- Data Brochure

Boiler Control 410

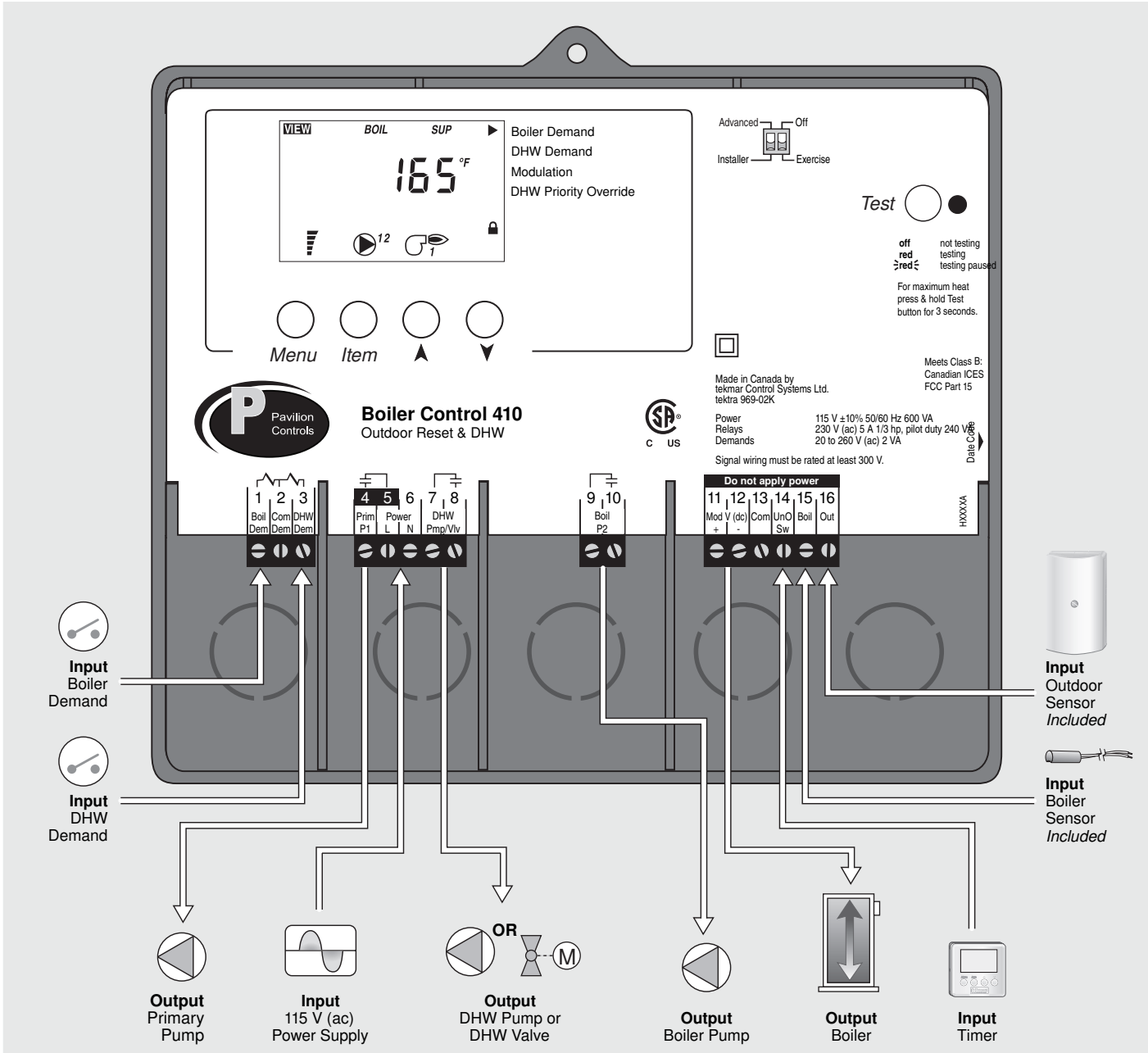
D 410

01/06

The Pavilion Control 410 can control the supply water temperature from a single modulating boiler based on outdoor temperature or domestic hot water requirements. A large easy to read display provides current system temperatures and operating status.

