INSTALLATION OPERATION AND SERVICE MANUAL

TEKMAR® SMARTFLAME BTCMPA

Temperature Controller is used on:

Camus® Dynaflame® on units built prior to the Honeywell SOLA

CAMUS® HYDRONICS LTD.

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99-0290
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PART 1 SMARTFLAME CONTROL PANEL

1.1 APPLIANCE TEMPERATURE CONTROLLER

This document applies to DynaFlame® boilers and water heaters built prior to the Honeywell SOLA control

The appliance is provided with a control panel at the front. Operating controls are installed inside the control box and are accessible by undoing the thumb screw and swinging opening the door. The diagnostic information centre as well as the on/off switch, 24V fuse, and the appliance temperature controls reside on the control box door the ignition control module, VFD, transformer and relays are mounted on the internal panel.

Figure 1: Control Panel Front

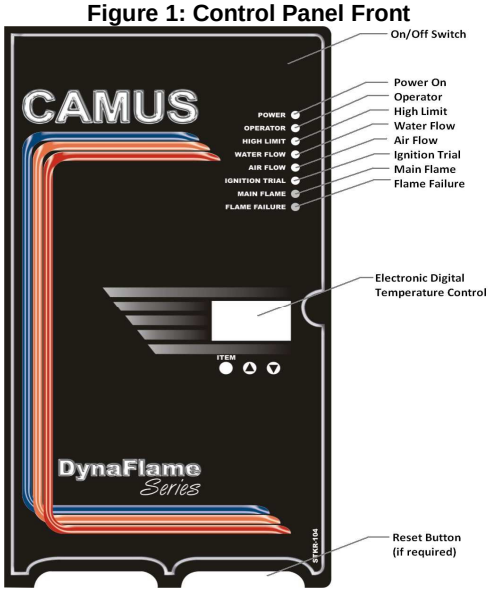
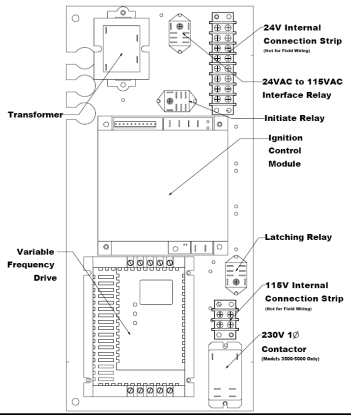


Figure 2: Control Panel Components



The Boiler Temperature Controller (BTC 1) for this appliance is a Camus 78-0017 Modulating SmartFlame control. It initiates the local call for heat and sets the target return (appliance inlet) water temperature. This controller offers eight modes of operation which provides set point as well as reset control. It provides the following:

- Readings of inlet and outlet water temperatures as well as ΔT temperature rise.
- Eight pre-set modes of operation; mode 1 for heating and constant circulation DHW, modes 2, 4, and 5 for heating , mode 3 for DHW with remote sensing and mode 6, 7 and 8 for operation by a remote controller.
- Operation as an auto reset limit.
- Operation as a control for inlet water temperature.
- Optional tank mounted sensor used in conjunction with inlet sensor.
- Adjustable pump delay feature based on ΔT temperature difference between inlet and outlet temperatures. Accepts 1/6 hp. pump directly across terminals 13 & 14. An optional 1 HP relay is available.
- Adjustable; target temp, inter-stage differential, on delay between stages, minimum on time per stage, minimum off time per stage.
- Display of run hours for maintenance purposes. Counter wraps around at 10000 hours. Pressing and holding up and down arrow key simultaneously will reset the counter.
- Flame failure signal 24V.
- Molex connector for ease of service.
- Error message display.
- Test override feature to test pump operation, stages 1, 2, and alarm. Press and hold the UP button to test. After one second the pump will turn ON. Stage 1 will turns ON after four seconds. Stage 2 will turn ON after seven seconds. Alarm will turn ON after ten seconds. The controller will return to normal operation after releasing the UP button.
- Pump exercising feature runs pump 10 seconds every three days of no pump operation.

Setting the Appliance Temperature Control

Press and hold the ITEM, UP and DOWN buttons simultaneously for 3 seconds. Press the ITEM key and then select the desired setting using the UP, DOWN buttons. Pressing the ITEM key again will cause the last setting to be accepted. Once all settings have been made, wait for 30 seconds for the control to return to normal operating mode. In normal operating mode the inlet temperature, outlet temperature, ΔT temperature and ON hours can be viewed by repeatedly pressing the ITEM key only. If you wish to check the setting you will have to start again by pressing and holding the ITEM, UP and DOWN buttons simultaneously for 1 second, and then use only the ITEM key to scroll through the settings. After checking the settings allow the control to return to normal operation on its own. Default display is outlet temperature.

Summary of 8 Modes of Operation

Mode 1

- For setpoint control at heater inlet sensor. Use for hydronic constant setpoint heating or domestic hot water applications.
- External heat demand or constant pumping required.

Mode 2

- For setpoint control at system sensor
- Ideal for monitoring constant hot loop or for open water reservoir heating
- Intermittent pumping provided.

Mode 3

- For DHW control with tank sensor. Controls to boiler inlet sensor.
- Intermittent pumping provided

Mode 4

- For hydronic heating with outdoor reset. Temperature control at boiler inlet sensor with proportional modulating logic.

Mode 5

- For hydronic heating with outdoor reset. Temperature control at system sensor with selectable P.I.D. or proportional modulating logic.
- Intermittent pumping provided

Mode 6

- External analogue 0-10VDC signal generates temperature target. Setpoint temperature control at heater inlet sensor using proportional modulating logic.
- Intermittent pumping provided

Mode 7

- External analogue 0-10VDC signal generates temperature target. Setpoint temperature control at system sensor with selectable PID or modulating logic.
- Intermittent pumping provided.

Mode 8

- External analogue 0-10VDC signal closes the stage contacts to initiate heater. Modulating output of the control follows the analog external input signal. Temperature is controlled remotely independently of local settings. Boiler max. setting remains functional.
- Intermittent pumping provided

Note: Modes 1 thru 5 are for local operation. Modes 6 thru 8 are for remote operation. In changing from local to remote operation and vice versa the mode setting must be manually changed.

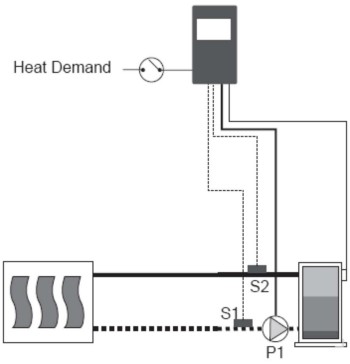
Mode 1: Constant Temperature Control

This mode is designed for hydronic heating or domestic hot water (DHW). Once a heat demand is present, the BTC 1 turns on the appliance pump and modulates the boiler burner to maintain the boiler target at the boiler inlet sensor. A heat demand is generated when a 24VAC is applied across CD (common demand) and Ht D (heat demand). Once voltage is applied, the BTC 1 turns on the Dem 1 segment in the display.

If the inlet sensor is ½ (half) of the differential below the BOIL TARGET, the BTC 1 then changes the proportional modulation output to the START modulation setting, the Stage contact (pins 15 & 16) close to proceed to trial for ignition. The burner remains at minimum modulation until the flame is proved and then the modulating output changes the boiler burner output to maintain the programmed boiler target temperature at the inlet sensor. If the inlet sensor reaches ½ (half) of the differential above BOIL TARGET setting, the burner shuts off. Once the external heat demand is removed, the BTC 1 turns off the appliance and operates the boiler pump based on the PUMP DELAY setting.

The water temperature is controlled based on a fixed setpoint (BOIL TARGET).The setpoint for inlet water is pre-set to 120^{o}F and the auto re-set limit is set to 210°F and is fixed. In addition to the auto reset limit the factory installs a manual re-set limit set to 250°F.

Figure 3: Mode 1 Piping & Electrical Layout



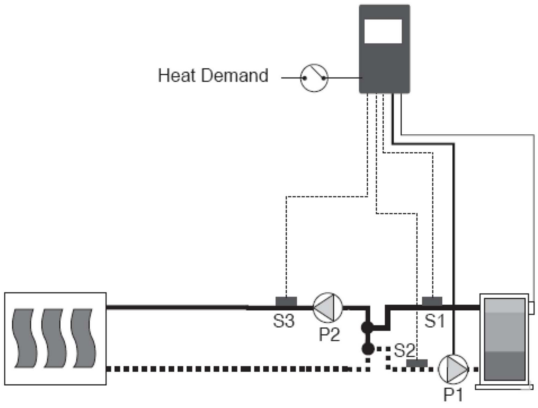
Mode 2: Constant Temperature Control at System Sensor

This mode is designed for constant temperature heating. Once a heat demand is present, the BTC 1 modulates the boiler burner to maintain the boiler target at the system sensor. A heat demand is generated when 24VAC is applied across CD (common demand) and Ht D (heat demand). Dem 1 on the LCD display is lit.

If the system sensor is ½ (half) of the differential below the BOIL TARGET, the BTC 1 then changes the proportional modulation output to the START modulation setting, the Stage contact (pins 15 & 16) closes to proceed to trial for ignition. The burner remains at minimum modulation until the flame is proved and then the modulating output changes the boiler burner output to maintain the programmed boiler target temperature at the system sensor. If the system sensor reaches ½ (half) of the differential above BOIL TARGET setting, the burner shuts off. Once the external heat demand is removed, the BTC 1 turns off the appliance and operates the boiler pump based on the PUMP DELAY setting. In this case, it is imperative that the system pump operates continuously in order to provide constant circulation past the system sensor.

