the name of the interactive calibration sequence being performed.

Currently Active Phase:

A non-interactive field identifying the phase of the interactive calibration program that is currently executing. Any Output Control Lines defined for this phase will be in the activate state at this time.

Data Acquisition is:

OFF or ON. A non-interactive field that indicates whether or not the logger is collecting calibration data for the above-referenced calibration phase.

START Data Acquisition

Press <Enter> at this field to begin collecting data for the Currently Active Phase of the calibration.

Display Readings

Press <Enter> at this field to view the Real-Time Engineering Units display (See page 8-3 "Display Readings with Units or Flags").

STOP Data, Go To Next Phase

Press <Enter> at this field to stop data collection for the Currently Active Phase and to make the next configured phase of the interactive calibration sequence the Currently Active Phase.

Display Cal Status

Press <Enter> at this field to view the Display Status of Single Cal screen (See page 11-7 "Single Calibration Status").

Edit Expected Values:

Press <Enter> at this field to edit the expected values for the Currently Active Phase of the interactive calibration program. See page 6-18 "Configuring Expected Values." Press<Tab> to skip the *Expected Values Editor*.

Abort Cal Entirely

Press <Enter> at this field to abort the interactive calibration sequence. The recovery portion of the calibration will be initiated, and the display will return to the *Cal Configuration Menu*.

6.13 Calibration flags

The ESC Model 8816 stores the following calibration flags along with the data in long-term storage. These calibration flags describe error conditions or events that took place during the calibration.

Flag	Condition
a	Cal Restore Caused Abort
E	Cal Error Caused Abort
C	Can't Find Cal Channel
P	Can't Find Parm Channel
<	All OOC Phases Not Done
m	OOC While In Maintenance
M	Cal Phase Ended While In Maintenance
F	Cal Phase Ended While Offline
A	Cal Aborted (lowest priority)
R	Error Rescaling
D	Instrument Drifted
O	Instrument OOC (highest priority)

Chapter 7
Alarms

The ESC Model 8816 logger can maintain up to 64 different alarm programs (if sufficient configuration memory is available) for reporting alarm conditions to the screen, to a line printer or to a host computer.

These types of alarms can be configured:

- average alarms, which are triggered by the presence of a validation or information flag on a data average, and
- calibration drift alarms, which are triggered:
  - when a calibration result differs from the expected value by more than the configured *Warning Drift Tolerance*;
  - when a calibration result differs from the expected value by more than the configured *OOC Drift Tolerance*;
  - when the calibration is aborted before completion;
  - when the auto-scale of any calibration channel fails (see page 6-18 “Configuring Expected Values.”);
  - by any combination of the above four conditions.

All alarms can be used to turn on control (relay) output lines, send messages to printers or to serial ports, and will create an entry in an alarm journal buffer, along with time tags and information about who and what triggered the alarm. An alarm can also be used to execute a user-defined dial-out program that initiates communication through a modem and outputs user-defined data in the form of text strings. An additional software option can be used to provide automatic and instant notification to a polling computer, even during polling.

Select *Configure Alarms* (hot key **A**) from the *Configuration Menu*, The following screen will display:

```
ESC Model 8816 v5.xx  ID:??        Alarm Configuration Menu        04/06/03 14:57:12

    N Enter New Alarm Program
    C Change Old Alarm Program
    D Delete Old Alarm Program
    1 Enter New Reason Code
    2 Change Old Reason Code
    3 Delete Old Reason Code
    4 Enter New Dial-out Program
    5 Change Old Dial-out Program
    6 Delete Old Dial-out Program
```

A brief description of each *Alarm Configuration Menu* item appears below. For more detailed explanations, refer to the section noted.

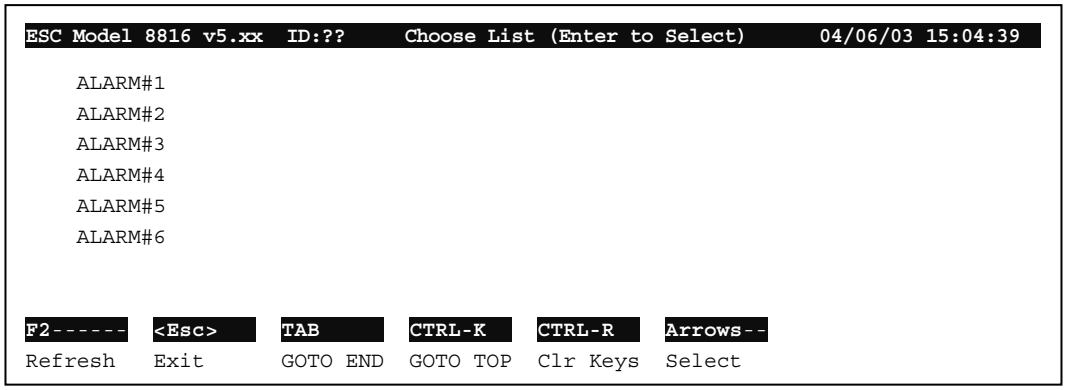
Hot Key	To Option	Purpose	See Page
N	*Enter New Alarm Program*	Configures a new alarm program	7-3
C	*Change Old Alarm Program*	Modifies an existing alarm program	7-2
D	*Delete Old Alarm Program*	Deletes an existing alarm program	7-3
1	*Enter New Reason Code*	Configures a reason code	7-8
2	*Change Old Reason Code*	Modifies an existing reason code	7-8
3	*Delete Old Reason Code*	Deletes an existing reason code	7-8
4	*Enter New Dial-out Program*	Configures a dial-out program	7-10
5	*Change Old Dial-out Program*	Modifies a dial-out program	7-9
6	*Delete Old Dial-out Program*	Deletes a dial-out program	7-10

Other Alarm Features in the ESC Model 8816

Menu	See Page
Status Menu ⇒ *Alarm Status/Log* ⇒ Acknowledge Active Alarm	11-6
Status Menu ⇒ *Alarm Status/Log* ⇒ Report Current Alarm Status	11-5
Status Menu ⇒ *Alarm Status/Log* ⇒ View, Print, Erase Alarm Log	11-4

7.1 Changing an Alarm Program

Select *Change Old Alarm Program* (hot key **C**) from the *Alarm Configuration Menu*. A list of all configured alarm programs will display.



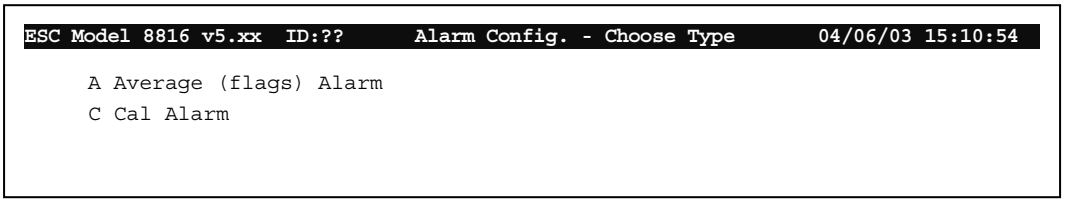
Press <Enter> for the highlighted alarm program's configuration screen to appear. The selected alarm program is copied into memory for editing. After any changes are made (refer to page 7-3 "Configuring Alarm Programs" for information about configuration fields), select *FINISHED (Configure Now)* for the new changes to take effect, or press <Esc> to cancel (the changes will not take effect)

7.2 Deleting an Alarm Program

Select *Delete Old Alarm Program* (hot key **D**) from the *Alarm Configuration Menu*. A list of all configured alarm programs will display. Press <Enter> for the highlighted alarm program to be deleted, or press <Esc> to cancel the deletion.

7.3 Configuring Alarm Programs

Select *Enter New Alarm Program* (hot key **N**) from the *Alarm Configuration Menu*. A list of the available alarm program types will display:



Hot Key	Selection	Configures
A	**Average (flags) Alarm**	An alarm to occur when an average has a particular data flag appended.
C	**Cal Alarm**	An alarm to occur when calibration data meet certain criteria.

7.3.1 *Acknowledging Alarms*

Each alarm program can have a particular method or combination of methods for acknowledging alarms. Acknowledgment methods may be:

- the transition of an input status line, perhaps from an acknowledgment switch, (*Input Lines for Ack* and *Encode DI as Reason Code* fields),
- an automatic acknowledgment after a specified time-out period (*Acknowledgment Timeout* field), or
- manual acknowledgment by the user. (See page 11-6 "Acknowledging Alarms.")

Any combination of these methods can be used to acknowledge alarms. If none of these methods is used, the alarm is reset when the alarm condition disappears, provided the *End Alarm When No Flag?* field is set to (Y)es.

7.3.2 *Average Alarms*

Average alarms are triggered by the presence of a data flag on an average. This alarm methodology provides a flexible system for notifying operators about multiple conditions on a single channel. For example, one alarm can be configured for high limits, another alarm for required maintenance, a third alarm for an invalid hour of data, etc.

See page 5-51 "Data Flags" for a description about data flags that can trigger alarms.

To configure an average alarm, the *Monitored Parameter(s)* list, the *Averaging Interval* to be observed and the *Flag(s) for Alarm Condition* must be defined. The first occurrence of the alarm is the triggering event, and the appropriate channel and flag are noted in the alarm log. If several alarm conditions occur simultaneously, only the first condition found will be logged in the alarm journal.

An average alarm can also be configured not to change state when certain flags are present. Generally, these conditions indicate system failure or calibration, such as the power failure flag (P), bad status flag (B), channel disabled flag (D), calibration flag (C) or maintenance flag (M).

As an option, a dial-out program can be executed upon the instance of an active alarm. The dial-out program must be configured prior to configuring the initiating average alarm (see page 7-8 "Configuring Reason Codes").

```
ESC Model 8816 v5.xx  ID:??          Alarm Configuration          04/06/03 15:13:23

    Alarm Program Name           :  TEMP
    Average Interval             :  1m
    Monitored Parameter(s)       :  (none)


    Flag(s) for Alarm Condition  :  (none)
    Ignore State Changes Flag(s):  (none)
    Output Lines During Alarm    :  (none)
    Output to Alarm Port?        :  N
    Dial-out Program Name        :  (none)
    Input Lines for Ack          :  (none)
    Encode DI as Reason Code?    :  N
    Acknowledgment Timeout       :  0s
    Retrigger Alarm?             :  N
    End Alarm When No Flag?      :  Y
    FINISHED (Configure Now)


  CTRL-O = Config Relay Outputs
```

Alarm Program Name:

Label that uniquely identifies this alarm program.

Monitored Parameter(s):

Indicates which channel(s) the alarm program should monitor. Any configured channel name(s), up to 255 characters, or **`ALL`** for all configured channels.

Average Interval:

Selects which average interval the alarm program should monitor. Default=**`1m`** (minute).

Flag(s) for Alarm Condition:

Specifies which flags are to trigger the alarm. Choose from any of the validation flags listed on page 5-51 "Data Flags." Up to 32 characters or **`ALL`** for all validation flags.

Ignore State Changes Flag(s):

Specifies which flags will prevent alarm state changes. If any of these flags are present, an active alarm will remain active, and an inactive alarm will remain inactive. Choose from any of the flags listed on page 5-51 "Data Flags." Up to 32 characters.

NOTE: If multiple Monitored Parameter(s) are configured, the alarm will not activate if any of these flags are present ONLY on all of the parameters that also have the Flag(s) for Alarm Condition. Alternately, the alarm will not clear if any of these flags are present on ANY of the Monitored Parameter(s).

Output Lines During Alarm:

Specifies the 2-digit output line number to activate while in alarm (until acknowledged). Up to 40 characters.

Output to Alarm Port?:

Yes or No to print alarm to the Alarm Printer Port as defined in the *EEPROM Configuration Menu* (see page 4-7 "Configuring EEPROM Parameters").

Dial-out Program Name:

The name of the previously configured dial-out program that is to be initiated when this alarm becomes active.

Input Lines for Ack:

Specifies the 2-digit digital input line number(s) for an acknowledgment signal. Up to 40 characters. The ESC Model 8816 will look for any of the specified lines to go active after an alarm has commenced. The active lines will then be binary-encoded as the reason code for that alarm. If *Encode DI as Reason Code?* field is set to Y, the lowest line number is treated as the 1's place, the second lowest line number is treated as the 2's place, and so on. Also enable the *Encode DI as Reason Code* field. See page 7-8 "Deleting a Reason Code."

Encode DI as Reason Code?:

Yes or No to use the above-referenced digital input acknowledgment line(s) to enter reason codes. See page 7-8 "Deleting a Reason Code."

Acknowledgment Timeout:

Automatic acknowledgment of alarms. Specifies the time-out period before automatic acknowledgment of an alarm. **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively). Use **0s** to configure the alarm program without an automatic acknowledgment.

Retrigger Alarm?

Yes or No. Answer **Y** to cause alarm to be retriggered on each averaging interval where the alarm condition still exists. The alarm is checked at each alarm average interval. If the alarm is active from the previous interval but unacknowledged, the alarm remains in the active state. If the alarm is active from the previous interval but acknowledged, the alarm is changed to the active state. In either case, any configured output lines, alarm port messages and dial-out programs are activated, and the acknowledgement timeout counter is reset. The existing alarm journal entry is closed, and a new entry is created. Default=**N**.

End Alarm When No Flag?:

Yes or No. Answer **N** to force manual acknowledgment of alarms by users; alarm will stay in effect until acknowledged, providing a "sticky" alarm. Sticky alarms terminate only upon acknowledgment. Default=**Y**.

NOTE: Press <Ctrl><O> to configure relay outputs; see page 4-20 "Configuring Digital Output States."

7.3.3 *Calibration Alarms*

Calibration alarms monitor one or more data parameters in a specific calibration sequence. The calibration sequence must already be configured, including expected values (see page 6-5 "Expected Values") and any drift tolerances that will initiate alarm conditions (see page 6-18 "Configuring Expected Values"). By setting a series of flags, an alarm can be configured to occur when:

- the calibration average differs from the expected value by more than the configured *Warning Drift Tolerance*.
- the calibration average differs from the expected value by more than the configured *OOC Drift Tolerance*.
- the calibration is aborted before completion.
- the automatic rescaling fails.

```
ESC Model 8816 v5.xx  ID:??          Alarm Configuration          04/06/03 15:15:26

    Alarm Program Name          :  TEMP
    Monitored Cal Program       :  (none)
    Monitored Parameter(s)      :  (none)


    Alarm on Cal Drift?         :  Y
    Alarm on Out of Control?    :  N
    Alarm on Cal Aborted?       :  N
    Alarm on Autoscale Fail?    :  N
    Output Lines During Alarm   :  (none)
    Output to Alarm Port?       :  N
    Dial-out Program Name       :  (none)
    Input Lines for Ack         :  (none)
    Encode DI as Reason Code?   :  N
    Acknowledgment Timeout      :  0s
    Retrigger Alarm?            :  N
    End Alarm When No Flag?     :  Y
    FINISHED (Configure Now)

  CTRL-O = Config Relay Outputs
```

Alarm Program Name:

Label that uniquely identifies this alarm program.

Monitored Cal Program:

Name of calibration sequence for this alarm program to monitor.

Monitored Parameter(s):

Indicates which channel(s) the alarm program should monitor. Any configured channel name(s), up to 255 characters, or **ALL** for all configured channels.

Alarm on Cal Drift?

Yes or No to indicate if the alarm should be generated when the calibration error exceeds the configured Warning Drift Tolerance.

Alarm on Out of Control?

Yes or No to indicate if the alarm should be generated when the calibration error exceeds the configured OOC Drift Tolerance.

Alarm on Cal Aborted?

Yes or No to indicate if an alarm should be generated when the calibration sequence is aborted before completion.

Alarm on Autoscale Fail?

Yes or No to indicate if an alarm should be generated when the automatic rescaling fails for any reason.

Output Lines During Alarm:

Specifies the 2-digit output line number to activate while in alarm (until acknowledged). Up to 40 characters.

Output to Alarm Port?:

Yes or No to print alarm to the Alarm Printer Port as defined in the *EEPROM Configuration Menu* (see page 4-7 "Configuring EEPROM Parameters").

Dial-out Program Name:

The name of the previously configured dial-out program that is to be initiated when this alarm becomes active.

Input Lines for Ack:

Specifies the 2-digit digital input line number(s) for an acknowledgment signal. Up to 40 characters. The ESC Model 8816 will look for any of the specified lines to go active after an alarm has commenced. The active lines will then be binary-encoded as the reason code for that alarm. If *Encode DI as Reason Code?* field is set to Y, the lowest line number is treated as the 1's place, the second lowest line number is treated as the 2's place, and so on. Also enable the Encode DI as Reason Code field. See page 7-8 "Deleting a Reason Code."

Encode DI as Reason Code?:

Yes or No to use the above-referenced digital input acknowledgment line(s) to enter reason codes. See page 7-8 "Deleting a Reason Code."

Acknowledgment Timeout:

Automatic acknowledgment of alarms. Specifies the time-out period before automatic acknowledgment of an alarm. **`0`** to **`999 s`**, **`m`**, **`h`**, or **`d`** (for seconds, minutes, hours, or days, respectively). Use **`0s`** to configure the alarm program without an automatic acknowledgment.

Retrigger Alarm?

Yes or No. Answer **`Y`** to cause alarm to be retriggered on each calibration where the alarm condition still exists. The alarm is checked at each calibration phase. If the alarm is active from the previous interval but unacknowledged, the alarm remains in the active state. If the alarm is active from the previous interval but acknowledged, the alarm is changed to the active state.

In either case, any configured output lines, alarm port messages and dial-out programs are activated, and the acknowledgement timeout counter is reset. The existing alarm journal entry

is closed, and a new entry is created. The alarm is retriggered only once during a single calibration sequence. Default=**N**.

End Alarm When No Flag?:

Yes or No. Answer N to force manual acknowledgment of alarms by users; alarm will stay in effect until acknowledged, providing a "sticky" alarm. Sticky alarms terminate only upon acknowledgment. Default=**Y**.

NOTE: Press <Ctrl><O> to configure relay outputs; see page 4-20 "Configuring Digital Output States."

7.4 Changing a Reason Code

Select *Change Old Reason Code* (hot key **2**) from the *Alarm Configuration Menu*. A list of all configured reason codes will display.

```
ESC Model 8816 v5.xx  ID:??      Choose List (Enter to Select)      04/06/03 15:04:39

   01:Monitor Equipment Fail
   02:Cleaning/Sootblowing




F2------   <Esc>     TAB        CTRL-K     CTRL-R     Arrows--
Refresh    Exit      GOTO END   GOTO TOP   Clr Keys   Select
```

Press <Enter> for the highlighted reason code's configuration screen to appear. The selected reason code is copied into memory for editing. After any changes are made (refer to page 7-8 "Changing a Reason Code" for information about configuration fields), select *FINISHED (Exit Menu)* for the new changes to take effect, or press <Esc> to cancel (the changes will not take effect).

7.5 Deleting a Reason Code

Select *Delete Old Reason Code* (hot key **3**) from the *Alarm Configuration Menu*. A list of all configured reason codes will display. Press <Enter> for the highlighted reason code to be deleted. Press <Esc> to exit without deleting a reason code.

7.6 Configuring Reason Codes

Select *Enter New Reason Code* (hot key **1**) from the *Alarm Configuration Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??        Edit Reason Code Buffer        04/06/03 15:22:25

    Code Number                :  01
    Code Text                  :
    FINISHED (Exit Menu)
```

Code Number

The two-digit number for this reason code. **00-99**.

Code Text

The accompanying text for the reason code; the explanation for the "alarming" data. Up to 40 characters.

7.7 Entering Reason Codes via Digital Inputs

The ESC Model 8816 can be configured to accept reason codes from a switch panel or distributed control system via its digital inputs. By listing digital input line numbers in the *Input Lines for Ack* field and enabling the *Encode DI as Reason Code?* switch (**Y**), the ESC Model 8816 will look for any of the specified lines to go active after an alarm has commenced.

The active lines will then be binary-encoded as the reason code for that alarm. The lowest line number is treated as the 1's place, the second lowest line number is treated as the 2's place, etc.

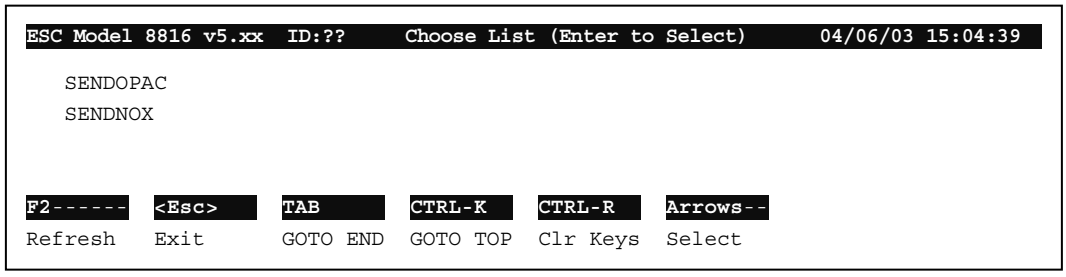
Example: The *Input Lines for Ack* are set to **8=1**, **9=1**, **10=1**, **11=0**, and the *Encode DI as Reason Code?* option is enabled. An alarm goes active, and the DCS switches digital input 9 on and lines 10 through 11 off. The reason code is encoded as follows:

DI#08	= 1's place	does not match = 0
DI#09	= 2's place	matches = 2
DI#10	= 4's place	does not match = 0
DI#11	= 8's place	matches = 8

The alarm is acknowledged with reason code 10.

7.8 Changing a Dial-out Program

Select *Change Old Dial-out Program* (hot key **5**) from the *Alarm Configuration Menu*. A list of all configured dial-out programs will display.



Press <Enter> for the highlighted dial-out program's configuration screen to appear. The selected dial-out program is copied into memory for editing. After any changes are made (refer to page 7-10 "Configuring Dial-out Programs" for information about configuration fields), select *FINISHED (Configure Now)* for the new changes to take effect, or press <Esc> to cancel (the changes will not take effect).

7.9 Deleting a Dial-out Program

Select *Delete Old Dial-out Program* (hot key **6**) from the *Alarm Configuration Menu*. A list of all configured dial-out programs will display. Press <Enter> for the highlighted dial-out program to be deleted unless it is in use by an alarm program. Press <Esc> to cancel the deletion.

7.10 Configuring Dial-out Programs

The dial-out on alarm feature provides the capability for the data logger to execute a user-defined dial-out program upon the instance of an active alarm. The data logger initiates communication through a modem and outputs user-defined data in the form of text strings. A printer or some other device capable of receiving text is required to be connected to the modem receiving the dial-out call. Each program can contain up to three user-defined phone number strings which can incorporate most standard modem dial characters. The number of retries, the carrier wait time and the data logger communications port are also configurable.

Several options for data logger behavior after the connection is established are provided. Three selectable types of information can be output including an eighty-character user-defined message, an alarm report containing the active alarm information and a comprehensive data report consisting of the latest base, extended 1 and extended 2 average information for each configured channel.

In order to execute a dial-out program, an associated alarm program must be configured. When the alarm is activated, a connection is attempted using the first valid phone string and is retried up to the configured retry count. If a connection is not established, then the second number and, if necessary, the third number is attempted. After a connection is established, the user-configured data strings are output.

Select *Enter New Dial-out Program* (hot key **4**) from the *Alarm Configuration Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??          Dial-out Program          04/06/03 15:22:25

    Dial-out Program name    :     none
    First Phone Number       :     none
    Second Phone Number      :     none
    Third Phone Number       :     none
    Number of retries        :     0
    Carrier Wait Time        :     1m
    Communications Port      :     0
    Output all data ?        :     N
    Use decimal positioner ? :     Y
    Output alarm message ?   :     N
    User defined string      :

    FINISHED (Exit Menu)


   <Esc> to exit
```

Dial-out Program name:

Label that uniquely identifies this dial-out program.

First Phone Number:

First phone number to be attempted by the dial-out program. Valid phone number characters include the following: **0123456789*,-;!/"**

Second Phone Number:

Phone number to be attempted by the dial-out program after the *First Phone Number* has been unsuccessfully attempted the configured *Number of retries*. Valid phone number characters include the following: **0123456789*,-;!/"**

Third Phone Number:

Phone number to be attempted by the dial-out program after both the *First Phone Number* and the *Second Phone Number* have been unsuccessfully attempted the configured *Number of retries*. Valid phone number characters include the following: **0123456789*,-;!/"**

Number of retries:

Number of times the dial-out program attempts to retry a phone number before ceasing to dial that number and attempting the next number or exiting. **0-9**

Carrier Wait Time:

Interval which the dial-out program waits for the modem to receive and report a character. **0** to **99 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Communications Port:

Serial port number that is attached to the modem desired to receive the dial-out information. **0-3**

Output all data ?:

If yes, the data and flags for all configured channels are included in the transmitted text strings. If no, only the data and flags for the alarming channel are included in the transmitted text strings. **Y** or **N**

Use decimal positioner ?:

If yes, the data for each channel included in the transmitted text strings are adjusted by the configured decimal positioners. If no, the data included in the transmitted text strings are not adjusted by the configured decimal positioners. **Y** or **N**

Output alarm message ?:

If yes, the data logger alarm message associated with the alarm activating the dial-out program is included in the transmitted text strings. If no, the data logger alarm message is not included in the transmitted text strings. **Y** or **N**

User defined string:

User-defined text string that is included in the text strings transmitted by the dial-out program. 80 characters maximum length.

Chapter 8
Real-Time Data Displays

The real-time data displays take advantage of a high-speed interface to report current voltage readings, scaled engineering values with units or flags, and digital inputs and outputs in real-time.

Select *Real-Time Display Menu* (hot key **D**) from the *Home Men.* The following screen will display:

```
ESC Model 8816 v5.xx  ID:??          Real-Time Display Menu          04/06/03 15:25:19

     V Display Raw Readings
     R Display Readings w/units
     F Display Readings w/flags
     B Display Last Base Avg
     C Continuous Avg Report
     L Show LARGE TEXT Display
     I Display Digital Inputs
     O Display Digital Outputs
     A Display Analog Outputs
```

Hot Key	To Option	Purpose	See Page
V	*Display Raw Readings*	Displays the analog inputs	8-2
R	*Display Reading w/units*	Displays Channel readings with Engineering units	8-3
F	*Display Readings w/flags*	Displays Channel readings with data flag(s)	8-3
B	*Display Last Base Avg*	Displays Channel averages with data flag(s)	8-4
C	*Continuous Avg Report*	Continuously displays Channel readings or averages with flag(s)	8-4
L	*Show LARGE TEXT Display*	Displays Channel readings with large font (LCD only)	8-9
I	*Display Digital Inputs*	Displays the status of all digital inputs	8-7
O	*Display Digital Outputs*	Displays the status of all digital outputs	8-8
A	*Display Analog Outputs*	Displays the current delivered by the analog outputs	8-9

These selections provide output only to the front-panel LCD display and serially connected terminals (except for the LARGE TEXT Display). The real-time display's update rate depends on the local baud rate. For updates every second, the terminal should be running at 9600 baud or faster.

