

Model K34C

Comparison Furnace
Operation and Maintenance Manual

by
Pond Engineering Laboratories, Inc.
2401 South Larimer County Road 21
Berthoud, Colorado 80513
(303)651-1678
www.pondengineering.com

1. BACKGROUND..... 3

2. GENERAL INFORMATION AND OPERATING PROCEDURES	3
3. SYSTEM CONTROLLER.....	4
3.1. NORMAL OPERATING MODE.....	5
3.2. THE COMMAND FUNCTIONS	5
3.2.1. <i>Change Setpoint Temperature</i>	5
3.2.2. <i>Adjust System Variables</i>	6
3.2.2.1. Adjust Memory Setpoint Temperatures	7
3.2.2.2. Adjust Alarm Temperature	7
3.2.2.3. Adjust GPIB Address	8
3.2.2.4. Calibrate Sensors	8
3.2.2.4.1. Calibration of Core Temperature	9
3.2.2.5. Access Vars Array	10
3.2.2.6. Save changes to Variables	12
3.2.2.7. Diagnostics Display Mode Select	13
4. OPERATING THE TEMPERATURE CALIBRATION FURNACE USING REMOTE INTERFACE COMMANDS.....	14
4.2. COMPARISON FURNACE COMMAND SET	14
4.2.1. <i>Read System Variable</i>	15
4.2.2. <i>Write System Variable</i>	15
4.2.3 <i>Remote Mode</i>	16
4.2.4 <i>External Feedback Control Variables</i>	16
5. SYSTEM HARDWARE DESCRIPTION.....	17
5.1. FRONT PANEL	17
5.2. ELECTRONICS CHASSIS/ BACK PANEL	18
6. CALIBRATION RECORD.....	19

Comparison Furnace System

1. Background

This report documents the operation and maintenance procedures for the Comparison Furnace system, Pond Engineering Model Number K34C.

Information contained in this manual is considered by Pond Engineering Laboratories to be proprietary and is provided for use exclusively by the purchaser for instructional and maintenance purposes relative to the hardware delivered, any other use is prohibited.

2. General Information and Operating Procedures

Figure 1, shows the general configuration of the Comparison Furnace system and provides the reader a better visualization of its appearance, as well as a point of reference in location and use of the control switches and service points discussed later in this manual.

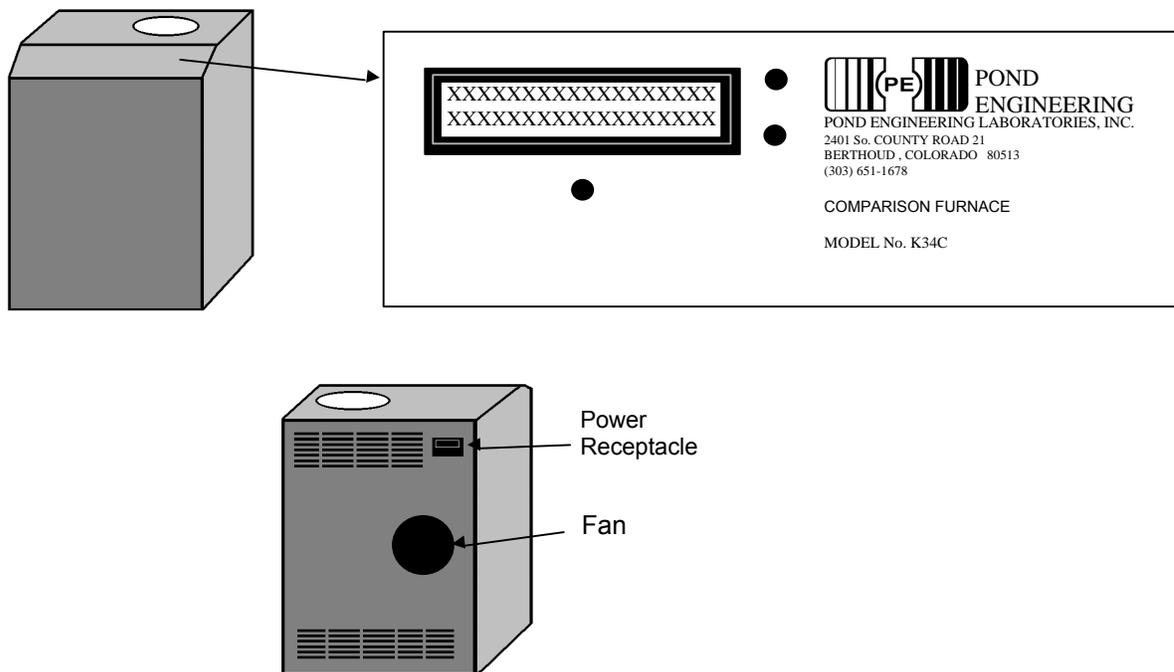


Figure 1 - System General Layout

As shown in Figure 1, the controller front panel is located on the sloping front surface of the Comparison Furnace. The Comparison Furnace is designed to calibrate thermometers within the range of 90-680 degrees C. Up to seven thermometers can be calibrated in the furnace through 0.333 inch holes in the bezel located on the top surface.

