



# MODEL SF-10 CONTROL

## OPERATION AND INSTRUCTION MANUAL

The SF-10 Boiler Temperature Control (BTC) is an efficient boiler operator with a digital LCD display with backlight, a boiler pump output, and an alarm. The control regulates the boiler based upon set-point, outdoor reset with domestic hot water heating priority, and several options for external boiler control.

### Features:

- Setpoint Operation
- Outdoor Reset with DHW Priority
- External Control through BMS Signal
- External Control through tekmar Boiler Controls
- Boiler Pump Operation and Purge
- DHW Pump and Purge
- DHW Priority
- Parallel Piping
- Primary - Secondary Piping
- Display Backlight



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## User Interface

The BTC uses a Liquid Crystal Display (LCD) as a method of supplying information. You use the LCD in order to setup and monitor the operation of your system. The BTC uses three push buttons (Item ▲, ▼) for selecting and adjusting settings. As you program your control, record your settings in the settings column of the Adjust menu. The table is found in the second half of this brochure.

### MENU

All of the items displayed by the control are organized into two menus:

- 1) View
- 2) Adjust

These menus are listed on the upper right hand side of the display (Menu Field). The default menu for the BTC is the View menu. While in the View menu, the VIEW segment is displayed.

To select the Adjust menu, press and hold simultaneously all three buttons (Item ▲, ▼) for 1 second.

The display then advances to the Adjust menu and the ADJUST segment is turned on in the display. The display will automatically revert back to the View menu after 20 seconds of keypad inactivity. Once in a menu, there will be a group of items that can be viewed within that menu.



### ITEM

The abbreviated name of the selected item will be displayed in the item field of the display.

To view the next available item, press and release the Item button.

Once you have reached the last available item in a menu, pressing and releasing the Item button will return the display to the first item in the selected menu.



### ADJUST

**To make an adjustment to a setting in the control, begin by selecting the Adjust menu by pressing and holding simultaneously all three buttons.**

**Then select the desired item using the Item button. Finally, use the ▲ or ▼ button to make the adjustment.**



### STATUS FIELD

Additional information can be gained by observing the Status field of the LCD. The status field will indicate which of the control's outputs are currently active. Symbols in the status field are only visible when the View menu is selected.

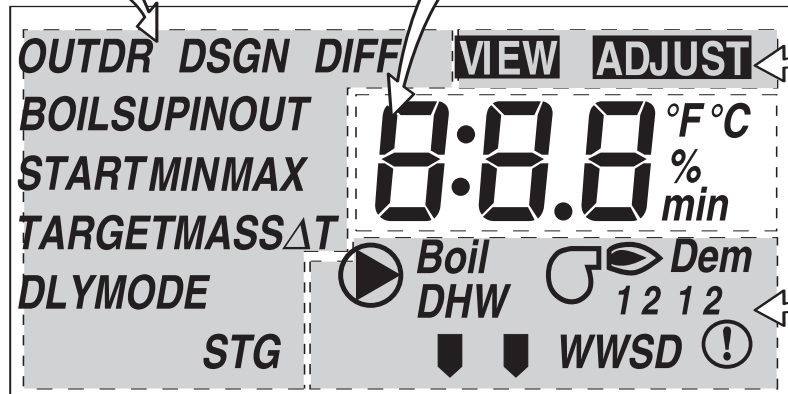
## Display

### Item Field

Displays an abbreviated name of the selected item

### Number Field

Displays the current value of the selected item



### Menu Field

Displays the current menu

### Status Field

Displays the current status of the control's inputs, outputs and operation

Offset

External Input Signal

### Buttons

Selects Menus, Items and adjusts settings

Item



## Symbol Description

<b>Boil</b> BOILER PUMP Displays when the boiler pump is in operation.	<b>Dem 1</b> HEAT DEMAND Displays when a heat demand is present.
<b>DHW</b> DHW PUMP Displays when the DHW pump is in operation.	<b>Dem 2</b> DHW DEMAND Displays when a DHW demand is present.
<b>1 2</b> BURNER Displays when the stage 1 or 2 contact is on. <i>Note: Stage 2 contact is not used in this application.</i>	<b>!</b> ERROR Displays when an error message is present.
<b>WWSD</b> WWSD Displays when the control is in Warm Weather Shut Down.	<b>↓</b> POINTERS Displays the operation as indicated by the text.

## Sequence of Operation

Section A  
General  
Operation  
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Section B  
Setpoint  
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## Section A: General

### POWERING UP THE CONTROL

When the control is powered up, the control turns on all segments in the display for 2 seconds. Next, the software version is displayed for 2 seconds. Last, the control enters into the normal operating mode.

### DISPLAY BACKLIGHT

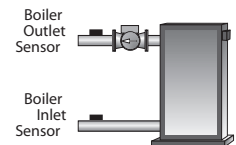
The control's display has a backlight that is permanently on while the control is powered.

### PIPING

The boiler can be piped in parallel or in primary / secondary to the system. The type of piping chosen affects the location of the control's operating temperature sensor. The control can either use the boiler outlet sensor or the boiler supply sensor.

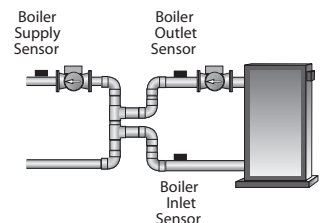
### PARALLEL PIPING

In parallel piping applications, the boiler outlet temperature is typically the same as that delivered to the system. Therefore the operating temperature sensor is the boiler outlet sensor.



### PRIMARY / SECONDARY PIPING

In primary / secondary applications, the boiler outlet temperature (primary loop) is typically hotter than the system supply temperature (secondary loop). This occurs when the system supply pipe has a larger flow rate than the boiler outlet pipe. Therefore, the control requires an additional sensor (boiler supply) to measure the temperature delivered out to the system. The operating temperature sensor is the boiler supply sensor.



### MODES OF OPERATION (MODE)

The control allows for seven modes of operation in order to define the control operation and piping arrangement used.

The piping arrangement can be categorized into parallel and primary / secondary. The mode of operation is selected using the MODE item in the Adjust menu. The temperature being controlled out to the heating system is measured by the operating sensor.

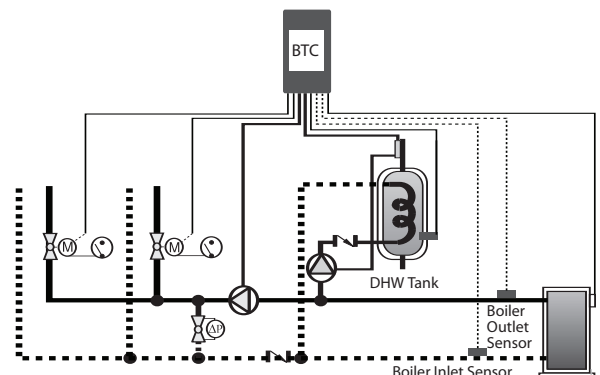
The piping arrangement determines which sensor the control uses as the operating sensor. The operating sensor is either the boiler outlet sensor or the boiler supply sensor.

### MODES 1

(Setpoint and DHW Operation with Parallel Piping)

Mode 1 is designed for setpoint and domestic hot water (DHW) operation using parallel piping. Once a heat demand signal is present, the control operates the boiler burner to maintain the boiler target at the boiler outlet sensor. Refer to section B for a description of setpoint operation.

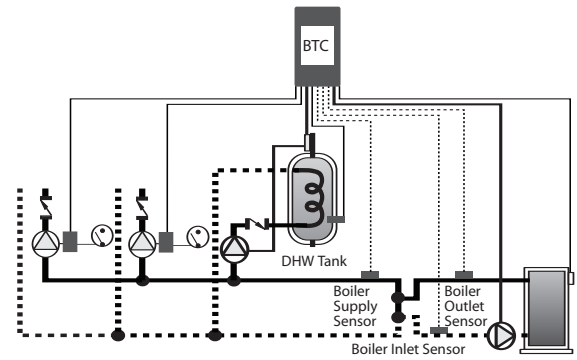
Once a DHW demand is present, the control operates the boiler burner to maintain the DHW target at the boiler outlet sensor. If both a heat demand and a DHW demand are present at the same time, the control targets the higher of the two requirements. Refer to section F for a description of indirect domestic hot water operation.



***(Setpoint and DHW Operation with Primary / Secondary Piping)***

Mode 2 is designed for setpoint and domestic hot water (DHW) operation using primary / secondary piping. Once a heat demand signal is present, the control operates the boiler burner to maintain the boiler target at the boiler supply sensor. Refer to section B for a description of setpoint operation.

Once a DHW demand is present, the control operates the boiler burner to maintain the DHW target at the boiler supply sensor. If both a heat demand and a DHW demand are present at the same time, the control targets the higher of the two requirements. Refer to section F for a description of indirect domestic hot water operation.

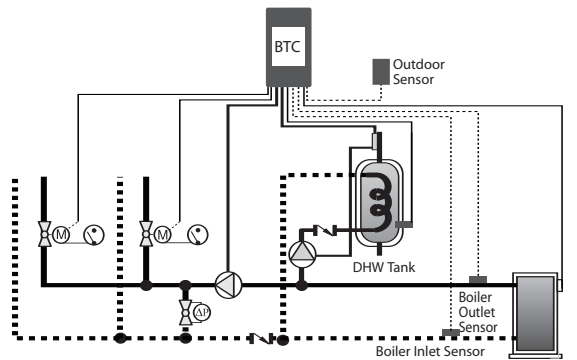


### ***MODE 3***

***(Outdoor Reset and DHW Operation with Parallel Piping)***

Mode 3 is designed for outdoor reset and domestic hot water (DHW) operation using parallel piping. Once a heat demand is present, the control operates the boiler burner to maintain the calculated outdoor reset target at the boiler outlet sensor. Refer to section C for a description of outdoor reset operation.