Real-time displays cannot be sent to a line printer. To print, use the *Report Generation Menu* (hot key **R**) option in the *Home Menu*.

Real-Time Display Interface

Key Command	Action
<Ctrl><N>	Swap pages to view the rest of the display. Also see instructions at the bottom of each display.
<Esc> or Spacebar	Exit a real-time display.

Related Features in the ESC Model 8816

Menu	See Page
Report Generation Menu	9-1
Graph Generation Menu ⇒ Real-Time Graph of Readings	10-1
Status Menu ⇒ Report Current Cal Status	11-6

8.1 Display Raw Readings

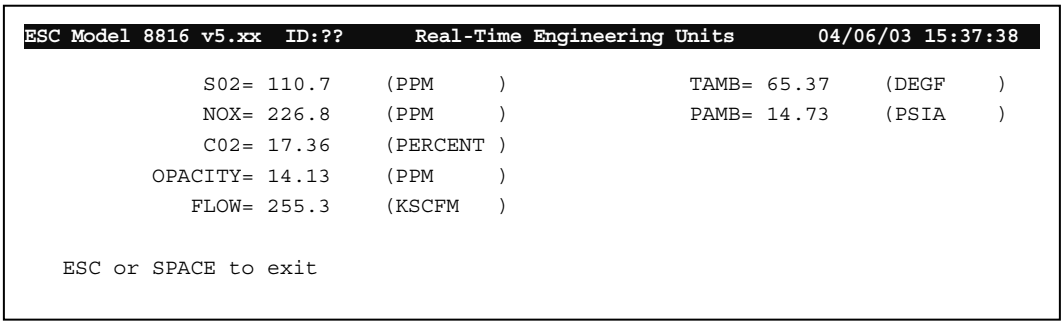
This display allows the user to view instantaneous input voltage or current values (whether they have been initialized as a data parameter or not). The configured instrument name and the three-digit analog input number are displayed along with the input voltage or current value. If more than one channel uses an analog input, the name of the first configured channel is displayed in reverse video (see SO2 below).

```
ESC Model 8816 v5.xx  ID:??          Real-Time Raw Readings          04/06/03 15:31:52

              SO2 (A01)=    8.4847 mA                 TAMB (A17)=    3.9910 V
              NOX (A02)=    4.7680 mA                 PAMB (A18)=    4.3278 V
              C02 (A03)=   15.0814 mA                      (A19)=    0.0006 V
          OPACITY (A04)=   12.0991 mA                      (A20)=   -0.0006 V
             FLOW (A05)=    0.0079 mA                      (A21)=    0.0006 V
                  (A06)=    0.0115 mA                      (A22)=    0.0006 V
                  (A07)=    0.0000 mA                      (A23)=   -0.0006 V
                  (A08)=   -0.0006 mA                      (A24)=    0.0006 V
                  (A09)=    0.0000 mA   <Met Reference 1> (M25)=    5.0092 V
                  (A10)=    0.0000 mA   <Met WDR Input 1> (M26)=    3.6348 V
                  (A11)=   -0.0006 mA   <Met TMP Input 1> (M27)=    1.9954 V
                  (A12)=    0.0000 mA                      ( D1)=    0.7256 V/V
                  (A13)=    0.0006 mA                      ( T1)=    0.3983 V/V
                  (A14)=    0.0006 mA                      ( S1)=      1227 Hz
                  (A15)=    0.0006 mA                      ( R1)=         0 CNTS
                  (A16)=    0.0000 mA

  ESC or SPACE to exit
```

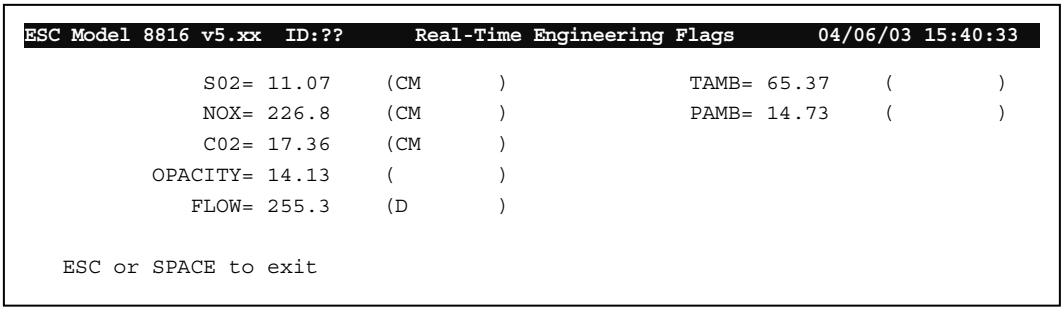
8.2 Display Readings with Units or Flags

These displays allow the scaled readings from all data channels that have been initialized to be viewed. They are analogous to the *Realtime Graph of Readings* (hot key **R**) selection in the *Graphs Menu*, where a bar graph of the readings of up to eight data channels can be viewed (see page 10-1 "Real-Time Graph of Readings").

Parentheses enclose the engineering units if *Display Readings w/units* (hot key **R**) was chosen from the *Real-Time Display Menu:*



Parentheses enclose the validation flags if *Display Readings w/flags* (hot key **F**) was chosen from the *Real-Time Display Menu*:



Some flags occur only on averages and thus will not appear on this readings with units display. These flags include the c, f, H, h, L, l, J, and j flags. To view occurrences of these flags, select *Display Last Base Avg* (hot key **B**) from the *Real-Time Display Menu*.

Also, this screen can be displayed in big, easy-to-read characters by selecting *Show LARGE TEXT Display* (hot key **L**) from the *Real-Time Display Menu*. See page 8-9 "Show Large Text Display."

8.3 Display Last Base Average

This real-time display allows the latest base averages from all data channels that have been initialized along with their flags to be viewed. Press <Ctrl><A> to switch between *Display Last Base Average*, *Display Last Avg#1 Average* and *Display Last Avg#2 Average* screens.

```
ESC Model 8816 v5.xx  ID:??       Display Last Base Average        04/06/03 15:44:47

               S02= 127.7      (<CM     )              TAMB= 63.21      (         )
               NOX= 213.8      (<CM     )              PAMB= 14.68      (         )
               C02= 17.36      (<CM     )
          OPACITY= 14.13       (h       )
             FLOW= 267.4       (<D      )

   ESC or SPACE to exit
```

8.4 Continuous Avg Report

This report allows the user to continuously view instantaneous or average data values for selected channels as they are calculated while also viewing as many as twenty of the most recently calculated values. The display screen automatically updates as new data become available. Up to 32 flags may be reported for each channel. The decimal positioner configured for each channel can optionally be used to format the data in the display.

```
ESC Model 8816 v5.xx  ID:01      Continuous Avg Report Setup       04/06/03 10:08:14

    Average Interval            :  1m
    Show Channels               :  (none)




    # of Flags to Report        :  02
    Use Decimal Positioner?     :  Y
    Start Continuous Report
```

Average Interval:

The averaging interval to be reported. For rolling average channels, the Input Avg Interval should be entered (the rate at which rolling averages are stored). **0** to **999 s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively). **0s** displays instantaneous data.

Show Channels:

The channel(s) to be displayed. Any configured channel name(s), up to 255 characters. **ALL** selects all channels configured with the Average Interval selected above. A maximum of 5 channels can be displayed at one time, depending on the value entered for the # of Flags to Report.

# of Flags to Report:

The maximum number of data validation flags that will be displayed with each average value. **00** to **32**. Default=**02**.

Use Decimal Positioner?:

Yes or No. If **Y**, the decimal postioner configured for the channel will be used to format the displayed data. If **N**, the full precision of the data will be displayed. Default=**Y**.

Start Continuous Report

Press <Enter> at this field to view the Continuous Average Report.

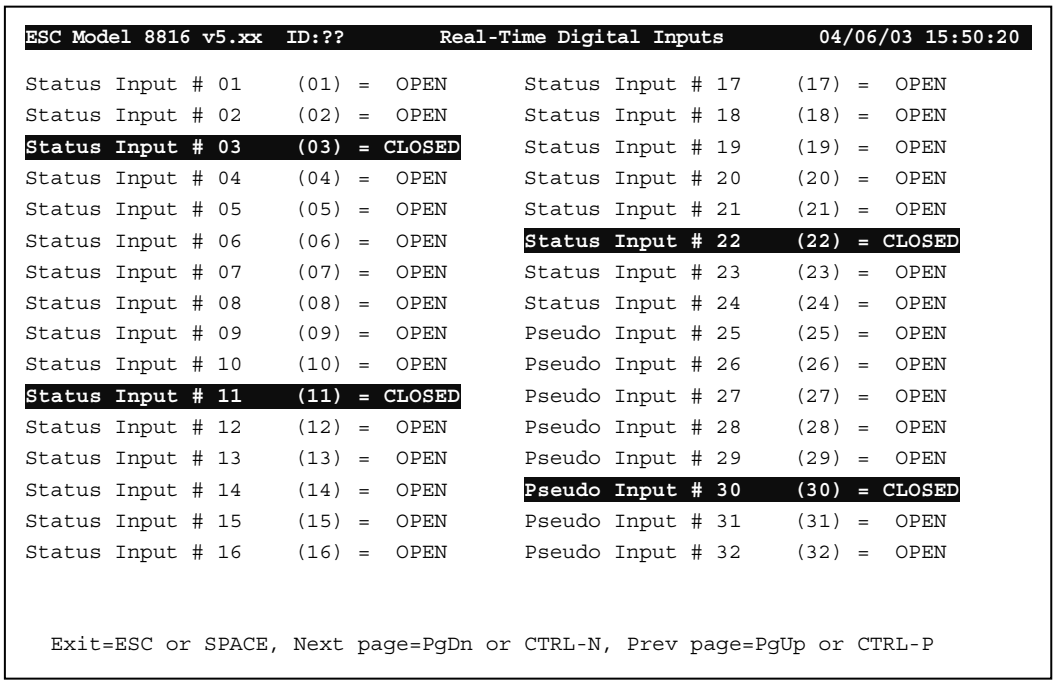
TIME	SO2	NOX	CO2	OPACITY	FLOW
08/29 10:14:14	127.99CM	220.32CM	8.35CM	12.35	255.3
08/29 10:14:15	126.99CM	223.32CM	9.32CM	13.24	254.7
08/29 10:14:16	127.98CM	220.32CM	8.82CM	13.53	253.6
08/29 10:14:17	128.98CM	219.32CM	9.24CM	13.55	253.8
08/29 10:14:18	127.98CM	221.32CM	10.23CM	13.34	252.4
08/29 10:14:19	127CM	220.32CM	10.72CM	12.92	251.7
08/29 10:14:20	128.99	223.31	9.54	12.87	252.3
08/29 10:14:21	125.98	220.31	7.36	13.11	252.9
08/29 10:14:22	128.97	225.31	8.04	13.33	254.1D
08/29 10:14:23	127.96	220.31	8.59	13.49	254.3D
08/29 10:14:24	127.95	222.31	10.92	13.62	255.0
08/29 10:14:25	128.95	220.3	9.81	13.73	255.1
08/29 10:14:26	127.94	221.3	9.8	14.1	249.7
08/29 10:14:27	127.99	220.32	8.35	12.35	255.3
08/29 10:14:28	126.99	223.32	9.32	13.24	254.7
08/29 10:14:29	127.98	220.32	8.82	13.53	253.6
08/29 10:14:30	128.98	219.32	9.24	13.55	253.8
08/29 10:14:31	127.98	221.32	10.23	13.34	252.4
08/29 10:14:32	127	220.32	10.72	12.92	251.7
08/29 10:14:33	128.99	223.31	9.54	12.87	252.3
08/29 10:14:34	125.98	220.31	7.36	13.11	252.9

ESC or SPACE to exit

Example of Continuous Average Report

8.5 Display Digital Inputs

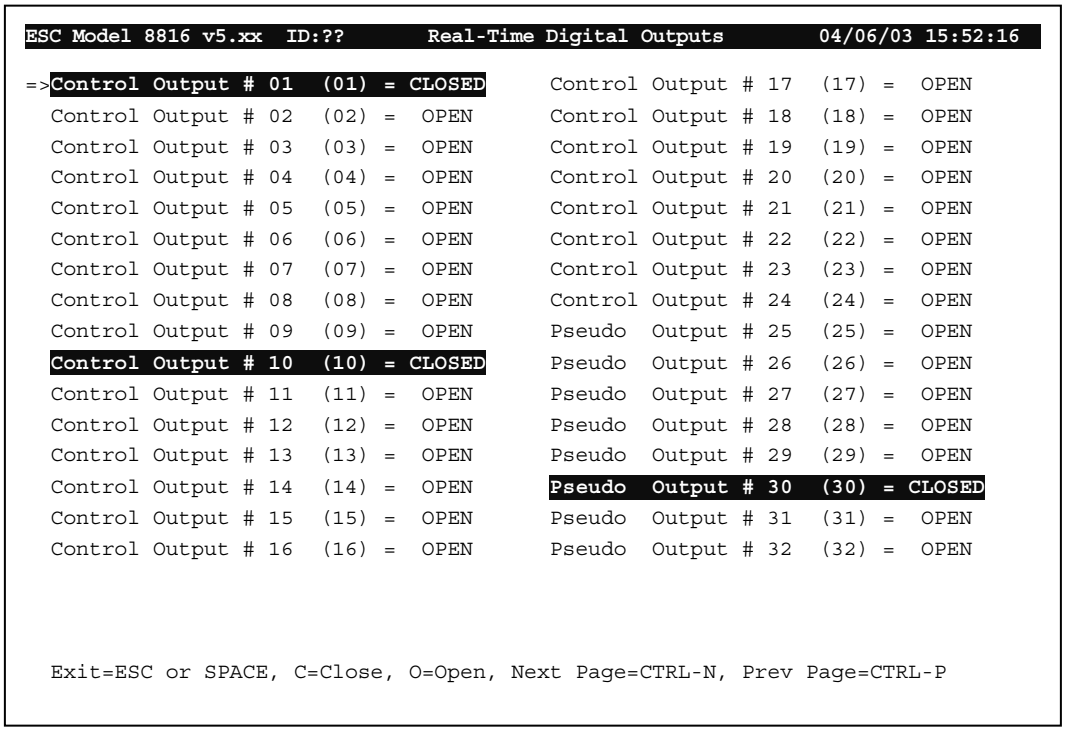
This display allows the current open or closed status of all digital inputs to be viewed.



NOTE: Descriptive labels can be assigned to digital inputs via the *Configure Digital I/O Menu* in the *Configuration Menu* (see page 4-20 "Editing Digital I/O Labels"). A log of input line status changes can be found in the *Status Menu* (see page 11-2 "Line Status Change Menu").

8.6 Display Digital Outputs

This report allows the current status of all digital outputs to be viewed. The report is similar in form to the real-time display of digital inputs (see above), except that the digital outputs display also allows the user to manually switch lines on and off.



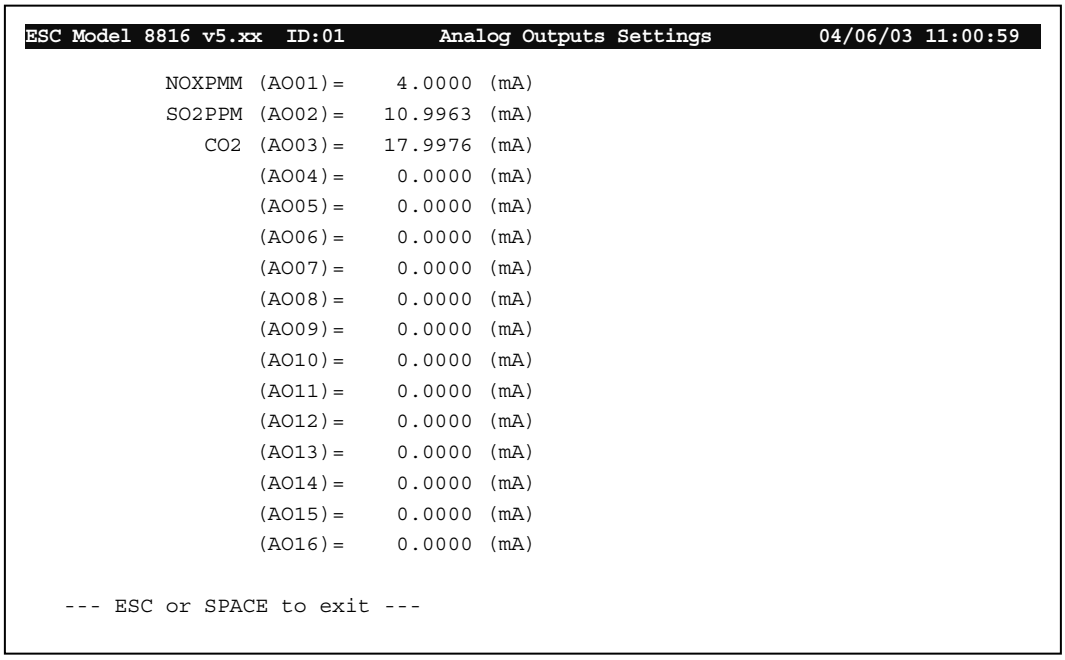
Step 1. To open or close an output, place the arrow => next to the desired control output line number using the arrow keys or by typing the two-digit relay number.

Step 2. Press the <O> key to open the selected relay, or press the <C> key to close the selected relay, *regardless of whether that output has been configured normally open or normally closed* (see page 4-20 "Configuring Digital Output States"). Press <Enter> to toggle the state of the selected relay. Closed relays remain highlighted until opened again.

NOTE: Descriptive labels can be assigned to digital outputs via the Configure Digital I/O Menu in the *Configuration Menu* (see page 4-20 "Editing Digital I/O Labels"). The default state of digital outputs, normally open or normally closed, can also be configured there (see page 4-20 "Configuring Digital Output States").

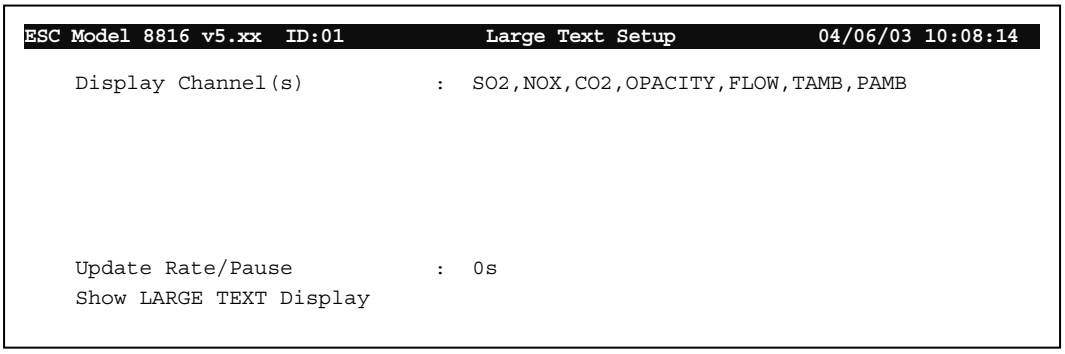
8.7 Display Analog Outputs

This display shows the status of all analog current outputs. The name of the channel whose value is being driven out of the analog output is displayed to the left of the analog output number.



8.8 Show Large Text Display

This display allows the instantaneous scaled readings from up to ten data channels that have been initialized to be viewed in big, easy-to-read characters. The two highest priority flags are also displayed for each channel. Some flags occur only on averages and thus will not appear on this display. These flags include the H, h, L, l, J, and j flags. To view occurrences of these flags, select **Display Last Base Avg** (hot key **B**) from the *Real-Time Display Menu*. This feature is only valid for the keyboard/LCD interface.



Display Channel(s):

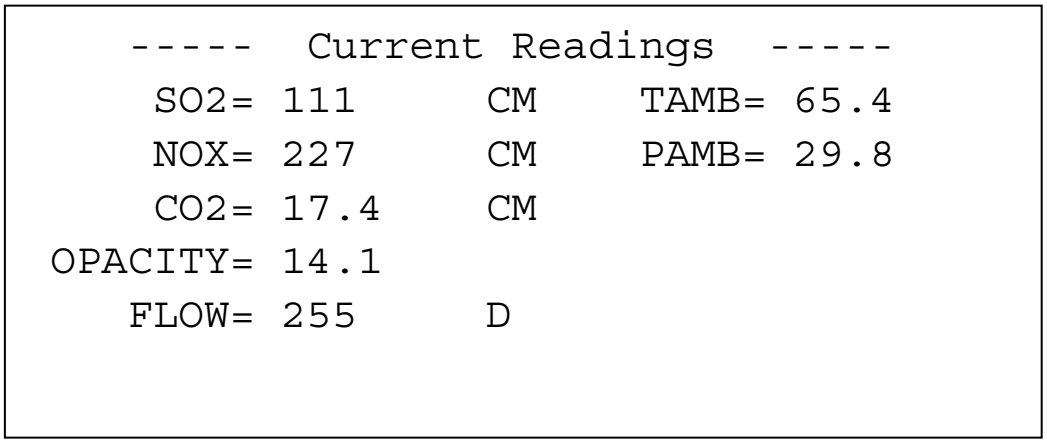
The channel(s) to be displayed. Any configured channel name(s), up to 255 characters. **ALL** selects all configured channels although a maximum of 10 channels can be displayed at one time. The channel names that are entered are saved so that the next time the Large Text Setup is accessed entry of the channel names is not necessary.

Update Rate/Pause:

The time between each update of the display with the current instantaneous reading.

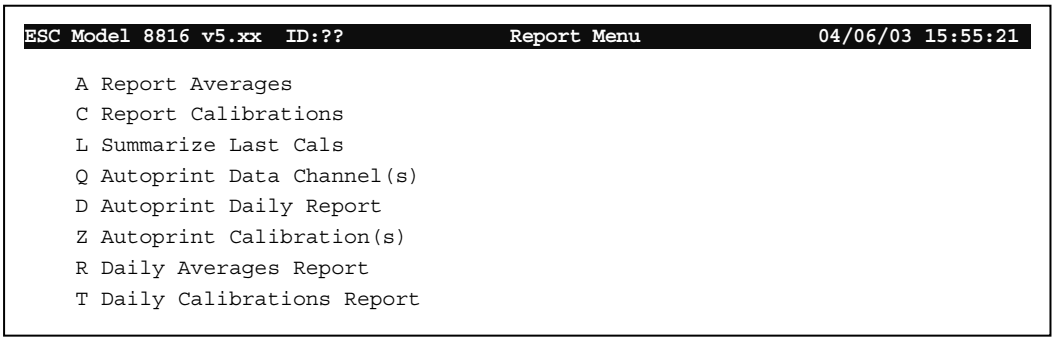
Show LARGE TEXT Display

Press <Enter> at this field to view the Large Text Display.



Chapter 9
Reports

The *Report Menu* is used to generate reports of historical (stored) data. Select *Report Generation Menu* (hot key **R**) from the *Home Menu*. The following screen will display:



Hot Key	To Option	Purpose	See Page
A	*Report Averages*	Report averages for one or more selected channels	9-2
C	*Report Calibrations*	Report results of a selected calibration program for one channel	9-5
L	*Summarize Last Cals*	Display results of the most recent run of all calibration programs for all channels	9-7
Q	*Autoprint Data Channel(s)*	Generate reports of channel average data automatically as the data becomes available	9-8
D	*Autoprint Daily Report*	Generate reports of hourly average data and summary data automatically at the end of each day	9-9
Z	*Autoprint Calibration(s)*	Generate reports of calibration data automatically at the completion of each calibration	9-8
R	*Daily Averages Report*	(Optional) Report hourly average data and summary data for the previous day	9-10
T	*Daily Calibrations Report*	(Optional) Report calibration data for the previous day	9-13

Reports can be viewed on screen or printed out. If an attempt is made to print a report when there is no printer attached to the logger, an error message is generated.

Key Command	Action
Right Arrow Key	Shifts report to the right, removing the first parameter or calibration phase and bringing the next parameter or phase into view.
Left Arrow Key	Shifts report to the left, removing the last parameter or calibration phase and bringing the previous parameter or phase into view.
Shift-Right Arrow or <R>	Shifts report to the right one page, removing the displayed parameters or calibration phases and bringing the next group of parameters or phases into view.
Shift-Left Arrow or <L>	Shifts report to the left one page, removing the displayed parameters or calibration phases and bringing the previous group of parameters or phases into view.
Down Arrow Key	Scrolls report vertically forward one record.
Up Arrow Key	Scrolls report vertically backward one record.
Shift-Down Arrow or <D>	Scrolls report vertically forward one page (24 data points or calibration records).
Shift-Up Arrow or <U>	Scrolls report vertically backward one page (24 data points or calibration records).

9.1 Report Averages

This selection is used to report blocks of averages for several parameters. All averages in a single report must have the same averaging interval (e.g., 5-minute data for SO2 and hourly data for NOx cannot be displayed on the same report).