The water temperature is controlled based on a fixed setpoint (BOIL TARGET).The setpoint for inlet water is pre-set to 120^{o}F and the auto re-set limit is set to 210°F and is fixed. In addition to the auto reset limit the factory installs a manual re-set limit set to 250°F.

Figure 4: Mode 2 Piping & Electrical Layout



Mode 3: Dedicated Domestic Hot Water Operation

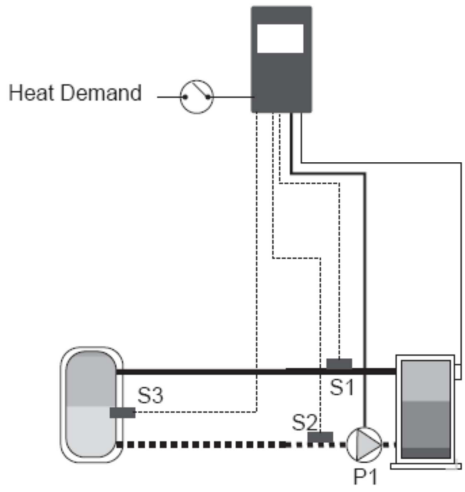
This mode is designed for domestic hot water. A DHW sensor must be inserted into a temperature immersion well within the DHW tank to function properly. The BTC 1 modulates the boiler based on the boiler inlet sensor to maintain a tank temperature at the DHW sensor.

An internal heat demand is generated when the DHW sensor drops ½ (half) of the tank differential setting below the desired DHW tank temperature. Dem 1 is lit on the LCD screen.

The BTC 1 then changes the modulation output to the START modulation setting and closes the Stage contact (pins 15 & 16) to proceed to trial for ignition. The burner remains at minimum modulation until the flame is proved and then modulating output changes the boiler output to maintain the programmed boiler target temperature at the boiler inlet sensor. Once the DHW tank reaches ½ of the tank differential above the TANK TARGET setting, the internal demand is removed and the boiler burner is shut off. The pump circulates until the PUMP DELAY timer expires.

The TANK TARGET setting is used to set the desired DHW tank setpoint. The set-point for inlet water is pre-set to 130°F and can be adjusted, the auto re-set limit is set to 210°F and is fixed. In addition to the auto reset limit the factory installs a manual re-set limit set to 210°F.

Figure 5: Mode 3 Piping & Electrical Layout



Mode 4: Outdoor Reset using Boiler Inlet Sensor

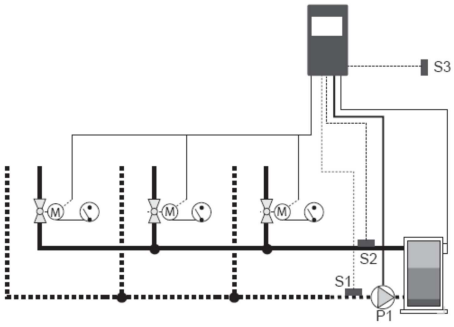
This mode is designed for hydronic heating. Once a heat demand is present, the BTC 1 turns on the appliance pump and modulates the boiler to maintain the calculated outdoor reset target at the boiler inlet sensor. Outdoor reset calculates the boiler target temperature based on the outdoor air temperature and reset ratio.

A heat demand is generated when a voltage between 24VAC and 120VAC is applied across CD (common demand) and Ht D (heat demand). Once voltage is applied, the BTC 1 turns on the Dem 1 segment in the display. If warm weather shut down (WWSD) is activated, the WWSD segment is lit.

If WWSD is not activated and the inlet sensor is ½ (half) of the differential below the calculated BOIL TARGET, the BTC 1 then changes the modulation output to the START modulation setting and closes the Stage contacts (pins 15 & 16) to proceed to trial for ignition. The burner remains at minimum modulation until the flame is proved and then modulating output changes the boiler output to maintain the calculated boiler target temperature at the inlet sensor. If the inlet sensor reaches ½ (half) of the differential above the BOIL TARGET, the appliance is shut off. The boiler pump continues to circulate until the PUMP DELAY timer expires.

The water temperature is controlled based on a calculated boiler target temperature. The boiler start (BOIL START) temperature is pre-set to 70°F and the auto re-set limit is set to 210°F and is fixed. In addition to the auto reset limit the factory installs a manual re-set limit set to 250°F.

Figure 6: Mode 4 Piping & Electrical Layout



Mode 5: Outdoor Reset using System Sensor

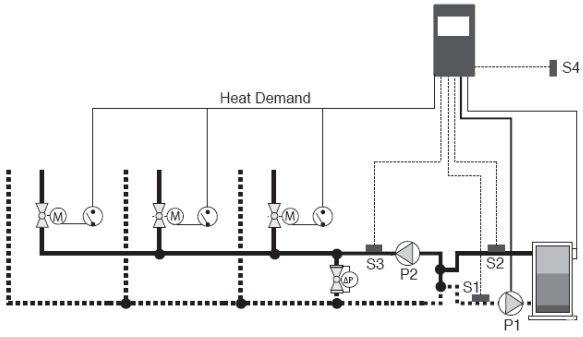
This mode is designed for hydronic heating. Once a heat demand is present, the BTC 1 turns on the appliance pump and modulates the boiler to maintain the calculated outdoor reset target at the system sensor. Outdoor reset calculates the boiler target temperature based on the outdoor air temperature and reset ratio.

A heat demand is generated when a voltage between 24VAC and 120VAC is applied across CD (common demand) and Ht D (heat demand). Once voltage is applied, the BTC 1 turns on the Dem 1 segment in the display. If warm weather shut down (WWSD) is activated, the WWSD segment is lit.

If WWSD is not activated and the system sensor is ½ (half) of the differential below the calculated BOIL TARGET, the control then changes the modulation output to the START modulation setting and closes the Stage contacts (pins 15 &16) to proceed to trial for ignition. The burner remains at minimum modulation until the flame is proved and then the modulating output changes the boiler output to maintain the calculated boiler target temperature at the system sensor. If the system sensor reaches ½ (half) of the differential above the BOIL TARGET, the appliance is shut off. The appliance pump continues to circulate until the PUMP DELAY timer expires. In this case, it is imperative that the system pump operates continuously in order to provide constant circulation past the system sensor.

The water temperature is controlled based on a calculated boiler target temperature. The boiler start (BOIL START) temperature is pre-set to 70°F and the auto re-set limit is set to 210°F and is fixed. In addition to the auto reset limit the factory installs a manual re-set limit set to 250°F.

Figure 7: Mode 5 Piping & Electrical Layout



Mode 6: External Target Temperature using Boiler Inlet Sensor

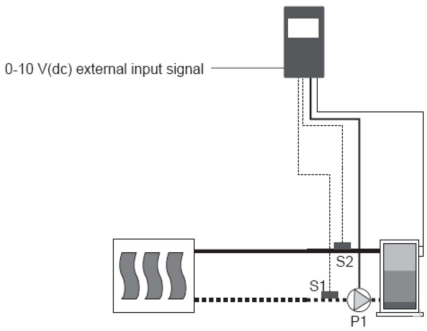
The external input signal can be provided from a BMS, EMS or a Tekmar tN4 System Control. The external input signal creates an internal demand and changes the boiler target according to a linear scale. The BTC 1 modulates the boiler to maintain the boiler target at the inlet sensor.

An internal heat demand is generated when an analog positive 2-10VDC signal is applied to the +V input and a negative DC signal is applied to the Com/- input.

If the inlet sensor is ½ (half) of the differential below the Boiler Target, the BTC 1 then changes the proportional modulation output to the START modulation setting, the Stage contact (pins 15 & 16) closes to proceed to trial for ignition. The burner remains at minimum modulation until the flame is proved and then the modulating output changes the boiler burner output to maintain the programmed boiler target temperature at the inlet sensor. If the inlet sensor reaches ½ (half) of the differential above Boiler Target, the burner goes to minimum fire. Once the external heat demand is removed, the BTC 1 turns off the appliance and operates the boiler pump based on the PUMP DELAY setting.

The auto re-set limit is set to 210°F and is fixed. In addition to the auto reset limit the factory installs a manual re-set limit set to 250°F.

Figure 8: Mode 6 Piping Schematic



Mode 7: External Target Temperature using System Temperature Sensor

The external input signal can be provided from a BMS, EMS or a Tekmar tN4 System Control. The external input signal creates an internal demand and changes the boiler target according to a linear scale. The control modulates the boiler to maintain the boiler target at the system sensor.

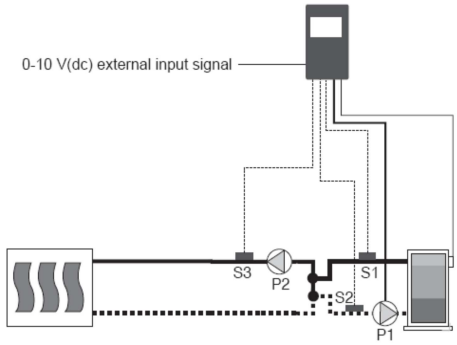
An internal heat demand is generated when an analog positive 2-10VDC signal is applied to the +V input and a negative DC signal is applied to the Com/- input.

Table 13 shows the relationship between various external signals to the boiler target temperature. A 4-20mA signal can be converted to a 2-10VDC signal by installing a 500Ω resistor on the external input signal device's terminal.

