

# tektra® - Data Brochure

## Boiler Temperature Control (BTC I MPDA)

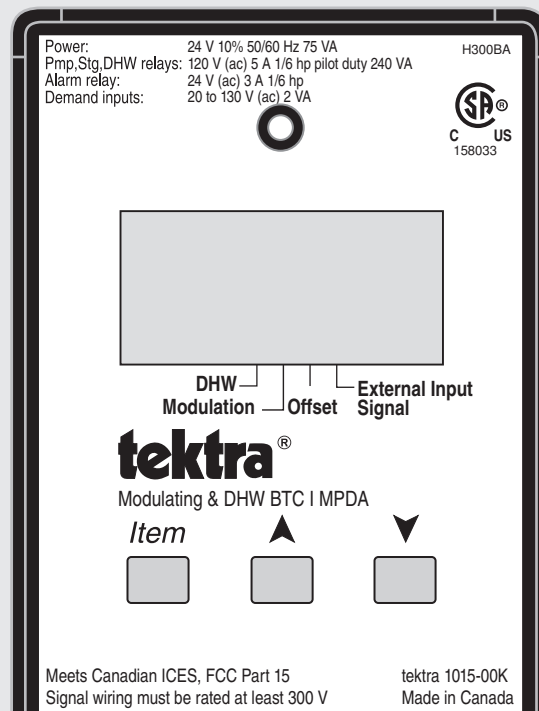
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The Boiler Temperature Control (BTC) is a cost effective boiler operator with a digital LCD display with backlight, a boiler pump output, an alarm output, and either a 4-20 mA or digital output. The control regulates the boiler based upon setpoint, dedicated domestic hot water heating, outdoor reset with domestic hot water heating priority, and several options for external boiler control.

### Features:

- Setpoint Operation
- Dedicated DHW
- Outdoor Reset with DHW Priority
- External Control through Temperature Target
- External Control through Direct Drive
- 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.

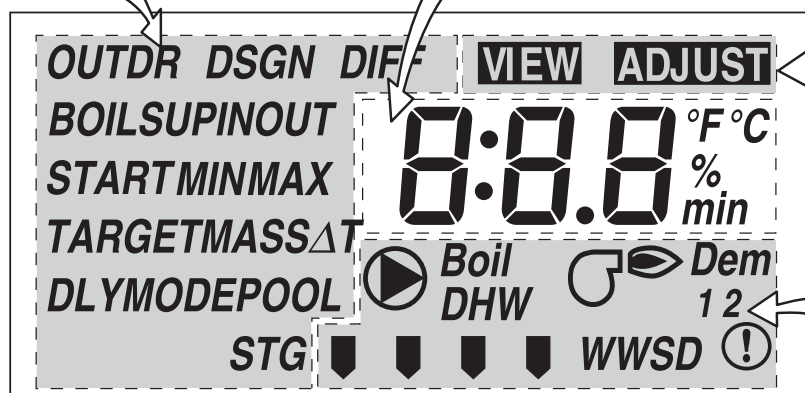
## Display

### 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

**Buttons**  
Selects Menus, Items and adjusts settings



## Symbol Description

 <b>Boil</b> <b>BOILER PUMP</b> Displays when the boiler pump is in operation.	 <b>BURNER</b> Displays when the burner is on.
 <b>DHW</b> <b>DHW PUMP</b> Displays when the DHW pump is in operation.	 <b>WARNING</b> Displays when an error message is present.
<b>Dem 1</b> <b>HEAT DEMAND</b> Displays when a heat demand is present.	 <b>POINTERS</b> Displays the operation as indicated by the text.
<b>Dem 2</b> <b>DHW DEMAND</b> Displays when a DHW demand is present.	<b>WWSD</b> <b>WWSD</b> Displays when the control is in Warm Weather Shut Down.

## Sequence of Operation

### Section A

General  
Operation  
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### Section B

Setpoint  
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### Section C

Dedicated DHW  
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### Section D

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### Section E

External Temp.  
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### Section F

External Direct  
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### Section G

Indirect DHW  
Operation  
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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

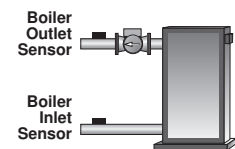
The control's display has a backlight that is permanently on while the control is powered.

### 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.

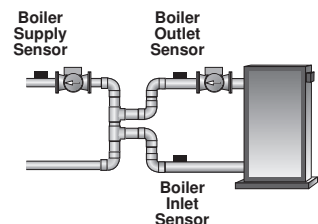
### PARALLEL PIPING

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)

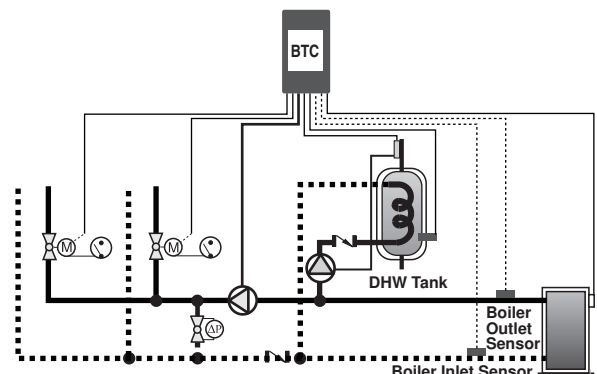
The control allows for eight modes of operation in order to define the control operation and piping arrangement used. The piping arrangement can be categorized into parallel and primary / secondary. The mode of operation is selected using the MODE item in the Adjust menu. The temperature being controlled 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, the boiler supply sensor, or DHW sensor.

### MODE 1

#### (Setpoint Operation with Parallel Piping)

Mode 1 is designed for setpoint operation using parallel piping. Once a heat demand signal is present, the control modulates 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 boiler 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 G for a description of indirect domestic hot water operation.

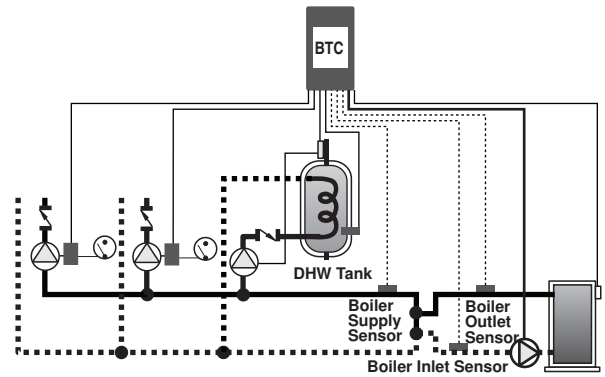


## MODE 2

### (Setpoint Operation with Primary / Secondary Piping)

Mode 2 is designed for setpoint operation using primary / secondary piping. Once a heat demand signal is present, the control modulates the boiler burner to maintain the boiler target at the boiler supply sensor. Refer to section B for a description of setpoint operation.

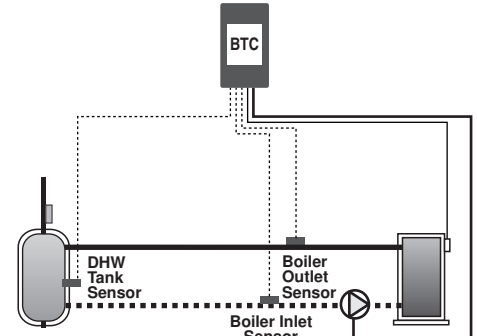
Once a DHW demand is present, the control operates the boiler burner to maintain the DHW boiler target at the boiler outlet sensor. If both a heat demand and a DHW demand are present at the same time, the control targets the higher of the two requirements. Refer to section G for a description of indirect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



## MODE 3

### (Dedicated Domestic Hot Water Operation)

Mode 3 is designed for dedicated DHW operation using parallel piping. The control modulates the boiler burner based on the boiler outlet sensor to maintain a tank temperature at the DHW sensor. Refer to section C for a description of dedicated DHW operation.

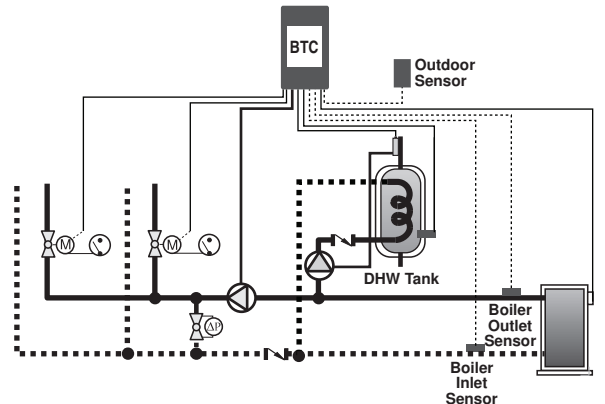


## MODE 4

### (Outdoor Reset and Domestic Hot Water Operation with Parallel Piping)

Mode 4 is designed for outdoor reset and domestic hot water (DHW) operation using parallel piping. Once a heat demand is present, the control modulates the boiler burner to maintain the calculated outdoor reset target at the boiler outlet sensor. Refer to section D for a description of outdoor reset operation.

Once a DHW demand is present, the control operates the boiler burner to maintain the DHW boiler 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 G for a description of indirect domestic hot water operation.

