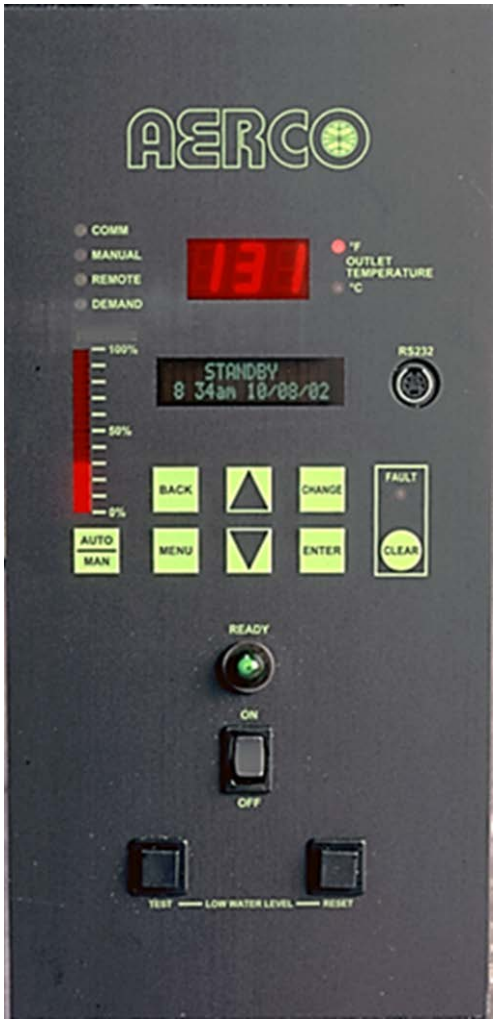
C-More Control Panel

USER MANUAL

Installation, Operation, and Maintenance

Applies to:

- **Benchmark Boilers**
- **Innovation Water Heaters**
- **WHM and BST Systems**
- **KC Boilers & Water Heaters**



C-More Controller Front Panel

Latest Update: 04/22/2014

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SECTION 1 - GENERAL INFORMATION

1.1 INTRODUCTION

The information in this Section provides a guide to the operation of Benchmark, Innovation and KC Series units using the C-More Control Panel. In addition, it provides information describing the numerous types of external sensors and control devices that can be interfaced to the unit using terminals provided in the Input/Output (I/O) Box utilized by the Control Panel. Information regarding the set-up of all water heater and boiler Operating Modes, as well as Water Heater Management (WHM) Systems and Boiler Sequencing Technology (BST) Systems of units is also included.

IMPORTANT

Unless otherwise specified, the descriptions, procedures and menu items contain in this manual apply to all C-More software versions.

1.2 SAFETY PRECAUTIONS AND WARNINGS

It is imperative that the initial startup of KC, Benchmark and Innovation units be performed by factory trained personnel. Operation prior to initial startup by factory trained personnel will void the equipment warranty. In addition, the following **WARNINGS** and **CAUTIONS** must be observed at all times.

CAUTION:

All initial installation procedures must be satisfied before attempting to start the unit.

WARNING:

ELECTRICAL VOLTAGES IN KC SERIES AND INNOVATION UNITS INCLUDE 120 AND 24 VOLTS AC. VOLTAGES IN BENCHMARK SERIES UNITS MAY ALSO INCLUDE 460 AND 220 VOLTS AC. THEREFORE, THESE UNITS MUST BE SERVICED ONLY BY FACTORY CERTIFIED SERVICE TECHNICIANS.

WARNING:

DO NOT ATTEMPT TO DRY FIRE THE UNIT. STARTING THE UNIT WITHOUT A FULL WATER LEVEL CAN SERIOUSLY DAMAGE THE UNIT AND MAY RESULT IN PERSONNEL INJURY OR PROPERTY DAMAGE. THIS SITUATION WILL VOID ANY WARRANTY.

1.3 FEATURES AND BENEFITS

Benchmark, Innovation and KC series units equipped with C-More Control Panels include the following additional features and benefits:

1.3.1 System Start Temperature

This feature allows a boiler to be enabled or disabled based on the outside air temperature. When the outside air temperature goes below the System Start Temperature, the boiler is enabled. When the outside air temperature is above the System Start Temperature, the boiler is disabled. This feature may be used in any boiler mode of operation. It requires that an outdoor air temperature sensor be connected to the boiler.

1.3.2 Setpoint Low Limit

This option allows the user to limit how low the unit's setpoint can be set. The allowable range is 40°F to 240°F. The factory default is set at 60°F.

1.3.3 Setpoint High Limit

This option has two functions. In the Indoor/Outdoor Reset, Constant Setpoint and 4 to 20 mA Remote Setpoint Modes, the Setpoint High Limit option limits how high the unit's setpoint can be set. The allowable range is 40°F to 240°F.

In the 4 to 20 mA Direct Drive, Combination or BST/ACS Mode of operation, the Setpoint High Limit acts as a temperature limiting governor. Should the unit's outlet temperature equal the Setpoint High Limit Setting, a PID function will intervene and maintain the outlet temperature at the Setpoint High Limit minus the Setpoint Limit Band.

To use the Setpoint High Limit feature, the Setpoint Limiting option must be enabled and a Setpoint Limit Band selected. This Band is preset at 5°F, however it is adjustable from 0°F to 10°F.

1.3.4 Temp Hi Limit

This is a temperature limit feature that will shut down the unit and generate an alarm if the outlet temperature exceeds its setting. It is preset at 210°F, but adjustable from 40°F to 240°F.

1.3.5 Max Valve Position

This feature allows the user to limit the unit's valve position. This feature can be useful if site or equipment limitations require that less BTU's be input into the system. This feature is meant to be used only on a temporary basis until the system or equipment limitations are resolved.

1.3.6 Pump Delay Timer

The C-More Control Panel allows the user to turn a pump on and off as the boiler cycles on and off on demand. The Pump Delay Timer feature allows the user to keep the pump running up to 30 minutes after the unit has shut down and the demand satisfied.

1.3.7 Aux Start On Delay

This feature works in conjunction with the Auxiliary Relay. When a call for heat is produced, the Aux Relay will energize and can be used to start a system or gas booster pump, open a louver or valve, or start some other necessary system process. The Aux Start On Delay is a timer that can be set from 0 to 120 seconds. It tells the combustion control system to wait a specified period of time for the device started by the Aux Relay to come up to speed, open or make a proving switch. Once the waiting period expires, the start sequence will resume. Should the device not prove within the preset time interval, the unit will shut down and generate an alarm.

1.3.8 Failsafe Mode

The Failsafe mode allows the user to select whether the unit shuts down or switches to the Constant Setpoint mode of operation in the event that a loss of signal causes the unit to become inoperable. For example, if a 4 to 20 mA Remote Setpoint signal is being sent, but is not seen by the unit, the unit will shut down or automatically switch to the Constant Setpoint mode and work off the unit's internal setpoint. The default setting for this option is Shutdown.

1.3.9 RS232 Monitoring

This feature allows a laptop computer or other suitable device to be connected to the RS232 port on the Control Panel front panel. This permits the unit to be monitored either locally or remotely via a Modem.

1.3.10 Password Entry

A simplified password entry feature allows the user to enter passwords one digit at a time, starting with the most significant digit (MSD). This eliminates the long and tedious process of holding down the ▲ or ▼ arrow key until the full password (3 or 4 digits) appears in the display. Refer to Table 3-1 for additional information.

NOTE

See Table 1-1 for a Feature Compatibility Chart associated with a number of the following features.

1.3.11 Ignition Retry Functions

It is now possible to successfully ignite the system following a momentary spurious fault condition. To aid in the unattended recovery from this type of spurious incident, the following Ignition Retry functions have been implemented:

- Air Flow Fault During Purge
- Flame Loss During Run

Refer to paragraphs 4.2.1 and 4.2.2 for additional information.

1.3.12 Fire Rate (FR) Change Rate

The *FR Change Rate* defines the rate at which the Fire Rate will increase or decrease. The purpose of slowing down the fire rate velocity when decreasing is to prevent flameouts caused by the inability of the blower motor to slow down in proportion to a rapid fire rate decrease. When decreasing the fire rate during operation above 30% Valve Position, the rate will decrease at the standard 0.5 seconds per 1% Valve Position. When operating at or below 30% Valve Position, the slow-down feature is enabled and the Fire Rate will decrease at the rate defined by the *FR Change Rate* value set in the Factory Menu. The rate can be Factory-set from 0.5 to 60 seconds per 1% Fire Rate (default = 1.5 seconds per 1% Valve Position).

The *FR Change Rate* feature is always enabled for Boilers. However, this feature is not active for Water Heaters.

1.3.13 PID Correction Deadband

The PID Correction Deadband allows the Outlet Temperature to drift within a temperature range defined by *Setpoint, Deadband High and Deadband Low.*

Allowing the Outlet Temperature to drift from the Setpoint Temperature minimizes Air Fuel Valve corrections when deemed unnecessary.

When the Setpoint Temperature is reached, and remains stable for a period of 15 seconds, the Deadband mode is enabled and the **°F** or **°C** LED will flash on and off.

No Air Fuel Valve corrections will be attempted until the Outlet Temperature exits the Deadband zone.

The *Deadband High* and *Deadband Low* functions are located in the *Configuration Menu*.

The default values are: *Deadband High* = 2, *Deadband Low* = 2.

1.3.14 On/Off Cycling Reduction Functions

When the unit is firing at close to the shutdown limit (minimum Fire Rate), the C-More will attempt to delay unit shutdown to the Standby Mode for as long as possible, while still maintaining adequate temperature control. This is accomplished utilizing the *HI DB Setpt EN* and *Deadband High* functions in the Configuration Menu. Refer to Table 3-1 and paragraph 3.1.2.

1.3.15 Demand Offset

The *Demand Offset* entry allows re-ignition delay of the unit while maintaining proper temperature control. In normal operation, the unit will re-ignite when the PID Loop calculates that the required Fire Rate is greater than the Start Level value. Refer to the *Demand Offset* entry in the Configuration Menu (Table 3-1) and paragraph 3.1.3.

1.3.16 PID Turn-On Delay

The *PID Turn ON Delay* defines the time the unit will stay at the “Low Fire” Valve Position level following the warm-up period after re-igniting. This feature will delay the time in which the temperature is regulated to the full Setpoint value thus further reducing on/off cycling.

PID Turn ON Delay is in the FACTORY Menu (Default setting is 60 seconds).

The *PID Turn ON Delay* feature is active only for Boilers and is NOT active for Water Heaters.

Setting the *Demand Offset* **(**paragraph 1.3.15) to Zero (0) will also disable the *PID Turn ON Delay.*

1.3.17 Propane/Natural Gas Selection

A new entry has been added to the Configuration Menu. This entry permits the selection of either Natural Gas or Propane as the fuel type (Default = Natural Gas). Refer to Table 3-1 for additional information on this function.

1.3.18 Set Blower Speed During Purge

It is possible to experience failure to successfully ignite the system at startup, due to the inability of the blower motor to slow down to the required rate following a pre ignition purge cycle.

A new entry, *Purge Blwr Offst* (Purge Blower Offset), has been added to the Factory Menu to define the offset of full blower speed used for the pre-ignition purge cycle.

This will affect the 0-10v outputs.

The default value for the *Purge Blwr Offst* entry is 0.0. The setting range is 0.0 to 8.0.

NOTE

Purge Blwr Offst will NOT affect blower operation during IGNITION or normal RUN operations.

1.3.19 Modbus Network Timeout Control

The Modbus communications system connecting the C-More to a central Energy Management or Building Automation System becomes more burdened as we add Boilers and Water Heaters to the system.

It is possible in larger installations for a boiler or water heater to drop off line due to the inability of the BMS/ACS to respond to the C-More in a timely manner (previously set at 10 seconds).

In order to eliminate Modbus timeout errors in an installation consisting of more than 8 Boilers, a *Network Timeout* menu Item has been added to the "Configuration Menu".

This entry allows the user to modify the time interval in which the C-More expects a reply from the BMS/ACS before invoking a MODBUS ERROR.

The *Network Timeout* entry is located in the *Configuration Menu*. The setting range is 5 to 240 seconds. The default is 30 seconds.

1.3.20 Fault Warning Functions

Enhanced Fault/Warning functions are associated with the following five input functions:

1. Exhaust Temp Warning
2. Inlet Water Temp Warning
3. Inlet Gas Pressure Warning
4. Gas Plate Dp Warning
5. Inlet Water Flow Warning

Whenever values for these functions exceed or drop below defined thresholds, a warning message will alternate with the normal message on the VFD Display.

The Alternating messages are only active when in the following menus: *OPERATING, SETUP* and *CONFIGURATION*.

These Fault/Warning functions can be Enabled or Disabled in the DIAGNOSTICS Menu.

1.3.21 0 – 10V Out Test

The 0-10v Output Test is located in the *Calibration Menu* and allows the Blower Output Voltage on the 0-10 Volt port to be varied for testing. This allows the 0-10v output to be tested without having to ignite the unit.

1.4 CONTROL PANEL DESCRIPTION

The C-More Control Panel is available in two models. One has a vertical control panel layout, as shown in Figure 1-1A and is used on Benchmark and Innovation units. The other model has a horizontal panel control layout, as shown in Figure 1-1B and is used on KC1000 Series units. These models contain identical controls, indicators and displays and are functionally identical. These controls, indicators and displays are listed and described in Table 1-2.

Table 1-1: Feature Compatibility Chart

Feature	Equipment Compatibility	Exceptions
Ignition Retry	Water Heaters AND Boilers	
Fire Rate Change Rate	Boilers ONLY	
PID Correction Deadband	Water Heaters AND Boilers	Not active in Direct Drive Mode

Cycling Reduction HI DB Setpt EN	Water Heaters AND Boilers	Not active in Direct Drive Mode
Cycling Reduction Demand Offset	Boilers ONLY	Not active in Direct Drive and Combo Unit Modes
Cycling Reduction PID Turn ON Delay	Boilers ONLY	

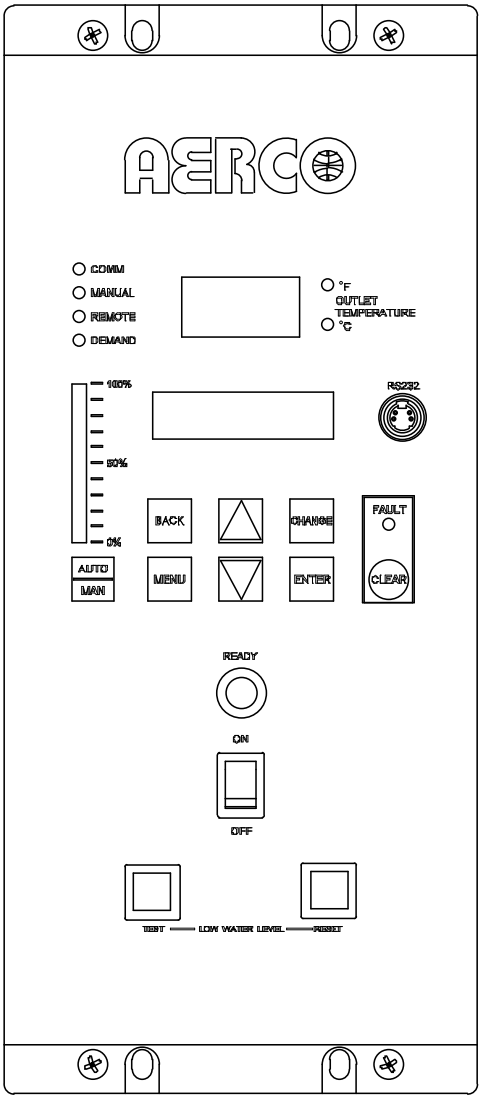

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Figure 1-1A: C-More Control Panel for Benchmark & Innovation Series Units

*** NOTE**

If there is a requirement to use the RS232 port (Item 4) on the C-More Control Panel's front panel, contact AERCO to purchase the RS232 Adaptor Cable (P/N 124675), which is designed for this purpose. This cable features a DB9 connector for connection to older computers with serial ports or can be used with a Serial-to-USB adaptor for use in modern computer USB ports.

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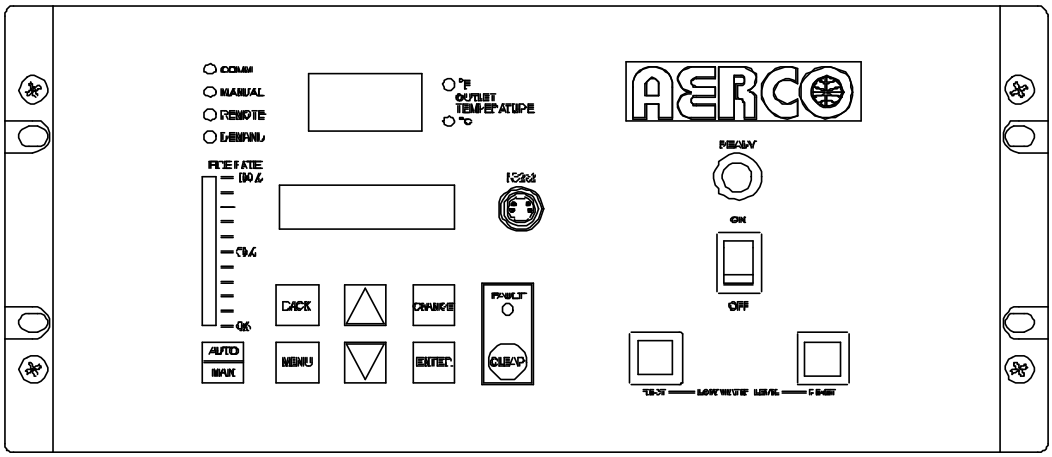

Figure 1-1B. C-More Control Panel For KC1000 Series Units

Table 1-2: Operating Controls, Indicators and Displays

ITEM NO.	CONTROL, INDICATOR OR DISPLAY	FUNCTION
1	**LED STATUS INDICATORS** Four Status LEDs indicate the current operating status as follows:	
	COMM	Lights when RS232 communication is occurring between the C-More and the I/O Box. This LED will light when a unit is sending OnAER data.
	MANUAL	Lights when the unit is being controlled using the front panel keypad.
	REMOTE	Lights when the unit is being controlled by an external signal from an Energy Management System
	DEMAND	Lights when there is a demand for heat.
2	VFD Display	Vacuum Fluorescent Display (VFD) consists of 2 lines each capable of displaying up to 16 alphanumeric characters. The information displayed includes: Startup Messages Alarm Messages Operating Status Messages Menu Selections
3	**OUTLET TEMPERATURE** Display	3–Digit, 7–Segment LED display continuously displays the outlet water temperature. The **°F** or **°C** LED next to the display lights to indicate whether the displayed temperature is in degrees Fahrenheit or degrees Celsius. The **°F** and **°C** LED blink when operating in the Deadband Mode.
4	**RS232** Port	Port permits a Laptop Computer or External Modem to be connected to the unit's Control Panel. AERCO offers for purchase the RS232 Adaptor Cable (P/N 124675), which is designed to work with this port. This cable features a DB9 connector for connection to older computers with serial ports or can be used with a Serial-to-USB adaptor for use in modern computer USB ports.
5	**READY** Indicator	Lights when **ON/OFF** switch is set to **ON** and all Pre-Purge conditions have been satisfied.
6	**ON/OFF** Switch	Enables and disables boiler operation.
7	**LOW WATER LEVEL TEST/RESET** Switches	Allow the operator to test the operation of the water level monitor. Pressing **TEST** opens the water level probe circuit and simulates a Low Water Level alarm. Pressing **RESET** resets the water level monitor circuit. Pressing **CLEAR** resets the display.
8	**FAULT** Indicator	Red **FAULT** LED indicator lights when a boiler alarm condition occurs. An alarm message will appear in the VFD.
9	**CLEAR** Key	Turns off the FAULT indicator and clears the alarm message if the alarm is no longer valid. Lockout type alarms will be latched and cannot be cleared by simply pressing this key. Troubleshooting may be required to clear these types of alarms

Table 1-2: Operating Controls, Indicators and Displays - Continued

ITEM NO.	CONTROL, INDICATOR OR DISPLAY	FUNCTION
10	**MENU KEYPAD** Consists of 6 keys which provide the following functions for the Control Panel Menus:	
	MENU	Steps through the main menu categories shown in Figure 2-1. The Menu categories wrap around in the order shown.
	BACK	Allows you to go back to the previous menu level without changing any information. Continuously pressing this key will bring you back to the default status display in the VFD. Also, this key allows you to go back to the top of a main menu category.
	▲ (Up) Arrow	When in one of the main menu categories (Figure 1-2), pressing this key will select the displayed menu category. If the **CHANGE** key was pressed and the menu item is flashing, pressing the ▲ arrow key will increment the selected setting.
	▼ (Down) Arrow	When in one of the main menu categories (Figure 1-2), pressing this key will select the displayed menu category. If the **CHANGE** key was pressed and the menu item is flashing, pressing the ▼ (Down) arrow key will increment the selected setting.
	CHANGE	Permits a setting to be changed (edited). A valid password must be entered before changing most menu items. When the **CHANGE** key is pressed, the displayed menu item will begin to flash. Pressing the ▲ or ▼ arrow key when the item is flashing will increment or decrement the displayed setting.
	ENTER	Saves the modified menu information in memory. The display will stop flashing.
11	**AUTO/MAN** Switch	This switch toggles the boiler between the Automatic and Manual modes of operation. When in the Manual (**MAN)** mode, the front panel controls are enabled and the **MANUAL** status LED lights. When in the Automatic (**AUTO)** mode, the **MANUAL** status LED will be off and the front panel controls disabled.
12	**VALVE POSITION** Bargraph	20 segment red LED bargraph continuously shows the Valve Open Position in 5% increments from 0 to 100%

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SECTION 2 - CONTROL PANEL MENU STRUCTURE

2.1 CONTROL PANEL MENUS

The Control Panel incorporates an extensive menu structure which permits the operator to set up, and configure the unit. The menu structure consists of seven (7) major menus, as shown in Figure 2-1. Each menu contains options that permit operating parameters to be viewed or changed. The menus are protected by two different password levels to prevent unauthorized use.

- Password Level 1 allows viewing of all menu categories and also allows the Setup, Configuration and Tuning Menu options to be changed. For Software Version 3.08.xx, the user-selectable options in the WHM menu can also be viewed or changed.
- Password Level 2 allows viewing and changing of all Level 1 menu categories and also allows access to the Combustion Calibration (Cal), Calibration and Diagnostic Menus. For Software Version 3.08.xx, additional options in the WHM menu can be viewed or changed. These additional menu categories should only be used by factory trained personnel to calibrate and troubleshoot the unit.

A third Password Level called the Factory Password also exists. However, access to this menu is restricted to Factory Authorized personnel only.

Prior to entering the correct password, the options contained in the Operating, Setup, Configuration and Tuning Menu categories can be viewed. However, except for Internal Setpoint Temperature (Configuration Menu), none of the viewable menu options can be changed.

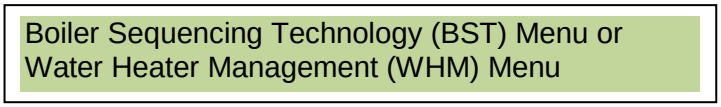
Once the valid Level 1 (159) or Level 2 (6817) password is entered, the options listed in the available menus can be viewed and changed, if desired.

2.2 MENU PROCESSING PROCEDURE

Accessing each menu and option is accomplished using the Menu Keys shown in Figure 1-1. Therefore, it is imperative that you be thoroughly familiar with the following basic steps before attempting to perform specific menu processing procedures.

1. The Control Panel will normally be in the Operating Menu and the VFD will display the current unit status. Pressing the ▲ or ▼ arrow key will display the other available data in the Operating Menu.
2. Press the **MENU** key. The display will show the Setup Menu that is the next menu category shown in Figure 2-1. This menu contains the Password option which must be entered if other menu options will be changed.
3. Continue pressing the **MENU** key until the desired menu is displayed.
4. With the desired menu displayed, press the ▲ or ▼ arrow key. The first option in the selected menu will be displayed.

5. Continue pressing the ▲or ▼ arrow key until the desired menu option is displayed. Pressing the ▲ arrow key will display the available menu options in the Top-Down sequence. Pressing the ▼ arrow key will display the options in the Bottom-Up sequence. The menu options will wrap-around after the first or last available option.
6. To change the value or setting of a displayed menu option, press the **CHANGE** key. The displayed option will begin to flash. Press the ▲ or ▼ arrow key to scroll through the available menu option choices for the option to be changed. The menu option choices do not wrap around.
7. To select and store a changed menu option, press the **ENTER** key.



NOTE: For BMK Boilers, the BST Menu is available in versions 4.00.01 or higher and enabled in the Configuration Menu.

Figure 2-1. Menu Structure

NOTE

Paragraphs 2.3 through 2.9 provide brief descriptions of the options contained in each menu. Refer to Section 3 for detailed descriptions of each menu option.

2.3 OPERATING MENU

The Operating Menu displays the unit status and a number of key operating parameters for the unit as listed in Table 2-1. This menu is "Read-Only" and does not allow personnel to change or adjust any of the displayed items. Since this menu is "Read-Only", it can be viewed at any time without entering a password. Press the ▲ arrow key to display the menu item in the order listed (Top-Down). Pressing the ▼ arrow key will display the menu items in reverse order (Bottom-Up).

NOTE

The Outdoor Temp display item shown with an asterisk in Table 2-1 will not be displayed unless the Outdoor Sensor function has been enabled in the Configuration Menu (Table 2-3).

Table 2-1: Operating Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Status Message			
Active Setpoint	40°F	240°F	
Air Temp	-70°F	245°F	
Outdoor Temp*	-70°F	130°F	
Valve Position In	0%	Max Valve Position	
Flame Strength	0%	100%	
Run Cycles	0	999,999,999	
Run Hours	0	999,999,999	
Fault Log	0	9	0

2.4 SETUP MENU

The Setup Menu (Table 2-2) permits the operator to set the unit password which is required to change any of the menu options. To prevent unauthorized use, a previously entered password entry will time-out after 1 hour.

Therefore, the password must be reentered when required. In addition to permitting password entries, the Setup Menu is also used to enter date and time, language to be used for display messages, units of temperature measurements and entries required for external communication and control of the unit via the RS232 port. A view-only software version display is also provided to indicate the current Control Box software version,

Table 2-2: Setup Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Passsword Level 1 = 159 Level 2 = 6817	0	9999	0
Language	English		English
Time	12:00 am	11:59 pm	
Date	01/01/00	12/31/99	
Unit of Temp	Fahrenheit Celsius		Fahrenheit
Comm Address	0	127	0
Baud Rate	2400 4800 9600 19.2K		9600
OnAER Mode	Ethernet SD Card		Ethernet
Min. Upload Timer	30	9999	0
Unit Alpha	A	Z	E
Unit Year	00	99	00
Unit Serial#	0000	9999	0000
Software Version	Read Only		Current software version is displayed

2.5 CONFIGURATION MENU

The Configuration Menu shown in Table 2-3 permits adjustment of the Internal Setpoint (Setpt) temperature regardless of whether the valid password has been entered. Setpt is required for operation in the Constant Setpoint mode. The remaining options in this menu require the valid password to be entered, prior to changing existing entries. This menu contains a number of other configuration settings which may or may not be displayed, depending on the current operating mode setting.

NOTE

The Configuration Menu settings shown in Table 2-3 are Factory-Set in accordance with the requirements specified for each individual order. Therefore, under normal operating conditions, no changes will be required.

Table 2-3: Configuration Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Internal Setpt	Lo Temp Limit	Hi Temp Limit	130°F
Unit Type	KC Boiler, KC Boiler LN, BMK Boiler Std, BMK Boiler LN, BMK Blr Std Dual, BMK Blr LN KC Water Heater, KC Wtr Heater LN, Innovation WH		BMK Boiler LN
Unit Size	600 MBH, 750 MBH, 800 MBH 1000 MBH, 1060 MBH, 1500 MBH, 2000 MBH, 3000 MBH		1000 MBH
Fuel Type	Natural Gas, Propane		Natural Gas
Boiler Mode	Constant Setpoint, Remote Setpoint, Direct Drive, Combination, Outdoor Reset		Constant Setpoint
Remote Signal (If Mode = Remote Setpoint, Direct Drive or Combination)	4 – 20 mA/1 – 5V, 0 -20 mA/0 – 5V PWM Input (BMS), Network		4 – 20 mA, 1-5V
Bldg Ref Temp, (If Mode = Outdoor Reset)	40°F	230°F	70°F
Reset Ratio, (If Mode = Outdoor Reset)	0.1	9.9	1.2
Outdoor Sensor	Enabled or Disabled		Disabled
System Start Tmp. (If Outdoor Sensor = Enabled)	30°F	100°F	60°F
Setpt Lo Limit	40°F	Setpt Hi Limit	60°F
Setpt Hi Limit	Setpt Lo Limit	220°F	200°F
Temp Hi Limit	40°F	240°F	210°F
Max Valve Position	40%	100%	100%
Pump Delay Timer	0 min.	30 min.	0 min.
Aux Start On Dly	0 sec.	120 sec.	0 sec.
Failsafe Mode	Shutdown or Constant Setpt		Shutdown
*Analog Output (See CAUTION at end of Table)	Off, Setpoint, Outlet Temp, Valve Position 4-20 mA, Valve Position 0-10V		*Valve Position 0-10V
Low Fire Timer	2 sec.	600 sec.	2 sec.
Setback Limiting	Enabled or Disabled		Disabled

Table 2-3: Configuration Menu – *Continued*

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Setpt Limit Band	0°F	10°F	5°F
Network Timeout	5 Sec	999 Sec	30 Sec
Hi DB Setpt En	0%	100%	30%
Demand Offset	0	25	10
Deadband High	0	25	2
Deadband Low	0	25	2
Spark Monitor	Enabled or Disabled		Disabled
Spark Current	Display		
IGST Version	Read Only		Current Version Displayed
Slow Shutdown	Enabled or Disabled		Disabled
BST Menu	Enabled or Disabled		Disabled

***CAUTION**:
DO NOT CHANGE the Analog Output Menu Item from its Default setting (Valve Position 0-10V).

2.6 WATER HEATER MANAGEMENT (WHM) MENU

The WHM Menu is only used with C-More software version 3.08.xx. It can only be viewed when the Unit Type option in the Configuration Menu is set to Innovation WH.

This menu is used to connect up to 8 Innovation Water Heaters in parallel to create a Water Heater Management System. Each of the heaters must be equipped with an actuator-controlled sequencing valve. Refer to Section 8 of this manual for detailed descriptions and and set-up instructions for a WHM System.

Some of the options in the WHM Menu can be changed by the user while others are intended for factory trained personnel only. Therefore, the WHM Menus is protected by two password levels; Level 1 for users and Level 2 for factory-trained personnel. The menu options protected by each password level are listed in Table 2-4. When the Level 2 password All of the menu options shown in this table can be viewed or changed.

Table 2-4: WHM Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Password Level 1			
WHM Mode	Off WHM Slave, WHM Master		Off

WHM Setpoint	60ºF	195ºF	130ºF
WHM Setpoint	60ºF	195ºF	130ºF
Next On VP	16%	100%	75%
Next Off VP	16%	100%	35%
Lead/Lag Hours	25	225	72
WHM Upload Timer	0	9999	0
Setback Setpoint	40ºF	220ºF	130ºF
Setback Start	12:00 am	11:59 pm	12:00 am
Setback End	12:00 am	11:59 pm	12:00 am

Table 2-4: WHM Menu - Continued

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Password Level 2 (includes all of the previous options, plus the following:)			
WHM Auto Mstr	Yes or No		No
WHM Auto Timer	10 sec.	120 sec.	30 sec.
WHM Min Addr	1	8	1
WHM Max Addr	1	8	8
WHM On Delay	30 sec.	300 sec.	60 sec.
WHM Off Delay	30 sec.	300 sec.	60 sec.
WHM Min Units	1	8	1
WHM Warmup Time	0 sec	300 sec.	30 sec.
WHM On Timeout	15 sec.	300 sec.	30 sec.
WHM Valve State	0 (closed) or 1 (open)		read only
WHM Units (1 – 8)	0 = Off 1 = On - = Off-Line * = Not available (fault, etc.) A = Lead On B = Lag On a = Lead Off b = Lag Off		

2.7 Boiler Sequencing Technology (BST) Menu

See Chapter 9.

2.8 TUNING MENU

The Tuning Menu items in Table 2-5 are factory set for each individual unit. Do not change these menu entries unless specifically requested to do so by factory-trained personnel.

NOTE

The Breakpoint Menu items shown in Table 2-5 with an asterisk are displayed only if Unit Type = Water Heater and the Heatr Bkpt Dsp option in the Calibration Menu (Table 2-6) is Enabled. These Breakpoint values correspond to a 130°F default setpoint.

Table 2-5: Tuning Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Prop Band	1°F	120°F	70°F (Boiler) 8°F (Water Heater)
Integral Gain	0.00	2.00	1.00 (Boiler) 1.60 (Water Heater)
Derivative Time (If Unit Type = Boiler)	0.00 min	2.00 min	0.00 min (Boiler) 0.10 min (Water Heater)
Min Load Adj (If Unit Type = Water Heater)	-50°F	50°F	0°F
Max Load Adj (If Unit Type = Water Heater)	-50°F	50°F	0°F
FFWD Temp (If Unit Type = Water Heater)	30°F	245°F	
Outlet Feedback (If Unit Type = Water Heater)	On (Yes) Off (No)		On (Yes)
Feedback Gain (If Unit Type = Water Heater & Heatr Tuning Dsp is Enabled)	.01	1.00	0.05
Breakpoints shown if Unit Type = Water Heater)			
Breakpt at 100%*	30°F	240°F	77°F
Breakpt at 90%*	30°F	240°F	81°F
Breakpt at 80%*	30°F	240°F	85°F
Breakpt at 70%*	30°F	240°F	91°F
Breakpt at 60%*	30°F	240°F	95F
Breakpt at 50%*	30°F	240°F	102F
Breakpt at 40%*	30°F	240°F	110°F
Breakpt at 30%*	30°F	240°F	112°F
Breakpt at 20%*	30°F	240°F	114°F
Breakpt at 10%*	30°F	240°F	130°F
Breakpt at 0%*	30°F	240°F	135°F
Warmup Prop Band	Range 1-120		Default 95
Warmup Int Gain	Range 1-200		Default 50
Warmup PID Timer	Range 1-240		Default 20
Reset Defaults?	Yes, No, Are You Sure?		No

2.9 COMBUSTION CAL MENU

The Combustion Cal (Calibration) Menu items are used to vary the speed of the unit's blower motor based on air temperature and air density at prescribed Air/Fuel Valve positions. These valve positions (% open) may vary depending on the Unit Type and Fuel selected in the Configuration Menu (Table 2-3). The blower motor speed is varied by providing a DC drive voltage to the motor which adjusts the rotational speed of the blower to maximize combustion efficiency.

C-More controllers with software Version 3.07.xx, used on all Benchmark (BMK) sizes and all KC1000 units, check calibration at 6 prescribed valve positions. Table 2-6 shows a sample listing, which applies to BMK 750 MBH and BMK 1000 MBH using Natural Gas. Refer to Table 3-2A for default values associated with each unit type and size.

Table 2-6: Sample Combustion Cal Menu (Version 3.07.xx)

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
CAL Voltage 18%	.25v	8.20v	1.80v
CAL Voltage 30%	.25v	8.20v	3.20v
CAL Voltage 45%	.25v	8.20v	3.70v
CAL Voltage 60%	.25v	8.20v	3.80v
CAL Voltage 80%	.25v	8.20v	4.60v
CAL Voltage 100%	.25v	8.20v	6.00v
SET Valve Position	0%	100%	0%
Blower Output	Monitor Blower Output Voltage		.00

C-More controllers with software version 3.08.xx, used on Innovation (INN) Water Heaters, check calibration at 8 prescribed valve positions. Table 2-7 shows a sample listing which applies to INN 1060 units running on Natural Gas. Refer to Table 3-2B for default values associated with each INN unit size and fuel used.

Table 2-7: Sample Combustion Cal Menu (Version 3.08.xx)

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
CAL Voltage 16%	.25v	8.20v	1.90v
CAL Voltage 20%	.25v	8.20v	2.30v
CAL Voltage 30%	.25v	8.20v	2.80v
CAL Voltage 40%	.25v	8.20v	3.00v
CAL Voltage 50%	.25v	8.20v	3.60v
CAL Voltage 60%	.25v	8.20v	3.90
CAL Voltage 80%	.25v	8.20v	4.80
CAL Voltage 100%	.25v	8.20v	6.00v
SET Valve Position	0%	100%	0%
Blower Output	Monitor Blower Output Voltage		.00

2.10 CALIBRATION MENU

The Calibration Menu is used by Factory Trained Service personnel to adjust or reset the parameters listed in Table 2-8.