Optional features include an IEEE-488 or RS-232 interface and a comparison core. An IEEE-488 or RS-232 interface can be installed at the factory to allow operation of the Comparison

Furnace system as part of an integrated automatic calibration system. Custom software can be purchased from Pond Engineering for IEEE-488 control of the Comparison Furnace.

Interior access to the system cabinet is provided by a removable back panel attached to the frame by button head screws. **CAUTION: High voltage is present inside the furnace cabinet even when the power switch is in the off position.**

Operator interface is provided by three front panel switches and a 2 line by 24 character Liquid Crystal Display (LCD) located in the front panel of the Metrology Furnace system as shown in Figure 2.

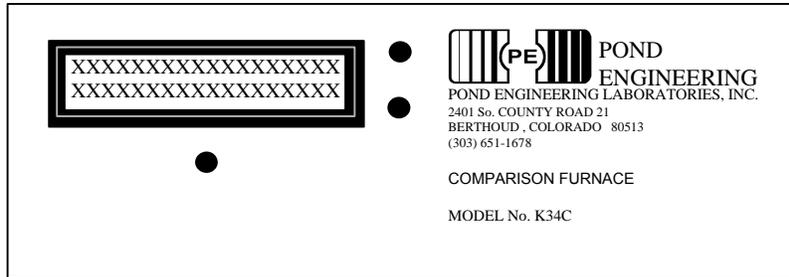


Figure 2 - Front Panel Layout

In the normal operating mode, this display presents the current temperature setpoint for the controller and the measured core temperature on the first and second lines of the display, respectively. Measurements are taken at approximately 3 second intervals and the lower line of the display is updated following measurement, indicating the measured core temperature. Additional controller functions (for the purpose of providing diagnostic information, sensor calibration etc.) are accessed through the use of the front panel switches and messages presented by the LCD display as outlined in the following sections.

3. System Controller

In an effort to provide simplicity, while maintaining flexibility to accommodate optional features, the operator interface is based largely on user interactive software control. The software provides prompts to the user through a set of "COMMAND FUNCTIONS", including "ADJUST SETPOINT TEMPERATURE", and "ADJUST SYSTEM VARIABLES". In a user-interactive manner, the software displays messages on the LCD prompting the user as necessary to perform all command functions through the use of the three front panel switches surrounding the LCD. An outline of the user interface is provided in the following text and figures, providing a detailed description of the prompts and user actions necessary to set up the system, edit configurations and operate the system manually.

Because of the multitude of functions which each switch will be called upon to perform, all "labeling" of the switches is provided by the system software and presented to the user via the LCD display. (The labels attached to the switches in Figure 3 are for the benefit of the reader in understanding the documentation herein. Such labels do not appear on the device front panel.)

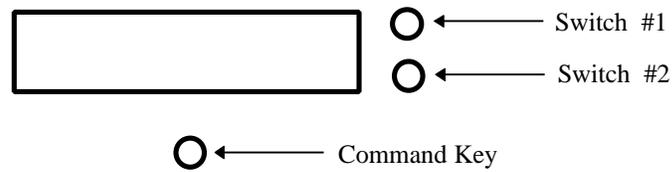


Figure 3 - Front Panel Switch Layout

3.1. Normal Operating Mode

In normal operation, the Comparison Furnace controller will continuously display the current temperature setpoint for the controller and the measured core temperature on the first and second lines of the display, as shown in Figure 4. Measurements are taken at approximately 3 second intervals and the lower line of the display is updated following measurement. This information is removed from the display when the user presses and holds the Command Key for a period of 2 to 3 seconds which allows entry to the “COMMAND FUNCTIONS” portion of the program.