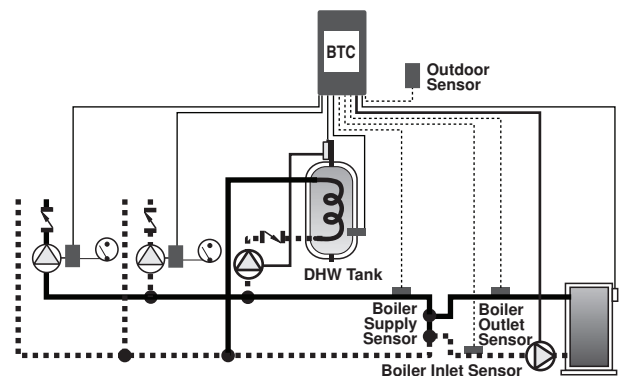


## MODE 5

### (Outdoor Reset and Domestic Hot Water with Primary / Secondary Piping)

Mode 5 is designed for outdoor reset and domestic hot water (DHW) operation using primary / secondary piping. Once a heat demand is present, the control modulates the boiler burner to maintain the calculated outdoor reset target at the boiler supply sensor. Refer to section D for a description of outdoor reset operation.

Once a DHW demand is present, the control operates the boiler burner to maintain the DHW boiler 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 G for a description of indirect domestic hot water operation.

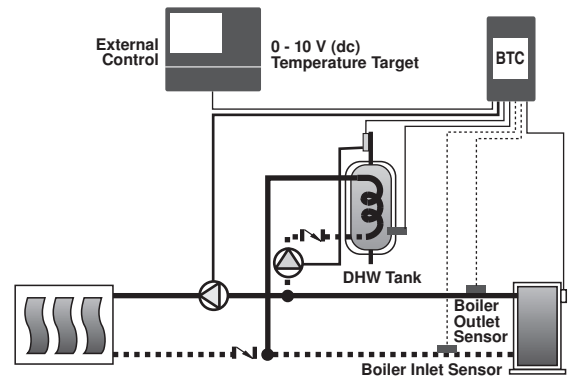


## MODE 6

### (External Target Temperature Input and DHW Operation with Parallel Piping)

Mode 6 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 modulates the boiler burner to maintain the boiler target at the boiler outlet sensor. Refer to section E for a description of external target temperature operation.

Once a DHW demand is present, the control operates the boiler burner to maintain the DHW boiler 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 G for a description of indirect domestic hot water operation.

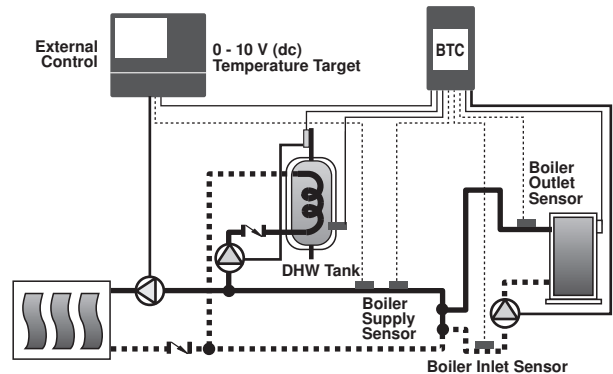


## MODE 7

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

Mode 7 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 modulates the boiler burner to maintain the boiler target at the boiler outlet sensor. Refer to section E for a description of external target temperature operation.

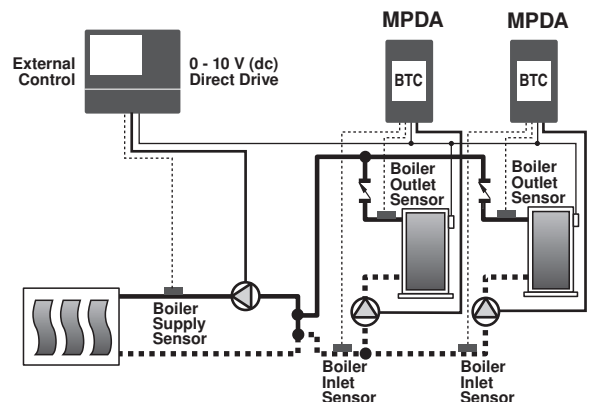
Once a DHW demand is present, the control operates the boiler burner to maintain the DHW boiler target at the boiler supply sensor. If both a heat demand and a DHW demand are present at the same time, the control targets the higher of the two requirements. Refer to section G for a description of indirect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



## MODE 8

### (External Direct Drive Operation)

Mode 8 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 F for a description of external target temperature operation.



## MODULATING OUTPUT

### Analog Signal

The control can operate a single modulating burner by providing an analog 4-20 mA signal to the blower variable frequency drive or the modulating gas valve motor.

### Digital Signal

The control can operate a single modulating burner by providing a digital pulse width modulation signal to the blower variable frequency drive or the modulating gas valve motor.

## STAGE CONTACT

The stage contact is closed to fire the burner. The stage contact typically activates an on / off gas valve. The stage contact closes when a demand is present and the boiler target is not satisfied. Once the boiler temperature is satisfied, or the demand is removed, the stage contact is opened. The control displays the status of the stage contact by showing a burner symbol in the View menu while the stage contact is activated.

## MOTOR SPEED (*Motor Speed*)

The control includes a motor speed adjustment that sets the fastest rate for the modulating output to change from 0% output to 100% output.

## START MODULATION (*START Modulation*)

The START Modulation setting is the firing rate recommended for proper burner ignition, and is based on the modulation output signal that provides burner ignition. Once the modulation output reaches the start modulation setting, the stage contact is closed to allow for boiler ignition. For example, if a 4-20 mA VFD is used and 4 mA is the signal recommended for burner ignition, the START Modulation should be set to 0%.

## FIRE DELAY (*G DLY*)

The Fire Delay is the delay time that may occur between the time that the control closes the stage contact and when the burner fires. This delay is usually the result of a burner pre-purge, ignition delay or other forms of time delay built into the burner's safety circuits. During the Fire Delay, the burner is held at the Start Modulation setting. Once the Fire Delay elapses, the modulating output is able to change the firing rate of the burner.

## MINIMUM MODULATION (*MIN Modulation*)

The MIN Modulation setting is the lowest firing rate the control will modulate down to during operation. This setting is based on the modulation output signal that provides low fire. For example, if a 4-20 mA VFD is used and 4 mA provides low fire, the MIN Modulation should be set to 0%.

## SOFT STOP

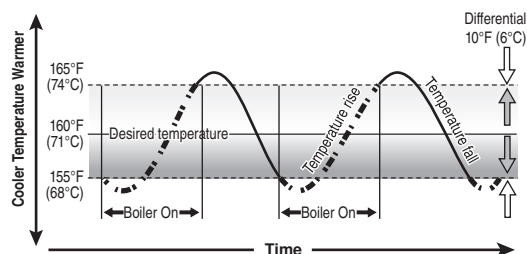
Once a demand is removed, the control allows for the firing rate to be modulated down to the MIN Modulation setting prior to turning off the burner. This feature is enabled by setting the Soft Stop / Off DIP switch to the Soft Stop position. If the Soft Stop / Off DIP switch is in the OFF position, the control turns off the burner at the current firing rate once a demand is removed.

## BOILER DIFFERENTIAL (*DIFF*)

At low fire, the burner must be operated with a differential in order to reduce short cycling. The boiler differential is divided around the boiler target temperature. The stage contact will close once the modulating output is at the start modulation setting and the water temperature at the operating sensor is 1/2 of the differential setting below the boiler target temperature, and will open once the modulating output is at the minimum modulation setting and the water temperature at the operating sensor is 1/2 of the differential setting above the boiler target temperature. The boiler differential does not apply once the modulation output is over the minimum modulation setting, instead, the modulation rate is increased or decreased.

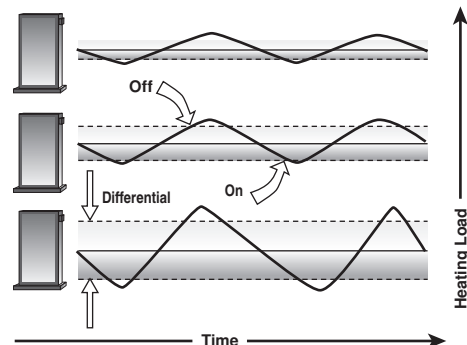
### Manual Differential

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 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.





## BOILER MASS (BOIL MASS)

The BOIL MASS setting allows the installer to adjust the control to the thermal mass of different types of heat sources used. Either Low, Medium, or High mass can be selected. The boiler mass setting automatically determines the rate of modulation, minimum on time and minimum off time of the boiler, and Proportional, Integral, and Derivative parameters.

Proportional, Integral, and Derivative (PID)

PID allows the control to determine the rate of modulation. The control examines the control error to determine the rate of modulation. The control error is determined using PID logic.

**Proportional** compares the actual operating sensor temperature to the boiler target temperature. The colder the temperature, the quicker the modulation.

**Integral** compares the actual operating sensor temperature to the boiler target temperature over a period of time. The modulation will increase if the temperature does not rise over a period of time.

**Derivative** responds to how fast or slow the operating sensor temperature is changing. If the temperature is increasing slowly, faster modulation will occur. If the temperature is increasing quickly, slower modulation will occur.

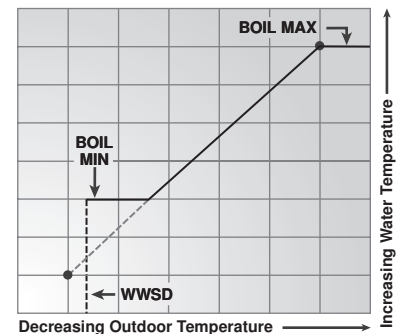
## BOILER MINIMUM (BOIL MIN)

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.