Select *Report Averages* (hot key **A**) from the *Report Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??        Report Averages Screen        04/06/03 21:35:23

    Average Interval            :  1h
    Show Channels               :  SO2,NOX,CO2,OPACITY,FLOW

    Start Time                  :  08/14/97 00:00:00
    # of Flags to Report        :  02
    Use Decimal Positioner?     :  N
    (Printer) Report Length     :  22
    (Printer) Page Length       :  22
    View On Screen
    Report to Printer
```

Average Interval:

The averaging interval to be reported. For rolling average channels, the Input Avg Interval should be entered (the rate at which rolling averages are stored). `0` to `999` **`s`**, **`m`**, **`h`**, or **`d`** (for seconds, minutes, hours, or days, respectively).

Show Channels:

The channel(s) to be displayed. Any configured channel name(s), up to 255 characters. **`ALL`** selects all channels configured with the Average Interval selected above. A maximum of 5 channels can be displayed at one time, depending on the value entered for the # of Flags to Report.

Start Time:

Date and time of the first data point to report; **`MM/DD/YY HH:MM:SS`** (in military format).

# of Flags to Report:

The maximum number of data validation flags that will be displayed with each average value. `00` to `32`. Default=`02`.

Use Decimal Positioner?:

Yes or No. If **`Y`**, the decimal positioner configured for the channel will be used to format the displayed data. If **`N`**, the full precision of the data will be displayed. Default=**`N`**.

(Printer) Report Length:

Maximum number of records to report to printer. Default=`22`. `0` to `999`.

(Printer) Page Length:

Because printed reports can only fit five parameters on a page horizontally, the report scrolls by printing data for additional parameters after printing *N* data points for the first five parameters. This field allows *N* be configured. If set equal to (Printer) Report Length, all required data points will be printed for the first five parameters before printing data for additional parameters. If less than six channels are selected, this selection is not significant. `0` to `999`.

View on Screen

Press <Enter> at this field to view the report on screen.

Report to Printer

Press <Enter> at this field to print the report.

TIME	SO2	NOX	CO2	OPACITY	FLOW
08/14 00:00	127.99	220.32	8.35	12.35	255.3
08/14 01:00	126.99	223.32	9.32	13.24	254.7
08/14 02:00	127.98	220.32	8.82	13.53	253.6
08/14 03:00	128.98	219.32	9.24	13.55	253.8
08/14 04:00	127.98	221.32	10.23	13.34	252.4
08/14 05:00	127	220.32	10.72	12.92	251.7
08/14 06:00	128.99	223.31	9.54	12.87	252.3
08/14 07:00	125.98	220.31	7.36	13.11>C	252.9>C
08/14 08:00	128.97>C	225.31>C	8.04>C	13.33	254.1
08/14 09:00	127.96	220.31	8.59	13.49	254.3
08/14 10:00	127.95	222.31	10.92	13.62	255.0
08/14 11:00	128.95	220.3	9.81	13.73	255.1
08/14 12:00	127.94	221.3	9.8	14.1	249.7
08/14 13:00	127.99	220.32	8.35	14.35	255.3
08/14 14:00	126.99	223.32	9.32	15.24	254.7
08/14 15:00	127.98<M	220.35<M	8.82<M	17.53	253.6
08/14 16:00	128.98	219.32	9.24	18.55	253.8
08/14 17:00	127.98	221.32	10.23	20.34H	252.4
08/14 18:00	127	220.32	10.72	20.92H	251.7
08/14 19:00	128.99	223.31	9.54	19.87	252.3
08/14 20:00	125.98	220.31	7.36	15.11	252.9
08/14 21:00	-9999.<N	-9999.<N	-9999.<N	-9999.<N	-9999.<N

Example of Average Report

Data reports employ flags and symbols to indicate information about data points:

>C Indicates that this value is a valid average, but at least one reading that should have been used in the calculation of the average was invalid for some reason; the reason is indicated by the validation flag following the > (in this case, 'C' for calibration).

<M Indicates that this value failed the test for valid data because too many readings that should have been used in the calculation were invalid for some reason; the reason is indicated by the flag following the < (in this case, 'M' for maintenance). The validity test is either the simple percentage test or the EPA Clean Air Act validation (see page 5-47 "Valid Average Determination").

-9999.<N Indicates that this data point has not been calculated. In this case, the report time is past the current time.

9.2 Report Calibrations

This selection reports calibration results and calibration flags. Select *Report Calibrations* (hot key **C**) from the *Report Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??       Report Calibrations Screen       04/06/03 16:20:37

    Cal Sequence Name           :  GASCAL
    Data Channel                :  SO2
    Start Time                  :  08/13/97 16:00:00
    (Printer) Report Length     :  22
    (Printer) Page Length       :  22
    View On Screen
    Report to Printer
```

Cal Sequence Name:

The name of the calibration sequence to be reported. (Only one calibration sequence can be reported at a time.)

Data Channel:

The data channel to be reported. Any configured channel name, up to 17 characters total.

Starting Time:

Date and time of the first calibration results to report. MM/DD/YY HH:MM:SS (in military format).

(Printer) Report Length:

Maximum number of records to report; default=22. 0 to 999.

(Printer) Page Length:

Because printed reports can only fit five parameters on a page horizontally, the report scrolls by printing data for additional parameters after printing *N* data points for the first five parameters. This field allows *N* be configured. If set equal to (Printer) Report Length, all required data points will be printed for the first five parameters before printing data for additional parameters. If less than six channels are selected, this selection is not significant. 0 to 999.

View on Screen

Press <Enter> at this field to view the report on screen.

Report to Printer

Press <Enter> at this field to print the report.

```
GASCAL, NOX
                  ---ZERO---  ---SPAN---  -----FLAGS------
04/06/03 08:00:00    -0.7572    872.3     D
04/06/03 08:00:00    -0.7601    897.3
04/06/03 08:00:00    -0.7738    916.8     F<
04/06/03 08:00:00     -0.738    894.9     F<
04/06/03 13:27:00     0.3361    922.6
04/06/03 08:00:00     0.3452    916.5
04/06/03 08:00:00     0.3351    958.6     DO
04/06/03 10:08:37     0.2887      922
04/06/03 08:00:00     -0.784    900.1
04/06/03 08:00:00     0.3195      890


SCROLL: Arrows. Page: U/D/R/L Keys/Shift-Arrows. Refresh: F2. Exit:<Space>/<Esc>
```

Example of Calibration Report

9.3 Summarize Last Calibrations

This selection displays the results of the most recent run of each calibration program. This report cannot be printed, and does not require any setup information. Select *Summarize Last Cals* (hot key **L**) from the *Report Menu*. The report will display on the terminal.

```
GASCAL   04/03 08:00  -EXPECTED- --ACTUAL-- --ERROR--- -UNITS-- -----FLAGS-----
   SO2
               ZERO           0    -0.1956          0    %     D
               SPAN       450.3      427.3        4.6    %
   NOX
               ZERO           0     0.3195          0    %
               SPAN       905.1        890        1.5    %
   CO2
               ZERO           0  -0.006151          0 PERCENT
               SPAN       18.37      18.49        0.1 PERCENT

FLOWCAL  08/14 07:20  -EXPECTED- --ACTUAL-- --ERROR--- -UNITS-- -----FLAGS-----
   FLOW
               ZERO           0        3.7        1.2    %
               SPAN       255.2      249.7        1.8    %
```

Use the up and down arrow keys to scroll the screen to view additional phases. Use the <U> and <D> keys to scroll the screen an entire page at a time.

9.4 Starting an Autoprint Program

The ESC Model 8816 can be configured to automatically issue reports out to an attached printer **as the required data becomes available**. The three types of Autoprint Programs are Data Channel, Daily Report and Calibration. From the *Report Menu*, select *Autoprint Data Channel(s)* (hot key **Q**), *Autoprint Daily Report* (hot key **D**) or *Autoprint Calibration(s)* (hot key **Z**).

```
ESC Model 8816 v5.xx  ID:??     Config. DATA Automatic Report      04/06/03 11:40:02

    N New CHL Autoprint Entry
    C Change Autoprint Entry
    D Delete Autoprint Entry
    S Suspend Autoprint Entry
    R Resume Autoprint Entry
```

9.4.1 *Configuring a Data Channel Autoprint Program*

This feature is used to generate average data reports to the report printer as the data becomes available. Select *New CHL Autoprint Entry* (hot key **N**) from the *Config. DATA Automatic Report Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??      Automatic Report Data Setup       04/06/03 16:31:11

    Average Interval            :  1h
    Show Channel(s)             :  SO2,NOX,CO2




    Enable Automatic Report
```

Average Interval:

The averaging interval to be reported. For rolling average channels, the Input Avg Interval should be entered (the rate at which rolling averages are stored). **0** to **999** **s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Show Channel(s):

The channel(s) to be displayed. Any configured channel name(s), up to 255 characters. **ALL** selects all channels configured with the Average Interval selected above.

Enable Automatic Report

Press <Enter> at this field to enable the automatic report.

9.4.2 *Configuring a Calibration Autoprint Program*

This feature is used to generate calibration data reports to the report printer as the data becomes available. Select *New CAL Autoprint Entry* (hot key **N**) from the *Config. CAL Automatic Report Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:01     Automatic Report Calib. Setup      04/06/03 16:36:08

    Show Calibration(s)         :  GASCAL,FLOWCAL




    Enable Automatic Report
```

Show Calibration(s):

The calibration(s) to be reported. Any configured calibration name, up to 255 characters. **ALL** selects all configured calibrations.

Enable Automatic Report

Press <Enter> at this field to enable the automatic report.

9.4.3 *Configuring a Daily Report Autoprint Program*

This feature is used to generate a 24-hour record of 1 hour averages to the report printer once a day. Select *New DAILY Autoprint Entry* (hot key **N**) from the *Config. DAILY Autoprint Entry Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:01      Automatic Report Daily Setup      04/06/03 16:34:50

    Average Interval(can't edit):  1h
    Show Channel(s)              :  SO2,NOX,CO2




    Time to Print Report         :  09/11/97 00:00:00
    Enable Automatic Report
```

Average Interval (can't edit):

The averaging interval to be reported. This field cannot be changed because the Daily Report uses 1 hour averages only.

Show Channel(s):

The channel(s) to be displayed. Any configured channel name(s), up to 255 characters. ALL selects all channels configured with the Average Interval selected above.

Time to Print Report:

Date and time for the report to be printed; **MM/DD/YY HH:MM:SS** (in military format). The report will be repeated every 24 hours after this time.

Enable Automatic Report

Press <Enter> at this field to enable the automatic report.

9.5 Changing an Autoprint Program

Select *Change Autoprint Entry* (hot key **C**) from an automatic report configuration menu. A list of all configured autoprint programs will display. Press <Enter> for the highlighted program to be copied into memory for editing. The program's configuration screen will be displayed. After any changes are made (see page 9-7 "Starting an Autoprint Program" for details about configuration), select *Enable Automatic Report* for the changes to take effect. Press <Esc> to exit without saving changes.

9.6 Deleting an Autoprint Program

Select *Delete Autoprint Entry* (hot key **D**) from an automatic report configuration menu. A list of all configured autoprint programs will display. Press <Enter> for the highlighted program to be deleted. Press <Esc> to exit without deleting.

9.7 Suspending an Autoprint Program

Select *Suspend Autoprint Entry* (hot key **S**) from an automatic report configuration menu. A list of all configured autoprint programs will display. Press <Enter> for the highlighted program to be suspended, but still configured. Press <Esc> to exit without suspending.

9.8 Resuming an Autoprint Program

Select *Resume Autoprint Entry* (hot key **R**) from an automatic report configuration menu. A list of all configured autoprint programs will display. Press <Enter> for the highlighted program to be enabled for printing. Press <Esc> to exit without resuming.

9.9 Daily Averages Report (Optional)

The Daily Averages Report is used to generate a 24 hour record of 1 hour averages to the LCD screen or the report printer. Select *Daily Averages Report* (hot key **R**) from the *Report Menu.* The following screen will display:

```
ESC Model 8816 v5.xx  ID:??          Daily Report Screen          04/06/03 21:42:54

    Show Channels            :      SO2,NOX,CO2




    Start Time               :      08/14/97 00:00:00
    # of Flags to Report     :      02
    Daily Report to screen   :
    Daily Report to printer  :
```

Show Channel(s):

The channel(s) to be reported. Any configured channel name(s), with an average interval of 1h with storage (up to 255 characters). **ALL** selects all configured channels meeting this criteria.

Start Time:

Date and time of the start of the report. **MM/DD/YY HH:MM:SS** (in military format).

# of Flags to Report:

The maximum number of data validation flags that will be displayed with each average value. 00 to 32. Default=02.

Daily Report on Screen:

Press <Enter> at this field to view the report on screen.

Daily Report to Printer:

Press <Enter> at this field to print the report.

When a Daily Report is shown on a display, the summary information is determined from the hourly values from 00:00 to 23:00 for the report start date.

```
Daily Average           04/06/03 21:43:33 EST  JDay: 226          Logger ID: ??
   Report                   ESC Model 8816                           Station
ID: A01
-------------------------------------------------------------------------------
Name:                  SO2          NOX          CO2
Channel Num:             1            2            3
Analog Input:            1            2            3
Units:                 PPM          PPM      PERCENT
Full Scale:            N/A          N/A          N/A
High Output:         500.0       1000.0         20.0
Low Output:            0.0          0.0          0.0
-------------------------------------------------------------------------------
08/14 00:00          128.0        220.7          8.4
08/14 01:00          127.2        223.3          9.3
08/14 02:00          128.3        220.1          8.8
08/14 03:00          127.7        219.3          9.2
08/14 04:00          128.1        221.5         10.2
08/14 05:00          126.5        219.3         10.7
08/14 06:00          129.2        217.4          9.5
08/14 07:00          124.6        215.6          7.4
-------------------------------------------------------------------------------
Minimum:             121.1        214.4          7.4
Maximum:             197.6<M      305.6<M       13.8<M
Average:             131.2<M      224.9<M        9.5<M
```

Example of Daily Average Report (displayed)

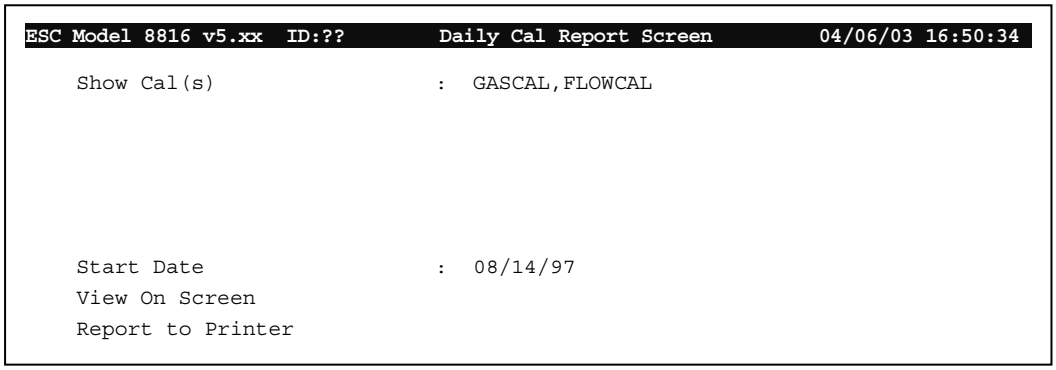
When a Daily Report is sent to a printer, the summary information is determined from the hourly values shown on the report.

```
Daily Average           04/06/03 21:43:33 EST  JDay: 226          Logger ID: ??
   Report                  ESC Model 8816                            Station ID: A01
-------------------------------------------------------------------------------
Name:                 SO2          NOX          CO2
Channel Num:            1            2            3
Analog Input:           1            2            3
Units:                PPM          PPM      PERCENT
Full Scale:           N/A          N/A          N/A
High Output:        500.0       1000.0         20.0
Low Output:           0.0          0.0          0.0
-------------------------------------------------------------------------------
08/14 00:00         128.0        220.7          8.4
08/14 01:00         127.2        223.3          9.3
08/14 02:00         128.3        220.1          8.8
08/14 03:00         127.7        219.3          9.2
08/14 04:00         128.1        221.5         10.2
08/14 05:00         126.5        219.3         10.7
08/14 06:00         129.2        217.4          9.5
08/14 07:00         124.6        215.6          7.4
08/14 08:00         130.3>C      218.2>C        8.0>C
08/14 09:00         131.7        221.9          8.6
08/14 10:00         133.5        225.5         10.9
08/14 11:00         132.7        223.7          9.8
08/14 12:00         131.1        219.8          9.8
08/14 13:00         127.3        214.4          8.4
08/14 14:00         124.2        216.0          9.3
08/14 15:00         197.6<M      305.6<M       13.8<M
08/14 16:00         121.1        220.7          9.2
08/14 17:00         123.6        222.2         10.2
08/14 18:00         125.2        225.8         10.7
08/14 19:00         129.4        227.3          9.5
08/14 20:00         127.7        225.5          7.4
08/14 21:00        -9999.<N     -9999.<N     -9999.<N
08/14 22:00        -9999.<N     -9999.<N     -9999.<N
08/14 23:00        -9999.<N     -9999.<N     -9999.<N
-------------------------------------------------------------------------------
Minimum:            121.1        214.4          7.4
Maximum:            197.6<M      305.6<M       13.8<M
Average:            131.2<M      224.9<M        9.5<M
```

Example of Daily Average Report (printed)

9.10 Daily Calibrations Report (Optional)

The Daily Calibrations Report is used to generate a report of the most recent run of each selected calibration for the date specified to the screen or to the report printer. Select *Daily Calibrations Report* (hot key **T**) from the *Report Menu*. The following screen will display:



Show Cal(s):

The calibration(s) to be reported. Any configured calibration name(s), (up to 255 characters). **ALL** selects all configured calibrations.

Start Date:

Starting date of the report. **MM/DD/YY**.

View on Screen

Pressing <Enter> at this field displays the report on the screen.

Report to Printer

Pressing <Enter> at this field prints the report.

```
Daily Calibration       04/06/03 21:43:33 EST  JDay: 226          Logger ID: ??
   Report                  ESC Model 8816                           Station ID: A01
-------------------------------------------------------------------------------
Cal Sequence:  GASCAL     Start Time: 04/03 08:00
Ch       Name                  ZERO       SPAN      FLAGS
-------------------------------------------------------------------------------
 1        SO2        Act       -0.2      427.3      D
                     Exp          0      450.3
                     Err          0        4.6
 2        NOX        Act        0.3        890
                     Exp          0      905.1
                     Err          0        1.5
 3        CO2        Act          0       18.5
                     Exp          0       18.4
                     Err          0        0.1
-------------------------------------------------------------------------------
Cal Sequence:  FLOWCAL    Start Time: 04/03 07:20
Ch       Name                  ZERO       SPAN      FLAGS
-------------------------------------------------------------------------------
 5       FLOW        Act        3.7      249.7
                     Exp          0      255.2
                     Err        1.2        1.8
```

Example of Daily Calibration Report:

Chapter 10
Graphs

The *Graphs Menu* allows real-time data to be viewed in a graphical, as opposed to text only (tabular), format. This selection is not active on the serial interface, as a VT-100 does not support graphics. Graphs cannot be printed out, only viewed on screen.

Since the logger‘s front-panel display only supports black and white, graphs are typically limited to one or two parameters, using a dotted or dashed line for the second parameter.

Select *Graphs Generation Menu* (hot key **G**) from the *Home Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??              Graphs Menu              04/06/03 16:36:43

    R Realtime Graph of Readings
    H Graph Historical Data
    T Trending Plot
    C Change Chart Memo
    D Delete Chart Memo
```

After a graph is displayed, press the spacebar or the <Esc> key to exit the graph display mode and return to the previous menu.

10.1 Real-Time Graph of Readings

This selection creates a real-time bar-chart display of readings for up to eight channels. The graph is updated with instantaneous readings at a configurable rate. This graph is analogous to the *Display Readings w/units* and *Display Readings w/flags* selections in the *Real-Time Display Menu* (see page 8-3 “Display Readings with Units or Flags”).

Select *Real-Time Graph of Readings* (hot key **R**) from the *Graphs Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??        Graph Readings Screen        04/06/03 16:40:08

    Graph Channel(s)           :   SO2,NOX,SO2#,NOX#,FLOW,BARP,STKTMP,FFAC



    Graph Maximum              :   100
    Graph Minimum              :   0
    Update Rate/Pause          :   0s
    View Graph On Screen       :
```

Graph Channel(s):

The channel(s) to be graphed. Any configured channel name(s), up to 255 characters. **ALL** selects all configured channels although a maximum of 8 channels can be displayed at one time.

Graph Maximum:

The maximum value of the y-axis (readings). Up to 10 digits.

Graph Minimum:

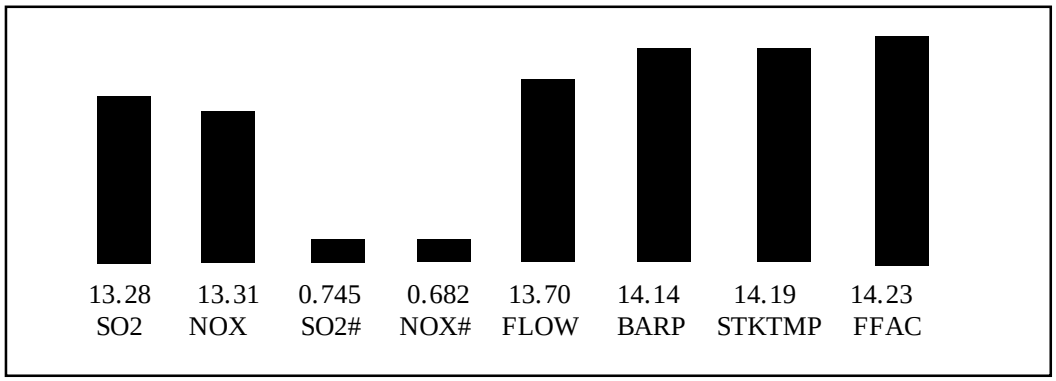
The minimum value of the y-axis (readings). Up to 10 digits.

Update Rate/Pause:

The time between each update of the display with the current instantaneous reading.

View Graph on Screen

Pressing <Enter> at this field displays the graph on the screen.



Press the spacebar or the <Esc> key to exit the graph and return to the previous menu.

10.2 Graph Historical Data

With this graph, data averages for up to three configured channels with a common averaging interval are displayed as line graphs. The first channel is represented by a solid line, the second channel is represented by a dashed line, and the third channel is represented by a dotted line. This graph is analogous to the *Report Averages* selection in the *Report Menu* (see page 9-2 "Report Averages").

Select *Graph Historical Data* (hot key **H**) from the *Graphs Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??        Graph Averages Screen        04/06/03 16:50:28

    Average Interval          :   1h
    Graph Channel             :   NOXPPM,SO2PPM,FLOW
    Start Time                :   08/13/97 17:00:00
    Number of Points          :   24
    Graph Maximum             :   100
    Graph Minimum             :   0
    View Static Graph
    View TRENDING Plot
```

Average Interval:

Specifies averaging interval to be graphed. **0** to **999** **s**, **m**, **h**, or **d** (for seconds, minutes, hours, or days, respectively).

Graph Channel(s):

The channel(s) to be graphed. Any configured channel name(s), up to 34 characters. **ALL** selects all configured channels although a maximum of 3 channels can be displayed at one time.

Start Time:

Date and time of the first data average(s) to be graphed. The graph will start at this date and time and graph up to the Number of Points. **MM/DD/YY HH:MM:SS** (in military format).

Number of Points:

The maximum number of data averages to be graphed. **0** to **999**.

Graph Maximum:

The maximum value of the y-axis (averages).

Graph Minimum:

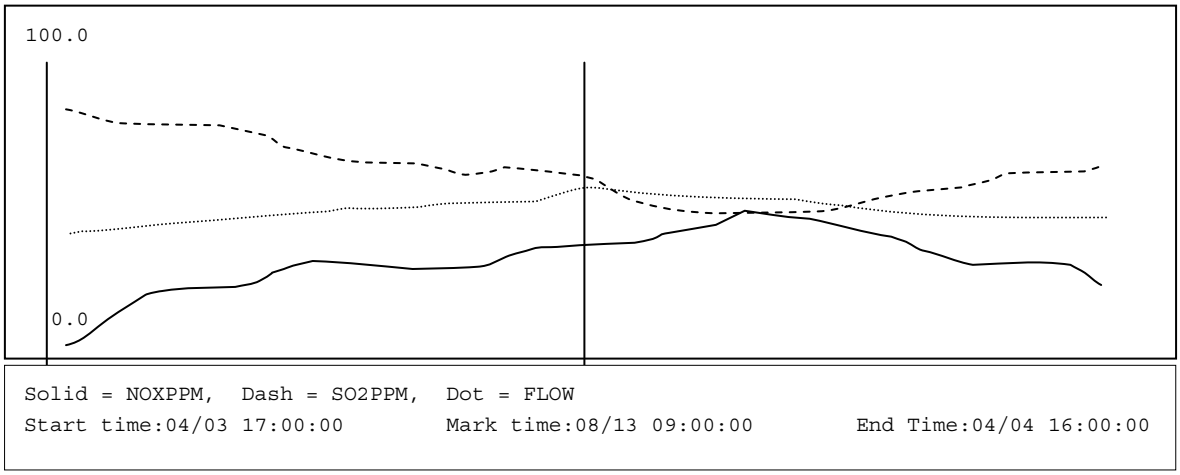
The minimum value of the y-axis (averages).

View Static Graph

Press <Enter> at this field to display the graph on the screen.

View TRENDING Plot

Press <Enter> at this field to display a trending plot on the screen.



The vertical bar, which is displayed at the midpoint of the x-axis of the graph, is considered to be the mark time and is used to improve the delineation of the graph. The start, mark and end times are displayed at the bottom of the graph.

Once the graph is displayed, use the <I> key to zoom in (expand the y-scale) and the <O> key to zoom out. Scroll from left or right one averaging interval by pressing the left or right arrow keys. For faster movement, the graph is scrolled left or right one half-screen width by pressing the <L> or <R> keys respectively.

Press the spacebar or <Esc> key to exit. The previous menu will display.

10.3 Trending Plots

Configuration of the trending graph is identical to the historical graphs (see page 10-2 "Graph Historical Data"), except that the start time is ignored.

The right side of the graph represents the current time. The left side of the graph represents the current time minus the number of points multiplied by the average interval:

Current Time - (Number of Points × Average Interval)

The trending plot is updated with the latest value at the end of each **Average Interval** time period.

10.4 Entering Chart Memos

The Chart Memo feature allows a note or memo to be stored pertaining to a data point or segment on the graph. The memo creation (or change) date and time, the displayed data mark date and time, and the associated parameter are stored with the text of the memo.

While a Historical Data Graph is displayed, press <Enter> for the following screen to be displayed:

```
ESC Model 8816 v5.xx  ID:??          Chart Memos Menu          04/06/03 16:50:28

    Parameter  :                 NOXPPM
    Mark time  :                 08/14/97 16:00:00
    Message    :

    Finished (Configure Now)
```

Parameter:

Specifies the channel from the graph for which the *Message* applies.

Mark Time:

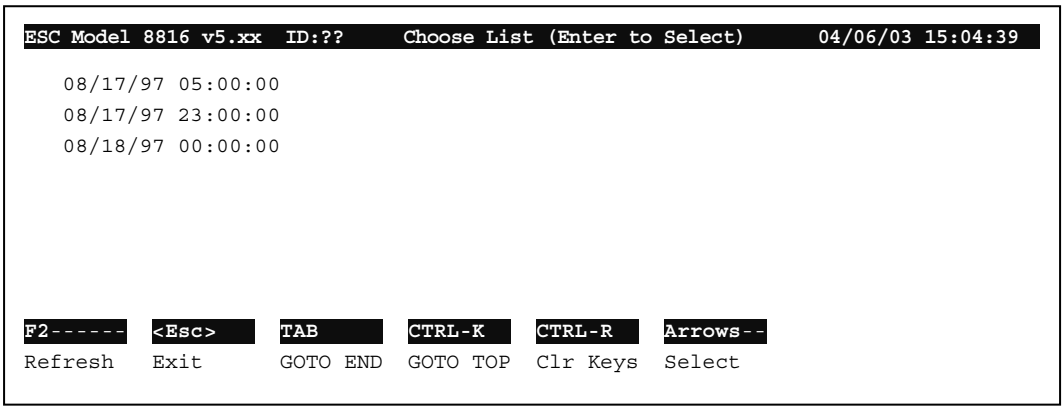
Date and time of the data for which the *Message* applies.

Message:

Text memo describing the parameter and data from the graph. Up to 80 characters.

10.5 Changing a Chart Memo

Select *Change Chart Memo* (hot key **C**) from the *Graphs Menu*. A list of the mark times for each of the saved chart memos will display.



