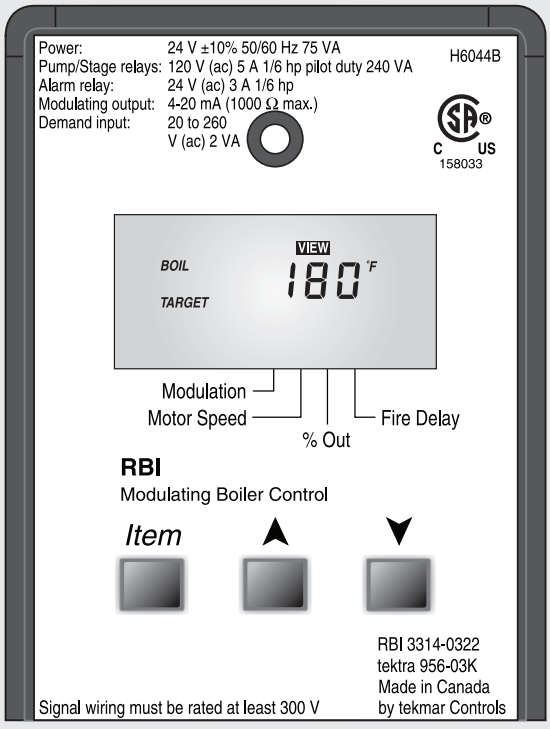
Data Brochure

Modulating Boiler Control

The Modulating Boiler Control operates a single modulating boiler to provide accurate water temperature control in a variety of applications. The control may be used to provide a setpoint temperature or dedicated DHW generation. Three relay contacts are included to provide operation for the boiler pump, alarm and ignition interlock.



Introduction

This brochure is organized into four main sections. They are: 1) Sequence of Operation, 2) Installation, 3) Control Settings, and 4) Troubleshooting. The Sequence of Operation section has 4 sub-sections. We recommend reading Section A: General of the Sequence of Operation, as this contains important information on the overall operation of the control. Then read the sub-sections that apply to your installation.

The Control Settings section (starting at DIP Switch Settings) of this brochure describes the various items that are adjusted and displayed by the control. The control functions of each adjustable item are described in the Sequence of Operation.

Table Of Contents

User Interface

The Modulating Boiler Control 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 control uses three push buttons (***Item,*** ▲, ▼) for selecting and adjusting settings. As you program your control, record your settings in the actual 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. These menus are listed on the upper right hand side of the display (Menu Field). The default menu for the control 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 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

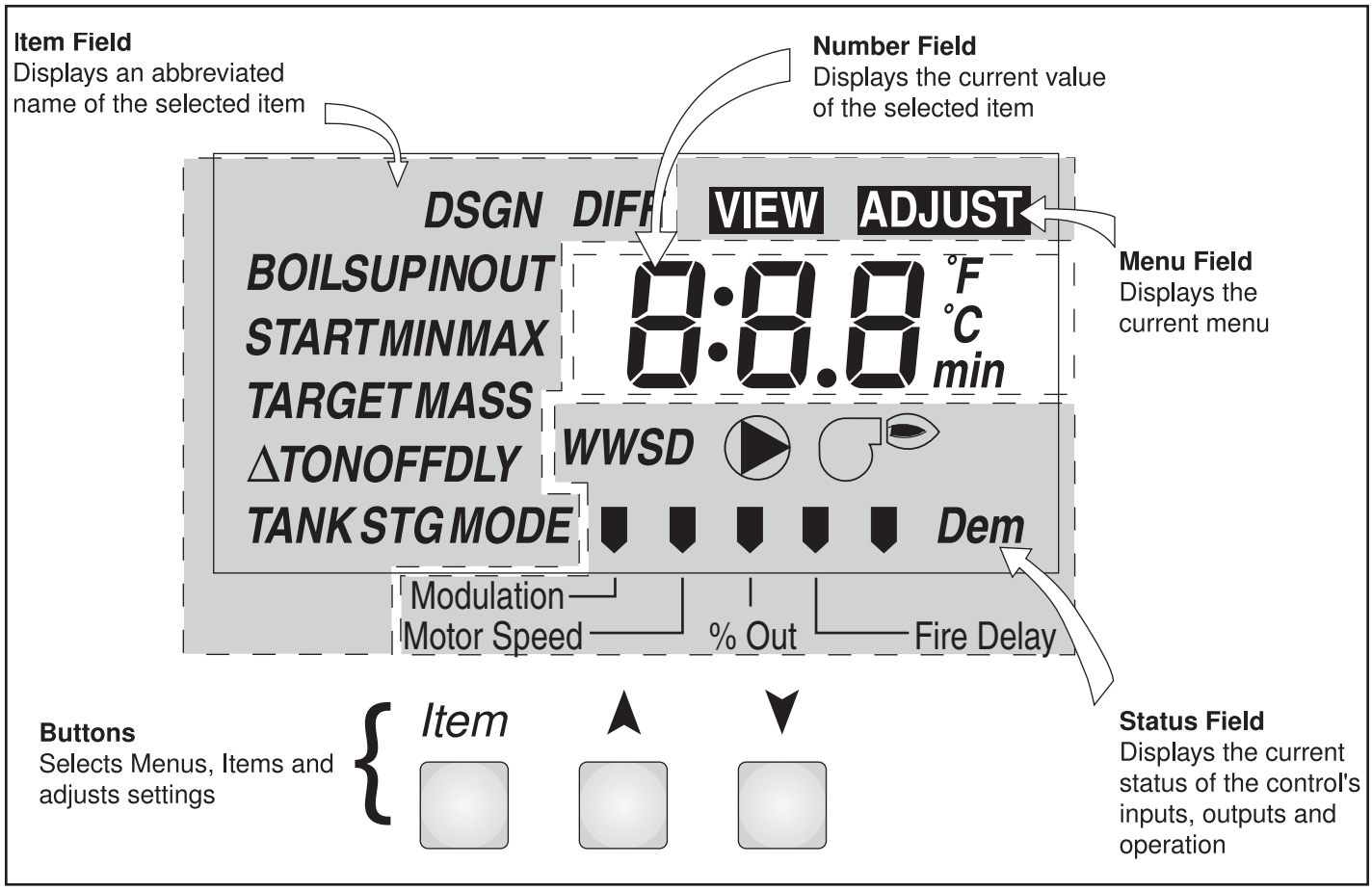
The abbreviated name of the selected item will be displayed in the item field of the display. To view the next available item, press and release the ***Item*** button. Once you have reached the last available item in a menu, pressing and releasing the Item button will return the display to the first 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.