Additional functions include:

- Outdoor Reset
- Primary pump output
- Pump exercising
- Pump purging
- Boiler demand for space heating loads
- DHW demand for domestic hot water loads
- Test sequence to ensure proper component operation
- Setback input for energy savings
- CSA C US certified



How To Use The Data Brochure

This brochure is organized into four main sections. They are: 1) Sequence of Operation, 2) Installation, 3) Control Settings, and 4) Testing and Troubleshooting. The Sequence of Operation section has five 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.

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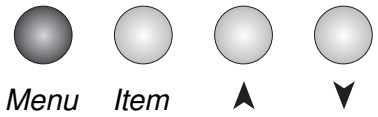
User Interface

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

Menu

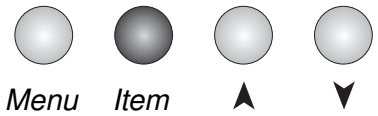
All of the items displayed by the control are organized into two menus (*View, Adjust*). These menus are listed on the top left hand side of the display (Menu Field). To select a menu, use the ***Menu*** button. By pressing and releasing the ***Menu*** button, the display sequences between the four menus. Once a menu is selected, there will be a group of items that can be viewed within the 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.

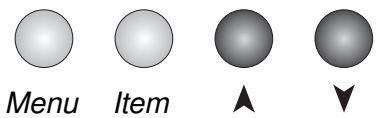
The items can be quickly scrolled through by holding the ***Item*** button and then pressing the ▼ button. To rapidly scroll through the items in the reverse order, hold the ***Item*** button and press the ▲ button.



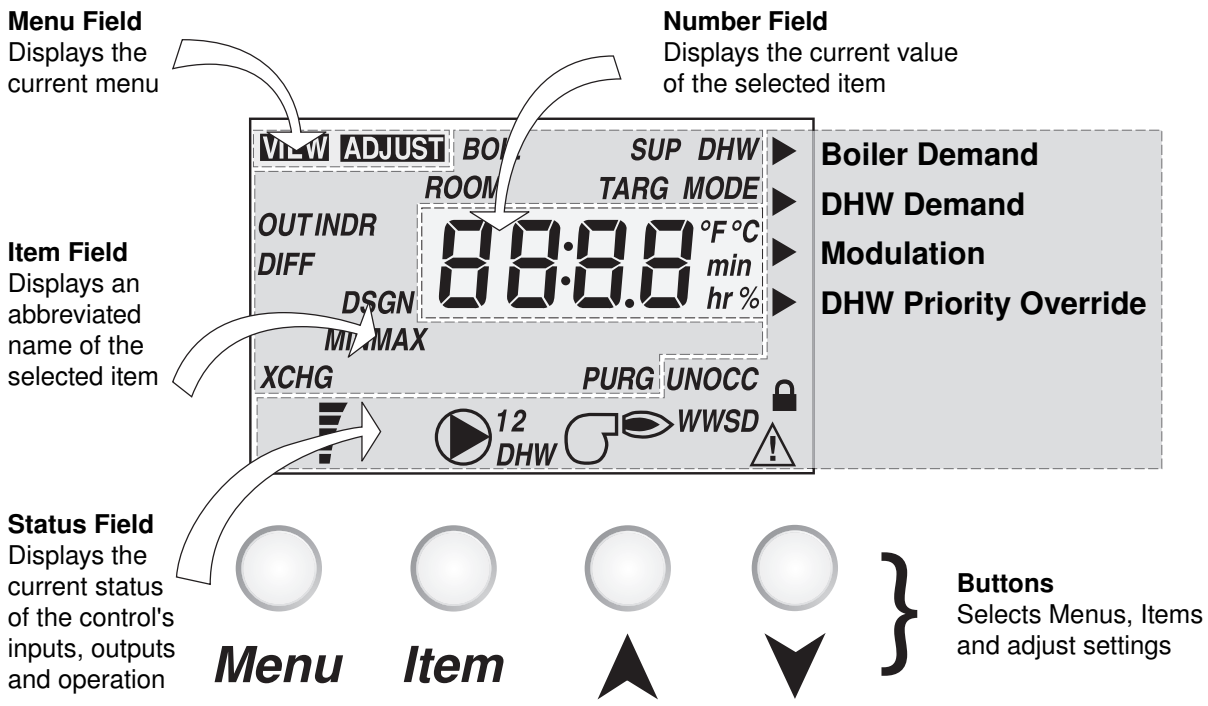
Adjust

To make an adjustment to a setting in the control, begin by selecting the ADJUST menu using the ***Menu*** button. Then select the desired item using the ***Item*** button. Finally, use the ▲, and/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