Once a DHW demand is present, the control operates the boiler burner to maintain the DHW target at the boiler outlet sensor. If both a heat demand and a DHW demand are present at the same time, the control targets the higher of the two requirements. Refer to section F for a description of indirect domestic hot water operation.

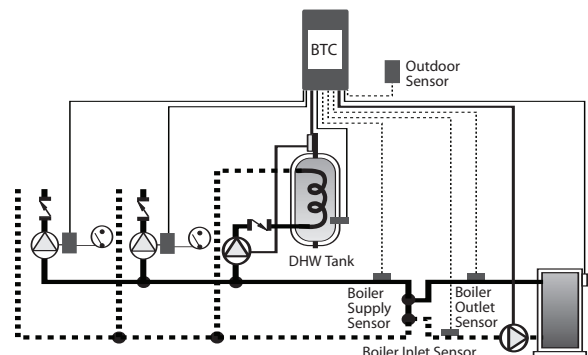


## MODE 4

***(Outdoor Reset and DHW Operation with Primary / Secondary Piping)***

Mode 4 is designed for outdoor reset and domestic hot water (DHW) operation using primary / secondary piping. Once a heat demand is present, the control operates the boiler burner to maintain the calculated outdoor reset target at the boiler supply sensor. Refer to section C for a description of outdoor reset operation.

Once a DHW demand is present, the control operates the boiler burner to maintain the DHW target at the boiler supply sensor. If both a heat demand and a DHW demand are present at the same time, the control targets the higher of the two requirements. Refer to section F for a description of indirect domestic hot water operation.

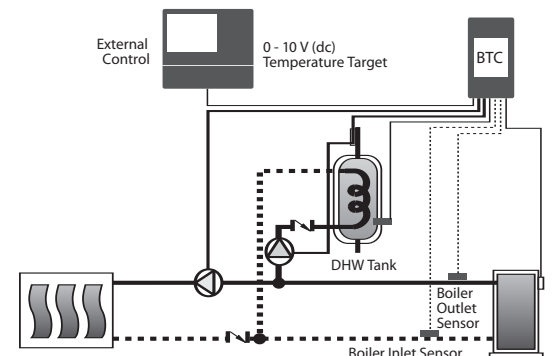


## MODE 5

***(External Target Temperature Input and DHW Operation—Parallel Piping)***

Mode 5 is designed for an external input signal and domestic hot water (DHW) with parallel piping. The external input signal can be provided from a BMS, an 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 operates the boiler burner to maintain the boiler target at the boiler outlet sensor. Refer to section D for a description of external target temperature operation.

Once a DHW demand is present, the control operates the boiler burner to maintain the DHW target at the boiler outlet sensor. If both a heat demand and a DHW demand are present at the same time, the control targets the higher of the two requirements. Refer to section F for a description of indirect domestic hot water operation.



## MODE 6

### (External Target Temperature Input and DHW Operation - Primary / Secondary Piping)

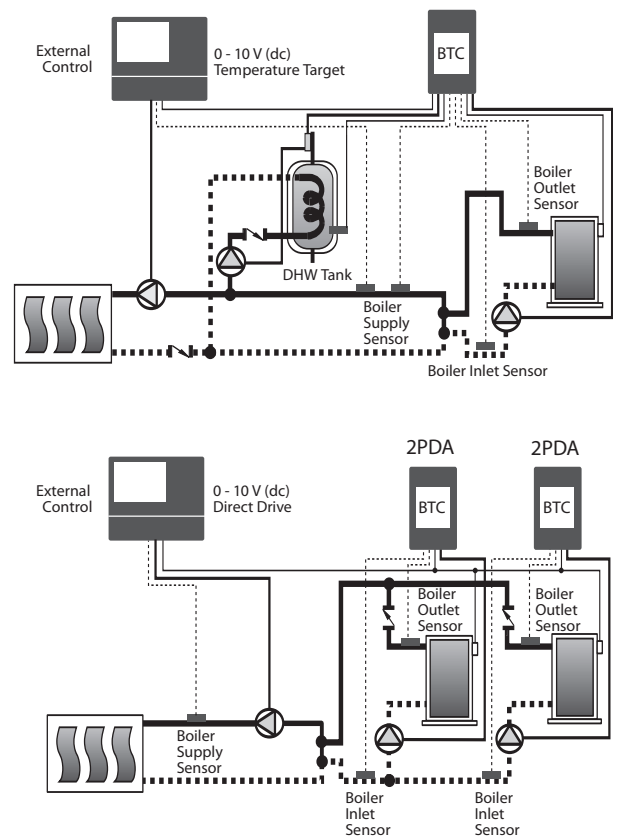
Mode 6 is designed for an external input signal and domestic hot water (DHW) with primary / secondary piping. The external input signal can be provided from a BMS, an EMS, or a tekmar tN4 System Control. The external input signal creates an internal demand and changes the boiler target according to a linear scale. The control operates the boiler burner to maintain the boiler target at the boiler supply sensor. Refer to section D for a description of external target temperature operation.

Once a DHW demand is present, the control operates the boiler burner to maintain the DHW target at the boiler supply sensor. If both a heat demand and a DHW demand are present at the same time, the control targets the higher of the two requirements. Refer to section F for a description of indirect domestic hot water operation.

## MODE 7

### (External Direct Drive Operation)

Mode 7 is designed for an external input signal to directly control the firing rate of the burner with either parallel or primary / secondary piping. The DHW demand input is disabled. Refer to section E for a description of external target temperature operation.



## BOILER DIFFERENTIAL (DIFF)

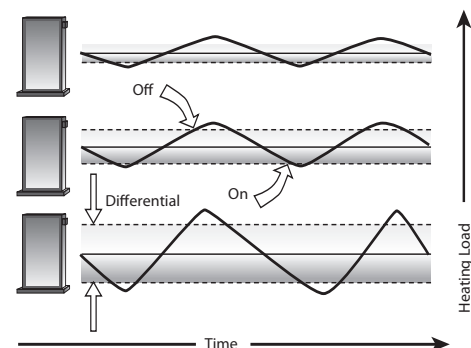
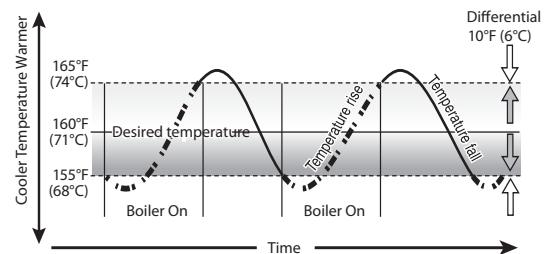
A heat source must be operated with a differential in order to reduce short cycling. The boiler differential is divided around the boiler target temperature. The first stage contact will close once the water temperature at the operating sensor is 1/2 of the differential setting below the boiler target temperature, and will open once the water temperature at the operating sensor is 1/2 of the differential setting above the boiler target temperature.

### Manual Differential

The differential can be manually set using the DIFF setting in the Adjust menu.

### Auto Differential

If the Auto Differential is selected, the control automatically determines the best differential as the load changes, thereby improving efficiency. During light loads, the differential is increased to allow longer on and off times to reduce the potential for short cycling. During large loads, the differential is narrowed thereby improving comfort in heating spaces by reducing temperature swing.



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## STAGING

Proportional & Integral & Derivative (PID) staging to are not used in this application.

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## STAGE DELAY (STG DLY)

STAGE DELAY (STG DLY) is not used in this application.

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## BOILER MASS (BOIL MASS)

The boiler mass setting allows the installer to adjust the control to the thermal mass of different types of heat sources used. The boiler mass setting automatically determines the minimum on time and minimum off time of the burner. A higher thermal mass setting provides slower cycling, while a lower thermal mass provides faster cycling.

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## FIRE DELAY (DLY)

The Fire Delay is the delay time that may occur between the time that the control closes the Stage 1 contact and when the burner fires. This delay is usually the result of a burner pre-purge or other forms of time delay built into the burner's safety circuits.

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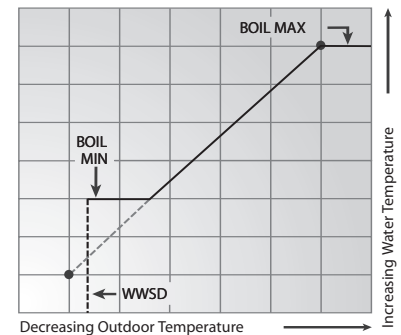
## BOILER MINIMUM (BOIL MIN)

The BOIL MIN setting is the lowest water temperature that the control is allowed to use as a boiler target temperature. During mild conditions, if the control calculates a boiler target temperature that is below the BOIL MIN setting, the boiler target temperature is adjusted to at least the BOIL MIN setting. During this condition, if the boiler is operating, the MIN segment turns on in the LCD while the boiler target temperature or boiler operating sensor temperature is viewed. If the installed boiler is designed for condensing or low temperature operation, set the BOIL MIN adjustment to OFF.

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## BOILER MAXIMUM (BOIL MAX)

The BOIL MAX setting is the highest water temperature that the control is allowed to use as a boiler target temperature. If the control does target BOIL MAX, and the temperature at the boiler outlet sensor is near the BOIL MAX temperature, the MAX segment turns on in the LCD while the boiler target, boiler inlet, boiler outlet or boiler supply temperature is viewed.



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## BOILER TARGET TEMPERATURE (BOIL TARGET)

The boiler target temperature is determined from the mode of operation and the type of demand applied. The control displays the temperature that it is currently trying to maintain at the operating sensor as BOIL TARGET in the View menu. The operating sensor for modes 1, 3 and 5 is the boiler outlet sensor, and the operating sensor for modes 2, 4 and 6 is the boiler supply sensor. If the control does not presently have a requirement for heat, it displays “— — —” in the LCD. There is no boiler target temperature generated in Mode 7.