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. Most symbols in the status field are only visible when the View menu is selected.

Display



Symbol Description

	**Pump** Displays when the boiler pump is in operation.	°F, °C	**°F, °C** Units of measurement.
	**Burner** Displays when the boiler is firing.		**Pointer** Displays the operation as indicated by the text.

Sequence of Operation

Section A: General

POWERING UP THE CONTROL

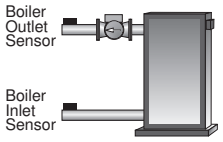
When the control is powered up, the control turns on all segments in the display for 2 seconds. Next, the software version is displayed for 2 seconds. Finally, the control enters into the normal operating mode.

MODES OF OPERATION (MODE)

The control allows for four modes of operation in order to define the control operation and piping arrangement used. The piping arrangement can be categorized into parallel and primary/secondary. The mode of operation is selected using the MODE item in the Adjust menu. The temperature being controlled out to the heating system is measured by the operating sensor. The piping arrangement determines which sensor the control uses as the operating sensor. The operating sensor is either the boiler outlet sensor or the boiler supply sensor. (see page 14 and 15 for typical applications)

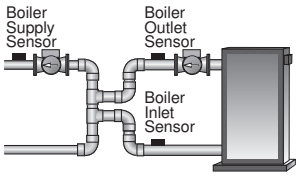
Parallel

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



Primary/Secondary

In primary/secondary applications, the boiler outlet temperature is typically higher than the primary loop temperature. Therefore, the control uses an additional sensor (boiler supply) to measure the temperature delivered out to the system. The operating sensor in primary/secondary piping applications is the boiler supply sensor.



Mode 1 (MODE = 1)

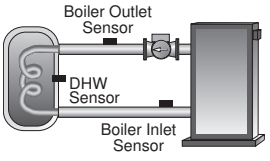
Mode 1 is designed for setpoint operation using parallel piping. Once a heat demand signal is present, the control operates the boiler and boiler pump to maintain a fixed temperature at the boiler outlet sensor. Refer to section B for a description of setpoint operation.

Mode 2 (MODE = 2)

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

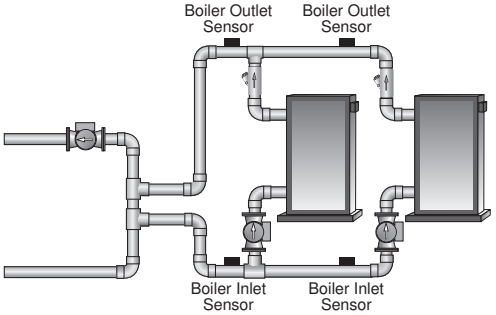
Mode 3 (MODE = 3)

Mode 3 is designed for dedicated DHW operation using parallel piping. Once an internal heat demand is present from the DHW sensor the control operates the boiler and boiler pump to maintain a fixed temperature at the boiler outlet sensor. Refer to section C for a description of dedicated DHW operation.



Mode 4 (MODE = 4)

Mode 4 is designed for external boiler control. This mode of operation allows for an external control to operate multiple boilers equipped with a Modulating Boiler Control. Once a heat demand is present, the control operates the ignition interlock and boiler pump. Refer to section D for a description of external boiler operation.



MODULATING OUTPUT

The control operates a single modulating boiler by providing a 4-20 mA analog output signal to an actuating motor which provides firing modulation. A visual indication of the current modulating output percentage is displayed in the LCD when the % Out pointer is indicated in the View menu.

MOTOR SPEED (Motor Speed)

The control includes a motor speed adjustment which sets the speed of the actuating motor which provides firing modulation.

START MODULATION (START Modulation)

The start modulation is the firing rate recommended for proper burner ignition, and is based on the analog output signal which provides burner ignition. For example, if 4 mA is the signal recommended for burner ignition, the START Modulation should be set to 0%.

MINIMUM MODULATION (MIN Modulation)

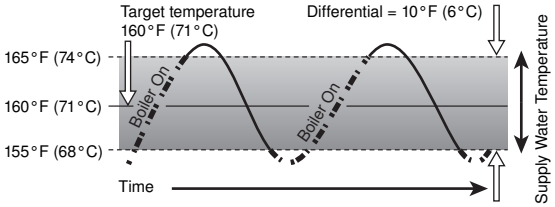
The minimum modulation is the firing rate the control will modulate down to during operation. This setting is based on the analog output signal which provides low fire. For example, if 4 mA provides low fire, the MIN Modulation should be set to 0%.

FIRE DELAY (Fire Delay)

The Fire Delay is the delay time between the analog output being adjusted to the Start Modulation and when the burner fires. This delay is usually the result of a burner pre-purge or other forms of time delay built into the burner's safety circuits.

BOILER DIFFERENTIAL (DIFF)

A modulating boiler must be operated with a differential while operating in low fire. The boiler differential is divided around the boiler target temperature. The boiler starts at low fire when the supply water temperature is ½ of the differential setting below the boiler target temperature. The boiler is shut off in low fire as the supply temperature reaches at least ½ of the differential above the boiler target temperature. With the control, either a fixed or an auto differential may be selected.



When the boiler is modulating above low fire, the differential does not apply. Instead, the modulation output signal is determined using Proportional, Integral and Derivative (PID) logic in order to satisfy the boiler target temperature.

Proportional & Integral & Derivative (PID)

The modulation rate of the boiler 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.

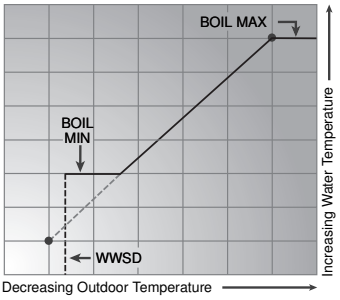
Derivative determines how fast or slow the operating sensor temperature is changing. If the temperature is increasing slowly, faster modulation will occur. If the temperature is increasing quickly, slower modulation will occur.