## 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.

In Mode 8 (External Input Direct Drive), the burner is immediately shut off once the boiler outlet sensor exceeds the BOIL MAX setting.



## 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, 4 and 6 is the boiler outlet sensor, and the operating sensor for modes 2, 5 and 7 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 8 (External Input Direct Drive).

## BOILER PUMP OPERATION (P)

The boiler pump contact operates when:

- A heat demand is present and parallel piping (Mode 1, 4, 6) 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, 5, 7) is used. Once the burner is shut off the boiler pump is shut off. Primary / secondary piping reduces standby losses by isolating the boiler from the system while the burner is off.
- During a DHW demand the boiler pump contact is closed unless DHW priority is selected. During DHW priority, the boiler pump contact is off.
- After the burner shuts off the boiler pump remains on for the Pump DLY time setting in order to purge heat from the boiler to the system.
- During dedicated DHW operation (Mode 3), the boiler pump contact closes whenever there is an internal heat demand.
- During external direct drive operation (Mode 8), the boiler pump contact closes whenever there is a heat demand.



## BOILER PURGE (► DLY)

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 boiler 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

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)

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) (pins 1 and 2). Once voltage is applied, the control turns on the Dem 1 segment in the display.

If the operating sensor is 1/2 of the differential below the BOIL TARGET, the control then changes the modulation output to the START modulation setting, then closes the Stage contact (pins 15 and 16). The control waits for the Fire Delay to expire and then the modulating output changes the boiler burner output to maintain the programmed boiler target temperature at the operating sensor. 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.

## Section C: Dedicated Domestic Hot Water (DHW) Operation

When mode 3 is selected, the control provides dedicated DHW operation.

## INTERNAL DEMAND (Dem 1)

A heat demand is required whenever the DHW tank needs heating. A sensor is required to be inserted into a temperature immersion well within the DHW tank and is connected on the Com (sensor common) and the Sys/D (DHW sensor) (pins 4 and 6) in this mode of operation. An internal heat demand for DHW is generated when the temperature at the DHW sensor drops 1/2 of the tank differential setting below the desired DHW tank temperature. The TANK TARGET setting is used to set the desired DHW tank temperature. Once a heat demand is generated, the Dem 1 segment turns on in the LCD. The control then closes the Pump contact (pins 13 and 14), which starts the boiler pump and the control turns on the boiler pump segment in the display. The control then changes the modulation output to the START modulation setting, then closes the Stage contact (pins 15 and 16). The control waits for the Fire Delay to expire, then the modulating output changes the boiler burner output to maintain the programmed boiler target temperature at the boiler outlet sensor. The boiler target temperature is set using the BOIL TARGET item in the Adjust menu. Once the DHW tank reaches 1/2 of the tank differential above the TANK TARGET setting, the internal demand is removed and the boiler burner is shut off. The pump contact remains closed until the Pump DLY setting expires.

**Note:** An external demand is not required in this mode of operation.

## TANK DIFFERENTIAL (TANK DIFF)

The DHW tank temperature is maintained between 1/2 of the TANK DIFF above and below the TANK TARGET setting. Select the TANK TARGET and the TANK DIFF items in the Adjust menu.

## Section D: Outdoor Reset Operation

When either mode 4 or 5 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) pins (1 and 2). 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 and if the operating sensor is 1/2 of the differential below the calculated BOIL TARGET, the control then changes the modulation output to the START modulation setting, then closes the Stage contact (pins 15 and 16). The control waits for the Fire Delay to expire, then the modulating output changes the boiler burner output to maintain the calculated boiler target temperature at the operating sensor. 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.

### 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**)

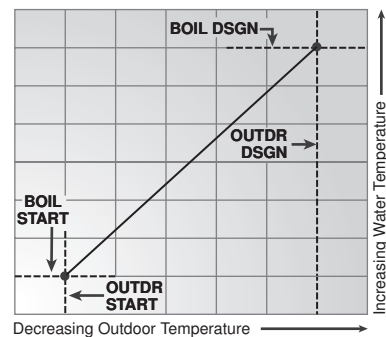
The OUTDR DSGN is the outdoor air temperature that is the typical coldest annual temperature where the building is located. This temperature is used when completing heat loss calculations for the building.

#### 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 E: External Temperature Target Input

When modes 6 or 7 are selected, the control allows for an external control to operate the boiler temperature through an analog input signal provided by a Building Management System (BMS), Energy Management System (EMS), or tekmar tN4 System Control. When in modes 6 or 7, the external heat demand (CD and Ht D) (pins 1 and 2) are disabled.

### INTERNAL HEAT DEMAND (*Dem 1*)

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 (pin 10). The negative V (dc) signal is applied to the Com/- input (pin 9). The control allows for the selection of the external input signal range, either 0-10 V (dc) or 2-10 V (dc).

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

When the 0-10 V (dc) signal 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 Ω 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

When the 2-10 V (dc) signal 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 Ω 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 Ω 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.

<b>Example</b>	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 F: External Direct Drive Operation

When mode 8 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 8, the external heat demand (CD and Ht D) (pins 1 and 2) and the DHW demand (CD and DHW D) (pins 1 and 3) 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 (pin 9).

The boiler burner remains off while the direct drive input signal range is between 0 to 0.5 V (dc). Once the direct drive input signal reaches 0.5 V (dc), the control modulating output changes to the Start Modulation setting and the Stage contact is closed to allow the boiler burner to enter ignition. The modulating output remains at the Start Modulation level until the Fire Delay setting elapses, after which the modulating output is adjusted to track the direct drive input signal up to the maximum of 10 V (dc) at which the boiler reaches 100% modulation. When the direct drive signal modulates down to 0.5 V (dc), the burner is adjusted to Minimum Modulation setting. Below 0.5 V (dc), the burner is shut off.

### PUMP OPERATION

The Pump contact (pins 13 and 14) 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 modulating output immediately changes to 0%, and 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 G: Indirect Domestic Hot Water Operation

When modes 1, 2, 4, 5, 6, or 7 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*)

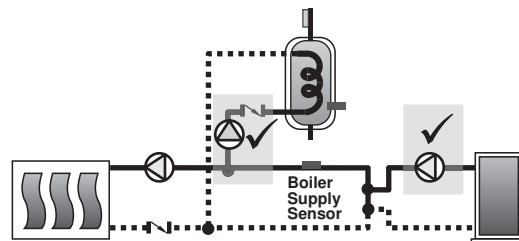
A DHW demand is required whenever the indirect DHW tank requires heating. A DHW demand is generated when a voltage between 24 and 120 V (ac) is applied across the CD (common demand) and the DHW D (DHW demand) (pins 1 and 3). Once voltage is applied, the control turns on the Dem 2 segment in the display. The control closes the DHW pump contacts (pins 17 and 18), 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

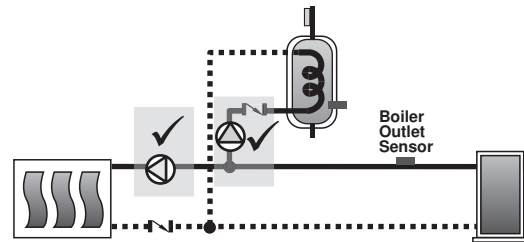
When the boiler is piped in primary / secondary to the boiler and MODE is set to 2, 4, or 6, the control operates the boiler pump together with the DHW pump.



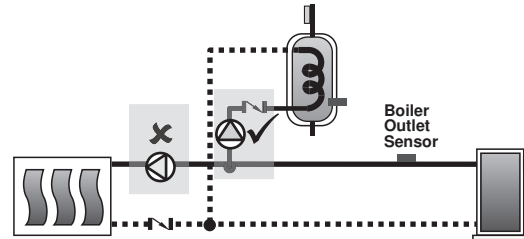
## DHW MODE & PRIORITY OPERATION (*Parallel Piping Only*)

It is often desirable to have priority for the DHW allowing 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, 4, or 6. DHW priority is achieved by shutting off the 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 the 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 4, 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 6, 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, 4, or 6 (parallel piping), the control shuts off the burner and continues to operate the DHW pump. In MODE 2, 5, or 7, 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.

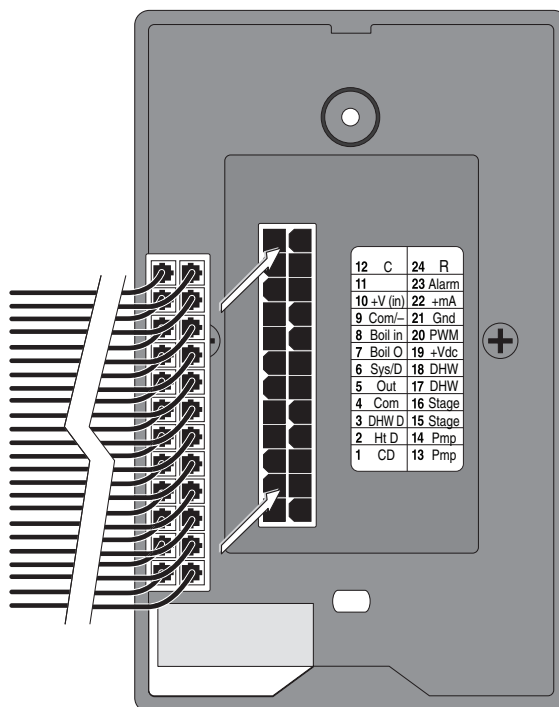
## DHW MIXING PURGE

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

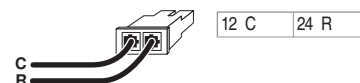
The installer should test to confirm that no voltage is present at any of the wires during installation. The control includes a 24 pin connector for ease of installation.