## BOILER PUMP OPERATION ( ▶ )

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The boiler pump contact operates when:

- A heat demand is present and parallel piping (Mode 1, 3, 5) is used. Parallel piping requires the boiler pump to operate even while the burner is off in order to provide heat to the system.
- While the burner is firing and primary / secondary piping (Mode 2, 4, 6) is used. Primary / secondary piping reduces standby losses by isolating the boiler from the system while the burner is off.
- During external direct drive operation (mode 7), the boiler pump contact closes whenever there is a heat demand.
- After the burner shuts off the boiler pump remains on to purge heat from the boiler to the system.
- During a DHW demand the boiler pump contact is closed unless DHW priority is selected. During DHW priority, the boiler pump contact is off.

## BOILER PUMP PURGE ( ▶ DLY )

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After the burner is shut off, the control continues to operate the boiler pump for a period of time. The length of time that the boiler pump continues to run is based on the Pump DLY setting. Once the burner turns off, the control keeps the boiler pump running for the time selected. This setting allows purging of any excess heat out of the boiler after the boiler is shut off. This also helps to prevent the water in the boiler from flashing into steam after the boiler is shut off.

When Pump DLY is set to OFF, there is no purging. When Pump DLY is set to ON, the pump runs continuously. When on is selected and the control is configured for outdoor reset, the pump continues to run even during Warm Weather Shut Down.

## EXERCISING

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If the boiler pump has not operated at least once every 70 hours, the control turns on the output for 10 seconds. This minimizes the possibility of the pump seizing during a long period of inactivity.

## Section B: Setpoint Operation

When either mode 1 or 2 is selected, the water temperature is controlled based on a fixed setpoint. The setpoint temperature is set using the BOIL TARGET item in the Adjust menu.

### HEAT DEMAND (*Dem 1*)

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A heat demand is required whenever heat is required for the setpoint load. A heat demand is generated when a voltage between 24 and 120 V (ac) is applied across the CD (common demand) and the Ht D (heat demand). Once voltage is applied, the control turns on the Dem 1 segment in the display. The control closes the pump contacts, which starts the boiler pump and the control turns on the boiler pump segment in the display.

If the operating sensor is 1/2 of the differential below the BOIL TARGET, the control then closes the Stage 1 contact. The boiler target temperature is set using the BOIL TARGET item in the Adjust menu. If the operating sensor reaches 1/2 of the differential above the BOIL TARGET setting, the boiler burner is shut off. The pump contact remains closed until the heat demand is removed and Pump DLY setting expires.



## Section C: Outdoor Reset Operation

When either mode 3 or 4 is selected, the control uses outdoor reset to control the water temperature while a heat demand is present. Outdoor reset calculates the boiler target temperature based on the outdoor air temperature and reset ratio. The reset ratio is determined from the Boiler Start, Boiler Design, Outdoor Start and Outdoor Design settings.

### HEAT DEMAND (*Dem 1*)

A heat demand is required whenever heat is required in the system. A heat demand is generated when a voltage between 24 and 120 V (ac) is applied across the CD (common demand) and the Ht D (heat demand). Once voltage is applied, the control turns on the Dem 1 segment in the display. If the control is in warm weather shut down (WWSD), the WWSD segment is shown in the display and the pump does not turn on and the burner remains off.

If the control is not in WWSD, it closes the pump contact, which starts the boiler pump and the control turns on the boiler pump segment in the display. If the operating sensor is 1/2 of the differential below the calculated BOIL TARGET, the control then closes the Stage 1 contact. The boiler target temperature is determined using the reset ratio. If the operating sensor reaches 1/2 of the differential above the BOIL TARGET setting, the boiler burner is shut off. The pump contact remains closed until the heat demand is removed and Pump DLY setting expires.

### RESET RATIO

The control uses the four following settings to determine the reset ratio:

#### Boiler Start (*BOIL START*)

The BOIL START temperature is the theoretical boiler supply water temperature that the heating system requires when the outdoor air temperature equals the OUTDR START temperature setting. The BOIL START is typically set to the desired building temperature.

#### Outdoor Start (*OUTDR START*)

The OUTDR START temperature is the outdoor air temperature at which the control provides the BOIL START water temperature to the system. The OUTDR START is typically set to the desired building temperature.

#### Outdoor Design (*OUTDR DSGN*)

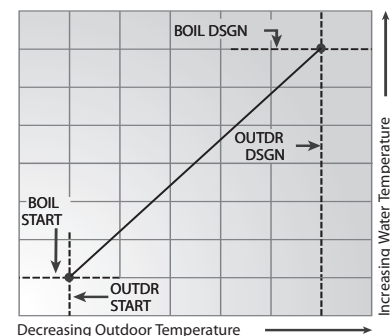
The OUTDR DSGN is the outdoor air temperature that is the typical coldest temperature of the year where the building is located. This temperature is used when completing heat loss calculations for the building.

#### Boiler Design (*BOIL DSGN*)

The BOIL DSGN temperature is the water temperature required to heat the boiler zones when the outdoor air is as cold as the OUTDR DSGN temperature.

#### Warm Weather Shut Down (*WWSD*)

When the outdoor air temperature rises above the WWSD setting, the control turns on the WWSD segment in the display. When the control is in Warm Weather Shut Down, the Dem 1 segment is displayed if there is a heat demand. However, the control does not operate the boiler to satisfy this demand. The control continues to respond to DHW demands.



## Section D: External Temperature Target Input

When modes 5 or 6 are selected, the control allows for an external control to operate the boiler temperature through an external input signal provided by a Building Management System (BMS), Energy Management System (EMS), or tekmar tN4 System Control. When in modes 5 or 6, the external heat demand (CD and Ht D) are disabled.

### INTERNAL HEAT DEMAND

An internal heat demand is generated when an analog positive 0-10 V (dc) or 2-10 V (dc) signal is applied to the +V(in) input. The negative V (dc) signal is applied to the Com/- input.

#### 0-10 V (dc) or 0-20 mA External Input Signal

The external input signal can be selected to be either 0-10 V (dc) or 2-10 V (dc) range. When the 0-10 V (dc) range is selected, an input voltage of 1 V (dc) corresponds to a boiler target temperature of 50°F (10°C). An input voltage of 10 V (dc) corresponds to a boiler target temperature of 210°F (99°C). As the voltage varies between 1 V (dc) and 10 V (dc), the boiler target temperature varies linearly between 50°F (10°C) and 210°F (99°C). If a voltage below 0.5 V (dc) is received, the boiler target temperature is displayed as “— — —” indicating that there is no longer an internal heat demand.

A 0-20 mA signal can be converted to a 0-10 V (dc) signal by installing a 500  $\Omega$  resistor on the external input signal device's terminals.

0-10 V (dc)	0-20 mA*	Boiler Target
0	0	— — — (OFF)
1	2	50°F (10°C)
2	4	68°F (20°C)
3	6	86°F (30°C)
4	8	103°F (39°C)
5	10	121°F (49°C)
6	12	139°F (59°C)
7	14	157°F (69°C)
8	16	174°F (79°C)
9	18	192°F (89°C)
10	20	210°F (99°C)

#### 2-10 V (dc) or 4-20 mA External Input Signal

The external input signal can be selected to be either 0-10 V (dc) or 2-10 V (dc) range. When the 2-10 V (dc) range is selected, an input voltage of 2 V (dc) corresponds to a boiler target temperature of 50°F (10°C). An input voltage of 10 V (dc) corresponds to a boiler target temperature of 210°F (99°C). As the voltage varies between 2 V (dc) and 10 V (dc), the boiler target temperature varies linearly between 50°F (10°C) and 210°F (99°C). If a voltage below 1.5 V (dc) is received the boiler target temperature is displayed as “— — —” indicating that there is no longer an internal heat demand.

A 4-20 mA signal can be converted to a 2-10 V (dc) signal by installing a 500 resistor on the external input signal device's terminals.

2-10 V (dc)	4-20 mA*	Boiler Target
0	0	— — — (OFF)
1	2	— — — (OFF)
2	4	50°F (10°C)
3	6	70°F (21°C)
4	8	90°F (32°C)
5	10	110°F (43°C)
6	12	130°F (54°C)
7	14	150°F (66°C)
8	16	170°F (77°C)
9	18	190°F (88°C)
10	20	210°F (99°C)

\* requires a 500  $\Omega$  resistor.

### OFFSET

The Offset setting allows the boiler target temperature to be fine tuned to the external input signal. The control reads the external input signal and converts this to a boiler target temperature. The Offset setting is then added to the boiler target temperature.

Example	Range	=	0-10 V (dc)	
	Input	=	7 V (dc)	157°F (69°C)
	Offset	=	+ 5°F (3°C)	+ 5°F (3°C)
	Boiler Target	=		162° F (72° C)

## Section E: External Direct Drive Operation

When mode 7 is selected, the control allows for an external control to operate the boiler through an analog direct drive input signal provided by a boiler sequencing control such as a tekmar Boiler Control 265. When in mode 7, the external heat demand (CD and Ht D) and the DHW demand (CD and DHW D are disabled).

### DIRECT DRIVE INPUT SIGNAL

An external boiler sequencer provides a positive 0-10 V (dc) input signal to the control +V(in) input (pin 10). The negative V (dc) signal is applied to the Com/- input. The boiler burner remains off while the direct drive input signal range is between 0 to 0.5 V (dc). The Stage 1 contact remains on as long as the direct drive input signal is over 0.5 V (dc).