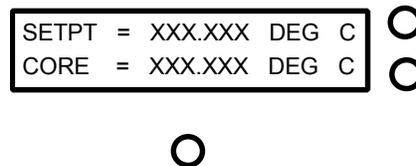


Figure 4 - Normal Operating Mode Display

3.2. The Command Functions

In order to perform the many functions necessary for operation, the user must leave the normal operating mode and enter the COMMAND FUNCTIONS mode. To do this, the user should depress and hold the Command Key. As the key is pressed, the words COMMAND FUNCTIONS will be immediately displayed on the lower line of the display and if the key is released the normal operation screen will again be displayed and normal operation will continue. In order to proceed to COMMAND FUNCTIONS the operator should press and hold the Command Key until the words COMMAND FUNCTIONS disappear (approximately three seconds) and then release the key.

****Note:** The system has been designed such that control functions operate normally even when the user is accessing the command functions.

3.2.1. Change Setpoint Temperature

The first command function accessed is CHANGE SETPOINT TEMPERATURE. This function is provided to allow the user to change the setpoint to one of three user adjustable memory setpoint temperatures or manually adjust the Setpoint Temperature. The three memory setpoint temperatures allow the user to customize their system by programming the memory setpoints to the three most frequently used setpoint temperatures. The memory setpoints are provided to allow the user to quickly change the setpoint temperature to one of these preset values (Adjusting memory setpoints is discussed in section 3.2.2.1). When changing the setpoint to a value not preprogrammed in one of the memory setpoints the user may adjust the setpoint manually. The setpoint value may be set within the range of 90.00 to 680.00 degrees C.

As shown in Figure 5, the “YES” is located adjacent to the top switch, which was identified earlier in Figure 3 as “Switch #1”. The “NO” is adjacent to the switch identified as “Switch #2”. If the “NO” selection is made, the program will continue on to allow access to the next function.

If the user selects “YES” by pressing the corresponding switch, the display shown in Figure 6 will be presented on the LCD.



Figure 5 - Setpoint Access Prompt

The user may choose to select one of the memory setpoint temperatures by pressing the corresponding “YES” switch. A “NO” selection will advance the system to the next memory setpoint. A “NO” response to all of the three memory setpoint temperatures will allow the user to change the setpoint manually.



Figure 6 - Memory Setpoint Change Prompt

The manual adjustment of the “SETPOINT” may be accomplished by using the two switches on the side corresponding to the labels “UP” and “DN” displayed on the LCD. The Command Key, located directly below the LCD, is used to advance the cursor to each of the digits. The current number presented on the display is used by the system controller as the current setpoint even while in the command functions mode.



Figure 7 - Manual Setpoint Change Prompt

As the cursor is scrolled past the last digit, setpoint adjustment is completed and the user is advanced to the next Command Function as described in the following section.

3.2.2. Adjust System Variables

This command function is provided to allow user examination and adjustment of the system variables used by the controller as well as the calibration variables for the system core temperature measurement.

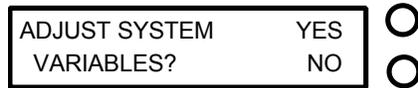


Figure 8 - System Variable Access Prompt

Pressing the switch by the display “YES” will allow access to the first system variable by presenting the messages shown in Figure 9, responding with a “NO” command will terminate the function and advance to the next command function.

3.2.2.1. Adjust Memory Setpoint Temperatures

The first variable accessed by the adjust system variables function is the “Memory 0” as shown in Figure 9. The “Memory 0” variable is the system startup setpoint. Responding “YES” to the prompt will allow the user to adjust the setpoint, a “NO” response will move to the next memory setpoint.

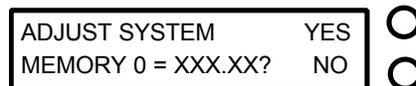


Figure 9- Adjust Setpoint Memory Prompt

The adjustment of ‘MEMORY 0” may be accomplished by using the two switches on the side corresponding to the labels “UP” and “DN” displayed on the LCD. The “COMMAND” switch, located directly below the LCD, is used to advance the cursor to each of the digits.

As the cursor is scrolled past the last digit, memory setpoint adjustment is completed and the user is advanced to the next memory setpoint. When all memory setpoint adjustments have been presented, the system advances to the next Command Function as described in the following section.

3.2.2.2. Adjust Alarm Temperature

The next variable accessed by this function is ALARM TEMPERATURE, the temperature at which the controller turns off the heater to prevent overheating the core or a cell in the furnace. Adjustment is accessed by displaying the messages shown in Figure 10.



Figure 10 - Adjust Alarm Temperature Access Prompt

Responding YES to the prompt will allow the user to modify the variable as described below, while a NO response will allow access to the next system variable in the sequence, as described in the following section.