BOILER MASS (BOIL MASS)

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

BOILER MINIMUM (BOIL MIN)

The BOIL MIN 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 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.

BOILER TARGET TEMPERATURE (BOIL TARGET)

The boiler target temperature is determined from the mode of operation. 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 and 3 is the boiler outlet sensor, and the operating sensor for mode 2 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 4.

BOILER PUMP OPERATION

The boiler pump contact *Pmp Pmp* (terminals 13 and 14) operates based on the mode of operation selected, the boiler purge feature and exercising.

During setpoint operation using parallel piping (Mode 1), the boiler pump contact closes whenever there is a heat demand. The boiler pump contact opens after the demand is removed and the control has completed a boiler purge.

During setpoint operation using primary - secondary piping (Mode 2), the boiler pump contact is cycled with the burner operation. This allows for intermittent boiler pump operation while there is a permanent heat demand. The system pump must remain on to ensure proper purging and provide temperature feedback from the boiler supply sensor. When the ignition sequence starts, the boiler pump is turned on. Once the burner shuts off, the boiler pump completes a boiler purge and then shuts off.

During dedicated DHW operation (Mode 3), the boiler pump contact closes whenever there is an internal heat demand. The boiler pump contact opens after the demand is removed and the control has completed a boiler purge.

During external boiler operation (Mode 4), the boiler pump contact closes whenever there is a heat demand. The boiler pump contact opens after the demand is removed and the control has completed a boiler purge.

BOILER PURGE (PMP DLY)

After a demand is satisfied (or burner shuts off in the case of Mode 2), 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.

When Pump DLY is set to OFF, there is no purging.

When Pump DLY is set to a time, the control keeps the boiler pump running for the time selected, once the boiler turns off. 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 ON, the pump runs continuously.

BOILER ΔT (BOIL ΔT)

The control monitors the temperature difference between the boiler outlet and the boiler inlet sensors. The boiler ΔT is one of the items displayed in the VIEW menu.

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 Modulating Boiler Control controls the water temperature based on a fixed setpoint. The setpoint temperature is set using the BOIL TARGET item in the Adjust menu.

HEAT DEMAND

A heat demand is required whenever heat is required for the setpoint load. A heat demand is generated when a voltage between 24 and 240 V (ac) is applied across the CD (common demand) and the *Ht D* (heat demand) (terminals 1 and 2). Once voltage is applied, the control turns on the Dem segment in the display. The control closes the *Pmp Pmp* (terminals 13 and 14) contact, which starts the boiler pump and the control turns on the boiler pump segment in the display. The control then operates to maintain the setpoint temperature.

Section C: Dedicated Domestic Hot Water (DHW) Operation

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

INTERNAL DHW DEMAND

An internal DHW demand is required whenever heat is required for DHW generation. A sensor is required to be connected on the *Com* and the *Sup/D* (terminals 4 and 6) in this mode of operation. An internal DHW demand 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 an internal DHW demand is generated, the control closes the *Pmp Pmp* (terminals 13 and 14) contact, which starts the boiler pump and the control turns on the boiler pump segment in the display. The control then operates the boiler 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.

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

TANK DIFFERENTIAL (TANK DIFF)

A differential setting that operates 1/2 above and below the TANK TARGET is selectable using the TANK DIFF item in the Adjust menu.

Section D: External Boiler Operation

When mode 4 is selected, the Modulating Boiler Control allows for an external boiler control to operate the boiler. In this mode, the Modulating Boiler Control operates the boiler's ignition interlock and the boiler pump. The boiler pump operates to provide purging and exercising while the ignition interlock operates in conjunction with the boiler maximum feature. In this case the control will turn off the Stage relay if the temperature at the boiler outlet sensor reaches the boiler maximum setting. The firing modulation is provided by an external device such as an Energy Management System (EMS) or Modulating Sequencer.

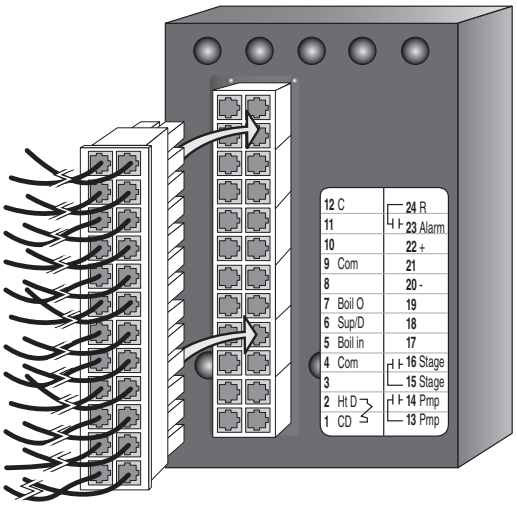
HEAT DEMAND

A heat demand is required in order for operation to occur. A heat demand is generated when a voltage between 24 and 240 V (ac) is applied across the *CD* (common demand) and the *Ht D* (heat demand) (terminals 1 and 2). Once voltage is applied, the control turns on the Dem segment in the display. The control closes the *Pmp Pmp* (terminals 13 and 14) contact, which starts the boiler pump and turns on the boiler pump segment in the display. The control also closes the *Stage Stage* (terminals 15 and 16) contact, which provides power to the boiler's ignition interlock circuit. Whenever the Stage relay is on, the burner segment is displayed.

Installation

ELECTRICAL CONNECTIONS TO THE CONTROL

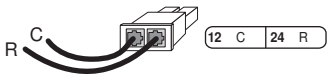
The installer should test to confirm that no voltage is present at any of the wires during installation. The Modulating Boiler Control includes a 24 pin connector for ease of installation.



Powered Input Connections

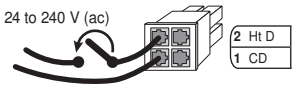
24 V (ac) Power

Connect the 24 V (ac) power supply to the *C* and *R* (terminals 12 and 24). This connection provides power to the microprocessor and display of the control. As well, this connection provides power to the *Alarm* (terminal 23) from the *R* (terminal 24).