If the system sensor is ½ (half) of the differential below the Boiler Target, the BTC 1 then changes the proportional modulation output to the START modulation setting, then closes the Stage contact (pins 15 & 16) to proceed to trial for ignition. The burner remains at minimum modulation until the flame is proved and then the modulating output changes the boiler burner out to maintain the programmed boiler target temperature at the system sensor. If the inlet sensor reaches ½ (half) of the differential above Boiler Target, the burner goes to minimum fire. Once the external heat demand is removed, the BTC 1 turns off the appliance and operates the boiler pump based on the PUMP DELAY setting.

The auto reset limit is set to 210°F and is fixed. In addition to the auto reset limit, Camus installs a manual reset limit set to 250°F.

Figure 9: Mode 7 Piping & Electrical Layout



The following table shows the various signals required to generate various Target temperatures.

Table 1: External Signal Cross Reference Chart

4-20 mA	Boiler Target	0-10V (dc)*	Boiler Target
0	- - - (OFF)	0	- - - (OFF)
2	- - - (OFF)	1	50°F (10°C)
4	50°F (10°C)	2	68°F (20°C)
6	70°F (21°C)	3	86°F (30°C)
8	90°F (32°C)	4	103°F (39°C)
10	110°F (43°C)	5	121°F (49°C)
12	130°F (54°C)	6	139°F (59°C)
14	150°F (66°C)	7	157°F (69°C)
16	170°F (77°C)	8	174°F (79°C)
18	190°F (88°C)	9	192°F (89°C)
20	210°F (99°C)	10	210°F (99°C)

* requires 500Ω resistor

A 4-20mA signal can be converted to a 2-10VDC signal by installing a 500Ω resistor on the external input signal device's terminal.

Mode 8: External Direct Drive Operation

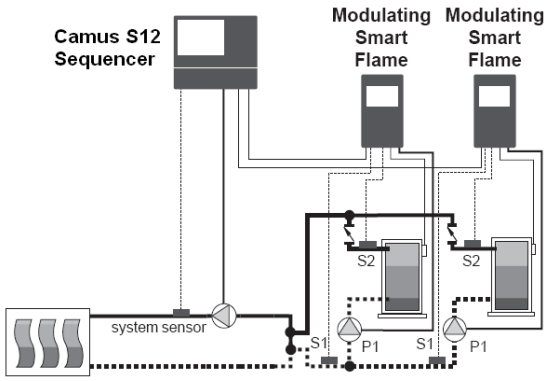
This mode is designed only for hydronic heating operation. This mode allows for an external control to operate the boiler through an analog direct drive input signal provided by a boiler sequencing control, such as, the S12 Sequencer. When operating in this mode the external heat demand and DHW demand are disabled.

An external boiler sequencer provides a positive 0-10 VDC input signal to the control at +V(in), and the negative signal is applied to the Com/- input.

The boiler remains off while the direct drive input signal range is between 0 to 0.5VDC. Once the direct drive input signal reaches 0.5VDC the control turns on the appliance pump and changes the modulating output to Start Modulation level until the flame is proved and then the modulating output is adjusted to track the direct drive input signal up to the maximum of 10VDC which is equivalent to maximum input rate. When the direct drive signal modulates down to 0.5VDC, the boiler operates at minimum fire. When the signal drops below 0.5VDC the burner is shut off and the pump continues to circulate until the PUMP DELAY timer expires, whereupon the pump shuts off.

The external boiler sequencer can specify the boiler inlet temperature. However, the BOIL MAX setting limits the highest temperature at the outlet sensor. If the outlet temperature exceeds 210°F, the modulating output immediately changes to 0% and the burner is shut off. The burner is to remain off until the minimum off timer is satisfied and the ***boiler outlet temperature falls by 2°F (1°C) below the BOIL MAX setting.***

Figure 10: Mode 8 Piping & Electrical Layout



1.2 VARIABLE FREQUENCY DRIVE (VFD)

The VFD has a factory set security code which has to be entered before any adjustments can be made. The VFD has 50 parameters, which can be adjusted. At present only the following are pertinent:

Table 2: Variable Frequency Drive Parameters

Parameter #	Function	Settings
1	High/Low Voltage Input Voltage 120, 220-240, 460-480	 01 02
2	Carrier Frequency	03
4	Stop Method	03
5	Standard Speed Source	04 (03 for 2- 10 VDC)
19	Acceleration Time	120 sec
20	Deceleration Time	60 sec
28	Fixed Boost	1.0
36	Preset Speed	29
38	Skip Bandwidth	3.0
45	Speed at Minimum Signal	• 500 - 3000 Non-Condensing: 29 or 32 • 501 – 3001 Near-Condensing: 20-25 • 502 – 3002 Condensing: 25 • 3502 – 6024 All Models: 14-18
46	Speed at Maximum Signal	• All Models: 60
50	Fault History	View Only
51 thru 58	Miscellaneous	View Only

1.3 SMARTFLAME CONTROL PANEL

Figure 11: BTC 1 Display Panel

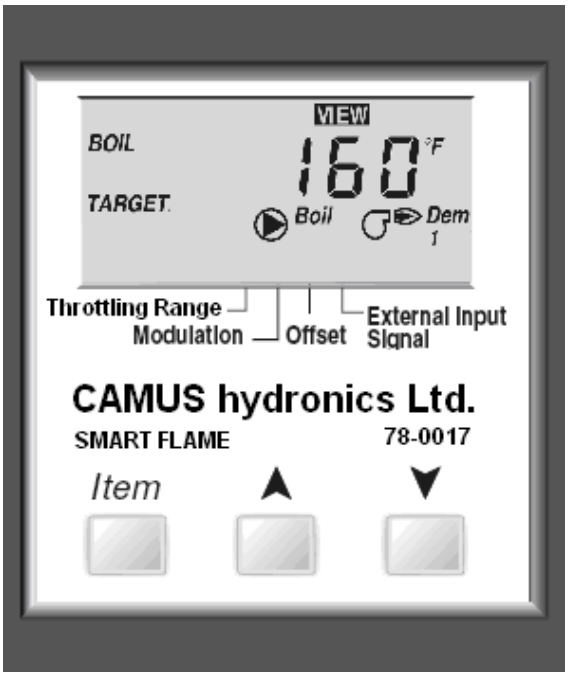


Figure 12: BTC 1 Key Functions

Table 3: BTC 1 Key Functions

KEY	KEY DESCRIPTION
Item	The abbreviated name of the selected item will be displayed in the item field of the display. To view the next item, press the Item button.
▲	Increase a parameter value.
▼	Decrease a parameter value.

Levels of Access

View – Access to general boiler and display settings and will allow adjustments to the central heating and domestic hot water setpoint.

Adjust – Access to all user parameters and allows for changes to additional boiler parameters to allow for ease of startup and serviceability.

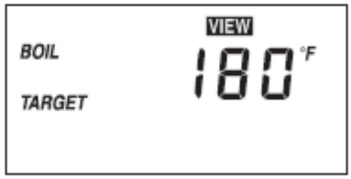
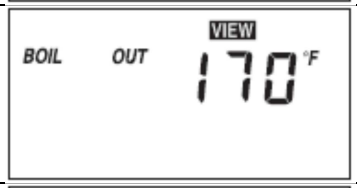
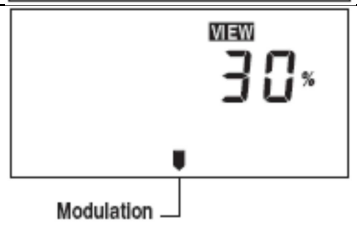
1.4 GENERAL SYMBOL DESCRIPTION

SYMBOL	SYMBOL NAME	SYMBOL DESCRIPTION
Boil	Boiler Pump	Shown when boiler pump is in operation
DHW	DHW Pump	Shown when DHW pump is in operation
Dem 1	Heat Demand	Shown when heat demand is present
Dem 2	Flame Proof	Shown when flame signal is proven
	Burner	Shown when burner is on
	Warning	Shown when an error is present
	Pointers	Shows the operation as indicated by the text (Throttling Range, Modulation, Offset, External Input Signal)
WWSD	WWSD	Displays when the control is in Warm Weather Shutdown
Throttling Range		Range of °C or °F over which modulation occurs
Modulation	%	Instantaneous % of modulation 1% - 100%
Offset		Temperature below setpoint at which modulation begins
External Input Signal		Shows the desired input signal to control modulation(0:20, 4:20)

1.5 MODE 1 & 2: SETPOINT OPERATION: VIEW DISPLAY

From the Home display;

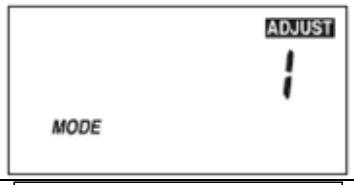
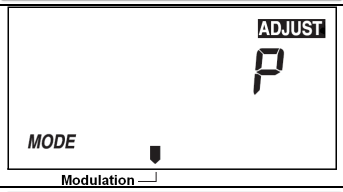
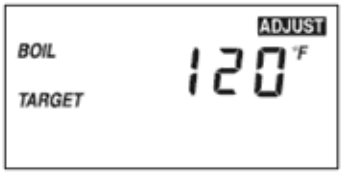
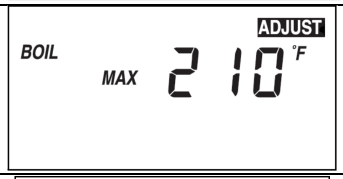
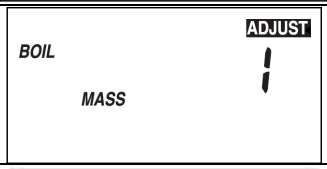
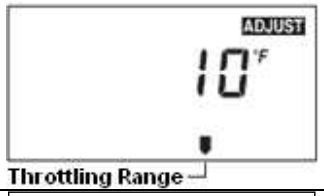
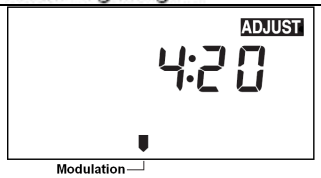
1) Press **[ITEM]** to view the following parameters:

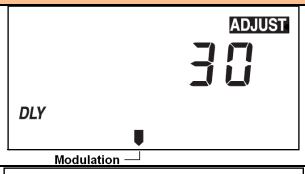
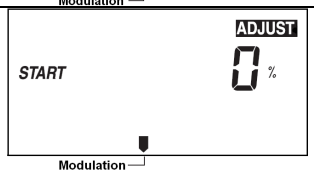
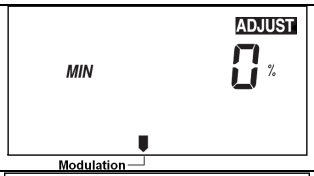
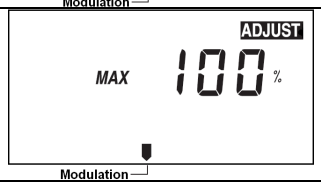
Display	Parameter Name	Parameter Description	Parameter Range
	Boiler Target Temperature	To provide a target setpoint for the heating system. Setpoint is controlled to the inlet sensor	---, 35 to 266°F (---, 2 to 130°C)
	System Temperature	System Temperature of Primary Loop **NOTE:** This parameter is only available in Mode 2	14 to 266°F (-10 to 130°C)
	Boiler Outlet Temperature	Real-time Outlet Temperature to Boiler	14 to 266°F (-10 to 130°C)
	Boiler Inlet Temperature	Real-time Inlet Temperature to Boiler	14 to 266°F (-10 to 130°C)
	Boiler Delta T	Real-time temperature difference between the outlet sensor and the inlet sensor.	-99 to 252°F (-72 to 140°C)
	Modulation	Real-time modulating output percentage	0 to 100%
	Total Run Time Since Installation	Monitors the amount of operational time since the boiler was installed. The first two digits are the number of thousands of hours and the three digit display shows the number of hundreds of hours. Press (▲, ▼) simultaneously to reset the counter	Alternates between 00 and 999

1.6 MODE 1 & 2: SETPOINT OPERATION: ADJUST DISPLAY

From the Home display;

1) Press (Item, ▲, ▼) simultaneously to view the following parameters:

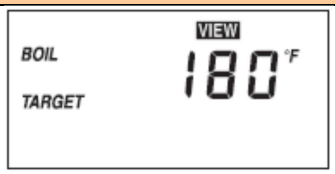
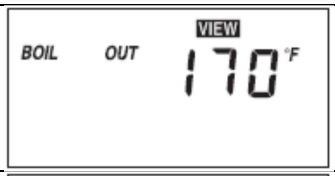
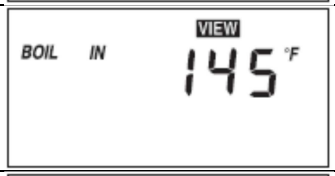
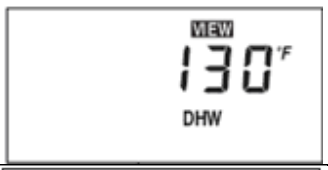
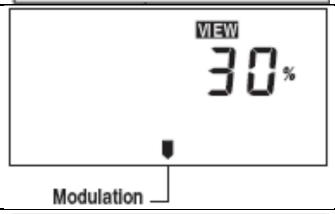
Display	Parameter Name	Parameter Description	Parameter Range
	Mode	Operating mode for the boiler. **NOTE:** A complete description of each mode can be found in section 1.1 Modes of Operation in this manual.	1 to 8 Default = 1
	Modulation Mode (Mode 2 ONLY)	Modulation mode. Automatic: PId Manual: P	PId or P Default: P
	Boiler Target Temperature	To provide a target setpoint for the heating system. Setpoint is controlled to the inlet sensor	70 to 220°F (21 to 104°C) Default = 120°F (49°C)
	Boil Max	Maximum outlet temperature	120 to 230°F (49 to 110°C) Default = 210°F (99°C)
	Boil Mass (Mode 2 ONLY)	Thermal mass of boiler. This determines interstage delay and minimum on and minimum off times.	1 to 3 Default = 1
	Throttling Range	To provide a modulation rate above and below the Boiler Target temperature. For example, if the value is 10°F and the Boiler Target is 160°F the boiler will begin to modulate at 150°F and shut off at 160°F	5 to 60°F (-15 to 15°C) Default = 10°F (5°C)
	Modulation	Selects the output modulating signal to the variable frequency drive	Default: 4:20

Display	Parameter Name	Parameter Description	Parameter Range
	Modulation Delay	Selects the time (in seconds) after a flame signal is established before modulation is allowed to proceed.	10 to 230 seconds Default = 30 seconds
	Start Modulation	Selects the start modulation rate	0% to 50% Default = 0%
	Minimum Modulation	Selects the minimum modulation rate	0% to 50% Default = 0%
	Maximum Modulation	Selects the maximum modulation rate	50% to 100% Default = 100%
	Differential Temperature	The operating range of the boiler above and below setpoint. For example, if the value is 10°F and the Boiler Target is 160°F the boiler will initiate at 150°F and shut off at 170°F.	Au, 2 to 42°F (Au, -17 to 6°C) Default = 10°F (5°C)
	Pump Delay	Boiler post pump time after burner has shut off, in seconds.	OFF, 0:20 to 9:55 min, On Default = 1:00 min
	Temperature Units	Select the desired unit of measurement	°F, °C Default = °F

1.7 MODE 3: DEDICATED DOMESTIC HOT WATER OPERATION: VIEW DISPLAY

From the Home display;

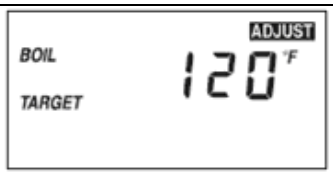
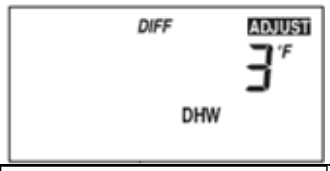
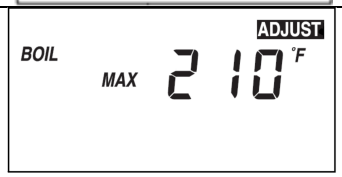
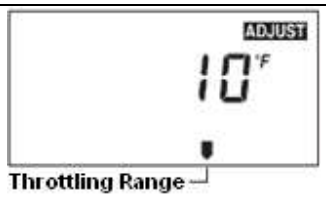
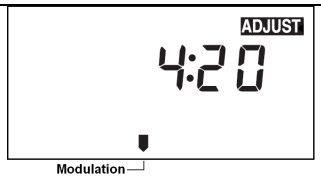
1) Press **[ITEM]** to view the following parameters:

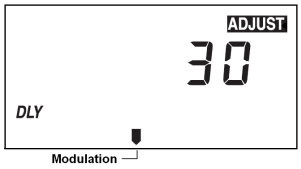
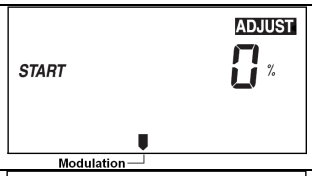
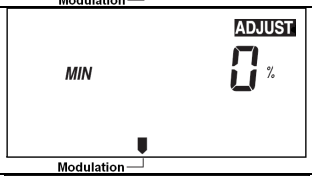
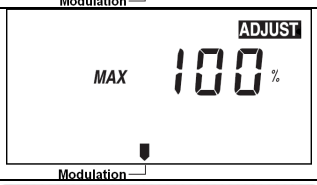
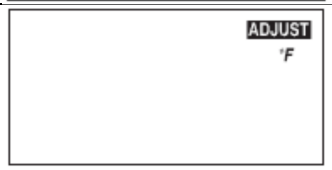
Display	Parameter Name	Parameter Description	Parameter Range
	Boiler Target Temperature	To provide a target setpoint for the heating system. Setpoint is controlled to the inlet sensor	---, 35 to 266°F (---, 2 to 130°C)
	Boiler Outlet Temperature	Real-time Outlet Temperature to Boiler	14 to 266°F (-10 to 130°C)
	Boiler Inlet Temperature	Real-time Inlet Temperature to Boiler	14 to 266°F (-10 to 130°C)
	Boiler Delta T	Real-time temperature difference between the outlet sensor and the inlet sensor.	-99 to 252°F (-72 to 122°C)
	DHW Temperature	Real-time DHW Temperature	14 to 266°F (-10 to 130°C)
	Modulation	Real-time modulating output percentage	0 to 100%
	Total Run Time Since Installation	Monitors the amount of operational time since the Boiler was installed. The first two digits are the number of thousands of hours and the three digit display shows the number of hundreds of hours. Press (▲, ▼) simultaneously to reset the counter	Alternates between 00 and 999

1.8 MODE 3: DEDICATED DOMESTIC HOT WATER OPERATION: ADJUST DISPLAY

From the Home display;

1) Press (Item, ▲, ▼) simultaneously to view the following parameters:

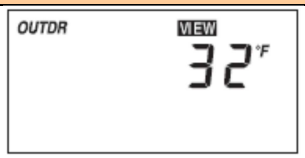
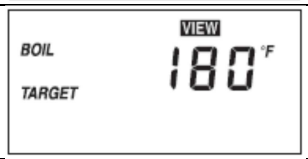
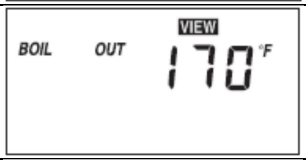
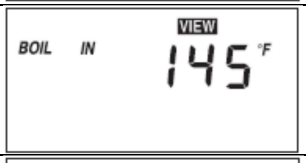
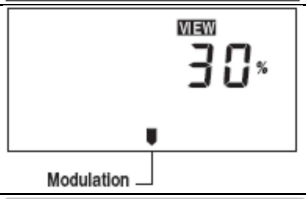
Display	Parameter Name	Parameter Description	Parameter Range
	Mode	Operating mode for the boiler. **NOTE:** A complete description of each mode can be found in section 1.1 Modes of Operation in this manual.	1 to 8 Default = 1
	Boiler Target Temperature	To provide a target setpoint for the heating system. Setpoint is controlled to the inlet sensor	OFF, 70 to 220°F (OFF,21 to 104°C) Default = 120°F (82°C)
	DHW Target Temperature	To provide a target setpoint for the DHW system. Setpoint is controlled to the DHW sensor	OFF, 70 to 190°F (OFF, 21 to 88°C) Default = 140°F (54°C)
	DHW Differential	The point in which a DHW call for heat is generated. For example, if the value is 10°F and the DHW Target Temperature is 160°F the boiler will begin to initiate at 155°F.	2 to 10°F (1 to 5°C) Default = 3°F (1°C)
	Boil Max	Maximum outlet temperature	120 to 230°F (49 to 110°C) Default = 210°F (99°C)
	Throttling Range	**NOTE:** This parameter is not used in Mode 3	5 to 60°F (-15 to 15°C) Default = 10°F (5°C)
	Modulation	Selects the output modulating signal to the variable frequency drive	Default: 4:20

Display	Parameter Name	Parameter Description	Parameter Range
	Modulation Delay	Selects the time (in seconds) after a flame signal is established before modulation is allowed to proceed.	10 to 230 seconds Default = 30 seconds
	Start Modulation	Selects the start modulation rate	0% to 50% Default = 0%
	Minimum Modulation	Selects the minimum modulation rate	0% to 50% Default = 0%
	Maximum Modulation	Selects the maximum modulation rate	50% to 100% Default = 1000%
	Differential Temperature	To provide a modulation rate above and below the Boiler Target temperature. For example, if the value is 10°F and the Boiler Target is 160°F the boiler will begin to modulate at 150°F and shut off at 160°F	Au, 2 to 42°F (Au, -17 to 5°C) Default = 10°F
	Pump Delay	Boiler post pump time after burner has shut off, in seconds.	OFF, 0:20 to 9:55 min, On Default = 1:00 min
	Temperature Units	Select the desired unit of measurement	°F, °C Default = °F

1.9 MODE 4 & 5: OUTDOOR RESET OPERATION: VIEW DISPLAY

From the Home display;

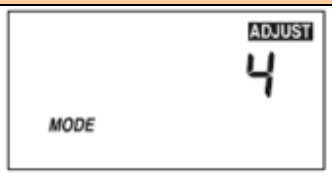
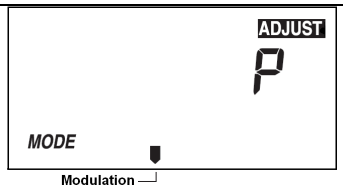
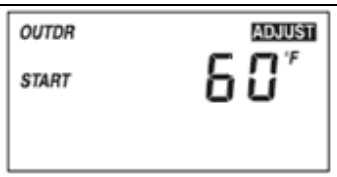
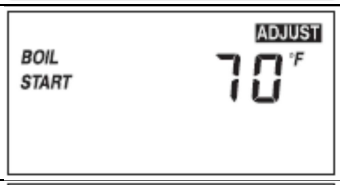
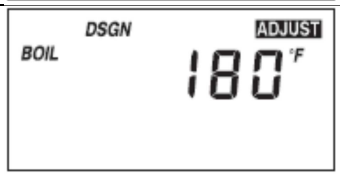
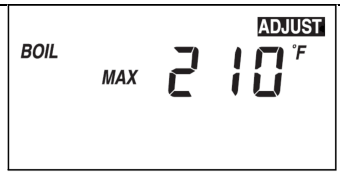
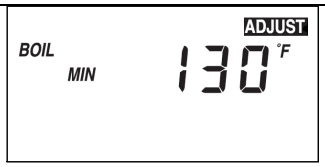
1) Press **[ITEM]** to view the following parameters:

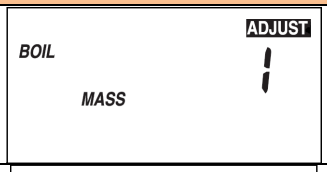
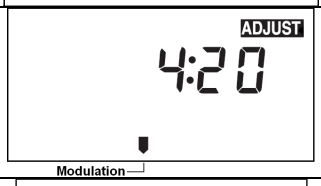
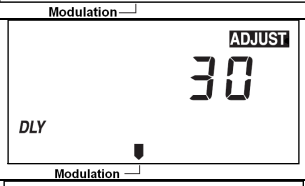
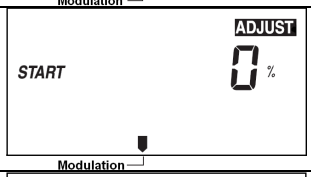
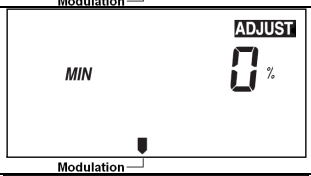
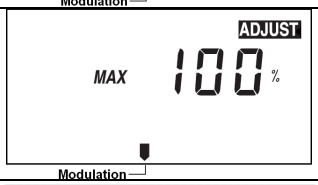
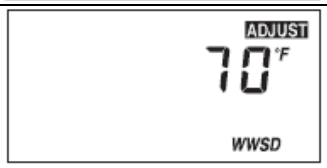
Display	Parameter Name	Parameter Description	Parameter Range
	Outdoor Temperature	Real-time Outdoor Temperature	-60 to 190°F (-51 to 88°C)
	Boiler Target Temperature	To provide a target setpoint for the heating system. Setpoint is controlled to the inlet sensor	---, 35 to 266°F (---, 2 to 130°C)
	System Temperature (Mode 5 ONLY)	System Temperature of Primary Loop	14 to 266°F (-10 to 130°C)
	Boiler Outlet Temperature	Real-time Outlet Temperature	14 to 266°F (-10 to 130°C)
	Boiler Inlet Temperature	Real-time Inlet Temperature	14 to 266°F (-10 to 130°C)
	Boiler Delta T	Real-time temperature difference between the outlet sensor and the inlet sensor.	-99 to 252°F (-72 to 122°C)
	Modulation	Real-time modulating output percentage	0 to 100%
	Total Run Time Since Installation	Monitors the amount of operational time since the Boiler was installed. The first two digits are the number of thousands of hours and the three digit display shows the number of hundreds of hours. Press (▲, ▼) simultaneously to reset the counter	Alternates between 00 and 999

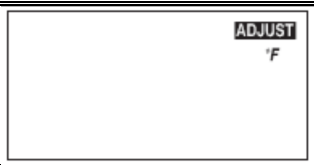
1.10 MODE 4 & 5: OUTDOOR RESET OPERATION: ADJUST DISPLAY

From the Home display;

1) Press (Item, ▲, ▼) simultaneously to view the following parameters:

Display	Parameter Name	Parameter Description	Parameter Range
	Mode	Operating mode for the boiler. **NOTE:** A complete description of each mode can be found in section 1.1 Modes of Operation in this manual.	1 to 8 Default = 1
	Modulation Mode (Mode 5 ONLY)	Modulation mode. Automatic: PId Manual: P	PId or P Default: P
	Outdoor Start Temperature	Outdoor starting temperature used in the reset ratio for the heating system. Typically set to the desired building temperature.	35 to 85°F (2 to 29°C) Default = 60°F (21°C)
	Outdoor Design Temperature	Outdoor design temperature used in the reset ratio for the heating system. Set to the coldest annual outdoor temperature in the local area.	-60 to 50°F (-51 to 10°C) Default = -10°F (-23°C)
	Boiler Start Temperature	Starting water temperature used in the reset ratio calculation for the heating system. Typically set to the desired building temperature.	35 to 150°F (2 to 66°C) Default = 70°F (21°C)
	Boiler Design Temperature	Boiler design water temperature used in the reset ratio calculation for the heating system. Set to the boiler water temperature required to heat the building on the coldest annual outdoor temperature.	70 to 230°F (21 to 110°C) Default = 180°F (82°C)
	Boil Max	Maximum outlet temperature	120 to 230°F (49 to 110°C) Default = 210°F (99°C)
	Boil Min	Minimum inlet temperature	80 to 180°F (26 to 82°C) Default = 130°F (54°C)