Table 2-8: Calibration Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Stepper Fbk (Not adjustable via RS232 serial communication)	Cal 0% Cal 100% Verify 50%		Cal 0%
PWM In Adj	-5.0%	5.0%	0.0%
Supply Gas Pressure In Adj	-5.0%	5.0%	0.0%
Gas Plate dp In Adj	-5.0%	5.0%	0.0%
mA Out Adj	-1.0 mA	1.0 mA	0.0 mA
A/F Sensitivity	1%	5%	2%
Power Reset	Automatic orManual		Automatic
Water Temp Reset	Automatic or Manual		Automatic
Gas Press Reset	Automatic or Manual		Manual
Min Off Time	0 Min	15 Min	1 Min (Boiler) 0 Min (Water Heater)
Heatr Tuning Dsp (If Unit Type = Water Heater)	Enabled or Disabled		Disabled

Table 2-8: Calibration Menu - *Continued*

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Heatr Bkpt Dsp (If Unit Type = Water Heater)	Enabled or Disabled		Disabled
Stop Level	0%	Start Level	16
Start Level	Stop Level	40%	20
Skip Range Cntr	10	95	40
Skip Range Span	0	3	0
Skip Speed	5	20	5
O2 Gain	920	1126	1024
O2 Offset	-3.0	+3.0	0
FFWD Temp Offset	-20	+20	0
Exhst Tmp Offset	-20	+20	0
Outdr Air Offset	-20	+20	0
Inlet Air Offset	-20	+20	0
Inlet Wtr Offset	-20	+20	0
Outlet Wtr Offset	-20	+20	0
0 – 10v Out Test	0.00	10.00	

2.11 DIAGNOSTICS MENU

The Diagnostics Menu shown in Table 2-9 is used by Factory-Trained Service personnel to troubleshoot the unit. This menu category contains a number of Built In Test (BIT) test routines to be used to check the operational status of the Control Panel displays and keypad keys. It also allows the operator to activate relays, view switch status and increment the stepper motor contained in the Air/Fuel Valve.

NOTE

With the exception of the Sensor Log Interval (Int) setting, none of the following Diagnostic Menu items can be initiated via a remote serial communications link.

Table 2-9: Diagnostics Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Exhaust Temp Sens	Enable, Disable		Disable
In Wtr Temp Sens	Enable, Disable		Disable
In Gas Press Sen	Enable, Disable		Disable
Gas Plate dp Sen	Enable, Disable		Disable
In Water Flw Sen	Enable, Disable		Disable
Display Test	Off, LEDs, 7-Seg Bar-graph		Off
Keypad Test	Off, Manual, Menu Up, Down, Change, Enter, Clear (BACK Key exits test mode)		Off
Relay Test (Allows user to force outputs ON or OFF)	Off, Igniter ON/Igniter OFF, Blower ON/Blower OFF Pump ON/Pump OFF, Aux ON/Aux OFF Fault ON/Fault OFF		Off
Switch Test (Allows user to view the status of all switch inputs)	Off, Exhaust sw ON/Exhaust sw OFF SSOV sw ON/SSOV sw OFF Blower Proof ON/Blower Proof OFF Ignition sw ON/Ignition sw OFF Over Temp sw ON/Over Temp sw OFF Low Gas Pres ON/Low Gas Pres OFF Hi Gas Pres ON/Hi Gas Pres OFF Water Lev sw ON/Water Lev sw OFF Rem Int sw ON/Rem Int sw OFF Front Pnl sw ON/Front Pnl sw OFF Delayed Int ON/Delayed Int OFF Purge sw ON/Purge sw OFF		Off
Stepper Test (Allows user to adjust the stepper motor position using the ▲ and ▼ keys)	0%	100%	0%
Sensor Log Int (Allows user to set the time interval for logging Sensor inputs in Database)	Off 1 Min, 5 Min, 15 Min, 30 Min 1 Hr, 6 Hrs, 12 Hrs, or 24 Hrs		30 Min.

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SECTION 3 - CONTROL PANEL MENU DESCRIPTIONS

3.1 MENU ITEM DESCRIPTIONS

Descriptions of the menu items and options contained in each of the seven (7) major menu categories are listed and described in Table 3-1.

Table 3-1: Menu Item Descriptions

MENU LEVEL & OPTION	DESCRIPTION
Operating Menu	
Active Setpoint	This is the setpoint temperature to which the control is operating when operating in the Constant Setpoint, Remote Setpoint or Outdoor Reset (boiler only) Mode. When in the Constant Setpoint Mode, this value is equal to the Internal Setpoint setting in the Configuration Menu. When in the Remote Setpoint Mode, this value is the setpoint equivalent to the remote analog signal supplied to the unit. When operating a boiler in the Outdoor Reset Mode, this is the value derived from the chart in Appendix B.
Air Temp	Air Temp displays the temperature of the air input to the Air/Fuel Valve. This reading is one of the components used to calculate blower motor speed during the Combustion Calibration process.
Outdoor Temp	Displayed only if outdoor sensor is installed and enabled.
Valve Position In	Desired input Valve Position. This would normally be the same as the Valve Position shown on the bar-graph (Valve Position out) when the boiler is operating.
Flame Strength	Displays flame strength from 0 to 100%.
Run Cycles	Displays the total number of run cycles from 0 to 999,999,999.
Run Hours	Displays total run time of unit in hours from 0 to 999,999,999.
Fault Log	Displays information on the last 20 faults (numbered 0 through 19).

Table 3-1: Menu Item Descriptions *- Continued*

MENU LEVEL & OPTION	DESCRIPTION
Setup Menu	
Password Level 1 Level 2	Allows Level 1 or Level 2 password to be entered. Entering the Level 1 Password (159) allows options in the Setup, Configuration and Tuning Menus to be modified. Entering the Level 2 Password (6817) allows options in the Calibration and Diagnostics Menus to be changed or activated, in addition to all Level 1 Menu options.
Language	English is the ONLY language available
Time	Displays time from 12:00am to 11:59pm.
Date	Displays dates from 01/01/00 to 12/31/99
Unit of Temp	Permits selection of temperature displays in degrees Fahrenheit (°F) or degrees Celsius (°C). Default is °F.
Comm Address	For RS485 Modbus communications (0 to 127). Default address is 0.
Baud Rate	Allows the RS232 communication Baud Rate to be set (2400 to 19.2K). Default is 9600.
OnAER Mode	Enables Ethernet communication in the I/O box or SD Card data logging. The SD Card is for future use.
Min Upload Timer	Mandatory for AERCO OnAER Remote Data Collection. This parameter defines the minimum amount of time between heartbeat data uploads in seconds. A setting of zero disables OnAER. The COMM LED will light/blink during the upload. 60-90 seconds is recommended.
Unit Alpha	Mandatory for AERCO OnAER Remote Data Collection. This value must match the first alpha digit on the Code Plate. e.g. **G**-12-1234.
Unit Year	Mandatory for AERCO OnAER Remote Data Collection. This value must match the 2-digit year on the Code Plate. e.g. G-**12**-1234.
Unit Serial #	Mandatory for AERCO OnAER Remote Data Collection. This value must match the 4-digit serial # on the Code Plate. e.g. G-12-**1234**.
Software Version	Identifies the current software version of the control box.

***Table 3-1: Menu Item Descriptions** - Continued*

MENU LEVEL & OPTION	DESCRIPTION
Configuration Menu	
Internal Setpoint	Allows internal setpoint to be set (40°F to 240°F). Default is 130°F.
Unit Type	Allows selection of: KC Boiler, KC Boiler LN, BMK Boiler Std, BMK Boiler LN, BMK Blr Std Dual, BMK Blr LN Dual, KC Water Heater, KC Wtr Heater LN, Innovation WH
Unit Size	Sets unit size from 500 MBH to 6000 MBH. Default is 2000 MBH.
Fuel Type	Allows selection of fuel type used (Natural Gas or Propane. Default is Natural Gas. **When selecting "Natural Gas" as the Fuel Type.** (a) The ignition Trial Time is set to 4 seconds. (b) The "Natural Gas" parameters will be enabled while running to ensure proper combustion. (c) The "Natural Gas" parameters will be used when performing Combustion Calibration. **When selecting "Propane" as the Fuel Type.** (a) The Ignition Trial Time is set to 4 seconds. (b) The "Propane" parameters will be enabled while running to ensure proper combustion. (c) The "Propane" parameters will be used when performing Combustion Calibration.
Boiler Mode (If Unit Type = Boiler)	Allows selection of: Constant Setpoint, Remote Setpoint, Direct Drive, Combination, or Outdoor Reset Mode. Default is Constant Setpoint Mode.
Heater Mode (If Unit Type = Water Heater)	Allows selection of Constant Setpoint or Remote Setpoint Mode. Default is Constant Setpoint Mode.
Remote Signal (If Mode = Remote Setpoint, Direct Drive or Combination)	Used to set the type of external signal which will be used when operating in the Remote Setpoint, Direct Drive or Combination Mode. Default is 4 to 20 mA / 1 to 5V.
Bldg Ref Temp (If Boiler Mode = Outdoor Reset)	Allows the building reference temperature to be set when operating a boiler in the Outdoor Reset Mode. Default is 70°F
Reset Ratio (If Boiler Mode = Outdoor Reset)	Permits setting of Reset Ratio when operating boiler in the Outdoor Reset Mode. Reset Ratio is adjustable from 0.1 to 9.9. Default is 1.2.
Outdoor Sensor	Allows outdoor sensor function to be enabled or disabled. Default is Disabled.

Table 3-1: Menu Item Descriptions *- Continued*

MENU LEVEL & OPTION	DESCRIPTION
Configuration Menu - (Continued)	
System Start Tmp (If Outdoor Sensor is Enabled)	If outdoor sensor is enabled, this menu item allows the system start temperature to be set from 30°F to 100°F. Default is 60°F.
Setpoint Lo Limit	Used to set the minimum allowable setpoint (40°F to Setpoint Hi Limit). Default is 60°F
Setpoint Hi Limit	Used to set the maximum allowable setpoint (Setpoint Lo Limit to 240°F). Default is 200°F.
Temp Hi Limit	This is the maximum allowable outlet temperature (40°F to 240°F). Any temperature above this setting will turn off unit. The temp must then drop 5°F below this setting to allow the unit to run. Default Hi Limit is 210°F.
Max Valve Position	Sets the maximum allowable Valve Position for the unit (40% to 100%). Default is 100%.
Pump Delay Timer (If Unit Type = Boiler)	Specifies the amount of time (0 to 30 min.) to keep the pump running after the unit turns off. Default is zero.
Aux Start On Dly	Specifies the amount of time to wait (0 to 240 sec.) between activating the Aux Relay (due to a demand) and checking the pre-purge string to start the unit. Default is 0 sec.
Failsafe Mode	Allows the Failsafe Mode to be set to either Constant Setpoint or Shutdown. Default is Shutdown.
Analog Output	Can be set to allow this output to monitor Setpoint, Outlet Temperature, Valve Position 4-20 mA, Valve Position 0-10v or be set to OFF. Default is Valve Position 0-10v.
Low Fire Timer	Specifies how long (2 to 600 sec.) to remain in the low fire position after ignition, before going to the desired output. Default is 2 sec.
Setpt Limiting	Allows Setpt Limiting to be enabled or disabled. Default is disabled.
Setpt Limit Band	When Setpt Limiting is enabled, this menu item allows the Setpt Limit Band to be set from 0°F to 10°F. Default is 5°F.
Network Timeout	Specifies the timeout value before a Modbus Fault is declared. Setting range is 5 - 999 seconds. Default is 30 seconds.
HI DB Setpt En	Operating at a Valve Position below this value will inhibit the DEADBAND feature. When operating at a Valve Position below this value, the effective Setpoint is Active Setpoint + Deadband High. Setting range is 0-100. Default is 30.
Demand Offset	This entry will reduce excessive ON/OFF cycling in AUTO mode. When this entry is a non-zero value, the unit will not turn on again until Valve Position In reaches the Start Level value AND the Outlet Temperature goes below Active Setpoint - Demand Offset. In addition, the boiler will fire at the 29% Valve Position level or below for a period of one minute. When this entry is set to zero, the unit will turn on again as soon as the Valve Position In reaches the Start Level value. There will be no one minute delay firing at the 29% Valve Position level. Setting Range is 0-25. Default is 10.

Table 3-1: Menu Item Descriptions *- Continued*

MENU LEVEL & OPTION	DESCRIPTION
Configuration Menu - (Continued)	
Deadband High Deadband Low	Deadband High and Deadband Low settings create an "Outlet Temperature" ZONE in which no Valve Position corrections will be attempted. The deadband ZONE is defined as operating with a an Outlet Temperature anywhere between Active Setpoint + Deadband High and Active Setpoint - Deadband Low. When the Outlet Temperature reaches "Active Setpoint" and remains there for a period of 15 seconds, The unit will go into a DEADBAND MODE at which point no Valve Position corrections will be attempted while the Outlet Temperature remains anywhere within the Deadband ZONE. When the unit is in the "DEADBAND MODE", the °F or °C LED will flash on and off. When the Outlet Temperature drifts out of the Deadband ZONE, the DEADBAND MODE will be terminated and the MD LOOP will again attempt Valve Position corrections. Setting Range is 0-25. Default is 2 for both Deadband High and Deadband Low.
Spark Monitor	Enables or disables the Spark Monitor function, which displays the AC current on the input of the Ignition Transformer.
Spark Current	Displays the AC current on the input of the Ignition Transformer.
IGST Version	Displays the current Ignition Stepper board firmware version.
Slow Shutdown	Enable or disable slow shutdown mode. The current setting is displayed.
BST Menu	Enable or disable the BST menu. The current setting is displayed.
Spark Current	Displays the AC current on the input of the Ignition Transformer.
Tuning Menu	
Prop Band	Generates a valve position based on the error that exists between the setpoint temperature and the actual outlet temperature. If the actual error is less than the proportional band setting (1 to 120°F), the valve position will be less than 100%. If the error is equal to or greater than the proportional band setting, the valve position will be 100%. Defaults are 70°F (Boiler), 8°F (Water Heater)
Integral Gain	This sets the fraction of the output, due to setpoint error, to add or subtract from the output each minute to move towards the setpoint. Gain is adjustable from 0.00 to 2.00 (Defaults are 1.00 for Boilers, 1.60 for Water Heaters).
Derivative Time	This value (0.00 to 2.00 min.) responds to the rate of change of the setpoint error. This is the time that this action advances the output. (Defaults are 0.0 min. for Boilers, 0.10 min. for Water Heaters)
Min Load Adj (If Unit Type = Water Heater)	Setting is adjustable from -50°F to +50°F (Default is zero). It adjusts the output by adding an offset to the breakpoint chart at minimum flow. This is used to fine tune Feed-Forward (FFWD) output at low flow levels.
Max Load Adj (If Unit Type = Water Heater)	Setting is adjustable from -50°F to +50°F (Default is zero). It adjusts the output by changing the scaling of the breakpoint chart at maximum flow.
FFWD Temp (If Unit Type = Water Htr)	Displays the Feed-Forward temperature.

Table 3-1: Menu Item Descriptions *- Continued*

MENU LEVEL & OPTION	DESCRIPTION	
Tuning Menu (Continued)		
Outlet Feedback	Used to Enable or Disable feedback. Disable this function for Feed-Forward control only.	
Feedback Gain (If Unit Type = Water Heater)	Adjustable from 0.01 to 1.00 (Default is 0.05).	
Breakpoint at 100% Thru Breakpoint at 0% (If Unit Type = Water Heater)	Allows breakpoint temperature settings to be entered for 100% to 0% in 10% increments. The Bkpt Dsp options in the Calibration Menu must be enabled to view breakpoint temperatures. See Table 2-4 for breakpoint default values.	
WARMUP: The feature embodied in the following three menu items eliminates Temperature Overshoots during the "Warmup" period of a cold ignition cycle on all boilers by temporarily modifying the PID Gain parameter during warmup and for a period defined in the Tuning Menu.		
Warmup Prop Band	Range = 1-120	Default = 95
Warmup Int Gain	Range = 1-200	Default = 50
Warmup PID Timer	Range = 1-240	Default = 20
Reset Defaults?	Resets Tuning Menu options to Factory Defaults	
Water Heater Management (WHM) Menu – (Software Version 3.08.xx Only)		
Password Level 1 Options:		
WHM Mode	This option is used to enable/disable the WHM Mode and set the unit to function as a WHM Slave, or WHM Master. (Default = Off)	
WHM Setpoint	This is the temperature (°F) that each unit in the WHM system is trying to control to. (Default = 130°F)	
Next On VP	This is the Next On A/F Valve position (%) for the system. When all enabled water heaters have a fire rate greater than this value, it is time to enable another water heater, if one is available. This value should always be greater than the Next Off A/F Valve, and there should be a reasonable spread between the 2 values. (Default = 65%)	
Next Off VP	This is the Next Off A/F Valve position (%) for the system. When all enabled water heaters have a A/F Valve position greater than this value, it is time to enable another water heater, if one is available. This value should always be greater than the Next Off A/F Valve position, and there should be a reasonable spread between the 2 values. (Default = 35%)	
Lead/Lag Hours	This feature is basically designed spread the total number of run hours accumulated on all units in the system so that each of the units have approximately the same number of run hours. The default value for this option is 72 hours,	
WHM Upload Timer	Communication data logging period in seconds between 0 to 9999. A value between 60 and 120 seconds is recommended. Note: If OnAER is enabled for WHM the Min Upload Timer in the Setup Men should be set between 300-600 seconds.	

***Table 3-1: Menu Item Descriptions** - Continued*

MENU LEVEL & OPTION	DESCRIPTION
Water Heater Management (WHM) Menu (Continued)	
Setback Setpoint	This is the setpoint temperature (°F) that each unit in the WHM system is trying to control to during periods of low (or no) DHW demand. The setback setpoint temperature can be set from 40°F to 220°F (Default = 130°F)
Setback Start Setback End	Specifies the start and end times that the Setback Setpoint will be in effect. (12:00am – 11:59pm)
Password Level 2 Options:	
WHM Auto Mstr	Enables (Yes) or disables (No) an Automatic WHM Master Switch-Over function. When enabled (Yes) the WHM will automatically select a new Master if the current Mater fails or loses power. Default = No (Disabled)
WHM Auto Timer	When the WHM Auto Mstr option is set to Yes (Enabled), the WHM Auto Timer option allows the user to select the elapsed time interval between failure of the WHM Master and switch-over to a new WHM Master. The default for this option is 30 seconds. The allowable entry range is 10 seconds to 120 seconds (Default = 30 seconds.
WHM Min Addr WHM Max Addr	Specifies the Minimum and Maximum Modbus addresses for the Innovation Water Heaters on the network. To simplify addressing, assign consecutive address numbers 1 through 8.
WHM On Delay WHM Off Delay	Specifies the WHM On and Off time delays associated with the Next ON VP and Next OFF VP menu options. Therefore, if the Next ON VP or Next OFF VP is at its preset Valve Position (%) for the specified Delay period, another heater will be turned ON or OFF. This is done to prevent cycling units on and off during short changes in load. Range = 30 to 300 seconds (Default = 60 sec.)
WHM Min Units	Specifies the number of units in the WHM system. Unit range is 1 through 8. Default = 1.
WHM Warmup Time	Specifies the warm-up time in minutes for the system. This value can be set from 0 to 300 minutes. (Default = 30)
WHM ON Timeout	Specifies the time that the WHM waits to see if a unit that it just turned On is actually running.
WHM Valve State	Displays the status of the WHM Sequencing Valve. (1 = ON, 0 = OFF)
1 WHM Units 8 _ _ _ _ _ _ _ _	This menu item shows the current status for each of the units being controlled by the WHM (8 max.). The characters in the display are defined as follows: - = Off Line, * = Not available (fault, etc.), 0 = Off, 1 = On, A = Lead On, a = Lead Off, B = Lag On, b = Lag Off The following example shows the status of 4 units (1 thru 4) being controlled by the WHM: 1 WHM Units 8 _1_ _0_ _1_ _*_ _A_ _b_ ___ ___ Where: Unit 1 & 3 = On, Unit 2 = Off, Unit 4 = Not available, Unit 5 = Lead On, Unit 6 = Lag Off

Table 3-1: Menu Item Descriptions *- Continued*

MENU LEVEL & OPTION	DESCRIPTION
Combustion Cal Menu (Controller Software Version 3.07.xx) **NOTE:** The CAL Voltage xx% values may differ according to the unit Size & Fuel Type selected in the Configuration Menu. Refer to Table 3-2A for setting & defaults for all unit sizes.	
*CAL Voltage 16%	Allows for the selection of the Blower Motor output voltage at 16%
*CAL Voltage 30%	Allows for the selection of the Blower Motor output voltage at 30%
*CAL Voltage 45%	Allows for the selection of the Blower Motor output voltage at 45%
*CAL Voltage 60%	Allows for the selection of the Blower Motor output voltage at 60%
*CAL Voltage 80%	Allows for the selection of the Blower Motor output voltage at 80%
*CAL Voltage 100%	Allows for the selection of the Blower Motor output voltage at 100%
Set Valve Position	Allows for setting of VALVE POSITION.
Blower Output	Allows for the monitoring of Blower Output Voltage.
SET Stdby V Out	The Blower Motor remains “ON” in STANDBY Mode. The motor speed is defined by setting this parameter to a non0zero value. Default for INNOVATION WH is 1.00 Volts. All others are 0 Volts.
Combustion Cal Menu (Controller Software Version 3.08.xx) **NOTE:** The CAL Voltage percent values shown apply to all Innovation Water Heater sizes and Fuel Type used. However, the default voltage settings may vary depending on unit size and fuel used. Refer to Table 3-2B for default voltage settings associated with each unit size and fuel type.	
*CAL Voltage 16%	Allows for the selection of the Blower Motor output voltage at 16%
*CAL Voltage 20%	Allows for the selection of the Blower Motor output voltage at 20%
*CAL Voltage 30%	Allows for the selection of the Blower Motor output voltage at 30%
*CAL Voltage 40%	Allows for the selection of the Blower Motor output voltage at 40%
*CAL Voltage 50%	Allows for the selection of the Blower Motor output voltage at 50%
*CAL Voltage 60%	Allows for the selection of the Blower Motor output voltage at 60%
*CAL Voltage 80%	Allows for the selection of the Blower Motor output voltage at 80%
*CAL Voltage 100%	Allows for the selection of the Blower Motor output voltage at 100%
Set Valve Position	Allows for setting of VALVE POSITION.
Blower Output	Allows for the monitoring of Blower Output Voltage.
SET Stdby V Out	The Blower Motor remains “ON” in STANDBY Mode. The motor speed is defined by setting this parameter to a non0zero value. Default for INNOVATION WH is 1.00 Volts. All others are 0.00 Volts.

Table 3-1: Menu Item Descriptions *- Continued*

MENU LEVEL & OPTION	DESCRIPTION
Calibration Menu	
Stepper Fbk (Not adjustable via RS232 serial communication)	Allows the Air/Fuel Valve stepper motor feedback current to be calibrated at the 0% (fully closed) and 100% (fully open) positions. Verification can also be accomplished at the 50% position.
PWM In Adj	Allows the Pulse Width Modulation (PWM) duty cycle to be adjusted from -5.0% to +5.0% in 0.1% increments. Default = 0.0%.
Analog In Adj	Allows adjustment of the analog input from -5.0% to +5.0%. Default = 0.0%.
Flow In Adj	Allows adjustment of the water Flow Rate Input from -5.0% to +5.0%. Default = 0.0%.
Supply Gas Pressure In Adj	Allows adjustment of the Supply Gas Pressure level from -5.0% to +5.0% in 0.1 % increments. Default = 0.0%.
Gas Plate dp In Adj	Allows adjustment of the Gas Plate dp level from -5.0% to +5.0% in 0.1% increments. Default = 0.0%
mA Out Adj	Allows adjustment of the milliamp output from -5.0 mA to +5.0 mA. Default = 0.0 mA
A/F Sensitivity	Allows adjustment of the Air/Fuel (A/F) Valve stepper motor sensitivity to be adjusted from 1% to 5% in 1% increments. Default is 2%.
Power Reset	Allows the Power Reset Option to be set to Auto or Manual. Default is Auto.
Water Temp Reset	Allows the Water Temperature Reset function to be set to Auto or Manual. Default is Auto.
Gas Press Reset	Allows the Gas Pressure Reset function to be set to Auto or Manual. Default is Manual.
Min Off Time	Allows the minimum Off time to be set from 0 to 10 minutes. Default = 1 min. (Boiler), 0 min. (Water Heater).
Heatr Tuning Dsp (Water Heater Only)	Allows Heater Tuning Display to be Enabled or Disabled. Default is Disabled.
Heatr Bkpt Dsp	Allows Heater Breakpoint Display to be Enabled or Disabled. When Enabled, Breakpoints can be viewed and/or changed. Default is Disabled. For water Heaters only.
Stop Level	Allows the Stop Level to be set to a valve position ranging from 0% to the presently set Start Level. Default is 16%.
Start Level	Allows the Start Level to be set to a valve position ranging from the presently set Stop Level to a maximum of 40%. Default is 20%.

Table 3-1: Menu Item Descriptions *- Continued*

MENU LEVEL & OPTION	DESCRIPTION
Calibration Menu (Continued)	
SKIP FEATURE: The following three menu items below embody a feature that allows the user to define a Fire Zone the C-More will avoid. In the rare instance when a boiler emits an objectionable noise at a certain Fire Rate and no other remedy solves the problem, a Fire Rate skip zone may be defined to command the C-More to Skip-Over the defined Fire Rate.	
Skip Range CNTR	Defines the Center (Fire Rate) of the skip band.
Skip Range Span	Defines the + and – band of the Skip Zone Size. 0 = disabled.
Skip Speed	Defines the speed (Seconds/Fire Rate) at which the band will be skipped.
Skip Speed	Defines the speed (Seconds/Fire Rate) at which the band will be skipped.
O2 Settings: The following two menu items allow calibration of the Oxygen readings.	
O2 Gain	Range = 920 to 1126. Default = 1024 (Unity Gain, No Mods)
O2 Offset	Range = -3.0 to +3.0. Default = 1.0.
Temperature Channel Offset: The following six menu items embody the feature, which allows the user to field calibrate all six temperature channels by entering an offset corresponding to the desired temperature channel.	
FFWD Temp Offset	Range = -20ºF to +20ºF. Default = 0º
Inlet Air Offset	Range = -20ºF to +20ºF .
Exhst Tmp Ofset	Range = -20ºFto +20ºF .
Inlet Wtr Offset	Range = -20ºF to +20ºF.
Outdr Air Offset	Range = -20ºF to +20ºF .
Outlet Wtr Offset	Range = -20ºF to +20ºF .
0 – 10V Out Test	

Table 3-1: Menu Item Descriptions *- Continued*

MENU LEVEL & OPTION	DESCRIPTION
Diagnostic Menu	
Exhaust Tmp Sens	Allows the Enabling or Disabling of the alternating warning and fault messages on the VFD display for EXHAUST TEMPERATURE Default is Disabled. (See Table 3-1A)
In Wtr Tmp Sens	Allows the Enabling or Disabling of the alternating warning and fault message on the VFD Display for INLET WATER TEMPERATURE. Default is Disabled. (See Table 3-1A)
In Gas Press Sen	Allows the Enabling or Disabling of the alternating warning and fault message on the VFD Display for INLET GAS PRESSURE. Default is Disabled. (See Table 3-1A)
Gas Plate dp Sen	Allows the Enabling or Disabling of the alternating warning and fault message on the VFD Display for GAS PLATE DIFFERENTIAL. Default is Disabled. (See Table 3-1A)
In Water Flw Sen	Allows the Enabling or Disabling of the alternating warning and fault message on the VFD Display for INLET WATER FLOW. Default is Disabled. (See Table 3-1A)
Display Test**	Allows testing of the front panel LED indicators, 3-character, 7-segment LED Outlet Temperature display and 20-segment LED Bargraph.
Keypad Test**	Allows testing of the operational status of each front panel key. The VFD will display the name of each key as it is pressed.
Relay Test**	Allows user to force relay outputs ON or OFF. The relays tested include: Igniter, Blower, Pump, Aux and Fault relay.
Switch Test**	Allows the ON/OFF status of all switch inputs to be viewed. These switches include: Exhaust, SSOV, Blower Proof, Ignition, Over-Temp, Low Gas Pres, Hi Gas Pres, Water Lev, Rem Int, Front Pnl, Delayed Int and Purge switches.
Stepper Test**	Allows adjustment of the Air/Fuel Valve stepper motor position using the ▲ and ▼ keys. The Bargraph display will light to indicate the current stepper motor position.
Sensor Log Int	Allows the Sensor Log Interval to be set to: 1 Min, 5 Min, 15 Min, 30 Min, 1 Hr, 6 Hrs, 12 Hrs or 24 Hrs. Default setting is 30 Min.

**Not Adjustable via RS232 Serial Port

Table 3-1A: Descriptions Associated With Diagnostic Menu Warnings

EXHAUST TEMPERATURE WARNINGS		
UNIT TYPE	**VALUE**	**C-MORE RESPONSE**
ALL	Open	Displays Fault, continues to run.
ALL	Short	Displays Fault, continues to run.
BMK Boiler LN	>= 300ºF	Displays alternating warning, continues to run.
BMK Boiler LN	>= 500ºF	Displays Fault and Halts.
BMK Boiler	>= 385ºF	Displays alternating warning, continues to run.
BMK Boiler	>= 500ºF	Displays Fault and Halts.
KC Boiler KC Boiler LN KC Water Heater	>= 475ºF	Displays alternating warning, continues to run.
KC Boiler KC Boiler LN KC Water Heater	>= 500ºF	Displays Fault and Halts.
INLET WATER TEMPERATURE WARNINGS		
UNIT TYPE	**VALUE**	**C-MORE RESPONSE**
ALL Boilers	Open	Displays Fault, continues to run.
ALL Boilers	Short	Displays Fault, continues to run.
ALL Water Heaters	Open	Displays Fault and Halts.
ALL Water Heaters	Short	Displays Fault and Halts.
BMK Boiler BMK Boiler LN	>= 210ºF	Displays alternating warning, continues to run.
KC Boiler	>= 230ºF	Displays alternating warning, continues to run.
KC Water Heater KC Water Heater LN	>= 200ºF	Displays alternating warning, continues to run.
ALL	< 20 Deg F	Displays Fault, continues to run.
SUPPLY GAS PRESSURE, GAS PLATE DP, INLET WATER FLOW WARNINGS		
UNIT TYPE	**VALUE**	**C-MORE RESPONSE**
ALL	Open (<3.5 mA)	Displays Fault and Halts

3.1.1 Deadband High & Deadband Low

The *Setpoint, Deadband High* and *Deadband Low* define a PID Correction Deadband in which the outlet temperature is allowed to drift. Allowing the outlet temperature to drift within this range (Figure 3-1) minimizes Air/Fuel Valve corrections when deemed unnecessary.

When the Setpoint Temperature is reached, and remains stable for a period of 15 seconds, the deadband mode is enabled and the **°F** or **°C** LED will flash on and off.

No Air Fuel Valve corrections will be attempted until the Outlet Temperature exits the Deadband zone.

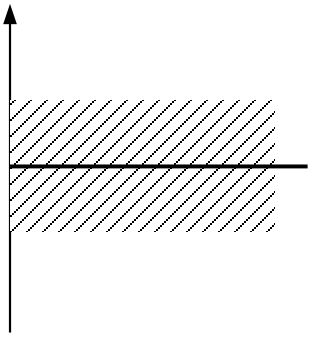

Figure 3-1: PID Correction Deadband

The PID correction Deadband feature is active for both Boilers and Water Heaters. However, this feature is not active in the Direct Drive Mode

3.1.2 HI DB Setpt EN Function

When firing at close to the shutdown limit (minimum Valve Position), the C-More will strive to delay the unit shutdown to Standby Mode for as long as possible while still maintaining adequate temperature control.

When the Valve Position is less than the Hi_DB_Setpt_En setting, (Figure 3-2), the Outlet Temperature target is not Setpoint but Setpoint + Deadband_High.

This means that when operating close to the Shutdown Limit we will strive to increase the Valve Position by changing the Setpoint Temperature to the Setpoint + Deadband_High Temperature limit thus delaying the Shutdown.

Figure 3-2: Valve Position Less Than HI DB Setpt EN

If the unit Valve Position is less than the *HI_DB_SETPT_EN* setting, The C-More will aim to bring the Outlet Temperature to the *Setpoint* + *Deadband_High* value. This will delay shutting *down the unit, thus decreasing "on/off cycling".*

Figure 3-3: Valve Position ≥ HI DB Setpt EN

3.1.3 Demand Offset Function

The *Demand Offset* entry in the *Configuration* Menu allows delay of re-ignition of the unit while maintaining proper temperature control.

In normal operation, the unit will re-ignite when the PID Loop calculates that the required Valve Position is greater than the *Start_Level* value.

Whenever the *Demand_Offset* value is Non Zero, the unit will re-ignite when the PID Loop calculates that the required Valve Position is greater than the *Start_Level* value AND the Outlet_ Temperature drops below the *Setpoint* minus the *Demand_Offset* **value**.

This will delay the unit re-ignition by waiting for the Outlet Temperature to decay.

The default value for *Demand Offset* is 10.

When set to zero (0), the *PID Turn On Delay* is also disabled.

NOTE

The Demand Offset feature is active for boilers EXCEPT in the Direct Drive and Combo Modes. Also, the Demand Offset feature is NOT active for Water Heaters.

Figure 3-4: Demand Offset

3.2 FACTORY DEFAULTS

The factory default values for each menu item are summarized in Table 3-2.

Table 3-2: Default Settings

MENU & OPTION	FACTORY DEFAULT
Setup Menu	
Password	0
Language	English
Unit of Temp	Fahrenheit
Comm Address	0
Baud Rate	9600
Configuration Menu	
Internal Setpt	130°F
Unit Type	BMK Boiler LN
Unit Size	2.0 MBTU
Fuel Type	Natural Gas
Boiler Mode (If Unit Type = Boiler)	Constant Setpoint
Heater Mode (If Unit Type = Water Heater)	Constant Setpoint
Remote Signal (If Mode = Remote Setpoint, Direct Drive or Combination)	4 – 20 mA / 1-5V
Bldg Ref Temp (If Boiler Mode = Outdoor Reset)	70°F
Reset Ratio (If Boiler Mode = Outdoor Reset)	1.2
Outdoor Sensor	Disabled
System Start Tmp (If Outdoor Sensor = Enabled)	60°F
Temp Hi Limit	210°F
Max Valve Position	100%
Pump Delay Timer (If Unit Type = Boiler)	0 min
Aux Start On Dly	0 sec
Failsafe Mode	Shutdown
Analog Output	Valve Position 0-10V
Low Fire Timer	2 sec

Table 3-2: Default Settings - Continued

MENU & OPTION	FACTORY DEFAULT
Configuration Menu (Continued)	
Setpt Limiting	Disabled
Setpt Limit Band	5°F
Network Timeout	30 Seconds
HI DB Setpt En	30
Demand Offset	10
Deadband High	2
Deadband Low	2
Spark Monitor	Disabled
Spark Current	
Tuning Menu	
Prop Band	70°F (Boiler), 8°F (Water Heater)
Integral Gain	1.00 (Boiler), 1.60 (Water Heater)
Derivative Time	0.00 min (Boiler), 0.10 min (Water Heater)
Min Load Adj (If Unit Type = Water Heater)	0°F
Max Load Adj (If Unit Type = Water Heater)	0°F
FFWD Temp Adj (If Unit Type = Water Heater)	N/A
Outlet Feedback (If Unit Type = Water Heater)	On
Feedback Gain (If Unit Type = Water Heater)	0.05
Breakpoint At 20% (If Unit Type = Water Heater)	114°F
Breakpoint At 10% (If Unit Type = Water Heater)	130°F
Breakpoint At 0% (If Unit Type = Water Heater)	135°F
Warmup Prop Band	Default = 95
Warmup Int Gain	Default = 50
Warmup PID Timer	Default = 20
Reset Defaults?	No

Combustion Cal Menu (See Tables 3-2A & 3-2B for Factory Defaults)	

Table 3-2: Default Settings - Continued

MENU & OPTION	FACTORY DEFAULT
Water Heater Management Menu (C-More Software Version 3.08.xx)	
WHM Mode	Off
WHM Setpoint	130ºF
Next On VP	+65%
Next Off VP	+35%
Lead/Lag Hours	72 hours
WHM Upload Timer	
WHM Auto Mstr	Disabled
WHM Auto Timer	
WHM Min Addr	1
WHM Max Addr	1
WHM On Delay	60 sec.
WHM Off Delay	60 sec.
WHM Min Units	1
WHM Warmup Time	30 min.
Calibration Menu	
Stepper Fbk	Cal 0%
PWM Adj	0.0%
Analog In Adj	0.0%
Flow In Adj	0.0%
Supply Gas Pressure In Adj	0.0%
Gas Plate Dp In Adj	0.0%
mA Out Adj	0.0 mA
A/F Sensitivity	2%
Power Reset	Auto
Water Temp Reset	Auto
Gas Press Reset	Manual
Min Off Time	1 Min (Boiler), 0 Min (Water Heater)

Heatr Tuning Dsp (If Unit Type = Water Heater)	Disabled
Heatr Bkpt Dsp (If Unit Type = Water Heater)	Disabled

Table 3-2: Default Settings - Continued

MENU & OPTION	FACTORY DEFAULT
Calibration Menu - Continued	
Stop Level	16
Start Level	20
Skip Range Cntr	40
Skip Range Span	0
Skip Speed	5
O2 Gain	1.000
O2 Offset	1.0
FFWD Temp Offset	0
Exhst Tmp Offset	0
Outdr Air Offset	0
Inlet Air Offset	0
Inlet Wtr Offset	0
Outlet Wtr Offset	0
0-10 Volt Out Test	0.0
Diagnostic Menu	
Display Test	Off
Keypad Test	Off
Relay Test	Off
Switch Test	Off
Stepper Test	0%
Sensor Log Int	30 min.