### Powered Input Connections

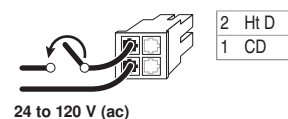
#### 24 V (ac) Power

Connect the 24 V (ac) power supply to the C and R pins (12 and 24). This connection provides power to the microprocessor and display of the control. As well, this connection provides power to the Alarm pin (25) from the R pin (24).



#### Heat Demand

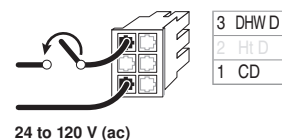
To generate a heat demand, a voltage between 24 V (ac) and 120 V (ac) must be applied across the CD (common demand) and the Ht D (heat demand) pins (1 and 2).



#### 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 (1 and 3).

**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

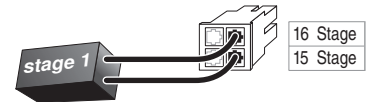
#### Boiler Pump Contact

The Pump pins (13 and 14) 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

The Stage pins (15 and 16) are isolated outputs 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 the burner circuit. When the control requires the burner to fire, it closes the Stage contact.



## DHW Pump Output

The DHW pump pins (17 and 18) 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).



## Analog Modulation Output

If a 4-20 mA modulating output is required, connect the positive 4-20 mA lead to the +mA pin (22) and the negative 4-20 mA lead to the Gnd pin (21). Maximum input impedance allowed in the 4-20 mA circuit is 1000  $\Omega$ .



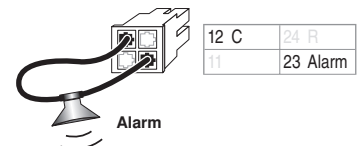
## Digital Modulation Output

If a digital output is required, connect the negative voltage lead to the Gnd pin (21), the positive voltage lead to the +Vdc pin (19), and the digital lead to the PWM pin (20).



## Alarm Contact

The Alarm pin (23) on the control is a powered output. When the relay contact in the control closes, 24 V (ac) from the R pin (24) is provided to the Alarm pin (23). To connect the alarm, connect one side of the alarm circuit to the Alarm pin (23) and the second side of the alarm circuit to the common (C) side of the 24 V (ac) power supply.



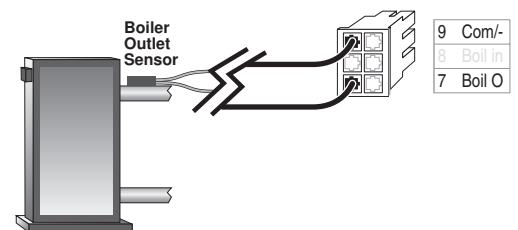
## Sensor Connections

**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) pins (9 and 7). The boiler outlet sensor is used by the control to measure the boiler outlet water temperature from the boiler.

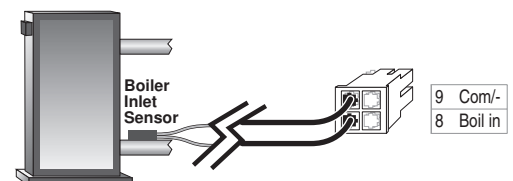
**Note:** The boiler outlet sensor is required for every mode of operation.



### Boiler Inlet Sensor

Connect the two wires from the Boiler Inlet Sensor to the Com/- (common sensor) and Boil in (boiler inlet sensor) pins (9 and 8). The boiler inlet sensor is used by the control to measure the boiler inlet water temperature from the boiler.

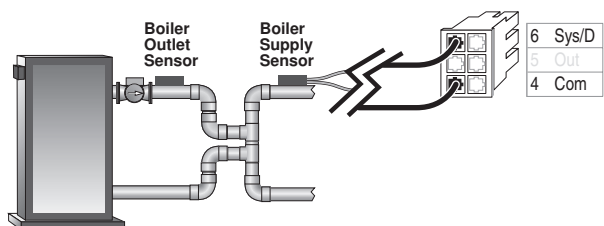
**Note:** The boiler inlet sensor is optional for every mode of operation.



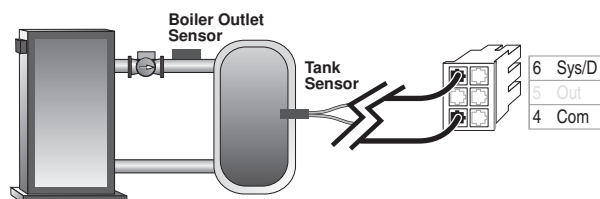


## Boiler Supply / DHW Sensor

An optional Boiler Supply Sensor or DHW Sensor may be connected to the control. If a sensor is used, connect the two wires from the sensor to the Com (common sensor) and Sys/D (boiler supply/DHW sensor) pins (4 and 6).

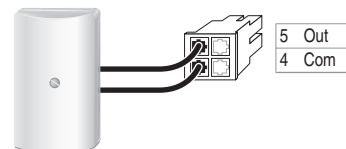


OR



## 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 (4 and 5). 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 (10) and connect the negative 0-10 V (dc) wire to the Com/- pin (9).



## 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.

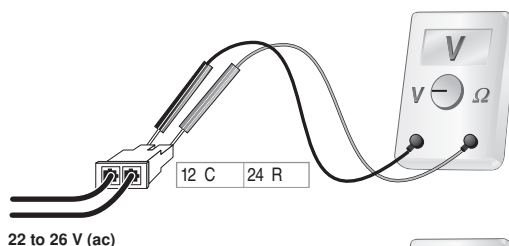
### TEST THE SENSORS

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

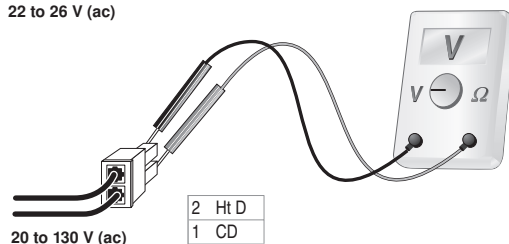
Make sure exposed wires and bare terminals are not in contact with other wires or grounded surfaces. Turn on the power and measure the voltage between the C and R pins (12 V and 24 V) using an AC voltmeter, the reading should be between 22 and 26 V (ac).



### 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 (1 and 2). 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.



#### DHW Demand

If a DHW demand is used, measure the voltage between the CD (common demand) and the DHW D (DHW demand) pins (1 and 3). 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 (9 and 10). 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>	After 1 second, the boiler pump contact is turned on.
STEP 2	 <b>Boil</b>  0 to 100%	After 4 seconds, the analog and digital modulating output ramps up to 100% over the motor speed setting, while the Stage contact turns on at the start modulation setting. The modulating output remains at 100% for 4 seconds.
STEP 3	 <b>Boil</b>  100 to 0%	The modulating output then ramps down to 0% while the Stage and pump contacts turn off at the minimum modulation setting.
STEP 4	 <b>DHW</b>	The DHW contact is turned on for 10 seconds and then shuts off.
STEP 5		The Alarm contact is turned on for 10 seconds and then shuts off.

The control exits the test sequence and resumes normal operation.

Control Settings

DIP SWITCH SETTING

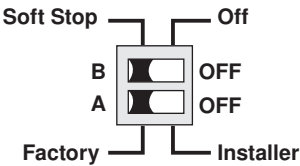
**Note:** DIP switches may be located either on the front or back of the control.

(A) 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 that are required for system setup.

(B) Soft Stop / Off

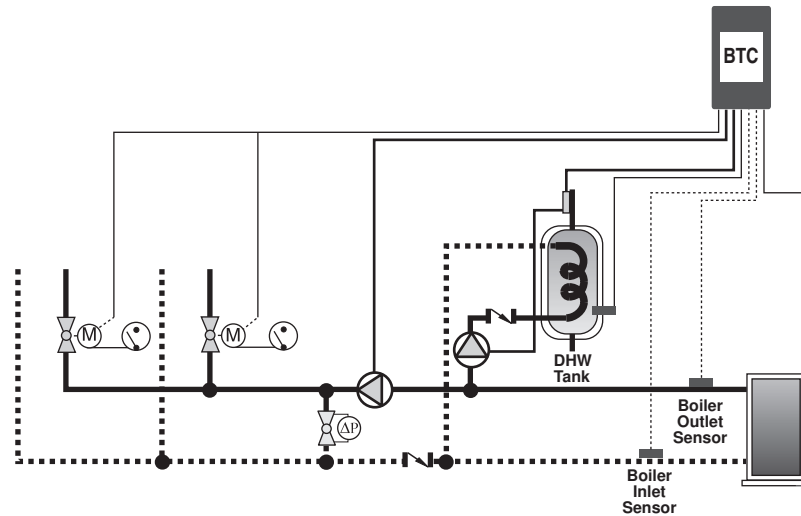
The Soft Stop / Off DIP switch is used to enable the soft stop feature once a demand is removed.