Press <Enter> for the highlighted chart memo's configuration screen to appear. The selected chart memo is copied into memory for editing. After any changes are made (refer to page 10-4 "Entering Chart Memos" for information about configuration fields), select *FINISHED (Configure Now)* for the new changes to take effect. Press the <Esc> key to exit (no changes will take effect).

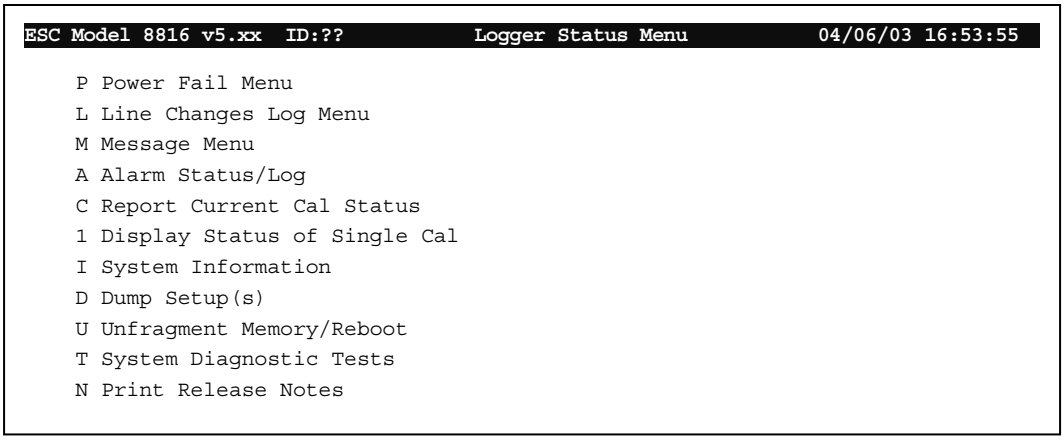
10.6 Deleting a Chart Memo

Select *Delete Chart Memo* (hot key **D**) from the *Graphs Menu*. A list of the mark times for each of the saved chart memos will display. Press <Enter> for the highlighted alarm chart memo to be deleted. Press the <Esc> to cancel the deletion.

Chapter 11
Status Menu

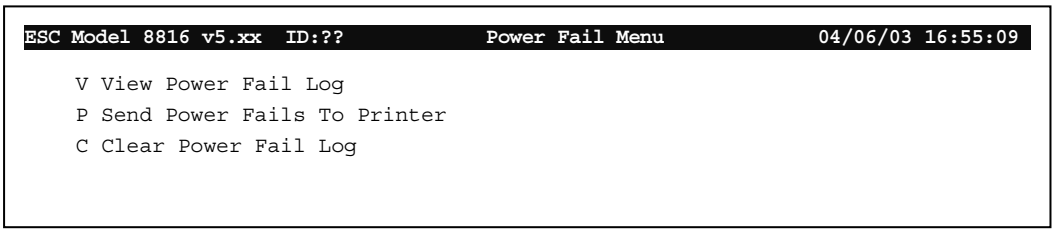
The *Status Menu* provides historical logs of various system occurrences, a report of current calibrations, and other system information and diagnostics.

Select *Status Menu* (hot key **S**) from the *Home Menu*. The following screen will display:



11.1 Power Fail Menu

This selection will display, print, and erase the log of power failures recorded by the data logger. Select *Power Fail Menu* (hot key **P**) from the *Logger Status Menu*. The following screen will display:



Hot Key	Selection	Action
V	*View Power Fail Log*	Displays the log of power failures.
P	*Send Power Fails to Printer*	Prints out the log of power failures. Once selected, printing begins immediately.
C	*Clear Power Fail Log*	Erases all power failure entries from the log. (Power failures are stored in a circular buffer and will automatically roll over after storing 48 power failures.)

In the *Power Fail Menu*, select *Power Fail Log* (hot key **V**). The Power Failures Log will display:

```
ESC Model 8816 v5.x  ID:??       Power Failures Log: Page 1       04/06/03 16:58:34

 04/06/03 16:57:35=> 04/06/03 16:57:40



   --- ESC or SPACE to exit, CTRL-N = next page ---
```

The first time shown is the time that power was lost. The second time shown (after the "=>") is the time that power was restored to the logger.

The date/time of a power failure is taken from the internal clock, so if the date/time has not been set or if the battery has failed, the information may be incorrect.

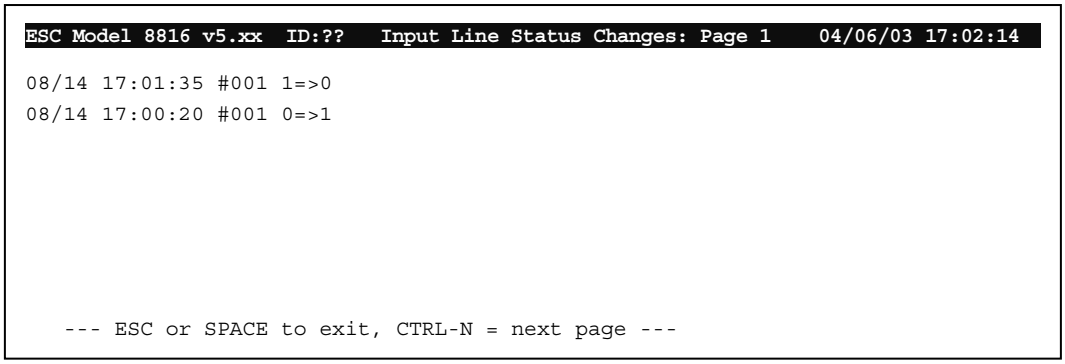
11.2 Line Status Change Menu

The ESC Model 8816 keeps track of the last 120 transitions of its input status lines. This selection will display, print, and erase the log of digital input transitions recorded by the data logger. Information includes the date and time of the transition and whether the transition was on-to-off or off-to-on. Select *Line Changes Log Menu* (hot key **L**) from the *Logger Status Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??          Line Change Log Menu          04/06/03 17:01:09

    V View INPUT Line Change Log
    P Send INPUT LC Log to Printer
    C Clear INPUT Line Change Log
    1 View OUTPUT Line Change Log
    2 Send OUTPUT LC Log to Printer
    3 Clear OUTPUT Line Change Log
```

Hot Key	Selection	Action
V	*View INPUT Line Change Log*	Displays the log of input line status changes, where 1 indicates an active input state and 0 indicates an inactive input state.
P	*Send INPUT LC Log to Printer*	Prints out the log of input line status changes. Once selected, printing begins immediately.
C	*Clear INPUT Line Change Log*	Erases all input line transition entries from the log. (Input line changes are stored in a circular buffer and will automatically roll over after storing 120 transitions.)
1	*View OUTPUT Line Change Log*	Displays the log of output line status changes, where 1 indicates a contact-closed output state and 0 indicates a contact-open output state.
2	*Send OUTPUT LC Log to Printer*	Prints out the log of output line status changes. Once selected, printing begins immediately.
3	*Clear OUTPUT Line Change Log*	Erases all output line transition entries from the log. (Output line changes are stored in a circular buffer and will automatically roll over after storing 120 transitions.)

In the *Line Change Log Menu*, select *View INPUT Line Change Log* (hot key **V**). The Input Line Status Changes will display:

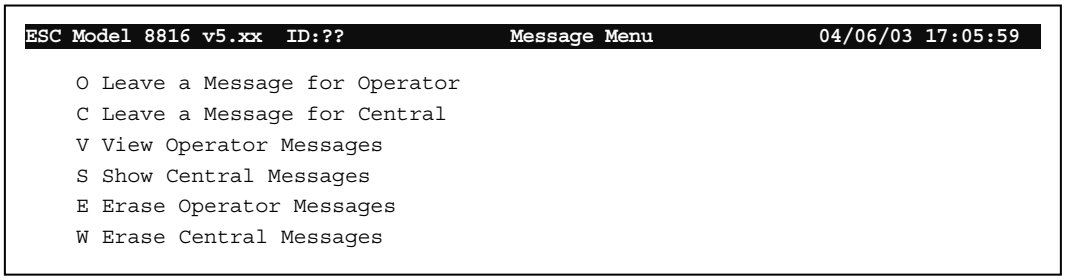


Only one time is listed (the time of the transition). Beside the time is the input/output number and a description of the transition that took place (old state => new state).

11.3 Message Menu

The ESC Model 8816 keeps track of two different message buffers: one for messages to the operator, the other for messages to be polled by the central computer. Each buffer can hold up to five messages (eight on an Ambient data logger) of up to 128 characters each, not counting the date/time tag. With this menu, the user can leave messages, view messages, and erase the message log(s).

Select *Message Menu* (hot key **M**) from the *Logger Status Menu*. The following screen will display:



Hot Key	Selection	Action
O	*Leave a Message for Operator*	Accesses the Operator Message screen where the message is typed.
C	*Leave a Message for Central*	Accesses the Central Message screen where the message is typed.
V	*View Operator Messages*	Displays messages sent to operators; only displays as many messages as will fit on one screen. Press any key to exit the display.

Hot Key	Selection	Action
S	*Show Central Messages*	Displays messages sent to the central computer; only displays as many messages as will fit on one screen. Press any key to exit the display.
E	*Erase Operator Messages*	Erases all operator messages.
W	*Erase Central Messages*	Erases all central messages (if Supervisor access or higher).

11.3.1 *Typing Operator and Central Messages*

Select *Leave a Message for Operator* (hot key **O**) or *Leave a Message for Central* (hot key **C**) from the *Message Menu*. The following screen will display with a highlighted field for message entry:

```
ESC Model 8816 v5.xx  ID:??          Operator Message Entry          04/06/03 17:07:39

    Enter Operator Message      :




   <ESCAPE> aborts message entry
```

Type the text to enter a message (use the backspace key to correct typing errors). Messages can be up to 128 characters long. Press <Enter> to save the message and returns the screen to the *Message Menu*.

A time stamp, the date and time that the message was created, is automatically appended to the message.

Messages are stripped of any **@**,**!**,**&** or **$** characters before they are sent to the central computer. These characters are part of the polling protocol (see Appendix A) and cannot be sent as part of a message.

11.4 Alarm Status / Log

The *Alarm Status/Log Menu* allows displaying, printing, and erasing of the log of alarms. The alarm log records the starting and ending times of an alarm as well as the reason code entered by the user. Currently active alarms are viewed and acknowledged via this menu.

Select *Alarm Status/Log* (hot key **A**) from the *Logger Status Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??          Alarm Status/Log Menu          04/06/03 17:12:19

    V View Alarm Log
    P Send Alarm Log to Printer
    C Clear Alarm Log
    S Report Current Alarm Status
    A Acknowledge Active Alarm
```

Hot Key	Selection	Action
V	*View Alarm Log*	Displays the alarm log; see "Viewing Alarm Log" below.
P	*Print Alarm Log to Printer*	Prints out the alarm log. Once selected, printing begins immediately.
C	*Clear Alarm Log*	Erases the entire alarm log.
S	*Report Current Alarm Status*	Displays only currently active alarms; see page 11-5 "Viewing Current Alarms."
A	*Acknowledge Active Alarm*	Accesses the alarm acknowledgment utility; see page 11-6 "Acknowledging Alarms."

11.4.1 *Viewing Alarm Log*

Select *View Alarm Log* (hot key **V**) from the *Alarm Status/Log Menu* to display a log of up to three pages of the most recent alarms, both active and expired. The alarm log display shows the alarm program name, the date/time the alarm started, the channel and flag code(s) that triggered the alarm and the current status of the alarm.

```
ESC Model 8816 v5.xx  ID:??       Alarm Journal Log: Page 1       04/06/03 17:31:05

ALARM:SO2HIGH Start:04/06 10:00 Source:SO2 Flags=H Status=ACTIVE
ALARM:NOXOOC Start:04/06 08:20 Source:NOX Flags=T Status=EXPIRED
CAL ALARM:FLWDRIFT Start:04/06 07:25 Source:FLOW Status=ACKED(01)









   --- ESC or SPACE to exit, CTRL-N = next page ---
```

If there are multiple occurrences of the same alarm on different channels, only the first alarm is reported. If this is unsatisfactory, the alarm configuration must be modified (see page 7-3 "Configuring Alarm Programs").

11.4.2 *Viewing Current Alarms*

Select *Report Current Alarm Status* (hot key **S**) from the *Alarm Status/Log Menu* to display active alarms. These are alarms for which the alarm condition still exists but which may or may not have been acknowledged. The current alarm display shows the alarm program name, the date/time the alarm started, the channel and flag code(s) that triggered the alarm and the current status of the alarm.

```
 ESC Model 8816 v5.xx  ID:??          Current Alarm Status          04/06/03 17:31:05

ALARM:SO2HIGH Start:04/06 10:00 Source:SO2 Flags=H Status=ACTIVE
CAL ALARM:FLWDRIFT Start:04/06 07:25 Source:FLOW Status=ACKED(01)









   --- ESC or SPACE to exit, CTRL-N = next page ---
```

If there are multiple occurrences of the same alarm on different channels, only the first alarm is reported. If this is unsatisfactory, the alarm configuration must be modified (see page 7-3 "Configuring Alarm Programs").

11.4.3 *Acknowledging Alarms*

This feature allows alarms to be manually acknowledged. This is not to be confused with the "active" status of alarms; "active" means the condition that caused the alarm still exists. To acknowledge alarms:

Step 1. From the *Alarm Status/Log Menu*, select *Acknowledge Active Alarm* (hot key **A**).

Step 2. From the choose list of active alarms, select the alarm to acknowledge (highlight and press <Enter>).

Step 3. From the choose list of reason codes, select the reason code for the chosen alarm. When <Enter> is pressed, the alarm status will change from "ACTIVE" to "ACKED(nn)" to indicate that the alarm was acknowledged with the reason code in parentheses. (Reason codes are defined in the *Alarm Configuration Menu*.)

If multiple instances of an alarm exist and the logged alarm is acknowledged, all of the multiple instances are also acknowledged.

Acknowledgment of an alarm results in the configured digital output line(s) being deactivated (see page 7-3 "Configuring Alarm Programs").

11.5 Current Calibration Status

This selection displays in real-time the status of all configured calibration programs. For any calibration that is currently running, the phase of the calibration that is active is shown along with the amount of time remaining in the phase (when known by the logger). Automatic calibrations that are not currently running are shown with the next scheduled start time listed. Other calibration types that are initiated by some external event are shown only as pending until they are actually in the process of running.

Select *Report Current Cal Status* (hot key **C**) from the *Logger Status Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??       Current Calibration Status       04/06/03 08:15:36

Sequence Type      Status
-------- --------  ------------------------------------------
GASCAL   Auto      SPAN     (4m 24s left)
FLOWCAL  Auto      Runs at 04/07/03 07:20:00
OPACCAL  Ext Init  PENDING
MANGAS   Inst Ctl  PENDING


    --- ESC or SPACE to exit ---
```

11.6 Single Calibration Status

This selection displays in real-time the status of one configured calibration program. A real-time screen of information about the current calibration state will display if you select a calibration that is currently running. The phase of the calibration that is active is shown along with the amount of time remaining in the phase (when known by the logger). All affected parameters of the calibration are also displayed along with the expected values for the current phase, the real-time readings, the real-time error from the expected values, the method of error calculation, the drift and OOC limits for the current phase and the units for the error from the expected values. If the error from the expected values is greater than either the drift or OOC limits, the value is displayed in reverse video mode.

Select *Display Status of Single Cal* (hot key **1**) from the *Logger Status Menu* to display a list of the configured calibration programs.

```
GASCAL    Auto      SPAN     (4m 19s left)

     Channel       Expected    Actual     Error   M   Drift      OOC     Units
---------------- ---------- ---------- --------- - --------- --------- --------
              SO2      450.3      427.3       4.6 S       2.5         5     %
              NOX      905.1        890       1.5 S       2.5         5     %
              CO2      18.37      18.49       0.1 D       0.5         1 PERCENT
```

The next scheduled start time for automatic calibration types will display if you select a calibration that is not currently running (or a pending message for other calibration types will display).

11.7 System Information

This option displays the ESC Model 8816's current memory status, software version, and optional features.

Select *System Information* (hot key **I**) from the *Status Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??          System Information          04/06/03 17:23:54

  ESC Model 8816 Software v5.xx dated MM-DD-YY

  Total Available Heap         = 21280 bytes
  Largest Avail. Heap Block    = 20576 bytes
  Available Operating Config.  = 167664 bytes
  Available User Configuration = 161520 bytes
  Largest Avail. Config. Block = 163264 bytes
  Available Data Storage       = 239 Blocks (Kbytes)

  ================================================================================
  Core Features            : ON
  Modbus Channel & Protocol: ON
  Daily Reports            : ON
  Digital Channel          : ON
  CEM                      : ON









   ESC or SPACE=EXIT, F2=Refresh
```

The memory display is divided into three segments: heap (volatile), configuration RAM, and long-term data storage RAM. The heap is used to fill short-term, temporary memory needs, such as holding channel configuration data while the user is editing it. The amount of heap should remain relatively constant. Configuration RAM holds permanent copies of channel, calibration, and alarm configurations. The long-term data storage area is divided into 1K blocks, and any number of blocks may be allocated to each averaging interval for each channel.

See "A Note About Storing Calibrations" in "Calibration" on page 6-1.

11.8 Print Configurations

This selection allows various logger configurations to be printed.

Select *Dump Setup(s)* (hot key **D**) from the *Logger Status Menu*. The following screen will display:

```
ESC Model 8816 v5.xx  ID:??          Dump Setup(s)          04/06/03 17:25:46

    D Dump One Data Channel
    C Dump One Calibration
    A Dump One Alarm
    E Dump One Event Program
    O Dump One DAC Config
    X Dump Everything
    P Dump All to Curr Port
```

After choosing one of the Dump One configurations, a choose list is displayed allowing a channel, calibration, alarm program, digital event, or DAC (analog output) configuration to be selected for printing. Once selected, printing begins immediately.

If *Dump Everything* (hot key **X**) is selected, all configurations for all channels, calibrations, digital programs, alarm programs, DACs (analog output), digital input and output labels, and reason codes are sent to the printer.

If *Dump All to Curr Port* (hot key **P**) is selected, all configurations for all channels, calibrations, digital programs, alarm programs, DACs (analog output), digital input and output labels, and reason codes are sent to the serial port from which this selection is made.

11.9 Unfragment Memory/Reboot

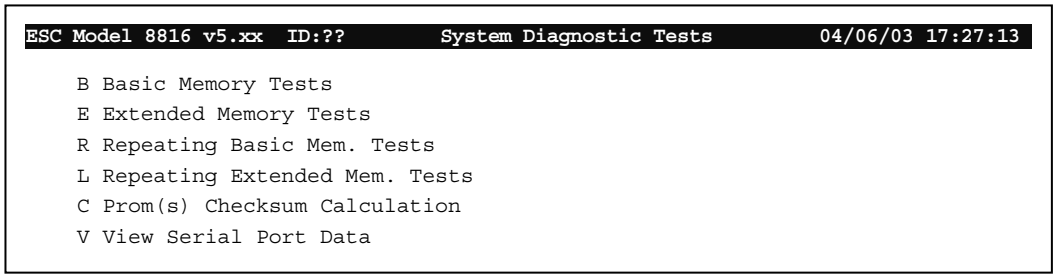
This selection is used to defragment the "scratchpad" memory used to hold temporary copies of configurations as they are edited. The logger reboots itself after the defragmentation is complete. The entire process should take about 3 to 5 seconds.

From the *Logger Status Menu*, select *Unfragment Memory/Reboot* (hot key **U**).

11.10 System Diagnostic Tests

This selection provides a series of system diagnostic tests that may help identify the source of a problem.

Select *System Diagnostic Tests* (hot key **T**) from the *Logger Status Menu*. The following screen will display:



When any of the memory tests are selected, a warning message is displayed requesting verification that the process should proceed:

```
WARNING! The logger will first be rebooted & processing
suspended prior to executing the selected diagnostic.

Are you sure you want to do this? (Y/N)
```

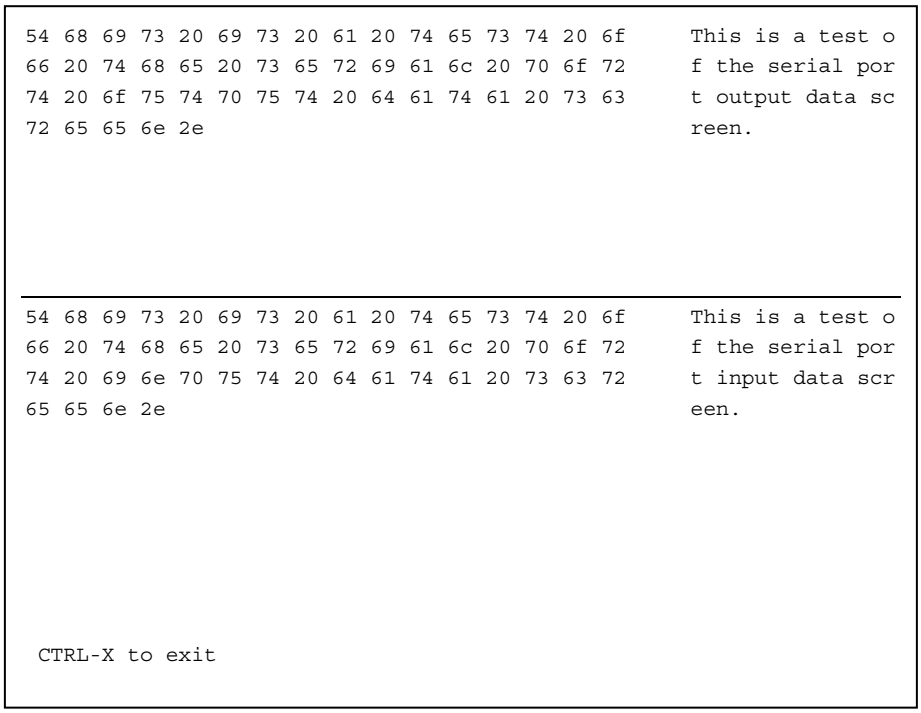
Key **N** to return to the *System Diagnostic Tests Menu*. Key **Y** to executed the selected diagnostic test.

11.10.1 *View Serial Port Data*

The primary purpose of this feature is to allow direct access to an attached device equipped with RS-232 port options via the ESC Model 8816 operator interface.

Step 1. Select the *View Serial Port Data* (hot key **V**) from the *System Diagnostics Tests Menu* to link the operator interface directly to another serial port. A list of configured terminal ports will display.

Step 2. Select one of the given ports. The screen will display characters sent to and received from the device connected to the ESC Model 8816 serial port. The characters are displayed in both ASCII and hexadecimal format.



If local echo is enabled, the top half of the screen shows characters that are typed at the data controller, and the bottom half of the screen shows characters that are received by the data controller on the selected port. Note that local echo is initially enabled. That is, all characters typed at the operator interface are echoed back to the display. Press <Ctrl><E> to toggle the local echo state between disabled and enabled.

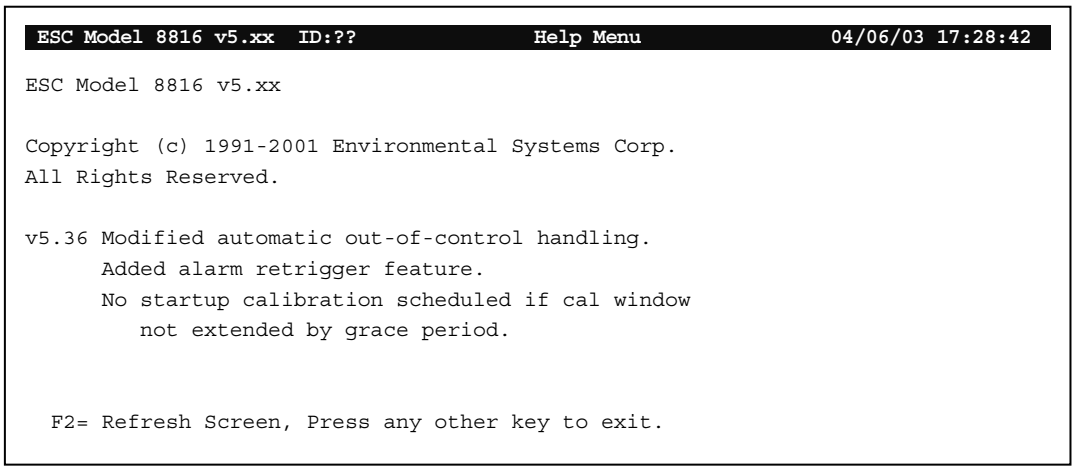
Note that alternate character entry is initially disabled. That is, only characters that can be typed on the attached keypad or keyboard can be sent out to the serial port from the data controller. Press <Ctrl><Y> to toggle the alternate entry state between disabled and enabled. When enabled, alternate characters can be entered in the format \xnn (where nn is a valid hexadecimal value, 00-ff) When a "\" character is entered, it, along with the next three characters entered, will not be sent out the serial port. If the format of the four characters is valid, then the represented hexadecimal value is sent out the serial port instead.

To exit terminal mode and return to the menu interface, press <Ctrl><X>.

11.11 Print Release Notes

This feature displays summaries of the latest software releases and the major features or changes for each.

Select *Print Release Notes* (hot key **N**) from the *Logger Status Menu*. The following screen will display:



Press any key to exit the display and return to the *Status Menu*.

Chapter 12
Application Note – Calibrations

This section provides helpful notes in regards to calibrations.

12.1 Typical Calibration Setup/Probe Controllers

A typical gas calibration sequence would be configured as shown in the screens below:

```
ESC Model 8816 v5.xx  ID:??        Auto Zero/Span Cal Cfg        04/06/03 10:20:20

     Name of Cal Sequence        :  GASCAL1
     Starting Time               :  04/07/03 23:00:00
     Interval                    :  1d
     Affected/Data Channels      :  SO2PPM,CO2,NOXPPPM,SO2PPMC,CO2C,NOXPPMC




     Minimum # Cal Records Stored:  1
     Zero Output Control Lines   :  25,30,
     Zero Phase Data Time        :  1m
     Zero Phase Duration         :  8m
     Edit Zero Expected Values   :
     Span Output Control Lines   :  25,27,
     Span Phase Data Time        :  1m
     Span Phase Duration         :  8m
     Edit Span Expected Values   :
     Recovery Time               :  5m
     FINISHED (Configure Now)

   CTRL-R = Advanced Options,  CTRL-O = Config Relay Outputs
```

Edit Zero Expected Values for GASCAL1, SO2PPM affected data channel:

```
ESC Model 8816 v5.xx  ID:??      Expected Value Configuration      04/06/03 10:21:59

     Name of Cal (not editable)  :  GASCAL1
     Name of Phase (not editable):  ZERO
     Channel Name (not editable) :  SO2PPM
     Expected Value              :  2116
     Tracer/ID Code (0000-9999)  :  0000
     Use EV For Automatic Correct?  N
     Write EV to Math Constant   :  (none)
     Write Result to Math Constant  (none)
     Warning Drift Tolerance     :  (not set)
     OOC Drift Tolerance         :  (not set)
     No Recovery If Warning Drift?  N
     No Recovery If OOC Drift?   :  N
     Store Result in Cal Record? :  Y
     Use Rounded Results?        :  N
     Method of Error Calc.(S,D,L):  D

  ESC to return to Phase Config
```

The expected value configuration would be done for each of the six affected data channels in the GASCAL1 calibration sequence for both zero and span phases, for a total of 12 expected value configurations.