Figure 11 - Alarm Temperature Adjust Prompt

Modification of the variable is accomplished by pressing the two switches on the right of the LCD. The command key located directly below the LCD, is used to advance the cursor to each of the digits. Pressing the switch adjacent to the “UP” prompt will cause the value of the selected digit to be incremented by one, while pressing the switch adjacent to the “DN” will cause it to be decremented by one. The range of the variable is 100 to 690 degrees C. As the cursor passes the last digit the value is stored as a temporary system variable.

3.2.2.3. *Adjust GPIB Address*

The next variable presented, Adjust GPIB Address, is the parameter that determines the address at which the system can be accessed over the IEEE-488 Interface Buss. Adjustment is accessed by displaying the messages shown in Figure 12.



Figure 12 - IEEE-488 Address Adjust Prompt

This variable may be examined or adjusted by the user by responding “YES” to the prompt, while a “NO” response will allow access to the next Command Function in the sequence as described in the following section.

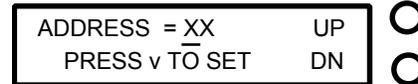


Figure 13 - Address Adjust Prompt

Here the user can modify the IEEE-488 address of the instrument as shown in Figure 13. The adjustment of address may be accomplished by using the two switches on the side corresponding to the labels “UP” and “DN” displayed on the LCD shown in Figure 13. This variable can be set within the range of 1 to 30. The Command Key, located directly below the LCD, is used to advance the cursor to each of the digits. Pressing the switch adjacent to the “UP” prompt shown in Figure 13 will cause the value of the selected digit to increment one, while pressing the switch adjacent to the “DN” will cause it to be decremented by one. As the cursor passes the last digit the value is stored as a temporary system variable.

3.2.2.4. *Calibrate Sensors*

The next set of variables accessed by this function are the calibration variables for the sensors. The user is given access to these variables by responding “YES” to the prompt shown in Figure 14. A “NO” response will allow access to the next system variable in the sequence, as described in the following section.

CALIBRATE INTERNAL	YES	<input type="radio"/>
TEMPERATURE SENSORS?	NO	<input type="radio"/>



Figure 14 - Calibration Access prompt

3.2.2.4.1. Calibration of Core Temperature

The first variable presented allows the user to calibrate the system's core temperature sensor. This is accomplished by adjusting the resistance at the triple point of water (RTPW) for the core sensor.

This variable may be examined or adjusted by the user by responding "YES" to the prompt shown below in Figure 15, while a "NO" response moves the user to the next prompt.

CALIBRATE CORE	YES	<input type="radio"/>
SENSOR?	NO	<input type="radio"/>



Figure 15 - Calibration Access prompt

The number shown in Figure 16 is the current core temperature as calculated by a temporary RTPW variable. This temporary variable is initially set to the current value of the core RTPW being used by the control routines. Adjusting this temporary variable will have no effect on the measured core temperature in the control routines until this function is completed. When calibrating the core sensor the user should place a precalibrated thermometer in the furnace. After allowing the system to become stable the user may then calibrate the core sensor.

CORE = 339.00	DEG C	UP	<input type="radio"/>
PRESS v TO SET		DN	<input type="radio"/>



Figure 16 - Calibration Adjust prompt

Modification of the core temperature is accomplished by pressing the two switches on the right of the LCD. Pressing the switch adjacent to the "UP" prompt will cause the systems measured core temperature to increase and pressing the switch adjacent to the "DN" will cause the systems measured core temperature to decrease. It is important to note that the "UP" switch actually decreases the core sensors RTPW by .001 which increases the calculated temperature. Also note that it may take several switch presses to change the systems measured core temperature by .01 degrees C. The system will continually update the measured sensor resistance value, apply the adjusted temporary RTPW and display the corrected temperature value so all changes are reflected on the display as they occur.

After the desired value has been established by incrementing or decrementing the RTPW value as described above, pressing the Command Key causes the value to be stored as a temporary system variable and the user is given the opportunity to examine or modify the RTPW value by the following prompt shown in Figure 17.

****Note:** At this point the value that is displayed as the CORE RTPW is being used in the control routines.

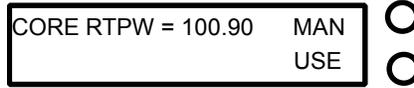


Figure 17 - Manual Core RTPW Adjustment Prompt

It is recommended that the user record any new RTPW resulting from a calibration in a log similar to the log provided at the end of this manual. The prompts shown allow the user to either manually adjust RTPW value, “MAN”, or “USE” this value as the calibrated RTPW. In the event that the user chooses to “USE” this value the system will skip the manual adjustment function discussed in the following section, while a choice to MANually adjust the system will display the prompt shown in Figure 18.