# MODE 1 and 2 – Setpoint & DHW Operation

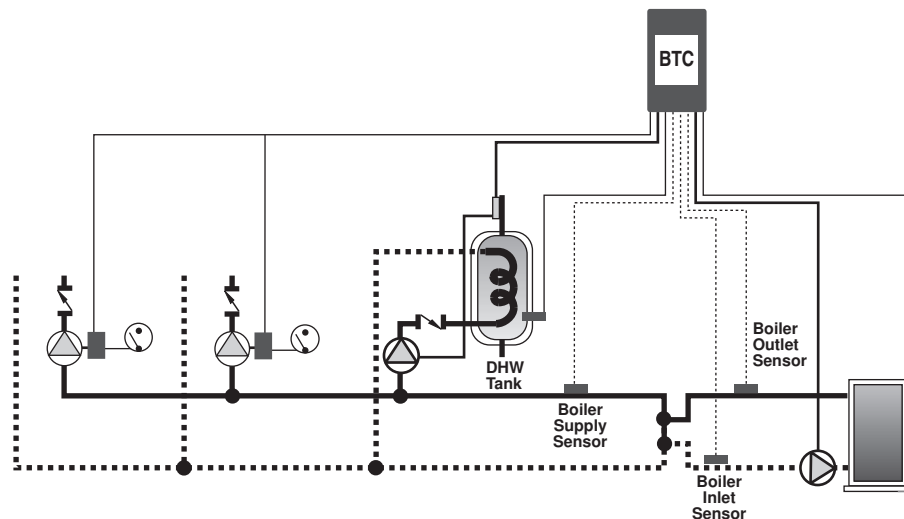
## Applications

### MODE 1 SETPOINT & DHW OPERATION – PARALLEL PIPING



- The control receives a heat demand provided from zone valve end switches or a switching relay end switch. The control turns on the boiler pump and operates the boiler to maintain the setpoint boiler target temperature at the boiler outlet sensor whenever a heat demand is present. 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 boiler target temperature at the boiler outlet sensor whenever a DHW demand is present.


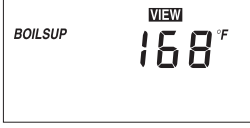
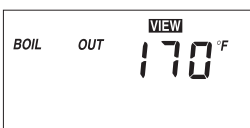
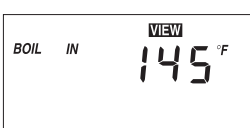
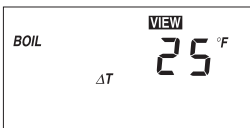
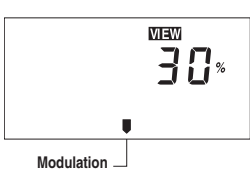
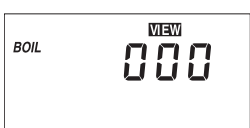
### MODE 2 – SETPOINT & DHW OPERATION-PRIMARY / SECONDARY PIPING



- The control receives a heat demand provided from zone valve end switches or a switching relay end switch. 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 boiler target temperature at the boiler supply sensor whenever a DHW demand is present.

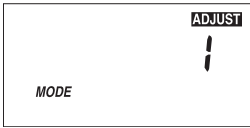
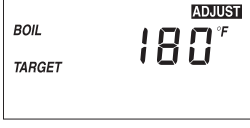



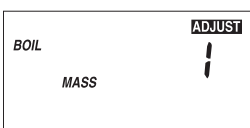
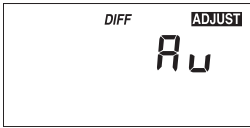

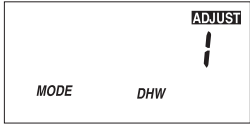

# MODE 1 and 2 – Setpoint & DHW Operation

## 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</b> Current boiler supply water temperature as measured by the boiler supply sensor. <b>Note:</b> 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. <b>Note:</b> 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. <b>Note:</b> 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. <b>Note:</b> This item is only available when a boiler inlet sensor is installed.	0 to 252°F (0 to 140°C)
	Factory Installer	<b>MODULATION</b> Current modulating output percentage.	0 to 100%
	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

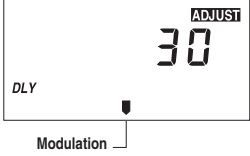
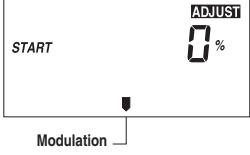
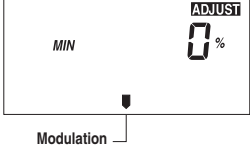


# MODE 1 and 2 – Setpoint & DHW Operation

## Adjust Menu (1 of 2)

Item Field	Access	Description	Range	Settings
	Factory Installer	<b>MODE</b> Select the operating mode for the control.	1, 2, 3, 4, 5, 6, 7, 8 Default = 1	
	Factory Installer	<b>BOILER TARGET</b> Select the boiler target temperature for setpoint operation.	OFF, 70 to 220°F (OFF, 21 to 104°C) Default = 180°F (82°C)	
	Factory	<b>BOILER MAXIMUM</b> Select the maximum boiler target water temperature.	120 to 225°F, OFF (49 to 107°C, OFF) Default = 210°F (99°C)	
	Factory	<b>BOILER MINIMUM</b> 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	<b>FIRE DELAY</b> Select the amount time required for combustion pre-purging, ignition and the flame to be established. The control will not adjust the modulation percentage from the Start Modulation percentage until this delay elapses.	0:00 to 3:00 minutes Default = 0:10 min (1 second increments)	
	Factory Installer	<b>BOILER MASS</b> Select the thermal mass of the boiler.	1 (low mass) 2 (medium mass) 3 (high mass) Default = 1	
	Factory	<b>DIFFERENTIAL</b> 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	<b>DHW BOILER TARGET</b> 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	<b>DHW MODE</b> Select no priority (1) or priority (2) of indirect DHW heating over space heating. <b>Note:</b> This item is only available when MODE is set to 1.	1, 2 Default = 1	
	Factory	<b>MODULATION</b> Select the analog modulation signal range.	0:20 or 4:20 Default = 4:20	

# MODE 1 and 2 – Setpoint & DHW Operation

## Adjust Menu (2 of 2)

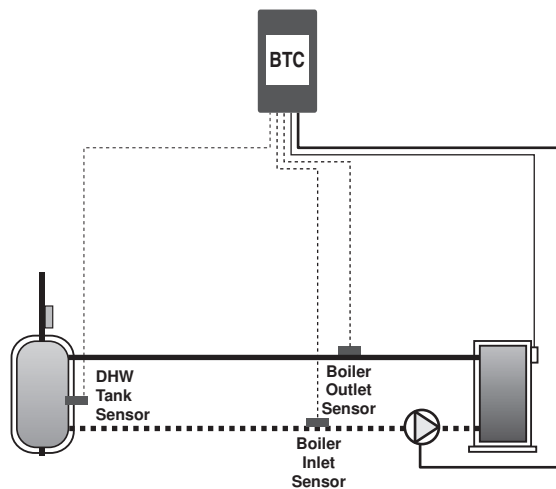
Item Field	Access	Description	Range	Settings
	Factory	<b>MODULATION DELAY</b> Select the rate at which the modulation signal changes from the Minimum Modulation setting to the Maximum Modulation setting.	10 to 230 seconds Default = 30 seconds	
	Factory	<b>START MODULATION</b> Select the percent modulation required for ignition.	0 to 50% Default = 0%	
	Factory	<b>MINIMUM MODULATION</b> Select the minimum modulation during burner operation.	0 to 50% Default = 0%	
	Factory	<b>PUMP DELAY</b> Select the boiler pump purge time after the burner is shut off.	OFF, 0:20 to 9:55 min, On Default = 0:20 min	
	Factory Installer	<b>TEMPERATURE UNITS</b> Select to display temperature in degrees Fahrenheit or in degrees Celsius.	°F, °C Default = °F	



# MODE 3 – Dedicated DHW Operation

## Applications

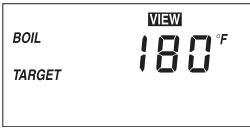
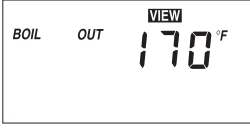
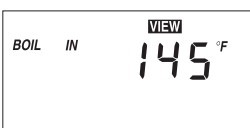
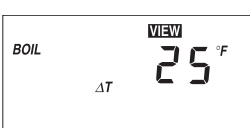
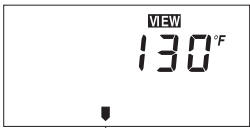
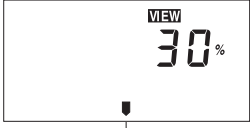
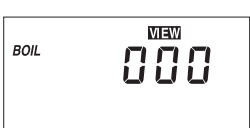
### MODE 3 – DEDICATED DHW OPERATION



- The control has a DHW sensor installed in an immersion well to measure the temperature of the tank. Once the DHW tank sensor falls 1/2 of the DHW Differential below the DHW target, an internal demand is created and the control turns on the boiler pump and operates the burner to maintain the boiler target temperature at the boiler outlet sensor. When the DHW tank sensor reaches 1/2 of the DHW Differential above the DHW target, the internal demand is removed, the burner is shut off, and the boiler pump completes a purge.