Heat Demand

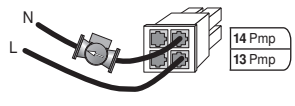
To generate a heat demand, a voltage between 24 V (ac) and 240 V (ac) must be applied across the *CD* (common demand) and the *Ht D* (heat demand) (terminals 1 and 2).



Output Connections

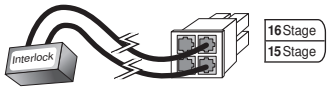
Boiler Pump Contact

The *Pmp Pmp* (terminals 13 and 14) contact are an isolated output in the control. There is no power available on these terminals from the control. These terminals are 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).



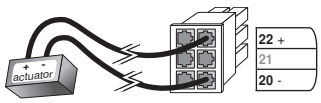
Stage Contact

The *Stage Stage* (terminals 15 and 16) contact are an isolated output in the control. There is no power available on these terminals from the control. These terminals are to be used as a switch to either make or break power to the boiler's interlock circuit. Since this is an isolated contact, it may switch a voltage between 24 V (ac) and 120 V (ac).



Modulating Output

Connect the positive 4-20 mA lead to the + (terminal 22) and the negative 4-20 mA lead to the - (terminal 20). Maximum resistance allowed in the 4-20 mA circuit is 1000 Ω.



Alarm Contact

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

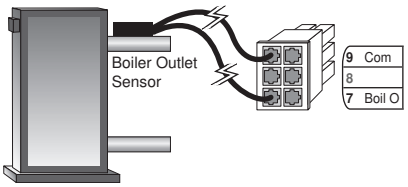
Sensor Connections

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

Boiler Outlet Sensor

Connect the two wires from the Boiler Outlet Sensor 91726C to the Com (common sensor) and *Boil O* (boiler outlet sensor) (terminals 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.



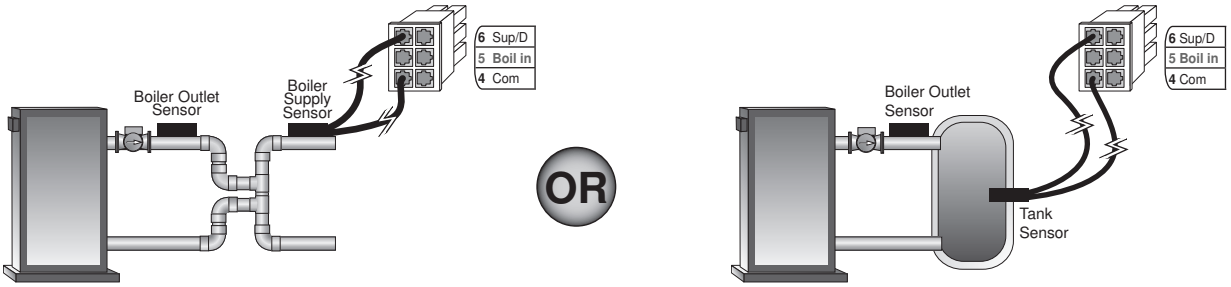
Boiler Inlet Sensor

Connect the two wires from the Boiler Inlet Sensor 91726C to the *Com* (common sensor) and *Boil in* (boiler inlet sensor) (terminals 4 and 5). The boiler inlet sensor is used by the control to measure the boiler inlet water temperature to the boiler.

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

Boiler Supply/DHW Sensor

Either a Boiler Supply Sensor 91726C or DHW Sensor 91726C may be connected to the control. If a sensor is used, connect the two wires from the sensor to the *Com* (common sensor) and *Sup/D* (boiler supply/DHW sensor) (terminals 4 and 6).



TESTING

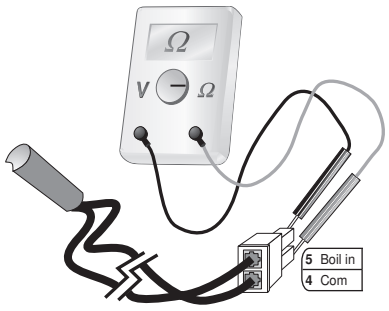
The wiring harness must be unplugged from the connector on the control before testing. To remove the wiring harness, push down on the tab which fits over the tab on the connector from the control and pull away form the control.

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

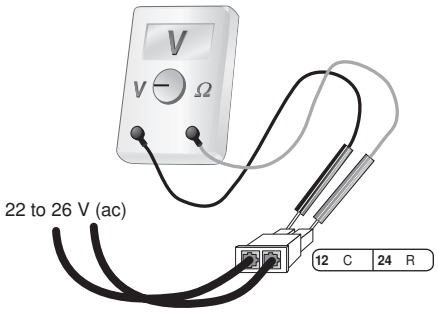
In order to test the sensors, the actual temperature at each sensor location must be measured. A good quality digital thermometer with a surface temperature probe is recommended for ease of use and accuracy. First measure the temperature using the thermometer and then measure the resistance of the sensor 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
-40	-40	336,606	30	-1	34,558	100	38	5,828	170	77	1,403
-30	-34	234,196	40	4	26,099	110	43	4,665	180	82	1,172
-20	-29	165,180	50	10	19,900	120	49	3,760	190	88	983
-10	-23	118,018	60	16	15,311	130	54	3,050	200	93	829
0	-18	85,362	70	21	11,883	140	60	2,490	210	99	703
10	-12	62,465	80	27	9,299	150	66	2,045	220	104	598

Test the Power Supply

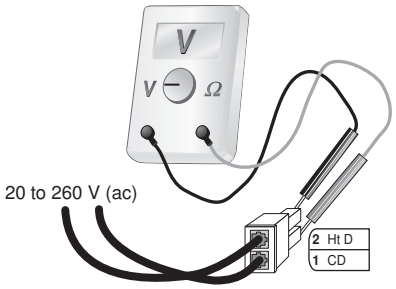
Make sure exposed wires and bare terminals are not in contact with other wires or grounded surfaces. Turn on the power and measure the voltage between the *C* and *R* (terminals 12 and 24) using an AC voltmeter, the reading should be between 22 and 26 V (ac).



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) (terminals 1 and 2). When the heat demand device calls for heat, you should measure between 20 and 260 V (ac) at the terminals. When the heat demand device is off, you should measure less than 5 V (ac).