	**Burner** Displays when the ignition sequence is initiated.	⚠	**Warning** Displays when an error exists or when a limit has been reached.
	**Pump** Displays when the primary or boiler pump is operating.	°F °C min hr %	**°F, °C, min, hr, %** Units of measurement.
DHW	**DHW** Displays when the DHW pump is on.	▶	**Pointer** Displays the control operation as indicated by the text.
OCC	**Occupied** Displays when the control is in occupied mode.		**Modulating Output Scale** Displays the total modulation output level of the boiler.
UNOCC	**UnOccupied** Displays when the control is in Unoccupied mode.		

Section A: General Operation

POWERING UP THE CONTROL

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

OPERATION

The control modulates the boiler to control the supply water temperature to a hydronic system. The supply water temperature is based on outdoor reset or a fixed temperature for DHW.

Outdoor Reset

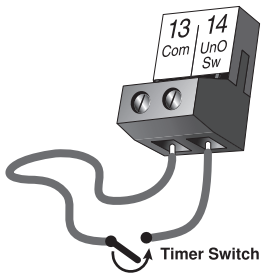
When a boiler demand signal from the heating system is present, the control operates the boiler to maintain the supply temperature based on the outdoor air temperature and the Reset Ratio settings. Refer to section D.

DHW

When a DHW demand is present, the control operates the boiler to maintain the supply water temperature at least as hot as the DHW exchange setting. Refer to section E.

SETBACK (Occ and UnOcc)

To provide greater energy savings, the control has a setback feature. With setback, the supply water temperature in the system is reduced when the building is unoccupied. By reducing the supply water temperature, the air temperature in the space may be reduced even when thermostat(s) are not turned down. Any time the *UnO Sw* (14) and the *Com* (13) are shorted together, the control operates in the unoccupied mode. When in the unoccupied mode, the *UNOCC* segment is displayed in the LCD. The control adjusts the supply water temperature based on the *UNOCC* settings made in the control.



EXERCISING

The control has a built-in exercising feature that is selected through the *Exercise/Off DIP* switch. To enable the exercising feature set the *Exercise/Off* DIP switch to *Exercise*. If exercising is enabled, the control ensures that each pump is operated at least once every 3 days. If a pump has not been operated at least once every 3 days, the control turns on the output for 10 seconds. This minimizes the possibility of the pump seizing during a long period of inactivity. While the control is exercising, the *Test* LED flashes quickly.

Note: The exercising function does not work if power to the control or pumps is disconnected.

RUNNING TIMES

The control displays the accumulated running time of the boiler in the VIEW menu.

Resetting the Running Times

To reset the running time for the boiler, select the running time in the VIEW menu. Next, press the ▲ and ▼ buttons simultaneously until *CLR* is displayed.

FACTORY DEFAULTS

The control comes preset with several factory defaults. To fine-tune building requirements, these defaults may be changed.

To reload the factory default, power down the control and wait for 10 seconds. Power up the control while simultaneously holding the ***Menu*** and ▼ buttons. An E01 error occurs forcing the installer to go through the ADJUST menu to ensure the settings are correct.

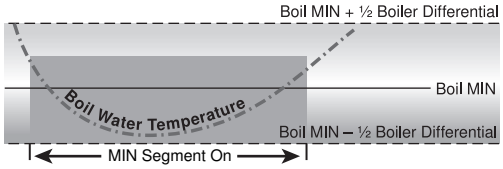
BOILER TARGET TEMPERATURE

The boiler target temperature is determined by the type of demand received by the control. A boiler demand calculates a boiler target based on the reset ratio settings and the outdoor air temperature. A DHW demand uses a fixed setpoint temperature as the boiler target temperature.

The control displays the temperature that it is currently trying to maintain as the boiler supply temperature. If the control does not presently have a requirement for heat, it does not show a boiler target temperature. Instead, "– – –" is displayed in the LCD.