Table 3-2A: Combustion Cal Menu Default Settings (Version 3.07.xx)

CALIBRATION POINTS Valve Position % Open Default Voltage Settings						UNIT TYPE & SIZE	FUEL
18%	**30%**	**45%**	**60%**	**80%**	**100%,**	BMK 750 1000 & 1.5	Nat. Gas
1.80v	*3.20v*	*3.70v*	*3.80v*	*4.60v*	*6.00v*		
16%	**30%**	**45%**	**60%**	**70%**	**75%,**		Propane
2.25v	3.95	2.70v	2.25v	2.60v	6.00v		
16%	**30%**	**45%**	**60%**	**80%**	**100%,**	BMK 750 ,1000, 1.5 Dual Fuel	Nat. Gas
1.80v	3.20v	3.70v	3.80v	4.60v	6.00v		
16%	**30%**	**45%**	**60%**	**70%**	**75%,**		Propane
2.25v,	3.95v	2.70v	2.25v	2.60v	6.00v		
14%	**30%**	**40%**	**50%**	**70%**	**100%,**	BMK STD 2.0	Nat. Gas
1.00v	2.30v	2.95v	3.60v	5.30v	9.10v		
14%	**30%**	**40%**	**50%**	**70%**	**100%,**		Propane
1.10v	1.95v	3.00v	3.00v	4.45v	8.20v		
14%	**30%**	**40%**	**50%**	**70%**	**100%,**	BMK STD 2.0 Dual Fuel	Nat. Gas
1.00v	2.30v	2.95v	3.60v	5.30v	9.10v		
14%	**30%**	**40%**	**50%**	**70%**	**100%,**		Propane
1.10v	1.95v	3.00v	3.00v	4.45v	8.20v		
18%	**30%**	**45%**	**60%**	**80%**	**100%,**	BMK LN CP 2.0	Nat. Gas
1.00v	2.30v	2.95v	3.60v	5.30v	9.10v		
20%	**30%**	**45%**	**60%**	**80%**	**100%,**		Propane
1.10v	1.95v	3.00v	3.00v	4.45v	8.20v		
20%	**30%**	**45%**	**60%**	**80%**	**100%,**	BMK LN CP 2.0 Dual Fuel	Nat. Gas
1.00v	2.30v	2.95v	3.60v	5.30v	9.10v		
21%	**30%**	**45%**	**60%**	**80%**	**91%,**		Propane
1.10v	1.95v	3.00v	3.00v	4.45v	8.20v		
16%	**30%**	**40%**	**50%**	**70%**	**100%,**	BMK 1500	Nat. Gas
1.00v	2.30v	2.50v	2.90v	3.80v	7.90v		
18%	**30%**	**40%**	**50%**	**70%**	**100%,**		Propane
1.20v	2.30v	2.80v	3.00v	3.50v	7.70v		
16%	**30%**	**40%**	**50%**	**70%**	**100%,**	BMK 1500 Dual Fuel	Nat. Gas
1.50v	2.60v	3.20v	3.30v	4.10v	8.30		
18%	**30%**	**40%**	**50%**	**70%**	**100%,**		Propane
1.20v	2.30v	2.80v	3.00v	3.50v	7.70v		

CALIBRATION POINTS Valve Position % Open Default Voltage Settings						UNIT TYPE & SIZE	FUEL
18%	**30%**	**40%**	**50%**	**70%**	**100%**	BMK 2000	Natural Gas
1.40v	3.80v	4.30v	5.40v	6.40v	9.50v		
16%	**30%**	**40%**	**50%**	**70%**	**100%**		Propane
2.10v	3.50v	3.90v	4.10v	4.10v	8.90v		
16%	**30%**	**40%**	**50%**	**70%**	**100%**	BMK 2000 Dual Fuel	Natural Gas
2.10v	4.50v	4.50v	4.50v	4.80v	9.60v		
16%	**30%**	**40%**	**50%**	**70%**	**100%**		Propane
2.10v	3.50v	3.90v	4.10v	4.10v	8.90v		

16%	**30%**	**40%**	**50%**	**70%**	**100%**	BMK 2500	Natural Gas
2.20v	4.10v	4.80v	5.30v	6.80v	8.50v		
18%	**22%**	**30%**	**45%**	**70%**	**100%**		Propane
2.00v	2.00v	3.30v	4.60v	5.60v	7.90v		
16%	**20%**	**30%**	**45%**	**70%**	**100%**	BMK 2500 Dual Fuel	Natural Gas
2.15v	2.10v	3.95v	5.60v	6.60v	8.50v		
18%	**22%**	**30%**	**45%**	**70%**	**100%**		Propane
2.00v	2.00v	3.30v	4.60v	5.60v	7.90v		

14%	**30%**	**40%**	**50%**	**70%**	**100%**	BMK 3000	Natural Gas
2.80v	4.60v	5.00v	5.50v	6.90v	9.10v		
18%	**30%**	**45%**	**65%**	**85%**	**100%**		Propane
2.30v	4.40v	5.60v	5.70v	7.00v	8.60v		
14%	**30%**	**45%**	**65%**	**85%**	**100%**	BMK 3000 Dual Fuel	Natural Gas
2.40v	5.40v	6.60v	7.00v	8.00v	8.70v		
18%	**30%**	**45%**	**65%**	**85%**	**100%**		Propane
2.30v	4.40v	5.60v	5.70v	7.00v	8.60v		

18%	**30%**	**45%**	**60%**	**75%**	**100%**	BMK LN CP 3.0	Propane
1.50v	4.00v	4.50v	4.30v	7.60v	10.00v		
14%	**30%**	**40%**	**50%**	**70%**	**100%**		Natural Gas
1.60v	3.00v	4.00v	5.00v	7.00v	10.00v		
18%	**30%**	**45%**	**65%**	**85%**	**100%**	BMK LN CP 3.0 Dual Fuel	Natural Gas
1.60v	3.00v	4.00v	5.00v	7.00v	10.00v		
18%	**30%**	**45%**	**60%**	**75%**	**100%**		Propane
1.50v	4.00v	4.50v	4.30v	7.60v	10.00v		

CALIBRATION POINTS Valve Position % Open Default Voltage Settings						UNIT TYPE & SIZE	FUEL
18%	**30%**	**40%**	**50%**	**70%**	**100%,**	BMK LN CP 6000	Natural Gas
1.60v	3.00v	4.00v	5.00v	7.00v	10.00v		
18%	**30%**	**45%**	**65%**	**85%**	**100%**	BMK LN CP 6000 Dual Fuel	Natural Gas
2.00v	2.00v	2.45v	3.70v	6.35v	8.50v		
18%	**30%**	**45%**	**65%**	**85%**	**100%**		Propane
2.00v	2.00v	2.45v	3.70v	6.35v	8.50v		

Table 3-2B: Combustion Cal Menu Default Settings (Version 3.08.xx)

CALIBRATION POINTS Valve Position % Open Default Voltage Settings								INN UNIT SIZE	FUEL
16%	20%	30%	40%	50%	60%	80%	100%	INN 600	Natural Gas
1.90v	2.05v	2.20v	2.50v	2.80v	3.00v	3.65v	4.40v		
16%	20%	30%	40%	50%	60%	80%,	100%	INN 600	Propane
2.00v	2.50v	3.20v	3.50v	3.70v	3.80v	4.00v	4.10v		
16%	20%	30%	40%	50%	60%	80%	100%	INN 800	Natural Gas
1.90v	2.00v	2.50v	3.10v	3.50v	3.85v	4.70v	5.45v		
16%	20%	30%	40%	50%	60%	80%,	100%	INN 800	Propane
2.10v	3.00v	4.40v	4.50v	4.60v	4.70v	4.80v	5.00v		
16%	20%	30%	40%	50%	60%	80%	100%	INN 1060	Natural Gas
1.90v	2.30v	2.80v	3.00v	3.60v	3.90v	4.80v	6.00v		
16%	20%	30%	40%	50%	60%	80%,	100%	INN 1060	Propane
2.00v	2.70v	3.80v	4.00v	4.50v	4.90v	5.50v	6.25v		
16%	20%	30%	40%	50%	60%	80%	100%	INN 1350	Natural Gas
1.90v	2.60v	4.20v	4.70v	5.00v	5.00v	5.50v	6.00v		
16%	20%	30%	40%	50%	60%	80%,	100%	INN 1350	Propane
2.10v	2.30v	4.70v	5.00v	5.20v	5.40v	5.80v	6.25v		

SECTION 4 - CONTROL PANEL DISPLAY MESSAGES

4.1 STARTUP & STATUS MESSAGES.

Startup and status messages are displayed on the VFD display on the front panel of the C-More Control Panel. This display is comprised of two lines with 16 characters per line. The startup and status messages which may appear in the display are listed in Tables 4-1.

4.2 FAULT MESSAGES.

Fault messages which may appear in the VFD display are listed in Table 4-2.

Table 4-1: Startup and Status Messages

MESSAGE	DESCRIPTION
DISABLED HH:MM pm MM/DD/YY	Displayed if ON/OFF switch is set to OFF. The display also shows the time and date that the unit was disabled.
STANDBY	Displayed when ON/OFF switch is in the ON position, but there is no demand for heat. The time and date are also displayed.
DEMAND DELAY XX sec	Displayed if Demand Delay is active.
PURGING XX sec	Displayed during the purge cycle during startup. The duration of the purge cycle counts up in seconds.
IGNITION TRIAL XX sec	Displayed during ignition trial of startup sequence. The duration of cycle counts up in seconds.
FLAME PROVEN	Displayed after flame has been detected for a period of 2 seconds. Initially, the flame strength is shown in %. After 5 seconds has elapsed, the time and date are shown in place of flame strength.
WARMUP XX sec	Displayed for 2 minutes during the initial warm-up only.
WAIT	Prompts the operator to wait.

Table 4-2: Fault Messages

FAULT MESSAGE	FAULT DESCRIPTION
HIGH WATER TEMP SWITCH OPEN	The High Water Temperature Limit Switch is open.
LOW WATER LEVEL	The Water Level Control board is indicating low water level.
LOW GAS PRESSURE	The Low Gas Pressure Limit Switch is open.
HIGH GAS PRESSURE	The High Gas Pressure Limit Switch is open.
INTERLOCK OPEN	The Remote Interlock is open.
DELAYED INTERLOCK OPEN	The Delayed Interlock is open.
AIRFLOW FAULT DURING PURGE	The Blower Proof Switch opened during purge. (see paragraph 4.2.1)
PRG SWTCH OPEN DURING PURGE	The Purge Position Limit switch on the air/fuel valve opened during purge.
IGN SWTCH OPEN DURING IGNITION	The Ignition Position Limit switch on the air/fuel valve opened during ignition.
IGN SWTCH CLOSED DURING PURGE	The Ignition Position Limit switch on the air/fuel valve closed during purge.
PRG SWTCH CLOSED DURING IGNITION	The Purge Position Limit switch on the air/fuel valve closed during ignition.
AIRFLOW FAULT DURING IGN	The Blower Proof Switch opened during ignition.
AIRFLOW FAULT DURING RUN	The Blower Proof Switch opened during run.
SSOV SWITCH OPEN	The SSOV switch opened during standby.
SSOV FAULT DURING PURGE	The SSOV switch opened during purge.
SSOV FAULT DURING IGN	The SSOV switch closed or failed to open during ignition.
SSOV FAULT DURING RUN	The SSOV switch closed for more than 15 seconds during run.
SSOV RELAY FAILURE	A failure has been detected in one of the relays that control the SSOV.
FLAME LOSS DURING IGN	The Flame signal was not seen during ignition or lost within 5 seconds after ignition.
FLAME LOSS DURING RUN	The Flame signal was lost during run. (see paragraph 4.2.2)
HIGH EXHAUST TEMPERATURE	The High Exhaust Temperature Limit Switch is closed.
RESIDUAL FLAME	The Flame signal was seen for more than 30 seconds during standby.
HEAT DEMAND FAILURE	The Heat Demand Relay on the Ignition/Stepper (IGST) board failed to activate when commanded.
IGN BOARD COMM FAULT	A communication fault has occurred between the Primary Micro-Controller (PMC) board and Ignition/Stepper (IGST) board.
DIRECT DRIVE SIGNAL FAULT	The direct drive signal is not present or is out of range.

***Table 4-2: Fault Messages** - Continued*

FAULT MESSAGE	FAULT DESCRIPTION
REMOTE SETPT SIGNAL FAULT	The remote setpoint signal is not present or is out of range.
OUTDOOR TEMP SENSOR FAULT	The temperature measured by the Outdoor Air Sensor is out of range.
OUTLET TEMP SENSOR FAULT	The temperature measured by the Outlet Sensor is out of range.
FFWD TEMP SENSOR FAULT	The temperature measured by the Feed-Forward (FFWD) Sensor is out of range.
HIGH WATER TEMPERATURE	The temperature measured by the Outlet Sensor exceeded the Temp Hi Limit setting.
LINE VOLTAGE OUT OF PHASE	The High AC voltage is out of phase from the low AC voltage.
STEPPER MOTOR FAILURE	The stepper motor failed to move the valve to the desired position.
MODBUS COMM FAULT	The RS485 (Modbus) network information is not present or is corrupted.
WAIT IGNITION RETRY	The unit is in Ignition Retry Mode. This is an informational message.
WAIT FAULT PURGE	The unit is purging after a fault. This is an informational message.
WAIT RETRY PAUSE	The unit is pausing between ignition retries. This is an informational message.
EXHAUST TEMP SENSOR SHORT	The temperature measured by Exhaust temperature sensor reading is out of range.
EXHAUST TEMP SENSOR OPEN	The temperature measured by Exhaust temperature sensor reading is out of range.
WARNING EXHAUST TEMP HIGH	The exhaust temperature has exceeded the high Exhaust Temp Limit. This is an informational warning.
EXHAUST TEMP HIGH	The temperature measured by the Exhaust temperature sensor is out of range.
INLET WATER TEMP SENSOR SHORT	The temperature measured by the inlet water temp sensor is out of range.
INLET WATER TEMP SENSOR OPEN	The temperature measured by the Inlet water temperature sensor is out of range.
WARNING IN WTR TEMP HIGH	This is a warning that the inlet water temperature has exceeded its high limit.
WARNING IN WTR TEMP LOW	This is a warning that the inlet water temperature is below the low limit.
INLET GAS PRESS SENSOR OPEN	The inlet gas pressure sensor is reading out of range.
GAS PLATE DP SENSOR OPEN	Not in use.
O2 PERCENTAGE LOW	The O2 percentage is below its low limit for the fire rate.
O2 SENSOR MALFUNCTION	The O2 sensor is reporting a fault condition.
WARNING O2 LEVEL HIGH	The o2 percentage is above its high limit for the fire rate.
RECIRC PUMP FAILURE	For water heaters. A recirculation pump condition has been detected. The inlet water temperature matches the FFWD temperature during operation for a predetermined amount of time.
IGNITION MONITOR	Ignition time. For information only.
NO FLOW SAFETY LOCKOUT	Not in use.

***Table 4-2: Fault Messages** - Continued*

FAULT MESSAGE	FAULT DESCRIPTION
IGNITION SPARK FAULT	The spark detector sensor did not detect spark current during the ignition cycle.
CLEANING IGNITER	This is a notice that the igniter cleaning cycle is occurring.
TOO MANY CYCLES IN 24 HOURS	This is a warning of high cycling. The period is a 24 hour cycle based on time of day.
TOO MANY OVRTMPS IN 24 HOURS	This is a warning of excessive over temperature conditions. The period is a 24 hour cycle based on time of day.
AIR SENSOR FAULT	The temperature measured by the inlet air temp sensor is out of range.
FAULT ACTIVE	A fault has occurred and the display is being updated to indicate the specific fault.

4.2.1 Airflow Fault During Purge (On Units Less Than 2.5 Million BTUs)

If an *Airflow Fault During Purge* fault is encountered, The C-More will attempt one re-ignition sequence. If the fault persists on the second successive try, the C-More will go into a Hard Fault mode requiring operator intervention.

The Ignition Retry Sequence for *Airflow Fault During Purge* consists of the following actions and displays:

1. WAIT RETRY PAUSE - A 30 second pause before another trial is attempted.
2. WAIT IGNITION RETRY – This is the standard Ignition Sequence

Any Ignition failure due to *Airflow Fault During Purge* will be recorded in the C-More Fault Log, even if it is followed by a successful Ignition Retry.

4.2.2 Flame Loss During Ignition (On Units Less Than 2.5 Million BTUs)

If a *Flame Loss During Ignition* fault is encountered, The C-More will attempt a re-ignition sequence. If the fault persists on the second successive try, the C-More will go into a Hard Fault mode requiring operator intervention.

The Ignition Retry Sequence for *Flame Loss During Ignition* consists of the following actions and displays:

1. WAIT RETRY PAUSE – A 30 second pause before another retry is attempted.
2. WAIT IGNITION RETRY – This is the standard ignition sequence.

Any Ignition failure due to *Flame Loss During Ignition* will be recorded in the C-More Fault Log, even if it is followed by a successful Ignition Retry.

4.2.3 Flame Loss During Run (On Units Less Than 2.5 Million BTUs)

If a *Flame Loss During Run* fault is encountered, the C-More will attempt one re-ignition sequence. If two successive *Flame Loss During Run* faults are encountered within a 15 minute span, the C-More will go into a Hard Fault mode requiring operator intervention.

The Ignition Retry Sequence for *Flame Loss During Run* consists of the following actions and displays:

1. WAIT FAULT PURGE – A 15 second PURGE to remove any GAS from the system.
2. WAIT RETRY PAUSE - A 30 second pause before another trial is attempted.
3. WAIT IGNITION RETRY – This is the standard Ignition Sequence

Any loss of flame while running will be recorded in the C-More Fault Log, even if it is followed by a successful Ignition Retry.

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SECTION 5 - INPUT/OUTPUT INTERFACES & OPERATING MODES

5.1 INTRODUCTION

This Section provides descriptions of the Input/Output (I/O) wiring connections which can be made at the Input/Output (I/O) Box included with the C-More Control Panel. For KC Series units, the I/O Box is located on the left side of the unit. For Benchmark Series units, the I/O Box is located on the front of the unit behind the door.

Also included in this Section are descriptions of the available operating modes which can be set up for water heaters and boilers utilizing the C-More menus.

5.2 I/O INTERFACES

All wiring connections are made at the terminal strips contained in the I/O Box. The I/O Box cover contains a connection diagram as shown in Figure 5-1. Refer to this diagram when making all field wiring connections to the I/O Box. The connections shown in Figure 5-1 are described in the following paragraphs.

NOTE

Older I/O PCBs are wired the same as new ones, even if silk-screen designations differ.

CAUTION!

DO NOT make any connections to the I/O Box terminals labeled "NOT USED". Attempting to do so may cause equipment damage.

5.2.1 Outdoor Sensor In

An outdoor air temperature sensor (AERCO Part No. 122790) will be required mainly for the Indoor/Outdoor Reset Mode of operation for boilers. It can also be used with another mode if it is desired to use the outdoor sensor enable/disable feature. This feature allows the boiler to be enabled or disabled based on the outdoor air temperature. The factory default for the outdoor sensor is DISABLED. To enable the sensor or choose a system start temperature, see the Configuration Menu in Table 2-3.

The outdoor sensor may be wired up to 200 feet from the boiler. It is connected to the OUTDOOR SENSOR IN and SENSOR COMMON terminals in the I/O Box (see Figure. 5-1). Wire the sensor using a twisted shielded pair cable of 18-22 AWG wire. There is no polarity to observe when terminating the wires. The shield is to be connected only to the terminals labeled SHEILD in the I/O Box. The sensor end of the shield must be left free and ungrounded.

When mounting the sensor, it must be located on the North side of the building where an average outside air temperature is expected. The sensor must be shielded from direct sunlight as well as impingement by the elements.

If a shield is used, it must allow for free air circulation.

5.2.2 Air Sensor In

The AIR SENSOR IN is connected to the AUX SENSOR IN and SENSOR COMMON terminals on the I/O board. The AIR SENSOR measures the temperature of the air input to the Air/Fuel Valve. This temperature reading is one of the components used to calculate the rotational speed of the blower motor in the Combustion Calibration process.

The AUX SENSOR IN terminals can be used to add an additional temperature sensor for monitoring purposes. This input is always enabled and is a view only input that can be seen in the Operating Menu. The sensor must be wired to the AUX SENSOR IN and SENSOR COMMON terminals. It must be similar to AERCO BALCO wire sensor P/N 123449. A resistance chart for this sensor is provided in Appendix C.

5.2.3 Analog In

The ANALOG IN + and – terminals are used when an external signal is used to drive the valve position (Direct Drive Mode - Boiler Only) or change the setpoint (Remote Setpoint Mode) of the unit.

Either a 4 to 20 mA / 1 to 5 VDC or a 0 to 20 mA/ 0 to 5 VDC signal may be used to vary the setpoint or valve position. The factory default setting is for 4 to 20 mA / 1 to 5 VDC, however this may be changed to 0 to 20 mA / 0 to 5 VDC using the Configuration Menu described in Sections 2 and 3. If voltage rather than current is selected as the drive signal, a DIP switch must be set on the PMC Board located inside the Control Box. Refer to Appendix D for information on setting DIP switches.

All supplied signals must be floating (unground-ed) signals. Connections between the source and the unit's I/O Box must be made using twisted shielded pair wire of 18 – 22 AWG, such as Belden 9841(see Fig. 5-1). Polarity must be maintained and the shield must be connected only at the source end and must be left floating (not connected) at the unit's I/O Box.

Whether using voltage or current for the drive signal, they are linearly mapped to a 40°F to 240°F setpoint or a 0% to 100% valve position. No scaling for these signals is provided.

5.2.4 B.M.S. (PWM) In

NOTE

Only BMS Model 168 can utilize pulse width modulation, not the BMS II and ACS.

These terminals are used to connect the AERCO Boiler Management System (BMS Model 168) to the unit. The BMS Model 168 utilizes a 12 millisecond, ON/OFF duty cycle. This duty cycle is Pulse Width Modulated (PWM) to control valve position rate. A 0% valve position rate = a 5% ON pulse and a 100% valve position rate = a 95% ON pulse.

5.2.5 Shield

The SHIELD terminals are used to terminate any shields used on sensor wires connected to the unit. Shields must only be connected to these terminals.

5.2.6 mA Out

These terminals provide a 4 to 20 mA output that can be used to monitor setpoint (40°F to 240°F), outlet temperature (30°F to 245°F), or valve position (0% to 100%). This function is enabled in the Configuration Menu (Table 2-3).

5.2.7 RS485 Comm

These terminals are used for RS485 Modbus serial communication between the unit and an external "Master", such as an Energy Management System, Boiler Automation System, or other suitable device.

5.2.8 0 – 10V Output

These terminals provide a 0 to 10 volt output used to directly drive the blower motor. In unit sizes 3.0 MBTU and above, these terminals connect to a Variable Frequency Drive (VFD) which in turn connects to the blower motor.

5.2.9 Exhaust Switch In

These terminals permit an external exhaust switch to be connected to the exhaust manifold of the unit. The exhaust sensor should be a normally open type switch (such as AERCO P/N 123463) that closes (trips) at 500°F.

5.2.10 O2 Sensor (O2+, O2-)

These terminals (O2+ and O2-) provide a connection for the O2 (oxygen) sensor.

5.2.11 Flow Meter (Flw+, Flw-)

These terminals (Flw+ and Flw-)) provide a connection for an external Flow Meter with any of the following outputs:

- 0-5 Volts
- 1-5 Volts
- 0-20 milliamps
- 4-20 milliamps

NOTE

The Flw+ and Flw- terminals are also used to connect a Spark Detector module to the C-More controller. If the Spark Detector is connected to the Flw+ and Flw- terminals, DIP Switch S1-3 must be set to OFF (Volt) Position (see detail "A" in Figure D-1 in Appendix D).

5.2.12 RS-232 Serial (TxD, RxD)

These terminals provide a connection to the RS-232 Serial communications port. To utilize the TxD and RxD terminals, DIP Switch SW1 (RS-232 on the I/O board) must be set to the ON position.

5.2.13 Interlocks

The unit offers two interlock circuits for interfacing with Energy Management Systems (EMS) or Building Automation System (BAS) and auxiliary equipment such as pumps or louvers. These interlocks are called the Remote Interlock and Delayed Interlock. The wiring terminals for these interlocks are located inside the I/O Box. The I/O Box cover contains a wiring diagram (Figure 5-1) which shows the terminal strip locations for these interlocks which are labeled REMOTE INTL'K IN and DELAYED INTL'K IN. Both interlocks, described below, are factory wired in the closed position.

NOTE

Both the Delayed Interlock and the Remote Interlock must be in the closed position to allow the unit to fire.

Remote Interlock In

The remote interlock circuit (REMOTE INTL'K IN) is provided to remotely start (enable) and stop (disable) the boiler if desired. The circuit is 24 VAC and comes factory pre-wired closed (jumpered).

Delayed Interlock In

The delayed interlock circuit (DELAYED INTL'K IN) is typically used in conjunction with the auxiliary relay described in paragraph 5.2.11. This interlock circuit is located in the purge section of the start string. It can be connected to the proving device (end switch, flow switch etc.) of an auxiliary piece of equipment started by the unit's auxiliary relay. The delayed interlock must be closed for the unit to fire. If the delayed interlock is connected to a proving device that requires time to close (make), a time delay (Aux Start On Dly) that holds the start sequence of the unit long enough for a proving switch to make can be programmed. Should the proving switch not prove within the programmed time frame, the unit will shut down. The Aux Start On Dly can be programmed from 0 to 240 seconds. This option is locate in the Configuration Menu.

5.2.14 Fault Relay

The fault relay is a single pole double throw (SPDT) relay having a normally open and normally closed set of relay contacts that are rated for 5 amps at 120 VAC and 5 amps at 30 VDC, resistive (2 Amps Inductive). The relay energizes when any fault condition occurs and remains energized until the fault is cleared and the CLEAR button is depressed.

5.2.15 Auxiliary Relay Contacts

Each unit is equipped with a single pole double throw (SPDT) relay that is energized when there is a demand for heat and de-energized after the demand for heat is satisfied. The relay is provided for the control of auxiliary equipment, such as pumps and louvers, or can be used as a unit status indictor (firing or not firing). Its contacts are rated for 120 VAC @ 5 amps resistive (2 Amps Inductive). . Refer to Figure 5-1 to locate the AUX RELAY terminals for wiring connections.

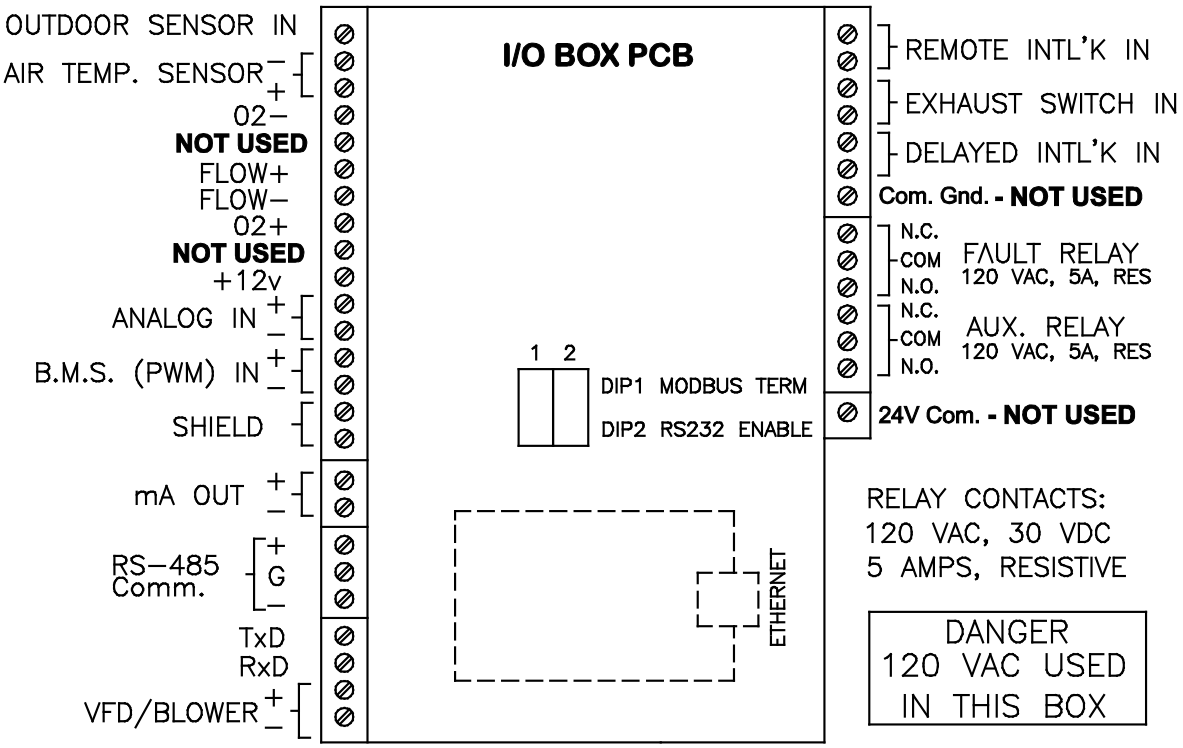

Figure 5-1: I/O Box Terminal Strip Connections

5.3 MODES OF OPERATION

Innovation and KC Series Water Heaters are capable of being operated in either the Constant Setpoint Mode or Remote Setpoint Mode. In addition to the Constant and Remote Setpoint Modes, KC and Benchmark Series Boilers can also be operated in the Direct Drive Mode, Boiler Management System (BMS) Mode, Indoor/Outdoor Reset Mode or Combination Mode.

The following paragraphs briefly describe the required connections and menu settings to place the unit in each of these modes.

5.3.1 Constant Setpoint Mode

The Constant Setpoint mode is used when a fixed header temperature is desired. Common uses of this mode of operation include water source heat pump loops, and indirect heat exchangers for potable hot water systems or processes.

There are no external sensors necessary to operate in this mode. While it is necessary to set the desired setpoint temperature, it is not necessary to change any other temperature-related functions. The unit is factory preset with settings that work well in most applications. Prior to changing any temperature-related parameters, other than the setpoint, it is suggested that an AERCO representative be contacted. See Sections 2 and 3 for complete listings of temperature related menu functions and factory defaults.

Setting The Setpoint

The setpoint temperature of the unit is adjustable from 40°F to 240°F. To set the unit for operation in the Constant Setpoint Mode, the following menu settings must be made in the Configuration Menu:

MENU OPTION	SETTING
Boiler (or Heater) Mode	*Constant Setpoint*
Internal Setpt	Select desired setpoint using ▲ and ▼ arrow keys (40°F to 240°F)

Refer to paragraph 2.2 for detailed instructions on changing menu options.

5.3.2 Remote Setpoint Modes

The unit's setpoint can be remotely controlled by an Energy Management System (EMS) utilizing either a current or voltage signal level.

The current/ voltage signal can be at either of the following levels:

- 4 - 20 mA/1 - 5 Vdc
- 0 - 20 mA/0 - 5 Vdc

The factory default setting for the Remote Setpoint mode is 4 - 20 mA/1 - 5 Vdc. With this setting, a 4 to 20 mA/1 to 5 Vdc signal, sent by an EMS or BAS, is used to change the unit's setpoint. The 4 mA/1V signal is equal to a 40°F setpoint while a 20 mA /5V signal is equal to a 240°F setpoint. When a 0 to 20 mA/0 to 5 Vdc signal is used, 0 mA is equal to a 40°F setpoint.

In addition to the current and voltage signals described above, the Remote Setpoint mode can also be driven by a RS485 Modbus Network signal from an EMS or BAS.

The Remote Setpoint modes of operation can be used to drive single as well as multiple units.

NOTE

If a voltage, rather than current signal is used to control the remote setpoint, a DIP switch adjustment must be made on the PMC Board located in the Control Panel Assembly. Refer to Appendix D for details.

In order to enable the Remote Setpoint Mode, the following menu setting must be made in the Configuration Menu:

MENU OPTION	SETTING
Boiler Mode	Remote Setpoint
Remote Signal	4-20mA/1-5V, 0-20mA/0-5V, or Network

Refer to paragraph 2.2 for detailed instructions on changing menu options.

If the Network setting is selected for RS485 Modbus operation, a valid Comm Address must be entered in the Setup Menu. Refer to Modbus Communication Manual GF-114 for additional information.

While it is possible to change the settings of temperature related functions, the unit is factory preset with settings that work well in most applications. It is suggested that an AERCO representative be contacted, prior to changing any temperature related function settings. For descriptions of temperature-related functions and their factory defaults, refer to Tables 3-1 and 3-2.

Remote Setpoint Field Wiring

The only wiring necessary for the Remote Setpoint modes is the external control wiring from the source, to the ANALOG IN terminals on the terminal strip inside the I/O Box. The I/O Box is located on the left side of the KC Series units and on the front of Benchmark Series units. Refer to the wiring diagram (Figure 5-1) provided on the cover of the I/O Box. For a Network setting, the connections are made at the RS-485 COMM terminals in the I/O Box. The signal must be floating (ungrounded), and the wire used must be a two wire shielded cable of 18 to 22 AWG. Polarity must be observed and the source end of the shield must be connected at the source. When driving multiple units, each unit's wiring must conform to the above.

Remote Setpoint Startup

Since this mode of operation is factory preset and the setpoint is being externally controlled, no startup instructions are necessary. In this mode, the **REMOTE** LED will light when the external signal is present.

To operate the unit in manual mode, press the **AUTO/MAN** switch. The **REMOTE** LED will go off and the **MANUAL** LED will light.

To change back to the Remote Setpoint mode, simply press the **AUTO/MAN** switch. The **REMOTE** LED will again light and the **MANUAL** LED will go off.

NOTE

The modes of operation described in paragraphs 5.3.3 through 5.3.6 apply ONLY to KC and Benchmark Series boilers. External wiring connections for these modes are made at the Input/Output (I/O) Box which is located on the left side of KC Series units and on the front of Benchmark Series units.

5.3.3 Indoor/Outdoor Reset Mode

This mode of operation is based on outside air temperatures. As the outside air temperature decreases, the supply header temperature will increase and vice versa. For this mode, it is necessary to install an outside air sensor as well as select a building reference temperature and a reset ratio.

Reset Ratio

Reset ratio is an adjustable number from 0.1 to 9.9. Once adjusted, the supply header temperature will increase by that number for each degree that the outside air temperature decreases. For instance, if a reset ratio of 1.6 is used, for each degree that outside air temperature decreases, the supply header temperature will increase by 1.6 degrees.

Building Reference Temperature

This is a temperature from 40°F to 230°F. Once selected, it is the temperature that the system references to begin increasing its temperature. For instance, if a reset ratio of 1.6 is used, and we select a building reference temperature of 70°F, then at an outside temperature of 69°F, the supply header temperature will increase by 1.6° to 71.6°F.

Outdoor Air Temperature Sensor Installation

The outdoor air temperature sensor must be mounted on the North side of the building in an area where the average outside air temperature is expected. The sensor must be shielded from the sun's direct rays, as well as direct impingement by the elements. If a cover or shield is used, it must allow free air circulation. The sensor may be mounted up to two hundred feet from the unit. Sensor connections are made inside the Input/Output (I/O) Box at the terminals labeled OUTDOOR SENSOR IN and SENSOR COMMON using shielded 18 to 22 AWG wire. A wiring diagram is provided on the cover of the I/O Box. Refer to Section 2 of Operation & Maintenance Manual GF-109 (KC Series) or GF-110 (Benchmark Series) for additional wiring information.

Indoor/Outdoor Startup

1. Refer to the indoor/outdoor reset ratio charts in Appendix B.
2. Choose the chart corresponding to the desired building reference temperature. Go down the left column of the chart to the coldest design outdoor air temperature expected for your area.

NOTE

A design engineer typically provides design outdoor air temperature and supply header temperature data

3. Once the design outdoor air temperature is chosen, go across the chart to the desired supply header temperature (setpoint) for the design temperature chosen in step 3.
4. Next, go up that column to the Reset Ratio row to find the corresponding reset ratio. Access the Configuration Menu and scroll through it until the display shows *Bldg Ref Temp (Building Reference Temperature)*.
5. Press the **CHANGE** key. The display will begin to flash.
6. Use the ▲ and ▼ arrow keys to select the desired building reference temperature.
7. Press **ENTER** to save any changes.
8. Next, scroll through the Configuration Menu until the display shows *Reset Ratio*. Press the **CHANGE** key. The display will begin to flash.
9. Use the ▲ and ▼ arrow keys to select the reset ratio determined in step 5. Press **ENTER** to save the change.