### PUMP OPERATION

The pump contact close as soon as the direct drive input signal reaches 0.5 V (dc). Once the direct drive input signal falls below 0.5 V (dc), the pump continues to operate until the Pump DLY purge expires, then the pump shuts off.

### BOILER MAXIMUM TEMPERATURE

The external boiler sequencer is able to operate the boiler temperature. However, the BOIL MAX setting limits the highest temperature at the boiler outlet sensor. Should the boiler outlet temperature exceed the BOIL MAX setting, the Stage contact is opened to shut off the burner. The burner remains off for the minimum off time and the boiler outlet temperature falls 2°F (1°C) below the BOIL MAX setting.

## Section F: Domestic Hot Water Operation

When modes 1, 2, 3, 4, 5, or 6 are selected, the control is able to override the heat demand operation and respond to heat an indirect domestic hot water (DHW) tank.

### DHW DEMAND (Dem 2)

A DHW demand is required whenever the indirect DHW tank requires heating. A DHW demand is generated when a voltage between 24 and 120 V (ac) is applied across the CD (common demand) and the DHW D (DHW demand). Once voltage is applied, the control turns on the Dem 2 segment in the display. The control closes the DHW pump contacts, which starts the DHW pump and the control turns on the DHW pump segment in the display.

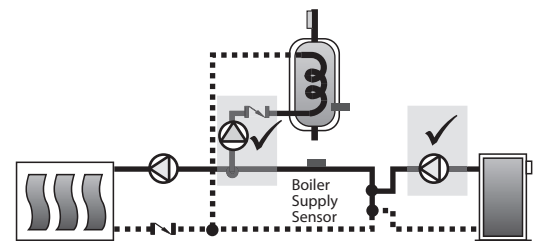
### BOILER TARGET DURING DHW OPERATION

The boiler target temperature is at least as hot as the DHW BOIL TARGET setting. If a heat demand is present during a DHW demand, the boiler target is the higher of the two temperatures.

### DHW OPERATION WITH PRIMARY / SECONDARY PIPING

When the boiler is piped in primary / secondary to the boiler and MODE is set to 2, 4, or 6, the control operates the boiler pump together with the DHW pump.

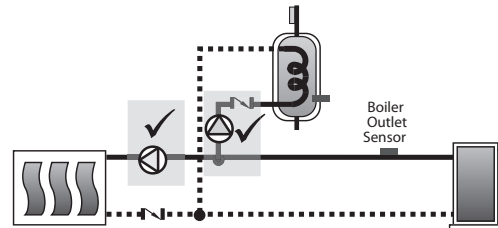
Ω



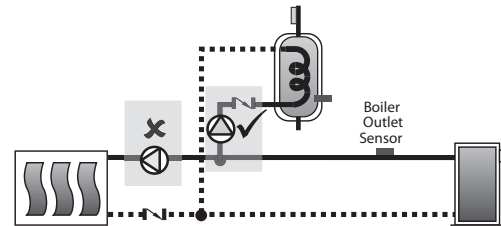
## DHW MODE & PRIORITY OPERATION (PARALLEL PIPING ONLY)

It is often desirable to have priority for the DHW tank. Priority allows for quick recovery of the DHW tank temperature. This is achieved by limiting or even stopping the flow of heat to the heating system when the DHW tank calls for heat. The control allows for DHW priority only when the boiler is piped in parallel to the heating system and MODE is set to 1, 3, or 5. DHW priority is achieved by shutting off the boiler pump contact while turning on the DHW pump contact.

- When DHW MODE is set to 1 there is no DHW priority.



- When DHW MODE is set to 2 there is DHW priority.



## DHW FULL & CONDITIONAL PRIORITY

The control provides full DHW priority when BOIL MIN is set to OFF. This is intended for use with condensing boilers. The control provides conditional DHW priority when BOIL MIN is not set to OFF. Should the DHW and the heat demand targets be similar in temperature, and the boiler target is maintained at the operating sensor, then simultaneous DHW and space heating occurs.

## DHW PRIORITY OVERRIDE

Should a DHW demand and a heat demand be present at the same time, the control limits the amount of time that DHW heating has priority over space heating. The amount of time is dependant on the Mode setting.

For Mode 3, the amount of time allowed for DHW priority is based on the measured outdoor air temperature. When the outdoor temperature is equal to the OUT DSGN setting, the priority time is 10 minutes. When the outdoor temperature is equal to the OUT START setting, the priority time is 2 hours. As the outdoor temperature changes between the OUT DSGN and the OUT START setting, the priority time increases linearly.

For Modes 1 and 5, the amount of time allowed for DHW priority is fixed at 1 hour.

Once the DHW priority time elapses, the DHW priority override operation is dependant on the BOIL MIN setting.

While in DHW priority override and the BOIL MIN setting is not set to OFF, the DHW pump and the boiler pump are operated together in order to provide simultaneous DHW and space heating. The control can resume DHW priority should the boiler target be satisfied for 5 minutes.

While in DHW priority override and the BOIL MIN setting is set to OFF, the control performs a DHW post purge to lower the boiler temperature, the DHW pump is shut off, and then space heating is resumed. This operation is intended for operation with condensing boilers.

## DHW POST PURGE

After the DHW Demand is removed, the control performs a purge on the boiler. In MODE 1, 3, or 5 (parallel piping), the control shuts off the burner and continues to operate the DHW pump. In MODE 2, 4, or 6 (primary / secondary piping), the control shuts off the burner and continues to operate the DHW pump while the boiler pump is turned on. This purges the residual heat from the boiler into the DHW tank. The control continues this purge for a maximum of two minutes or until the boiler supply water temperature drops 20°F (11°C) below the boiler target temperature during the DHW operation. The control also stops the purge if the operating sensor temperature is close to the current boiler target temperature.

## DHW MIXING PURGE

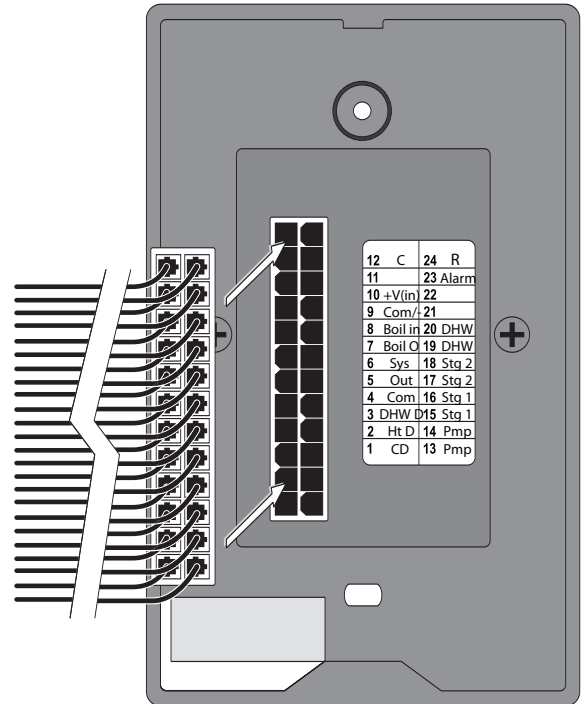
After DHW priority, the space heating zones may have cooled off considerably after being off for a period of time; meanwhile, the boiler is hot. To avoid thermally shocking the boiler after DHW priority, the control shuts off the burner, but continues to operate the DHW pump while restarting the boiler pump. This allows some of the DHW tank return water to mix with the cool return water from the zones and temper the boiler return water.

## Installation

### ELECTRICAL CONNECTIONS TO THE CONTROL

The installer should test to confirm that no voltage is present at any of the wires during installation. The BTC includes a 24 pin connector for ease of installation.

**NOTE:** Figure shown should be used for checking control only. Boiler wiring diagram should be used for checking the rest of boiler, because interface board has different terminal numbers.



### Powered Input Connections

#### 24 V (ac) Power

Connect the 24 V (ac) power supply to the C and R pins. This connection provides power to the microprocessor and display of the control. As well, this connection provides power to the Alarm pin from the R pin.

#### Heat Demand

To generate a heat demand, a voltage between 24 V (ac) and 120 V (ac) must be applied across the CD (common demand) and the Ht D (heat demand) pins.

#### DHW Demand

To generate a DHW demand, a voltage between 24 V (ac) and 120 V (ac) must be applied across the CD (common demand) and the DHW D (DHW demand) pins.

**Caution:** The same power supply must be used for both the heat demand and DHW demand circuits since they share the CD (common demand) pin.

### Output Connections

#### Boiler Pump Contact

The Pump pins are an isolated output in the control. There is no power available on these pins from the control. This output is to be used as a switch to either make or break power to the boiler pump. Since this is an isolated contact, it may switch a voltage between 24 V (ac) and 120 V (ac).

## Stage Contacts

Stage 1 pins are used in this application; stage 2 pins are not.

## DHW Pump Output

The DHW pump pins are an isolated output in the control. There is no power available on these pins from the control. This output is to be used as a switch to either make or break power to the DHW pump. Since this is an isolated contact, it may switch a voltage between 24 V (ac) and 120 V (ac).

## Alarm Signal

The Alarm on the interface board is activated when anyone of the temperature sensors is open. When activated, there will be an audible signal and a visual indication on the control panel.

To clear audio alarm signal set Access level DIP switch A to Factory (on position) then check all adjust menu items.

## Sensor and Unpowered Input Connections

**Do not apply power to these terminals as this damages the control.**

### Boiler Outlet Sensor

Connect the two wires from the Boiler Outlet Sensor to the Com/- (common sensor) and Boil O (boiler outlet sensor). The boiler outlet sensor is used by the control to measure the boiler outlet water temperature from the boiler.