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 which is used to the main control functions. The test sequence is enabled when the ▲ button is pressed and held for 5 seconds while in the View menu. The test sequence can be cancelled by pressing either the *Item*, ▲ or ▼ button. Once the test sequence is enabled, the outputs are tested in the following sequence:

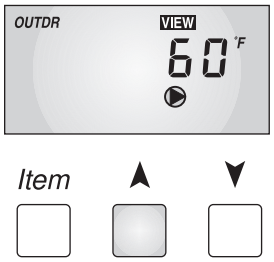
Step 1: After 1 second, the pump contact is turned on.

Step 2: After 4 seconds, the modulating output ramps up to 100% over the motor speed setting, with the Stage relay turning on at the start modulation setting. The modulating output remains at 100% for 4 seconds.

Step 3: The modulating output then ramps down to 0% with the Stage and Pump relays turning off at the minimum modulation setting.

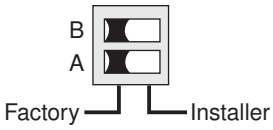
Step 4: The Alarm relay is then turned on for 4 seconds.

Step 5: The Alarm relay turns off and the control continues normal operation.



Control Settings

DIP SWITCH SETTINGS



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

(A) Factory/Installer

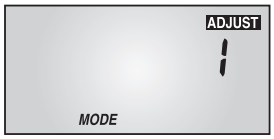
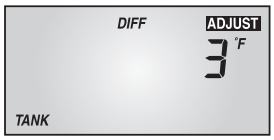
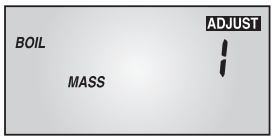
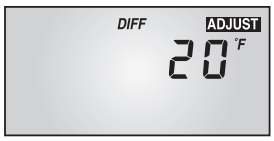
The Factory/Installer DIP switch is used to select which items are available to be viewed and/or adjusted in the user interface. The Factory Access Level includes all the settings available in the control. The Installer Access Level includes the settings and items which are required for system setup.

(B) Not Used

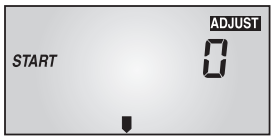
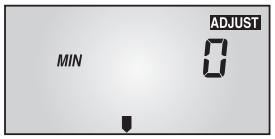
View Menu (1 of 1)

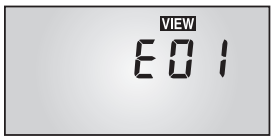
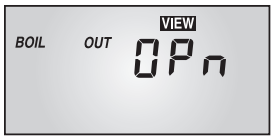
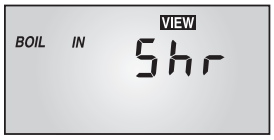
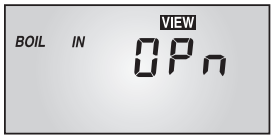
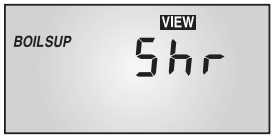
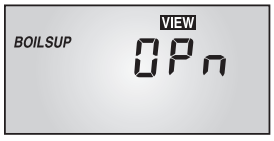
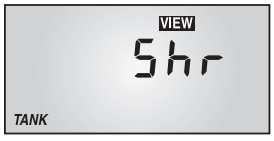
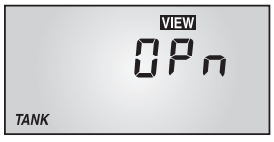
Item Field	Section	Access Level: Installer	Access Level: Factory	Description	Range
VIEW BOIL TARGET 180 °F	A	●	●	**Boil Target** Target boiler supply is the temperature the control is currently trying to maintain at the boiler supply sensor or the boiler outlet sensor. **MODE = 1, 2, 3**	---, 35 to 226°F (2 to 108°C)
VIEW BOILSUP 168 °F	A	●	●	**Boil Supply** Current boiler supply water temperature as measured by the boiler supply sensor. **MODE = 2**	14 to 266°F (-10 to 130°C)
VIEW BOIL OUT 190 °F	A	●	●	**Boil Out** Current boiler outlet water temperature as measured by the boiler outlet sensor. **MODE = 1, 3 (Installer Level)** **MODE = 2 (Factory Level)**	14 to 266°F (-10 to 130°C)
VIEW BOIL IN 155 °F	A	●	●	**Boil In** Current boiler inlet water temperature as measured by the boiler inlet sensor.	14 to 266°F (-10 to 130°C)
VIEW BOIL ΔT 35 °F	A		●	**Boil ΔT** Current T (temperature difference) between the boiler outlet sensor and the boiler inlet sensor.	-99 to 252°F (-55 to 140°C)
VIEW 140 °F TANK	A	●	●	**Tank** Current DHW tank temperature as measured by the DHW sensor. **MODE = 3**	14 to 266°F (-10 to 130°C)
VIEW 80			●	**%Out** Current modulating output percentage.	0 to 100
VIEW BOIL ON 239			●	**Boil On** The total number of running hours of the boiler since this item was last cleared.	0 to 999

Adjust Menu (1 of 2)

Item Field	Access Level: Section	Installer	Factory	Description	Range	Actual Setting
	A	●	●	**Mode** Sets the operating mode for the control.	1, 2, 3, 4	
	A	●	●	**Boil Target** Minimum boiler target temperature during reset override, setpoint or DHW operation. **MODE = 1, 2, 3**	OFF, 70 to 220°F (OFF, 21 to 104°C)	
	C	●	●	**Tank Target** Sets the DHW storage tank's temperature. **MODE = 3**	OFF, 70 to 190°F (OFF, 21 to 88°C)	
	C	●	●	**Tank Diff** Sets the differential for the DHW storage tank. **MODE = 3**	2 to 10°F (1 to 6°C)	
	A		●	**Boil Max** The maximum boiler target water temperature.	120 to 225°F, OFF (49 to 107°C, OFF)	
	A		●	**Boil Min** The minimum temperature allowed for the boiler target temperature. **MODE = 1, 2, 3**	OFF, 80 to 180°F (OFF, 27 to 82°C)	
	A	●	●	**Fire Delay** Delay time between ignition and actual flame. **MODE = 1, 2, 3**	0:00 to 3:00 min	
	A	●	●	**Boil Mass** The thermal mass of the boiler used. **MODE = 1, 2, 3**	1 (light mass) 2 (medium mass) 3 (heavy mass)	
	A	●	●	**Diff** The differential that the control is to use when it is operating the boiler. **MODE = 1, 2, 3**	2 to 42°F (1 to 23°C)	
	A		●	**Motor Speed** The modulating motor response time. **MODE = 1, 2, 3**	10 to 230 seconds	