Refer to paragraph 2.2 for detailed instructions on menu changing.

5.3.4 Direct Drive Modes

The boiler's valve position can be changed by a remote signal typically sent from an energy management system. The Direct Drive modes are driven by current or voltage signals in the following ranges:

- 4 - 20 mA/1 - 5 Vdc
- 0 - 20 mA/0 - 5 Vdc

The factory default setting is 4 - 20 mA/1 - 5 Vdc. In this mode of operation, a 4 to 20mA signal, sent by an energy management system, is used to change the boiler's valve position from 0% to 100%. The 4 mA/1Vdc signal is equal to a 0% valve position while a 20 mA /5Vdc signal is equal to a 100% valve position. When a 0-20 mA/0-5 Vdc signal is used, zero is equal to a 0% valve position.

In addition to the current and voltage signals described above, the Direct Drive mode can also be driven by a RS-485 Modbus Network signal from an EMS or BAS.

When in a Direct Drive mode, the boiler is a slave to the energy management system and does not have a role in temperature control. Direct Drive can be used to drive single as well as multiple boilers.

NOTE

If a voltage, rather than current signal is used to control the remote setpoint, a DIP switch adjustment must be made on the PMC Board in the Control Box. Refer to Appendix D for details.

To enable the Direct Drive Mode, the following menu setting must be made in the Configuration Menu:

MENU OPTION	SETTING
Boiler Mode	*Direct Drive*
Remote Signal	*4-20mA/1-5V,* *0-20mA/0-5V, or Network*

Refer to paragraph 2.2 for instructions on changing menu options.

If the Network setting is selected for RS485 Modbus operation, a valid Comm Address must be entered in the Setup Menu. Refer to Modbus Communication Manual GF-114 for additional information.

Direct Drive Field Wiring

The only wiring necessary for Direct Drive mode is connection of the remote signal leads from the source to the ANALOG IN terminals at the I/O Box. For a Network setting, the connections are made at the RS-485 COMM terminals in the I/O Box. The signal must be floating, (ungrounded), and the wire used must be a two wire shielded cable of 18 to 22 AWG. Polarity must be observed. The source end of the shield must be connected at the source. When driving multiple units, each unit's wiring must conform to the above.

Direct Drive Startup

Since this mode of operation is factory preset and the valve position is being externally controlled, no startup instructions are necessary. In this mode, the **REMOTE** LED will light when the signal is present.

To operate the boiler in manual mode, press the **MAN** switch. The **REMOTE** LED will go off and the **MANUAL** LED will light.

To change back to the Direct Drive mode, simply press the **AUTO** switch. The **REMOTE** LED will again light and the **MANUAL** LED will go off.

5.3.5 Boiler Management System (BMS)

NOTE

BMS Model 168 can utilize either pulse width modulation (PWM) or RS485 Modbus signaling to the boiler. BMS II and ACS can utilize only RS485 signaling to the boiler.

The BMS mode of operation is used in conjunction with an AERCO Boiler Management System (BMS, BMS II)/AERCO Control System (ACS). The BMS mode is used when it is desired to operate multiple units in the most efficient manner possible. The BMS can control up to 40

boilers; 8 via pulse width modulation (PWM) and up to 32 via Modbus (RS485) network communication. For BMS/BMS II/ACS programming and operation, see GF-108M (BMS Model 168), GF-124 (BMS II Model 5R5-384), and GF-131 (ACS) Operation Guides. For operation via an RS485 Modbus network, refer to Modbus Communication Manual GF-114. The AERCO BMS/BMS II/ACS monitors all system-related parameters and modulates the valve positions of the units.

To enable the BMS Mode, the following menu settings must be made in the Configuration Menu:

MENU OPTION	SETTING
Boiler Mode	*Direct Drive*
Remote Signal	*BMS (PWM Input) or Network (RS485)*

Refer to paragraph 2.2 for instructions on changing menu options.

BMS/ACS External Field Wiring

Wiring for this system configuration is connected between the BMS panel Model 168, boilers 1 through 8, to the B.M.S. (PWM) IN terminals in the I/O Box on the boiler. Refer to the wiring diagram provided on the cover of the I/O Box.

Wiring connections for RS485 Modbus control are made between connector JP11 on the BMS/BMS II/ACS (boilers 9 to 40)/or JP6 on BMS II/ACS (boilers 1 to 32 and the RS485 COMM terminals in the I/O Box.

Wire the units using shielded twisted pair wire between 18 and 22 AWG. Observe the polarity shown for the B.M.S. (PWM) IN connections. The shield is connected at the BMS/BMS II/ACS to any minus (-) boiler terminal and the boiler end of the shield must be left floating. Each unit's wiring must conform to the above.

Boiler Management System Setup and Startup

This mode of operation is factory preset and the BMS/BMS II/ACS controls the firing rate (air/fuel valve position). There are no setup instructions for each individual unit.

To operate the unit in manual mode, press the **AUTO/MAN** switch. The **REMOTE** LED will go off and the **MANUAL** LED will light

To change back to the BMS mode, simply press the **AUTO/MAN** switch. The **REMOTE** LED will again light and the **MANUAL** LED will go off.

NOTE

Paragraph 5.3.6 applies only to Innovation Series Water Heaters with Controller Software Version 3.08.xx.

5.3.6 Water Heater Management (WHM)

The WHM mode of operation is used when it is desired to operate multiple Innovation Water Heaters in the most efficient manner possible. The WHM software incorporated in Version

3.08.xx can control up to 8 Innovation Water Heaters utilizing RS485 Modbus communication. Detailed information and set-up instructions for implementing a WHM System are provided in Section 8 of this manual.

5.3.7 Boiler Sequencing Technology (BST)

Integrated Boiler Sequencing Technology for Benchmark boilers allows for sequencing operation up to 8 units, for optimal plant efficiency and uptime reliability. This flash upgradeable control system can be linked directly to BAS via Modbus protocol and includes options for integrated valve control and remote monitoring. AERCO also offers a Communications Gateway to support BACnet, Lonworks and N2 system integration.

NOTE

See Chapter 9 AERCO Boiler Sequencing technology for a complete description of this solution and instructions for implementing it.

5.3.8 Combination Control System (CCS)

NOTE

Only the BMS Model 168 and ACS can be utilized for the Combination Mode, not the BMS II or BST system.

A Combination Control System is one that uses multiple boilers to cover both space-heating and domestic hot water needs. A BMS and a Combination Control Panel (CCP) or an ACS and ACS Relay Panel (optional, depending on application) are necessary to configure this system. Typically, enough boilers are installed to cover the space-heating load on the design day, however one or more units are used for the domestic load.

The theory behind this type of system is that the maximum space-heating load and the maximum domestic hot water load do not occur simultaneously. Therefore, boilers used for the domestic hot water are capable of switching between constant setpoint and BMS modes of operation. These boilers are the combination units and are referred to as the combo boilers. The combo boilers heat water to a constant setpoint temperature. That water is then circulated through a heat exchanger in a domestic hot water storage tank.

When the space-heating load is such that all the space-heating boilers are at the 100% valve position (firing rate), the BMS/ACS will then operate the domestic boilers to become space-heating boilers, provided the domestic hot water load is satisfied. If the domestic hot water load is not satisfied, the combo boiler(s) remain on the domestic hot water load. If the combo boilers switch over to space heating, but there is a call for domestic hot water, the combo units will go back to domestic heating.

When the combo units are satisfying the domestic load, they are in constant setpoint mode of operation. When the combo units switch over to space heating, their mode of operation changes to the BMS mode. For more information concerning the operation of the Combination Control Panel see the AERCO CCP-1 literature (BMS 168 applications)/TAG-0049 (ACS).

Combination Control System Field Wiring

Wiring for this system is between the BMS panel, the CCP and the B.M.S. (PWM) IN terminals in the I/O Box. For ACS applications, the wiring is between the ACS panel, the ACS Relay Panel (optional, depending on application), and the RS485 Comm. Terminals in the I/O Box. Wire the units using a shielded twisted pair of 18 to 22 AWG wire. When wiring multiple units, each unit's wiring must conform to the above. For a complete CCP system-wiring diagram see the AERCO CCP-1 literature (BMS 168 applications)/TAG-0049 (ACS).

Combination Control System Setup and Startup

Setup for the Combination Mode requires entries to be made in the Configuration Menu for boiler mode, remote signal type and setpoint. The setpoint is adjustable from 40°F to 220°F.

Enter the following settings in the Configuration Menu:

MENU OPTION	SETTINGS	
	BMS 168 Application	**ACS Applications**
Boiler Mode	*Combination*	*Combination*
Remote Signal	*BMS (PWM) Input*	*Network (RS485)*
Internal Setpt	40°F to 240°F	40°F to 240°F

Refer to paragraph 2.2 for instructions on changing menu options.

While it is possible to change other temperature-related functions for combination mode, the unit is factory preset. These preset settings work well in most applications. It is suggested that AERCO be contacted prior to changing settings other than the unit's setpoint.

5.4 START SEQUENCE

When the unit is in the Standby mode and all pre-purge safety switches are closed, the **READY** light above the **ON/OFF** switch will be lit. When there is a demand for heat, the following events will occur:

NOTE

If any of the Pre-Purge safety switches (low water level, high water temperature, high or low gas pressure) are open, the appropriate fault message will be displayed. Also, the appropriate fault messages will be displayed throughout the start sequence, if the required conditions are not observed.

1. The **DEMAND** LED status indicator will light.
2. The unit checks the proof of closure switch on the Safety Shut-Off Valve (SSOV) shown in Figure 5-2.

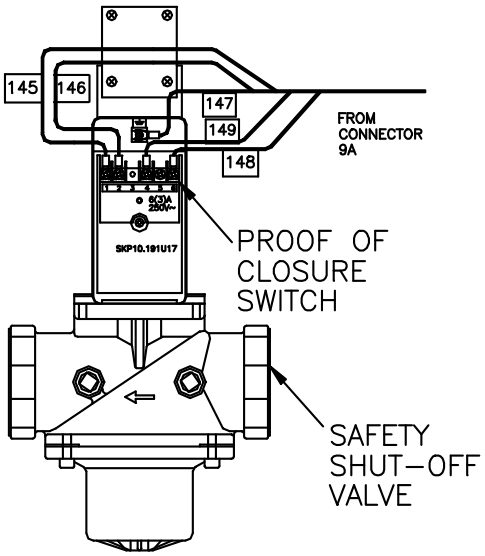

Figure 5-2: Proof of Closure Switch

3. With all required safety switches closed, a purge cycle will be initiated and the following events will occur:

   (a) Blower relay energizes and turns on blower.

   (b) Air/Fuel Valve rotates to the full-open purge position and closes purge position switch. The dial on the Air/Fuel Valve (Figure 5-3) will read 100 to indicate that the valve is full-open (100%).

   (c) The **VALVE POSITION** bargraph will show 100%.

NOTE

The Air/Fuel Valves shown in Figures 5-3 and 5-5 are used on KC Series units. Although slight physical differences exist between the Air/Fuel Valves used on Benchmark Series units, the valves are functionally identical.

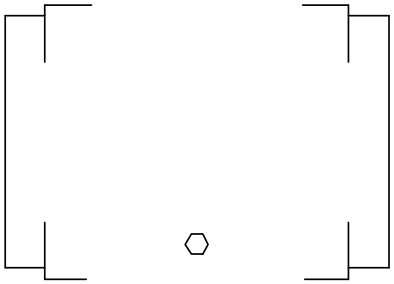

Figure 5-3: KC1000 Air/Fuel Valve In Purge Position

4. Next, the blower proof switch (Figure 5-4) closes and the display will show *Purging* and indicate the elapsed time of the purge cycle in seconds. The normal (default) time for the purge cycle is 7 seconds.

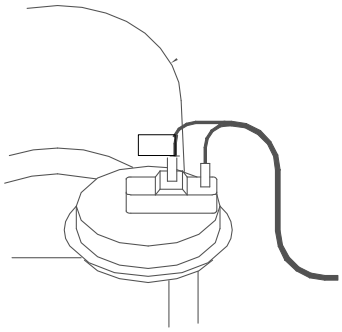

Figure 5-4; Blower Proof Switch

5. Upon completion of the purge cycle, the Control Box initiates an ignition cycle and the following events occur:

   (a) The Air/Fuel Valve rotates to the low-fire ignition position and closes the ignition switch. The dial on the Air/Fuel Valve (Figure 5-5) will read between 25 and 35 to indicate that the valve is in the low-fire position.

   (b) The igniter relay is activated and provides ignition spark.

   (c) The gas Safety Shut Off Valve (SSOV) is energized (opened) allowing gas to flow into the Air/Fuel Valve. Up to 7 seconds will be allowed for ignition to be detected. The igniter relay will be turned off one second after flame is detected.

6. After 2 seconds of continuous flame, *Flame Proven* will be displayed and the flame strength will be indicated. After 5 seconds, the current date and time will be displayed in place of the flame strength.
7. With the unit firing properly, it will be controlled by the temperature controller circuitry. The **VALVE POSITION** will be continuously displayed on the front panel bargraph.
8. Once the demand for heat has been satisfied, the Control Box will turn off the gas valve. The blower relay will be deactivated and the Air/Fuel Valve will be closed. *Standby* will be displayed.

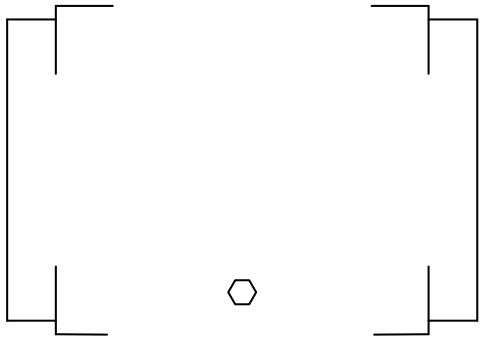

Figure 5-5: KC1000 Air/Fuel Valve In Ignition Position

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SECTION 6 - CALIBRATION AND DIAGNOSTIC MENUS

6.1 INTRODUCTION

The Level 2 Password (**6817**) must be entered to access the Calibration and Diagnostic procedures describe in this Section.

6.2 CALIBRATION PROCEDURES

The items contained in the Calibration Menu shown in Table 2-8 permit the user to set or adjust a number of functions in the KC and Benchmark Series units. The descriptions and procedures necessary to implement each of these Calibration Items are provided in the following paragraphs.

6.2.1 Stepper Feedback Calibration

The Stepper Feedback (Fbk) function checks the calibration of the Air/Fuel Valve Stepper Motor feedback current. This is accomplished by positioning the Air/Fuel Valve stepper motor at the 0% (fully closed) and 100% (fully open) positions and storing the feedback potentiometer readings at these settings. It also permits verification of the Stepper Motor Feedback at the 50% position. The position of the Stepper Motor is verified by visually checking the dial on the Air/Fuel Valve. In addition, the **VALVE POSITION** bargraph segments will light to indicate motor position. To initiate this calibration procedure, proceed as follows:

1. Press the ▲ or ▼ arrow key until *Stepper Fbk Cal 0%* is displayed.
2. Press the **CHANGE** key. *Stepper Fbk* will begin to flash.
3. Press and hold the ▼ arrow key and monitor the dial on the Air/Fuel Valve.
4. Release the ▼ arrow key when the Air/Fuel Valve reaches the 0% (fully closed) position, but is not pressing against the stop. Momentarily tap the ▲ arrow key a few times to ensure it is not contacting the stop.
5. Press the **ENTER** key. *Cal 100%* will be displayed.
6. Press and hold the ▲ arrow key and monitor the dial on the Air/Fuel Valve.
7. Release the ▲ arrow key when the Air/Fuel Valve reaches the 100% (fully open) position, but is not pressing against the stop. Momentarily tap the ▼ arrow key a few times to ensure it is not contacting the stop.
8. Press the **ENTER** key. *Verify 50%* will be displayed and the Air/Fuel Valve will rotate to the 50% position.
9. Verify that the dial on the Air/Fuel Valve indicates approximately 50%. Press **ENTER** to confirm.
10. Press **BACK** to exit the Stepper Fbk Calibration.

6.2.2 PWM In Adjustment.

The Pulse Width Modulation (PWM) Input Adjustment is used when the unit is being controlled by a Boiler Management System (BMS). This Calibration procedure allows the PWM duty cycle to be varied ±5.0% in 0.1% increments. The nominal PWM duty cycle is 12 milliseconds where: a 5% pulse ON time = a 0% valve position and a 95% pulse ON time represents a 100% valve position. To adjust the overall PWM duty cycle, proceed as follows:

1. Press the ▲ or ▼ arrow key until PWM In Adj is displayed along with the currently entered adjustment percentage.
2. If the desired percentage is not displayed, press the CHANGE key. PWM In Adj will begin to flash.
3. Press the ▲ or ▼ arrow key to increment or decrement the display until the desired adjustment percentage is displayed.
4. Press ENTER to store the selection.
5. Press BACK to exit the adjustment procedure.

6.2.3 Analog In Adjustment

The Analog Input Adjustment may be utilized when an external signal is used to change the setpoint (Remote Setpoint Mode – boiler or heater), or drive the air/fuel valve position (Direct Drive Mode – boiler only). This adjustment allows the 0 to 20 mA or 1 to 5 Vdc input to be changed ±5.0% in 0.1 % increments. The default setting is 0.0%. To view or change this adjustment, proceed as follows:

1. Press the ▲ or ▼ arrow key until *Analog In Adj* is displayed along with the current adjustment percentage.
2. If the desired percentage is not displayed, press the **CHANGE** key. *Analog In Adj* will begin to flash.
3. Press the ▲ or ▼ arrow key to increment or decrement the display until the desired adjustment percentage is displayed.
4. Press **ENTER** to store the selection.
5. Press **BACK** to exit the adjustment procedure.

6.2.4 Flow In Adjustment.

The Flow Input Adjustment is not currently implemented in the C-More Control Panel. When implemented, it will allow the water flow rate measured by a flow sensor to be adjusted ± 5%.

6.2.5 Supply Gas Pressure In Adjustment.

The Supply Gas Pressure Input Adjustment is not currently implemented in the C-More Control Panel. When implemented, it will allow input flow rate to be adjusted ±5%.

6.2.6 Gas Plate dp In Adjustment

The Gas Plate dp Input Adjustment is not currently implemented in the C-More Control Panel. When implemented, it will allow the input oxygen level to be adjusted ±5%.

6.2.7 mA Out Adjustment

The Milliamp (mA) Output Adjustment permits the output current to be adjusted from -1.0 mA to +1.0 mA in 0.1 mA increments. The default setting is 0.0 mA. This function is associated with the mA OUT terminals in the I/O Box. These terminals provide an output that can be used to monitor setpoint, outlet temperature or valve position. The function to be monitored is selected in the Configuration Menu. To view or adjust this setting, proceed as follows:

1. Press the ▲ or ▼ arrow key until *mA Out Adj* is displayed along with the current adjustment setting in mA.
2. If the desired setting is not displayed, press the **CHANGE** key. *mA Out Adj* will begin to flash.

3. Press the ▲ or ▼ arrow key to increment or decrement the display until the desire value appears.
4. Press **ENTER** to store the displayed setting.
5. Press **BACK** to exit the mA Out Adj function.

6.2.8 A/F Sensitivity

The Air/Fuel (A/F) Valve Sensitivity is used to set the allowable error on the Air/Fuel Valve Stepper Motor position. The sensitivity is adjustable from 1% to 5% in 1% increments. The default value for this setting is 2%. The sensitivity setting represents the maximum percentage that the output fire rate can change without the valve having to move. For example; if the sensitivity is set for 2% and the output fire rate changes 1%, no movement is required. To view or change the A/F Sensitivity, proceed as follows:

1. Press the ▲ or ▼ arrow key until *A/F Sensitivity* is displayed. The currently set sensitivity percentage will also appear in the display.
2. If the desired percentage is not displayed, press the **CHANGE** key. *A/F Sensitivity* will begin to flash.
3. Press the ▲ or ▼ arrow key to increment or decrement the displayed sensitivity percentage to the desired value.
4. Press **ENTER** to store the new setting.
5. Press **BACK** to exit the A/F Sensitivity Calibration.

6.2.9 Power Reset

The Power Reset function can be set to Automatic or Manual. However, AERCO strongly recommends that this function always be set to the Automatic (Default) setting.

6.2.10 Water Temp Reset

The Water Temperature Reset function can be set to Automatic or Manual to indicate whether the unit can be restarted or must wait for manual acknowledgement following a high water temperature fault and fault correction. Regardless which setting is used, the High Temperature fault message will be latched. The default for this function is Automatic. To view or change the setting, proceed as follows:

1. Press the ▲ or ▼ arrow key until *Water Temp Reset* is displayed. *Automatic* or *Manual* will be displayed to indicate the present setting.
2. If the desired setting is not displayed, press the **CHANGE** key. *Water Temp Reset* will begin to flash.
3. Press **ENTER** to toggle the display.
4. Press **BACK** to exit the Water Temp Reset function.

6.2.11 Gas Press Reset

The Gas Pressure Reset function can be set to Automatic or Manual to indicate whether the unit can be restarted or must wait for manual acknowledgement following a high or low gas pressure fault and fault correction. The default setting for this function is Manual. Regardless which setting is used, the High or Low Gas Pressure fault message will be latched. The default for this function is Manual. To view or change the setting, proceed as follows:

IMPORTANT

DO NOT change this setting to Automatic without written permission from AERCO.

1. Press the ▲ or ▼ arrow key until *Gas Pres Reset* is displayed. *Automatic* or *Manual* will be displayed to indicate the present setting.
2. If the desired setting is not displayed, press the **CHANGE** key*. Gas Press Reset* will begin to flash.
3. Press **ENTER** to toggle the display.
4. Press **BACK** to exit the Gas Press Reset function.

6.2.12 Min Off Time

The Minimum Off Time specifies the minimum amount of time that the unit must remain off when operating under automatic control. This time is adjustable from 0 to 10 minutes in 1 minute increments. The default value is 1 minute. To view or change this setting, proceed as follows:

1. Press the ▲ or ▼ arrow key until *Min Off Time* is displayed. The present setting will also appear in the display.
2. If the desired minimum off time is not displayed, press the **CHANGE** key. *Min Off Time* will begin to flash.
3. Press the ▲ or ▼ arrow key to increment or decrement the displayed until the desired value is shown.
4. Press **ENTER** to store the new setting.
5. Press **BACK** to exit the Min Off Time function.

6.2.13 Heater Tuning Display

The Heater Tuning Display function can be set to Enable or Disable (Default = Disable). When Enabled, it permits the Prop Band, Integral Gain and Derivative Time functions in the Tuning Menu to be set. See Table 2-4 for entry ranges.

6.2.14 Heater Breakpoint Display

This menu option is applicable only to Water Heaters and can be set to Enable or Disable (Default = Disable). When Enabled, it permits the Heater Breakpoints listed in the Tuning Menu (Table 2-4) to be viewed or changed.

6.3 DIAGNOSTICS PROCEDURES

The Diagnostics Menu Items listed in Table 2-9 permit the user to check the operational status of the front panel controls indicators and displays and the control system relays and switches. To perform each of the following Diagnostic procedures, first scroll to the Diagnostics Menu using the MENU key and press the ▲ or ▼ arrow key. Proceed to the desired Diagnostic procedure specified in the following paragraphs.

6.3.1 Display Test

The Display Test checks the front panel LED indicators, 7-segment display and LED **VALVE POSITION** bargraph.

1. Press the ▲ or ▼ arrow key until *Display Test* Off is displayed.
2. Press the **CHANGE** key. *Display Test* will begin to flash.

3. Press the ▲ key. *LEDs* will be displayed and the seven panel LEDs will light. These LEDs are: **COMM, MANUAL, REMOTE, DEMAND, °F, °C** and **FAULT**.
4. Press the ▲ key. 7-SEG will be displayed and all segments of the three-digit 7-segment display will light.
5. Press the ▲ key. *Bar-graph* will be displayed and the 20 segment **VALVE POSITION** bargraph will light.
6. This completes the Display Test. Press the **BACK** key to exit the test.

6.3.2 Keypad Test

The Keypad Test checks the status of the eight keypad keys on the front panel. The test is initiated as follows:

1. Press the ▲ or ▼ arrow key until *Keypad Test Off* is displayed.
2. Press the **CHANGE** key. *Keypad Test* will begin to flash.
3. Press each of the keys in the following sequence and verify that the name of each key appears in the panel display:
   (a) **AUTO/MAN** (Manual is displayed).
   (b) MENU
   (c) ▲ (Up is displayed)
   (d) ▼ (Down is displayed)
   (e) CHANGE
   (f) ENTER
   (g) CLEAR
4. Press the **BACK** key to exit the Keypad Test.

6.3.3 Relay Test

The Relay Test allows the user to switch relays ON or OFF. The relays which are tested are: Igniter, Blower, Pump, Aux and Fault relays. The Aux and Fault relays are located in the I/O Box on the left side of the unit. Removing the cover on the I/O Box will permit the ON/OFF status of these relays to be observed. The remaining relays are located in the C-More Control Panel. A “click” can be heard as each relay is turned ON and OFF.

1. Press the ▲ or ▼ arrow key until *Relay Test* Off is displayed.
2. Press the **CHANGE** key. *Relay Test* will begin to flash.
3. Press the ▲ arrow key. *Fault OFF* will be displayed.
4. To switch relay to ON, press **ENTER.** *Fault ON* will be displayed. Press **ENTER** again to toggle relay back to OFF. The ON/OFF status of this relay can be observed with the I/O Box cover removed.
5. To change the ON/OFF status of the remaining relays, repeat steps 3 and 4. The display will show the relays in the following order:
   (a) Aux
   (b) Pump
   (c) Blower

(d) Igniter

6. Pressing the ▼ arrow key will display the previous relay.
7. Press the **BACK** key to exit the Relay Test.

6.3.4 Switch Test

The Switch Test allows the user to observe the ON/OFF status of all control system switches in "Real Time". However, the displayed status can not be changed. This test is useful in determining that all required switches in the "Start String" on in the required positions to permit system startup.

1. Press the ▲ or ▼ arrow key until *Switch Test* Off is displayed.
2. Press the **CHANGE** key. *Switch Test* will begin to flash.
3. Press the ▲ arrow key. *Exhaust sw* will be displayed along with the present ON/OFF switch status.
4. To check the status of the remaining switches, continue to press the ▲ arrow key. The switch status will be displayed in the following order:
   (a) SSOV sw
   (b) Blower Proof sw
   (c) Ignition sw
   (d) Over Temp sw
   (e) Low Gas Pres
   (f) Hi Gas Pres
   (g) Water Lev sw
   (h) Rem Int sw
   (i) Front Pnl sw
   (j) Delayed Int
   (k) Purge sw
5. Press the **BACK** key to exit the Switch Test.

6.3.5 Stepper Test

The Stepper Test allows the Air/Fuel Valve Stepper Motor to be rotated between virtually any position between 0% (fully closed) and 100% (fully open).

1. Press the ▲ or ▼ arrow key until *Stepper Test* 0% is displayed.
2. Press the **CHANGE** key. *Stepper Test* will begin to flash.
3. Press and hold the ▲ arrow key to increment the Stepper Motor position. The **VALVE POSITION** bargraph will increase to show the valve position and the dial on the Air/Fuel valve will also rotate to track the current position.
4. Press and hold the ▼ arrow key to decrement the Stepper Motor position and verify that bargraph display and Air/Fuel Valve dial track the change.

6.3.6 Sensor Log Int

The Sensor Log Interval function permits the user to set the interval at which sensor readings are recorded and stored in memory. By default, this option is set to OFF. However, if desired, the Sensor Log Interval can be enabled and set to values ranging from 1 minute to 24 hours.

1. Press the ▲ or ▼ arrow key until *Sensor Log Int Off* is displayed.
2. Press the **CHANGE** key. *Sensor Log Int* will begin to flash.
3. Press the ▲ arrow key until the desired interval is displayed. The available choices are:
   (a) 1 Min
   (b) 5 Min
   (c) 15 Min
   (d) 30 Min
   (e) 1 hr
   (f) 6 hrs
   (g) 12 hrs
   (h) 24 hrs
4. With the desired interval displayed, press **ENTER** to store the selection in memory.
5. Press BACK to exit the Sensor Log Int function.

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SECTION 7 - RS232 COMMUNICATION

7.1 INTRODUCTION

The RS232 communication feature permits viewing or changing of Control Panel menu options and also provides access to data logs showing Event Time Line, Fault and Sensor log displays.

The RS232 port on the front panel of the C-More Control Box (Figure 3-1) can be interfaced to a laptop computer or other suitable terminal using the AERCO RS232 adapter cable (P/N 124675), which has a DB9 connector for use with older computer serial ports or can be used with a Serial-to-USB adaptor for use in modern computer USB ports. RS232 communication can be accomplished using any "Dumb Terminal" emulation, such as "PuTTY" which is not included with Microsoft Windows, but can be downloaded for free on the internet. Source and instructions for using PuTTY are provided here:

7.2 AQUIRING THE PuTTY APPLICATION

Download the **putty.exe** program to your desktop from:

www.chiark.greenend.org.uk/~sgtatham/putty/download.html

You can use PuTTY to logon to remote computers as well as run a single command on a remote server. PuTTY does not need to be installed, so just clicking the downloaded executable will start it.

7.2.1 Logging on to a Remote Machine Using PuTTY

To use **PuTTY** to logon to a remote machine, bring up the PuTTY application by double-clicking its icon. You will see the main window as shown in left image of Figure 7-1.

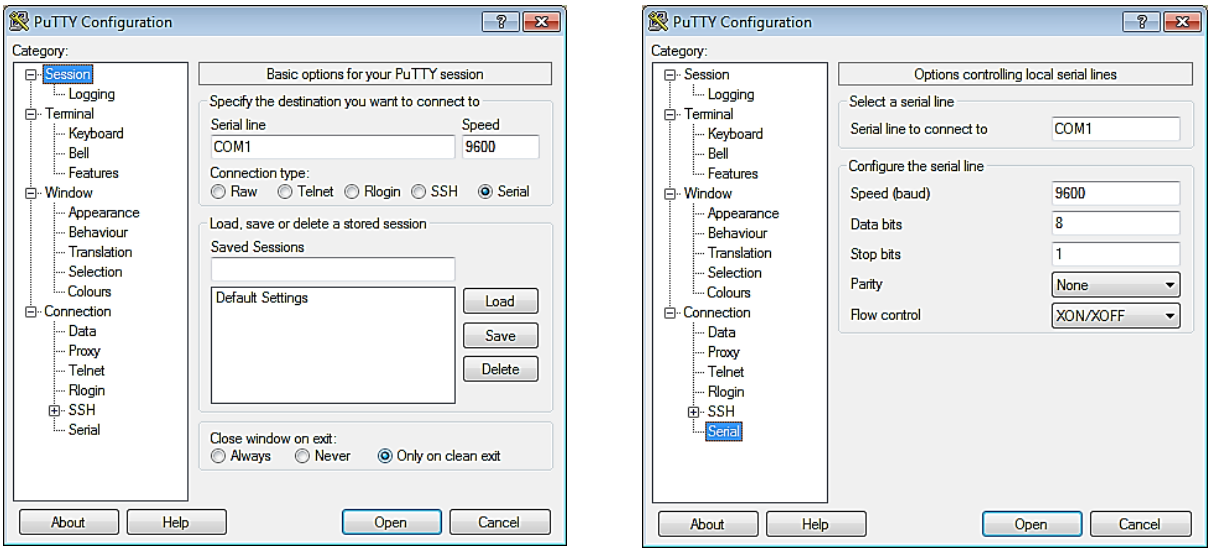


Figure 7-1: PuTTY GUI: Basic Serial Session (L) and Serial Options (R)

In Serial mode, text typed into the PuTTY window will be sent straight out of your computer's serial port, and data received through that port will be displayed in the PuTTY window.

To create a Serial connection, click the radio button labeled **Serial**. The **Serial line** and **Speed** fields will then be automatically filled in as shown in ***left*** image of Figure 7-1, but will allow you to specify the serial line to use (if your computer has more than one) and what speed (baud rate) to use when transferring data. For further configuration options (data bits, stop bits, parity, flow control), you can use the **Serial Configuration** panel (***right*** image in Figure 7-1) by selecting "Serial" in the left navigation pane.

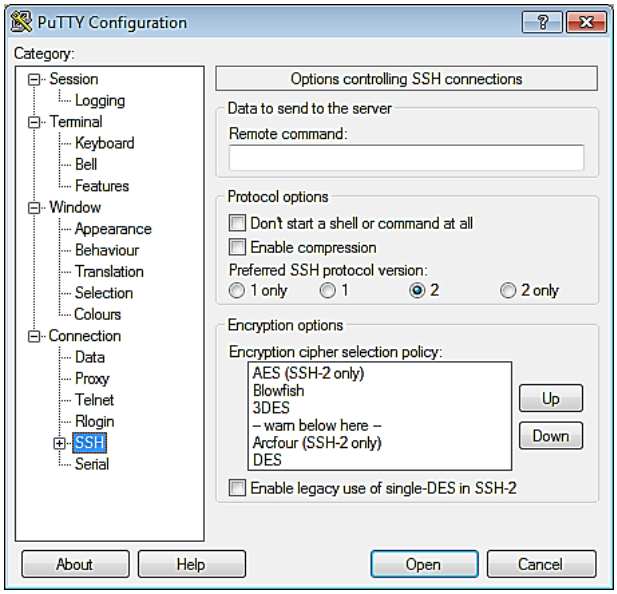
Now, to connect to the remote server, simply click the **Open** button at the bottom of the dialog box. A new terminal window will pop up and ask you to log in.

So that you don't have to enter this information every time you wish to connect to your server, you can save this configuration by typing an appropriate *name* in the **Saved Sessions** text box in the PuTTY "Basic Options" window (left image of Figure 7-1) and then clicking the **Save** button. In the future, you can select the *name* you chose in the list box and click the **Load** button to initialize this particular configuration.

7.2.2 Running a Command on a Remote Machine Using PuTTY

PuTTY may also be used to run some command residing on the remote server. After specifying the command line you want to run, you will be asked for your account name and password, and then the command you specified will execute. When it completes, your session will terminate, and your window will either close or remain open depending on how you configure the session. Here are the steps:

1. Bring up the PuTTY application and select the server you wish to connect to.
2. At the bottom of the Basic Options dialog box (left image of Figure 7-1) in the section titled: **Close window on exit**, select the **Never** radio button. This will keep the window open after the command has finished executing so that you can see any results in the terminal window.
3. In the menu bar along the left side of the dialog box, click the **SSH** menu near the bottom. The following screen will be presented:



4. Into the textbox titled, **Remote command** type the full command line you wish to have executed on the remote machine.
5. You are now ready to execute this command on the remote machine, simply click the **Open** button at the bottom of the dialog.
6. You will have to provide an account name and password in the terminal window to complete the process.

7.3 RS232 COMMUNICATION SETUP

Regardless of the terminal emulation utilized, the following guidelines must be adhered to when setting up the RS232 communication link:

1. Baud Rate – The baud rates which can be used with the C-More Control Panel are:
   (a) 2400
   (b) 4800
   (c) 9600 (Default)
   (d) 19.2K
2. Data Format – The program must be set for: 8 data bits, 1 stop bit, no parity and either Xon/Xoff or No flow control.

7.4 MENU PROCESSING UTILIZING RS232 COMMUNICATION

Viewing data logs and viewing or changing Control Panel menu options using RS232 communication is accomplished as follows:

1. Start the emulator software program and ensure that the specified baud rate and data formats have been entered.
2. Press the Enter key on the laptop. An asterisk (*) prompt should appear.
3. At the prompt, enter the valid RS232 password (jaguar) in lower case letters and press Enter.
4. “Welcome to Aerco” will appear in the laptop or “dumb terminal” display with a listing of the following available entry choices:

   M = Display next Menu
   D = Display menu items
   N = Display next menu items
   Cxx = Change item xx
   F = Fault log display
   S = Sensor log display
   T = Time line display
   L = Log off

NOTE

The Level 1 password must be entered to change options in the Setup, Configuration and Tuning Menus. The Level 2 password must be entered to view or change options in the Calibration and Diagnostics Menus.

With the exception of the password entry, all other keyboard entries can be made using either upper or lower case.

5. To view the available menus in the top-down sequence shown in Figure 2-1, enter *M* <*Rtn*>. The Menu title and first 10 options will be displayed.
6. When viewing menus containing more than 10 options, enter *N* <*Rtn*> to display the remaining options.
7. Shortcut keys are also available to go directly to a specific menu. These shortcut keys are:

m0	Default (Operating) Menu
m1	Setup Menu
m2	Configuration Menu
m3	Tuning Menu
m4	Calibration Menu
m5	Diagnostic Menu

8. To change a value or setting for a displayed menu option, proceed as follows:
   (a) Enter C, followed by the number to the right of the displayed option to be changed, and then press <*Rtn*>.
   (b) Enter the desired value or setting for the option and press <*Rtn*>. Refer to Tables 2-1 through 2-6 for allowable entry ranges and settings.
   (c) The change will be stored in non-volatile memory.
9. To redisplay the menu and view the option which was just changed in step 5, enter D and press <*Rtn*>.
10. To display the Fault (F) Log, Sensor (S) Log or Time (T) Line Log, press F, S or T followed by <*Rtn*>. Refer to paragraph 7.4 for descriptions and samples of these data logs.
11. To log off and terminate the RS232 communication link, press L followed by <*Rtn*>.