**Note:** The boiler outlet sensor is required for every mode of operation.

### Boiler Inlet Sensor

Connect the two wires from the Boiler Inlet Sensor to the Com/- (common sensor) and Boil in (boiler inlet sensor) pins. The boiler inlet sensor is used by the control to measure the boiler inlet water temperature from the boiler.

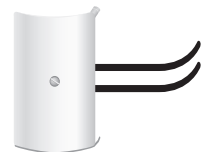
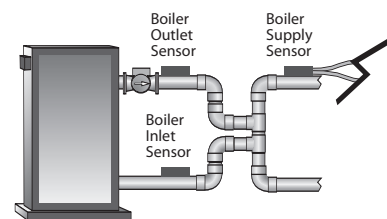
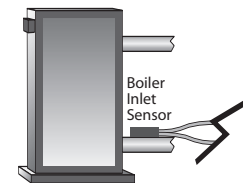
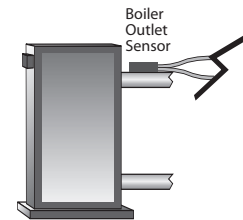
Note: The boiler inlet sensor is optional for every mode of operation.

### Boiler Supply Sensor

An optional Boiler Supply Sensor may be connected to the control. If the sensor is required, connect the two wires from the sensor to the Com (common sensor) and Sys (boiler supply) pins.

### Outdoor Sensor

An optional Outdoor Sensor may be connected to the control. If the sensor is required, connect the two wires from the Outdoor Sensor to the Com (common sensor) and Out (outdoor sensor) pins. The outdoor sensor is used by the control to measure the outdoor air temperature.



## External Input

The control can accept an external input signal from an external control. If an external input signal is required, connect the positive 0-10 V (dc) wire to the +V(in) pin and connect the negative 0-10 V (dc) wire to the Com/-.

## Testing

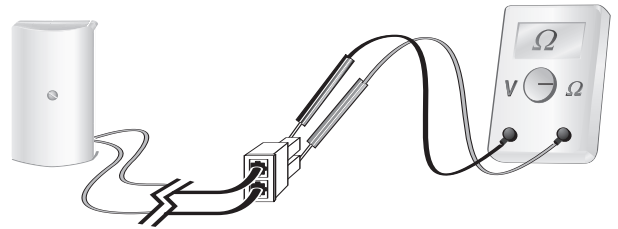
The wiring harness must be unplugged from the connector on the control before testing. To remove the wiring harness, push down on the tab on the connector and pull away from the control.

The following tests are performed using standard testing practices and procedures and should only be carried out by properly trained and experienced persons.

A good quality electrical test meter, capable of reading from at least 0-300 V (ac) and at least 0-2,000,000 Ohms, is essential to properly test the wiring and sensors.

### TEST THE SENSORS

In order to test the sensors, the actual temperature at each sensor location must be measured. A good quality digital thermometer with a surface temperature probe is recommended for ease of use and accuracy. First measure the temperature using the thermometer and then measure the resistance of the sensor at the control. Using the chart below, estimate the temperature measured by the sensor. The sensor and the thermometer readings should be close. If the meter reads a very high resistance, there may be a broken wire, a poor wiring connection or a defective sensor. If the resistance is very low, the wiring may be shorted, there may be moisture in the sensor or the sensor may be defective. To test for a defective sensor, measure the resistance directly at the sensor location.



Temperature		Resistance	Temperature		Resistance	Temperature		Resistance	Temperature		Resistance
°F	°C	Ω	°F	°C	Ω	°F	°C	Ω	°F	°C	Ω
-50	-46	490,813	20	-7	46,218	90	32	7,334	160	71	1,689
-45	-43	405,710	25	-4	39,913	95	35	6,532	165	74	1,538
-40	-40	336,606	30	-1	34,558	100	38	5,828	170	77	1,403
-35	-37	280,279	35	2	29,996	105	41	5,210	175	79	1,281
-30	-34	234,196	40	4	26,099	110	43	4,665	180	82	1,172
-25	-32	196,358	45	7	22,763	115	46	4,184	185	85	1,073
-20	-29	165,180	50	10	19,900	120	49	3,760	190	88	983
-15	-26	139,402	55	13	17,436	125	52	3,383	195	91	903
-10	-23	118,018	60	16	15,311	130	54	3,050	200	93	829
-5	-21	100,221	65	18	13,474	135	57	2,754	205	96	763
0	-18	85,362	70	21	11,883	140	60	2,490	210	99	703
5	-15	72,918	75	24	10,501	145	63	2,255	215	102	648
10	-12	62,465	80	27	9,299	150	66	2,045	220	104	598
15	-9	53,658	85	29	8,250	155	68	1,857	225	107	553



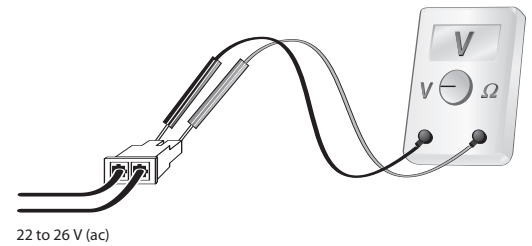
## TEST THE POWER SUPPLY

Make sure exposed wires are not in contact with other wires or grounded surfaces. Turn on the power and measure the voltage between the C and R pins using an AC voltmeter, the reading should be between 22 and 26 V (ac).

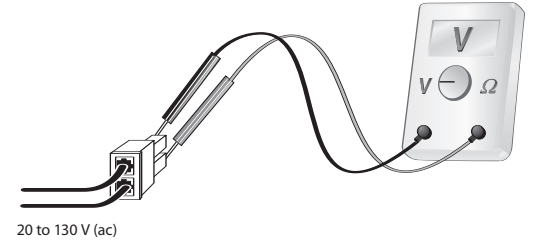
## TEST THE POWERED INPUTS

### *Heat Demand*

If a heat demand is used, measure the voltage between the CD (common demand) and the Ht D (heat demand) pins. When the heat demand device calls for heat, between 20 and 130 V (ac) should be measured at the pins. When the heat demand device is off, less than 5 V (ac) should be measured.



22 to 26 V (ac)



20 to 130 V (ac)

### *DHW Demand*

If a DHW demand is used, measure the voltage between the CD (common demand) and the DHW D (DHW demand) pins. When the DHW demand device calls for heat, between 20 and 130 V (ac) should be measured at the pins. When the setpoint demand device is off, less than 5 V (ac) should be measured.

## TEST THE EXTERNAL INPUT

If an external input signal is used, measure the voltage between the Com/- and +V(in) pins. When the external control calls for heat, between 0 and 10 V (dc) should be measured.

## CONNECTING THE CONTROL

Make sure all power to the devices and wiring harness is off.








Reconnect the wiring harness to the connector on the control by aligning the tab on the wiring harness to the tab on the connector on the control and then pushing the wiring harness into the connector on the control. The tab on the wiring harness should snap over the tab on the connector of the control.

Apply power to the control. The operation of the control on power up is described in the Sequence of Operation section of the brochure.

TESTING THE CONTROL'S OUTPUTS

The control has a built-in test routine that is used to override the main control functions. The test sequence is enabled when the Up button is pressed and held for 5 seconds while in the View menu. The test sequence can be cancelled by pressing either the Item, Up or Down button. Once the test sequence is enabled, the outputs are tested in the following sequence:

Press and hold the up button for 3 seconds while in the View menu.

STEP 1	 <b>Boil</b>	The boiler pump is turned on.
STEP 2	 <b>Boil</b> 	Stage 1 burner is turned on.
STEP 3	 <b>Boil</b> 	Stage 2 burner is turned on. Note: Stage 2 is not used in this application.
STEP 4	 <b>DHW</b>	The boiler pump, Stage 1 and Stage 2 are shut off. The DHW pump is turned on for 10 seconds.
STEP 5		The DHW pump shuts off. The alarm contact is closed for 10 seconds

The control exits the test sequence and resumes normal operation.

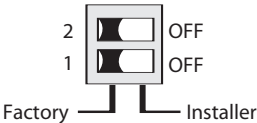
Control Settings

DIP SWITCH SETTING

Note: DIP switches are located on the front of the control. Remove bottom cover and screw for access.

(1) Factory / Installer

The Factory / Installer DIP switch is used to select which items are available to be viewed and / or adjusted in the user interface. The Factory Access Level includes all the settings available in the control. The Installer Access Level includes the settings and items which are required for system setup.

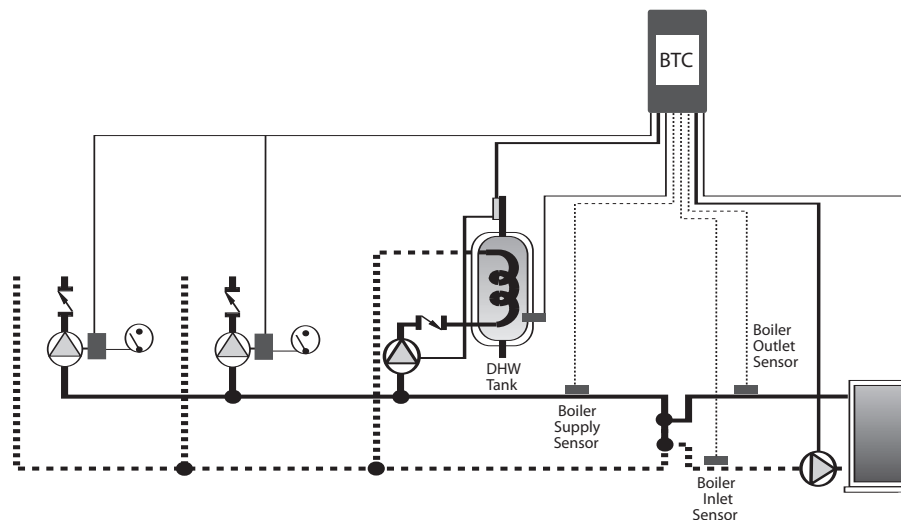


(2) Not Used

## Applications

The diagram illustrates a hydronic heating system. A boiler is connected to a DHW (Domestic Hot Water) Tank. The system includes a BTC (Boiler Thermal Control) unit. The flow is controlled by pumps and valves. A sensor is located at the boiler outlet. The system is designed to provide both space heating and domestic hot water.