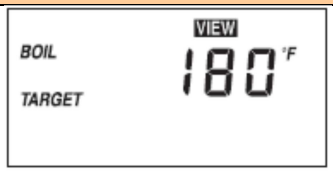
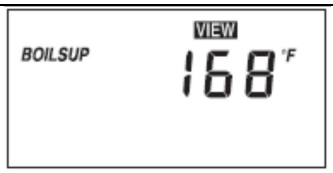
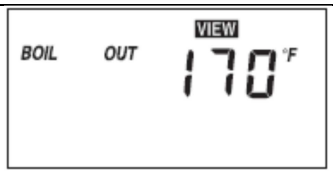
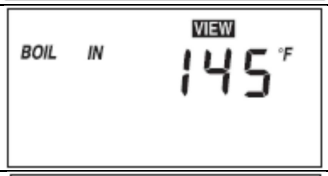
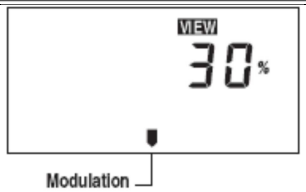
Display	Parameter Name	Parameter Description	Parameter Range
	Boil Mass (Mode 5 ONLY)	Thermal mass of boiler. This determines interstage delay and minimum on and minimum off times.	1 to 3 Default = 1
	Modulation	Selects the output modulating signal to the variable frequency drive	Default: 4:20
	Modulation Delay	Selects the time (in seconds) after a flame signal is established before modulation is allowed to proceed.	10 to 230 seconds Default = 30 seconds
	Start Modulation	Selects the start modulation rate	0% to 50% Default = 0%
	Minimum Modulation	Selects the minimum modulation rate	0% to 50% Default = 0%
	Maximum Modulation	Selects the maximum modulation rate	50% to 100% Default = 100%
	Differential Temperature	The operating range of the boiler above and below setpoint. For example, if the value is 10°F and the Boiler Target is 160°F the boiler will initiate at 150°F and shut off at 170°F.	Au, 2 to 42°F (Au, -16 to 5°C) Default = 10°F
	Pump Delay	Boiler post pump time after burner has shut off, in seconds.	OFF, 0:20 to 9:55 min, On Default = 1:00 min
	Warm Weather Shutdown Temperature	Warm weather shutdown temperature using outdoor reset.	35 to 105°F, OFF (2 to 41°C, OFF) Default = 0:20 min

	Temperature Units	Select the desired unit of measurement	°F, °C Default = °F

1.11 *MODE 6 & 7:* EXTERNAL TARGET TEMPERATURE INPUT OPERATION: VIEW DISPLAY

From the Home display;

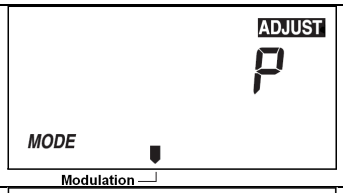
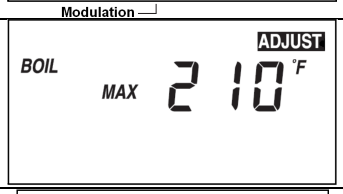
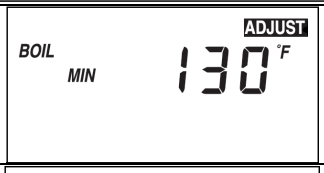
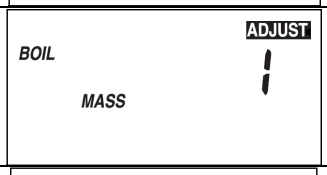
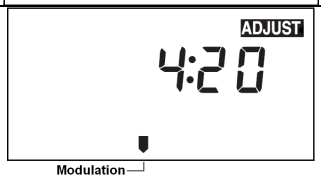
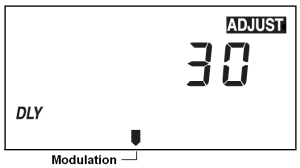
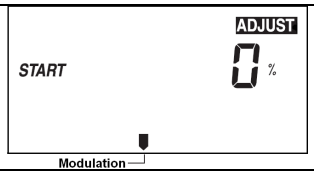
1) Press **[ITEM]** to view the following parameters:

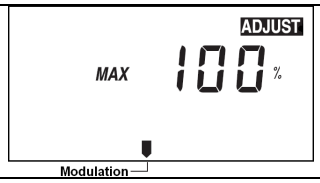
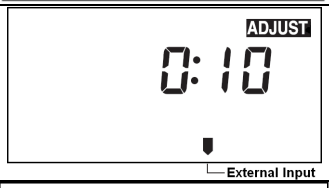
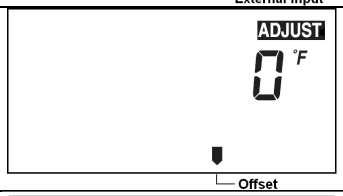
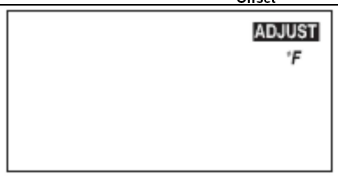
Display	Parameter Name	Parameter Description	Parameter Range
	Boiler Target Temperature	To provide a target setpoint for the heating system. Setpoint is controlled to the inlet sensor.	---, 35 to 266°F (---, 2 to 130°C)
	System Temperature (Mode 7 ONLY)	Real-time System Temperature	14 to 266°F (-10 to 130°C)
	Boiler Outlet Temperature	Real-time Outlet Temperature to Boiler	14 to 266°F (-10 to 130°C)
	Boiler Inlet Temperature	Real-time Inlet Temperature to Boiler	14 to 266°F (-10 to 130°C)
	Boiler Delta T	Real-time temperature difference between the outlet sensor and the inlet sensor.	-99 to 252°F (-72 to 122°C)
	Modulation	Real-time modulating output percentage	0 to 100%
	Total Run Time Since Installation	Monitors the amount of operational time since the Boiler was installed. The first two digits are the number of thousands of hours and the three digit display shows the number of hundreds of hours. Press (▲, ▼) simultaneously to reset the counter	Alternates between 00 and 999

1.12 MODE 6 & 7: EXTERNAL TARGET TEMPERATURE INPUT OPERATION: ADJUST DISPLAY

From the Home display;

1) Press (Item, ▲, ▼) simultaneously to view the following parameters:

Display	Parameter Name	Parameter Description	Parameter Range
	Mode	Operating mode for the boiler. **NOTE:** A complete description of each mode can be found in section 1.1 Modes of Operation in this manual.	1 to 8 Default = 1
	Modulation Mode (Mode 7 ONLY)	Modulation mode. Automatic: PId Manual: P	PId or P Default: P
	Boil Max	Maximum outlet temperature	120 to 230°F (49 to 110°C) Default = 210°F (99°C)
	Boil Min	Minimum inlet temperature	80 to 180°F (26 to 82°C) Default = 130°F (54°C)
	Boil Mass (Mode 5 ONLY)	Thermal mass of boiler. This determines interstage delay and minimum on and minimum off times.	1 to 3 Default = 1
	Modulation	Selects the output modulating signal to the variable frequency drive	Default: 4:20
	Modulation Delay	Selects the time (in seconds) after a flame signal is established before modulation is allowed to proceed.	10 to 230 seconds Default = 30 seconds
	Start Modulation	Selects the start modulation rate	0% to 50% Default = 0%

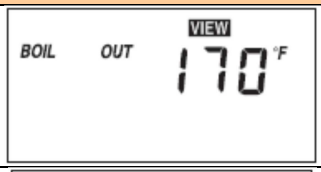
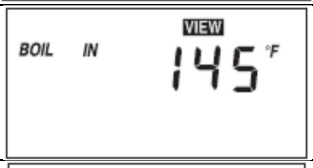
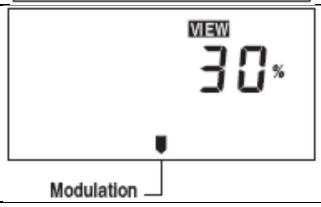
Display	Parameter Name	Parameter Description	Parameter Range
	Minimum Modulation	Selects the minimum modulation rate	0% to 50% Default = 0%
	Maximum Modulation	Selects the maximum modulation rate	50% to 100% Default = 100%
	Differential Temperature	To provide a modulation rate above and below the Boiler Target temperature. For example, if the value is 10°F and the Boiler Target is 160°F the boiler will begin to modulate at 150°F and shut off at 160°F	Au, 2 to 42°F (Au, -17 to 6°C) Default = 10°F
	Pump Delay	Boiler post pump time after burner has shut off, in seconds.	OFF, 0:20 to 9:55 min, On Default = 1:00 min
	External Input	Select the range of external input signal (Vdc)	0:10 or 2:10 Default: 0:10
	Offset	Select the temperature offset of the boiler target temperature. The boiler target is determined from the external input signal.	-10 to 10°F (-5 to 5°C) Default = 0°F
	Temperature Units	Select the desired unit of measurement	°F, °C Default = °F

4-20 mA	Boiler Target	0-10V (dc)*	Boiler Target
0	- - - (OFF)	0	- - - (OFF)
2	- - - (OFF)	1	50°F (10°C)
4	50°F (10°C)	2	68°F (20°C)
6	70°F (21°C)	3	86°F (30°C)
8	90°F (32°C)	4	103°F (39°C)
10	110°F (43°C)	5	121°F (49°C)
12	130°F (54°C)	6	139°F (59°C)
14	150°F (66°C)	7	157°F (69°C)
16	170°F (77°C)	8	174°F (79°C)
18	190°F (88°C)	9	192°F (89°C)
20	210°F (99°C)	10	210°F (99°C)

1.13 MODE 8: EXTERNAL DRIVE OPEATION: VIEW DISPLAY

From the Home display;