7.5 DATA LOGGING

During operation, the C-More Control Panel continuously monitors and logs data associated with operational events, faults and sensor readings associated with the boiler or water heater system. Descriptions of these data logs are provided in the following paragraphs. The basic procedure for accessing each data log is described in paragraph 7.3, step 7.

7.5.1 Fault Log

The C-More Control Panel logs the last 20 faults (0 – 19) starting with the most recent (#0). They can be viewed in the front panel display or via the RS232 port. The Fault Log cannot be cleared. If the Fault Log already contains 20 faults, the earliest fault is overwritten when a new fault occurs. A sample Fault Log display is shown in Table 7-1.

NOTE

The Operation Time (T) Log can store thousands of records. Therefore, to view the most recently logged record, enter "T" followed by 0 (zero) and press Enter (i.e. T0 <Enter>). To view earlier records in reverse chronological order, enter T and press Enter. To go back 200 or 1000 records, enter T200 or T1000, etc. and press Enter.

Table 7-1: Sample Fault Log Display

No.	Fault Message	Cycle	Date	Time
0	Direct Drive Signal Fault	609	1/10/02	8:42am
1	Low Gas Pressure	366	7/04/01	5:29pm
2	Loss of Power	0	1/01/01	11:50am

7.5.2 Operation Time Log

The Operation Time Log consists of a string of ASCII records stored in non-volatile memory within the C-More Control Panel. Events such as power-up, ignition and turn-off are time stamped. Data logged while the unit is running are run-length encoded. Data is logged or the run-length incremented every 30 seconds. For a new run record to be logged, the fire rate or flame strength must change by more than 5%, or the run mode must change. At steady-state, the run-length is allowed to reach a maximum of 30 minutes before the record is logged. This means that no more than 30 minutes of data can be lost if the unit loses power. Table 7-2 shows a sample Operation Time Log for a boiler: The Operation Time Log can only be accessed through the RS232 interface using a laptop or other terminal device. Ten operation time records are displayed for each T command entry. The operation time log can be cleared ONLY by factory authorized personnel using the Clear Log option in the Factory menu.

NOTE

The Sensor (S) Log can store up to 1200 records. Therefore, to view the most recently logged record, enter "S" followed by 0 (zero) and then press Enter (i.e. S0 <Enter>). To view earlier records in reverse chronological order, enter S and press Enter. To go back 200 or 700 records, enter S200 or S700, etc. and press Enter.

Table 7-2: Sample Operation Time Log Display

Status	Valve Position	Flame	Run Length	Date	Time
Off, Direct Drive	0	0	8	1/15/02	2:35pm
Run, Direct Drive	38	100	34	1/15/02	2:27pm
Run, Direct Drive	31	100	30	1/15/02	1:53am
Run, Direct Drive	35	100	2	1/15/02	1:23pm
Run, Direct Drive	29	100	0	1/15/02	1:21pm
Ignition	0	0	0	1/15/02	1:20pm
Off, Switch	0	0	35	1/15/02	12:30pm
Run, Manual	40	100	0	1/15/02	11:55am
Ignition	0	0	0	1/15/02	11:55am
Power-up	0	0	0	1/15/02	11:50am

7.5.3 Sensor Log

The sensor values can be logged at a different rate if needed by setting the Sensor Log Interval in the Diagnostics Menu. The log interval can vary from once every minute to once every day. Table 7-3 shows a sample Sensor Log every 5 minutes for a boiler running in Constant Setpoint mode.

Table 7-3: Sample Sensor Log Display

Setpt	Outlet	Outdr	FFWD	Aux	Inlet	Exhst	CO	O2	Flow	Date	Time
130	181	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:51pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:46pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:41pm
130	179	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:36pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:31pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:26pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:21pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:16pm
130	179	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:11pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:06pm

SECTION 8 - WATER HEATER MANAGEMENT (WHM)

NOTE

The Water Heater Management (WHM) feature is used with Innovation Water Heaters equipped with C-More Software Version 3.08.xx.

8.1 INTRODUCTION

The C-More Water Heater Management (WHM) feature is designed for use with multiple AERCO Water Heaters equipped with C-More Controllers. The software code required to operate the WHM resides in each of the C-Mores that are part of the system. The WHM can control up to eight (8) water heaters in parallel. Each water heater controlled by the WHM must be equipped with an Actuator-Controlled Sequencing Valve, Part No. 92093. These valves are installed on the cold water inlet of each water heater being controlled by the WHM.

8.2 GENERAL DESCRIPTION

The C-More Water Heater Management System (WHM) is designed to ensure that all water heaters in the system operate at maximum efficiency. This is accomplished by monitoring the Air/Fuel Valve position (VP) of all water heaters that have their sequencing valves open. Units with open sequencing valves are called enabled units. Units with closed sequencing valves are called disabled units. Units which are unable to function, due to a fault or user intervention, are called off-line units. When there is minimal, or no demand for hot water, the sequencing valve for one unit will be open. As system load increases, the WHM will open the sequencing valves on additional heaters. A simplified block diagram of multiple water heaters connected to a WHM is shown in Figure 8-1.

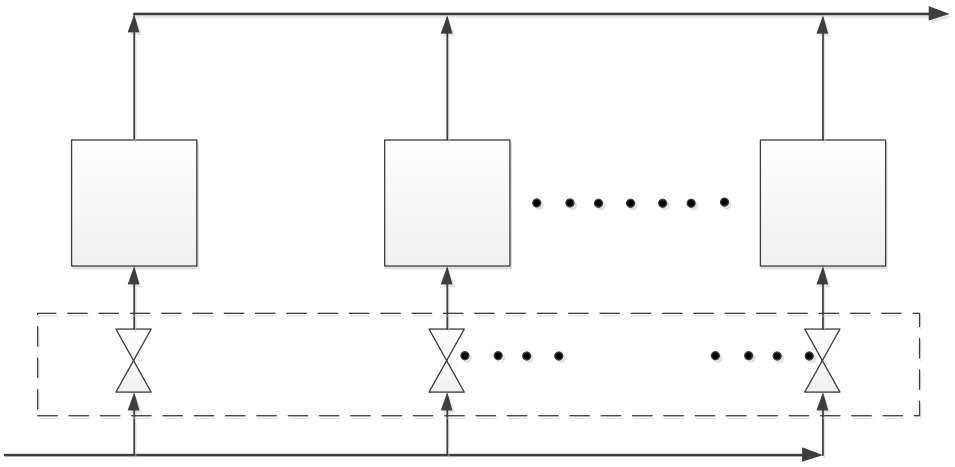


Figure 8-1. Simplified Block Diagram - Water Heater Management (WHM)

8.3 WHM PRINCIPLES OF OPERATION

The WHM system communicates with the plant water heaters via a RS485 network utilizing Modbus RTU protocol (8 bit, 9600 baud, no parity). All Modbus networks are implemented using a Master/Slave scenario where only one device, the Master, can initiate a communication sequence. All other C-More equipped units on the network are called Slaves. However, since the WHM software code resides in each C-More that is part of the system, any one of the C-Mores can be selected to control the system.

The controlling Master monitors the Air/Fuel Valve position (VP) of all enabled units. When this valve position (% open) exceeds a user-selectable limit (WHM Nxt On VP), the WHM will open the sequencing valve of another water heater in the system. Conversely, when the valve positions of all enabled units have dropped below a different user-selectable limit (WHM Nxt Off VP) threshold, the WHM will close the sequencing valve on a unit. The philosophy behind this approach is to maintain the fire rates (Air/Fuel Valve % open) at a level that maximizes heater efficiency.

In addition to collecting Air/Fuel Valve position data, the controlling Master also monitors the total accumulated operating time for each unit on the system and attempts to balance the system so that all units operate for approximately the same number of hours.

8.4 WHM MENU

The WHM Menu in each C-More can only be viewed when the *Unit* Type option in the *Configuration Menu* is set to *Innovation WH.* The WHM Menu items are protected by Password Levels 1 and 2. Level 1 protects user menu items and Level 2 protects menu items used by Factory-Trained personnel. The WHM Menu options are listed in Table 2-4. Descriptions for each of these menu items are included in Section.3, Table 3-1.

8.5 HARDWARE INSTALLATION & SET-UP INSTRUCTIONS

The following paragraphs provide the basic installation and set-up instructions for implementing a Water Heater Management System (WHM) to control up to eight (8) AERCO Innovation Water Heaters. Some of the descriptions and procedures included in Chapter 2 may be repeated here to avoid unnecessary referencing.

8.5.1 Hardware Installation

All Innovation Water Heaters which will be controlled by a WHM master must be equipped with an actuator-controlled sequencing valve (part no. 92093). This valve is installed on the cold water inlet as shown in Figure 8-2.

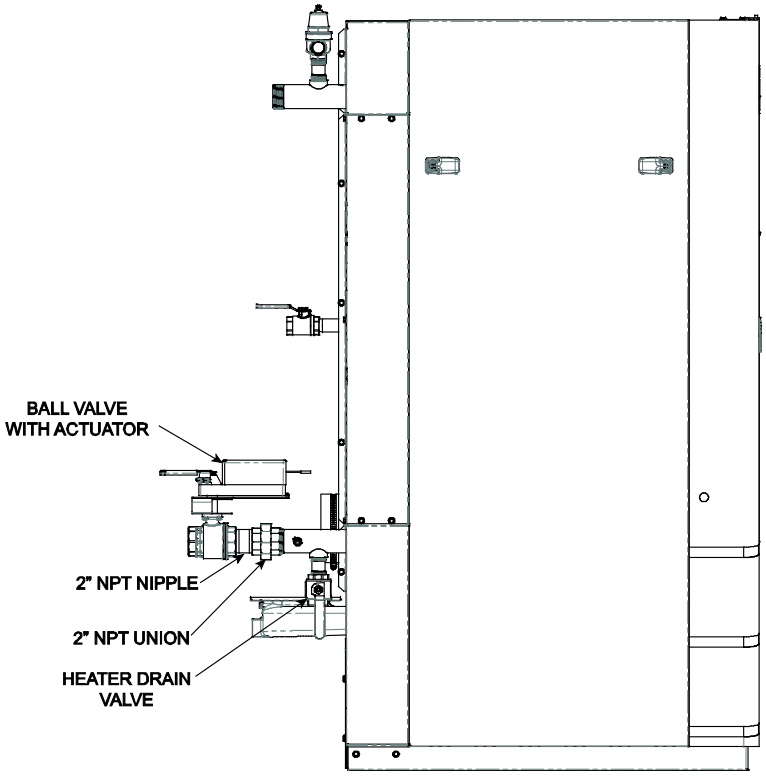
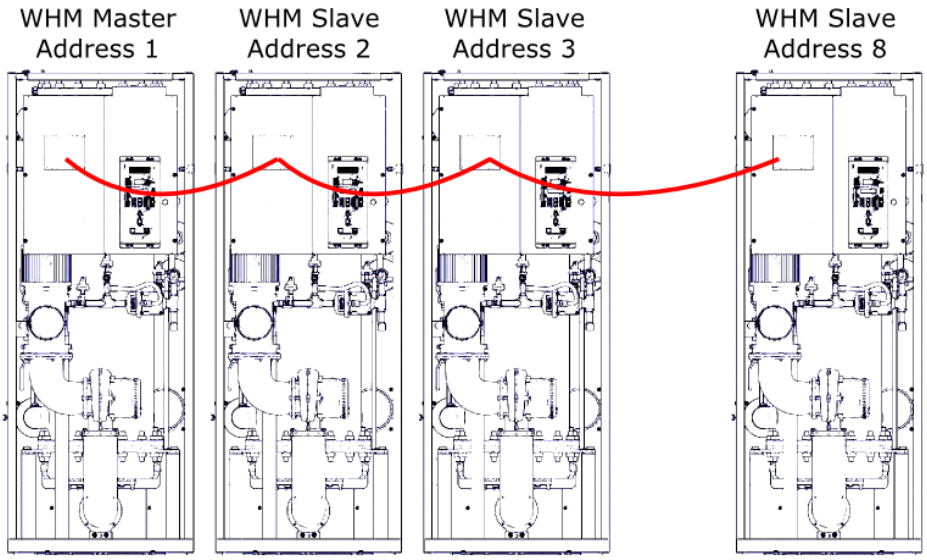


Figure 8-2. Innovation Water Heater Equipped With Sequencing Valve

8.5.2 WHM Modbus Network Wiring

As previously mentioned, all units being controlled by the WHM will be connected to a RS485 Modbus Network. All Modbus networks are wired in a daisy-chain configuration using a Master/Slave scenario as shown in Figure 8-3.



Note: The master does not need to be at an end of the daisy-chain loop.

Figure 8-3. Typical Daisy-Chain Modbus/RS485 Network

Any one of the C-More WHM units included in the Modbus network can be the Master. However, it is recommended that you decide which unit will be the Master and which will be the last unit on the daisy-chain prior to performing the wiring connections. This will simplify wiring connections and Modbus address assignments.

Modbus network wiring connections must be made using shielded twisted-pair wiring, (18 – 24 AWG) such as Belden #9841, #3105A, #8760, or equivalent. The Modbus wiring connections are made at the RS485 COMM terminals on the I/O board included with each C-more Control System.

Connect the Modbus wiring as follows:

1. Starting at the first unit, connect the twisted, shielded pair cable to the RS485 Comm plus (+) and minus (-) terminals on the left side I/O board as shown in Figure 8-4.
2. At the Modbus Master I/O board, activate the DIP switch labeled “MODBUS TERM” by placing it in the up position. This will connect a termination resistor across the terminals at the source end.
3. Refer to Figure 8-4 and run the shielded cable to the next unit in the daisy-chain and connect the + and – wire leads (+ to +, - to -). DO NOT terminate the shield of the RS485 Comm leads to the SHIELD terminal at the Slave. Instead, connect the shields of the incoming and outgoing RS485 leads together.
4. Continue connecting the + and - wire leads and shields for the remaining units as described in step 3 for the remaining Slave units in the chain.
5. At the end unit in the chain, activate the DIP switch labeled “MODBUS TERM” by placing it in the up position. This will ensure that the termination resistors are activated at both ends of the loop.

8.5.3 Control and Power Wiring

Control and power wiring connections to the sequencing valves associated with each C-More WHM unit is accomplished by simply ensuring that the 3-pin Molex connectors on the units are connected to the corresponding connectors on the valves

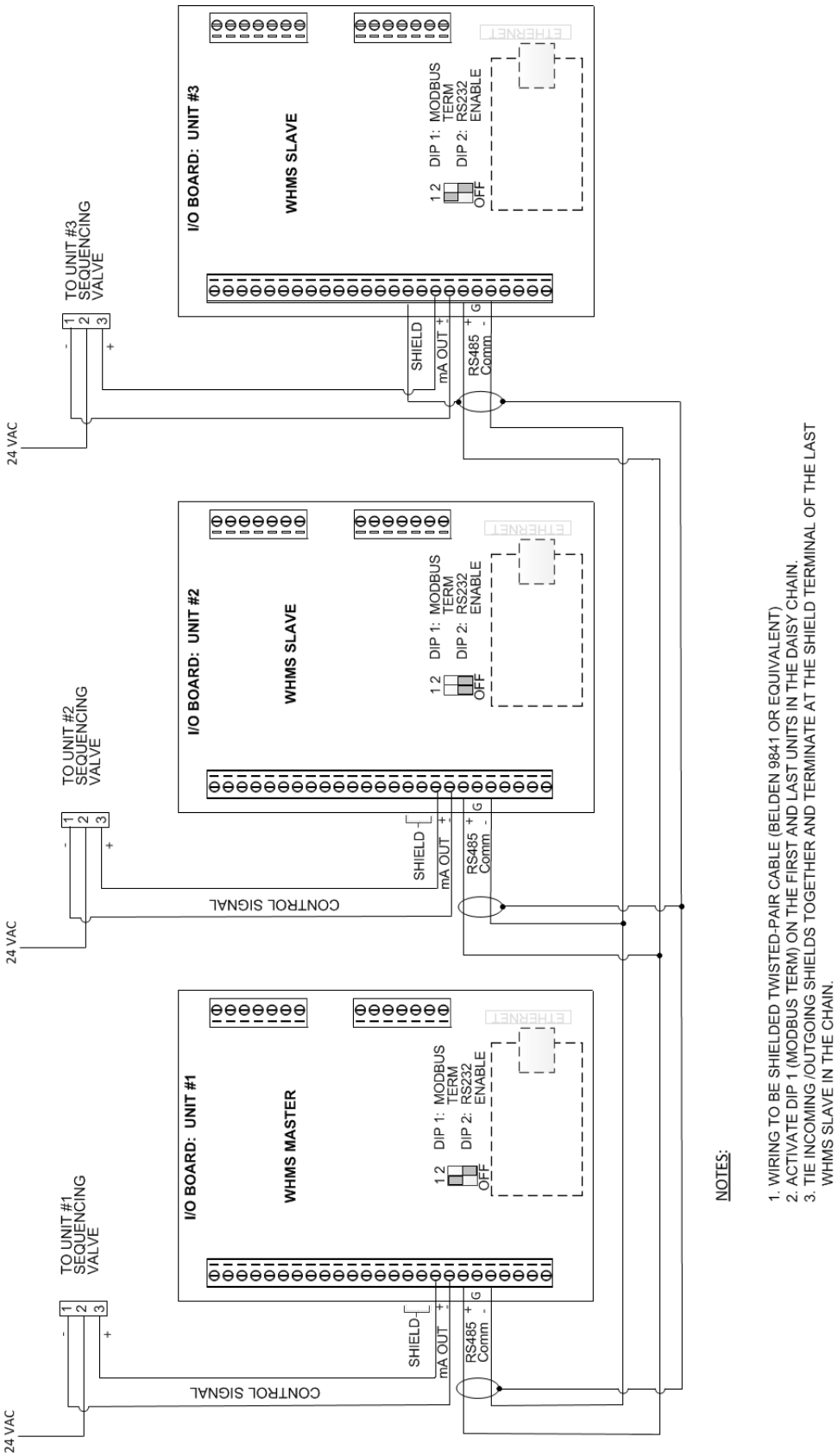


Figure 8-4. WHM Network Wiring Diagram

8.6 WHM MENU SETTINGS

The required settings for WHM Menu items listed in Table 8-1 will vary depending on the number of units connected to the Modbus network and required setpoint and operating conditions to be maintained on the network. Set the menu options in accordance with the descriptions provided in the paragraphs 8.6.1 through 8.6.10 which follow.

NOTE

It is recommended that the WHM Menu settings described in the following paragraphs be performed first at the WHM Master. This will simplify the number of required entries since most of the settings will be "pushed" to the appropriate Slaves.

8.6.1 WHM Mode

Set the WHM Mode option to WHM Master for the controlling Master. Set the WHM Mode option to WHM Slave for all other units on the Modbus network.

8.6.2 Comm Address (Located in Setup Menu)

This option, located in the Setup Menu, is the Modbus address for the for the water heater on the network. To simplify addressing, assign consecutive address numbers 1 through 8.

8.6.3 WHM Setpoint

The default setpoint for the WHM is 130°F. If a different setting is desired, the setpoint can be varied from 40°F to 240°F.

8.6.4 WHM Nxt On VP

This is the Next On Air/Fuel Valve Position (VP), % open) for the system. The default value for this option is 75%. When all enabled water heaters have a valve position (VP) greater than this value, the WHM Master will enable another water heater, if one is available. If a different value is desired for the system, this menu option can be varied from 16% to 100%. The selected value must always be greater than the Next Off Valve Position, and there should be a reasonable spread between the two values.

8.6.5 WHM Nxt Off VP

This is the Next Off Air/Fuel Valve Position (VP), % open) for the system. The default value for this option is 35%. When all enabled water heaters have a valve position (VP) less than this value the WHM will disable one of the enabled water heaters. The exception to this rule is if there is only one water heater currently enabled.

8.6.6 Lead/Lag Hours

This feature is designed to spread the total number of run hours accumulated on all units in the system so that each of the units have approximately the same number of run hours. The default value for this option is 72 hours.

8.6.7 Setback Setpoint

This menu item specifies the setpoint temperature that the WHM system will maintain during time periods of low DHW demand.

8.6.8 Setback Start & Setback End

These two menu items specify the start and end times that the Setback Setpoint will be in effect. The start and end times can be set from 12:00am (midnight) to 11:59pm. To disable the setback feature, leave the start and end times set to 12:00am (midnight).

8.6.9 WHM Auto Mstr

Password Level 2 (6817) must be entered in order to access the WHM Auto Mstr menu option. This item is used to enable (yes) or disable (no) an Automatic Master switch-over function. When enabled (yes), the WHM will automatically select a new Master if the current Master fails or loses power. This option is used with the WHM Auto Timer option described in the following paragraph. The default for this option is No (disabled).

8.6.10 WHM Auto Timer

Password Level 2 (6817) must be entered in order to access the WHM Auto Timer menu option. When the WHM Auto Mstr option is set to Yes (enabled), the WHM Auto Timer option allows the user to select the elapsed time interval between failure of the WHM Master and switch-over to a new WHM Master. The default for this option is 30 seconds.

8.7 WHM PROGRAMMING & START-UP

Prior to programming the required WHM Menu options into the WHM Master and Slaves, all required hardware installation and network wiring must be completed. In addition, the required menu entries to be entered must be determined based on the descriptions in the previous paragraphs.

AERCO recommends that the WHM Master be set up first. By doing so, the Master will “push” most of the required menu entries to each WHM Slave as each unit is brought on-line. The following steps assume that the WHM Master and Slaves will be consecutively numbered, starting at 1 (WHM Master). Proceed as follows starting at the unit which has previously been determined to be the WHM Master:

1. Access the Setup menu and scroll to the Comm Address option. Press the CHANGE key.
2. Enter 1 for the Comm Address of the Master. Press the ENTER key to store the entry.
3. Access the WHM menu and scroll to the WHM Mode option (default = Off).
4. Press the CHANGE key.
5. Select WHM Master. Press the ENTER key to store the entry. Note that the Outlet Temperature display on the WHM Master will begin flashing every two seconds.
6. Select the WHM Setpoint option. The default value is 130°F. If this is not the desired setpoint for the WHM, press the CHANGE key.
7. Enter the desired WHM setpoint temperature. Press ENTER to store the selection.
8. Scroll to the WHM Nxt On option (default = 75%). If the desired setting for this option is not displayed, press the CHANGE key.
9. Enter the desired value for the Nxt On option. Press ENTER to store the selection.
10. Scroll to the WHM Nxt Off option (default = 35%). If the desired setting for this option is not displayed, press the CHANGE key.
11. Enter the desired value for the Nxt Off option. Press ENTER to store the selection.
12. Scroll to the Lead/Lag Hours option (default = 72). If the desired setting for this option is not displayed, press the CHANGE key.
13. Enter the desired value for the Lead/Lag Hours option. Press ENTER to store the selection.

14. The WHM menu contains Setback options which are used to adjust the setpoint temperature, start time and end time during periods of low DHW demand. These options are selected as specified in steps 15 through 18 which follow.
15. To specify the setback temperature, scroll to the Setback Setpoint option (default = 130ºF). If this is not the desired setting, press the CHANGE key.
16. Enter the desired Setback Setpoint temperature. Press ENTER to store the selection.
17. Next, the Setback Start and Setback End time options must be specified (defaults = 12:00am for both options). To change each option scroll to Setback Start or Setback End and press the CHANGE key.
18. Separately enter the desired Start and End time (12:00am to 11:59pm). Press ENTER to store each entry.
19. This completes the required entries for the WHM Master. All but two of the required menu setting will be automatically be "pushed" to the WHM Slaves as they are brought on-line. The options which are not "pushed" to each WHM Slave are:
    - Comm Address
    - WHM Mode
20. Enter the desired Comm Address and WHM Mode (WHM Slave) at the C-More Control Panel for each of the WHM Slaves on the network.
21. After the required entries are made at each WHM Slave, check to ensure the REMOTE LED on the C-More Control Panel for each unit in the WHM network is illuminated. When illuminated, it indicates that the RS485 communications are operating properly.
22. The WHM menu contains two additional menu options which can be set at the WHM Master. These options are WHM Auto Mstr and WHM Auto Timer. In order to view or change these two options, the Level 2 Password (6817) must be entered as follows:
    (a) Press the MENU key on the front panel of the C-More and access the Setup Menu.
    (b) Scroll to the Password menu option and press the CHANGE key.
    (c) Enter 6817 and then press the ENTER key to store the password.
    (d) Press the MENU key on the C-More and scroll back to the WHM Menu.
23. Scroll to the WHM Auto Mstr option. The default value for this option is Off (disabled). If you wish to enable this option, select Yes and then press the ENTER key to store the setting.
24. If the WHM Auto Mstr option was set to Yes (enabled) in step 23, proceed to step 25. If this option remains set to No (disabled), skip step 25 and go to step 27.
25. Scroll to the WHM Auto Timer option will appear. This option is used to select the elapsed time interval between failure of the WHM Master and switch-over to a new WHM Master (default = 30 seconds). If desired, this time interval can be changed to any value within the allowable range of 10 to 120 seconds. To alter this setting, press the CHANGE key and enter the desired time interval. Press the ENTER key to store the new setting.
26. The WHM Auto Mstr and WHM Auto Timer options will be automatically "pushed" to the WHM Slaves on the network.
27. This completes all programming for the WHM.

SECTION 9 - AERCO Boiler Sequencing Technology (BST)

9.1 INTRODUCTION

This Section applies only Benchmark boilers, but does not apply to Innovation water heaters.

The C-More on-board Boiler Sequencing Technology system (BST) is an integrated 8 boiler control system incorporated into the C-More controller. The BST has its own sophisticated PID control system designed to simultaneously control the light off and modulation of up to 8 boilers while achieving maximum operational efficiency.

9.1.1 New AERCO BST Features

The following are new and innovative features incorporated into the AERCO BST:

1. **One Boiler Mode**
   The "One Boiler Mode" eliminates excessive cycling in the Boiler Management System due to low flow conditions.

   A common and difficult to solve problem that results in excessive cycling occurs in a multi-boiler system when a header sensor is mounted remotely downstream from any of the boilers, and a "low-flow" condition exists.

   NOTE

   It is recommended that that the Header Sensor be installed within 2-10 feet downstream of the last boiler's outlet.

   Due to low-flow and the distance of the header sensor, changes in header temperature cannot be detected in sufficient time to precisely control temperature. The excessive delay in detecting temperature changes by the header sensor causes boiler firing rates to continuously drop and rise, thereby "chasing" (or hunting) the desired setpoint.

   The "One Boiler Mode" is an innovative and exclusive feature in On-Board BST that detects a "low-flow" condition in a multi-boiler system. When BST determines that a low-flow condition exists, it will slowly shut down one boiler at a time in an attempt to raise the Fire Rate of the remaining boilers. If the low-flow condition persists and only a single boiler remains ignited, BST will use the "Outlet Temperature Sensor" of the remaining ignited boiler to control the temperature. The Outlet Temperature Sensor is mounted in the individual boiler and drastically increases the response time to precisely control temperature.

   With Isolation Valves Installed
   In One Boiler Mode with isolation valves installed, the master will use the ignited boiler's Outlet Temperature sensor for PID control. The distant Header Temperature Sensor is monitored, but not used for control in this mode of operation.

   Without Isolation Valves Installed
   In One Boiler Mode with no isolation valves installed, the master will take the average value of the Header Temperature and the ignited boiler's Outlet Temperature for PID control.

2. **Fire Rate Hold during Warm-Up and Low-Fire-Delay**
   When an extra boiler is lit off to meet demand, the fire rate of all ignited boilers will be held at their present level until the newly ignited boiler has completed Warm-up and Low Fire Delay. When the newly ignited boiler has completed Warm-up and Low Fire Delay, all boilers will decrease fire rates to approximately 30%. All boiler fire rates will then rise together to the required fire rate to meet demand.

3. **PID Hold during Warm-Up and Low-Fire-Delay**
   Whenever any boiler is in either Warm-up or Low Fire Delay, the Integral portion of the BST PID will be frozen in order to prevent the PID from winding up too high, causing the temperature to overshoot causing an over-temp condition.

4. **Setpoint Approach Rate control**
   To avoid header temperature overshoots, whenever the header temperature nears the setpoint temperature too quickly to prevent a temperature overshoot, the BST fire rate will temporarily decrease in order to lower the temperature rise momentum. This feature will help avoid temperature overshoots due to variable flow as well as other conditions.

   This feature is a supervisory function installed as a failsafe (or backup) to normal PID control.

5. **Setback Setpoint gradual decrease**
   Whenever boilers are running at a high rate and the Setback-Setpoint feature is activated, the sudden decrease in setpoint will cause the PID to drastically cut back on Fire Rate. This sudden decrease in fire rate will often cause the boilers to drop below their Stop Levels causing them to turn off, thereby causing excessive cycling and loss of heating capacity while the boilers re-ignite.

   The **Setback-Setpoint gradual decrease** feature decreases the setpoint at a slow rate thereby allowing the PID to recover and preventing any boiler from shutting down if not required to do so.

6. **Next Turn On Valve Position**
   When all ignited boilers reach or exceed the **BST Next on VP** value, another boiler will be lit off to share the load (if one is available).

   The default value for Next Turn On Valve Position is 50%.

   This feature is also useful if a user wishes to always have as few boilers as possible on at any one time. Setting the **BST Next on VP** value to a high number (Example 100%) will only light off a new boiler if all currently ignited boilers reach their total BTU capacity (100%).

9.2 GENERAL DESCRIPTION

BST is designed to ensure that all boilers in the system operate at maximum efficiency. This is accomplished by lighting off boilers only if all ignited boilers reach or exceed a defined Valve Position (Fire Rate). Operating all boilers below the defined Fire Rate “Next on VP” (for Next Turn on Valve Position) insures that they are firing at their most efficient Fire Rate. One C-More unit on the BST Modbus Network is defined as the MASTER unit and all other C-More units are defined as SLAVE units. The Master unit will monitor the system Header Temperature, monitor all Slave units’ status information and efficiently control all units in order to achieve and maintain the required BST Setpoint Temperature.

When there is a demand, the Master unit will light off one of the boilers based on the BST Sequencing selection in the BST menu. As system load increases and the valve position of the ignited units reach the Next On VP (% valve position), the BST master will light off the next available unit. A simplified block diagram of multiple boilers connected to a BST is shown in Figure 9-1 below.

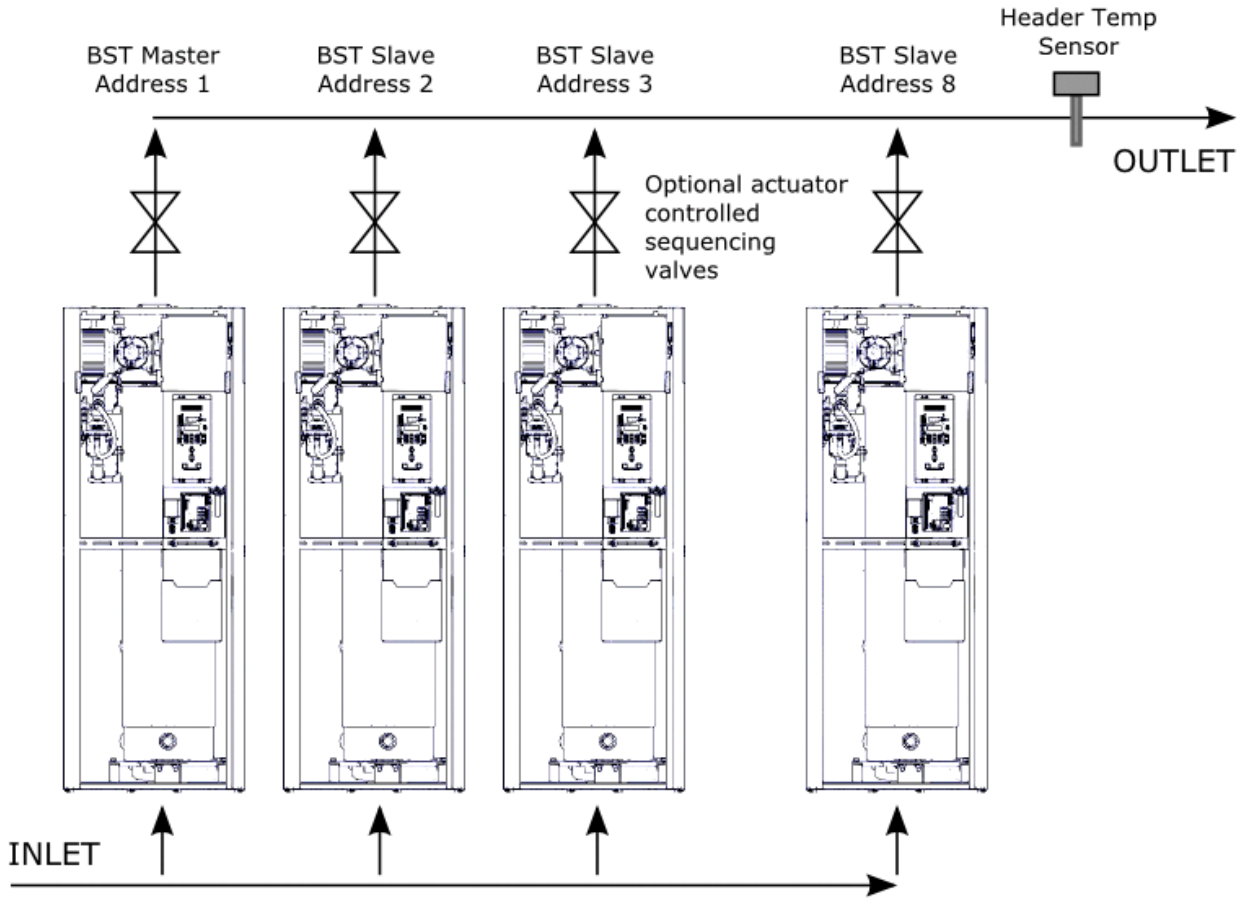


Figure 9-1. Simplified BST Block Diagram

NOTE

The header temperature sensor is either connected directly to the BST Master's FFWD connector or to the optional Modbus transmitter. The Modbus transmitter with header temp sensor is accessible to any unit on the Modbus bus. The ability to read the header temperature from any unit is required for the automatic failover feature.