12.2 Daily Calibrations and Boiler Operation

A daily calibration error check is not required if the boiler is offline for the entire day. If a boiler operates for part of a day, the daily calibration error check must be performed in most cases. Generally, to avoid failing the calibration due to temperature differences, it is desirable to perform the calibration after the system has reached a stable operating temperature. Therefore, these are the desired goals:

- In normal operation, run a daily calibration at the same time every day.
- If the boiler is offline, do not run the daily calibration.
- Once a boiler goes from offline to online, run a daily calibration after a delay.

12.2.1 *Daily Calibration Program*

Most daily calibration error programs are automatic (type A) calibrations.

A more complicated, but still valid, approach to starting the calibration is to change the calibration type to externally initiated (cal type E), specify a pseudo digital input/output pair as the starting digital input pattern, and have a timed digital event program toggle the pseudo digital output line once per day.

The advantage to the latter approach is that conditions can be added to the starting input pattern for the type E calibration, such as the boiler online conditions. The digital start pattern can be configured

so that the calibration only starts when the timed digital event program runs AND the boiler is operating. This meets the first two goals.

12.2.2 *Boiler Startup*

To accomplish the third goal, a simple method is to configure the **Startup Delay** and **Startup Minute (00-59)** fields in the *Advanced Cal Options* screen of the calibration configuration (see page 6-6 "Handling Out-of-Control Calibrations"). This method is valid when the amount of operating time needed after the boiler comes online before a calibration can successfully run is a known constant. If this time is not known or varies based on certain conditions during startup, then a more complicated method can be implemented using a "ready to cal" digital input pulse. The easiest way to generate this pulse is to create an average alarm program that represents the desired conditions and momentarily turns on a pseudo digital input/output pair.

In order to make an alarm program generate a pulse, the automatic *Acknowledgment Timeout* field should be configured to **`005s`** (or however long the pulse is desired to be) and the *End Alarm When No Flag?* field should be set to **`Y`**.

Example: The system's digital input #01 is on when the boiler is online.

The system should calibrate when the stack temperature rises above 300°F after the boiler comes online. Therefore, on the STKTEMP channel, the *High Alarm Limit* ('h' flag) is configured as **`300.0`** on the minute average (1m), and the instantaneous validation *Boiler Offline Status* is configured as **`1`**.

A STARTUP alarm is configured with the *Average Interval* configured as **`1m`**, the *Flag(s) for Alarm Condition* configured as **`h`**, the *Ignore State Changes Flag(s)* configured as **`F`** and the *Output Lines During Alarm* configured as **`33`** (pseudo digital input/output #33). The *Acknowledgment Timeout* is configured as **`5s`** in order to generate a 5-second pulse on DI#33 when the alarm activates.

A TEMPOK alarm should also be created that is identical to the STARTUP alarm except that the *Acknowledgement Timeout* is configured as **`0s`**. The *Output Lines During Alarm* is configured as **`34`** (pseudo digital input/output #34).This alarm is used to keep the normal daily calibration from running in cases where the normal daily calibration start time happens to fall during the startup period before the stack temperature reaches 300°F.

A CALTIME timed digital event program is created with the *Starting Time* configured as the normal calibration start time, the *Output Line(s)* configured as **`35`** (pseudo digital input/output #35) and the *Output Duration* configured as **`5s`**.

Thus, considering all inputs, the system should start a calibration when:

(DI#01=1 AND DI#34=1 AND DI#35=1) OR (DI#33=1).

This can be done by creating a CALSTART digitally triggered digital event program with the *Trigger DI Pattern* configured as **`1&34&35`** and the *Output Line(s)* configured as **`36`** (pseudo digital input/output #36).

The DAILYGAS automatic calibration program is then changed from a type A calibration to a type E with the *Start Pattern Status Lines* configured as `33|36`.

12.3 Handling Pitot Tube/Differential Pressure Flow Interference Checks

The EMRC probe must detect an out-of-control condition by comparing ΔP in the stack before and after the purge. If the difference in the ΔP reading (% difference = ((before - after) ÷ before) x 100) is greater than 3%, then the instrument is considered out-of-control.

Setting up the ESC Model 8816 to threshold on a 3% difference is accomplished as follows:

Step 1. Set up one phase called BASELINE (or whatever name is desired). Make ΔP a data parameter for that phase.

Step 2. Set up a second phase called PURGE. This phase should activate the purge air line.

Step 3. Set up a third phase called CHECK. This phase will take another reading on the ΔP channel.

Step 4. In the *Expected Value Configuration* screen for ΔP during the CHECK phase:

Expected Value: **`BASELINE`**

OOC Drift Tolerance: **`0.03*BASELINE`** `or` **`0.03*CHECK`**

Thus, at the end of the CHECK phase, the ESC Model 8816 will test the CHECK reading against the BASELINE reading, and test against a drift limit equal to 0.03*BASELINE (or CHECK). If the difference is greater than this threshold, the ΔP channel will go out-of-control and be flagged with a 'T'.

The central system can be configured to set the out-of-control flag based on this flag. A calibration drift alarm can also be configured at the ESC Model 8816 to alarm on OOC drift and turn on a digital output, possibly a pseudo-digital input/output, which the central software would detect.

If the purge pressure is measured on a channel other than ΔP, the OOC flag must be propagated to the FLOW channel. In order to propagate flags, "**`+ (0*PURGPRES)`**" can be added to the flow equation. This makes PURGPRES a constituent channel without affecting the result of the equation.

12.4 Calibration Correction on Analog Inputs

The ESC Model 8816 can be configured to perform automatic adjustments to the scaling parameters of analog inputs based on calibration results (see page 6-1 "Calibration").

It should be noted, however, that these corrections are incremental. For example, assume that the ESC Model 8816 is currently using a set of scaling parameters "A" (high/low inputs, high/low outputs) based on

the analyzer's factory settings. The system goes through a calibration correction and is now using scaling parameters "B." On the next day, the system goes through another calibration using scaling parameters "B" (not the factory settings). The results are then used to set scaling parameters "C," and so on.

The system will alarm on excess calibration drift and OOC limits, but these checks are on a day-to-day drift, not the drift from the original factory settings. If the analyzer has a slow degradation, the user may never be aware of the drift until the scaling curve becomes very flat (or vertical).

One approach to warn the user of excess drift from factory settings is to wire the analog input in parallel with another analog input (in series if a current loop), and to configure an uncorrected version of the channel. This channel is also used as a data parameter in the calibration, but the automatic correction is not enabled for that channel. Thus, this channel will always represent the calibration results in terms of factory settings. The user then sets up a calibration alarm to look at the uncorrected parameters and check them for excess drift.

Chapter 13
Application Note - Modbus Interface

The Modbus software option allows the ESC Model 8816 to emulate a Modicon PLC using the Modbus RTU interface. The Modbus master is allowed to read data values and status bits and can even provide data input by writing to certain registers. The ESC Model 8816 acts as a Modbus "slave" and currently supports ONLY the following Modbus commands:

- Read Coils (01) (Reads digital inputs)
- Read Multiple Registers (03) (Max # of registers read per access is 124)
- Force Single Coil (05)
- Write Single Register (06)
- Loop-back Maintenance (08)
- Write Multiple Register (16) (Max # of registers written per access is 124)
- Report Slave ID (17)

Communications:	8 bits
	1 stop bit
	No parity
	Data rate adjustable from 300-19200 baud

13.1 PLC Addressing

Each ESC Model 8816 can be assigned a *Modbus ID Code* of **`001-246`** in the *System Configuration Screen* that may be different from the *Logger ID Code* used by the polling computer.

13.2 Register Mapping

The ESC Model 8816 Modbus interface consists of 3 separate tables: the Address Table and the Input Table, which can both be read by the Modbus master, and the Output Table, which can be read or written to by the Modbus master. The starting addresses of the tables are editable by the user, and the defaults are listed below:

Address Table	=	40001
Input Table	=	40005
Output Table	=	41005

Commands can reference the register addresses directly or by relative addressing. If the specified starting register address is less than the starting address of the Address Table, then the address is assumed to be an index from the starting address of the Address Table. For example, if the Address Table begins at the default of 40001, then a Starting Register Address of 101 is used as an index to the actual address of 40001+101, or 40102.

13.3 Address Table

The Address Table consists of 4 sixteen-bit read-only registers. When the first 2 registers are read, the values configured for the *Modbus Address Table[0]* and *Modbus Address Table[1]* in the *Modbus Address Table Config* screen are returned respectively. When the second 2 registers are read, the maximum and minimum values that can be returned as Modbus register values are returned respectively.

13.4 Input Table

The Input Table consists of 389 sixteen-bit read-only registers. The first 5 registers contain the current state of the first 80 digital status inputs (both real & pseudo inputs). The first status input corresponds to bit 0 of the first register, and the 80th status input corresponds to bit 15 of the fifth register. The next 64 registers contain the values for the base average (usually a 1-minute average) for channels 01 through 64 configured in the ESC Model 8816. The next 64 registers contain the flags pertaining to each of the preceding 64 base averages. The next 64 registers contain the values for the second extended average (usually a 1-hour average) for channels 01 through 64. The next 64 registers contain the flags pertaining to each of the preceding 64 second extended averages. The next 64 registers contain the values for the first extended average (usually a 6-minute or 15-minute average) for channels 01 through 64. The next 64 registers contain the flags pertaining to each of the preceding 64 first extended averages.

13.5 Output Table

The Output Table consists of 69 sixteen-bit registers which can be read or written. The first 5 contain the current state of the first 80 digital outputs (both real & pseudo outputs). Writing to these registers updates the state of the corresponding digital relay outputs, **regardless of any other control being performed by the ESC Model 8816**. Typically, the Modbus slave is assigned one of the registers corresponding to 16 of the pseudo-digital I/O lines and does not write to any of the other registers. The first relay output corresponds to bit 0 of the first register, and the 80th relay output corresponds to bit 15 of the fifth register. The next 64 registers are used to update the base average inputs (usually 1-minute averages) for any of the channels 01 through 64 that are configured as Modbus-type channels; see page 5-39 "Modbus Channels (Optional)." These registers must be updated at least once per base average interval, or the base average data will be invalidated with the 'B' flag for lack of sufficient input.

13.6 Numerical Values in Modbus Registers

Because the Modbus interface uses 16-bit registers which are interpreted as signed integers (2's complement), some manipulation must be performed to map floating point numbers in and out of these registers. Each channel may be assigned a scaling factor for this conversion; the default scaling factor is 0.01. The relevant formulas are:

Input Table Value (read by master) = value in ESC Model 8816 ÷ scaling factor.

Output Table Value (written by master) = value written × scaling factor.

Using the default scaling factor, an SO2 channel with a value of 34.56 ppm would be read by the Modbus master as 3,456.

A TEMPF channel with a value of –5.25 degF would be read by the Modbus master as –525 (or 65,011 if the master views the register as an unsigned integer). If the Modbus master wrote a value of 1,890 to the register for the LOAD Modbus channel, the ESC Model 8816 would report a value of 18.9 MW.

NOTE: Modbus scaling factors are configured by pressing <Ctrl><D> at the channel configuration screen; see page 5-41 "Modbus Scaling Factor."

The floating-point Modbus interface uses two 16-bit registers to represent floating-point values in a format conforming to the IEEE Standard 754. The layout of the 32-bit information used to represent the floating-point value is described below:

Mantissa 2	Mantissa 3	Sign/Exp.	Mantissa 1
Byte 3	Byte 4	Byte 1	Byte 2
Register N		Register N + 1	

No scaling factor is used for the floating-point interface as decimals and exponentials are already handled by the format. If a scaling factor is configured, it is ignored. Because each floating-point value is represented by two 16-bit registers, a single Write Register command 06 cannot be used to transfer a point of data to a channel in the data logger.

13.7 Status Words

Each of the 16-bit status words for minute and hourly averages are mapped to the normal ESC Model 8816 flags as follows:

Status Word		Flag
bit 15 (MSB)	=	< (data invalid)
bit 14	=	T (out-of-control)
bit 13	=	F (boiler offline signal)
bit 12	=	B (bad status/instrument failure)
bit 11	=	C (in calibration)
bit 10	=	M (in maintenance)
bit 9	=	H (high-high alarm)
bit 8	=	L (low-low alarm)
bit 7	=	P (power failure)
bit 6	=	D (channel disabled)
bit 5	=	O | U | A (overrange/underrange)
bit 4	=	- | + | R (limit exceeded)
bit 3	=	h (high alarm)
bit 2	=	l (low alarm)
bit 1	=	V (digital information #1)
bit 0 (LSB)	=	currently unused

13.8 Command Descriptions

The following section contains a detailed description of the supported Modbus commands and the corresponding responses. Note that each field is designated by using the '<' and '>' characters, ***but these characters are NOT part of the actual command.***

13.8.1 *Read Coils*

The Read Coils command is used to read the status of the ESC Model 8816 Digital Inputs.

Command:

<ID><01><Starting Coil #><# Coils to Read><CRC16>

Command	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
01	Modbus Read Coils command code (1 byte – hex).
Starting Coil #	The # of the first coil (digital input) to read (2 bytes, high byte followed by low byte).
# Coils to Read	The # of coils (digital inputs) to read (2 bytes, high byte followed by low byte).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

Response:

<ID><01><# Bytes of Coil Data><Coils Data><CRC16>

Response	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
01	Modbus Read Coils command code (1 byte – hex).
# Bytes of Coil Data	The # of bytes of Coils Data returned (1 byte). This value is computed by dividing the # Coils to Read by 8 and adding 1 if the # Coils to Read is not evenly divisible by 8.
Coils Data	Coil states where each bit represents a coil (total bytes = # Bytes of Coil Data). The Starting Coil # state is returned in bit 0 of the first byte of the response.
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

13.8.2 *Read Multiple Registers*

The Read Multiple Registers command is used to read registers in any of the three Modbus tables. Register reads across table boundaries (e.g. Address Table into Input Table or Input Table into Output Table) are allowed provided that the tables are contiguous in the Modbus memory map.

Command:

<ID><03><Starting Register Address><# Registers to Read><CRC16>

Command	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
03	Modbus Read Multiple Registers command code (1 byte – hex).
Starting Register Address	The address of the first register to read (2 bytes, high byte followed by low byte). If this address is less than the starting address of the Address Table, it is assumed to be an index from the starting address of the Address Table.
# Registers to Read	The # of registers to read beginning at the address referenced by the Starting Register Address (2 bytes, high byte followed by low byte).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

Response:

<ID><03><# Bytes of Data><Registers Data><CRC16>

Response	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
03	Modbus Read Multiple Registers command code (1 byte – hex).
# Bytes of Data	The # of bytes of Register Data returned (1 byte). This value is computed by multiplying the # Registers to Read by 2.
Register Data	Data for the # of Registers to Read beginning at the address referenced by the Starting Register Address (total bytes = # Bytes of Data, high byte followed by low byte for each register).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

13.8.3 *Force Single Coil*

The Force Single Coil command is used to activate or deactivate a single ESC Model 8816 Digital Output.

Command:

<ID><05><Coil#><Coils State><CRC16>

Command	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
05	Modbus Force Single Coil command code (1 byte – hex).
Coil #	The # of the coil (digital output) to force (2 bytes, high byte followed by low byte).
Coils State	The requested state of the coil (digital output) to force (2 bytes, high byte followed by low byte). A value of 0xFF00 requests that the coil be activated. A value of 0x0000 requests that the coil be deactivated.
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

Response:

<ID><05><Coil #><Coil State><CRC16>

Response	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
05	Modbus Force Single Coil command code (1 byte – hex).
Coil #	The # of the coil (digital output) to force (2 bytes, high byte followed by low byte).
Coil State	The requested state of the coil (digital output) to force (2 bytes, high byte followed by low byte). A value of 0xFF00 requests that the coil be activated. A value of 0x0000 requests that the coil be deactivated.
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

13.8.4 *Write Register*

The Write Register command is used to write data to a single register in the Output Table.

Command:

<ID><06><Register Address><Register Data><CRC16>

Command	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
06	Modbus Write Register command code (1 byte – hex).
Register Address	The address of the register to write (2 bytes, high byte followed by low byte). If this address is less than the starting address of the Address Table, it is assumed to be an index from the starting address of the Address Table.
Register Data	Data to write at the Register Address (2 bytes, high byte followed by low byte).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

Response:

<ID><06><Register Address><Register Data><CRC16>

Response	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
06	Modbus Write Register command code (1 byte – hex).
Register Address	The address of the register to write (2 bytes, high byte followed by low byte).
Register Data	Data to write at the Register Address (2 bytes, high byte followed by low byte).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

13.8.5 *Loop-back Maintenance Mode*

The Loop-back Maintenance Mode command is used to echo a command and to set or reset "listen only mode".

Command:

<ID><08><Code><Data><CRC16>

Command	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
08	Modbus Loop-back Maintenance Mode command code (1 byte – hex).
Code	Loop-back code (2 bytes, high byte followed by low byte). Valid codes are 0, 1, and 2 where the following actions are taken: 0 – Echoes entire string as response 1 – Resets "listen only mode" if Data is 0x00 or 0xFF00 2 – Sets "listen only mode" if Data is 0x00.
Data	Data for the Code (2 bytes, high byte followed by low byte).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

Response (for Codes 0 and 1):

<ID><08><Code><Data><CRC16>

Response	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
08	Modbus Loop-back Maintenance Mode command code (1 byte – hex).
Code	Loop-back code (2 bytes, high byte followed by low byte).
Data	Data for the Code (2 bytes, high byte followed by low byte).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

Response (for Code 2):

<ID><08><CRC16>

Response	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
08	Modbus Loop-back Maintenance Mode command code (1 byte – hex).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

13.8.6 *Write Multiple Registers*

The Write Multiple Registers command is used to write data to multiple registers in the Output Table.

Command:

<ID><10><Starting Register Address><# of Registers to Write><Byte Count of Data><Register Data><CRC16>

Command	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
10	Modbus Write Multiple Registers command code (1 byte – hex).
Starting Register Address	The address of the first register to write (2 bytes, high byte followed by low byte). If this address is less than the starting address of the Address Table, it is assumed to be an index from the starting address of the Address Table.
# of Registers to Write	The # of registers to write data beginning at the address referenced by the Starting Register Address (2 bytes, high byte followed by low byte).
Byte Count of Data	The # of data bytes to write (1 byte).
Register Data	Data to write beginning at the address referenced by the Starting Register Address (total bytes = Byte Count of Data, high byte followed by low byte for each register).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

Response:

<ID><10><Starting Register Address><# of Registers to Write><CRC16>

Response	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
10	Modbus Write Multiple Registers command code (1 byte – hex).
Starting Register Address	The address of the first register to write (2 bytes, high byte followed by low byte).
# of Registers to Write	The # of registers to write data beginning at the address referenced by the Starting Register Address (2 bytes, high byte followed by low byte).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

13.8.7 *Report Slave ID*

The Report Slave ID command returns a description of the type of controller present at the slave address, the current status of the slave Run indicator, and other information specific to the slave device.

Command:

<ID><11><CRC16>

Command	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
11	Modbus Report Slave ID command code (1 byte – hex).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

Response:

<ID><11><Byte Count><Slave ID Device><Run Indicator Status><Additional Data><CRC16>

Response	Explanation
ID	Modbus ID of the ESC Model 8816 Data Logger (1 byte, e.g. a Modbus ID of 100 is transmitted as hex 64).
11	Modbus Report Slave ID command code (1 byte – hex).
Byte Count	The number of data bytes to follow (1 byte, always 09 for this command).
Slave ID Device	The slave ID device code (1 byte, always 03 for this command corresponding to a Modicon 584 Controller).
Run Indicator Status	Current status of the slave Run indicator (1 byte, always 0xFF for this command indicating ON).
Additional Data	Additional information specific to the slave device (7 bytes, all data 0x00 for this command).
CRC16	Cyclic Redundancy Check based on all preceding bytes beginning with the Modbus ID (2 bytes, high byte followed by low byte).

13.9 Standard Modbus Tables

The following table shows the complete default mapping of the standard Modbus registers in the ESC Model 8816 Data Logger.

Modbus Address	Table Type	Table Offset	Description
40001	Address	0	Returns value configured in Modbus Address Table[0].
40002	Address	1	Returns value configured in Modbus Address Table[1].
40003	Address	2	Returns maximum Modbus register value.
40004	Address	3	Returns minimum Modbus register value.
40005	Input	0	Digital Input Register 1 - 16 bits (Bit 0-15 => DI#01-16)
40006	Input	1	Digital Input Register 2 - 16 bits (Bit 0-15 => DI#17-32)
40007	Input	2	Digital Input Register 3 - 16 bits (Bit 0-15 => DI#33-48)
40008	Input	3	Digital Input Register 4 - 16 bits (Bit 0-15 => DI#49-64)
40009	Input	4	Digital Input Register 5 - 16 bits (Bit 0-15 => DI#65-80)
40010	Input	5	Base Average for Channel #1
40011	Input	6	Base Average for Channel #2
40012	Input	7	Base Average for Channel #3
40013	Input	8	Base Average for Channel #4
40014	Input	9	Base Average for Channel #5
40015	Input	10	Base Average for Channel #6
40016	Input	11	Base Average for Channel #7
40017	Input	12	Base Average for Channel #8
40018	Input	13	Base Average for Channel #9
40019	Input	14	Base Average for Channel #10
40020	Input	15	Base Average for Channel #11
40021	Input	16	Base Average for Channel #12
40022	Input	17	Base Average for Channel #13
40023	Input	18	Base Average for Channel #14
40024	Input	19	Base Average for Channel #15
40025	Input	20	Base Average for Channel #16

Modbus Address	Table Type	Table Offset	Description
40026	Input	21	Base Average for Channel #17
40027	Input	22	Base Average for Channel #18
40028	Input	23	Base Average for Channel #19
40029	Input	24	Base Average for Channel #20
40030	Input	25	Base Average for Channel #21
40031	Input	26	Base Average for Channel #22
40032	Input	27	Base Average for Channel #23
40033	Input	28	Base Average for Channel #24
40034	Input	29	Base Average for Channel #25
40035	Input	30	Base Average for Channel #26
40036	Input	31	Base Average for Channel #27
40037	Input	32	Base Average for Channel #28
40038	Input	33	Base Average for Channel #29
40039	Input	34	Base Average for Channel #30
40040	Input	35	Base Average for Channel #31
40041	Input	36	Base Average for Channel #32
40042	Input	37	Base Average for Channel #33
40043	Input	38	Base Average for Channel #34
40044	Input	39	Base Average for Channel #35
40045	Input	40	Base Average for Channel #36
40046	Input	41	Base Average for Channel #37
40047	Input	42	Base Average for Channel #38
40048	Input	43	Base Average for Channel #39
40049	Input	44	Base Average for Channel #40
40050	Input	45	Base Average for Channel #41
40051	Input	46	Base Average for Channel #42
40052	Input	47	Base Average for Channel #43
40053	Input	48	Base Average for Channel #44

Modbus Address	Table Type	Table Offset	Description
40054	Input	49	Base Average for Channel #45
40055	Input	50	Base Average for Channel #46
40056	Input	51	Base Average for Channel #47
40057	Input	52	Base Average for Channel #48
40058	Input	53	Base Average for Channel #49
40059	Input	54	Base Average for Channel #50
40060	Input	55	Base Average for Channel #51
40061	Input	56	Base Average for Channel #52
40062	Input	57	Base Average for Channel #53
40063	Input	58	Base Average for Channel #54
40064	Input	59	Base Average for Channel #55
40065	Input	60	Base Average for Channel #56
40066	Input	61	Base Average for Channel #57
40067	Input	62	Base Average for Channel #58
40068	Input	63	Base Average for Channel #59
40069	Input	64	Base Average for Channel #60
40070	Input	65	Base Average for Channel #61
40071	Input	66	Base Average for Channel #62
40072	Input	67	Base Average for Channel #63
40073	Input	68	Base Average for Channel #64
40074	Input	69	Base Average Status for Channel #1
40075	Input	70	Base Average Status for Channel #2
40076	Input	71	Base Average Status for Channel #3
40077	Input	72	Base Average Status for Channel #4
40078	Input	73	Base Average Status for Channel #5
40079	Input	74	Base Average Status for Channel #6
40080	Input	75	Base Average Status for Channel #7
40081	Input	76	Base Average Status for Channel #8

Modbus Address	Table Type	Table Offset	Description
40082	Input	77	Base Average Status for Channel #9
40083	Input	78	Base Average Status for Channel #10
40084	Input	79	Base Average Status for Channel #11
40085	Input	80	Base Average Status for Channel #12
40086	Input	81	Base Average Status for Channel #13
40087	Input	82	Base Average Status for Channel #14
40088	Input	83	Base Average Status for Channel #15
40089	Input	84	Base Average Status for Channel #16
40090	Input	85	Base Average Status for Channel #17
40091	Input	86	Base Average Status for Channel #18
40092	Input	87	Base Average Status for Channel #19
40093	Input	88	Base Average Status for Channel #20
40094	Input	89	Base Average Status for Channel #21
40095	Input	90	Base Average Status for Channel #22
40096	Input	91	Base Average Status for Channel #23
40097	Input	92	Base Average Status for Channel #24
40098	Input	93	Base Average Status for Channel #25
40099	Input	94	Base Average Status for Channel #26
40100	Input	95	Base Average Status for Channel #27
40101	Input	96	Base Average Status for Channel #28
40102	Input	97	Base Average Status for Channel #29
40103	Input	98	Base Average Status for Channel #30
40104	Input	99	Base Average Status for Channel #31
40105	Input	100	Base Average Status for Channel #32
40106	Input	101	Base Average Status for Channel #33
40107	Input	102	Base Average Status for Channel #34
40108	Input	103	Base Average Status for Channel #35
40109	Input	104	Base Average Status for Channel #36