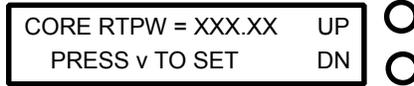


Figure 18 - Manual Core RTPW Adjustment Prompt

Manual adjustment of “CORE RTPW” may be accomplished by using the two switches on the side corresponding the labels “UP” and “DN” displayed on the LCD. The Command Key, located directly below the LCD, is used to advance the cursor to each of the digits.

As the cursor is scrolled past the last digit, the CORE RTPW adjustment is completed and the system sets the variable to the manually established value and advances to the next Command Function as described in the following section.

3.2.2.5. Access Vars Array

This function allows access to variables stored in the system’s memory. It is strongly recommended that before responding “YES” , that a careful review of what each variable represents be conducted (see chart below). It is strongly recommended that only experienced users familiar with this system and its limitations exercise this option.

****DO NOT ADJUST VARS ARRAY WITHOUT FIRST CONSULTING FACTORY!!!** Doing so can cause severe damage to the furnace and could be very dangerous! If the message “UNABLE TO LOAD VARIABLES” should appear on the front panel display call Pond Engineering immediately for service.

ACCESS VARS	YES	<input type="radio"/>
ARRAY?	NO	<input type="radio"/>



Figure 19 - Access Variables Array Prompt

Responding “YES” will cause Figure 19 to appear. This is to warn the user of the danger that could occur if this function is not used properly. Press Switch #1 to continue or Switch #2 to exit to the next function.

WARNING	CONTINUE	<input type="radio"/>
REFER TO MANUAL	EXIT	<input type="radio"/>



Figure 20 - Warning Prompt

Variables can be viewed and changed as shown below. The variables are not labeled. Please refer to the chart below for information about each variable.

VAR 0 = XXX.XXXX	UP	<input type="radio"/>
PRESS v TO SET	DN	<input type="radio"/>



Figure 21 - Variable 0 Adjustment Prompt

Scrolling through the variables is accomplished by pressing the two switches to the right of the LCD, the switch adjacent to “UP” increments the variable number and the switch adjacent to “DN” decrements it. The command key located directly below the LCD, is used to start the adjustment of the selected variable by advancing the cursor through the digits. Pressing the switch adjacent to the “UP” prompt shown in Figure 21 will cause the value of the selected digit to increment one, while pressing the switch adjacent to the “DN” will cause it to be decremented by one. As the cursor passes the last digit the value is stored as a temporary system variable.

****WARNING** Software checking is not done for these entries and inputting values outside the recommended ranges can result in permanent damage to the system if utilized for operating the system.**

Following is a list of the variables and their locations:

#	Variable \Description	Default Values	Recommend Range
0	Setpoint Temperature	100.0000 degrees C	90-680 degrees C
1	Memory 0 Setpoint Temperature	100.0000 degrees C	90-680 degrees C
2	Memory 1 Setpoint Temperature	156.0000 degrees C	90-680 degrees C
3	Memory 2 Setpoint Temperature	232.0000 degrees C	90-680 degrees C
4	Memory 3 Setpoint Temperature	419.0000 degrees C	90-680 degrees C
5	Alarm Temperature	690.0000 degrees C	100-690 degrees C
6	GPIB Primary Address	6.0000	1.0000-30.0000
10	RTPW for Core Sensor	101.35	
11	A Coefficient	-0.0012	
12	B Coefficient	0.0001	

13	C Coefficient	0.0000	
14	RTPW for Shell Sensor	0.0000	
15	A Coefficient for high temp only	3.3760	
20	ACCESS CODE for protected vars 7663	766.3000	

****Protected Variables****

21	Proportional 1 Gain	3.0000	1.0000-4.0000
22	Integral 1 Gain	0.02	0.0025-.0100
23	Derivative 1 Gain	-50.0000	-100.0000- -25.0000
24	Proportional 2 Gain	6.0000	
25	Integral 2 Gain	0.0050	
26	Derivative 2 Gain	-300.0000	
27	Integral increment maximum	0.0400	
28	Integral hold off limit	1.0000	
29	Time of hold after condition	10.0000	
30	Integral one power slope	0.0300	
31	Integral one power intercept	0.0000	
32	Prop 2 limit	10.0000	
33	Integral 2 Limit	10.0000	
34	Integral 2 increment max per ISR	0.0100	
35	Derivative 2 Limit	10.0000	
37	cr_PID2	0.0000	
40	Variable initial check	34.0100	
45			
46			
47	HTR_Volt		
58	System status variable	-0.0000	
59	Average Core Temperature	(current reading)	
60	Core Temperature	(current reading)	
63	Core Sensor Resistance	(current reading)	
66	Proportional Signal	(current reading)	
67	Integral Signal	(current reading)	
68	Derivative Signal	(current reading)	

****Variables accessible by remote only****

72	Guard prop signal		
73	Guard integral signal		
74	Guard derivative signal		
75	Flag to indicate external control		
76	Temperature written by external system		

3.2.2.6. Save changes to Variables

The prompt in Figure 22 provides the opportunity to save the newly established system variables as the power-up default values. As mentioned earlier, the newly established system variables are stored as temporary system variables at this point. Responding YES to this prompt causes the variables to be stored in the non-volatile memory within the system controller. The variables will then be utilized as the systems power on defaults.