9.2.1 SEQUENCE OF OPERATIONS

Single boiler operation:

Below is the sequence of operation of the single boiler:

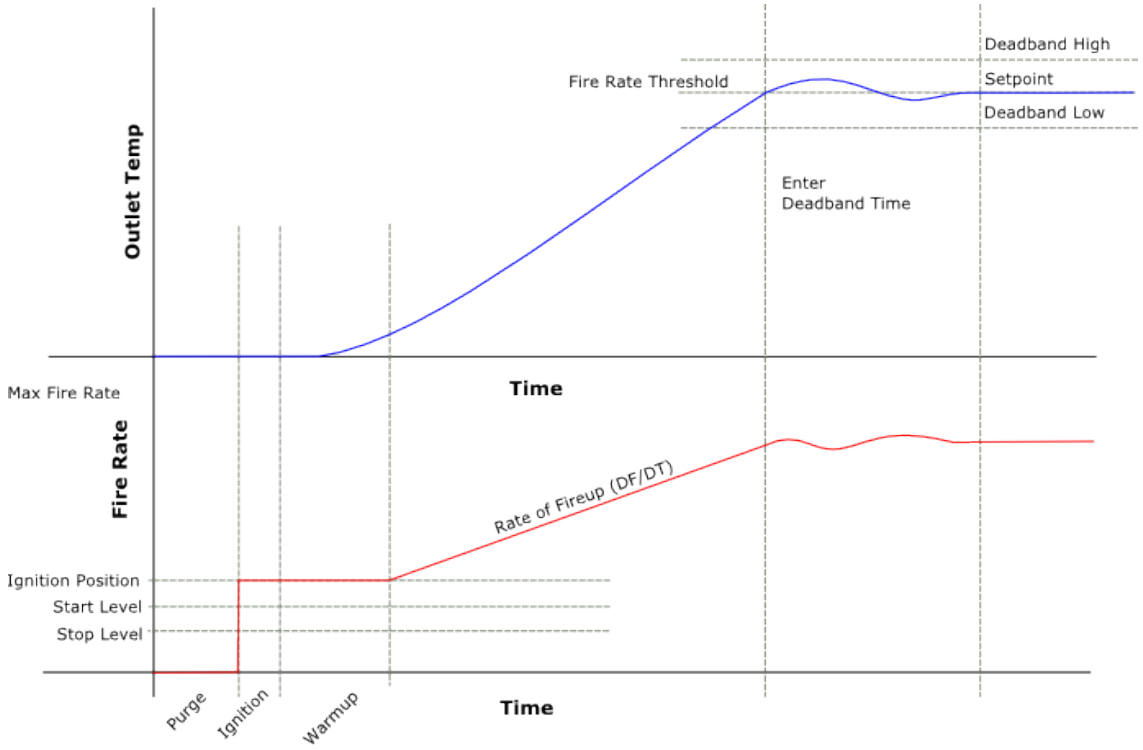


Figure 9-2: BST Single Boiler Sequence of Operation – 1 of 2

Multiple Boiler Operations:

Below is the sequence of operation for multiple boilers:

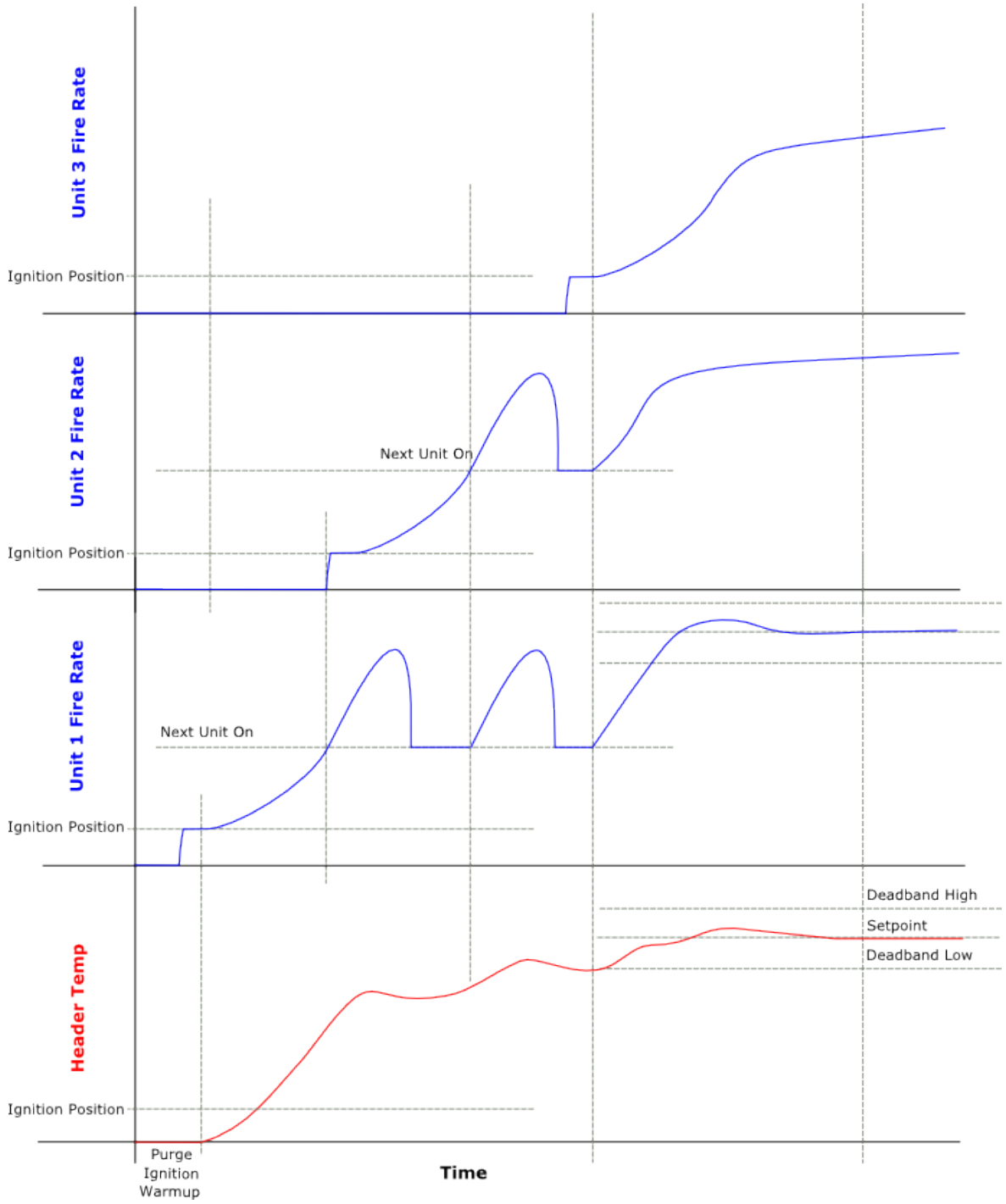


Figure9.2: BST Multiple Boiler Sequence Of Operation – 2 of 2

BST Multiple Boiler Light Off sequence

Igniting the first boiler:

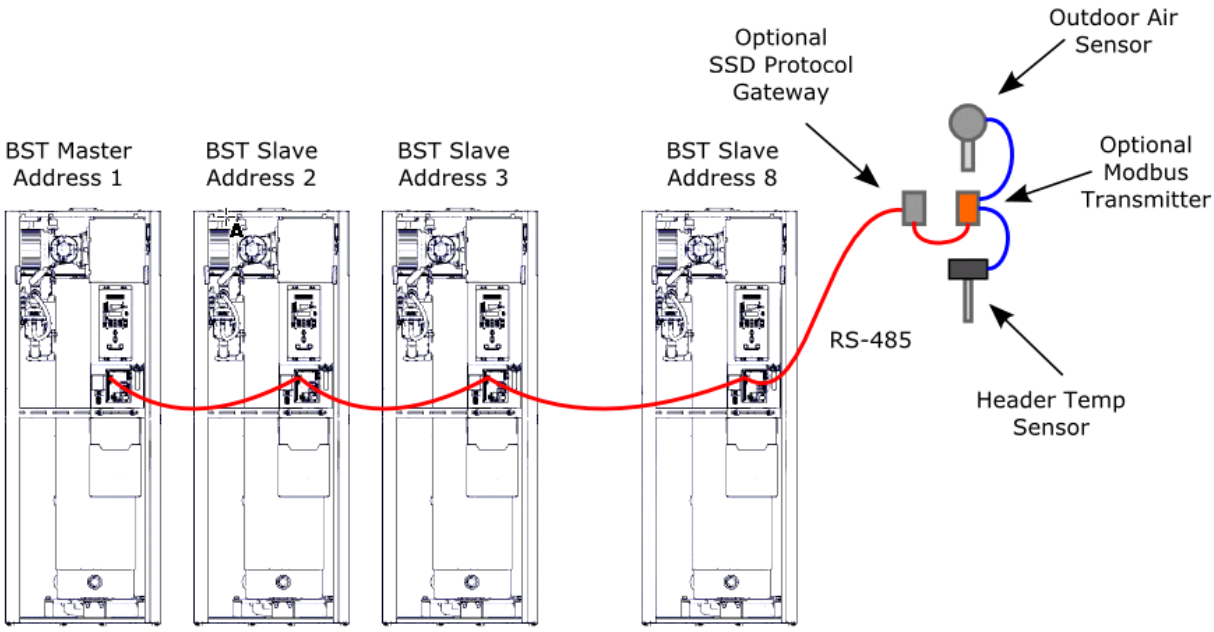
1. The BST PID determines that there is a demand for heat and begins a light off sequence.
2. BST executes the “Sequence” firmware to select a Lead Boiler to light off.
3. BST examines the Unit Type and Unit Size of the Lead Boiler to light off and sends the Lead Boiler a Valve Position (Fire Rate) equal to that boiler’s Start Level to initiate a light off sequence.
4. The boiler being ignited sets its internal Valve Position (Fire Rate) at its’ own particular Ignition Position (Low Fire Pct) during the light off Sequence.
5. When the boiler is successfully ignited, it executes either the Warmup Delay, if required, or the Low Fire Delay, if required. The Warmup and Low Fire Delays will be executed with the boiler at its Ignition Position (Fire Rate).
6. The BST PID will adjust the boiler’s Valve Position (Fire Rate) as required to achieve and maintain the required Setpoint temperature.
7. If the Valve Position reaches or exceeds the “BST Next Turn On VP” level, the BST will attempt to light off another boiler to meet the demand.

Igniting the next boiler:

8. The BST executes the “Sequence” firmware to select the next Lead Boiler to light off.
9. The BST examines the Unit Type and Unit Size of the boiler to light off and sends it a Valve Position (Fire Rate) equal to that boiler’s Start Level to initiate a light off sequence.
10. The boiler being lit off sets its internal Valve Position (Fire Rate) at its own particular Ignition Position (Low Fire Pct) during the light off Sequence.
11. When the boiler is successfully ignited, it executes either the Warmup Delay, if required, or the Low Fire Delay, if required. The Warmup and Low Fire Delays will be executed with the boiler at its Ignition Position (Fire Rate).
12. During the Warmup or Low Fire Delays, the Valve Position of ANY previously ignited boilers will remain at their present (Fire Rate) level in order to maintain proper loop temperature during the extended Wait Periods. The boiler temperatures will be locally monitored and modulated during this Wait period to prevent overheating.
13. During the Warmup or Low Fire Delays, the “Integral” portion of the BST PID Calculation will be frozen in order to prevent the PID from un-necessarily “Winding UP” and causing Overtemp problems.
14. Following the successful light off and delays, BST sets the Valve Position (Fire Rate) of all previously ignited boilers to 30% to evenly distribute the load among all boilers.
15. The BST PID will now modulate all boilers up or down in order to reach and maintain the Setpoint Temperature.

9.3 BST Modbus Network Wiring

As previously mentioned, all units being controlled by the BST will be connected to a RS485 Modbus Network. All Modbus networks are wired in a daisy-chain configuration using a Master/Slave scenario as shown in Figure 9-3.



NOTE: The BST master unit does not have to be address 1. Master unit is also an internal slave.

Figure 9.3: Typical Daisy-Chain Modbus/RS485 Network

Any one of the C-More BST units included in the Modbus network can be the Master. However, it is recommended that you decide which unit will be the Master and which will be the last unit on the daisy-chain prior to performing the wiring connections. This will simplify wiring connections and Modbus address assignments.

Modbus network wiring connections must be made using shielded twisted-pair wiring, (18 – 24 AWG) such as Belden #9841, #3105A, #8760, or equivalent. The Modbus wiring connections are made at the RS485 COMM terminals on the I/O board included with each C-more Control System.

Connect the Modbus wiring as follows:

Modbus Network Wiring

1. Starting at the first unit, connect the twisted, shielded pair cable to the RS485 Comm plus (+) and minus (-) terminals on the left side I/O board as shown in Figure 5-1.
2. At the first unit on the wiring daisy chain, activate the DIP switch labeled “MODBUS TERM” by placing it in the up position. This will connect a termination resistor across the terminals at the source end.
3. Refer to Figure 5-1 and run the shielded cable to the next unit in the daisy-chain and connect the + and – wire leads (+ to +, - to -). DO NOT terminate the shield of the RS485 Comm leads to the SHIELD terminal at the Slave. Instead, connect the shields of the incoming and outgoing RS485 leads together.

Modbus Network Wiring – Continued

4. Continue connecting the + and - wire leads and shields for the remaining slave units in the chain, as described in step 3.
5. At the end unit in the chain, activate the DIP switch labeled "MODBUS TERM" by placing it in the up position. This will ensure that the termination resistors are activated at both ends of the loop.

NOTE

For reliable performance, the termination resistors must be activated on the units at the beginning and end of the physical wiring sequence. The first and last units in terms of MODbus address can be assigned in any sequence within the MODbus network.

9.4 BST Status Displays

The following BST status information will be displayed on the two line VFD Display on the front of the C-More to inform the user of critical BST real-time operating conditions**:**

- **BST Header Temperature**

  Whenever a BST boiler is defined as the MASTER, the large, 3 digit display of the front for the C-More will continuously blink and display **BST HEADER TEMPERATURE.**

- **Master Display**

  The boiler defined as the MASTER will display the flowing status information on the two line VFD display:

  MASTER-DISABLED - *The Master has been disabled and is not available*
  MASTER-STANDBY - *The Master is "Cycled Off" and is available to be lit off*
  MASTER-IGNITED - *The Master is ignited*

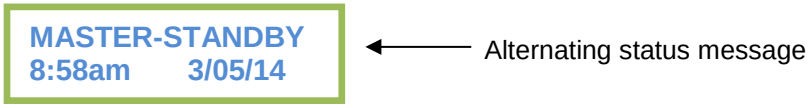
- **Slave Displays**

  The boilers defined as the SLAVE boilers will display the flowing status information on the two line VFD display:

  SLAVE-DISABLED - *The Slave has been disabled and is not available*
  SLAVE-STANDBY - *The Slave is "Cycled Off" and is available to be lit off*
  SLAVE-IGNITED - *The Slave is Ignited*

Examples:

If a Master is enabled and in Standby mode, the C-More display will display the following:



BST Alternating Status Displays

- **Master/Slave Status Displays**

  On both BST Master and Slave boilers, the following status information will alternate, and be displayed on the two line VFD display on the front of the C-More.

FAILSAFE ACTIVE - *The Slave Failsafe Mode has been activated*
ONE BOILER MODE - *One Boiler Mode has been activated*
BST IN DEADBAND - *BST is locked in deadband*
BST IN CONTROL - *BST is controlling this Slave unit*
All Boilers Off - *All available boilers are off*
Igniting First - *The first boiler is being lit off*
Boiler Ignited - *The boiler has been successfully ignited*
Igniting Next - *The next boiler is being lit off*
Raise Fire Rate - *Raising the Fire Rate of all ignited boilers*
All On-Raise FR - *All available boilers are ignited and raising the Fire Rate*
Lower Fire Rate - *Lower the Fire Rate of all ignited boilers*
Lower Next Off - *Lower the Fire Rate of next boiler to be cycled off*
All On at MAX FR - *All available boilers are ignited and at MAX Fire Rate*
BST OVERTEMP - *BST temperature is above MAX temperature*
REMOTE SIG FAULT - *Remote signal fault*
BST FAILSAFE - *BST is in Failsafe Mode*

Example: If all available boilers are turned off, the C-More display will alternate the display above (MASTER-STANDBY) with the **All Boilers Off** status message as follows:

9.5 BST Menu Structure

The BST Menu must be Enabled in order to be displayed and accessed. The BST Enable item is located at the end of the Configuration Menu.

The Boiler Sequencing Technology (BST) Menu contains all of the items required to configure, operate and monitor the functionality of the BST System. There are over 50 items in this menu, and selecting any particular item from the list, for inspection or modification, could be time consuming. As a result, the BST Menu has been segmented into five logical groups based on functionality.

The five item groups are:

1. **BST Monitor Items**
2. **BST SETUP MENU***
3. *** OPERATE MENU ***
4. *** TEMP CTRL MENU ***
5. *** BST COMM MENU ***

The displayed item groups are displayed in UPPER CASE letters, and are bounded by an asterisk * in order to readily identify them within the item list.

The items contained in group 1 (BST Monitor Items) are *ALWAYS* displayed within the menu, as these items are critical for proper system operation. Therefore, the BST Monitor Items Header itself is NOT displayed.

The Items contained in groups 2-5 are *NOT* displayed unless that particular item group has been enabled from the C-More keypad.

Menu Item Chart

Menu Item Display	Available Choices or Limits			Default
	Minimum		Maximum	
BST Mode	Off	BST Slave	BST Master	Off
BST Setpoint	BST Setpt Lo Limit		BST Setpt Hi Limit	130°F
Header Temp	NA			Header Temp (°F)
BST Fire Rate	0		100%	Fire rate %
BST Ave Fire Rate	0		100%	Avg Fire Rate %
BST Outdoor Temp	NA			Outdoor Temp (°F)
Units Available	0		8	Units Present
Units Ignited	0		8	Units firing
BST Valve State	0 (CLOSED)		1 (OPEN)	0
1 Comm Errors 8	0		9	0
1 BST Units 8	0 (see table)		0 (see table)	0
BST SETUP MENU	Disabled		Enabled	Disabled
BST Setpoint Mode	Constant Setpoint	Remote Setpoint	Outdoor Reset	Constant Setpt
Head Temp Source	Network		FFWD Temp	FFWD Temp
Header Temp Addr	0		255	240
Header Temp Point	0		255	14
BST Outdoor Sens	Disabled		Enabled	Disabled
Outdr Tmp Source	Outdoor Temp		Network	Outdoor Temp
Outdoor Tmp Addr	0		255	240
Outdoor Tmp Pnt	0		255	215
BST Remote Signal	4-20 mA/1-5 Vdc;	0-20 mA/0-5 Vdc;	Network	Network
BST Auto Mstr	No		Yes NOTE! A Modbus temperature transmitter must be installed in conjunction with this feature.	No
BST Auto Timer	10 sec		120 sec	30 sec
Remote Intlk Use	Boiler Shutdown		System Shutdown	System Shutdown
One Boiler Mode	Off	On-Outlet Temp	On-Avg Temp	Off
1 Blr Threshold	10		35	25

Menu Item Display	Available Choices or Limits			Default
	Minimum		Maximum	
Setpoint Setback	Disable		Enable	Disable
Setback Setpoint	BST Setpt Lo Limit		BST Setpt HI Limit	130°F
Setback Start	12:00am		11:59pm	12.00am
Setback End	12:00am		11:59pm	12.00am
Rate Threshold	1°F		30°F	15°F
BST OPERATE MENU	Disabled		Enabled	Disabled
BST Next On VP	16%		100%	50%
BST Max Boilers	1		8	8
BST On Delay	30 sec		300 sec	60 sec
BST On Timeout	15 sec		300 sec	60 Sec
Valve Override	Off	Closed	Open	Off
Valve Off Delay	0		15 min	1 min
BST Sequencing	Run Hours	Unit Size	Select Lead	Run Hours
Select Lead Unit	0		127	0
Select Lag Unit	0		127	0
Lead/Lag Hours	25 hours		225 hours	72 hours
BST TEMP CTRL MENU	Disabled		Enabled	Disabled
BST Temp Hi Limit	40°F		210°F	210°F
BST Setpt Lo Limit	40°F		BST Setpt HI Limit	60°F
BST Setpt HI Limit	BST Setpt Lo Limit		220°F	195°F
BST Prop Band	1°F		120°F	100°F
BST Intgral Gain	0.00		2.00	0.50
BST Deriv Time	0.00 Min		2.00 Min	0.10 Min
BST Deadband Hi	0		25	1
BST Deadband Lo	0		25	1
Deadband En Time	0		120 Sec	30 Sec
BST FR Up Rate	1		120	20
BST Bldg Ref Tmp	40°F		230°F	70°F
BST Reset Ratio	0.1		9.9	1.2
System Start Tmp	30°F		120°F	60°F
BST COMM MENU	Disabled		Enabled	Disabled
Comm Address	0		127	0
BST Min Addr	1		128	1
BST Max Addr	1		128	8
SSD Address	0		250	247
SSD Poll Control	0		1000	0

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Err Threshold	1	9	5
SSD Temp Format	Degrees	Points	Degrees
BST Upld Timer	0	9999 sec	0

9.5.1 BST Menu Item Map

NOTE 1. The BST Monitor Items header is NOT displayed.
NOTE 2. The items in the "BST Monitor Items" menu are ALWAYS displayed.
NOTE 3. All menus with asterisks in their headers must be ENABLED for their contents to be displayed.

BST Monitor Items	*BST SETUP MENU*	* OPERATE MENU *	*TEMP CTRL MENU*	*BST COMM MENU*
BST Mode	BST Setpt Mode	BST Next On VP	BST Temp Hi Limit	Comm Address
BST Setpoint	BST Remote Signl	BST On Delay	BST Setpoint Lo Limit	BST Min Addr
Header Temp	Head Temp Source	BST Max Boilers	BST Setpoint Hi Limit	BST Max Addr
BST Fire Rate	Mdbus Temp Units	BST On Timeout	BST Prop Band	SSD Address
BST Avg FRate	Header Temp Addr	Valve Override	BST Integral Gain	SSD Poll Control
BST Outdoor Temp	Header Temp Point	Valve Off Delay	BST Deriv Time	Err Threshold
Units Available	BST Outdoor Sens	BST Sequencing	BST Deadband Hi	SSD Temp Format
Units Ignited	Outdr Tmp Source	Select Lead Unit	BST Deadband Lo	BST Upld Timer
BST Valve State	Outdoor Tmp Addr	Select Lag Unit	Deadband En Time	
BST Comm Errors	Outdoor Tmp Pnt	Lead/Lag Hours	BST FR Up Rate	
BST Units (Status)	BST Auto Mstr		BST Bldg Ref Tmp	
	BST Auto Timer		BST Reset Ratio	
	Remote Intlk Use		System Start Tmp	
	One Boiler Mode			
	1 Blr Threshold			
	Setpoint Setback			
	Setback Setpoint			
	Setback Start			
	Setback End			
	Rate Threshold			

9.5.2 BST Monitor Items

BST Mode (settings = OFF, BST SLAVE, BST MASTER, Default = OFF)
This item sets the state of the On Board Boiler Sequencing Technology feature as follows:

- Set to "OFF" to disable the BST feature. The unit will operate as a standard "standalone" boiler.
- Set to "BST SLAVE" to enable the BST Sequencing feature and define this unit as a slave unit within the Modbus Network.
- Set to "BST Master" to enable the BST Sequencing feature and define this unit as the master unit within the Modbus Network.

The master unit always displays the **System Header Temperature** on the large three digit display of the C-More. The Header Temperature displayed on the master unit flashes at a rate of once per second.

NOTE

Only one C-More should be assigned as a master unit.

Slave units display their individual Outlet Temperature on the three digit display, as on a standalone unit.

Selecting the BST feature automatically selects the Direct Drive boiler mode and network remote signal. The Remote LED turns on to indicate Direct Drive mode.

BST Setpoint (span = BST setpt lo limit – BST setpt hi limit, Default = 130°F)
BST Setpoint item is the desired system operating Setpoint temperature.

The default Setpoint for the BST is 130°F. If a different setting is desired, the Setpoint can be varied on the Master unit from "*BST setpt lo limit*" to "*BST setpt hi limit*". The BST master unit automatically pushes the BST Setpoint temperature to all slave units on the network via Modbus commands.

Header Temp
The header temp item is the current temperature of the BST. Only The Master C-More displays the BST header Temperature and the Slave units display their individual outlet temperature.

BST Fire Rate
The BST Fire Rate item is the current fire rate output sent to all ignited slave units.

BST Avg FRate
The BST Avg Frate item is the real time average fire rate of all ignited units.

BST Outdoor Temp
The BST Outdoor Temp item is the outside air temperature used in the "Outdoor Reset" mode of operation. This option will be available only if the "BST Outdoor Sens" option is enabled.

Units Available
The Units Available item is the number of units available to be controlled by the BST. Units must be enabled as either slave or master, have a valid Modbus address, not be in a fault state and the READY switch in the C-More panel must be set to ON.

Units Ignited
The Units Ignited item is the number of units currently ignited and firing.

BST Valve State
The BST Valve State item displays the status of the Isolation Valve. (1 = OPEN, 0 = CLOSED)

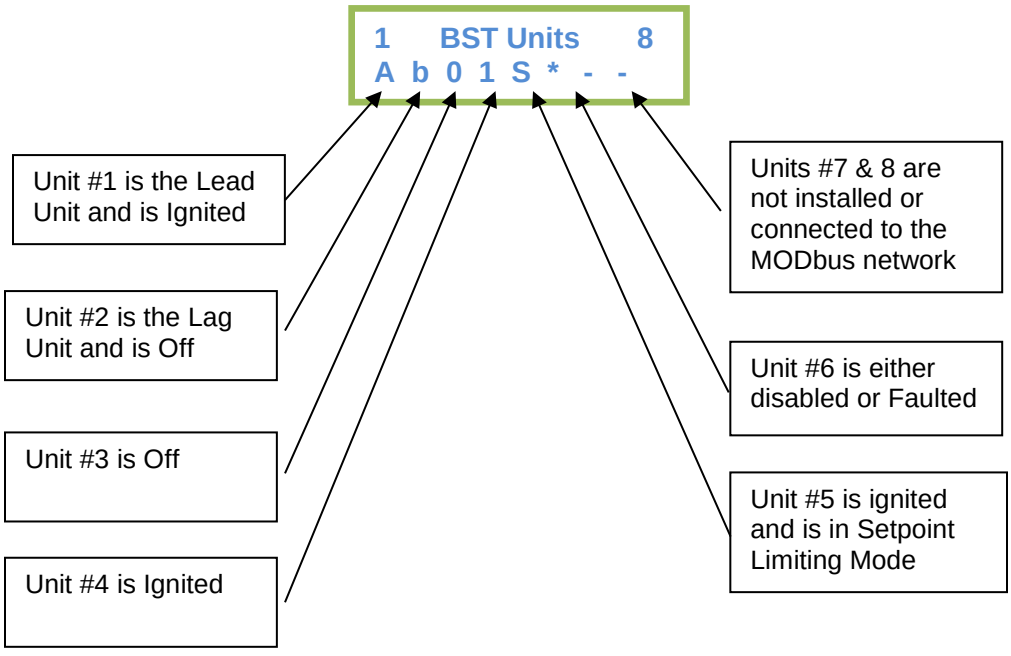
1 Comm Errors 8

This item displays the number of Comm errors on each Comm port (slave Unit). If no valid address is entered for a slave unit, the display will read "-" for that address. The Max number of error count is 9.

1 BST Unit 8
This item displays eight characters representing the status of each of the possible eight units on the network.

Symbol	Explanation
1	ON
0	Off
-	Offline
*	Not Available
S	Setpoint Limiting is active
A	Lead unit
B	Lag Unit
a	Lead Off
b	Lag Off

Example of **1 BST Unit 8** display:



9.5.3 BST SETUP MENU

BST Setpt Mode *(Selections = Constant Setpoint, Remote Setpoint, Outdoor Reset. Default = Constant Setpoint)*
The BST Setpt Mode item configures the BST to one of the following three Setpoint modes of operation:

- ***Constant Setpoint:*** In the Constant Setpoint Mode, the BST Setpoint is fixed and must be entered into the BST Setpoint Item.
- ***Remote Setpoint:*** In the Remote Setpoint Mode, the BST Setpoint is set by an external device. When Remote Setpoint is selected, the Remote Signal Type must be selected.
- ***Outdoor Reset:*** The Outdoor Reset mode is based on outside air temperature. The header temperature will vary up or down in accordance with outside air temperature. This mode requires that a System Start Temperature, BST Building Reference Temperature and BST Reset Ratio be programmed into the BST. An outdoor air sensor MUST be installed and enabled when operating in this mode.

Head Temp Source *(Selections = Feed Forward, Network. Default = Feed Forward)*
The Head Temp Source item allows the user to define the source of the Header Temperature Probe as follows:

- **Feed Forward**
  When selecting Feed Forward as the Head Temp Source, the Header Temperature probe must be connected to the Feed Forward terminal on the Master Boiler. See Section 9.6.1 for wiring instructions. In this mode the temperature probe must be a BALCO 1K type probe.
- **Modbus Network**

  When selecting Network as the Head Temp Source, the Temperature probe is connected to a Modbus Temperature Transmitter, as defined in Section 9.6.2.
  - When selecting Network as the Head Temp Source, a Modbus Address (***Header Temp Addr***) and Modbus Point (***Header Temp Point***) must be entered to define the Modbus Address and Point of the Modbus temperature transmitter.

Mdbus Temp Units *(Selections = Degrees C, Degrees F. Default = Degrees C)*
The Mdbus Temp Units item defines the temperature format (Degrees C or Degrees F) of the temperature readings transmitted by the Modbus Temperature Transmitter to the Master unit.

BST Outdoor Sens *(default = disabled)*
The BST Outdoor Sens item enables or disables the Outdoor Temperature Sensor used in the Outdoor Reset Mode. The BST Outdoor Sens item must be enabled when the Outdoor Reset mode is selected.

Outdoor Temp Source *(Selections = Outdoor, Network. Default = Outdoor)*
The Outdoor Temp Source item allows the user to define the source of the Outdoor Temperature Probe utilized in the Outdoor Reset Mode of operation as follows:

- **Outdoor**
  When selecting Outdoor as the Outdoor Temp Source, the Outdoor Temperature probe must be connected to the Out and Com terminals on the Master Boiler I/O Box,

See Section 9.6.3 Step 1 for wiring instructions. In this mode the temperature probe must be a BALCO 1K type probe.

- **Modbus Network**

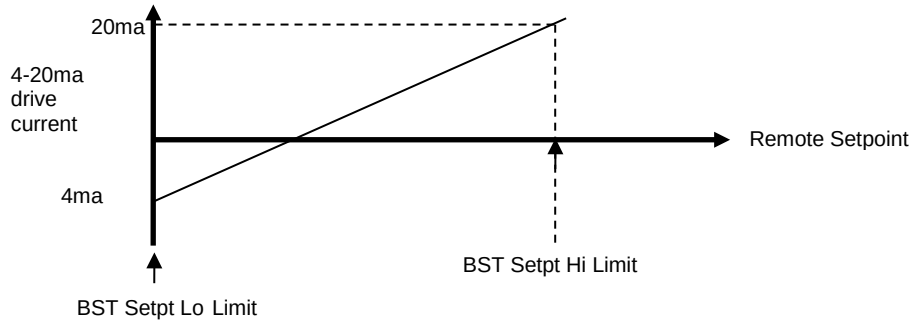
  When selecting Network as the Outdoor Temp Source, The Temperature probe is connected to a Modbus Temperature transmitter as defined in Section 9.6.3, Step 2.
  - When selecting Network as the Head Temp Source, a Modbus Address (***Outdoor Temp Addr***) and Modbus Point (***Outdoor Temp Point***) must be entered to Define the Modbus Address and Point of the Modbus temperature transmitter.

BST Remote Signal *(Default = 4-20ma / 1-5V)*
The BST Remote Signl item will only be displayed if Remote Setpoint Mode is selected. The unit's Setpoint can be remotely controlled by an Energy Management System (EMS)

The BST Remote Signl item selections are as follows:

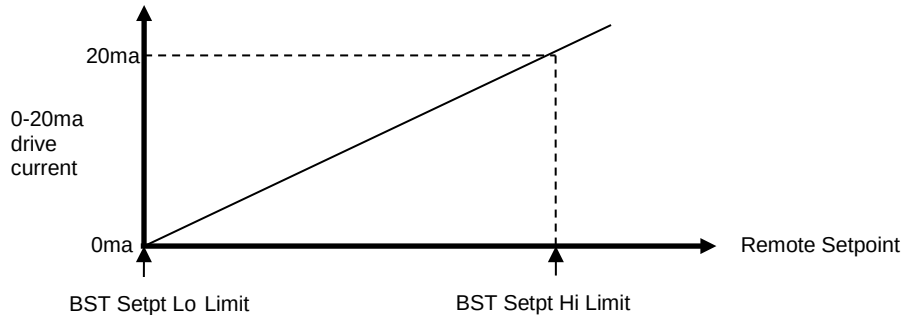
- **4-20ma / 1-5V**

  When the BST Remote Signl item is set to 4-20ma / 1-5V, a 4 to 20 mA/1 to 5 Vdc signal, sent by an EMS or BAS, is used to change the unit's setpoint. The 4 mA/1V signal is equal to the value entered in "BST Setpt Lo Limit" while a 20 mA /5V signal is equal to the value entered in "BST Setpt Hi Limit".



- **0-20ma / 0-5V**

  When the BST Remote Signl item is set to 0 - 20 mA/0 - 5 Vdc, 0 mA is equal to the value entered in "BST Setpt Lo Limit" while a 20 mA /5V signal is equal to value entered in "BST Setpt Hi Limit".



- **Network**
  When the BST Remote Signal item is set to **Network**, the setpoint is set by the SSD Device connected via Modbus connection (see ProtoNode Gateway User Manual, GF-129).

BST Auto Mstr *(Default = disabled)*
The BST Auto Mstr item Enables or disables an Automatic BST Master Switch-Over function. When "BST Auto Mstr" is enabled, the BST will automatically select a new Master if the current Mater fails or loses power.

NOTE

A Modbus temperature transmitter must be installed in conjunction with this feature.

BST Auto Timer *(Span = 10 sec – 120 sec, Default = 30 sec)*
When the BST Auto Mstr option is set Enabled, the BST Auto Timer item allows the user to select the elapsed time interval between failure of the BST Master and switch-over to a new BST Master.

Remote Intlk Use *(Default = system shutdown)*
The Remote Intlk Use item selects the functioning of the Remote Interlock circuit on the I/O Box as follows:

- **Boiler Shutdown**
  When the Remote Intlk Use item is set to Boiler Shutdown, the boiler whose Remote Interlock circuit has been opened will be cycled down (shut down) regardless of whether the unit is a Master or a Slave.

- **System Shutdown**
  When the **Remote Intlk Use** item is set to System Shutdown, opening the Remote Interlock of The BST Master unit will cause all units to cycle down (shut down). Opening the Remote Interlock of any slave unit will only cause the slave unit to shut down.

  If System Shutdown and BST Auto Mstr are both selected, this feature will only function across all units if ALL of the interlocks are externally connected in series with dry contact relays.
  WARNING!
  DO NOT INTER-CONNECT THE REMOTE INTERLOCK OF ONE UNIT TO THE REMOTE INTERLOCK OF ANOTHER UNIT DIRECLTY, AS THIS WILL CAUSE DAMAGE TO INTERNAL CIRCUITRY.

One Boiler Mode *(Selections = Off, On-Outlet Temp, on-Avg Temp. Default = off)*
The One Boiler Mode is a BST Unique and innovative feature that eliminates excessive boiler cycling during low-flow conditions. When the One Boiler Mode is enabled, The BST will determine if a low-flow condition exists and will cycle down one boiler at a time, every 15 minutes, until one boiler remains ignited. The BST will then use the remaining ignited boilers' Outlet Sensor as the new Header temperature. This will eliminate the excessive delays in utilizing immediate real-time temperature readings, thereby eliminating low-flow related cycling.

Temperature Control under Low Flow Conditions
When the boilers in the BST system raise the water temperature under Low Flow conditions, there is a delay (as long as 2-3 minutes observed in the field) until the heated water travels the length of the outlet piping until it reaches the Header Sensor. During this delay, the PID Controller assumes that the temperature is still too cold and further raises Fire Rate to meet the temperature demand. By the time the heated water reaches the Header Temperature Sensor, the Fire Rate is too high and must be reduced. Reducing the Fire Rate will lower the water temperature, but by the time the cooler water reaches the Header Sensor, the Fire Rate is now too low. This is a classic definition of a PID Loop 'HUNTING" or cycling up and down in order to maintain temperature.

The One Boiler Mode virtually eliminates the distance the water needs to travel until it reaches the controlling Temperature Sensor, thereby eliminating the "HUNTING" or cycling up and down.

The One Boiler Mode has three options as follows:

- **Off**
  The One Boiler Mode is disabled.
- **On-Outlet Temp** (Select On-Outlet Temp if Isolation Valves are installed)

  The BST substitutes the ignited units' Outlet Temperature instead of the Header temperature. This mode is used when Isolation valves are installed on the boilers.
- **On-Avg Temp** (Select On-Avg Temp if isolation valves are not installed)

  The BST substitutes the average of the ignited units' Outlet Temperature and the Header temperature. This mode is used when no Isolation valves are installed on the boilers.

With Isolation Valves Installed
In One Boiler Mode with isolation valves installed, the master will use the ignited boiler's Outlet Temperature sensor for PID control. The distant Header Temperature Sensor is monitored, but not used for control in this mode of operation.

Without Isolation Valves Installed
In One Boiler Mode with no isolation valves installed, the master will take the average value of the Header Temperature and the ignited boiler's Outlet Temperature for PID control.

1 Blr Threshold *(Span = 10% - 35%, Default = 25%)*
When One Boiler Mode is selected, The BST will try to determine if a Low-Flow condition exists. A Low-Flow condition is detected by comparing a "Long Fire Rate Average" of all ignited boilers with the "1 Blr Threshold" item value. If the "Long Fire Rate Average" is less than the "1 Blr Threshold" for a period of fifteen minutes, the BST will cycle down one boiler. This process will be repeated until one boiler remains ignited, at which time the One Boiler Mode is activated to prevent excessive cycling.

The 1 Blr Threshold can be set from 10% to 35%, the default value is 25%.

Setpoint Setback *(Selections = Enable – Disable, Default Disable)*
The Setpoint Setback item Enables or Disables the Setpoint Setback feature.

This Setpoint Setback feature, when enabled, allows the user to substitute the BST System Setpoint during pre-programmed time intervals.

Whenever the Setpoint Setback time is reached (between Setback Start and Setback End), the new setpoint (Setback Setpoint value) is activated to satisfy differing Heat-Demand during certain times of the day.

The new Setpoint is activated on a gradual basis in order to avoid the PID from shutting down units unnecessarily due to a sudden change in setpoint.

Setback Setpoint *(Span = BST Setpt Lo Limit - BST Setpt HI Limit, Default = 130°F)*
The Setback Setpoint item is the Setpoint value to be invoked when the Setpoint Setback feature is activated.

Setback Start, Setback End *(Span = 12.00am - 11.59pm, Default = 12.00am)*
The Setback Start and Setback End items are the time values to define the time interval during which the BST Setpoint is substituted by the Setback Setpoint value when the Setpoint Setback feature is Enabled.

The same Setback Start and Setback End times apply to all 7 days of the week.