Modbus Address	Table Type	Table Offset	Description
40110	Input	105	Base Average Status for Channel #37
40111	Input	106	Base Average Status for Channel #38
40112	Input	107	Base Average Status for Channel #39
40113	Input	108	Base Average Status for Channel #40
40114	Input	109	Base Average Status for Channel #41
40115	Input	110	Base Average Status for Channel #42
40116	Input	111	Base Average Status for Channel #43
40117	Input	112	Base Average Status for Channel #44
40118	Input	113	Base Average Status for Channel #45
40119	Input	114	Base Average Status for Channel #46
40120	Input	115	Base Average Status for Channel #47
40121	Input	116	Base Average Status for Channel #48
40122	Input	117	Base Average Status for Channel #49
40123	Input	118	Base Average Status for Channel #50
40124	Input	119	Base Average Status for Channel #51
40125	Input	120	Base Average Status for Channel #52
40126	Input	121	Base Average Status for Channel #53
40127	Input	122	Base Average Status for Channel #54
40128	Input	123	Base Average Status for Channel #55
40129	Input	124	Base Average Status for Channel #56
40130	Input	125	Base Average Status for Channel #57
40131	Input	126	Base Average Status for Channel #58
40132	Input	127	Base Average Status for Channel #59
40133	Input	128	Base Average Status for Channel #60
40134	Input	129	Base Average Status for Channel #61
40135	Input	130	Base Average Status for Channel #62
40136	Input	131	Base Average Status for Channel #63
40137	Input	132	Base Average Status for Channel #64

Modbus Address	Table Type	Table Offset	Description
40138	Input	133	Extended Average 2 for Channel #1
40139	Input	134	Extended Average 2 for Channel #2
40140	Input	135	Extended Average 2 for Channel #3
40141	Input	136	Extended Average 2 for Channel #4
40142	Input	137	Extended Average 2 for Channel #5
40143	Input	138	Extended Average 2 for Channel #6
40144	Input	139	Extended Average 2 for Channel #7
40145	Input	140	Extended Average 2 for Channel #8
40146	Input	141	Extended Average 2 for Channel #9
40147	Input	142	Extended Average 2 for Channel #10
40148	Input	143	Extended Average 2 for Channel #11
40149	Input	144	Extended Average 2 for Channel #12
40150	Input	145	Extended Average 2 for Channel #13
40151	Input	146	Extended Average 2 for Channel #14
40152	Input	147	Extended Average 2 for Channel #15
40153	Input	148	Extended Average 2 for Channel #16
40154	Input	149	Extended Average 2 for Channel #17
40155	Input	150	Extended Average 2 for Channel #18
40156	Input	151	Extended Average 2 for Channel #19
40157	Input	152	Extended Average 2 for Channel #20
40158	Input	153	Extended Average 2 for Channel #21
40159	Input	154	Extended Average 2 for Channel #22
40160	Input	155	Extended Average 2 for Channel #23
40161	Input	156	Extended Average 2 for Channel #24
40162	Input	157	Extended Average 2 for Channel #25
40163	Input	158	Extended Average 2 for Channel #26
40164	Input	159	Extended Average 2 for Channel #27
40165	Input	160	Extended Average 2 for Channel #28

Modbus Address	Table Type	Table Offset	Description
40166	Input	161	Extended Average 2 for Channel #29
40167	Input	162	Extended Average 2 for Channel #30
40168	Input	163	Extended Average 2 for Channel #31
40169	Input	164	Extended Average 2 for Channel #32
40170	Input	165	Extended Average 2 for Channel #33
40171	Input	166	Extended Average 2 for Channel #34
40172	Input	167	Extended Average 2 for Channel #35
40173	Input	168	Extended Average 2 for Channel #36
40174	Input	169	Extended Average 2 for Channel #37
40175	Input	170	Extended Average 2 for Channel #38
40176	Input	171	Extended Average 2 for Channel #39
40177	Input	172	Extended Average 2 for Channel #40
40178	Input	173	Extended Average 2 for Channel #41
40179	Input	174	Extended Average 2 for Channel #42
40180	Input	175	Extended Average 2 for Channel #43
40181	Input	176	Extended Average 2 for Channel #44
40182	Input	177	Extended Average 2 for Channel #45
40183	Input	178	Extended Average 2 for Channel #46
40184	Input	179	Extended Average 2 for Channel #47
40185	Input	180	Extended Average 2 for Channel #48
40186	Input	181	Extended Average 2 for Channel #49
40187	Input	182	Extended Average 2 for Channel #50
40188	Input	183	Extended Average 2 for Channel #51
40189	Input	184	Extended Average 2 for Channel #52
40190	Input	185	Extended Average 2 for Channel #53
40191	Input	186	Extended Average 2 for Channel #54
40192	Input	187	Extended Average 2 for Channel #55
40193	Input	188	Extended Average 2 for Channel #56

Modbus Address	Table Type	Table Offset	Description
40194	Input	189	Extended Average 2 for Channel #57
40195	Input	190	Extended Average 2 for Channel #58
40196	Input	191	Extended Average 2 for Channel #59
40197	Input	192	Extended Average 2 for Channel #60
40198	Input	193	Extended Average 2 for Channel #61
40199	Input	194	Extended Average 2 for Channel #62
40200	Input	195	Extended Average 2 for Channel #63
40201	Input	196	Extended Average 2 for Channel #64
40202	Input	197	Extended Average 2 Status for Channel #1
40203	Input	198	Extended Average 2 Status for Channel #2
40204	Input	199	Extended Average 2 Status for Channel #3
40205	Input	200	Extended Average 2 Status for Channel #4
40206	Input	201	Extended Average 2 Status for Channel #5
40207	Input	202	Extended Average 2 Status for Channel #6
40208	Input	203	Extended Average 2 Status for Channel #7
40209	Input	204	Extended Average 2 Status for Channel #8
40210	Input	205	Extended Average 2 Status for Channel #9
40211	Input	206	Extended Average 2 Status for Channel #10
40212	Input	207	Extended Average 2 Status for Channel #11
40213	Input	208	Extended Average 2 Status for Channel #12
40214	Input	209	Extended Average 2 Status for Channel #13
40215	Input	210	Extended Average 2 Status for Channel #14
40216	Input	211	Extended Average 2 Status for Channel #15
40217	Input	212	Extended Average 2 Status for Channel #16
40218	Input	213	Extended Average 2 Status for Channel #17
40219	Input	214	Extended Average 2 Status for Channel #18
40220	Input	215	Extended Average 2 Status for Channel #19
40221	Input	216	Extended Average 2 Status for Channel #20

Modbus Address	Table Type	Table Offset	Description
40222	Input	217	Extended Average 2 Status for Channel #21
40223	Input	218	Extended Average 2 Status for Channel #22
40224	Input	219	Extended Average 2 Status for Channel #23
40225	Input	220	Extended Average 2 Status for Channel #24
40226	Input	221	Extended Average 2 Status for Channel #25
40227	Input	222	Extended Average 2 Status for Channel #26
40228	Input	223	Extended Average 2 Status for Channel #27
40229	Input	224	Extended Average 2 Status for Channel #28
40230	Input	225	Extended Average 2 Status for Channel #29
40231	Input	226	Extended Average 2 Status for Channel #30
40232	Input	227	Extended Average 2 Status for Channel #31
40233	Input	228	Extended Average 2 Status for Channel #32
40234	Input	229	Extended Average 2 Status for Channel #33
40235	Input	230	Extended Average 2 Status for Channel #34
40236	Input	231	Extended Average 2 Status for Channel #35
40237	Input	232	Extended Average 2 Status for Channel #36
40238	Input	233	Extended Average 2 Status for Channel #37
40239	Input	234	Extended Average 2 Status for Channel #38
40240	Input	235	Extended Average 2 Status for Channel #39
40241	Input	236	Extended Average 2 Status for Channel #40
40242	Input	237	Extended Average 2 Status for Channel #41
40243	Input	238	Extended Average 2 Status for Channel #42
40244	Input	239	Extended Average 2 Status for Channel #43
40245	Input	240	Extended Average 2 Status for Channel #44
40246	Input	241	Extended Average 2 Status for Channel #45
40247	Input	242	Extended Average 2 Status for Channel #46
40248	Input	243	Extended Average 2 Status for Channel #47
40249	Input	244	Extended Average 2 Status for Channel #48

Modbus Address	Table Type	Table Offset	Description
40250	Input	245	Extended Average 2 Status for Channel #49
40251	Input	246	Extended Average 2 Status for Channel #50
40252	Input	247	Extended Average 2 Status for Channel #51
40253	Input	248	Extended Average 2 Status for Channel #52
40254	Input	249	Extended Average 2 Status for Channel #53
40255	Input	250	Extended Average 2 Status for Channel #54
40256	Input	251	Extended Average 2 Status for Channel #55
40257	Input	252	Extended Average 2 Status for Channel #56
40258	Input	253	Extended Average 2 Status for Channel #57
40259	Input	254	Extended Average 2 Status for Channel #58
40260	Input	255	Extended Average 2 Status for Channel #59
40261	Input	256	Extended Average 2 Status for Channel #60
40262	Input	257	Extended Average 2 Status for Channel #61
40263	Input	258	Extended Average 2 Status for Channel #62
40264	Input	259	Extended Average 2 Status for Channel #63
40265	Input	260	Extended Average 2 Status for Channel #64
40266	Input	261	Extended Average 1 for Channel #1
40267	Input	262	Extended Average 1 for Channel #2
40268	Input	263	Extended Average 1 for Channel #3
40269	Input	264	Extended Average 1 for Channel #4
40270	Input	265	Extended Average 1 for Channel #5
40271	Input	266	Extended Average 1 for Channel #6
40272	Input	267	Extended Average 1 for Channel #7
40273	Input	268	Extended Average 1 for Channel #8
40274	Input	269	Extended Average 1 for Channel #9
40275	Input	270	Extended Average 1 for Channel #10
40276	Input	271	Extended Average 1 for Channel #11
40277	Input	272	Extended Average 1 for Channel #12

Modbus Address	Table Type	Table Offset	Description
40278	Input	273	Extended Average 1 for Channel #13
40279	Input	274	Extended Average 1 for Channel #14
40280	Input	275	Extended Average 1 for Channel #15
40281	Input	276	Extended Average 1 for Channel #16
40282	Input	277	Extended Average 1 for Channel #17
40283	Input	278	Extended Average 1 for Channel #18
40284	Input	279	Extended Average 1 for Channel #19
40285	Input	280	Extended Average 1 for Channel #20
40286	Input	281	Extended Average 1 for Channel #21
40287	Input	282	Extended Average 1 for Channel #22
40288	Input	283	Extended Average 1 for Channel #23
40289	Input	284	Extended Average 1 for Channel #24
40290	Input	285	Extended Average 1 for Channel #25
40291	Input	286	Extended Average 1 for Channel #26
40292	Input	287	Extended Average 1 for Channel #27
40293	Input	288	Extended Average 1 for Channel #28
40294	Input	289	Extended Average 1 for Channel #29
40295	Input	290	Extended Average 1 for Channel #30
40296	Input	291	Extended Average 1 for Channel #31
40297	Input	292	Extended Average 1 for Channel #32
40298	Input	293	Extended Average 1 for Channel #33
40299	Input	294	Extended Average 1 for Channel #34
40300	Input	295	Extended Average 1 for Channel #35
40301	Input	296	Extended Average 1 for Channel #36
40302	Input	297	Extended Average 1 for Channel #37
40303	Input	298	Extended Average 1 for Channel #38
40304	Input	299	Extended Average 1 for Channel #39
40305	Input	300	Extended Average 1 for Channel #40

Modbus Address	Table Type	Table Offset	Description
40306	Input	301	Extended Average 1 for Channel #41
40307	Input	302	Extended Average 1 for Channel #42
40308	Input	303	Extended Average 1 for Channel #43
40309	Input	304	Extended Average 1 for Channel #44
40310	Input	305	Extended Average 1 for Channel #45
40311	Input	306	Extended Average 1 for Channel #46
40312	Input	307	Extended Average 1 for Channel #47
40313	Input	308	Extended Average 1 for Channel #48
40314	Input	309	Extended Average 1 for Channel #49
40315	Input	310	Extended Average 1 for Channel #50
40316	Input	311	Extended Average 1 for Channel #51
40317	Input	312	Extended Average 1 for Channel #52
40318	Input	313	Extended Average 1 for Channel #53
40319	Input	314	Extended Average 1 for Channel #54
40320	Input	315	Extended Average 1 for Channel #55
40321	Input	316	Extended Average 1 for Channel #56
40322	Input	317	Extended Average 1 for Channel #57
40323	Input	318	Extended Average 1 for Channel #58
40324	Input	319	Extended Average 1 for Channel #59
40325	Input	320	Extended Average 1 for Channel #60
40326	Input	321	Extended Average 1 for Channel #61
40327	Input	322	Extended Average 1 for Channel #62
40328	Input	323	Extended Average 1 for Channel #63
40329	Input	324	Extended Average 1 for Channel #64
40330	Input	325	Extended Average 1 Status for Channel #1
40331	Input	326	Extended Average 1 Status for Channel #2
40332	Input	327	Extended Average 1 Status for Channel #3
40333	Input	328	Extended Average 1 Status for Channel #4

Modbus Address	Table Type	Table Offset	Description
40334	Input	329	Extended Average 1 Status for Channel #5
40335	Input	330	Extended Average 1 Status for Channel #6
40336	Input	331	Extended Average 1 Status for Channel #7
40337	Input	332	Extended Average 1 Status for Channel #8
40338	Input	333	Extended Average 1 Status for Channel #9
40339	Input	334	Extended Average 1 Status for Channel #10
40340	Input	335	Extended Average 1 Status for Channel #11
40341	Input	336	Extended Average 1 Status for Channel #12
40342	Input	337	Extended Average 1 Status for Channel #13
40343	Input	338	Extended Average 1 Status for Channel #14
40344	Input	339	Extended Average 1 Status for Channel #15
40345	Input	340	Extended Average 1 Status for Channel #16
40346	Input	341	Extended Average 1 Status for Channel #17
40347	Input	342	Extended Average 1 Status for Channel #18
40348	Input	343	Extended Average 1 Status for Channel #19
40349	Input	344	Extended Average 1 Status for Channel #20
40350	Input	345	Extended Average 1 Status for Channel #21
40351	Input	346	Extended Average 1 Status for Channel #22
40352	Input	347	Extended Average 1 Status for Channel #23
40353	Input	348	Extended Average 1 Status for Channel #24
40354	Input	349	Extended Average 1 Status for Channel #25
40355	Input	350	Extended Average 1 Status for Channel #26
40356	Input	351	Extended Average 1 Status for Channel #27
40357	Input	352	Extended Average 1 Status for Channel #28
40358	Input	353	Extended Average 1 Status for Channel #29
40359	Input	354	Extended Average 1 Status for Channel #30
40360	Input	355	Extended Average 1 Status for Channel #31
40361	Input	356	Extended Average 1 Status for Channel #32

Modbus Address	Table Type	Table Offset	Description
40362	Input	357	Extended Average 1 Status for Channel #33
40363	Input	358	Extended Average 1 Status for Channel #34
40364	Input	359	Extended Average 1 Status for Channel #35
40365	Input	360	Extended Average 1 Status for Channel #36
40366	Input	361	Extended Average 1 Status for Channel #37
40367	Input	362	Extended Average 1 Status for Channel #38
40368	Input	363	Extended Average 1 Status for Channel #39
40369	Input	364	Extended Average 1 Status for Channel #40
40370	Input	365	Extended Average 1 Status for Channel #41
40371	Input	366	Extended Average 1 Status for Channel #42
40372	Input	367	Extended Average 1 Status for Channel #43
40373	Input	368	Extended Average 1 Status for Channel #44
40374	Input	369	Extended Average 1 Status for Channel #45
40375	Input	370	Extended Average 1 Status for Channel #46
40376	Input	371	Extended Average 1 Status for Channel #47
40377	Input	372	Extended Average 1 Status for Channel #48
40378	Input	373	Extended Average 1 Status for Channel #49
40379	Input	374	Extended Average 1 Status for Channel #50
40380	Input	375	Extended Average 1 Status for Channel #51
40381	Input	376	Extended Average 1 Status for Channel #52
40382	Input	377	Extended Average 1 Status for Channel #53
40383	Input	378	Extended Average 1 Status for Channel #54
40384	Input	379	Extended Average 1 Status for Channel #55
40385	Input	380	Extended Average 1 Status for Channel #56
40386	Input	381	Extended Average 1 Status for Channel #57
40387	Input	382	Extended Average 1 Status for Channel #58
40388	Input	383	Extended Average 1 Status for Channel #59
40389	Input	384	Extended Average 1 Status for Channel #60

Modbus Address	Table Type	Table Offset	Description
40390	Input	385	Extended Average 1 Status for Channel #61
40391	Input	386	Extended Average 1 Status for Channel #62
40392	Input	387	Extended Average 1 Status for Channel #63
40393	Input	388	Extended Average 1 Status for Channel #64

Modbus Address	Table Type	Table Offset	Description
41005	Output	0	Digital Output Register 1 - 16 bits (Bit 0-15 => DO#01-16)
41006	Output	1	Digital Output Register 2 - 16 bits (Bit 0-15 => DO#17-32)
41007	Output	2	Digital Output Register 3 - 16 bits (Bit 0-15 => DO#33-48)
41008	Output	3	Digital Output Register 4 - 16 bits (Bit 0-15 => DO#49-64)
41009	Output	4	Digital Output Register 5 - 16 bits (Bit 0-15 => DO#65-80)
41010	Output	5	Input for Channel #1
41011	Output	6	Input for Channel #2
41012	Output	7	Input for Channel #3
41013	Output	8	Input for Channel #4
41014	Output	9	Input for Channel #5
41015	Output	10	Input for Channel #6
41016	Output	11	Input for Channel #7
41017	Output	12	Input for Channel #8
41018	Output	13	Input for Channel #9
41019	Output	14	Input for Channel #10
41020	Output	15	Input for Channel #11
41021	Output	16	Input for Channel #12
41022	Output	17	Input for Channel #13
41023	Output	18	Input for Channel #14
41024	Output	19	Input for Channel #15
41025	Output	20	Input for Channel #16
41026	Output	21	Input for Channel #17
41027	Output	22	Input for Channel #18
41028	Output	23	Input for Channel #19
41029	Output	24	Input for Channel #20
41030	Output	25	Input for Channel #21
41031	Output	26	Input for Channel #22

Modbus Address	Table Type	Table Offset	Description
41032	Output	27	Input for Channel #23
41033	Output	28	Input for Channel #24
41034	Output	29	Input for Channel #25
41035	Output	30	Input for Channel #26
41036	Output	31	Input for Channel #27
41037	Output	32	Input for Channel #28
41038	Output	33	Input for Channel #29
41039	Output	34	Input for Channel #30
41040	Output	35	Input for Channel #31
41041	Output	36	Input for Channel #32
41042	Output	37	Input for Channel #33
41043	Output	38	Input for Channel #34
41044	Output	39	Input for Channel #35
41045	Output	40	Input for Channel #36
41046	Output	41	Input for Channel #37
41047	Output	42	Input for Channel #38
41048	Output	43	Input for Channel #39
41049	Output	44	Input for Channel #40
41050	Output	45	Input for Channel #41
41051	Output	46	Input for Channel #42
41052	Output	47	Input for Channel #43
41053	Output	48	Input for Channel #44
41054	Output	49	Input for Channel #45
41055	Output	50	Input for Channel #46
41056	Output	51	Input for Channel #47
41057	Output	52	Input for Channel #48
41058	Output	53	Input for Channel #49
41059	Output	54	Input for Channel #50

Modbus Address	Table Type	Table Offset	Description
41060	Output	55	Input for Channel #51
41061	Output	56	Input for Channel #52
41062	Output	57	Input for Channel #53
41063	Output	58	Input for Channel #54
41064	Output	59	Input for Channel #55
41065	Output	60	Input for Channel #56
41066	Output	61	Input for Channel #57
41067	Output	62	Input for Channel #58
41068	Output	63	Input for Channel #59
41069	Output	64	Input for Channel #60
41070	Output	65	Input for Channel #61
41071	Output	66	Input for Channel #62
41072	Output	67	Input for Channel #63
41073	Output	68	Input for Channel #64

13.10 Floating-Point Modbus Tables

The following table shows the complete default mapping of the floating point Modbus registers in the ESC Model 8816 Data Logger.

Modbus Address	Table Type	Table Offset	Description
40001	Address	0	Returns value configured in Modbus Address Table[0].
40002	Address	1	Returns value configured in Modbus Address Table[1].
40003	Address	2	Returns maximum Modbus register value.
40004	Address	3	Returns minimum Modbus register value.
40005	Input	0	Digital Input Register 1 - 16 bits (Bit 0-15 => DI#01-16)
40006	Input	1	Digital Input Register 2 - 16 bits (Bit 0-15 => DI#17-32)
40007	Input	2	Digital Input Register 3 - 16 bits (Bit 0-15 => DI#33-48)
40008	Input	3	Digital Input Register 4 - 16 bits (Bit 0-15 => DI#49-64)
40009	Input	4	Digital Input Register 5 - 16 bits (Bit 0-15 => DI#65-80)
40010	Input	5	Base Average (LSW) for Channel #1
40011	Input	6	Base Average (MSW) for Channel #1
40012	Input	7	Base Average (LSW) for Channel #2
40013	Input	8	Base Average (MSW) for Channel #2
40014	Input	9	Base Average (LSW) for Channel #3
40015	Input	10	Base Average (MSW) for Channel #3
40016	Input	11	Base Average (LSW) for Channel #4
40017	Input	12	Base Average (MSW) for Channel #4
40018	Input	13	Base Average (LSW) for Channel #5
40019	Input	14	Base Average (MSW) for Channel #5
40020	Input	15	Base Average (LSW) for Channel #6
40021	Input	16	Base Average (MSW) for Channel #6
40022	Input	17	Base Average (LSW) for Channel #7
40023	Input	18	Base Average (MSW) for Channel #7
40024	Input	19	Base Average (LSW) for Channel #8
40025	Input	20	Base Average (MSW) for Channel #8

Modbus Address	Table Type	Table Offset	Description
40026	Input	21	Base Average (LSW) for Channel #9
40027	Input	22	Base Average (MSW) for Channel #9
40028	Input	23	Base Average (LSW) for Channel #10
40029	Input	24	Base Average (MSW) for Channel #10
40030	Input	25	Base Average (LSW) for Channel #11
40031	Input	26	Base Average (MSW) for Channel #11
40032	Input	27	Base Average (LSW) for Channel #12
40033	Input	28	Base Average (MSW) for Channel #12
40034	Input	29	Base Average (LSW) for Channel #13
40035	Input	30	Base Average (MSW) for Channel #13
40036	Input	31	Base Average (LSW) for Channel #14
40037	Input	32	Base Average (MSW) for Channel #14
40038	Input	33	Base Average (LSW) for Channel #15
40039	Input	34	Base Average (MSW) for Channel #15
40040	Input	35	Base Average (LSW) for Channel #16
40041	Input	36	Base Average (MSW) for Channel #16
40042	Input	37	Base Average (LSW) for Channel #17
40043	Input	38	Base Average (MSW) for Channel #17
40044	Input	39	Base Average (LSW) for Channel #18
40045	Input	40	Base Average (MSW) for Channel #18
40046	Input	41	Base Average (LSW) for Channel #19
40047	Input	42	Base Average (MSW) for Channel #19
40048	Input	43	Base Average (LSW) for Channel #20
40049	Input	44	Base Average (MSW) for Channel #20
40050	Input	45	Base Average (LSW) for Channel #21
40051	Input	46	Base Average (MSW) for Channel #21
40052	Input	47	Base Average (LSW) for Channel #22
40053	Input	48	Base Average (MSW) for Channel #22

Modbus Address	Table Type	Table Offset	Description
40054	Input	49	Base Average (LSW) for Channel #23
40055	Input	50	Base Average (MSW) for Channel #23
40056	Input	51	Base Average (LSW) for Channel #24
40057	Input	52	Base Average (MSW) for Channel #24
40058	Input	53	Base Average (LSW) for Channel #25
40059	Input	54	Base Average (MSW) for Channel #25
40060	Input	55	Base Average (LSW) for Channel #26
40061	Input	56	Base Average (MSW) for Channel #26
40062	Input	57	Base Average (LSW) for Channel #27
40063	Input	58	Base Average (MSW) for Channel #27
40064	Input	59	Base Average (LSW) for Channel #28
40065	Input	60	Base Average (MSW) for Channel #28
40066	Input	61	Base Average (LSW) for Channel #29
40067	Input	62	Base Average (MSW) for Channel #29
40068	Input	63	Base Average (LSW) for Channel #30
40069	Input	64	Base Average (MSW) for Channel #30
40070	Input	65	Base Average (LSW) for Channel #31
40071	Input	66	Base Average (MSW) for Channel #31
40072	Input	67	Base Average (LSW) for Channel #32
40073	Input	68	Base Average (MSW) for Channel #32
40074	Input	69	Base Average (LSW) for Channel #33
40075	Input	70	Base Average (MSW) for Channel #33
40076	Input	71	Base Average (LSW) for Channel #34
40077	Input	72	Base Average (MSW) for Channel #34
40078	Input	73	Base Average (LSW) for Channel #35
40079	Input	74	Base Average (MSW) for Channel #35
40080	Input	75	Base Average (LSW) for Channel #36
40081	Input	76	Base Average (MSW) for Channel #36

Modbus Address	Table Type	Table Offset	Description
40082	Input	77	Base Average (LSW) for Channel #37
40083	Input	78	Base Average (MSW) for Channel #37
40084	Input	79	Base Average (LSW) for Channel #38
40085	Input	80	Base Average (MSW) for Channel #38
40086	Input	81	Base Average (LSW) for Channel #39
40087	Input	82	Base Average (MSW) for Channel #39
40088	Input	83	Base Average (LSW) for Channel #40
40089	Input	84	Base Average (MSW) for Channel #40
40090	Input	85	Base Average (LSW) for Channel #41
40091	Input	86	Base Average (MSW) for Channel #41
40092	Input	87	Base Average (LSW) for Channel #42
40093	Input	88	Base Average (MSW) for Channel #42
40094	Input	89	Base Average (LSW) for Channel #43
40095	Input	90	Base Average (MSW) for Channel #43
40096	Input	91	Base Average (LSW) for Channel #44
40097	Input	92	Base Average (MSW) for Channel #44
40098	Input	93	Base Average (LSW) for Channel #45
40099	Input	94	Base Average (MSW) for Channel #45
40100	Input	95	Base Average (LSW) for Channel #46
40101	Input	96	Base Average (MSW) for Channel #46
40102	Input	97	Base Average (LSW) for Channel #47
40103	Input	98	Base Average (MSW) for Channel #47
40104	Input	99	Base Average (LSW) for Channel #48
40105	Input	100	Base Average (MSW) for Channel #48
40106	Input	101	Base Average (LSW) for Channel #49
40107	Input	102	Base Average (MSW) for Channel #49
40108	Input	103	Base Average (LSW) for Channel #50
40109	Input	104	Base Average (MSW) for Channel #50