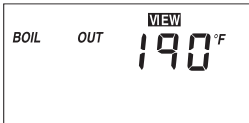

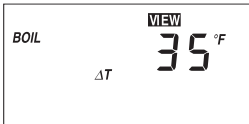
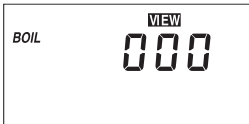
## MODE 2 SETPOINT & DHW OPERATION – PRIMARY / SECONDARY



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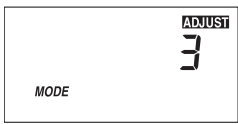
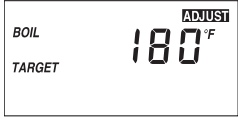



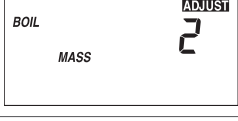
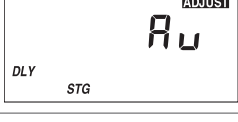
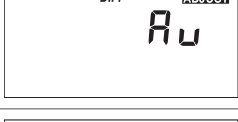

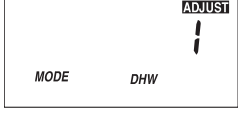


# MODE 1 and 2 – Setpoint & DHW Operation

## View Menu (1 of 1)

Item Field	Access	Description	Range
	Factory Installer	<b>BOILER TARGET</b> The boiler target is the temperature the control is currently trying to maintain at the boiler supply sensor or the boiler outlet sensor.	---, 35 to 226°F, OFF (---, 2 to 108°C, OFF)
	Factory Installer	<b>BOILER SUPPLY SENSOR</b> Current boiler supply water temperature as measured by the boiler supply sensor. Note: This item is only available when MODE is set to 2.	14 to 266°F (-10 to 130°C)
	Factory Installer	<b>BOILER OUTLET</b> Current boiler outlet water temperature as measured by the boiler outlet sensor. Note: When MODE is set to 2 this item is only visible in the Factory access level.	14 to 266°F (-10 to 130°C)
	Factory Installer	<b>BOILER INLET</b> Current boiler inlet water temperature as measured by the boiler inlet sensor. Note: This item is only available when a boiler inlet sensor is installed.	14 to 266°F (-10 to 130°C)
	Factory	<b>BOILER DELTA T</b> Current temperature difference between the boiler outlet sensor and the boiler inlet sensor. Note: This item is only available when a boiler inlet sensor is installed.	0 to 252°F (0 to 140°C)
	Factory	<b>BOILER HOURS</b> The total number of running hours of the boiler since this item was last cleared. Clear the numbers of hours by pressing and holding the Up and Down buttons together while viewing this item.	0 to 999

# MODE 1 and 2 – Setpoint & DHW Operation

## Adjust Menu (1 of 1)

Item Field	Access	Description	Range	Settings
	Factory Installer	MODE Select the operating mode for the control.	1, 2, 3, 4, 5, 6, 7 Default = 3	
	Factory Installer	BOILER TARGET Select the boiler target temperature for setpoint operation.	OFF, 70 to 220°F (OFF, 21 to 104°C) Default = 180°F (82°C)	
	Factory	BOILER MAXIMUM Select the maximum boiler target water temperature.	120 to 225°F, OFF (49 to 107°C, OFF) Default = 180°F (82°C)	
	Factory	BOILER MINIMUM Select the minimum temperature allowed for the boiler target temperature.	OFF, 80 to 180°F (OFF, 27 to 82°C) Default = 140°F (60°C)	
	Factory	FIRE DELAY Select the amount of time required for combustion pre-purging, ignition and the flame to be established.	0:00 to 3:00 minutes Default = 0:10 min (1 second increments)	
	Factory Installer	BOILER MASS Select the thermal mass of the boiler.	1 (low mass) 2 (medium mass) 3 (high mass) Default = 2	
	Factory Installer	STAGE DELAY Select the minimum time delay between stages. Note: This setting is not used in this application.	Au, 0:30 to 9:55 min Default = Au	
	Factory	DIFFERENTIAL Select the differential that the control is to use when it is operating the boiler.	Au, 2 to 42°F (Au, 1 to 23°C) Default = Au	
	Factory	DHW BOILER TARGET Select the boiler target temperature while heating an indirect DHW tank.	OFF, 70 to 220°F (OFF, 21 to 104°C) Default = 180°F (82°C)	
	Factory	DHW MODE Select no priority (1) or priority (2) of indirect DHW heating over space heating. Note: This item is only available when MODE is set to 1.	1, 2 Default = 1	
	Factory	PUMP DELAY Select the boiler pump purge time after shutting off the burner.	OFF 0:20 to 9:55 min , On Default = 0:20 min	
	Factory Installer	TEMPERATURE UNITS Select to display temperature in degrees Fahrenheit or in degrees Celsius.	°F, °C Default = °F	

## Applications

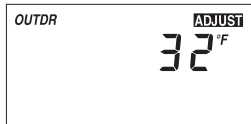
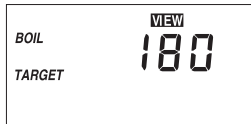
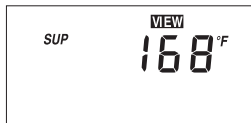
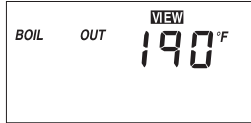
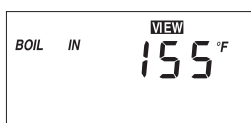
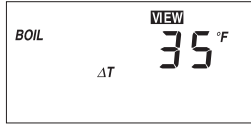
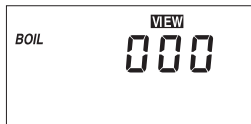
The diagram illustrates a hydronic heating system. A central boiler is connected to a DHW (Domestic Hot Water) Tank. The system includes a BTC (Building Thermal Control) unit, which is connected to the boiler and the DHW tank. The boiler is equipped with a boiler outlet sensor and a boiler inlet sensor. The DHW tank is connected to a hot water tap. The system also features a pump and a pressure differential (ΔP) sensor. The diagram shows the flow of water through the system, with solid lines representing the main supply and return lines, and dashed lines representing the DHW supply and return lines.

The diagram illustrates a hydronic heating system. A central boiler is connected to a Domestic Hot Water (DHW) Tank. A Bypass Thermal Control (BTC) unit is connected to the system. The system includes a Boiler Supply Sensor, a Boiler Inlet Sensor, and a Boiler Outlet Sensor. The flow is indicated by arrows, showing the circulation of water through the system. The BTC unit is shown as a rectangular box with a 'BTC' label. The DHW Tank is a vertical cylindrical tank. The boiler is a horizontal unit with a burner and heat exchanger. The sensors are small rectangular devices. The flow is indicated by arrows, showing the circulation of water through the system. The BTC unit is shown as a rectangular box with a 'BTC' label. The DHW Tank is a vertical cylindrical tank. The boiler is a horizontal unit with a burner and heat exchanger. The sensors are small rectangular devices.

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# MODE 3 and 4 – Outdoor Reset & DHW Operation





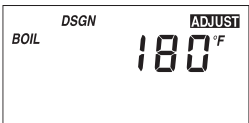



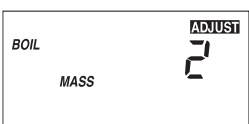
## View Menu (1 of 1)

Item Field	Access	Description	Range
	Factory Installer	<b>OUTDOOR</b> Current outdoor air temperature as measured by the outdoor sensor.	-60 to 190°F (-51 to 88°C)
	Factory Installer	<b>BOILER TARGET</b> The boiler target is the temperature the control is currently trying to maintain at the boiler supply sensor or the boiler outlet sensor.	---, 35 to 226°F, OFF (---, 2 to 108°C, OFF)
	Factory Installer	<b>BOILER SUPPLY SENSOR</b> Current boiler supply water temperature as measured by the boiler supply sensor.  Note: This item is only available when MODE is set to 4.	14 to 266°F (-10 to 130°C)
	Factory Installer	<b>BOILER OUTLET</b> Current boiler outlet water temperature as measured by the boiler outlet sensor.  Note: When MODE is set to 4 this item is only visible in the Factory access level.	14 to 266°F (-10 to 130°C)
	Factory Installer	<b>BOILER INLET</b> Current boiler inlet water temperature as measured by the boiler inlet sensor.  Note: This item is only available when a boiler inlet sensor is installed.	14 to 266°F (-10 to 130°C)
	Factory	<b>BOILER DELTA T</b> Current temperature difference between the boiler outlet sensor and the boiler inlet sensor.  Note: This item is only available when a boiler inlet sensor is installed.	0 to 252°F (0 to 140°C)
	Factory	<b>BOILER HOURS</b> The total number of running hours of the boiler since this item was last cleared. Clear the numbers of hours by pressing and holding the Up and Down buttons together while viewing this item.	0 to 999