Adjust Menu (2 of 2)

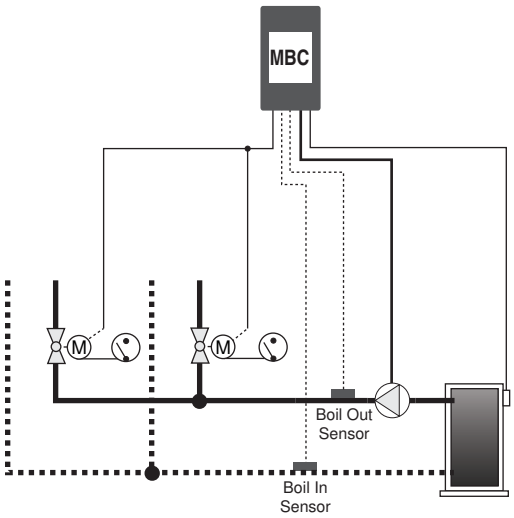
Item Field	Section	Access Level: Installer	Access Level: Factory	Description	Range	Actual Setting
	A		●	**Start Modulation** Percent modulation for ignition. **MODE = 1, 2, 3**	0 to 50%	
	A		●	**MIN Modulation** Minimum percent modulation. **MODE = 1, 2, 3**	0 to 50%	
	A	●	●	**Delay** Determines when to stop purging.	OFF, 0:20 to 9:55 min, On	
		●	●	**Units** The units of measure that all of the temperatures are to be displayed in by the control.	°F, °C	

Error Displayed	Description of Error
	The control was unable to read a piece of information from its EEPROM. The control will stop operation until all settings in the Adjust menu have been checked by the user or installer.
	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 boiler.
	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 boiler.
	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.
	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.
	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 present and 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 boiler.
	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 present and 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 boiler.
	The control is no longer able to read the tank sensor due to a short circuit. In this case the control will not operate the boiler.
	The control is no longer able to read the tank sensor due to an open circuit. In this case the control will not operate the boiler.

Applications - Mechanical

The following are only mechanical and electrical concept drawings, not engineered drawings. They are not intended to describe a complete system, nor any particular system. It is up to the designer to determine the necessary components for and configuration of the particular system being designed, including additional equipment, isolation relays (for loads greater than the control's specified output ratings), and any safety devices which in the judgement of the designer are appropriate, in order to properly size, configure and design that system and to ensure compliance with building and safety code requirements.

MODE 1



Setpoint Operation - Parallel Piping

Control receives a heat demand from the valve end switches or zone box end switch. Once a heat demand is present, the control operates the boiler and boiler pump to provide a setpoint temperature at the boiler outlet sensor. Once the heat demand is removed, the boiler is turned off and the pump provides purging based on the pump DLY setting. If the zones have no purging capabilities, the purging option on the control must be disabled, unless a bypass is piped in.

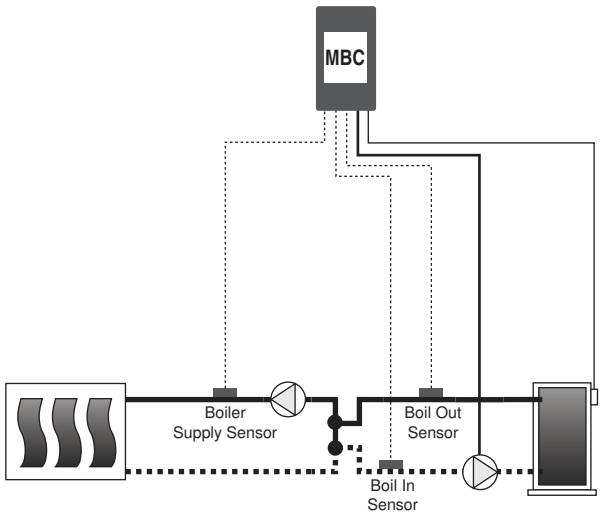
Applicable Settings - ADJUST Menu

MODE	operating mode for control (set to 1 for this application)
BOIL TARGET	set to desired setpoint temperature that the boiler will operate at to maintain at the boiler outlet sensor whenever heat demand is present.
***BOIL MAX**	set to maximum boiler target temperature.
***BOIL MIN**	set to minimum boiler target temperature.
***Fire Delay**	set to delay time that occurs between the Pump relay contact closure and actual flame ignition.
BOIL MASS	set the thermal mass of the boiler. (1 provides faster modulation, while 3 provides slower modulation)
DIFF	set the operating differential for boiler target temperature to operate around.
***Motor Speed**	set the motor speed for the actuating motor which provides the firing modulation.
***START Modulation**	set the percentage modulation required for burner ignition.
***MIN Modulation**	set the minimum percentage modulation. (this is based on the turn down ratio of the boiler)
***Pump DLY**	set the purge time that the pump will operate for once the boiler is turned off.
Units	select the desired units for the temperatures to be displayed.

Notes: *Indicates that setting is ***only*** available in the advanced access level (DIP switch A set to OFF)

Application - Mechanical

MODE 2



Setpoint Operation -Primary/Secondary Piping

Control has a permanent heat demand. The control operates the boiler and boiler pump to provide a setpoint temperature at the boiler supply sensor. The system pump must operate continuously. The boiler pump is activated whenever the burner goes through the ignition sequence. The boiler pump is shut off whenever the burner is shut off and the boiler pump completes a boiler pump purge. Cycling the boiler pump with the burner operation can reduce stand-by losses.