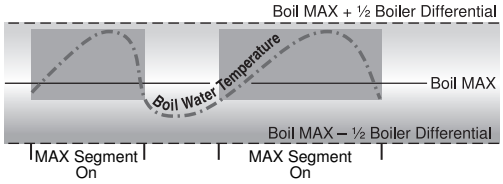
BOILER MINIMUM

The boiler minimum is the lowest 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 *Boiler Minimum* setting, the boiler target temperature is adjusted to at least the *Boiler Minimum* setting. During this condition, if the boiler is operating, the minimum segment is turned on in the display when viewing either the boiler supply temperature or the boiler target temperature. Set the *Boiler Minimum* setting to the boiler manufacturer's recommended temperature.



BOILER MAXIMUM

The boiler maximum is the highest temperature that the control is allowed to use as a boiler target temperature. If the control does target the *Boiler Maximum* setting, and the boiler temperature is near the boiler maximum temperature, the maximum segment will be displayed in the LCD while either the boiler target temperature or the boiler temperature is being viewed. At no time does the control operate the boiler above 248°F (120°C).



MODULATION

The control provides a 0 - 5 V (dc) output signal to the P125 burner module to control burner modulation. The P125, in turn, drives the fan at a speed (RPM) which is proportional to the control's modulating output signal. The control displays the current percentage modulation using the BOIL Modulation item in the VIEW menu.

When boiler operation is required, the control first provides the minimum modulation percentage required to initiate the burner's ignition sequence. The burner is then modulated from the minimum modulation percentage using Proportional, Integral and Derivative (PID) logic in order to satisfy the boiler target temperature. The control will always modulate the burner down to the minimum modulation percentage prior to turning off the boiler. In the event the burner is operating above the low fire position and the demands are removed, the control will also modulate the burner down to the minimum modulation percentage prior to turning off the boiler.

Proportional	compares the actual supply temperature to the boiler target temperature.
Integral	compares the actual supply temperature to the boiler target temperature over a period of time.
Derivative	compares how fast or slow the supply water temperature is changing.

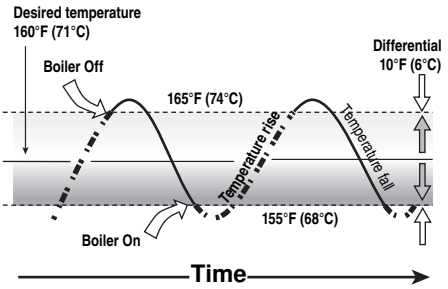
DIFFERENTIAL

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 burner ignites at low fire when the supply water temperature is 1/2 of the *Boiler Differential* setting below the boiler target temperature. The boiler is shut off in low fire as the supply temperature reaches at least 1/2 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.

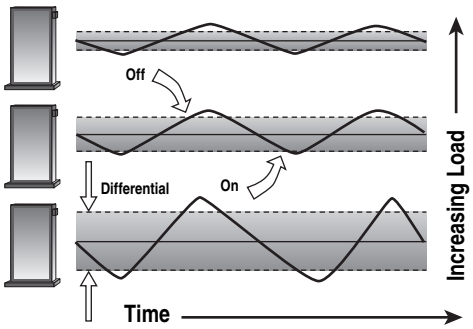
Fixed Differential

If the user desires to have a fixed differential, this is set using the *Boiler Differential* setting in the ADJUST menu.



Auto Differential

If the Auto Differential is selected, the control automatically determines the best differential as the load changes. This reduces potential short cycling during light load conditions.



Section C: Pump Operation

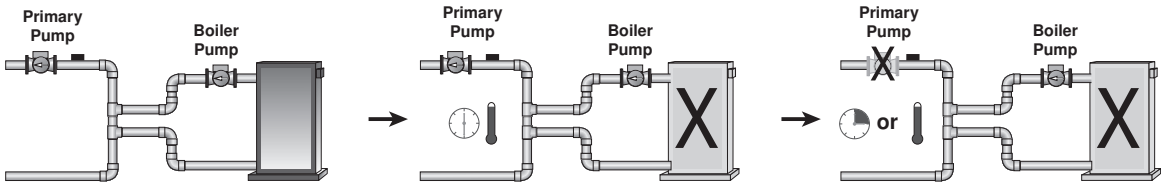
PRIMARY PUMP OPERATION

The primary pump operates under the following conditions:

- A boiler demand is present and the control is not in Warm Weather Shut Down (WWSD).
- A DHW demand is present and DHW MODE is set to 3 or 4.