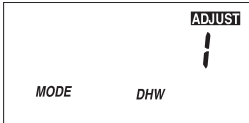



# MODE 3 and 4 – Outdoor Reset & DHW Operation

## Adjust Menu (1 of 2)

Item Field	Access	Description	Range	Settings
	Factory Installer	MODE Select the operating mode for the control.	1, 2, 3, 4, 5, 6, 7 Default = 3	
	Factory Installer	OUTDOOR START The 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 = 70°F (21°C)	
	Factory Installer	OUTDOOR DESIGN The 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 32°F (-51 to 0°C) Default = 10°F (-12°C)	
	Factory Installer	BOILER START The 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)	
	Factory Installer	BOILER DESIGN The 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 220°F (21 to 104°C) Default = 180°F (82°C)	
	Factory	BOILER MAXIMUM Select the maximum boiler target water temperature.	120 to 225°F, OFF (49 to 107°C, OFF) Default = 180°F (82°C)	
	Factory	BOILER MINIMUM Select the minimum temperature allowed for the boiler target temperature.	OFF, 80 to 180°F (OFF, 27 to 82°C) Default = 140°F (60°C)	
	Factory	FIRE DELAY Select the amount of time required for combustion pre-purging, ignition and the flame to be established.	0:00 to 3:00 minutes Default = 0:10 min (1 second increments)	
	Factory Installer	BOILER MASS Select the thermal mass of the boiler.	1 (low mass) 2 (medium mass) 3 (high mass) Default = 2	

# MODE 3 and 4 – Outdoor Reset & DHW Operation

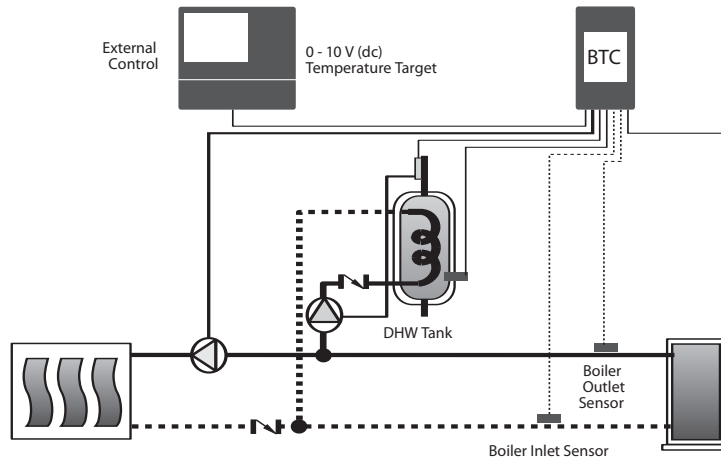
## Adjust Menu (2 of 2)

Item Field	Access	Description	Range	Settings
	Factory Installer	STAGE DELAY Select the minimum time delay between stages. Note: This setting is not used in this application.	Au, 0:30 to 9:55 min Default = Au	
	Factory	DIFFERENTIAL Select the differential that the control is to use when it is operating the boiler.	Au, 2 to 42°F (Au, 1 to 23°C) Default = Au	
	Factory	DHW BOILER TARGET Select the boiler target temperature while heating an indirect DHW tank.	OFF, 70 to 220°F (OFF, 21 to 104°C) Default = 180°F (82°C)	
	Factory	DHW MODE Select no priority (1) or priority (2) of indirect DHW heating over space heating. Note: This item is only available when MODE is set to 3.	1, 2 Default = 1	
	Factory	PUMP DELAY Select the boiler pump purge time after shutting off the burner.	OFF, 0:20 to 9:55 min, On Default = 0:20 min	
	Factory Installer	WARM WEATHER SHUT DOWN Select the space heating system's warm weather shut down when using outdoor reset.	35 to 100°F, OFF (2 to 38°C, OFF) Default = 65°F (18°C)	
	Factory Installer	TEMPERATURE UNITS Select to display temperature in degrees Fahrenheit or in degrees Celsius.	°F, °C Default = °F	

# MODE 5 and 6 – External Target Temperature

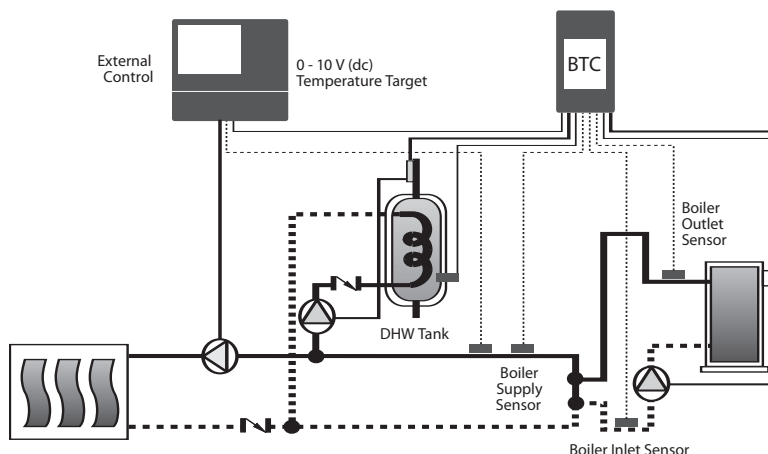
## Applications

### MODE 5 – EXTERNAL TARGET TEMPERATURE INPUT & DHW OPERATION-PARALLEL PIPING



The control receives a heat demand provided via an external analog input signal from an EMS, BMS or tekmar tN4 system control. The external analog input signal is interpreted as a setpoint target temperature. The control turns on the boiler pump and operates the boiler to maintain the setpoint boiler target temperature at the boiler outlet sensor. The control receives a DHW Demand from a DHW aquastat. The control turns on the DHW pump, and operates the boiler to maintain the DHW setpoint boiler target temperature at the boiler outlet sensor whenever a DHW demand is present.



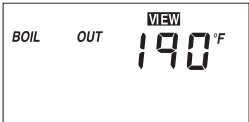
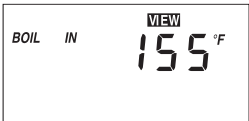
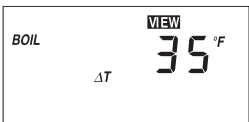
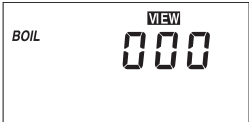
### MODE 6 – EXTERNAL TARGET TEMPERATURE INPUT & DHW OPERATION-PRIMARY / SECONDARY



The control receives a heat demand provided via an external analog input signal from an EMS, BMS, or tekmar tN4 system control. The external analog input signal is interpreted as a setpoint target temperature. The control turns on the boiler pump and operates the boiler to maintain the setpoint boiler target temperature at the boiler supply sensor. The control receives a DHW Demand from a DHW aquastat. The control turns on the DHW pump, boiler pump, and operates the boiler to maintain the DHW setpoint boiler target temperature at the supply sensor whenever a DHW demand is present.





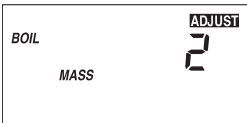
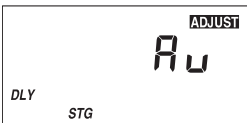
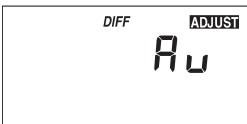

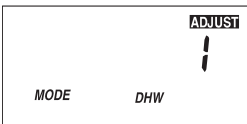
# MODE 5 and 7 – External Target Temperature

## View Menu (1 of 1)

Item Field	Access	Description	Range
	Factory Installer	<b>BOILER TARGET</b> The boiler target is the temperature the control is currently trying to maintain at the boiler supply sensor or the boiler outlet sensor.	---, 35 to 226°F, OFF (---, 2 to 108°C, OFF)
	Factory Installer	<b>BOILER SUPPLY SENSOR</b> Current boiler supply water temperature as measured by the boiler supply sensor. Note: This item is only available when MODE is set to 6.	14 to 266°F (-10 to 130°C)
	Factory Installer	<b>BOILER OUTLET</b> Current boiler outlet water temperature as measured by the boiler outlet sensor. Note: When MODE is set to 6 this item is only visible in the Factory access level.	14 to 266°F (-10 to 130°C)
	Factory Installer	<b>BOILER INLET</b> Current boiler inlet water temperature as measured by the boiler inlet sensor. Note: This item is only available when a boiler inlet sensor is installed.	14 to 266°F (-10 to 130°C)
	Factory	<b>BOILER DELTA T</b> Current temperature difference between the boiler outlet sensor and the boiler inlet sensor. Note: This item is only available when a boiler inlet sensor is installed.	0 to 252°F (0 to 140°C)
	Factory	<b>BOILER HOURS</b> The total number of running hours of the boiler since this item was last cleared. Clear the numbers of hours by pressing and holding the Up and Down buttons together while viewing this item.	0 to 999





# MODE 5 and 6 – External Target Temperature

## Adjust Menu (1 of 2)

Item Field	Access	Description	Range	Settings
	Factory Installer	MODE Select the operating mode for the control.	1, 2, 3, 4, 5, 6, 7 Default = 3	
	Factory	BOILER MAXIMUM Select the maximum boiler target water temperature.	120 to 225°F, OFF (49 to 107°C, OFF) Default = 180°F (82°C)	
	Factory	BOILER MINIMUM Select the minimum temperature allowed for the boiler target temperature.	OFF, 80 to 180°F (OFF, 27 to 82°C) Default = 140°F (60°C)	
	Factory	FIRE DELAY Select the amount of time required for combustion pre-purging, ignition and the flame to be established.	0:00 to 3:00 minutes Default = 0:10 min (1 second increments)	
	Factory Installer	BOILER MASS Select the thermal mass of the boiler.	1 (low mass) 2 (medium mass) 3 (high mass) Default = 2	
	Factory Installer	STAGE DELAY Select the minimum time delay between stages. Note: This setting is not used in this application.	Au, 0:30 to 9:55 min Default = Au	
	Factory	DIFFERENTIAL Select the differential that the control is to use when it is operating the boiler. Note: This setting is not used in this application.	Au, 2 to 42°F (Au, 1 to 23°C) Default = Au	
	Factory	DHW BOILER TARGET Select the boiler target temperature while heating an indirect DHW tank.	OFF, 70 to 220°F (OFF, 21 to 104°C) Default = 180°F (82°C)	
	Factory	DHW MODE Select no priority (1) or priority (2) of indirect DHW heating over space heating. Note: This item is only available when MODE is set to 5.	1, 2 Default = 1	