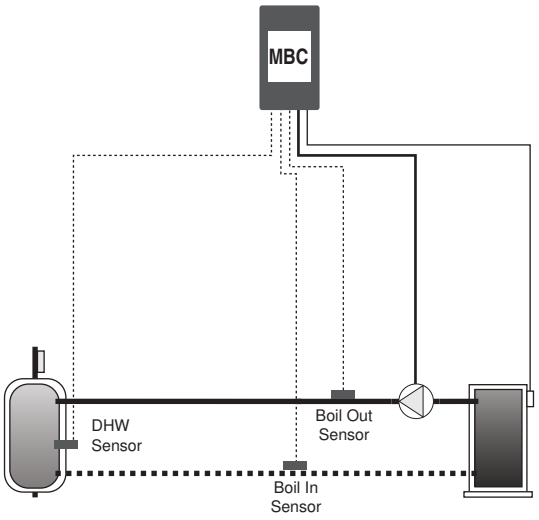
Applicable Settings - ADJUST Menu

MODE	operating mode for control (set to 2 for this application)
BOIL TARGET	set to desired setpoint temperature that the boiler will operate at to maintain at the boiler outlet sensor whenever heat demand is present.
***BOIL MAX**	set to maximum boiler target temperature.
***BOIL MIN**	set to minimum boiler target temperature.
***Fire Delay**	set to delay time that occurs between the Pump relay contact closure and actual flame ignition.
BOIL MASS	set the thermal mass of the boiler. (1 provides faster modulation, while 3 provides slower modulation)
DIFF	set the operating differential for boiler target temperature to operate around.
***Motor Speed**	set the motor speed for the actuating motor which provides the firing modulation.
***START Modulation**	set the percentage modulation required for burner ignition.
***MIN Modulation**	set the minimum percentage modulation. (this is based on the turn down ratio of the boiler)
***Pump DLY**	set the purge time that the pump will operate for once the boiler is turned off.
Units	select the desired units for the temperatures to be displayed.

Notes: * indicates that setting is ***only*** available in the advanced access level (DIP switch A set to OFF)

Application - Mechanical

MODE 3



DHW Operation - Dedicated DHW

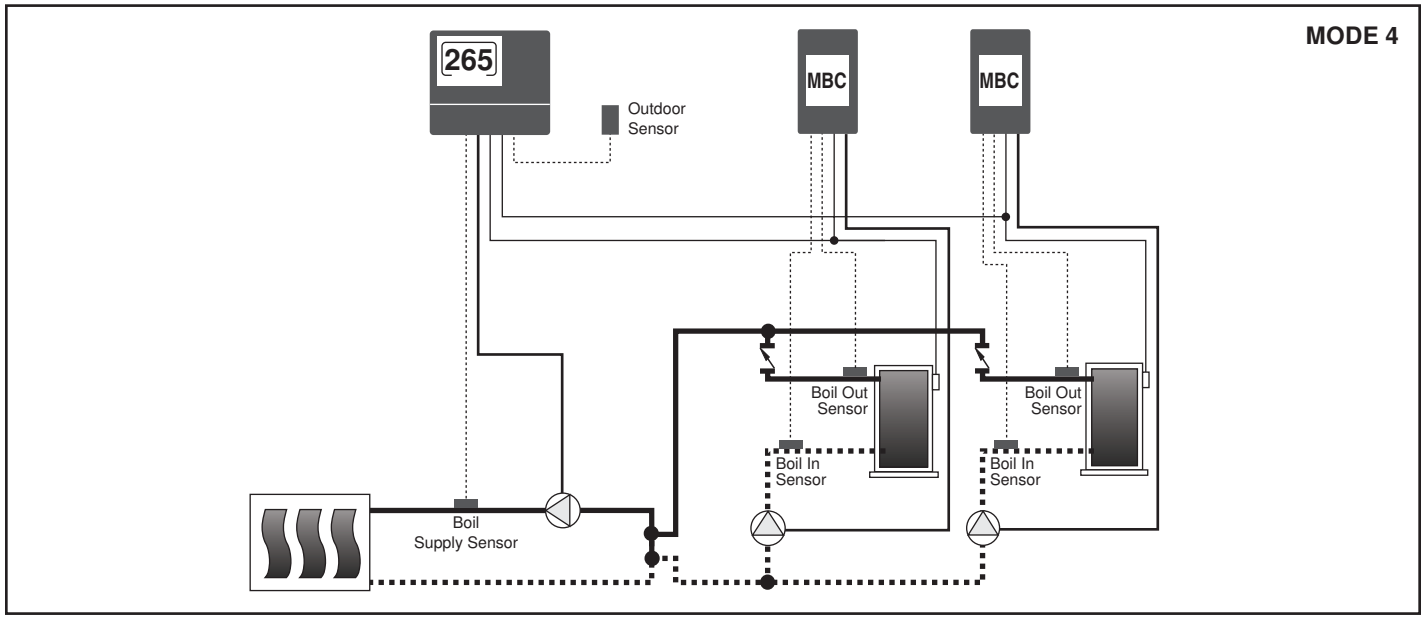
Control receives and internal DHW demand from the tank sensor. Once an internal demand is present, the control operates the boiler and boiler pump to provide setpoint temperature at the boiler outlet sensor. Once the internal demand is removed, the boiler is turned off and the pump provides purging based on the pump DLY setting.

Applicable Settings - ADJUST Menu

MODE	operating mode for control (set to 3 for this application)
BOIL TARGET	set to desired setpoint temperature that the boiler will operate at to maintain at the boiler outlet sensor whenever heat demand is present.
TANK TARGET	set to desired tank temperature.
TANK DIFF	set differential for the tank target temperature to operate around.
***BOIL MAX**	set to maximum boiler target temperature.
***BOIL MIN**	set to minimum boiler target temperature.
***Fire Delay**	set to delay time that occurs between the Pump relay contact closure and actual flame ignition.
BOIL MASS	set the thermal mass of the boiler. (1 provides faster modulation, while 3 provides slower modulation)
DIFF	set the differential for boiler target temperature to operate around.
***Motor Speed**	set the motor speed for the actuating motor which provides the firing modulation.
***START Modulation**	set the percentage modulation required for burner ignition.
***MIN Modulation**	set the minimum percentage modulation. (this is based on the turn down ratio of the boiler)
***Pump DLY**	set the purge time that the pump will operate for once the boiler is turned off.
Units	select the desired units for the temperatures to be displayed.