Modbus Address	Table Type	Table Offset	Description
40110	Input	105	Base Average (LSW) for Channel #51
40111	Input	106	Base Average (MSW) for Channel #51
40112	Input	107	Base Average (LSW) for Channel #52
40113	Input	108	Base Average (MSW) for Channel #52
40114	Input	109	Base Average (LSW) for Channel #53
40115	Input	110	Base Average (MSW) for Channel #53
40116	Input	111	Base Average (LSW) for Channel #54
40117	Input	112	Base Average (MSW) for Channel #54
40118	Input	113	Base Average (LSW) for Channel #55
40119	Input	114	Base Average (MSW) for Channel #55
40120	Input	115	Base Average (LSW) for Channel #56
40121	Input	116	Base Average (MSW) for Channel #56
40122	Input	117	Base Average (LSW) for Channel #57
40123	Input	118	Base Average (MSW) for Channel #57
40124	Input	119	Base Average (LSW) for Channel #58
40125	Input	120	Base Average (MSW) for Channel #58
40126	Input	121	Base Average (LSW) for Channel #59
40127	Input	122	Base Average (MSW) for Channel #59
40128	Input	123	Base Average (LSW) for Channel #60
40129	Input	124	Base Average (MSW) for Channel #60
40130	Input	125	Base Average (LSW) for Channel #61
40131	Input	126	Base Average (MSW) for Channel #61
40132	Input	127	Base Average (LSW) for Channel #62
40133	Input	128	Base Average (MSW) for Channel #62
40134	Input	129	Base Average (LSW) for Channel #63
40135	Input	130	Base Average (MSW) for Channel #63
40136	Input	131	Base Average (LSW) for Channel #64
40137	Input	132	Base Average (MSW) for Channel #64

Modbus Address	Table Type	Table Offset	Description
40138	Input	133	Base Average Status for Channel #1
40139	Input	134	Base Average Status for Channel #2
40140	Input	135	Base Average Status for Channel #3
40141	Input	136	Base Average Status for Channel #4
40142	Input	137	Base Average Status for Channel #5
40143	Input	138	Base Average Status for Channel #6
40144	Input	139	Base Average Status for Channel #7
40145	Input	140	Base Average Status for Channel #8
40146	Input	141	Base Average Status for Channel #9
40147	Input	142	Base Average Status for Channel #10
40148	Input	143	Base Average Status for Channel #11
40149	Input	144	Base Average Status for Channel #12
40150	Input	145	Base Average Status for Channel #13
40151	Input	146	Base Average Status for Channel #14
40152	Input	147	Base Average Status for Channel #15
40153	Input	148	Base Average Status for Channel #16
40154	Input	149	Base Average Status for Channel #17
40155	Input	150	Base Average Status for Channel #18
40156	Input	151	Base Average Status for Channel #19
40157	Input	152	Base Average Status for Channel #20
40158	Input	153	Base Average Status for Channel #21
40159	Input	154	Base Average Status for Channel #22
40160	Input	155	Base Average Status for Channel #23
40161	Input	156	Base Average Status for Channel #24
40162	Input	157	Base Average Status for Channel #25
40163	Input	158	Base Average Status for Channel #26
40164	Input	159	Base Average Status for Channel #27
40165	Input	160	Base Average Status for Channel #28

Modbus Address	Table Type	Table Offset	Description
40166	Input	161	Base Average Status for Channel #29
40167	Input	162	Base Average Status for Channel #30
40168	Input	163	Base Average Status for Channel #31
40169	Input	164	Base Average Status for Channel #32
40170	Input	165	Base Average Status for Channel #33
40171	Input	166	Base Average Status for Channel #34
40172	Input	167	Base Average Status for Channel #35
40173	Input	168	Base Average Status for Channel #36
40174	Input	169	Base Average Status for Channel #37
40175	Input	170	Base Average Status for Channel #38
40176	Input	171	Base Average Status for Channel #39
40177	Input	172	Base Average Status for Channel #40
40178	Input	173	Base Average Status for Channel #41
40179	Input	174	Base Average Status for Channel #42
40180	Input	175	Base Average Status for Channel #43
40181	Input	176	Base Average Status for Channel #44
40182	Input	177	Base Average Status for Channel #45
40183	Input	178	Base Average Status for Channel #46
40184	Input	179	Base Average Status for Channel #47
40185	Input	180	Base Average Status for Channel #48
40186	Input	181	Base Average Status for Channel #49
40187	Input	182	Base Average Status for Channel #50
40188	Input	183	Base Average Status for Channel #51
40189	Input	184	Base Average Status for Channel #52
40190	Input	185	Base Average Status for Channel #53
40191	Input	186	Base Average Status for Channel #54
40192	Input	187	Base Average Status for Channel #55
40193	Input	188	Base Average Status for Channel #56

Modbus Address	Table Type	Table Offset	Description
40194	Input	189	Base Average Status for Channel #57
40195	Input	190	Base Average Status for Channel #58
40196	Input	191	Base Average Status for Channel #59
40197	Input	192	Base Average Status for Channel #60
40198	Input	193	Base Average Status for Channel #61
40199	Input	194	Base Average Status for Channel #62
40200	Input	195	Base Average Status for Channel #63
40201	Input	196	Base Average Status for Channel #64
40202	Input	197	Extended Average 2 (LSW) for Channel #1
40203	Input	198	Extended Average 2 (MSW) for Channel #1
40204	Input	199	Extended Average 2 (LSW) for Channel #2
40205	Input	200	Extended Average 2 (MSW) for Channel #2
40206	Input	201	Extended Average 2 (LSW) for Channel #3
40207	Input	202	Extended Average 2 (MSW) for Channel #3
40208	Input	203	Extended Average 2 (LSW) for Channel #4
40209	Input	204	Extended Average 2 (MSW) for Channel #4
40210	Input	205	Extended Average 2 (LSW) for Channel #5
40211	Input	206	Extended Average 2 (MSW) for Channel #5
40212	Input	207	Extended Average 2 (LSW) for Channel #6
40213	Input	208	Extended Average 2 (MSW) for Channel #6
40214	Input	209	Extended Average 2 (LSW) for Channel #7
40215	Input	210	Extended Average 2 (MSW) for Channel #7
40216	Input	211	Extended Average 2 (LSW) for Channel #8
40217	Input	212	Extended Average 2 (MSW) for Channel #8
40218	Input	213	Extended Average 2 (LSW) for Channel #9
40219	Input	214	Extended Average 2 (MSW) for Channel #9
40220	Input	215	Extended Average 2 (LSW) for Channel #10
40221	Input	216	Extended Average 2 (MSW) for Channel #10

Modbus Address	Table Type	Table Offset	Description
40222	Input	217	Extended Average 2 (LSW) for Channel #11
40223	Input	218	Extended Average 2 (MSW) for Channel #11
40224	Input	219	Extended Average 2 (LSW) for Channel #12
40225	Input	220	Extended Average 2 (MSW) for Channel #12
40226	Input	221	Extended Average 2 (LSW) for Channel #13
40227	Input	222	Extended Average 2 (MSW) for Channel #13
40228	Input	223	Extended Average 2 (LSW) for Channel #14
40229	Input	224	Extended Average 2 (MSW) for Channel #14
40230	Input	225	Extended Average 2 (LSW) for Channel #15
40231	Input	226	Extended Average 2 (MSW) for Channel #15
40232	Input	227	Extended Average 2 (LSW) for Channel #16
40233	Input	228	Extended Average 2 (MSW) for Channel #16
40234	Input	229	Extended Average 2 (LSW) for Channel #17
40235	Input	230	Extended Average 2 (MSW) for Channel #17
40236	Input	231	Extended Average 2 (LSW) for Channel #18
40237	Input	232	Extended Average 2 (MSW) for Channel #18
40238	Input	233	Extended Average 2 (LSW) for Channel #19
40239	Input	234	Extended Average 2 (MSW) for Channel #19
40240	Input	235	Extended Average 2 (LSW) for Channel #20
40241	Input	236	Extended Average 2 (MSW) for Channel #20
40242	Input	237	Extended Average 2 (LSW) for Channel #21
40243	Input	238	Extended Average 2 (MSW) for Channel #21
40244	Input	239	Extended Average 2 (LSW) for Channel #22
40245	Input	240	Extended Average 2 (MSW) for Channel #22
40246	Input	241	Extended Average 2 (LSW) for Channel #23
40247	Input	242	Extended Average 2 (MSW) for Channel #23
40248	Input	243	Extended Average 2 (LSW) for Channel #24
40249	Input	244	Extended Average 2 (MSW) for Channel #24

Modbus Address	Table Type	Table Offset	Description
40250	Input	245	Extended Average 2 (LSW) for Channel #25
40251	Input	246	Extended Average 2 (MSW) for Channel #25
40252	Input	247	Extended Average 2 (LSW) for Channel #26
40253	Input	248	Extended Average 2 (MSW) for Channel #26
40254	Input	249	Extended Average 2 (LSW) for Channel #27
40255	Input	250	Extended Average 2 (MSW) for Channel #27
40256	Input	251	Extended Average 2 (LSW) for Channel #28
40257	Input	252	Extended Average 2 (MSW) for Channel #28
40258	Input	253	Extended Average 2 (LSW) for Channel #29
40259	Input	254	Extended Average 2 (MSW) for Channel #29
40260	Input	255	Extended Average 2 (LSW) for Channel #30
40261	Input	256	Extended Average 2 (MSW) for Channel #30
40262	Input	257	Extended Average 2 (LSW) for Channel #31
40263	Input	258	Extended Average 2 (MSW) for Channel #31
40264	Input	259	Extended Average 2 (LSW) for Channel #32
40265	Input	260	Extended Average 2 (MSW) for Channel #32
40266	Input	261	Extended Average 2 (LSW) for Channel #33
40267	Input	262	Extended Average 2 (MSW) for Channel #33
40268	Input	263	Extended Average 2 (LSW) for Channel #34
40269	Input	264	Extended Average 2 (MSW) for Channel #34
40270	Input	265	Extended Average 2 (LSW) for Channel #35
40271	Input	266	Extended Average 2 (MSW) for Channel #35
40272	Input	267	Extended Average 2 (LSW) for Channel #36
40273	Input	268	Extended Average 2 (MSW) for Channel #36
40274	Input	269	Extended Average 2 (LSW) for Channel #37
40275	Input	270	Extended Average 2 (MSW) for Channel #37
40276	Input	271	Extended Average 2 (LSW) for Channel #38
40277	Input	272	Extended Average 2 (MSW) for Channel #38

Modbus Address	Table Type	Table Offset	Description
40278	Input	273	Extended Average 2 (LSW) for Channel #39
40279	Input	274	Extended Average 2 (MSW) for Channel #39
40280	Input	275	Extended Average 2 (LSW) for Channel #40
40281	Input	276	Extended Average 2 (MSW) for Channel #40
40282	Input	277	Extended Average 2 (LSW) for Channel #41
40283	Input	278	Extended Average 2 (MSW) for Channel #41
40284	Input	279	Extended Average 2 (LSW) for Channel #42
40285	Input	280	Extended Average 2 (MSW) for Channel #42
40286	Input	281	Extended Average 2 (LSW) for Channel #43
40287	Input	282	Extended Average 2 (MSW) for Channel #43
40288	Input	283	Extended Average 2 (LSW) for Channel #44
40289	Input	284	Extended Average 2 (MSW) for Channel #44
40290	Input	285	Extended Average 2 (LSW) for Channel #45
40291	Input	286	Extended Average 2 (MSW) for Channel #45
40292	Input	287	Extended Average 2 (LSW) for Channel #46
40293	Input	288	Extended Average 2 (MSW) for Channel #46
40294	Input	289	Extended Average 2 (LSW) for Channel #47
40295	Input	290	Extended Average 2 (MSW) for Channel #47
40296	Input	291	Extended Average 2 (LSW) for Channel #48
40297	Input	292	Extended Average 2 (MSW) for Channel #48
40298	Input	293	Extended Average 2 (LSW) for Channel #49
40299	Input	294	Extended Average 2 (MSW) for Channel #49
40300	Input	295	Extended Average 2 (LSW) for Channel #50
40301	Input	296	Extended Average 2 (MSW) for Channel #50
40302	Input	297	Extended Average 2 (LSW) for Channel #51
40303	Input	298	Extended Average 2 (MSW) for Channel #51
40304	Input	299	Extended Average 2 (LSW) for Channel #52
40305	Input	300	Extended Average 2 (MSW) for Channel #52

Modbus Address	Table Type	Table Offset	Description
40306	Input	301	Extended Average 2 (LSW) for Channel #53
40307	Input	302	Extended Average 2 (MSW) for Channel #53
40308	Input	303	Extended Average 2 (LSW) for Channel #54
40309	Input	304	Extended Average 2 (MSW) for Channel #54
40310	Input	305	Extended Average 2 (LSW) for Channel #55
40311	Input	306	Extended Average 2 (MSW) for Channel #55
40312	Input	307	Extended Average 2 (LSW) for Channel #56
40313	Input	308	Extended Average 2 (MSW) for Channel #56
40314	Input	309	Extended Average 2 (LSW) for Channel #57
40315	Input	310	Extended Average 2 (MSW) for Channel #57
40316	Input	311	Extended Average 2 (LSW) for Channel #58
40317	Input	312	Extended Average 2 (MSW) for Channel #58
40318	Input	313	Extended Average 2 (LSW) for Channel #59
40319	Input	314	Extended Average 2 (MSW) for Channel #59
40320	Input	315	Extended Average 2 (LSW) for Channel #60
40321	Input	316	Extended Average 2 (MSW) for Channel #60
40322	Input	317	Extended Average 2 (LSW) for Channel #61
40323	Input	318	Extended Average 2 (MSW) for Channel #61
40324	Input	319	Extended Average 2 (LSW) for Channel #62
40325	Input	320	Extended Average 2 (MSW) for Channel #62
40326	Input	321	Extended Average 2 (LSW) for Channel #63
40327	Input	322	Extended Average 2 (MSW) for Channel #63
40328	Input	323	Extended Average 2 (LSW) for Channel #64
40329	Input	324	Extended Average 2 (MSW) for Channel #64
40330	Input	325	Extended Average 2 Status for Channel #1
40331	Input	326	Extended Average 2 Status for Channel #2
40332	Input	327	Extended Average 2 Status for Channel #3
40333	Input	328	Extended Average 2 Status for Channel #4

Modbus Address	Table Type	Table Offset	Description
40334	Input	329	Extended Average 2 Status for Channel #5
40335	Input	330	Extended Average 2 Status for Channel #6
40336	Input	331	Extended Average 2 Status for Channel #7
40337	Input	332	Extended Average 2 Status for Channel #8
40338	Input	333	Extended Average 2 Status for Channel #9
40339	Input	334	Extended Average 2 Status for Channel #10
40340	Input	335	Extended Average 2 Status for Channel #11
40341	Input	336	Extended Average 2 Status for Channel #12
40342	Input	337	Extended Average 2 Status for Channel #13
40343	Input	338	Extended Average 2 Status for Channel #14
40344	Input	339	Extended Average 2 Status for Channel #15
40345	Input	340	Extended Average 2 Status for Channel #16
40346	Input	341	Extended Average 2 Status for Channel #17
40347	Input	342	Extended Average 2 Status for Channel #18
40348	Input	343	Extended Average 2 Status for Channel #19
40349	Input	344	Extended Average 2 Status for Channel #20
40350	Input	345	Extended Average 2 Status for Channel #21
40351	Input	346	Extended Average 2 Status for Channel #22
40352	Input	347	Extended Average 2 Status for Channel #23
40353	Input	348	Extended Average 2 Status for Channel #24
40354	Input	349	Extended Average 2 Status for Channel #25
40355	Input	350	Extended Average 2 Status for Channel #26
40356	Input	351	Extended Average 2 Status for Channel #27
40357	Input	352	Extended Average 2 Status for Channel #28
40358	Input	353	Extended Average 2 Status for Channel #29
40359	Input	354	Extended Average 2 Status for Channel #30
40360	Input	355	Extended Average 2 Status for Channel #31
40361	Input	356	Extended Average 2 Status for Channel #32

Modbus Address	Table Type	Table Offset	Description
40362	Input	357	Extended Average 2 Status for Channel #33
40363	Input	358	Extended Average 2 Status for Channel #34
40364	Input	359	Extended Average 2 Status for Channel #35
40365	Input	360	Extended Average 2 Status for Channel #36
40366	Input	361	Extended Average 2 Status for Channel #37
40367	Input	362	Extended Average 2 Status for Channel #38
40368	Input	363	Extended Average 2 Status for Channel #39
40369	Input	364	Extended Average 2 Status for Channel #40
40370	Input	365	Extended Average 2 Status for Channel #41
40371	Input	366	Extended Average 2 Status for Channel #42
40372	Input	367	Extended Average 2 Status for Channel #43
40373	Input	368	Extended Average 2 Status for Channel #44
40374	Input	369	Extended Average 2 Status for Channel #45
40375	Input	370	Extended Average 2 Status for Channel #46
40376	Input	371	Extended Average 2 Status for Channel #47
40377	Input	372	Extended Average 2 Status for Channel #48
40378	Input	373	Extended Average 2 Status for Channel #49
40379	Input	374	Extended Average 2 Status for Channel #50
40380	Input	375	Extended Average 2 Status for Channel #51
40381	Input	376	Extended Average 2 Status for Channel #52
40382	Input	377	Extended Average 2 Status for Channel #53
40383	Input	378	Extended Average 2 Status for Channel #54
40384	Input	379	Extended Average 2 Status for Channel #55
40385	Input	380	Extended Average 2 Status for Channel #56
40386	Input	381	Extended Average 2 Status for Channel #57
40387	Input	382	Extended Average 2 Status for Channel #58
40388	Input	383	Extended Average 2 Status for Channel #59
40389	Input	384	Extended Average 2 Status for Channel #60

Modbus Address	Table Type	Table Offset	Description
40390	Input	385	Extended Average 2 Status for Channel #61
40391	Input	386	Extended Average 2 Status for Channel #62
40392	Input	387	Extended Average 2 Status for Channel #63
40393	Input	388	Extended Average 2 Status for Channel #64
40394	Input	389	Extended Average 1 (LSW) for Channel #1
40395	Input	390	Extended Average 1 (MSW) for Channel #1
40396	Input	391	Extended Average 1 (LSW) for Channel #2
40397	Input	392	Extended Average 1 (MSW) for Channel #2
40398	Input	393	Extended Average 1 (LSW) for Channel #3
40399	Input	394	Extended Average 1 (MSW) for Channel #3
40400	Input	395	Extended Average 1 (LSW) for Channel #4
40401	Input	396	Extended Average 1 (MSW) for Channel #4
40402	Input	397	Extended Average 1 (LSW) for Channel #5
40403	Input	398	Extended Average 1 (MSW) for Channel #5
40404	Input	399	Extended Average 1 (LSW) for Channel #6
40405	Input	400	Extended Average 1 (MSW) for Channel #6
40406	Input	401	Extended Average 1 (LSW) for Channel #7
40407	Input	402	Extended Average 1 (MSW) for Channel #7
40408	Input	403	Extended Average 1 (LSW) for Channel #8
40409	Input	404	Extended Average 1 (MSW) for Channel #8
40410	Input	405	Extended Average 1 (LSW) for Channel #9
40411	Input	406	Extended Average 1 (MSW) for Channel #9
40412	Input	407	Extended Average 1 (LSW) for Channel #10
40413	Input	408	Extended Average 1 (MSW) for Channel #10
40414	Input	409	Extended Average 1 (LSW) for Channel #11
40415	Input	410	Extended Average 1 (MSW) for Channel #11
40416	Input	411	Extended Average 1 (LSW) for Channel #12
40417	Input	412	Extended Average 1 (MSW) for Channel #12

Modbus Address	Table Type	Table Offset	Description
40418	Input	413	Extended Average 1 (LSW) for Channel #13
40419	Input	414	Extended Average 1 (MSW) for Channel #13
40420	Input	415	Extended Average 1 (LSW) for Channel #14
40421	Input	416	Extended Average 1 (MSW) for Channel #14
40422	Input	417	Extended Average 1 (LSW) for Channel #15
40423	Input	418	Extended Average 1 (MSW) for Channel #15
40424	Input	419	Extended Average 1 (LSW) for Channel #16
40425	Input	420	Extended Average 1 (MSW) for Channel #16
40426	Input	421	Extended Average 1 (LSW) for Channel #17
40427	Input	422	Extended Average 1 (MSW) for Channel #17
40428	Input	423	Extended Average 1 (LSW) for Channel #18
40429	Input	424	Extended Average 1 (MSW) for Channel #18
40430	Input	425	Extended Average 1 (LSW) for Channel #19
40431	Input	426	Extended Average 1 (MSW) for Channel #19
40432	Input	427	Extended Average 1 (LSW) for Channel #20
40433	Input	428	Extended Average 1 (MSW) for Channel #20
40434	Input	429	Extended Average 1 (LSW) for Channel #21
40435	Input	430	Extended Average 1 (MSW) for Channel #21
40436	Input	431	Extended Average 1 (LSW) for Channel #22
40437	Input	432	Extended Average 1 (MSW) for Channel #22
40438	Input	433	Extended Average 1 (LSW) for Channel #23
40439	Input	434	Extended Average 1 (MSW) for Channel #23
40440	Input	435	Extended Average 1 (LSW) for Channel #24
40441	Input	436	Extended Average 1 (MSW) for Channel #24
40442	Input	437	Extended Average 1 (LSW) for Channel #25
40443	Input	438	Extended Average 1 (MSW) for Channel #25
40444	Input	439	Extended Average 1 (LSW) for Channel #26
40445	Input	440	Extended Average 1 (MSW) for Channel #26

Modbus Address	Table Type	Table Offset	Description
40446	Input	441	Extended Average 1 (LSW) for Channel #27
40447	Input	442	Extended Average 1 (MSW) for Channel #27
40448	Input	443	Extended Average 1 (LSW) for Channel #28
40449	Input	444	Extended Average 1 (MSW) for Channel #28
40450	Input	445	Extended Average 1 (LSW) for Channel #29
40451	Input	446	Extended Average 1 (MSW) for Channel #29
40452	Input	447	Extended Average 1 (LSW) for Channel #30
40453	Input	448	Extended Average 1 (MSW) for Channel #30
40454	Input	449	Extended Average 1 (LSW) for Channel #31
40455	Input	450	Extended Average 1 (MSW) for Channel #31
40456	Input	451	Extended Average 1 (LSW) for Channel #32
40457	Input	452	Extended Average 1 (MSW) for Channel #32
40458	Input	453	Extended Average 1 (LSW) for Channel #33
40459	Input	454	Extended Average 1 (MSW) for Channel #33
40460	Input	455	Extended Average 1 (LSW) for Channel #34
40461	Input	456	Extended Average 1 (MSW) for Channel #34
40462	Input	457	Extended Average 1 (LSW) for Channel #35
40463	Input	458	Extended Average 1 (MSW) for Channel #35
40464	Input	459	Extended Average 1 (LSW) for Channel #36
40465	Input	460	Extended Average 1 (MSW) for Channel #36
40466	Input	461	Extended Average 1 (LSW) for Channel #37
40467	Input	462	Extended Average 1 (MSW) for Channel #37
40468	Input	463	Extended Average 1 (LSW) for Channel #38
40469	Input	464	Extended Average 1 (MSW) for Channel #38
40470	Input	465	Extended Average 1 (LSW) for Channel #39
40471	Input	466	Extended Average 1 (MSW) for Channel #39
40472	Input	467	Extended Average 1 (LSW) for Channel #40
40473	Input	468	Extended Average 1 (MSW) for Channel #40

Modbus Address	Table Type	Table Offset	Description
40474	Input	469	Extended Average 1 (LSW) for Channel #41
40475	Input	470	Extended Average 1 (MSW) for Channel #41
40476	Input	471	Extended Average 1 (LSW) for Channel #42
40477	Input	472	Extended Average 1 (MSW) for Channel #42
40478	Input	473	Extended Average 1 (LSW) for Channel #43
40479	Input	474	Extended Average 1 (MSW) for Channel #43
40480	Input	475	Extended Average 1 (LSW) for Channel #44
40481	Input	476	Extended Average 1 (MSW) for Channel #44
40482	Input	477	Extended Average 1 (LSW) for Channel #45
40483	Input	478	Extended Average 1 (MSW) for Channel #45
40484	Input	479	Extended Average 1 (LSW) for Channel #46
40485	Input	480	Extended Average 1 (MSW) for Channel #46
40486	Input	481	Extended Average 1 (LSW) for Channel #47
40487	Input	482	Extended Average 1 (MSW) for Channel #47
40488	Input	483	Extended Average 1 (LSW) for Channel #48
40489	Input	484	Extended Average 1 (MSW) for Channel #48
40490	Input	485	Extended Average 1 (LSW) for Channel #49
40491	Input	486	Extended Average 1 (MSW) for Channel #49
40492	Input	487	Extended Average 1 (LSW) for Channel #50
40493	Input	488	Extended Average 1 (MSW) for Channel #50
40494	Input	489	Extended Average 1 (LSW) for Channel #51
40495	Input	490	Extended Average 1 (MSW) for Channel #51
40496	Input	491	Extended Average 1 (LSW) for Channel #52
40497	Input	492	Extended Average 1 (MSW) for Channel #52
40498	Input	493	Extended Average 1 (LSW) for Channel #53
40499	Input	494	Extended Average 1 (MSW) for Channel #53
40500	Input	495	Extended Average 1 (LSW) for Channel #54
40501	Input	496	Extended Average 1 (MSW) for Channel #54

Modbus Address	Table Type	Table Offset	Description
40502	Input	497	Extended Average 1 (LSW) for Channel #55
40503	Input	498	Extended Average 1 (MSW) for Channel #55
40504	Input	499	Extended Average 1 (LSW) for Channel #56
40505	Input	500	Extended Average 1 (MSW) for Channel #56
40506	Input	501	Extended Average 1 (LSW) for Channel #57
40507	Input	502	Extended Average 1 (MSW) for Channel #57
40508	Input	503	Extended Average 1 (LSW) for Channel #58
40509	Input	504	Extended Average 1 (MSW) for Channel #58
40510	Input	505	Extended Average 1 (LSW) for Channel #59
40511	Input	506	Extended Average 1 (MSW) for Channel #59
40512	Input	507	Extended Average 1 (LSW) for Channel #60
40513	Input	508	Extended Average 1 (MSW) for Channel #60
40514	Input	509	Extended Average 1 (LSW) for Channel #61
40515	Input	510	Extended Average 1 (MSW) for Channel #61
40516	Input	511	Extended Average 1 (LSW) for Channel #62
40517	Input	512	Extended Average 1 (MSW) for Channel #62
40518	Input	513	Extended Average 1 (LSW) for Channel #63
40519	Input	514	Extended Average 1 (MSW) for Channel #63
40520	Input	515	Extended Average 1 (LSW) for Channel #64
40521	Input	516	Extended Average 1 (MSW) for Channel #64
40522	Input	517	Extended Average 1 Status for Channel #1
40523	Input	518	Extended Average 1 Status for Channel #2
40524	Input	519	Extended Average 1 Status for Channel #3
40525	Input	520	Extended Average 1 Status for Channel #4
40526	Input	521	Extended Average 1 Status for Channel #5
40527	Input	522	Extended Average 1 Status for Channel #6
40528	Input	523	Extended Average 1 Status for Channel #7
40529	Input	524	Extended Average 1 Status for Channel #8