SAVE CHANGES TO	YES	<input type="radio"/>
VARIABLES?	NO	<input type="radio"/>



Figure 1 - Save Variables Prompt

Responding "NO" to this prompt causes the system to exit the function without saving the variables to non-volatile memory. This allows the user to temporarily establish new values for the system variables without permanently altering the default values. If the power were to be shut off or interrupted before the new information was stored in the non-volatile memory, the newly established values would be lost and the system would utilize the default values. Following verification of performance of the newly established variable values, they may be stored by entering the "ADJUST SYSTEM VARIABLES" routine, stepping through the prompts and responding "YES" to the "SAVE CHANGES" prompt.

3.2.2.7. *Diagnostics Display Mode Select*

Here the user is given the opportunity to choose which set of information is presented by the display during operation. Two choices are presented, "NORMAL DISPLAY" and "DIAGNOSTIC INFORMATION". The "NORMAL DISPLAY" mode is always presented upon system power up and is changed through this control function to allow display of "DIAGNOSTIC INFORMATION" by answering YES to the command function prompt.

DISPLAY DIAGNOSTIC	YES	<input type="radio"/>
INFORMATION?	NO	<input type="radio"/>



Figure 23 - Diagnostics Mode Display Prompt

If the system is currently displaying "DIAGNOSTIC INFORMATION", the prompt will be modified as shown below to allow the user to toggle back to the "NORMAL DISPLAY" mode by answering "YES" to the command function prompt.

CHANGE TO NORMAL	YES	<input type="radio"/>
DISPLAY?	NO	<input type="radio"/>



Figure 24- Normal Mode Display Prompt

The "DIAGNOSTIC INFORMATION" display presents an array of numeric information for system diagnostics for the "CORE" zone and the "GUARD" zone. An example of the core diagnostic information is shown below in Figure 25.

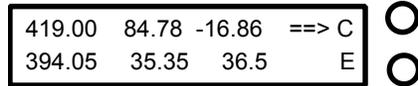


Figure 25 - Core Diagnostics Display

The information presented by this display is as follows. Top row from left to right: core setpoint, core proportional signal, core derivative signal. Bottom row left to right: current core temperature, core integrator signal, current core heater voltage.

Pressing the button opposite the letter "E" on the display will allow the user to scroll to the next diagnostics display.

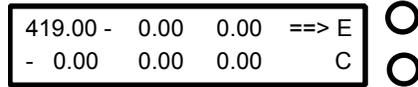


Figure 26 - External Feedback Diagnostics Display

The information presented by the guard diagnostics is as follows. Top row left to right: guard zone setpoint, guard proportional signal, guard derivative signal. Bottom row left to right: current guard temperature, guard integrator signal, current guard zone heater voltage.

****Note: Once the DIAGNOSTIC INFORMATION mode has been entered the display will only present the diagnostic information; normal display mode can be obtained through the COMMAND FUNCTIONS option as described above.**

After completing all of the command functions as described above, the Metrology Furnace system will again return to the normal operating mode as described earlier.

4. Operating the Temperature Calibration Furnace Using Remote Interface Commands

The Temperature Calibration Furnace has been equipped with an IEEE-488 Remote Interface. Any host computer which can be set up as a system controller may be used to operate the Calibration Furnace over the interface. Pond Engineering has software available for reading the furnace variables by an IBM compatible or Macintosh computer with a National Instruments 488 interface card. Custom software packages are also available to integrate the furnace into an automated lab. The system variables which can be accessed over the 488 and the command set recognized by the furnace are as follows.

4.2. Comparison Furnace Command Set

The command set for the furnace is outlined in the following paragraphs. The commands are issued from the host computer which acts as the controller. The furnace acting as the slave listens when addressed as a listener, talks when addressed as a talker, and does not issue a service request(SRQ).