Notes: * indicates that setting is ***only*** available in the advanced access level (DIP switch A set to OFF)

Application - Mechanical



External Control Operation

Modulating Sequencer provides a heat demand to the required Modulating Boiler Control. Once a heat demand is present, the control turns on the Boiler Pump relay and the Stage relay. The Stage relay turns off if the temperature at the boiler outlet sensor reaches the boiler maximum setting. Once the heat demand is removed, the Stage relay is turned off and the boiler pump provides purging based on the pump DLY setting. Modulation is provided through the sequencer to maintain a target temperature at the boiler supply sensor.

Applicable Settings - ADJUST Menu

MODE operating mode for control (set to 4 for this application).

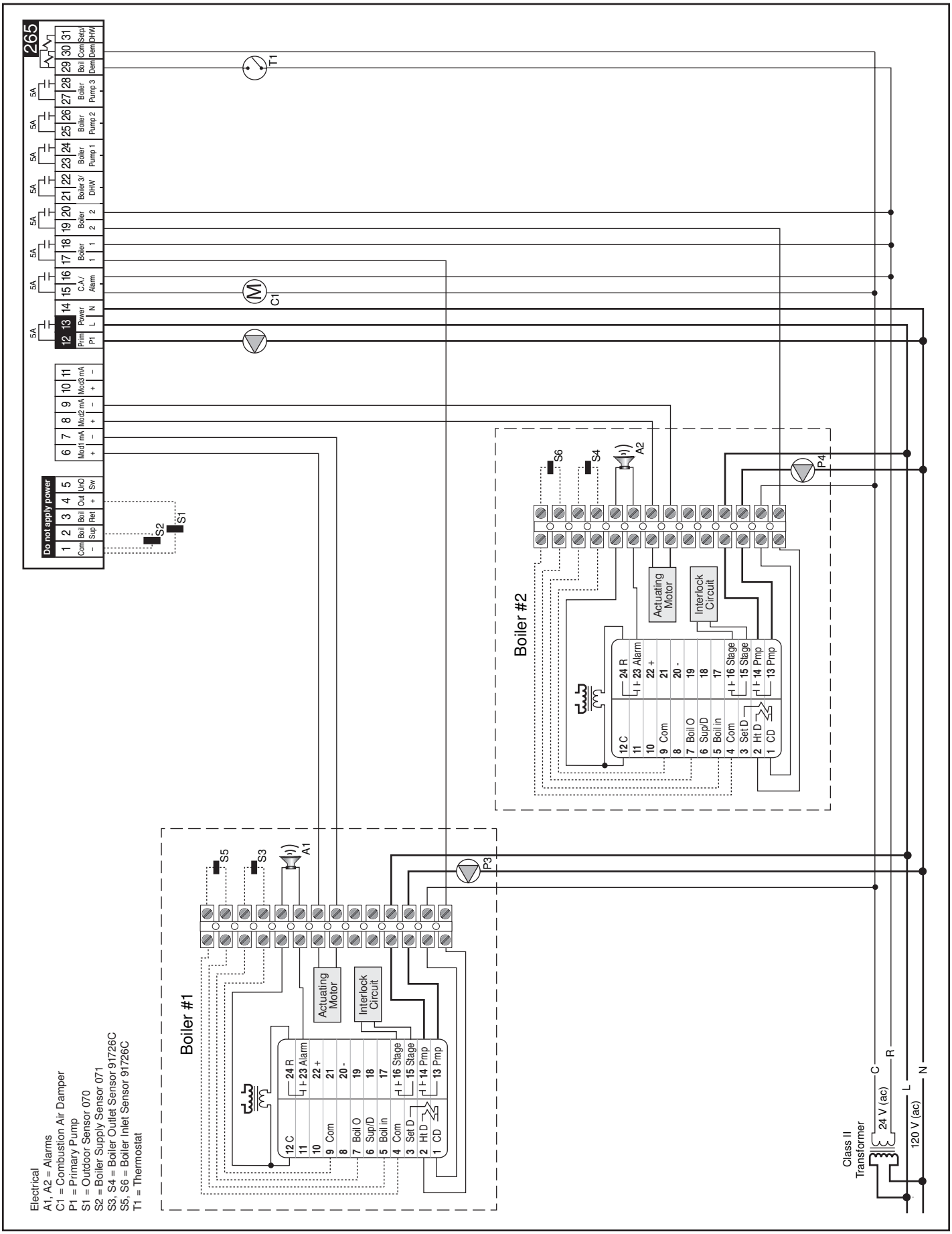
***BOIL MAX** set to maximum boiler outlet temperature.

***Pump DLY** set the purge time that the pump will operate for once the boiler is turned off.

Units select the desired units for the temperatures to be displayed.

Notes: * indicates that setting is ***only*** available in the advanced access level (DIP switch A set to OFF)

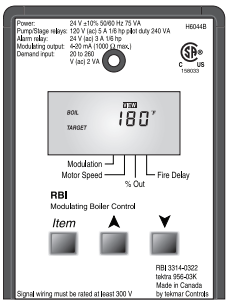
Application - Electrical, Mode 4 example (2x Modulating Boiler Control, 1x tekmar 265)



Notes

Modulating BTC MPA

Control	—	Microprocessor PID control; This is not a safety (limit) control.
Enclosure	—	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	—	CSA C US, meets ICES & FCC regulations for EMI/RFI.
Ambient conditions	—	Indoor use only, -40 to 140°F (-40 to 60°C), < 90% RH non-condensing.
Power supply	—	24 V ±10% 50/60 Hz 75 VA
Pump/Stage relay	—	120 V (ac) 5 A 1/6 hp, pilot duty 240 VA
Alarm relay	—	24 V (ac) 3 A 1/6 hp
4-20 mA Output	—	Output to drive 4-20 devices (loads up to 1000Ω)
Demand	—	20 to 260 V (ac) 2VA
Sensors included	—	NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) ß=3892 3 of Universal Sensor 91726C



All specifications are subject to change without notice.
Printed in Canada. Modulating Boiler Control - 01/05.