# MODE 5 and 6 – External Target Temperature

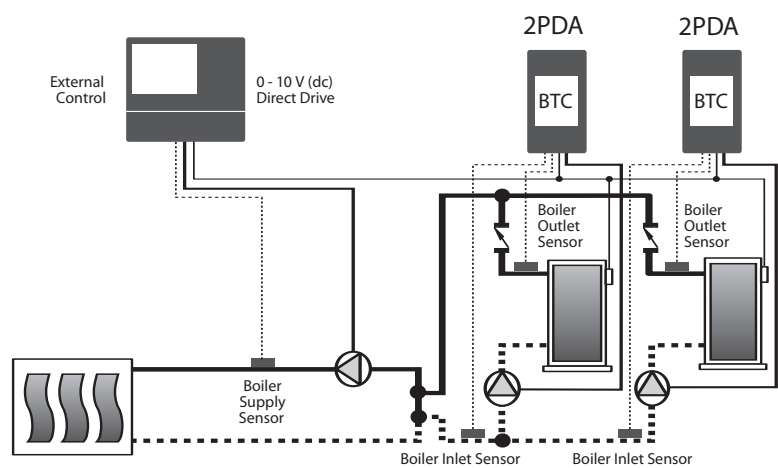
## Adjust Menu (2 of 2)

Item Field	Access	Description	Range	Settings
	Factory	<b>PUMP DELAY</b> Select the boiler pump purge time after shutting off the burner.	OFF, 0:20 to 9:55 min, On Default = 0:20 min	
	Factory	<b>EXTERNAL INPUT SIGNAL</b> Select the range of the external input signal.	0:10 or 2:10 Default = 0:10	
	Factory	<b>OFFSET</b> Select the amount of offset when the boiler target is determined from an external input signal.	-10 to +10°F (-5 to +5°C) Default = 0°F (0°C)	
	Factory Installer	<b>TEMPERATURE UNITS</b> Select to display temperature in degrees Fahrenheit or in degrees Celsius.	°F, °C Default = °F	

# MODE 7 – External Direct Drive Operation

## Applications

### MODE 7 – EXTERNAL DRIVE OPERATION



The control receives a heat demand provided via an external analog input signal from a tekmar sequencing control (such as a 265). The control turns on the boiler pump and the Stage 1 contact according to the external input signal.

# MODE 7 – External Direct Drive Operation





## View Menu (1 of 1)

Item Field	Access	Description	Range
<div>BOIL OUT <span>VIEW</span> 190 °F</div>	Factory Installer	BOILER OUTLET Current boiler outlet water temperature as measured by the boiler outlet sensor.	14 to 266°F (-10 to 130°C)
<div>BOIL IN <span>VIEW</span> 155 °F</div>	Factory Installer	BOILER INLET Current boiler inlet water temperature as measured by the boiler inlet sensor.  Note: This item is only available when a boiler inlet sensor is installed.	14 to 266°F (-10 to 130°C)
<div>BOIL <span>VIEW</span> 35 °F ΔT</div>	Factory	BOILER DELTA T Current temperature difference between the boiler outlet sensor and the boiler inlet sensor.  Note: This item is only available when a boiler inlet sensor is installed.	0 to 252°F (0 to 140°C)
<div>BOIL <span>VIEW</span> 000</div>	Factory	BOILER HOURS The total number of running hours of the boiler since this item was last cleared. Clear the numbers of hours by press and holding the Up and Down buttons together while viewing this item.	0 to 999



# MODE 7 – External Direct Drive Operation

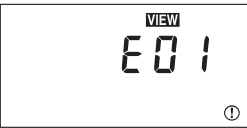
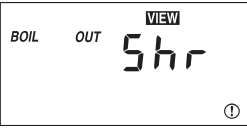
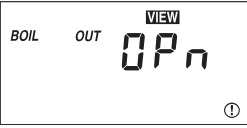
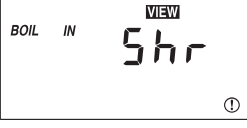
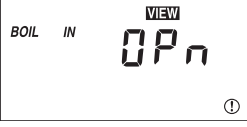
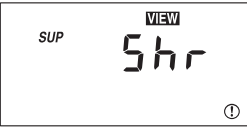
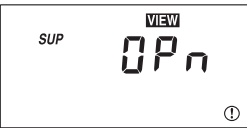

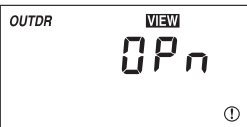
## Adjust Menu (1 of 1)

Item Field	Access	Description	Range	Settings
	Factory Installer	MODE Select the operating mode for the control.	1, 2, 3, 4, 5, 6, 7 Default = 3	
	Factory	BOILER MAXIMUM Select the maximum boiler water temperature.	120 to 225°F, OFF (49 to 107°C, OFF) Default = 180°F (82°C)	
	Factory	PUMP DELAY Select the boiler pump purge time after a shutting off the burner.	OFF, 0:20 to 9:55 min, On Default = 0:20 min	
	Factory Installer	TEMPERATURE UNITS Select to display temperature in degrees Fahrenheit or in degrees Celsius.	°F, °C Default = °F	

## RELOAD FACTORY DEFAULTS

To reload FACTORY DEFAULT SETTINGS, press and hold the outside buttons (Item and Down) while powering the control up. This will reload the FACTORY DEFAULTS.

# Error Messages

Error Message	Description
	<p>E01</p> <p>The control was unable to read a piece of information from its EEPROM memory. The control will stop operation until all settings in the Adjust menu have been checked by the user or installer. To clear the error message <b>and alarm</b>, set Access Level DIP Switch A to Factory (on position), then check all Adjust menu items.</p>
	<p>BOILER OUTLET SENSOR SHORT CIRCUIT</p> <p>The control is no longer able to read the boiler outlet sensor due to a short circuit. In this case, if the boiler inlet sensor is present and operational, the control will operate using the boiler inlet sensor. Otherwise, the control will not operate the burner.</p> <p>Test the boiler outlet sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.</p>
	<p>BOILER OUTLET SENSOR OPEN CIRCUIT</p> <p>The control is no longer able to read the boiler outlet sensor due to an open circuit. In this case, if the boiler inlet sensor is present and operational, the control will operate using the boiler inlet sensor. Otherwise, the control will not operate the burner.</p> <p>Test the boiler outlet sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.</p>
	<p>BOILER INLET SENSOR SHORT CIRCUIT</p> <p>The control is no longer able to read the boiler inlet sensor due to a short circuit. In this case, the control will continue operation.</p> <p>Test the boiler inlet sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.</p>
	<p>BOILER INLET SENSOR OPEN CIRCUIT</p> <p>The control is no longer able to read the boiler inlet sensor due to an open circuit. In this case, the control will continue operation.</p> <p>Test the boiler inlet sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.</p>
	<p>BOILER SUPPLY SENSOR SHORT CIRCUIT</p> <p>The control is no longer able to read the boiler supply sensor due to a short circuit. In this case, if the boiler outlet sensor is operational, the control will operate based on the boiler outlet sensor.</p> <p>If the boiler outlet sensor is not available and the boiler inlet sensor is present and operational, the control will operate using the boiler inlet sensor. Otherwise, the control will not operate the burner.</p> <p>Test the boiler supply sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.</p>
	<p>BOILER SUPPLY SENSOR OPEN CIRCUIT</p> <p>The control is no longer able to read the boiler supply sensor due to an open circuit. In this case, if the boiler outlet sensor is operational, the control will operate based on the boiler outlet sensor. If the boiler outlet sensor is not available and the boiler inlet sensor is present and operational, the control will operate using the boiler inlet sensor. Otherwise, the control will not operate the burner.</p> <p>Test the boiler supply sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.</p>
	<p>OUTDOOR SENSOR SHORT CIRCUIT</p> <p>The control is no longer able to read the outdoor sensor due to a short circuit. In this case the control assumes an outdoor temperature of 32°F (0°C) and continues operation.</p> <p>Test the outdoor sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.</p>
	<p>OUTDOOR SENSOR OPEN CIRCUIT</p> <p>The control is no longer able to read the outdoor sensor due to an open circuit. In this case the control assumes an outdoor temperature of 32°F (0°C) and continues operation.</p> <p>Test the outdoor sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.</p>

## Technical Data

SF-10 Boiler Temperature Control		
Weight	0.38 lbs (170g)	
Enclosure	D, black noryl plastic	
Dimensions	4-3/4" H x 2-7/8" W x 1-7/8" D (120 x 74 x 48 mm)	
Approvals	ANSI Z21.23, CAN 1-6.6-M78-R 2001, UL873, UL840	
Ambient Conditions	Indoor use only, -40 to 140°F (-40 to 60°C), < 90% RH non-condensing.	
Power Supply	24 V (ac) ±10% 50/60 Hz 75 VA	
Pump / Stage 1 relays	120 V (ac) 5 A 1/6 hp pilot duty 240 VA	
Stage 2 / DHW relays	120 V (ac) 3 A 1/6 hp pilot duty 240 VA	
Demands	24 to 120 V (ac) 2 VA	
Sensors	NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) β=3892	
	included	1 of Universal Sensor 071 with 96" long wires (S/F# 790400000)
	included	Outdoor Sensor 070 (S/F# 339070000)
	optional	Universal Sensor 071 with 96" long wires (S/F# 790400000)



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