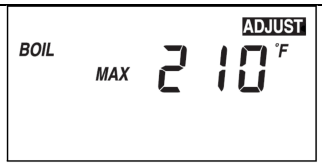
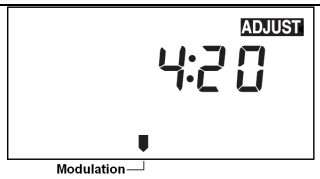
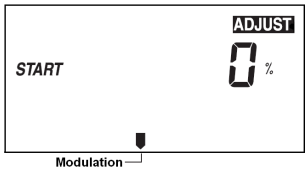
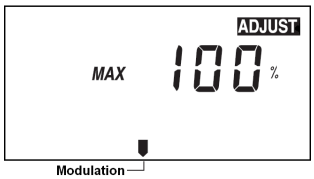
1) Press **[ITEM]** to view the following parameters:

Display	Parameter Name	Parameter Description	Parameter Range
	Boiler Outlet Temperature	Real-time Outlet Temperature to Boiler	14 to 266°F (-10 to 130°C)
	Boiler Inlet Temperature	Real-time Inlet Temperature to Boiler	14 to 266°F (-10 to 130°C)
	Boiler Delta T	Real-time temperature difference between the outlet sensor and the inlet sensor.	-99 to 252°F (-72 to 122°C)
	Modulation	Real-time modulating output percentage	0 to 100%
	Total Run Time Since Installation	Monitors the amount of operational time since the Boiler was installed. The first two digits are the number of thousands of hours and the three digit display shows the number of hundreds of hours. Press (▲, ▼) simultaneously to reset the counter	Alternates between 00 and 999

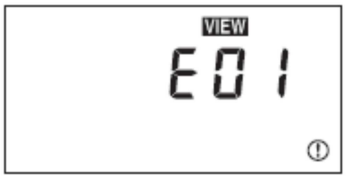
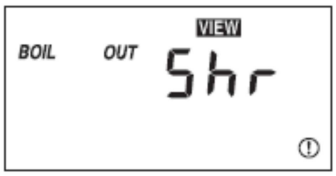
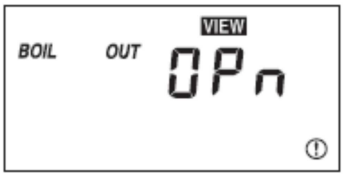
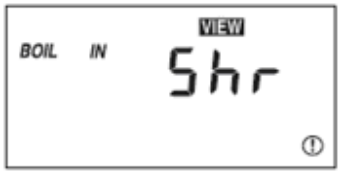
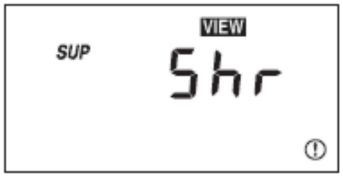
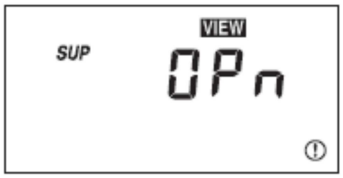
1.14 MODE 8: EXTERNAL DRIVE OPEATION: ADJUST DISPLAY

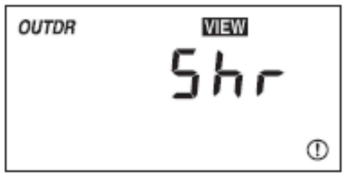
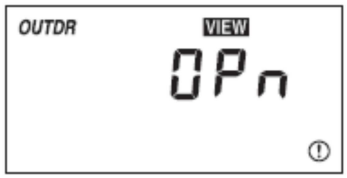
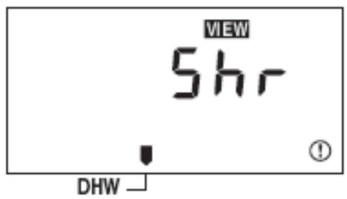
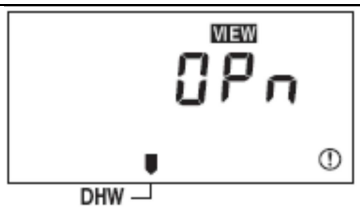
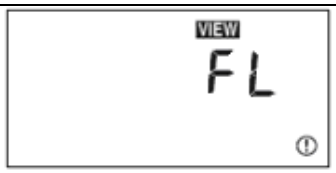
From the Home display;

1) Press (Item, ▲, ▼) simultaneously to view the following parameters:

Display	Parameter Name	Parameter Description	Parameter Range
	Mode	Operating mode for the boiler. **NOTE:** A complete description of each mode can be found in section 6.1 Modes of Operation in this manual.	1 to 8 Default = 1
	Boil Max	Maximum outlet temperature	120 to 230°F (49 to 110°C) Default = 210°F (99°C)
	Modulation	Selects the output modulating signal to the variable frequency drive	Default: 4:20
	Start Modulation	Selects the start modulation rate	0% to 50% Default = 0%
	Minimum Modulation	Selects the minimum modulation rate	0% to 50% Default = 0%
	Maximum Modulation	Selects the maximum modulation rate	50% to 100% Default = 100%
	Pump Delay	Boiler post pump time after burner has shut off, in seconds.	OFF, 0:20 to 9:55 min, On Default = 1:00 min
	Temperature Units	Select the desired unit of measurement	°F, °C Default = °F

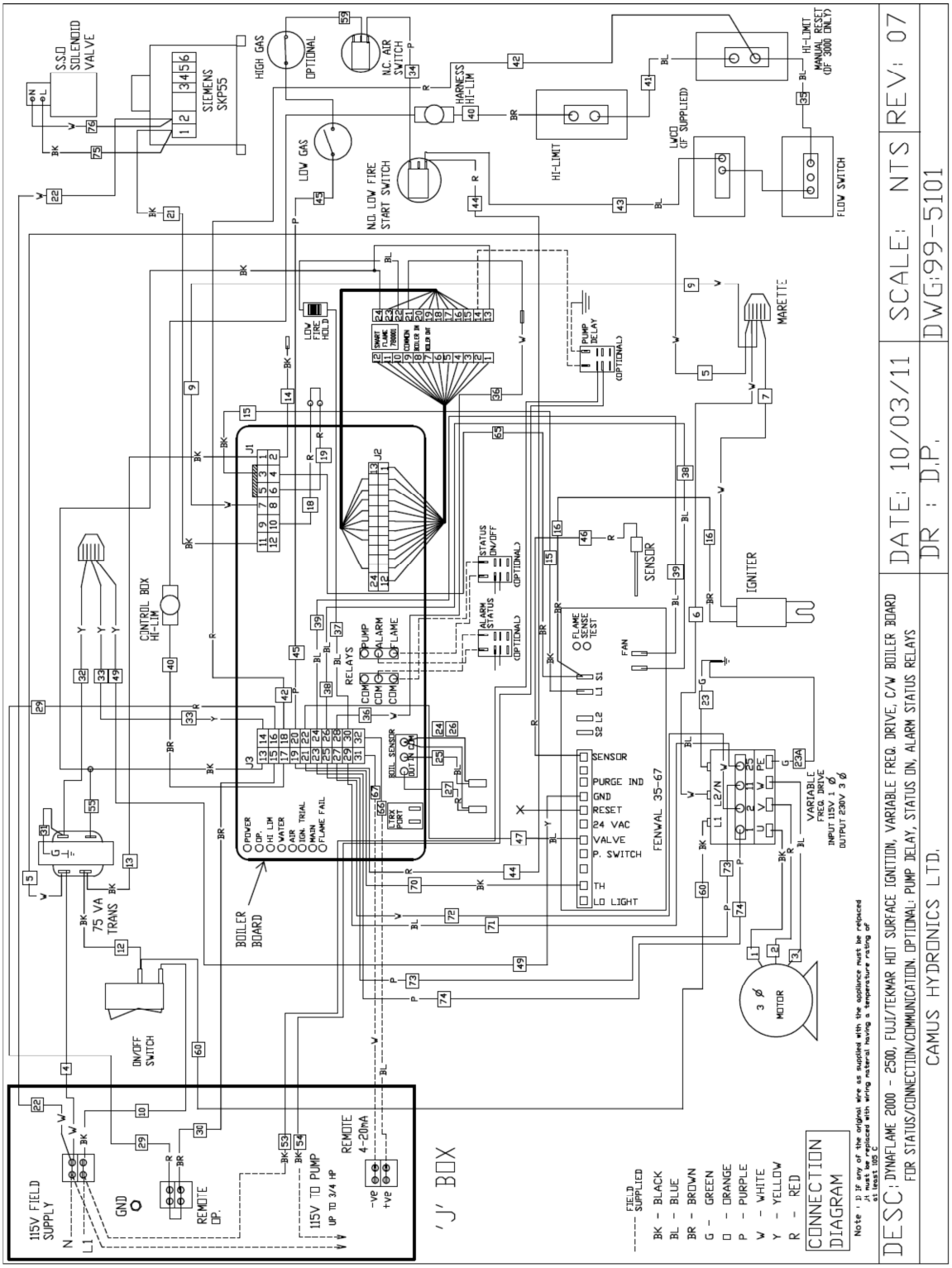
1.15 ERROR MESSAGES

Error Message	Description
	The control was unable to read a piece of information its EEPROM memory. The control will stop operation until all settings in the Adjust menu have been checked by the installer.
	**Outlet Sensor Short Circuit**. If the inlet sensor is operational, the control will operate using the inlet sensor. Otherwise, the control will not operate the burner. Test the outlet sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.
	**Outlet Sensor Open**. If the inlet sensor is operational, the control will operate using the inlet sensor. Otherwise, the control will not operate the burner. Test the outlet sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.
	**Inlet Sensor Short Circuit** The boiler will continue operation. Test the inlet sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.
	**Inlet Sensor Open** The boiler will continue operation Test the inlet sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.
	**System Sensor Short Circuit** If the outlet sensor is operational, the boiler will operate using the outlet sensor. If the outlet sensor is not available and the inlet sensor is operational, the boiler will operate using the inlet sensor. Otherwise, the control will not operate the burner. Test the supply sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.
	**System Sensor Open** If the outlet sensor is operational, the boiler will operate using the outlet sensor. If the outlet sensor is not available and the inlet sensor is operational, the boiler will operate using the inlet sensor. Otherwise, the control will not operate the burner. Test the supply sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.