Primary Pump Purge

After the demands are removed, the control continues to operate the primary pump for a period of time. The maximum length of time that the primary pump continues to run is adjustable using the Primary Pump Purge setting. The primary pump continues to run until either the purging time has elapsed or the boiler supply temperature drops more than a differential below the Boiler Minimum setting.

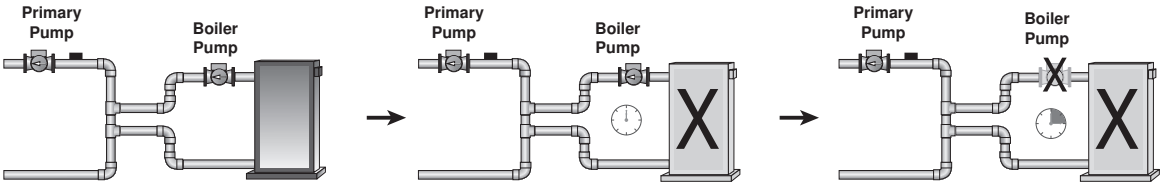


BOILER PUMP OPERATION

The control can operate the boiler pump on the boiler in addition to the primary pump. The boiler pump turns on 5 seconds prior to the boiler firing (pre-purge) and continues to run after the boiler is turned off (post-purge).

Boiler Pump Purge

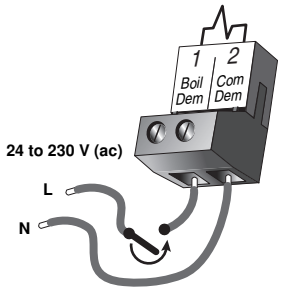
The amount of time that the boiler pump continues to run after the boiler turns off is adjustable using the *Boiler Pump Purge* setting.



Section D: Outdoor Reset Operation

BOILER DEMAND

A boiler demand is required in order for the control to provide heat to the heating system. A boiler demand is generated by applying a voltage between 24 and 230 V (ac) across the *Boil Dem and Com Dem* terminals (1 and 2). Once voltage is applied, the *Boiler Demand* pointer is displayed in the LCD. If the control is not in Warm Weather Shut Down (*WWSD*), the control closes the primary pump contact. The control calculates a boiler target supply temperature based on the outdoor air temperature and the reset ratio settings. The control then modulates the burner firing rate, if required, to maintain the target supply temperature.



RESET RATIO

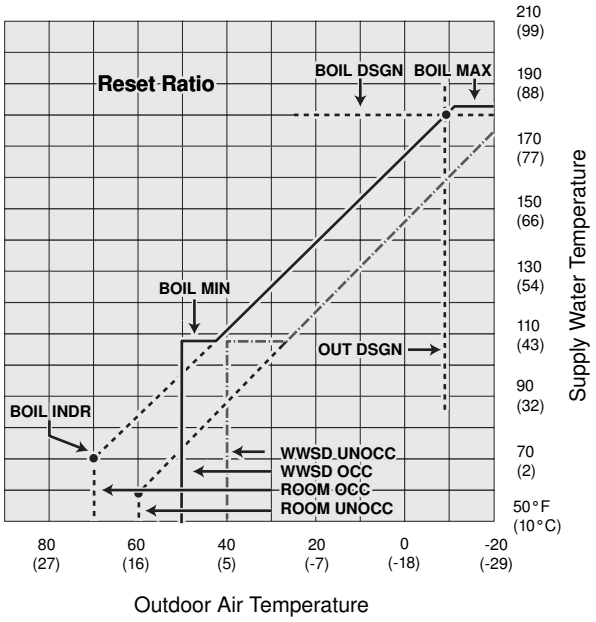
The reset ratio establishes the relationship between the outdoor air temperature and the supply water temperature. The reset ratio determines the amount the supply water temperature is raised for every 1 degree outdoor temperature drop. The control automatically calculates the reset ratio based on the outdoor design temperature, boiler design temperature and the boiler indoor design temperature.