Rate Threshold *(Span = 1 sec – 30 sec, Default = 15 sec)*
The Rate Threshold is a BST feature that checks the operation of the PID control when a boilers' temperature needs to be increased by a large amount. If conditions change suddenly, such as flow or load, when the temperature of a boiler is increasing, The Rate Threshold will immediately decrease the boiler's Fire Rate by 10% if the temperature is rising too quickly as we approach the Setpoint. This feature will help prevent nuisance Temperature overshoots and overtemp faults. If the temperature rises from15°F below Setpoint to 8°F below Setpoint within the time value set in Rate Threshold, the rise rate will be deemed to be too quick and the Fire Rate will be temporarily reduced by 10%.

This feature allows the temperature to rise in a normal manner until temperature approaches setpoint. The feature is active ONLY when **increasing** temperature.

The feature is activated anytime the header temperature drops to 20 degrees F below the setpoint.

NOTE

Setting the **Rate Threshold** value to 1 will effectively disable this function.

9.5.4 OPERATE MENU

BST Next on VP (Span = 16% – 100%, Default = 50%)

When the Valve Position (VP) of all ignited boilers reach or exceed the BST Next on VP value, another boiler will be lit off to share the load (if one is available).

This feature is also useful if a user wishes to always have as few boilers ignited at any one time. Setting the BST Next on VP value to a high number (Example 99%) will only light off a new boiler if all currently ignited boilers reach their total BTU capacity (99% Valve Position).

BST On Delay *(Span = 30 seconds – 300 seconds, Default = 60 seconds)*

The BST On Delay is the minimum amount of time BST will wait before turning on two successive boilers. Once any boiler is ignited by BST, the time value entered in BST On Delay must elapse before another boiler can be ignited.

This **BST On Delay** is a constant MINIMUM wait time between successive boiler ignitions. The PID will decide when to attempt to turn on another boiler.

BST Max Boilers *(Span = 1 – 8, Default = 8)*
The value entered in BST Max Boilers will determine the maximum number of boilers allowed to be ignited at any one time (regardless of the number of available boilers).

BST On Timeout *(Span = 15 seconds – 300 seconds, Default = 60 seconds)*
The BST On Timeout is the amount of time BST will allow a boiler to successfully light off once an light off command has been issued for that boiler. If the commanded boiler has not successfully ignited within the allotted BST On Timeout time, BST will attempt to light off a replacement boiler.

Valve Override *(Selections = Off – Open – Closed, Default = off)*
Valve Override allows the user to manually control an Isolation Valve as follows:

- **Off**– Valve Override is disabled and BST will automatically control the Isolation Valve.
- **Open** – Valve Override is enabled and the Isolation Valve is Opened.
  Note! The valve will remain opened as long as the Valve Override feature is set to Open. Care must be taken to insure that this mode is turned Off during normal BST operation.
- **Closed** – Valve Override is enabled and the Isolation Valve is closed ONLY if the boiler is NOT ignited.

Valve Off Delay *(Span = 0 min – 15 min, Default = 1 min)*
Valve Off Delay is the time an open Isolation Valve will remain open once a boiler has been cycled off. When an ignited boiler is cycled off, its' Isolation Valve will remain open for the specified Valve Off Delay time in order to dissipate residual heat in the heat exchanger.

BST Sequencing *(Default = Run Hours)*
The BST Sequencing feature allows the user to define the LEAD and LAG units based on the following selections:

- **Run Hours**

  The Lead and Lag Boilers selection will be determined, in real time, by each unit's accumulated Run Hours.
- **Unit Size**

  The Lead and Lag Boilers selection will be determined by the unit size. In this mode, the lower unit sizes will be defined as Lead units and be lit off first.
  NOTE! In the event of multiple units with the same size, the BST will default to Run Hours to determine Lead and Lag units.
- **Select Lead / Select Lag**

  The Lead and Lag Boilers will be selected by the user via the C-More Keypad.

When a boiler is manually selected as the Lead or Lag Boiler, it will remain the Lead or Lag boiler until either another boiler selection is made, or either Run Hours or Unit Size is selected as the BST Sequencing Mode.

This feature is useful if the user prefers that a selected boiler will always be lit off first.

Lead/Lag Hours *(Span = 25 hours – 225 hours, Default = 72 hours)*
If the BST Sequencing item is set to Run Hours, the BST will control the boiler light off and shutdown, in a calculated manner to equalize the Run Hours of all boilers.

When the Run Hours of the Lead unit exceeds the Run Hours of the Lag Unit by the Lead/Lag Hours item entry, the BST will cycle down the Lead unit and search for a new Lead unit to light off in its' place. The Lead/Lag Hours item is designed to spread the total number of run hours accumulated on all units in the system so that each of the units have approximately the same number of run hours.

9.5.5 TEMP CTRL MENU

BST Temp Hi Limit *(Span = 40°F - 240°F, Default = 210°F)*
The BST Temp Hi Limit is the maximum allowable BST Header Temperature before invoking the BST Master "BST OVERTEMP" message. Invoking the "BST OVERTEMP" message will not cause any fault conditions, but will further modulate the BST Fire Rate to lower the header temperature below this limit.

NOTE! In over-temp conditions, each individual boiler on the BST network will respond to its' own "Setpoint Limiting" settings and Hi Temp Limit settings to either reduce Fire Rates or invoke Boiler Over-Temp Faults.

BST Setpoint Lo Limit *(Span = 40°F - BST Setpt HI Limit, Default = 60°F)*
The BST Setpoint Lo Limit is the Minimum allowable BST Setpoint value entered via:

- The C-More Keypad in BST Constant Setpoint Mode.
- The Remote Signal in BST Remote Setpoint Mode.

BST Setpoint Hi Limit *(Span* = BST Setpt Lo Limit - 220°F *Default* = 195°F*)*
The BST Setpoint Hi *Limit* is the Maximum allowable BST Setpoint value entered via:

- The C-More Keypad in BST Constant Setpoint Mode.
- The Remote Signal in BST Remote Setpoint Mode.

BST Prop Band *(Span = 1°F - 120°F, Default = 100°F)*
The BST Prop Band item is the Proportional component of the PID control algorithm. The BST Prop Band *generates* a valve position based on the error that exists between the BST Setpoint temperature and the actual header temperature. If the actual error is less than the proportional band setting (1 to 120°F), the valve position will be less than 100%. If the error is equal to or greater than the proportional band setting, the valve position will be 100%.

Smaller values (below 70°F) for **BST Prop Band** will result in more aggressive Fire Rate changes to reach setpoint temperature. This can cause excessive cycling (or hunting) while trying to reach setpoint temperature.

BST Integral Gain *(Span = 0.00 - 2.00, Default = 0.50)*
The BST Integral Gain item is the Integral component of the PID control algorithm.

The BST Integral Gain item sets the fraction of the output, due to BST Setpoint error, to add or subtract from the output each minute to move towards the BST Setpoint.

BST Deriv Time *(Span 0.00 min – 2.00 min, Default = 0.10 min)*
The BST Deriv Time item is the Derivative component of the PID control algorithm.

The BST Deriv Time item value (0.00 to 2.00 min.) responds to the rate of change of the setpoint error. This is the time that this action advances the output.

BST Deadband Hi *(Span = 0 – 25, Default = 1)*
BST Deadband Lo *(Span = 0 – 25, Default = 1)*
Note! These values are scaled in either Degrees F or Degrees C depending on the Degrees Scale selected by the user on the S-More Setup Menu.
The Deadband High and Deadband Low settings create the "Header Temperature" Zone in which no Valve Position corrections will be attempted.

When the header temperature reaches the BST setpoint and remains within the range BST Setpoint +1degree and BST Setpoint -1degree for the period of time entered into "Deadband En Time", The Deadband Mode is set and all valve position corrections will be halted. When the Outlet Temperature drifts out of the Deadband ZONE (BST Setpoint + BST Deadband Hi) & (BST Setpoint - BST Deadband Lo), the DEADBAND MODE will be terminated and the PID LOOP will again attempt Valve Position corrections.

When in Deadband mode, the ˚F or ˚C LED on the C-More Control Panel will flash to confirm Deadband Mode is set or reached.

Deadband En Time *(Span = 0 seconds – 120 seconds, Default = 30 seconds)*
The "Deadband En Time" is the amount of time the header temperature has to stay within the temperature range BST Setpoint +1 and BST Setpoint -1 before invoking the BST Deadband Mode.

BST FR Up Rate *(Span = 1 sec – 120 sec, Default = 20 sec)*
The BST Fire Rate Up Rate controls the frequency of updates made to the BST Fire Rate sent to all boilers. This feature can be used to slow down the rate of change of the Fire Rate of the BST System. The BST PID calculates the BST Target Fire Rate for the system. When we need to increase the Fire Rate to all boilers, the BST increases the Fire Rate of all ignited boilers incrementally based on the BST FR Up Rate.

Example: If the BST FR Up Rate is set to 20 sec, Incremental increases will be made to the BST Fire Rate every 20 seconds until we reach the BST Target Fire Rate.

The Fire Rate increase is 2% per BST FR Up Rate until we are withinn10 Degrees F of setpoint, at which time the increase is 1% per BST FR Up Rate. This feature does not apply to decreasing fire rate.

(See Appendix C for Reset Ratio, Header Temperature setup charts)

BST Bldg Ref Tmp *(Span = 40°F - 230°F, Default = 70°F)*
BST Bldg Ref Tmp is used with Outdoor Reset Setpoint Mode. It is the temperature the system references to begin increasing its header temperature (See section BST Reset Ratio for more details). Default is 70°F. It can be varied from 40°F to 230°F.

(See Appendix C for Reset Ratio, Header Temperature setup charts)

BST Reset Ratio *(Span = 0.1 – 9.9, Default = 1.2)*
The BST Reset ratio is an adjustable number from 0.1 to 9.9. Once adjusted, the supply header temperature will increase by that number for each degree that the outside air temperature decreases. For instance, if a reset ratio of 1.6 is used, for each degree that outside air temperature decreases, the supply header temperature will increase by 1.6 degrees.
The BST Reset Ratio is adjustable from 0.1 to 9.9. Default is 1.2.

(See Appendix C for Reset Ratio, Header Temperature setup charts)

System Start Tmp *(Span = 30°F - 120°F, Default = 60°F)*
The System Start Temperature feature allows the BST to be enabled or disabled based on the outside air temperature. When the outside air temperature goes below the System Start Temperature, the BST is enabled. When the outside air temperature is above the System Start Temperature, the BST is disabled. (Warm weather shut-down). This feature requires that an outdoor air temperature sensor be connected to the boiler.

9.5.6 BST COMM MENU

Comm Address *(Span = 0 – 127, Default = 0)*
The Comm Address is the Modbus Address assigned to this unit. Each unit on the Modbus Network must be assigned a unique address between **1** and **127**.

Address **0** disables the unit.

BST Min Addr *(Span = 0 – 127, Default = 0)*
The BST Min Addr is the lowest Modbus address, between **1** and **127**, assigned to any boiler unit in the Modbus network.

BST Max Addr *(Span = 0 -127, Default = 0)*
The BST Max Addr is the highest Modbus address, between **1** and **127**, assigned to any boiler unit in the Modbus network.

SSD Address *(Default = 0)*
The SSD Address is the Modbus address, between **10** and **127**, assigned to the PROTONODE SSD Device. This device is used when the BST Master needs to communicate with a building automation system (BAS).

Err Threshold *(Span = 1-9, Default = 5)*
The Err threshold specifies the maximum number of successive Modbus Comm errors allowed before invoking the Modbus Comm fault.

SSD Temp Format *(Selections = Degrees - Points, Default = Degrees)*
The SSD Temp Format selects the temperature data format employed in communications between the BST Master and the SSD.

Selecting Degrees will format the temperature data in Degrees.

Selecting Points will format the temperature data in Points format, described in the Modbus Point List section of Appendix A, below.

BST Upld Timer *(Span = 0 and 30 - 9999, Default = 0)*
The BST Upld Timer specifies the frequency of BST OnAER Data Logging transmissions. This value defines the time, in seconds, between successive OnAER Data Logging transmissions from the BST Master to either an Internet destination or and SD-Card.

The default value is 0, which disables the periodic OnAER data transmissions.

This value can be varied from 30 seconds to 9999 seconds.

Example: Setting the BST Upld Timer to 40, will cause the BST Master to transmit OnAER data every 40 seconds.

9.6 BST Setup

The BST can be configured for any of the following three modes of operation:

- Constant Setpoint
- Remote Setpoint
- Outdoor Reset

NOTES

The standard boiler parameters such as: Unit Type, Unit Size, Fuel Type, etc. should have been set at the factory.

On each boiler, enter The Modbus Comm Address of each boiler in the Comm Address Item in the Setup Menu.

Select the single option that suites your installation and then complete the instructions in the corresponding sub-section below.

Constant Setpoint (choose option 1 or 2)

This is the BST Default mode of operation, used when a fixed header temperature is desired.

Option 1 – Direct Wired Header Complete section 9.6.1

OR

Option 2 – Modbus Header Complete section 9.6.2

Header Temperature Sensor Selection

If the BST Master Fail Rollover (BST Auto Mstr) feature is enabled, The Header Temperature Sensor **MUST** be installed as a **Modbus Header Sensor** using the Modbus Temperature Transmitter (see Section 9.6.2 ***Constant Setpoint with Modbus Wired Header Sensor***, below).

Note! If no header sensor is installed, the sensor fault message will appear on the C-More Control Panel and the unit will not operate.

If the BST Master Fail Rollover (BST Auto Mstr) feature is disabled, it is recommended that the Header Temperature sensor be directly wired to the FFWD Temp sensor input of the Master unit (see Section 9.6.1 ***Constant Setpoint with Direct Wired Header Sensor***, below).

Outdoor Reset (choose option 3 or 4)

Option 3 – Direct Wired Header and Direct Wired Outdoor Air Complete section 9.6.3

OR

Option 4 – Modbus Header and Modbus Outdoor Air Complete section 9.6.4

The Outdoor Reset mode is based on outside air temperature. This mode requires that a System Start Temperature, BST Building Reference Temperature and BST Reset Ratio be programmed into the BST.

If the BST Master Fail Rollover (BST Auto Mstr) feature is enabled, The outdoor Reset Temperature Sensor MUST be installed as a **Modbus Outdoor Reset Sensor** using the Modbus Temperature Transmitter (see Section 9.6.4 ***Outdoor Reset with Modbus Header Sensor & Modbus Outdoor Sensor*****,** below).

If the BST Master Fail Rollover (BST Auto Mstr) feature is disabled, it is recommended that the Outdoor Reset Temperature sensor be directly wired to the "OUT" Temp sensor input on the I/O Box of the Master unit (see Section 9.6.3 ***Outdoor Reset with Direct Wired Header Sensor & Direct Wired Outdoor Sensor***, below).

Remote Setpoint (choose option 5 through 8)

Option 5 – 4-20ma Drive and Direct Wired Header Complete section 9.6.5

OR

Option 6 – Modbus Drive and Direct Wired Header Complete section 9.6.6

OR

Option 7 – 4-20ma Drive and Modbus Header Complete section 9.6.7

OR

Option 8 – Modbus Drive and Modbus Header Complete section 9.6.8

In the Remote Setpoint Mode, the setpoint can be entered from a remote device such as a Building Automation System. The Remote Signal source must be selected from the following:

- 4-20ma
- 0-20ma
- Network

When selecting Network, the signal is input from the ProtoNode SSD Device.

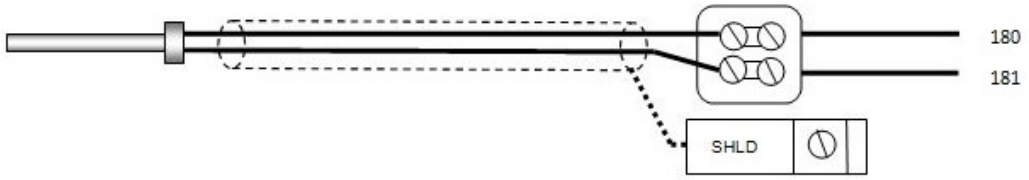
9.6.1 Option 1 - Constant Setpoint with Direct Wired Header Sensor

Step 1: Direct Wired Header Sensor Wiring

1. On the MASTER Unit, Connect the Header Temperature Sensor (**AERCO PN 61040**) to the Feed Forward (FFWD) terminals on the P-1 Harness Via the terminal block labeled “Header Temp sensor” in the I/O Box.

NOTES:

- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant’s supply water header.
- Shielded pair 18 - 22 AWG cable is recommended for header sensor wiring. There is no polarity to be observed. The ground for the shield is at the “SHLD” terminal in the I/O the Box. The sensor end of the shield must be left free and ungrounded.



Temp Sensor PN 61040 Header Temp Sensor I/O Box

Step 2: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the desired Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select Constant **Setpoint**.
6. Go to the **Head Temp Source** item and select **FFWD Temp**.

When ALL C-More units have been configured:

7. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

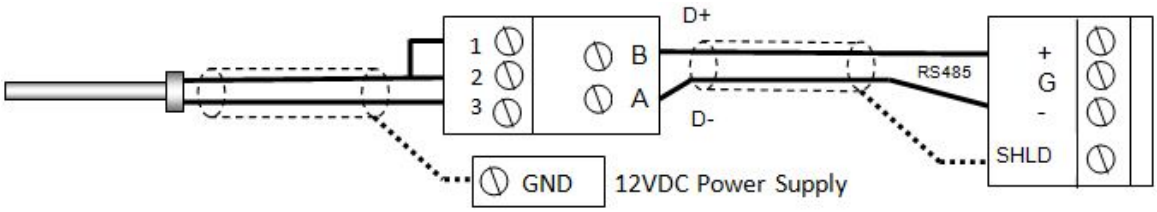
9.6.2 Option 2 - Constant Setpoint with Modbus Wired Header Sensor

Step 1: Modbus Header Sensor Wiring

1. Using Shielded pair 18 - 22 AWG cable, connect the Temperature Transmitter (**AERCO P/N 65169**) terminal Pin B to the RS485+ terminal on the I/O Box of any of the boiler units, and Pin A of the Temperature Transmitter to the RS485- terminal on the I/O Box of any of the boiler units.
2. Using Shielded pair 18 - 22 AWG cable, connect the Modbus Header Temperature Sensor (**AERCO PN 24410**) to pins 2 and 3 of the Temperature Transmitter.
3. Install a jumper wire between pins 1 and 2 of the Temperature Transmitter**.**

NOTES:

- Polarity must be observed for the RS485 connections.
- The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- There is no polarity to be observed. The ground for the shield is at the power supply ground. The sensor end of the shield must be left free and ungrounded.



Temp Sensor PN 24410 Modbus Transmitter I/O Box

Step 2: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the desired Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select Constant **Setpoint**.
6. Go to the **Head Temp Source** item and select **Network**.
7. Go to the **Header Temp Addr** item and enter the Modbus Address (240).
8. Go to the **Header Temp Point** item and enter the Modbus Point (14).

When ALL C-More units have been configured:

9. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

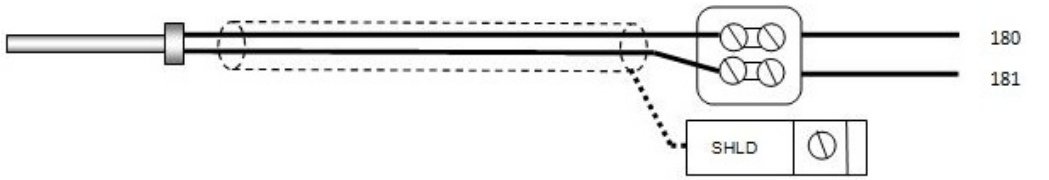
9.6.3 Option 3 - Outdoor Reset with Direct Wired Header Sensor & Direct Wired Outdoor Sensor

NOTE: Both Header Sensor AND Outdoor Sensor must be wired. See the ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1 - Direct Wired Header Sensor Wiring

1. On the MASTER Unit, connect the Header Temperature Sensor (**AERCO PN 61040**) to the Feed Forward (FFWD) terminals on the P-1 Harness Via the terminal block labeled "Header Temp sensor" in the I/O Box.

NOTES: The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header. Shielded pair 18 - 22 AWG cable is recommended for header sensor wiring. There is no polarity to be observed. The ground for the shield is at the "SHLD" terminal in the I/O the Box. The sensor end of the shield must be left free and ungrounded.

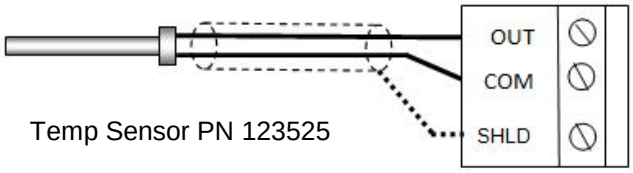


Step 2 - Direct Wired Outdoor Sensor

1. On the MASTER Unit, Connect the Outdoor Temperature Sensor (**AERCO PN 123525**) to the "OUT" and "COM" terminals in the I/O Box.

NOTES:

- Twisted shielded pair 18 - 22 AWG cable is recommended for header sensor wiring. There is no polarity to be observed. The ground for the shield is at the "SHLD" terminal in the I/O the Box. The sensor end of the shield must be left free and ungrounded.
- When mounting the Outdoor sensor, it must be located on the North side of the building where an average outside air temperature is expected. The sensor must be shielded from direct sunlight as well as impingement by the elements. The outdoor sensor may be wired up to 200 feet from the boiler.



Option 3 – Continued

Step 3 - Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the Failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select **Outdoor Reset**.
6. Go to the **Head Temp Source** item and select **FFWD Temp**.
7. Go to the **BST Outdoor Sens** item and select **Enabled**.
8. Go to the **Outdoor Temp Source** item and select **Outdoor Temp**.

When ALL C-More units have been configured:

9. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

9.6.4 Option 4 - Outdoor Reset with Modbus Header Sensor & Modbus Outdoor Sensor

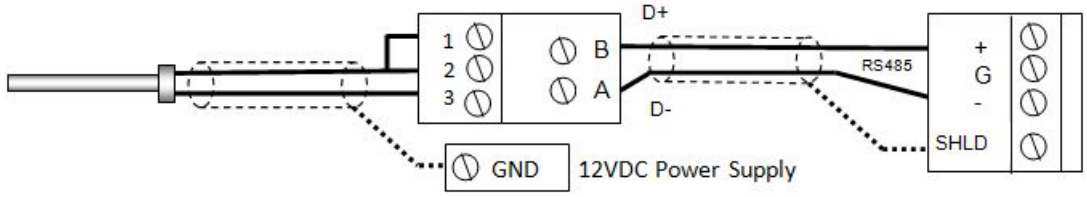
NOTE: Both Header Sensor AND Outdoor Sensor must be wired. See the ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1 - Modbus Header Sensor Wiring

1. Using Shielded pair 18 - 22 AWG cable, connect the Temperature Transmitter (**AERCO P/N 65169**) terminal Pin B to the RS485+ terminal on the I/O Box of any of the boiler units, and Pin A of the Temperature Transmitter to the RS485- terminal on the I/O Box of any of the boiler units.
2. Using Shielded pair 18 - 22 AWG cable, connect the Modbus Header Temperature Sensor (**AERCO PN 24410**) to pins 2 and 3 of the Temperature Transmitter.
3. Install a jumper wire between pins 1 and 2 of the Temperature Transmitter**.**

NOTES:

- Polarity must be observed for the RS485 connections. The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- There is no polarity to be observed. The ground for the shield is at the power supply ground. The sensor end of the shield must be left free and ungrounded.



Temp Sensor PN 24410 Modbus Transmitter I/O Box

Step 2 - Modbus Outdoor Sensor Wiring

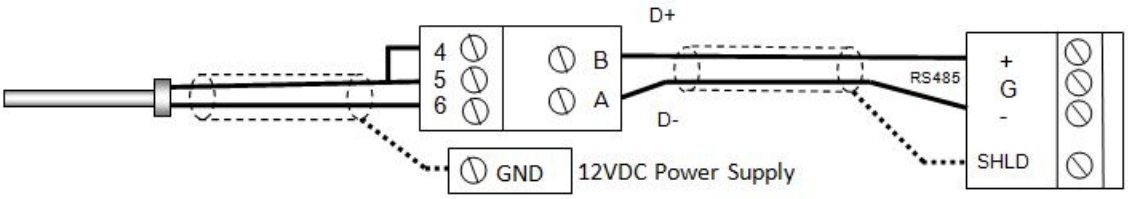
1. If you have not already done so when installing the Modbus Header Sensor, use Shielded pair 18 - 22 AWG cable to connect the Temperature Transmitter terminal Pin B to the RS485+ terminal on the I/O Box of any of the boiler units, and Pin A of the Temperature Transmitter to the RS485- terminal on the I/O Box of any of the boiler units.
2. Using Shielded pair 18 - 22 AWG cable, connect the Modbus Header Temperature Sensor (**AERCO PN 24410**) to pins 2 and 3 of the Temperature Transmitter.
3. Install a jumper wire between pins 1 and 2 of the Temperature Transmitter**.**

NOTES:

- Polarity must be observed for the RS485 connections. The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- When mounting the Outdoor sensor, it must be located on the North side of the building where an average outside air temperature is expected. The sensor must be shielded from direct sunlight as well as impingement by the elements. The outdoor sensor may be wired up to 200 feet from the boiler.

Option 4 – Continued

- There is no polarity to be observed. The ground for the shield is at the power supply ground. The sensor end of the shield must be left free and ungrounded.



Temp Sensor PN 61043 Modbus Transmitter I/O Box

Step 3 - Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu item to Enabled**.
2. Go to the **BST Menu** and set the **BST Mode item** to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the Failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select **Outdoor Reset**.
6. Go to the **Head Temp Source** item and select **Network**.
7. Go to the **Header Temp Addr** item and enter the Modbus Address (240).
8. Go to the **Header Temp Point** item and enter the Modbus Point (14).
9. Go to the **BST Outdoor Sens** item and select **Enabled**.
10. Go to the **Outdoor Temp Source** item and select **Network**.
11. Go to the **Outdoor Temp Addr** item and enter the Modbus Address (240).
12. Go to the **Outdoor Temp Point item** and enter the Modbus Point (15).

When ALL C-More units have been configured:

13. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

9.6.5 Option 5 - Remote Setpoint with Direct Wired Header Sensor & 4-20ma Setpoint Drive

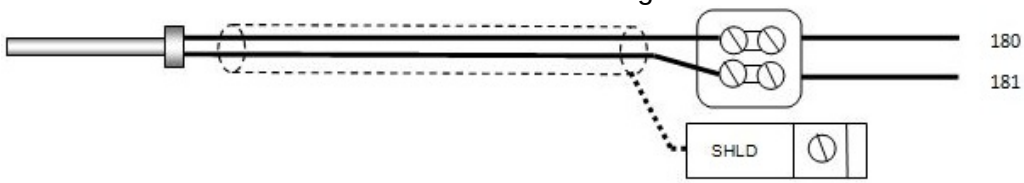
NOTE: Both Header Sensor AND 4-20ma Direct Drive must be wired. See the ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1: Direct Wired Header Sensor Wiring

1. On the MASTER Unit, Connect the Header Temperature Sensor (**AERCO PN 61040**) to the Feed Forward (FFWD) terminals on the P-1 Harness Via the terminal block labeled "Header Temp sensor" in the I/O Box.

NOTES:

- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- Shielded pair 18 - 22 AWG cable is recommended for header sensor wiring.
- There is no polarity to be observed.
- The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- The sensor end of the shield must be left free and ungrounded.

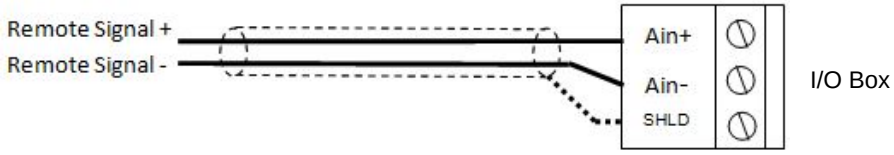


Step 2: Direct Wired 0-20ma or 4-20ma Wiring

1. Connect the 4-20ma or 0-20ma terminals from the Direct Drive source to the Ain+ and Ain- terminals on the Master Unit's I/O Box.

NOTE:

- Shielded pair 18 - 22 AWG cable is recommended for this connection. Polarity must be observed.
- The ground for the shield is at the driver signal source.



Step 3: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

Option 5 – Continued

On MASTER only:

3. Go to the **BST Setpoint** item and enter the Failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select **Remote Setpoint**.
6. Go to the **Head Temp Source** item and select **FFWD Temp**.
7. Go to the **BST Remote Signal** and select either **4-20ma** or **0-20ma**.

When ALL C-More units have been configured:

7. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

9.6.6 Option 6 - Remote Setpoint with Direct Wired Header Sensor & Modbus Setpoint Drive

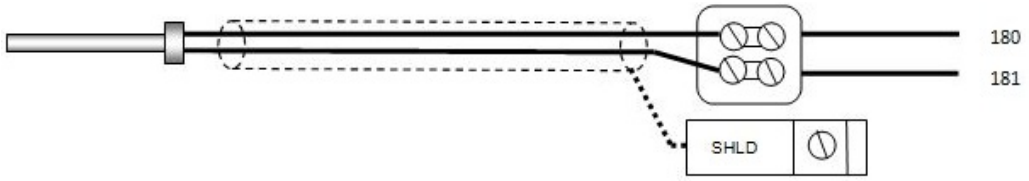
NOTE: Both Header Sensor AND the ProtoNode SSD Device must be wired. See the ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1: Direct Wired Header Sensor Wiring

1. On the MASTER Unit, Connect the Header Temperature Sensor (**AERCO PN 61040**) to the Feed Forward (FFWD) terminals on the P-1 Harness Via the terminal block labeled "Header Temp sensor" in the I/O Box.

NOTES:

- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- Shielded pair 18 - 22 AWG cable is recommended for header sensor wiring. There is no polarity to be observed. The ground for the shield is at the "SHLD" terminal in the I/O the Box. The sensor end of the shield must be left free and ungrounded.



Temp Sensor PN 61040 Header Temp Sensor I/O Box

Step 2: Remote Setpoint with Network

1. Configure and Connect the SSD Device (ProtoNode) per the AERCO Manual (GF129).

Step 3: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On Master only:

3. Go to the **BST Setpoint** item and enter the Failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select **Remote Setpoint**.
6. Go to the **Head Temp Source** item and select **FFWD Temp**.
7. Go to the **BST Remote Signal** item and select **Network**.

When ALL C-More units have been configured:

8. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

9.6.7 Option 7 - Remote Setpoint with Modbus Header Sensor & 4-20ma Setpoint Drive

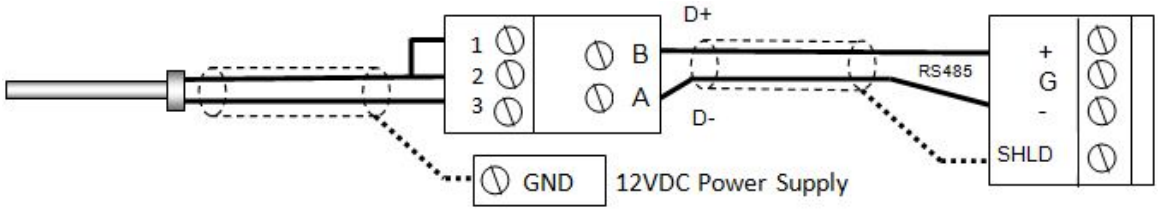
NOTE: Both Header Sensor AND 4-20ma Direct Drive must be wired. See the ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1: Modbus Header Sensor

1. Using Shielded pair 18 - 22 AWG cable, Connect the Temperature Transmitter (**AERCO P/N 65169**) terminal Pin B to the RS485+ terminal on the I/O Box of any of the boiler units, and Pin A of the Temperature Transmitter to the RS485- terminal on the I/O Box of any of the boiler units.
2. Using Shielded pair 18 - 22 AWG cable, connect the Modbus Header Temperature Sensor (**AERCO PN 24410**) to pins 2 and 3 of the Temperature Transmitter.
3. Install a jumper wire between pins 1 and 2 of the Temperature Transmitter.

NOTES:

- Polarity must be observed for the RS485 connections. The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- There is no polarity to be observed. The ground for the shield is at the power supply ground. The sensor end of the shield must be left free and ungrounded.

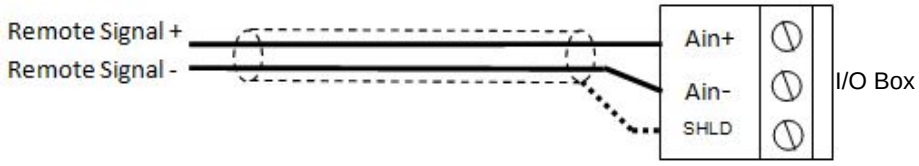


Step 2: Direct Wired 0-20ma or 4-20ma Wiring

1. Connect the 4-20ma or 0-20ma terminals from the Direct Drive source to the Ain+ and Ain- terminals on the Master.

NOTES:

- Unit's I/O Box. Shielded pair 18 - 22 AWG cable is recommended for this connection. Polarity must be observed.
- The ground for the shield is at the driver signal source.



Option 7 – Continued

Step 3: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the Failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select Remote **Setpoint**.
6. Go to the **BST Remote Signal** and select either **4-20ma** or **0-20ma**.
7. Go to the **Head Temp Source** item and select **Network**.
8. Go to the **Header Temp Addr** item and enter the Modbus Address (240).
9. Go to the **Header Temp Point** item and enter the Modbus Point (14).

When ALL C-More units have been configured:

10. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

9.6.8 Option 8 - Remote Setpoint with Modbus Header Sensor & Modbus Setpoint Drive

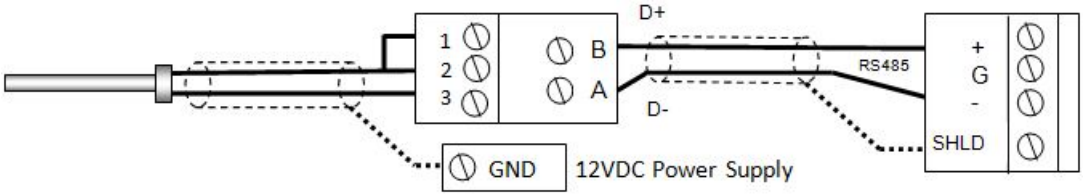
NOTE! Both Header Sensor AND ProtoNode SSD Device must be wired. See the ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1: Modbus Header Sensor

1. Using Shielded pair 18 - 22 AWG cable, Connect the Temperature Transmitter (**AERCO P/N 65169**) terminal Pin B to the RS485+ terminal on the I/O Box of any of the boiler units, and Pin A of the Temperature Transmitter to the RS485- terminal on the I/O Box of any of the boiler units.
2. Using Shielded pair 18 - 22 AWG cable, connect the Modbus Header Temperature Sensor (**AERCO PN 24410**) to pins 2 and 3 of the Temperature Transmitter.
3. Install a jumper wire between pins 1 and 2 of the Temperature Transmitter**.**

NOTES:

- Polarity must be observed for the RS485 connections. The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- There is no polarity to be observed. The ground for the shield is at the power supply ground. The sensor end of the shield must be left free and ungrounded.



Temp Sensor PN 24410 Modbus Transmitter I/O Box

Step 2: Remote Setpoint with Network

1. Configure and connect the SSD Device (ProtoNode) per the ProtoNode Manual (GF129).

Step 3: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select Remote **Setpoint**.
6. Go to the **BST Remote Signal** and select either **Network**.
7. Go to the **Head Temp Source** item and select **Network**.
8. Go to the **Header Temp Addr** item and enter the Modbus Address (240).
9. Go to the **Header Temp Point** item and enter the Modbus Point (14).

Option 8 – Continued

When ALL C-More units have been configured:

10. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

9.7 TROUBLESHOOTING

Faults which may occur during BST operation include the items listed below.

FAULT INDICATION	PROBABLE CAUSE	CORRECTIVE ACTION
OUTLET TEMPERATURE display is flashing on 2 C-More Control Panels	1. Two C-Mores have their BST Mode menu option set to BST Master	1. Check the BST Mode entries in the units which have their displays flashing. Change one of the BST Mode settings to BST Slave.
REMOTE LED on one or more BST units is Off.	1. Improperly connected or faulty RS485 Modbus wiring. 2. Improper Comm address. 3. Unit Comm address is not unique.	1. Check the polarity of the RS485 Comm connections on the I/O board of the affected unit. Also, ensure that all Modbus wiring connections to the unit are secure. 2. Verify that the address of the affected unit is within the allowable range (1 thru 8). The address numbers do not have to be sequential. 3. Check to ensure that none of the units have the same Comm address.
Actuator-controlled sequencing valve does not open	1. Control cable not connected to valve actuator. 2. 24 VAC power not being supplied to valve actuator. 3. Defective valve actuator.	1. Ensure that the control cable from the unit's I/O Box is connected to the valve actuator. 2. Remove the enclosure cover from the valve actuator and verify that 24 VAC is present at Terminal 2 of the actuator. 3. Replace valve actuator. Following replacement, the actuator stroke will have to be calibrated to ensure it fully opening and closing.