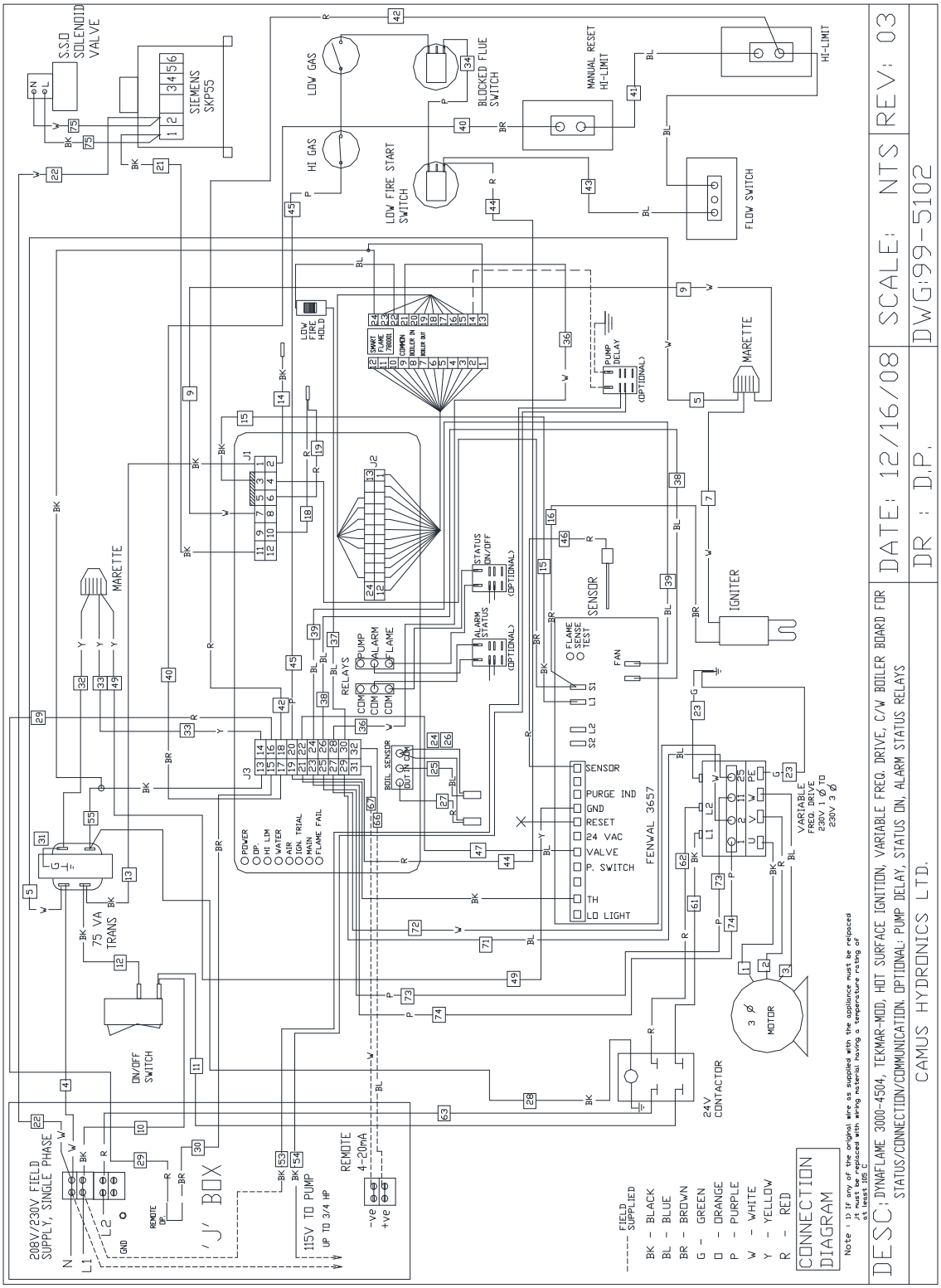
Error Message	Description
	**Outdoor Sensor Short Circuit** The BTC assumes an outdoor temperature of 32°F (0°C) and continues operation. Test the outdoor sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.
	**Outdoor Sensor Open** The BTC assumes an outdoor temperature of 32°F (0°C) and continues operation. Test the outdoor sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.
	**DHW Sensor Short Circuit** The control will not operate the burner. Test the DHW sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.
	**DHW Sensor Open** The control will not operate the burner. Test the DHW sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.
	**Flame Proof Error** Flame was not proved within 120 seconds of Demand 1
	**Flame Loss Error** Flame loss occurs when burner is lit and unexpectedly loses the flame signal.

PART 2 ELECTRICAL DIAGRAMS

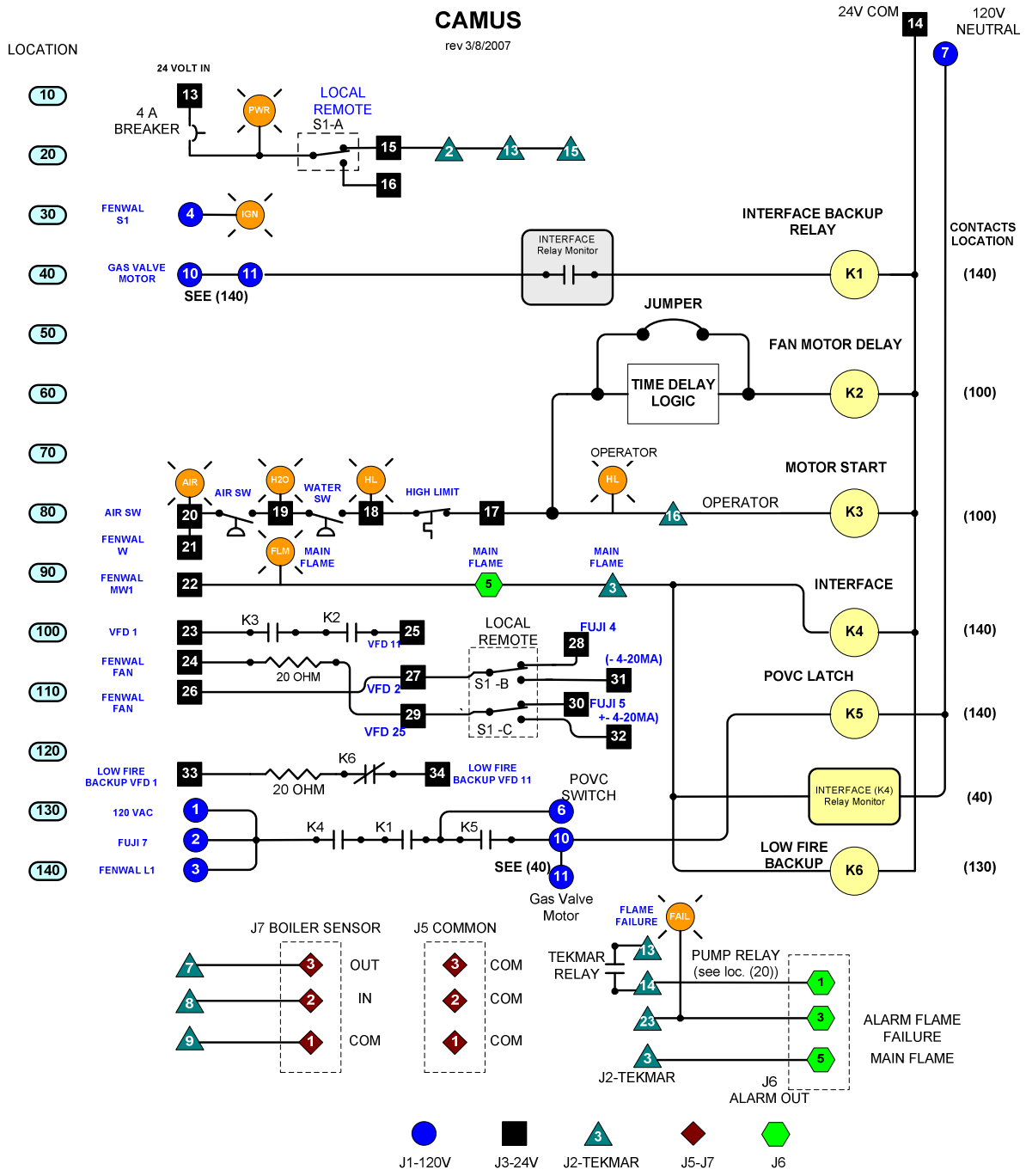
Dynaflame® 500 – 3000 with Tekmar SmartFlame and Fenwal Ignition Module



Dynaflame® 3500 – 5000 with Tekmar SmartFlame and Fenwal Ignition Module



Camus Dynaflame® SmartFlame PCB Electrical Ladder Diagram



NOTE: Ladder diagram does not represent actual circuit board schematic. Use for logic flow purposes and wiring only

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