4.2.1. Read System Variable

The “READ” command, called by sending a “R” (upper or lower case) followed by the two digit address of the variable, enables the user to read or interrogate the current values for system variables. The syntax for the read command is “Rxx”, where xx is the address of the variable to interrogate. The address must be two digits in length, therefore addresses less than 10 MUST HAVE LEADING ZEROS.

After receiving a read command, the furnace will wait to be addressed as a talker to return the data at the read location over the bus. The furnace has a one second write time-out, thus the controller in charge must read from the furnace within one second after sending the R command to receive data. For example: If the user wants to see the value stored as the systems alarm temperature, the user would send the character string:

R05

The controller in charge would then address the furnace as a talker and wait for the data to be returned. NOTE: The furnace must maintain control of the furnace core as the highest priority and may put off responding to 488 commands for as long as 500 ms. The furnace being addressed as a talker and not in the control cycle would return the alarm temperature(variable address 05), as follows:

+4.300000e+02(space)05

The values returned are always in the above scientific format followed by a space and address number for the given value.

4.2.2. Write System Variable

The “WRITE” command, called by sending a “W” (upper or lower case) followed by the two digit address, a comma, and the desired new value, enables the user to write or set the values for system variables. The syntax for the write command is “Wxx,(value)”, where xx is the address of the variable and (value) is the new desired value for the variable. The format for (value) must be decimal with at most seven significant digits not to exceed 15 digits in length.

For example: If the user wants to change the value stored as the alarm temperature to 300 °C, the user would send:

W05,300

and the alarm temperature variable would then be set to 300 °C.

****Note: As variables are written to the system the new value is immediately used by the system. However this new value is not stored as a permanent system variable until the user saves the variable using the “Save variables” command through the front panel. IMPORTANT! SAVING CHANGED VARIABLES WILL PERMANENTLY CHANGE THE SYSTEMS VARIABLES. Pond Engineering strongly recommends the users keep a log of any changed variables. Also, Pond Engineering is in no way responsible for any damage caused by the failure to use these commands properly. DO NOT set a variable outside the recommended range.**

In order to maintain flexibility the only variables that are limit checked are the Setpoint variables and the alarm variable. All other variables can be set to any value received over the 488. Extreme caution must be used when setting any variable over the 488. The user should read back any variable after setting it to insure the variable was received by the furnace correctly.

This is especially important when setting the RTPW's and calibration coefficients, since an errant RTPW or coefficient may cause the furnace to overheat and damage the furnace core.

4.2.3 Remote Mode

After receipt of a command over the 488 Buss the furnace will go into remote mode. In remote mode the LCD will display the message as shown in Figure 27.

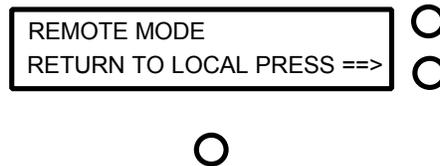


Figure 27 - Remote Mode Display

In remote mode the system will only respond to the return to local switch, switch #2. After returning to local control the system will respond normally to all switches.

4.2.4 External Feedback Control Variables

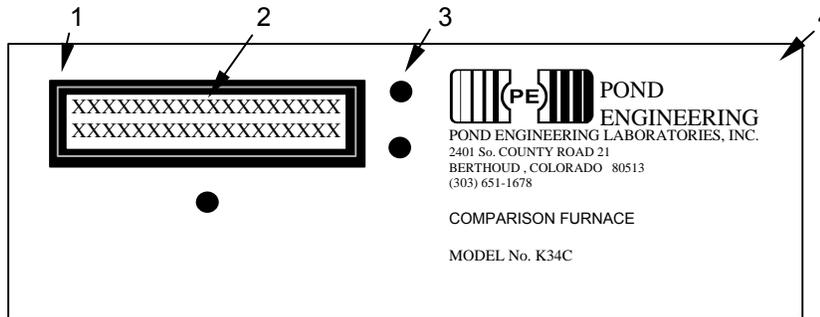
As part of the IEEE-488 remote interface option, the furnace is capable of accepting feedback from a temperature sensor directly in the comparison block. In effect this allows a calibrated standard thermometer to be used as the control sensor directly in the comparison block. Operation of this feature is controlled by variables 75 and 76, described earlier in Section 4.1 System Variables List. Variable 75 is used as a flag, only when this variable is set to a value of 1.0 will the system look to receive a temperature input from the external thermometer. The temperature measured by the external thermometer may be written to variable 76 and will be used by the furnace controller to modify the furnace core setpoint to achieve a comparison block temperature (as measured by the external thermometer) equal to the current system setpoint. This modification of the core control temperature is internally limited to 10 degrees C. It is recommended that the external temperature be updated at least every 60 seconds in order to allow proper operation of the control system, shorter update periods (as short as 10 seconds) provide better system performance.