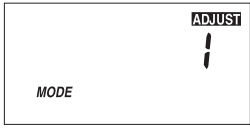

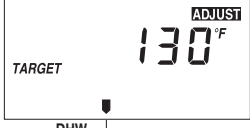




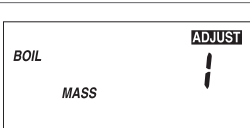
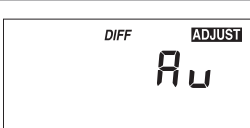
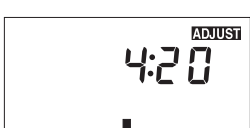
# MODE 3 – Dedicated DHW Operation

## 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 OUTLET</b> Current boiler outlet water temperature as measured by the boiler outlet sensor.	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. <b>Note:</b> 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. <b>Note:</b> This item is only available when a boiler inlet sensor is installed.	0 to 252°F (0 to 140°C)
	Factory Installer	<b>DHW</b> Current DHW tank temperature as measured by the DHW sensor.	14 to 266°F (-10 to 130°C)
	Factory Installer	<b>MODULATION</b> Current modulating output percentage.	0 to 100%
	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

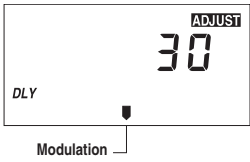
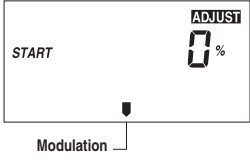
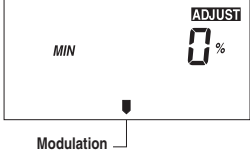


# MODE 3 – Dedicated & DHW Operation

## Adjust Menu (1 of 2)

Item Field	Access	Description	Range	Settings
	Factory Installer	<b>MODE</b> Select the operating mode for the control.	1, 2, 3, 4, 5, 6, 7, 8 Default = 1	
	Factory Installer	<b>BOILER TARGET</b> Select the boiler target temperature for setpoint operation.	OFF, 70 to 220°F (OFF, 21 to 104°C) Default = 180°F (82°C)	
	Factory Installer	<b>DHW TARGET</b> Select the DHW tank temperature.	OFF, 70 to 190°F (OFF, 21 to 88°C) Default = 130°F (54°C)	
	Factory Installer	<b>DHW DIFFERENTIAL</b> Select the DHW tank differential.	2 to 10°F (1 to 5°C) Default = 3°F (1°C)	
	Factory	<b>BOILER MAXIMUM</b> Select the maximum boiler target water temperature.	120 to 225°F, OFF (49 to 107°C, OFF) Default = 210°F (99°C)	
	Factory	<b>BOILER MINIMUM</b> 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	<b>FIRE DELAY</b> 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	<b>BOILER MASS</b> Select the thermal mass of the boiler.	1 (low mass) 2 (medium mass) 3 (high mass) Default = 1	
	Factory	<b>DIFFERENTIAL</b> 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	<b>MODULATION</b> Select the analog modulation signal range.	0:20 or 4:20 Default = 4:20	

# MODE 3 – Dedicated & DHW Operation

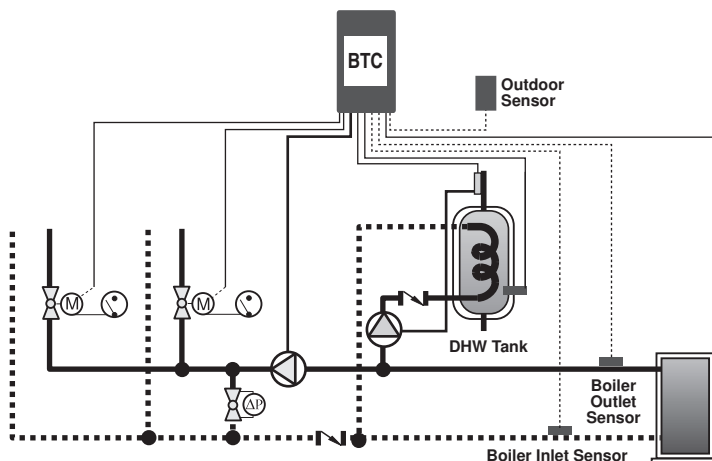
## Adjust Menu (2 of 2)

Item Field	Access	Description	Range	Settings
 <p>The screen displays 'DLY' on the left, '30' in the center, and 'ADJUST' in the top right corner. Below the display is a 'Modulation' label with a small downward arrow.</p>	Factory	<b>MODULATION DELAY</b> Select the rate at which the modulation signal changes from the Minimum Modulation setting to the Maximum Modulation setting.	10 to 230 seconds Default = 30 seconds	
 <p>The screen displays 'START' on the left, '0%' in the center, and 'ADJUST' in the top right corner. Below the display is a 'Modulation' label with a small downward arrow.</p>	Factory	<b>START MODULATION</b> Select the percent modulation required for ignition.	0 to 50% Default = 0%	
 <p>The screen displays 'MIN' on the left, '0%' in the center, and 'ADJUST' in the top right corner. Below the display is a 'Modulation' label with a small downward arrow.</p>	Factory	<b>MINIMUM MODULATION</b> Select the minimum modulation during burner operation.	0 to 50% Default = 0%	
 <p>The screen displays 'DLY' on the left, '0:20 min' in the center, and 'ADJUST' in the top right corner. Below the display is a play button icon.</p>	Factory	<b>PUMP DELAY</b> Select the boiler pump purge time after the burner is shut off.	OFF, 0:20 to 9:55 min, On Default = 0:20 min	
 <p>The screen displays 'ADJUST' in the top right corner and '°F' in the center.</p>	Factory Installer	<b>TEMPERATURE UNITS</b> Select to display temperature in degrees Fahrenheit or in degrees Celsius.	°F, °C Default = °F	

# MODE 4 and 5 – Outdoor Reset & DHW Operation

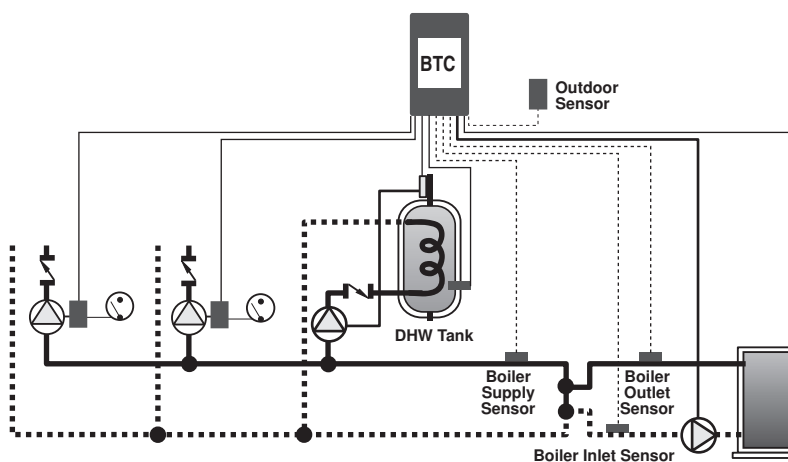
## Applications

### MODE 4 – OUTDOOR RESET & DHW OPERATION - PARALLEL PIPING



- The control receives a heat demand provided from zone valve end switches or a switching relay end switch. The control turns on the boiler pump and operates the boiler to maintain the outdoor reset 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 boiler target temperature at the boiler outlet sensor whenever a DHW demand is present.

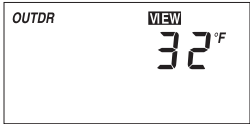

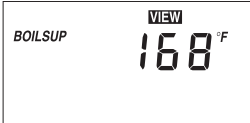
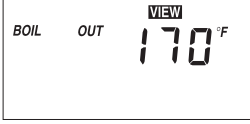
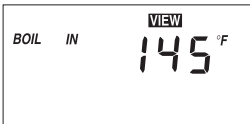
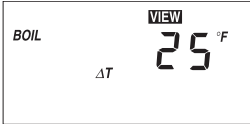
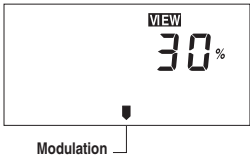
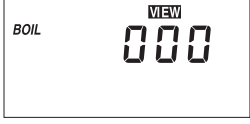
### MODE 5 – OUTDOOR RESET & DHW OPERATION - PRIMARY / SECONDARY



- The control receives a heat demand provided from zone valve end switches or a switching relay end switch. The control operates the boiler to maintain the outdoor reset boiler target temperature at the boiler supply sensor. The control receives a DHW Demand from a DHW aquastat. The control turns on both the DHW pump and boiler pump, and then operates the boiler to maintain the DHW boiler target temperature at the boiler supply sensor whenever a DHW demand is present.




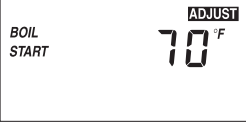




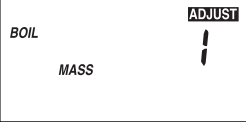
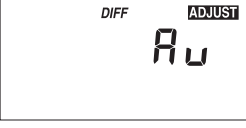
# MODE 4 and 5 – Outdoor Reset & DHW Operation

## 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</b> Current boiler supply water temperature as measured by the boiler supply sensor. <b>Note:</b> This item is only available when MODE is set to 5.	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. <b>Note:</b> When MODE is set to 5 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. <b>Note:</b> 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. <b>Note:</b> This item is only available when a boiler inlet sensor is installed.	0 to 252°F (0 to 140°C)
	Factory Installer	<b>MODULATION</b> Current modulating output percentage.	0 to 100%
	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 4 and 5 – Outdoor Reset & DHW Operation

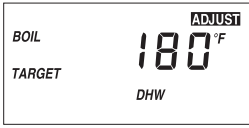
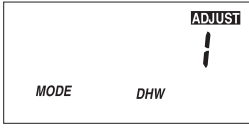
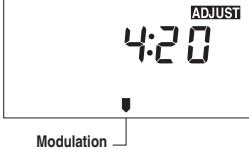
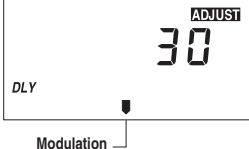
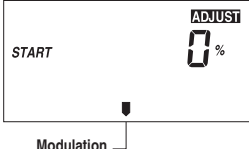
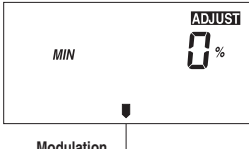