Modbus Address	Table Type	Table Offset	Description
40530	Input	525	Extended Average 1 Status for Channel #9
40531	Input	526	Extended Average 1 Status for Channel #10
40532	Input	527	Extended Average 1 Status for Channel #11
40533	Input	528	Extended Average 1 Status for Channel #12
40534	Input	529	Extended Average 1 Status for Channel #13
40535	Input	530	Extended Average 1 Status for Channel #14
40536	Input	531	Extended Average 1 Status for Channel #15
40537	Input	532	Extended Average 1 Status for Channel #16
40538	Input	533	Extended Average 1 Status for Channel #17
40539	Input	534	Extended Average 1 Status for Channel #18
40540	Input	535	Extended Average 1 Status for Channel #19
40541	Input	536	Extended Average 1 Status for Channel #20
40542	Input	537	Extended Average 1 Status for Channel #21
40543	Input	538	Extended Average 1 Status for Channel #22
40544	Input	539	Extended Average 1 Status for Channel #23
40545	Input	540	Extended Average 1 Status for Channel #24
40546	Input	541	Extended Average 1 Status for Channel #25
40547	Input	542	Extended Average 1 Status for Channel #26
40548	Input	543	Extended Average 1 Status for Channel #27
40549	Input	544	Extended Average 1 Status for Channel #28
40550	Input	545	Extended Average 1 Status for Channel #29
40551	Input	546	Extended Average 1 Status for Channel #30
40552	Input	547	Extended Average 1 Status for Channel #31
40553	Input	548	Extended Average 1 Status for Channel #32
40554	Input	549	Extended Average 1 Status for Channel #33
40555	Input	550	Extended Average 1 Status for Channel #34
40556	Input	551	Extended Average 1 Status for Channel #35
40557	Input	552	Extended Average 1 Status for Channel #36

Modbus Address	Table Type	Table Offset	Description
40558	Input	553	Extended Average 1 Status for Channel #37
40559	Input	554	Extended Average 1 Status for Channel #38
40560	Input	555	Extended Average 1 Status for Channel #39
40561	Input	556	Extended Average 1 Status for Channel #40
40562	Input	557	Extended Average 1 Status for Channel #41
40563	Input	558	Extended Average 1 Status for Channel #42
40564	Input	559	Extended Average 1 Status for Channel #43
40565	Input	560	Extended Average 1 Status for Channel #44
40566	Input	561	Extended Average 1 Status for Channel #45
40567	Input	562	Extended Average 1 Status for Channel #46
40568	Input	563	Extended Average 1 Status for Channel #47
40569	Input	564	Extended Average 1 Status for Channel #48
40570	Input	565	Extended Average 1 Status for Channel #49
40571	Input	566	Extended Average 1 Status for Channel #50
40572	Input	567	Extended Average 1 Status for Channel #51
40573	Input	568	Extended Average 1 Status for Channel #52
40574	Input	569	Extended Average 1 Status for Channel #53
40575	Input	570	Extended Average 1 Status for Channel #54
40576	Input	571	Extended Average 1 Status for Channel #55
40577	Input	572	Extended Average 1 Status for Channel #56
40578	Input	573	Extended Average 1 Status for Channel #57
40579	Input	574	Extended Average 1 Status for Channel #58
40580	Input	575	Extended Average 1 Status for Channel #59
40581	Input	576	Extended Average 1 Status for Channel #60
40582	Input	577	Extended Average 1 Status for Channel #61
40583	Input	578	Extended Average 1 Status for Channel #62
40584	Input	579	Extended Average 1 Status for Channel #63
40585	Input	580	Extended Average 1 Status for Channel #64

Modbus Address	Table Type	Table Offset	Description
41005	Output	0	Digital Output Register 1 - 16 bits (Bit 0-15 => DO#01-16)
41006	Output	1	Digital Output Register 2 - 16 bits (Bit 0-15 => DO#17-32)
41007	Output	2	Digital Output Register 3 - 16 bits (Bit 0-15 => DO#33-48)
41008	Output	3	Digital Output Register 4 - 16 bits (Bit 0-15 => DO#49-64)
41009	Output	4	Digital Output Register 5 - 16 bits (Bit 0-15 => DO#65-80)
41010	Output	5	Input (LSW) for Channel #1
41011	Output	6	Input (MSW) for Channel #1
41012	Output	7	Input (LSW) for Channel #2
41013	Output	8	Input (MSW) for Channel #2
41014	Output	9	Input (LSW) for Channel #3
41015	Output	10	Input (MSW) for Channel #3
41016	Output	11	Input (LSW) for Channel #4
41017	Output	12	Input (MSW) for Channel #4
41018	Output	13	Input (LSW) for Channel #5
41019	Output	14	Input (MSW) for Channel #5
41020	Output	15	Input (LSW) for Channel #6
41021	Output	16	Input (MSW) for Channel #6
41022	Output	17	Input (LSW) for Channel #7
41023	Output	18	Input (MSW) for Channel #7
41024	Output	19	Input (LSW) for Channel #8
41025	Output	20	Input (MSW) for Channel #8
41026	Output	21	Input (LSW) for Channel #9
41027	Output	22	Input (MSW) for Channel #9
41028	Output	23	Input (LSW) for Channel #10
41029	Output	24	Input (MSW) for Channel #10
41030	Output	25	Input (LSW) for Channel #11
41031	Output	26	Input (MSW) for Channel #11
41032	Output	27	Input (LSW) for Channel #12

Modbus Address	Table Type	Table Offset	Description
41033	Output	28	Input (MSW) for Channel #12
41034	Output	29	Input (LSW) for Channel #13
41035	Output	30	Input (MSW) for Channel #13
41036	Output	31	Input (LSW) for Channel #14
41037	Output	32	Input (MSW) for Channel #14
41038	Output	33	Input (LSW) for Channel #15
41039	Output	34	Input (MSW) for Channel #15
41040	Output	35	Input (LSW) for Channel #16
41041	Output	36	Input (MSW) for Channel #16
41042	Output	37	Input (LSW) for Channel #17
41043	Output	38	Input (MSW) for Channel #17
41044	Output	39	Input (LSW) for Channel #18
41045	Output	40	Input (MSW) for Channel #18
41046	Output	41	Input (LSW) for Channel #19
41047	Output	42	Input (MSW) for Channel #19
41048	Output	43	Input (LSW) for Channel #20
41049	Output	44	Input (MSW) for Channel #20
41050	Output	45	Input (LSW) for Channel #21
41051	Output	46	Input (MSW) for Channel #21
41052	Output	47	Input (LSW) for Channel #22
41053	Output	48	Input (MSW) for Channel #22
41054	Output	49	Input (LSW) for Channel #23
41055	Output	50	Input (MSW) for Channel #23
41056	Output	51	Input (LSW) for Channel #24
41057	Output	52	Input (MSW) for Channel #24
41058	Output	53	Input (LSW) for Channel #25
41059	Output	54	Input (MSW) for Channel #25
41060	Output	55	Input (LSW) for Channel #26

Modbus Address	Table Type	Table Offset	Description
41061	Output	56	Input (MSW) for Channel #26
41062	Output	57	Input (LSW) for Channel #27
41063	Output	58	Input (MSW) for Channel #27
41064	Output	59	Input (LSW) for Channel #28
41065	Output	60	Input (MSW) for Channel #28
41066	Output	61	Input (LSW) for Channel #29
41067	Output	62	Input (MSW) for Channel #29
41068	Output	63	Input (LSW) for Channel #30
41069	Output	64	Input (MSW) for Channel #30
41070	Output	65	Input (LSW) for Channel #31
41071	Output	66	Input (MSW) for Channel #31
41072	Output	67	Input (LSW) for Channel #32
41073	Output	68	Input (MSW) for Channel #32
41074	Output	69	Input (LSW) for Channel #33
41075	Output	70	Input (MSW) for Channel #33
41076	Output	71	Input (LSW) for Channel #34
41077	Output	72	Input (MSW) for Channel #34
41078	Output	73	Input (LSW) for Channel #35
41079	Output	74	Input (MSW) for Channel #35
41080	Output	75	Input (LSW) for Channel #36
41081	Output	76	Input (MSW) for Channel #36
41082	Output	77	Input (LSW) for Channel #37
41083	Output	78	Input (MSW) for Channel #37
41084	Output	79	Input (LSW) for Channel #38
41085	Output	80	Input (MSW) for Channel #38
41086	Output	81	Input (LSW) for Channel #39
41087	Output	82	Input (MSW) for Channel #39
41088	Output	83	Input (LSW) for Channel #40

Modbus Address	Table Type	Table Offset	Description
41089	Output	84	Input (MSW) for Channel #40
41090	Output	85	Input (LSW) for Channel #41
41091	Output	86	Input (MSW) for Channel #41
41092	Output	87	Input (LSW) for Channel #42
41093	Output	88	Input (MSW) for Channel #42
41094	Output	89	Input (LSW) for Channel #43
41095	Output	90	Input (MSW) for Channel #43
41096	Output	91	Input (LSW) for Channel #44
41097	Output	92	Input (MSW) for Channel #44
41098	Output	93	Input (LSW) for Channel #45
41099	Output	94	Input (MSW) for Channel #45
41100	Output	95	Input (LSW) for Channel #46
41101	Output	96	Input (MSW) for Channel #46
41102	Output	97	Input (LSW) for Channel #47
41103	Output	98	Input (MSW) for Channel #47
41104	Output	99	Input (LSW) for Channel #48
41105	Output	100	Input (MSW) for Channel #48
41106	Output	101	Input (LSW) for Channel #49
41107	Output	102	Input (MSW) for Channel #49
41108	Output	103	Input (LSW) for Channel #50
41109	Output	104	Input (MSW) for Channel #50
41110	Output	105	Input (LSW) for Channel #51
41111	Output	106	Input (MSW) for Channel #51
41112	Output	107	Input (LSW) for Channel #52
41113	Output	108	Input (MSW) for Channel #52
41114	Output	109	Input (LSW) for Channel #53
41115	Output	110	Input (MSW) for Channel #53
41116	Output	111	Input (LSW) for Channel #54

Modbus Address	Table Type	Table Offset	Description
41117	Output	112	Input (MSW) for Channel #54
41118	Output	113	Input (LSW) for Channel #55
41119	Output	114	Input (MSW) for Channel #55
41120	Output	115	Input (LSW) for Channel #56
41121	Output	116	Input (MSW) for Channel #56
41122	Output	117	Input (LSW) for Channel #57
41123	Output	118	Input (MSW) for Channel #57
41124	Output	119	Input (LSW) for Channel #58
41125	Output	120	Input (MSW) for Channel #58
41126	Output	121	Input (LSW) for Channel #59
41127	Output	122	Input (MSW) for Channel #59
41128	Output	123	Input (LSW) for Channel #60
41129	Output	124	Input (MSW) for Channel #60
41130	Output	125	Input (LSW) for Channel #61
41131	Output	126	Input (MSW) for Channel #61
41132	Output	127	Input (LSW) for Channel #62
41133	Output	128	Input (MSW) for Channel #62
41134	Output	129	Input (LSW) for Channel #63
41135	Output	130	Input (MSW) for Channel #63
41136	Output	131	Input (LSW) for Channel #64
41137	Output	132	Input (MSW) for Channel #64

Chapter 14
Application Note - Stream-Switched Channel

This approach to configuring a stream-switching system supports both switching and non-switching modes, selected via an external switch contact.

Stream-switching (or time-sharing) is normally controlled by digital event programs. These programs switch a specified output or outputs starting at a specified time and repeating at a specified time interval. The ESC Model 8816 also supports digital programs that are triggered by digital inputs, rather than on a timed basis. The system example herein uses a combination of these.

It is important to note that the ESC Model 8816 supports pseudo-digital outputs and inputs. These are input/output line numbers that extend beyond what the logger physically possesses. These pseudo-inputs/outputs are considered to be wired back to each other via software. That is, if a logger has 24 digital inputs and 24 digital outputs, then digital outputs 25-88 and digital inputs 25-88 are pseudo digital points. Digital output #25 is considered to be wired back to digital input #25, and so on.

14.1 Assumptions

This example assumes three boilers with the system normally monitoring one boiler at a time. During startup and shutdown periods, the system may have to switch between two boilers. The system is not required to switch between all three systems at the same time. In this scenario, there are six cases to consider:

1. Only Boiler #1 is monitored.
2. Only Boiler #2 is monitored.
3. Only Boiler #3 is monitored.
4. Boilers 1 & 2 are monitored.
5. Boilers 2 & 3 are monitored.
6. Boilers 3 & 1 are monitored.

Also assumed is that three digital inputs (01, 02, 03) are used to indicate that the system should be monitoring Boiler #1, #2, or #3, respectively. The system has an additional input (04) to indicate that stream-switching should take place. When digital input 04 is closed, digital inputs 01 through 03 have the following meaning:

DI 01	=	Switch between Boiler #1 and Boiler #2
DI 02	=	Switch between Boiler #2 and Boiler #3
DI 03	=	Switch between Boiler #3 and Boiler #1

14.2 Configuration

The system is configured with the digital event programs shown below.

TIMEDEP Timed digital event program that turns on pseudo-digital output/input #25.

The next three programs, all digital-input triggered, handle the case where time-sharing (signified by DI #04) is off.

SAMPLE1 When DI #01 is on and DI #04 is off, switch the lines appropriate to sampling Boiler #1.

SAMPLE2 When DI #02 is on and DI #04 is off, switch the lines appropriate to sampling Boiler #2.

SAMPLE3 When DI #03 is on and DI #04 is off, switch the lines appropriate to sampling Boiler #3.

Example of configuration screen for SAMPLE3 case.

```
ESC Model 8816 v5.xx  ID:??       Config. Dig.Event Program       04/06/03 10:24:36

    Dig. Event Program Name     :  SAMPLE3
    Trigger DI Pattern          :  3&4=0
    Output Line(s)              :  8,12,14,
    Output Duration             :  6m
    Disable During Cal(s)       :  (none)


    FINISHED (Configure Now)

  CTRL-O = Config Relay Outputs
```

The next six digital event programs, all digital-input triggered, handle the case where time-sharing is active (DI #04 is on) and the system is sampling either the first boiler listed (DI #25 is off) or the second boiler listed (DI #25 is on).

SWITCH1A When DI #01 and #04 are on, and DI #25 is off, switch the lines appropriate to sampling Boiler #1.

SWITCH2A When DI #02 and #04 are on, and DI #25 is off, switch the lines appropriate to sampling Boiler #2.

SWITCH3A When DI #03 and #04 are on, and DI #25 is off, switch the lines appropriate to sampling Boiler #3.

SWITCH2B When DI #01 and #04 and #25 are all on, switch the lines appropriate to sampling Boiler #2.

SWITCH3B When DI #02 and #04 and #25 are all on, switch the lines appropriate to sampling Boiler #3.

SWITCH1B When DI #03 and #04 and #25 are all on, switch the lines appropriate to sampling Boiler #1.

Example of configuration for SWITCH3B case.

```
ESC Model 8816 v5.xx  ID:??       Config. Dig.Event Program        04/06/03 10:30:06

    Dig. Event Program Name     :  SWITCH3B
    Trigger DI Pattern          :  2&4&25
    Output Line(s)              :  8,12,14,
    Output Duration             :  6m
    Disable During Cal(s)       :  (none)


    FINISHED (Configure Now)

  CTRL-O = Config Relay Outputs
```

Thus, nine digital event programs define the nine possible states in the system. These programs can switch on additional pseudo-points to inform the acquisition programs which channels are active, or physical limit switches from the valves can be used.

Chapter 15 Application Note - Standby Mode

Some configurations require the system to monitor for failure conditions (digital inputs, analog value alarms) and enter a standby mode when a failure is detected. This standby mode typically requires several digital outputs to be turned on or off, and for all other normal operations, such as calibrations and purges, to cease.

For this example, a rather complex system of stream-switching is used, one which monitors two sample points with one set of instruments. The failure conditions can be tied to a particular probe or to the instruments themselves. However, the assumption is that a failure on one probe puts the entire system into standby mode, shutting down sampling of both streams.

15.1 I/O Specifics

The following table lists the digital outputs in the system and their expected state in various operating modes:

Functions	DL Relays	Pt. A Measure	Pt. B Measure	Probe Cal	Purge	Standby
Ext Pump #2	1	1	1	1	0	0
Control Air #1 (SV3)	2	X	X	1	1	1
Purge Probe #1 (SV4)	3	X	X	X	1 (0-15s)	X
Control Air #2 (SV5)	4	X	X	1	1	1
Purge Probe #2 (SV6)	5	X	X	X	1 (15-30s)	X
Heated Valve #1 (SV8)	6	1	0	1	0	0
Heated Valve #2 (SV9)	7	0	1	1	0	0
Span Gas #3 (SV10)	8	X	X	1 (10-15m)	X	X
CSS +15VDC	9	1	1	1	1	1
CSS Measure Mode / CSS Control External	10	0	0	0	1	1
Span Gas #1 (SV1)	11	X	X	1 (0-5m)	X	X
	12	X	X	X	1	X
	13	0	0	0	0	1

Functions	DL Relays	Pt. A Measure	Pt. B Measure	Probe Cal	Purge	Standby
CSS Pump #1	14	1	1	1	0	0
Span Gas #2	15	X	X	1 (5-10m)	X	X
	16	0	1	X	X	X

15.2 Failure Conditions

The failure inputs are defined as follows:

At any time: DI#10, #12

While sampling A: DI#04, #01

While sampling B: DI#05, #02

15.3 Approach

Assume a pseudo digital output/input pair called P1 identifies which stream is being sampled. P1=0 when sampling stream A and p1=1 when sampling stream B.

The "default" state of the system is to monitor stream A. Sampling on stream B is controlled by a digital program called SAMPLEB, which switches P1 on, as well as any physical relays necessary to control stream-switching.

The probe calibration is controlled by a calibration program called PROBECAL. The purge is controlled by a digital event program called PURGE.

Now to define which relay outputs are normally open (NO) and which contacts are normally closed (NC): For the most part, the state of the relay during the stream A measurement (the "default" state) defines whether the contact is NO or NC. For those points listed as "X", the default setting is generally the opposite of the state specified in any calibration, purge, or standby mode. Thus:

Digital Output	Physical Relay	Status
DO#01	Ext Pump 2	NC
DO#02	Control Air 1	NO (could go either way)
DO#03	Purge Probe 1	NO (could go either way, but name implies NO)
DO#04	Control Air 2	NO (could go either way)
DO#05	Purge Probe 2	NO (could go either way, but name implies NO)
DO#06	Heated Valve 1	C (on when stream A)
DO#07	Heated Valve 2	O (off when stream A)

Digital Output	Physical Relay	Status
DO#08	Span Gas 3	NC (could go either way, but name implies NO)
DO#09	CSS +15VDC	NC
DO#10	CSS Measure Mode	NO
DO#11	Span Gas 1	NC (could go either way, but name implies NO)
DO#12	???	NO
DO#13	???	NO
DO#14	CSS Pump 2	NC
DO#15	Span Gas 2	NC (could go either way, but name implies NO)
DO#16	???	NO

NOTE: The ESC Model 8816 simply "activates" digital outputs referenced in calibrations. Whether the relay opens or closes depends on the NO/NC setting. For example, the pump lines are NC. They are activated by the PURGE and STANDBY programs, which open the relays.

15.4 Timed Digital Event Programs

Thus, the SAMPLEB and PURGE digital event programs activate the following lines:

SAMPLEB: DO#06, 07, 16 (start, duration, interval depend on user's requirements)

PURGE1: DO#01, 03, 06, 10, 13, 14 (duration = 15s)

PURGE2: DO#01, 05, 06, 10, 13, 14 (starts 15s after PURGE1 starts, duration = 15s)

These can be simple timed digital event programs.

15.5 Calibrations

The PROBECAL calibration program must have DO#04 and #07 referenced in each phase, and the span gas lines (08, 11, 15) referenced in the appropriate phases of the calibration.

15.6 Standby Mode

The standby mode must activate the following output lines: DO#01, 02, 04, 06, 10, 13, 14. The trigger for the standby mode is one of several digital inputs (see above).

There are two approaches to this.

- The first is to let the failure digital inputs flag the data and let an alarm look for these flags and flag the data. The Ignore State Changes feature of the average alarm configuration could be used to inhibit going into standby on a probe 1 failure while sampling on probe 2. Alarm programs only perform their checks at the smallest averaging interval—generally one minute—which may not be fast enough.
- A second approach is to use digitally triggered digital event programs, which allows near instantaneous triggering of the standby mode. However, this approach is a little more complex because one event program must be configured for every possible digital input trigger condition. The output duration should be set to the shortest possible time (5s).

Name	Trigger DI	Output Lines	Duration
STBY10	10=1	01,02,04,06,10,13,14	5s
STBY12	12=1	01,02,04,06,10,13,14	5s

For failure inputs that should only be examined when the appropriate probe is in use, take advantage of the ANDing performed when multiple digital inputs are defined as the triggering condition. (Recall that pseudo digital input P1 signals which stream is being sampled.)

Name	Trigger DI	Output Lines	Duration
STBY01	01=1,P1=0	01,02,04,06,10,13,14	5s
STBY02	02=1,P1=1	01,02,04,06,10,13,14	5s
STBY04	04=1,P1=0	01,02,04,06,10,13,14	5s
STBY05	05=1,P1=1	01,02,04,06,10,13,14	5s

NOTE: The reference to P1 should not be directly typed into the configuration as "P1." An actual number must be typed in. See page 2-3 "Pseudo Digital Input/Output Lines."

15.7 Lockout

A lockout method is needed to ensure that the system does not try to perform a stream-switch, purge, or calibration while in standby mode. In addition, the system should not switch or purge while in calibration.

The latter requirement is easy to achieve. All digital event programs have a *Disable During Calibration(s)* feature that prevents the program from running while specified calibrations are in progress. By setting the MEASUREB and PURGE programs to be disabled during PROBECAL, the latter lockout is in place.

The former requirement is more difficult. The MEASUREB and PURGE event programs and the PROBECAL calibration must be locked out while in standby mode. Only another calibration could lockout both event programs and calibrations.

Therefore, another calibration program, STBYCAL, must be configured. This calibration is a single-phase, instrument-controlled calibration program, and it must share at least one affected parameter with

PROBECAL. That ensures that PROBECAL and STBYCAL lock each other out. By also adding STBYCAL to the *Disable During Calibration(s)* list of MEASUREB and PROBECAL, those programs are locked out while in standby mode.

The last step is to link STBYCAL with the standby mode. This is done by adding one more digital output (pseudo) to all the STBYxx digitally triggered digital event programs. This pseudo DO is linked to a pseudo digital input. This pseudo DI is the input line pattern for the STBYCAL calibration program.

Thus, to review the final configuration:

Timed Digital Event Programs

Name	Start Time	Output Lines
SAMPLEB	???	06,07,16
PURGE1	???	01,03,06,10,13,14
PURGE2	Purge1+15s	01,05,06,10,13,14

(All three are disabled during PROBECAL, STBYCAL.)

DI-Triggered Digital Event Programs

Name	Trigger DI Pattern	Output Lines	Output Duration
STBY10	10=1	01,02,04,06,10,13,14,P2	5s
STBY12	12=1	01,02,04,06,10,13,14,P2	5s
STBY01	01=1,P1=0	01,02,04,06,10,13,14,P2	5s
STBY02	02=1,P1=1	01,02,04,06,10,13,14,P2	5s
STBY04	04=1,P1=0	01,02,04,06,10,13,14,P2	5s
STBY05	05=1,P1=1	01,02,04,06,10,13,14,P2	5s

Calibrations

Name	Description
PROBECAL:	Normal automatic calibration program.
STBYCAL:	Instrument-controlled, one-phase, shares at least one affected parameter with PROBECAL, input pattern is P2=1.

Chapter 16 Troubleshooting

Problem	*Solution*
Display does not light up.	Check 120 VAC power, power cord connection, fuse. Test points on power supply: T1 to T2 120 VAC T8 to T14 5 volts T11 to T12 15 volts T13 to T12 -15 volts T6 to T14 12 volts Check CN6 ribbon connector; red stripe should be towards CPU (U1).
Speckle pattern or bars on LCD.	Bad LCD controller. Call ESC Technical Support.
Main menu does not appear; text messages on LCD.	Record text messages and call ESC Technical Support.
Main menu appears; no response from external keyboard.	Check keyboard connection. Does NUM LOCK/CAPS LOCK light up on keyboard? Swap with spare keyboard. If second keyboard fails, call ESC Technical Support. If oscilloscope with capture is available, test for low to high transition on T23 on main board when key is pressed.
Keypad on front panel does not work.	If oscilloscope with capture is available, test for low to high transition on T22 when key is pressed. Call ESC Technical Support.
Main menu appears and keyboard works but “out of memory“ message appears.	Check System Information in *Status Menu*. If heap memory is low, perform a warm restart (described below). If configuration memory or data storage blocks are low, delete unnecessary channels or calibrations.
ESC Model 8816 appears “hung.”	Perform a warm restart (see below).

16.1 Warm Restart

While running or during power-up, simultaneously press the blue key, orange key, and the left arrow/delete key on the front panel keypad.

A warm restart forces a complete restart of the tasks and deallocation of any unused heap space. This is <u>not</u> true for a normal power failure—a normal power failure causes the ESC Model 8816 to restore the <u>exact</u> state it was in when power failed.

In either case (normal power outage or warm restart), the ESC Model 8816 updates its internal clock from the battery-backed clock, aborts all calibrations and digital event programs, and reschedules all calibrations and event programs.

16.2 Cold Start

A "cold start" erases all configuration information as well as all stored data in the ESC Model 8816 and resets the interval clock to its default value. Thus, the logger must be downloaded again after a cold start.

To cold start the ESC Model 8816:

1. Turn off the AC power, remove the top panel and locate SW1 (next to the lithium button battery).
2. Hold down SW1 (the red push button near the CPU) for approximately 1 minute.
3. Replace the top panel and restore AC power.
4. Configure the logger for the correct 2-digit ID code and the correct baud rate on the port to be used to download tables if these are not set in EEPROM.

16.3 ESC Technical Support

When calling ESC at 865-688-7900, please have the following information on hand:

- For a hardware problem or failure, please have the unit serial number available. When calling, ask for Data Logger Hardware Repair.
- For a software problem, please write down the information shown in the *System Information* screen (refer to page 11-7 "System Information"), particularly the software version number and memory levels. Also, if the Supervisor password is known, log into the data logger at Supervisor level and type CTRL-L. This will display a log of potentially suspicious events and may be of help to the ESC staff in identifying the problem. When calling, ask for Data Logger Software Support.

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