Only when variable 75 is active will an external temperature feedback be utilized. On power up, variable 75 is set to 0.0, disabling operation of this feature.

5. System Hardware Description

A brief description of system hardware is provided in this section as a reference to aid the user in providing periodic maintenance of the system. In the event that the system requires significant maintenance or repair, it is recommended that Pond Engineering be contacted prior to replacing or modifying major system components.

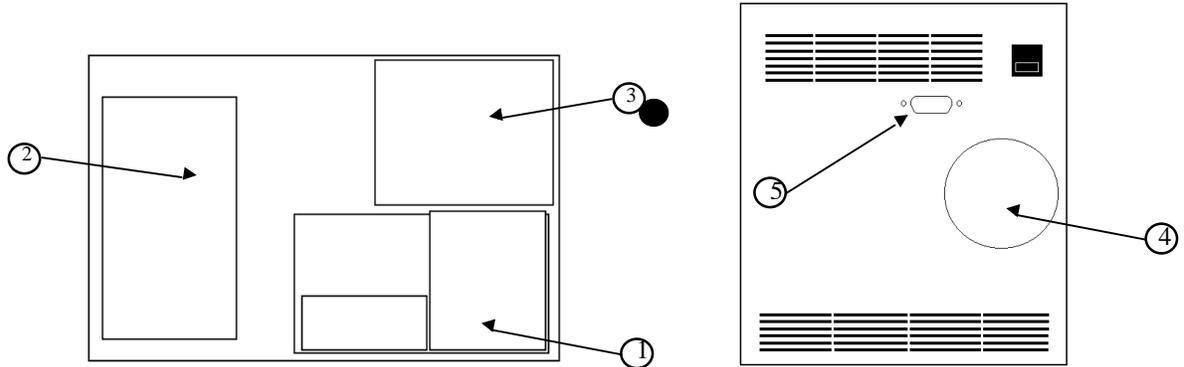
5.1. Front Panel



<u>REF. #</u>	<u>NAME</u>	<u>MAKE</u>	<u>MODEL</u>
1	Die Cast Metal Bezel	JMJ Technical Products, Inc.	1-458
2	24X2 Dot Matrix LCD Module DMC Series	Optrex	DMC20261
3	Miniature Push-button panel Mount SPDT Switches -- 3 each -- with Caps for Miniature Switches	Eaton Cutler-Hammer Eaton Cutler-Hammer	PS1-100Q W-KN-17
4	Engraved Laminate Front Panel	Pond Engineering	K34-FP

5.2. *Electronics Chassis/ Back Panel*

The electronic components are located on the base of the K34C box. The diagram of the electronics, is drawn from the top view, of the interior of the box. The back of the box is drawn to show the exterior face of the back.



<u>REF. #</u>	<u>NAME</u>	<u>MAKE</u>	<u>MODEL</u>
1	Microprocessor/Controller	Pond Engineering Labs.	K34M-400
2	Computer Power Supply	Power-One Inc.	MAP55-4002
3	Main Power Supply	Pond Engineering Labs.	K34-HE24-7.2-A
4	Fan	Comair Rotron	FE12B3
5	488 connector	Pond Engineering	488-connector

6. Calibration Record

#	Variable \Description	Factory Values	Comments
10	RTPW for Core Sensor	101.35	
11	A Coefficient	-0.0012	
12	B Coefficient	0.0001	
13	C Coefficient	0.0000	
14	RTPW for Shell Sensor	0.0000	
15	A Coefficient for high temp only	3.3760	

#	Variable \Description	Values	Comments
10	RTPW for Core Sensor		
11	A Coefficient		
12	B Coefficient		
13	C Coefficient		
14	RTPW for Shell Sensor		
15	A Coefficient for high temp only		

10	RTPW for Core Sensor		
11	A Coefficient		
12	B Coefficient		
13	C Coefficient		
14	RTPW for Shell Sensor		
15	A Coefficient for high temp only		

10	RTPW for Core Sensor		
11	A Coefficient		
12	B Coefficient		
13	C Coefficient		
14	RTPW for Shell Sensor		
15	A Coefficient for high temp only		

10	RTPW for Core Sensor		
11	A Coefficient		
12	B Coefficient		
13	C Coefficient		
14	RTPW for Shell Sensor		
15	A Coefficient for high temp only		

10	RTPW for Core Sensor		
11	A Coefficient		
12	B Coefficient		
13	C Coefficient		
14	RTPW for Shell Sensor		
15	A Coefficient for high temp only		