## Adjust Menu (1 of 2)

Item Field	Access	Description	Range	Settings
	Factory Installer	<b>MODE</b> Select the operating mode for the control.	1, 2, 3, 4, 5, 6, 7, 8 Default = 1	
	Factory Installer	<b>OUTDOOR START</b> 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	<b>OUTDOOR DESIGN</b> 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 (-23°C)	
	Factory Installer	<b>BOILER START</b> 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	<b>BOILER DESIGN</b> 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	<b>BOILER MAXIMUM</b> Select the maximum boiler target water temperature.	120 to 225°F, OFF (49 to 107°C, OFF) Default = 210°F (99°C)	
	Factory	<b>BOILER MINIMUM</b> 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	<b>FIRE DELAY</b> The amount time required for combustion pre-purging, ignition and the flame to be established. The control will not adjust the modulation percentage from the Start Modulation percentage until this delay elapses.	0:00 to 3:00 minutes Default = 0:10 min (1 second increments)	
	Factory Installer	<b>BOILER MASS</b> Select the thermal mass of the boiler.	1 (low mass) 2 (medium mass) 3 (high mass) Default = 1	
	Factory	<b>DIFFERENTIAL</b> 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	



# MODE 4 and 5 – Outdoor Reset & DHW Operation

## Adjust Menu (2 of 2)

Item Field	Access	Description	Range	Settings
 <p>BOIL TARGET DHW</p>	Factory	<b>DHW BOILER TARGET</b> Select the boiler target temperature while heating an indirect DHW tank.	70 to 220°F (21 to 104°C) Default = 180°F (82°C)	
 <p>MODE DHW</p>	Factory	<b>DHW MODE</b> Select no priority (1) or priority (2) of indirect DHW heating over space heating. <b>Note:</b> This item is only available when MODE is set to 4.	1, 2 Default = 1	
 <p>Modulation</p>	Factory	<b>MODULATION</b> Select the analog modulation signal range.	0:20 or 4:20 Default = 4:20	
 <p>DLY Modulation</p>	Factory	<b>MODULATION DELAY</b> Select the rate at which the modulation signal changes from the Minimum Modulation setting to the Maximum Modulation setting.	10 to 230 seconds Default = 30 seconds	
 <p>START Modulation</p>	Factory	<b>START MODULATION</b> Select the percent modulation required for ignition.	0 to 50% Default = 0%	
 <p>MIN Modulation</p>	Factory	<b>MINIMUM MODULATION</b> Select the minimum modulation during burner operation.	0 to 50% Default = 0%	
 <p>DLY</p>	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	
 <p>WWSD</p>	Factory Installer	<b>WARM WEATHER SHUT DOWN</b> Select the space heating system's warm weather shut down when using outdoor reset. The control continues to respond to heat the DHW tank.	35 to 100°F, OFF (2 to 38°C, OFF) Default = 70°F (21°C)	
 <p>°F</p>	Factory Installer	<b>TEMPERATURE UNITS</b> Select to display temperature in degrees Fahrenheit or in degrees Celsius.	°F, °C Default = °F	

## Applications

External Control

0 - 10 V (dc)  
Temperature Target

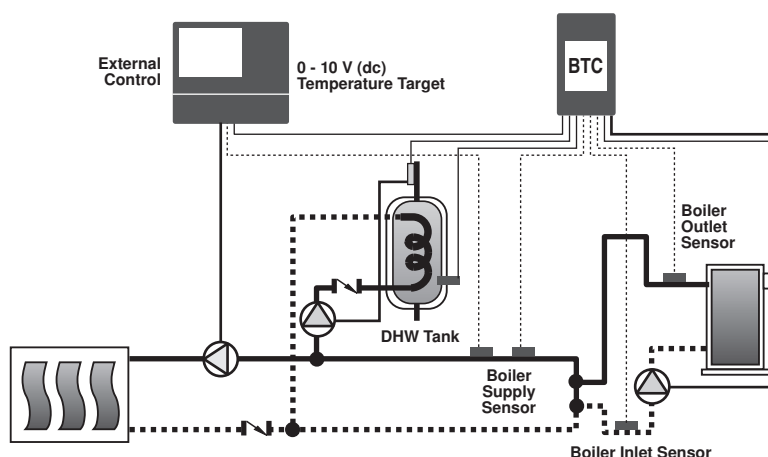
BTC

DHW Tank

Boiler Inlet Sensor

Boiler Outlet Sensor

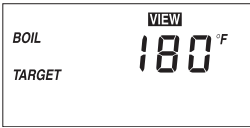

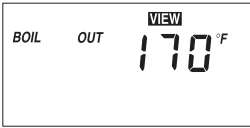
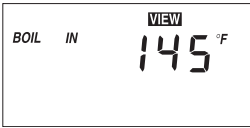
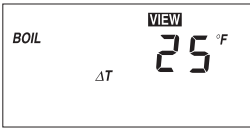
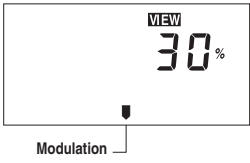
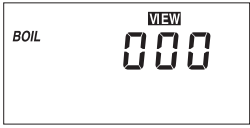
- ## MODE 7 – EXTERNAL TARGET TEMPERATURE INPUT & DHW OPERATION-PRIMARY / SECONDARY



- © 2007 **tektra**® D 1015 - 02/07

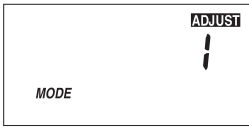



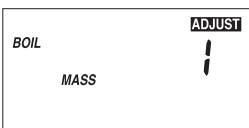
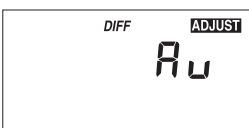

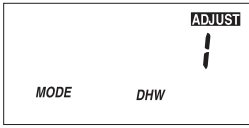
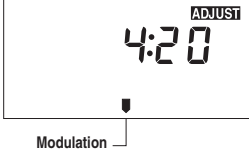
# MODE 6 and 7 – External Target Temperature

## 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. <b>Note:</b> This item is only available when MODE is set to 7.	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. <b>Note:</b> When MODE is set to 7 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. <b>Note:</b> 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. <b>Note:</b> This item is only available when a boiler inlet sensor is installed.	0 to 252°F (0 to 140°C)
	Factory Installer	<b>MODULATION</b> Current modulating output percentage.	0 to 100%
	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

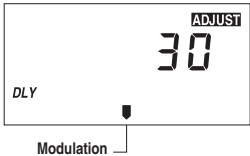
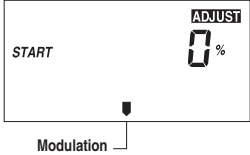
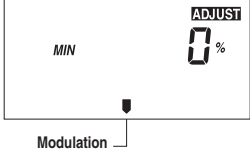

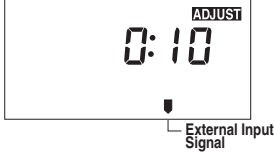
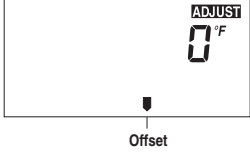

# MODE 6 and 7 – External Target Temperature

## Adjust Menu (1 of 2)

Item Field	Access	Description	Range	Settings
	Factory Installer	<b>MODE</b> Select the operating mode for the control.	1, 2, 3, 4, 5, 6, 7, 8 Default = 1	
	Factory	<b>BOILER MAXIMUM</b> Select the maximum boiler target water temperature.	120 to 225°F, OFF (49 to 107°C, OFF) Default = 210°F (99°C)	
	Factory	<b>BOILER MINIMUM</b> 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	<b>FIRE DELAY</b> The amount time required for combustion pre-purging, ignition and the flame to be established. The control will not adjust the modulation percentage from the Start Modulation percentage until this delay elapses.	0:00 to 3:00 minutes Default = 0:10 min	
	Factory Installer	<b>BOILER MASS</b> Select the thermal mass of the boiler.	1 (low mass) 2 (medium mass) 3 (high mass) Default = 1	
	Factory	<b>DIFFERENTIAL</b> 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	<b>DHW BOILER TARGET</b> 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	<b>DHW MODE</b> Select no priority (1) or priority (2) of indirect DHW heating over space heating. <b>Note:</b> This item is only available when MODE is set to 6.	1, 2 Default = 1	
	Factory	<b>MODULATION</b> Select the analog modulation signal range.	0:20 or 4:20 Default = 4:20	

# MODE 6 and 7 – External Target Temperature

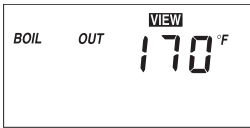
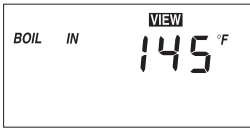
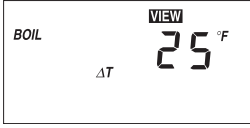
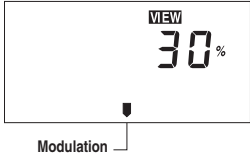
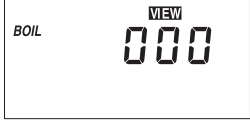
## Adjust Menu (2 of 2)

Item Field	Access	Description	Range	Settings
	Factory	<b>MODULATION DELAY</b> Select the rate at which the modulation signal changes from the Minimum Modulation setting to the Maximum Modulation setting.	10 to 230 seconds Default = 30 seconds	
	Factory	<b>START MODULATION</b> Select the percent modulation required for ignition.	0 to 50% Default = 0%	
	Factory	<b>MINIMUM MODULATION</b> Select the minimum modulation during burner operation.	0 to 50% Default = 0%	
	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 8 – External Direct Drive Operation