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APPENDIX A: ProtoNode SSD Setup for BST and HST Applications

This appendix applies to ProtoNode SSD Setup for BST and HST applications requiring Building Automation System Access.

Description

The AERCO SSD (Slave Slave Device) is a one-of-a-kind gateway developed by AERCO to enable two (2) Modbus masters to communicate. Use the SSD to enable a Building Automation System Modbus masters to bi-directionally communicate to BST/HST Modbus masters.

Main Features

The AERCO SSD device is unique because it enables two (2) Modbus masters to bi-directionally communicate over RS-485. The AERCO SSD device is also specifically designed to support the BST/HST Automatic failover Feature. While the BST/HST role can be transferred to another unit (with a different Modbus address) the SSD device operates at a fixed and constant Modbus address. The fixed SSD address is propagated to each unit and allows the BST/HST master to resume communications after a failover without BAS changes.

AERCO SSD Setup

Please follow all of the (ProtoNode) setup instructions included in document GF-129 with the exceptions as noted here.

SSD Wiring Setup

The SSD is wired to the “end” unit on the Modbus RS-485 bus. The location should be chosen to reduce cable length and limit EMI noise.

SSD Configuration File Setup

The SSD must be loaded with the appropriate bin file (profile) below. The instructions for selecting the bin file (profiles) are in Section 2 of the ProtoNode Gateway User Manual, GF-129:

- See Table 2-4 for RER
- See Table 2-5 for LER

C-More Configuration Settings for SSD

To setup and enable SSD communications, make the following changes to the C-More configuration:

1) In the BST menu, set **SSD Modbus Address** to a number greater than the maximum unit address. It is recommended to use the address 247 for standardization proposes.
2) In the BST menu, verify the SSD Poll Timer is at the default value of 0.

3) To change from Degrees F, degrees C, to “counts”, select the appropriate value for the SSD Format parameter. In most cases degrees F/C are used. The Counts option should only be used for legacy installations.

BAS Setup

To setup BAS communications, use the following Modbus point tables below.

Reading Operational Data from a BST System and Writing Control Values

This document assumes that the BAS side of the SSD will be using Modbus, but equivalent addressing and timing considerations apply to other communications methods (e.g. BACNET, Modbus over TCP, etc.).

During normal operation, the BAS writes to two (2) address ranges on the SSD to send control values to the BST system. It reads from two address ranges to retrieve operational state information from the BST system.

Data is structured into header data (the BST system data) and then sections of data that is repeated for each unit.

Modbus Points List

Writing Control Values

The registers used to write control values are 40200 through 40203 and 40051.

BAS Register	Use	Description/Notes
40200	BST setpoint	This is the temperature each water heater in system will control outlet temp to. If the value written to BST setpoint is below the minimum allowed value or above the Maximum allowed value, all registers between 40200 and 40203 will be ignored on the assumption that none of the data is valid.
40201	BST setback setpoint	This is the temperature each water heater in system will control outlet temp to during the night setback period (if night setback is enabled).
40202	BST setback start	The time the setback period starts. This is expressed in minutes since midnight. For example 360 would correspond to 6am.
40203	BST setback end	The time the setback period ends. This is expressed in minutes since midnight. If setback start and setback end are the same value, there is no setback period.

40051	Write Control Values to BST	The BAS must write a 1 to this location for the first 4 values to be copied across the SSD device, to the BST side. In normal operation update the 4 registers 40200 through 40203 fairly regularly. Once all four have been written, write a one to 40051. This is done to insure that all control values are copied to the BST side of the SSD as a block.
40050	Write Op Values to BAS	BST Master writes to this address to copy operational parameters to the BAS side of the SSD. The BAS should never read or write this address.

Reading Operational Data

The registers used to read operational data are 30100 through 30108 and 40054.

BAS Register	Use	Description
30100	BST	This will typically always read as 2.
30101	BST setpoint	This is the temperature to which each boiler in the system will control outlet temp. This values is not used in BST Mode.
30102	BST setback setpoint	This is the temperature to which each boiler in the system will control outlet temp to during the night setback period (if night setback is enabled).
30103	BST setback start	The time the setback period starts. This is expressed in minutes since midnight. So for example 360 would correspond to 6am.
30104	BST setback end	The time the setback period ends. This is expressed in minutes since midnight. If setback start and setback end are the same value, there is no setback period.
30105	Auto Master	Zero “0” if the master unit is fixed, one “1” if it can automatically failover to another unit after a fault.
30106	Average Outlet Temperature	This is an average outlet temperature of all ignited boilers in the system. Note! This item is for Water Heater units only.
30107	Units Enabled	This is the number of boilers in the system that can be lit off.
30108	Units Faulted	This is the number of boilers in the system that are faulted.
30109	Master Address	The Master Address is the comm address of the Master unit.
30110	BST Header Temp	The BST Header Temp is the BST Header Temperature reading.
30111	BST Outdoor Temp	The BST Outdoor Temp is the Outdoor Temperature reading if an outdoor temperature sensor is installed).
30112	BST Fire Rate	The BST Fire Rate is the Fire Rate command sent to all ignited boilers.
30113	Units Ignited	This is the number of ignited units.
30114	BST Active Setpoint	The actual setpoint the BST Master is working towards, depending on the BST Setpoint Mode.
30115	BST Next On VP	The Fire Rate (Valve Position) above which the BST master will light off another boiler if available.

30116	BST Setpoint Hi Limit	The BST Setpoint Hi Limit is the maximum allowable setpoint setting.
30117	BST Setpoint Lo Limit	The BST Setpoint Lo Limit is the minimum allowable setpoint setting.
30118	BST Temp Hi Limit	The critical temperature limit above which the BST Master will alarm and lower the Fire Rate of all boilers.
30119	BST Setpoint Mode	The operating mode of the BST Master – Constant Setpoint, Remote Setpoint or Outdoor Reset.
40053	BST Timeout	If the BST system has not written to the SSD in 15 seconds, this register will read as one.

Reading individual Boilers or Water Heaters:

Unit Addr	Modbus Address
1	30300 to 30349
2	30400 to 30449
3	30500 to 30549
4	30600 to 30649
5	30700 to 30749
6	30800 to 30849
7	30900 to 30949
8	31000 to 31049

Below are examples for Boiler Address 1:

BAS Register	**Use**	**Description**
30300	comm_addr	Modbus address of unit.
30301	unit_status	status (0=Disabled, 1=Standby, 2=Manual, 3=Remote, 4=Auto, 5=Fault).
30302	fault_code	Fault codes 0-74 matching the normal unit fault codes. See GF-XXX for meaning (0 to 74)
30303	outlet_temp	Outlet temp sensor in degrees or counts.
30304	ffwd_temp	Feed forward temp sensor in degrees or counts. Used as Header Temp Sensor in Master unit.
30305	inlet_temp	inlet water temp sensor in degrees or counts.
30306	exhaust_temp	Exhaust temp sensor in degrees or counts.
30307	air_temp	Air temp sensor in degrees or counts.
30308	flame_strength	Measured flame strength of unit while it is running.
30309	fire_rate_in	Valve position signal sent to the boiler.
30310	fire_rate_out	Measured valve position.
30311	unit_type	The type of the unit. C_mnue.h
30312	unit_size	see A_BMSG.H for enum of sizes.
30313	comm_err_count	count of errors for this unit (0 if unit functioning).
30314	network_remote_setpt	temperature (in counts) unit is set for when in HST mode.
30315	run_cycles	upper 16 bits of run cycles.
30316	run_cycles	lower 16 bits of run cycles.
30317	run_hours	upper 16 bits of run hours.
30318	run_hours	lower 16 bits of run hours.

To convert from “counts” to degrees C or degrees F

This is for reference only. The use of counts is depreciated and should not be used for new setups.

To convert a temperature in degrees Fahrenheit (F) to counts (X), use the following formula:

X = (((F – 20) * 1000) +115)/230

To convert a temperature expressed in counts (X) to degrees Fahrenheit (F), use the following formula:

F = (((X * 230) +500)/1000) + 20

To convert a temperature in degrees Celsius (C) to counts (X), use the following formula:

X = (((C +7) * 1000) +64)/128

To convert a temperature expressed in counts (X) to degrees Celsius (C), use the following formula:

C = (((X * 128) +500)/1000) -7

To convert long integers (run hours and run cycles)

Run hours = 65536 * run_hours upper + run_hours lower.
Run cycles = 65536 * run_cycles upper + run_cycles lower.

BST Header Temperature Sensor and Outdoor Air Temperature Sensor
There are two header sensor and outdoor air sensor connection options available. The two options are the “direct connect to the BST master” option and the Modbus option. If the BST Automatic Master Failover feature is required, the Modbus sensor option is required.

Modbus Header Sensor Kit
The Modbus Outdoor air and Header temp sensor connection method is the higher cost option and it requires more setup. This method allows for the use of the Automatic Master Failover feature. In the event of a Master Failover the Modbus header and outdoor air temperatures are available to the new master.

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APPENDIX B: MODbus Temperature Transmitter Installation

The Modbus transmitter will be installed at one end of the Modbus bus. If a ProtoNode will also be used, the ProtoNode should be the last device on the RS-485 bus. In that case connect the Modbus transmitter, between the last unit and the ProtoNode. The choice of which end to connect the transmitter and ProtoNode depends on the most convenient mounting that is clean, dry, etc. location that results in the shortest RS-485 bus length. The Modbus transmitter is designed to be mounted on a 6"-10" din rail.

To connect the outdoor air and header temp sensor using the Modbus sensor

1. Install the Modbus transmitter (PN 65169) on the DIN rail.
2. Add the Modbus transmitter to the Modbus bus wiring at a convent end location.
3. Install the Power Supply on the Din rail.
4. Install the Modbus transmitter on the DIN rail.
5. Connect transmitter Terminal A (D-) to the negative lead of the Modbus bus.
6. Connect transmitter Terminal B (D+) to the positive lead of the Modbus bus.
7. Connect power supply + terminal to the V+ terminal on the transmitter.
8. Connect power supply - terminal to the V- terminal on the transmitter.
9. Connect the Header sensor (PN 69195) in screw terminal 1 and screw terminal 3 with jumper wire from terminal 1 to terminal 2. There should be both the sensor wire and jumper in terminal 1.
10. Connect the outdoor air sensor (PN 69XXX) in screw terminal 4 and screw terminal 6 with jumper wire from terminal 4 to terminal 5. There should be both the sensor wire and jumper in terminal 4.

To configure a SmartMod HE359RTD100A MODbus Temperature Transmitter (APN 65169)

In the following order

1. Attach a wire (jumper) from terminal C GND to D INIT.
2. Attach power and Modbus connections as described for production use.
3. Apply power to the device after attaching the jumper.
4. Using Omni or another Modbus program
    a. Set Holding register #5 (40006) to 123 for the Baud Rate value (9600).
    b. Set holding register #5 (40007) to 240 for the Modbus address (240).
    c. Set holding register #10 (40011) to 25 for the Sensor Type selection (Pt1000).
5. Remove power (disconnect phoenix connector).
6. Remove the jumper wire.
7. Reattach power (reconnect phoenix connector).

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APPENDIX C: INDOOR/OUTDOOR RESET RATIO CHARTS

Header Temperature for a Building Reference Temperature of 50F

	RESET RATIO									
Air Temp	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.2**	**2.4**
50F	50	50	50	50	50	50	50	50	50	50
45F	53	54	55	56	57	58	59	60	60	62
40F	56	58	60	62	64	66	68	70	72	74
35F	59	62	65	68	71	74	77	80	83	86
30F	62	66	70	74	78	82	86	90	94	98
25F	65	70	75	80	85	90	95	100	105	110
20F	68	74	80	86	92	98	104	110	116	122
15F	71	78	85	92	99	106	113	120	127	134
10F	74	82	90	98	106	114	122	130	138	146
5F	77	86	95	104	113	122	131	140	149	158
0F	80	90	100	110	120	130	140	150	160	170
-5F	83	94	105	116	127	138	149	160	171	182
-10F	86	98	110	122	134	146	158	170	182	194
-15F	89	102	115	128	141	154	167	180	193	206
-20F	92	106	120	134	148	162	176	190	204	218

Header Temperature for a Building Reference Temperatrure of 60F

	RESET RATIO									
Air Temp	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.2**	**2.4**
60F	60	60	60	60	60	60	60	60	60	60
55F	63	64	65	66	67	68	69	70	71	72
50F	66	68	70	72	74	76	78	80	82	84
45F	69	72	75	78	81	84	87	90	93	96
40F	72	76	80	84	88	92	96	100	104	108
35F	75	80	85	90	95	100	105	110	115	120
30F	78	84	90	96	102	108	114	120	126	132
25F	81	88	95	102	109	116	123	130	137	144
20F	84	92	100	108	116	124	132	140	148	156
15F	87	96	105	114	123	132	141	150	159	168
10F	90	100	110	120	130	140	150	160	170	180
5F	93	104	115	126	137	148	159	170	181	192
0F	96	108	120	132	144	156	168	180	192	204
-5F	99	112	125	138	151	164	177	190	203	216
-10F	102	116	130	144	158	172	186	200	214	
-15F	105	120	135	150	165	180	195	210		
-20F	108	124	140	156	172	188	204			

Header Temperature for a Building Reference Temperature of 65F

	RESET RATIO									
Air Temp	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.2**	**2.4**
65	65	65	65	65	65	65	65	65	65	65
60	68	69	70	71	72	73	74	75	76	77
55	71	73	75	77	79	81	83	85	87	89
50	74	77	80	83	86	89	92	95	98	101
45	77	81	85	89	93	97	101	105	109	113
40	80	85	90	95	100	105	110	115	120	125
35	83	89	95	101	107	113	119	125	131	137
30	86	93	100	107	114	121	128	135	142	149
25	89	97	105	113	121	129	137	145	153	161
20	92	101	110	119	128	137	146	155	164	173
15	95	105	115	125	135	145	155	165	175	185
10	98	109	120	131	142	153	164	175	186	197
5	101	113	125	137	149	161	173	185	197	209
0	104	117	130	143	156	169	182	195	208	
-5	107	121	135	149	163	177	191	205	219	
-10	110	125	140	155	170	185	200	215		
-15	113	129	145	161	177	193	209			
-20	116	133	150	167	201	218				

Header Temperature for a Building Reference Temperature of 70F

	RESET RATIO									
Air Temp	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.2**	**2.4**
70F	70	70	70	70	70	70	70	70	70	70
65F	73	74	75	76	77	78	79	80	81	82
60F	76	78	80	82	84	86	88	90	92	94
55F	79	82	85	88	91	94	97	100	103	106
50F	82	86	90	94	98	102	106	110	114	118
45F	85	90	95	100	105	110	115	120	125	130
40F	88	94	100	106	112	118	124	130	136	142
35F	91	98	105	112	119	126	133	140	147	154
30F	94	102	110	118	126	134	142	150	158	166
25F	97	106	115	124	133	142	151	160	169	178
20F	100	110	120	130	140	150	160	170	180	190
15F	103	114	125	136	147	158	169	180	191	202
10F	106	118	130	142	154	166	178	190	202	214
5F	109	122	135	148	161	174	187	200	213	
0F	112	126	140	154	168	182	196	210		
-5F	115	130	145	160	175	190	205			
-10F	118	134	150	166	182	198	214			
-15F	121	138	155	172	189	206				
-20F	124	142	160	178	196	214				

Header Temperature for a Building Reference Temperature of 75F

	RESET RATIO									
Air Temp	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.2**	**2.4**
75F	75	75	75	75	75	75	75	75	75	75
70F	78	79	80	81	82	83	84	85	86	87
65F	81	83	85	87	89	91	93	95	97	99
60F	84	87	90	93	96	99	102	105	108	111
55F	87	91	95	99	103	107	111	115	119	123
50F	90	95	100	105	110	115	120	125	130	135
45F	93	99	105	111	117	123	129	135	141	17
40F	96	103	110	117	124	131	138	145	152	159
35F	99	107	115	123	131	139	147	155	163	171
30F	102	111	120	129	138	147	156	165	174	183
25F	105	115	125	135	145	155	165	175	185	195
20F	108	119	130	141	152	163	174	185	196	207
15F	111	123	135	147	159	171	183	195	207	219
10F	114	127	140	153	166	179	192	205	218	
5F	117	131	145	159	173	187	201	215		
0F	120	135	150	165	180	195	210			
-5F	123	139	155	171	187	203	219			
-10F	126	143	160	177	194	211				
-15F	129	147	165	183	201	219				

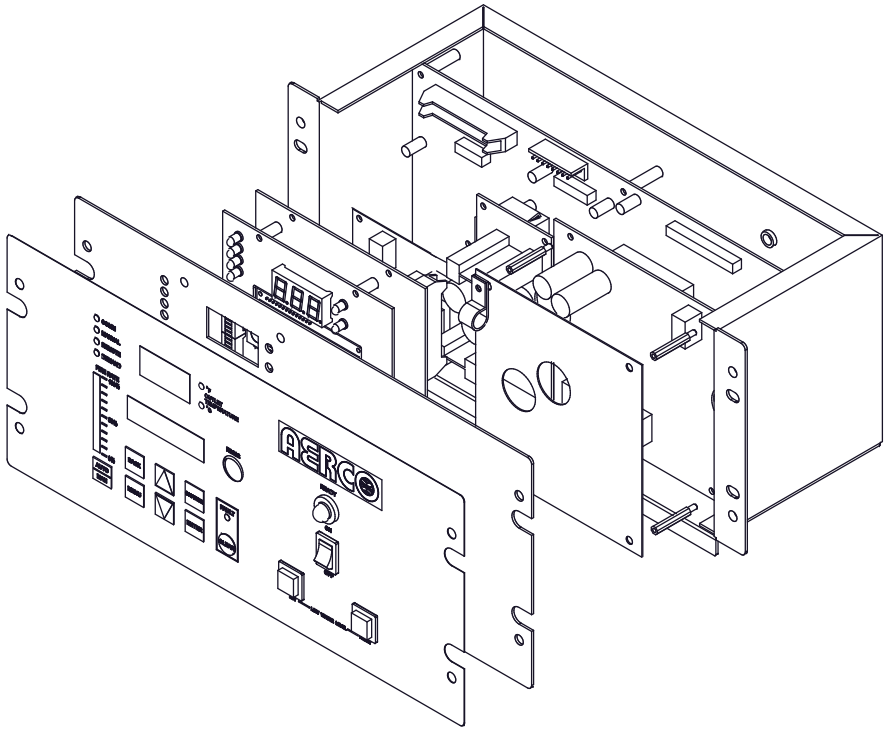
Header Temperature for a Building Reference Temperature of 80F

	RESET RATIO									
Air Temp	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.2**	**2.4**
80F	80	80	80	80	80	80	80	80	80	80
75F	83	84	85	86	87	88	89	90	91	92
70F	86	88	90	92	94	96	98	100	102	104
65F	89	92	95	98	101	104	107	110	113	116
60F	92	96	100	104	108	112	116	120	124	128
55F	95	100	105	110	115	120	125	130	135	140
50F	98	104	110	116	122	128	134	140	146	152
45F	101	108	115	122	129	136	143	150	157	164
40F	104	112	120	128	136	144	152	160	168	176
35F	107	116	125	134	143	152	161	170	179	188
30F	110	120	130	140	150	160	170	180	190	200
25F	113	124	135	146	157	168	174	190	201	212
20F	116	128	140	152	164	176	188	200	212	
15F	119	132	145	158	171	184	197	210		
10F	122	136	150	164	178	192	206			
5F	125	140	155	170	185	200	215			
0F	128	144	160	176	192	208				
-5F	131	148	165	182	199	216				
-10F	134	152	170	188	206					

Header Temperature for a Building Reference Temperature of 90F

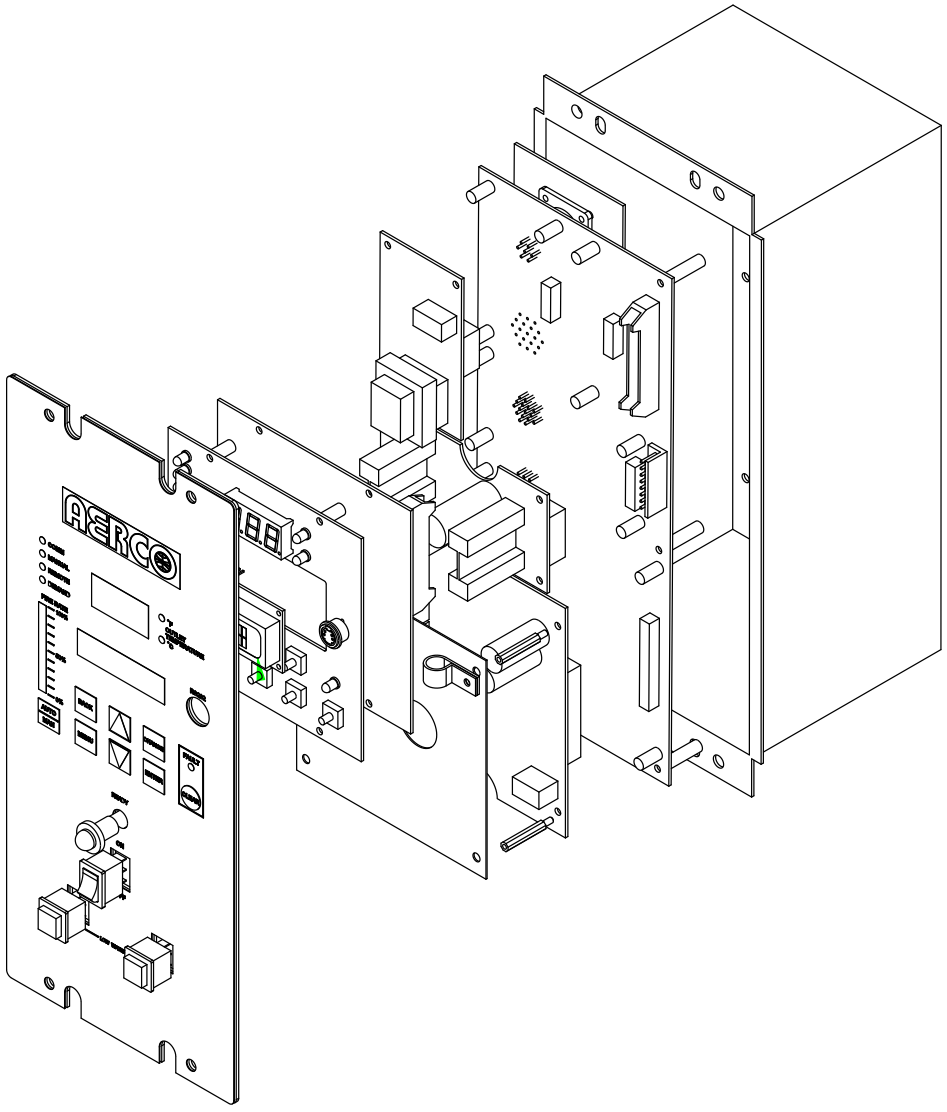
	RESET RATIO									
Air Temp	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.2**	**2.4**
90F	90	90	90	90	90	90	90	90	90	90
85F	93	94	95	96	97	98	99	100	101	102
80F	96	98	100	102	104	106	108	110	112	114
75F	99	102	105	108	111	114	117	120	123	126
70F	102	106	110	114	118	122	126	130	134	138
65F	105	110	115	120	125	130	135	140	145	150
60F	108	114	120	126	132	138	144	150	156	162
55F	111	118	125	132	139	146	153	160	167	174
50F	114	122	130	138	146	154	162	170	178	186
45F	117	126	135	144	153	162	171	180	189	198
40F	120	130	140	150	160	170	180	190	200	210
35F	123	134	145	156	167	178	189	200		
30F	126	138	150	162	174	186	198	210		
25F	129	142	155	168	181	194	207			
20F	132	146	160	174	188	202	216			
15F	135	150	165	180	195	210				
10F	138	154	170	186	202	218				
5F	141	158	175	192	209					
0F	144	162	180	198	216					

APPENDIX D: C-MORE CONTROL PANEL VIEWS

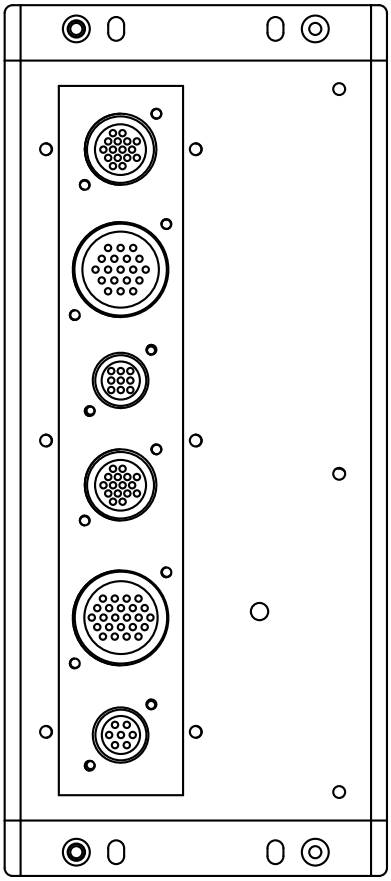


KC1000 Series Control Panel - Exploded View

KC1000 Series Control Panel - Rear View



Benchmark & Innovation Series Control Panel - Exploded View



Benchmark & Innovation Series Control Panel - Rear View

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APPENDIX E: TEMPERATURE SENSOR RESISTANCE-VOLTAGE CHART

TEMPERATURE SENSOR RESISTANCE VOLTAGE CHART (BALCO)

TEMP (°F)	RES (OHMS)	VOLTS*
-40	779.0	
-30	797.5	1.93
-20	816.3	1.96
-10	835.4	1.99
0	854.8	2.02
10	874.6	2.05
20	894.7	2.07
30	915.1	2.10
40	935.9	2.12
50	956.9	2.15
60	978.3	2.17
70	1000.0	2.20
80	1022.0	2.23
90	1044.4	2.25
100	1067.0	2.27
110	1090.0	2.30
120	1113.3	2.32
130	1137.0	2.34
140	1160.9	2.36
150	1185.2	2.39
160	1209.5	2.41
170	1234.7	2.43
180	1260.0	2.45
190	1285.6	2.47
200	1311.4	2.50
210	1337.7	2.52
220	1364.2	2.54
230	1391.0	2.56
240	1418.2	2.58
250	1445.7	

*Voltage at AUX & Common terminals in the I/O Box

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APPENDIX F: C-MORE CONTROL PANEL DIP SWITCH SETTINGS

F-1. INTRODUCTION

The PMC (Primary Micro-Controller) Board in the C-More Control Panel Assembly contains two 4-position DIP switches (S1, S2) as shown in Figure D-1. The functions of these DIP switches are as follows:

- 4-Position DIP switch S1 (Detail "A") is used to select either current or voltage as the Remote Signal Source when operating in the Remote Setpoint or Direct Drive Mode. The factory default for this switch is current (CURR).
- 4-Position DIP switch S2 (Detail "B") is used to enable a terminating (TERM) resistor and bias (BIAS1, BIAS2) when it is the last unit on a RS485 (Modbus) Network chain. The factory default setting for the switches is OFF. Refer to Modbus Communication Manual GF-114 for additional information on setting these switches

The following procedures provide the instructions necessary to access the DIP switches on the PMC Board and select the required settings.

F-2. ACCESSING AND SETTING PMC BOARD DIP SWITCHES

The following procedures provide the instructions necessary to access the DIP switches on the PMC Board and select the required settings.

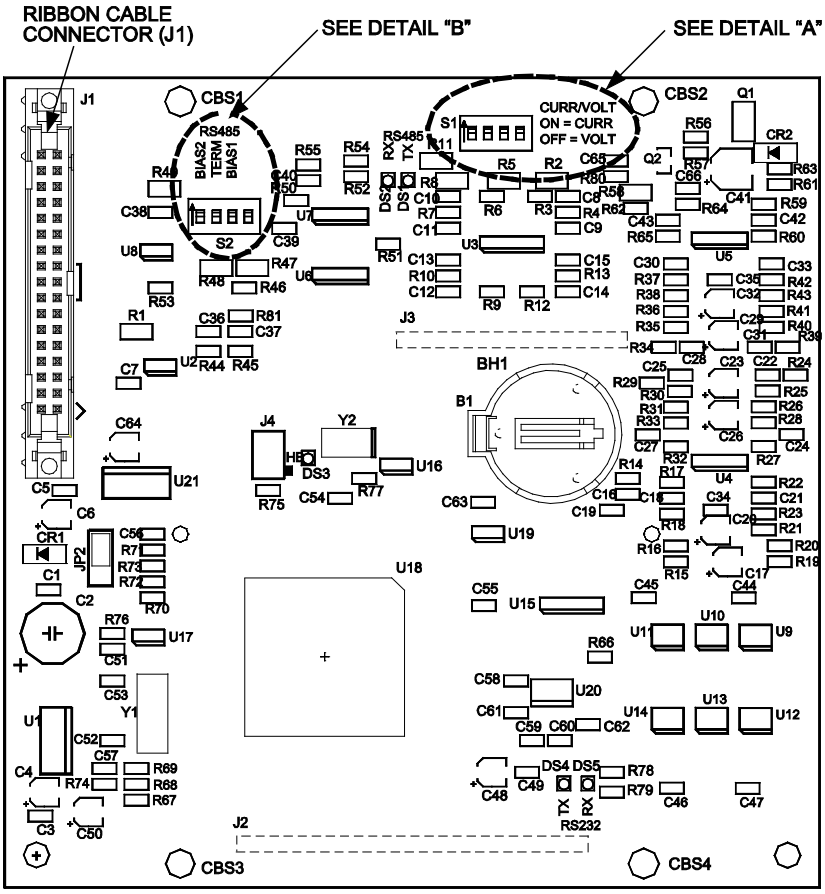
1. Remove power from the C-More Control Panel.
2. Loosen and remove the four (4) screws securing the front panel assembly to the chassis as shown in Figure D-2. The horizontal panel configuration shown in Figure D-2 is for a KC1000 unit. Benchmark units utilize a vertical panel layout, however removal is identical for both configurations.
3. Carefully separate the panel from the chassis. Use care to avoid applying undue stress to the ribbon cable connected between the back of the panel and the chassis-mounted printed circuit boards.

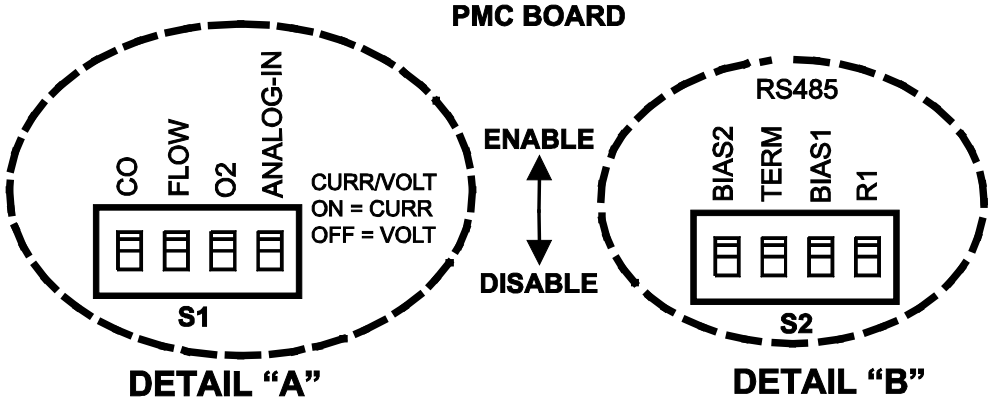
CAUTION

The C-More Controller Printed Circuit Boards contain electronic components that are sensitive to electrostatic discharge (ESD). Prior to performing the following steps, put on an anti-static wrist strap and connect the clip lead to earth ground. Failure to observe this precaution may result in permanent damage to on-board ESD-sensitive components.

4. Put on an anti-static wrist strap and attach the clip lead to earth ground.
5. From the back of the Panel Assembly (Figure D-3), locate the 4-position Curr/Volt DIP switch S1 shown in Figure D-1 (Detail "A") on the PMC Board. All 4 positions of switch S1 should currently be set to the ON (Up) position which is the factory default setting of current (CURR). If your installation will utilize voltage as the Remote Signal source, set all 4 positions of S1 to the OFF (Down) position to select voltage (VOLT).
6. If the C-More Control Panel is the last unit in a RS485 Network chain, it will be necessary to activate the RS485 4-position DIP switch S2 shown in Figure D-1 (Detail "B"). Refer to GF-114 Modbus Communication Manual prior to changing the switch setting.

7. S2 – R1 Switch (See Detail B of Figure D1): Set R1 switch to ON (UP) position if an O2 (Oxygen) sensor is NOT installed. Set R1 switch to the OFF (down) position in O2 sensor IS installed.
8. After the DIP switches have been set, reposition the Front Panel Assembly on the chassis and secure it in place with the four screws.
9. This completes the procedure for setting the DIP switches. Return the unit to service use.





S1: These DIP Switches are used to set either current (CURR) or voltage (VOLT) as the remote signal input source.
ON (up) = CURRENT
OFF (down) = VOLTAGE

NOTE:
Refer to GF-114 before activating any of the DIP switches.

S2: The BIAS2, TERM, and BIAS1 DIP switches are used only when this is the last unit connected at the end of a RS485 (Modbus) network chain. If an Oxygen Sensor is attached to the C-More Controller, set R1 to DISABLED (down). If an Oxygen Sensor is NOT used, set R1 to ENABLED (up). Factory default is ENABLED.

Figure E-1: C-More Control Panel PMC Board

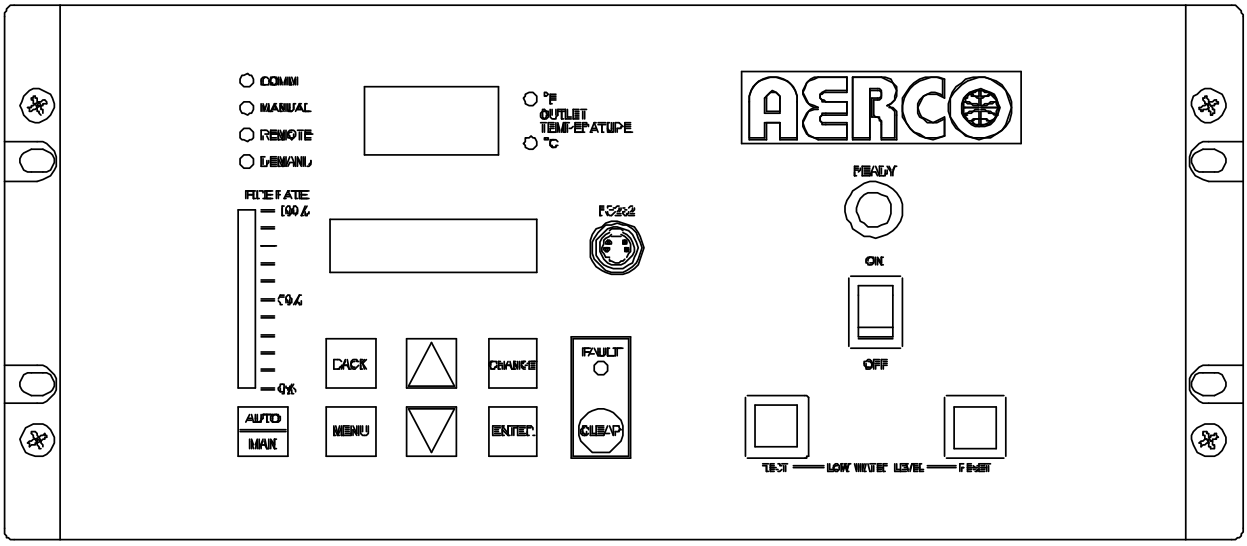


Figure E-2: C-More Control Panel Front View – KC1000

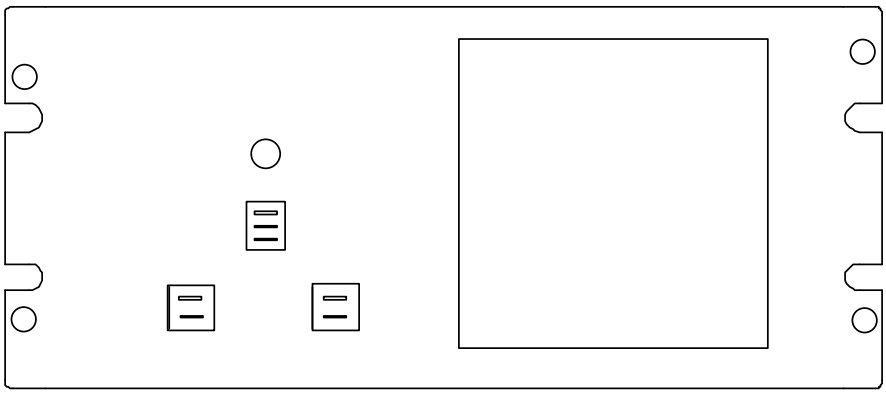


Figure E-3: C-More Control Panel Rear Views

Change Log

Date	Description	Changed By
10/24/2013	Rev D:	Curtis Harvey
04/22/2014	Rev E: Addition of Chapter 9 – Boiler Sequencing Technology (BST), added additional models to table 3-2A.	Chris Blair