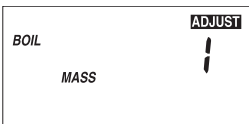
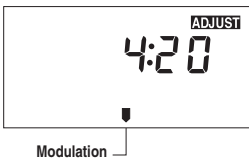
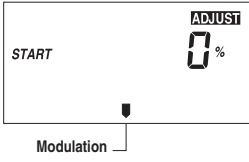
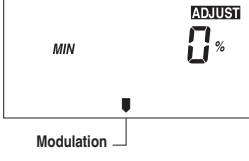


## View Menu (1 of 1)

Item Field	Access	Description	Range
	Factory Installer	<b>BOILER OUTLET</b> Current boiler outlet water temperature as measured by the boiler outlet sensor.	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. <b>Note:</b> 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. <b>Note:</b> This item is only available when a boiler inlet sensor is installed.	0 to 252°F (0 to 140°C)
	Factory Installer	<b>MODULATION</b> Current modulating output percentage.	0 to 100%
	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 press and holding the Up and Down buttons together while viewing this item.	0 to 999

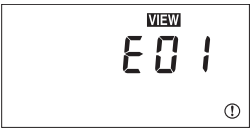
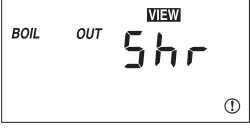
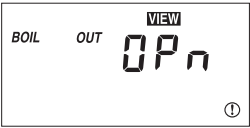
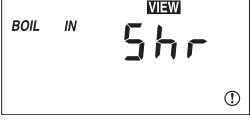
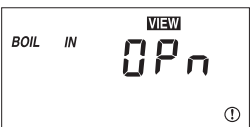
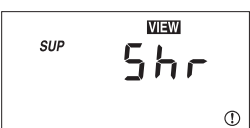
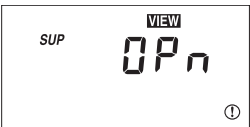


# MODE 8 – External Direct Drive Operation

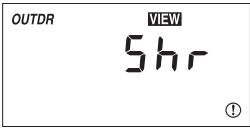
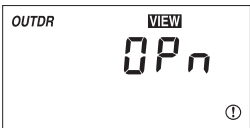
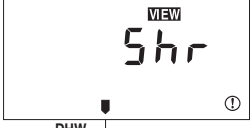
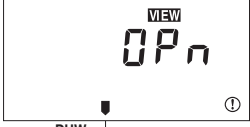
## Adjust Menu (1 of 1)

Item Field	Access	Description	Range	Settings
	Factory Installer	<b>MODE</b> Select the operating mode for the control.	1, 2, 3, 4, 5, 6, 7, 8 Default = 1	
	Factory	<b>BOILER MAXIMUM</b> Select the maximum boiler water temperature.	120 to 225°F, OFF (49 to 107°C, OFF) Default = 210°F (99°C)	
	Factory	<b>FIRE DELAY</b> Select the amount time required for combustion pre-purging, ignition and the flame to be established. The control will not adjust the modulation percentage from the Start Modulation percentage until this delay elapses.	0:00 to 3:00 minutes Default = 0:10 min (1 second increments)	
	Factory Installer	<b>BOILER MASS</b> Select the thermal mass of the boiler.	1 (low mass) 2 (medium mass) 3 (high mass) Default = 1	
	Factory	<b>MODULATION</b> Select the analog modulation signal range.	0:20 or 4:20 Default = 4:20	
	Factory	<b>START MODULATION</b> Select the percent modulation required for ignition.	0 to 50% Default = 0%	
	Factory	<b>MINIMUM MODULATION</b> Select the minimum modulation during burner operation.	0 to 50% Default = 0%	
	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 Installer	<b>TEMPERATURE UNITS</b> Select to display temperature in degrees Fahrenheit or in degrees Celsius.	°F, °C Default = °F	

# Error Messages 1 of 2

Error Message	Description
	<p><b>E01</b></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, set Access Level DIP Switch A to Factory (on position), then check all Adjust menu items.</p>
	<p><b>BOILER OUTLET SENSOR SHORT CIRCUIT</b></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><b>BOILER OUTLET SENSOR OPEN CIRCUIT</b></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><b>BOILER INLET SENSOR SHORT CIRCUIT</b></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><b>BOILER INLET SENSOR OPEN CIRCUIT</b></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><b>BOILER SUPPLY SENSOR SHORT CIRCUIT</b></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. 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><b>BOILER SUPPLY SENSOR OPEN CIRCUIT</b></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>

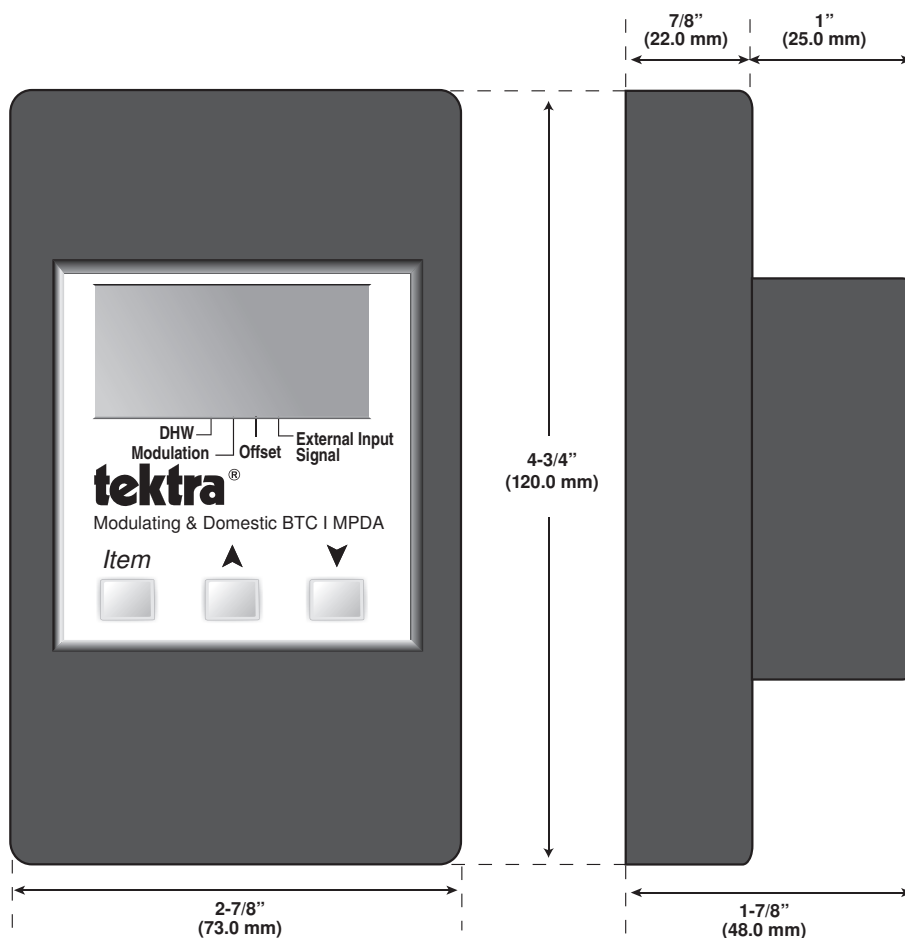
# Error Messages 2 of 2

Error Message	Description
 <p>The display shows 'OUTDR' in the top left, 'VIEW' in the top right, and 'Shr' in the center. A small circle with an 'i' is in the bottom right corner.</p>	<p><b>OUTDOOR SENSOR SHORT CIRCUIT</b></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>The display shows 'OUTDR' in the top left, 'VIEW' in the top right, and 'OPn' in the center. A small circle with an 'i' is in the bottom right corner.</p>	<p><b>OUTDOOR SENSOR OPEN CIRCUIT</b></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>
 <p>The display shows 'VIEW' in the top right, 'Shr' in the center, and 'DHW' with a small square icon in the bottom left. A small circle with an 'i' is in the bottom right corner.</p>	<p><b>DHW SENSOR SHORT CIRCUIT</b></p> <p>The control is no longer able to read the DHW sensor due to a short circuit. In this case the control will not operate the burner.</p> <p>Test the DHW sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.</p>
 <p>The display shows 'VIEW' in the top right, 'OPn' in the center, and 'DHW' with a small square icon in the bottom left. A small circle with an 'i' is in the bottom right corner.</p>	<p><b>DHW SENSOR OPEN CIRCUIT</b></p> <p>The control is no longer able to read the DHW sensor due to an open circuit. In this case the control will not operate the burner.</p> <p>Test the DHW sensor and related wiring. The error message will clear once the error condition is corrected and a button is pressed.</p>

## Technical Data

### BTC I MPDA Modulating Control

Weight	0.38 lb. (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-R2001
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
Modulating Analog (mA)	0/4-20 mA (1000 Ω Maximum)
Modulating Digital (PWM)	3 kHz carrier frequency, 0 to 100 % PWM range, supply 26 V (dc) through 13 kΩ sink 0.5 V (dc) through 1 kΩ
Pump / Stage / DHW relays	120 V (ac) 5 A 1/6 hp pilot duty 240 VA
Alarm relay	24 V (ac) 3 A 1/6 hp
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
optional	Universal Sensor 071, Outdoor Sensor 070



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