OUTDOOR DESIGN TEMPERATURE (OUT DSGN)

The outdoor design temperature is the outdoor air temperature that is the typical coldest temperature of the year where the building is located. This temperature is used when doing the heat loss calculations for the building. If a cold outdoor design temperature is selected, the boiler supply temperature rises gradually as the outdoor temperature drops. If a warm outdoor design temperature is selected, the boiler supply temperature rises rapidly as the outdoor temperature drops.

BOILER DESIGN TEMPERATURE (BOIL DSGN)

The boiler design supply temperature is the supply water temperature required to heat the building when the outdoor air temperature is as cold as the outdoor design temperature.



BOILER INDOOR DESIGN TEMPERATURE (BOIL INDR)

The indoor design temperature is the room temperature that was used in the original heat loss calculations for the building. This setting establishes the beginning of the reset ratio.

ROOM (OCC / UNOCC)

The *Room* setting is the desired room temperature for the building and provides a parallel shift of the reset ratio. The room temperature desired by the occupants is often different from the design indoor temperature. If the room temperature is not correct, adjusting the *Room* setting increases or decreases the amount of heat available to the building. A *Room* setting is available for both the occupied (day) and unoccupied (night) periods.

WARM WEATHER SHUT DOWN (OCC AND UNOCC)

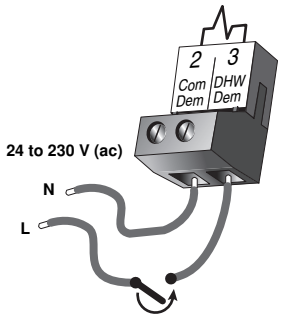
The warm weather shut down (*WWSD*) disables the space heating system during warm outdoor weather. There is a separate WWSD for both the occupied and the unoccupied periods. When the outdoor air temperature rises above the *WWSD* setting, the control turns on the *WWSD* pointer in the display. When the control is in *WWSD*, the *Boiler Demand* pointer is displayed if there is a boiler demand. However, the control does not operate the heating system to satisfy this demand. The control does respond to a DHW demand and operates as described in section E.

Section E: Domestic Hot Water Operation

DHW DEMAND

A DHW Demand is required in order for the control to provide heat to the DHW system. A DHW aquastat or setpoint control is used as a switch in the DHW demand circuit. Once the control detects a DHW demand, the *DHW Demand* pointer turns on in the LCD and the control operates the boiler to provide a sufficient boiler supply water temperature to the DHW tank. The control operates the pumps as described below.

The control registers a DHW Demand when a voltage between 24 and 230 V (ac) is applied across the *Com Dem* and *DHW Dem* terminals (2 and 3).



BOILER TARGET DURING DHW GENERATION

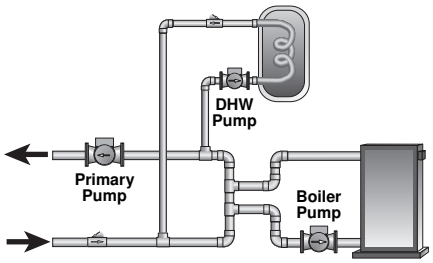
The boiler target (*BOIL TARG*) temperature during DHW operation is at least as hot as the DHW heat exchange setting *(DHW XCHG)*. The DHW demand overrides the reset water temperature, except when the reset water temperature requirement is higher than that of the DHW tank.

DHW MODE AND PRIORITY OPERATION

The control has four different modes of DHW operation, which depends on the piping arrangement of the DHW tank. It is often desirable to limit or even stop the flow of heat to the heating system when the DHW tank calls for heat. This allows for a faster recovery of the DHW tank.

DHW Mode 1 - DHW in Parallel no Priority

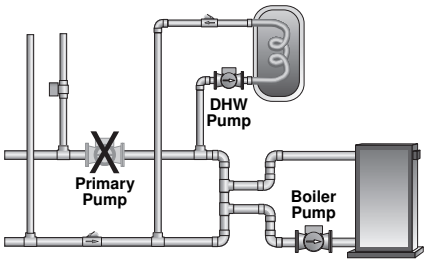
When a *DHW Demand* is present, the *DHW Pmp/Vlv* contact terminals (7 and 8) closes. The primary pump contact does not turn on, but may operate based on a boiler demand.



MODE 1

DHW Mode 2 - DHW in Parallel with Priority

When a *DHW Demand* is present, the *DHW Pmp/Vlv* contact terminals (7 and 8) closes and the primary pump contact is opened.

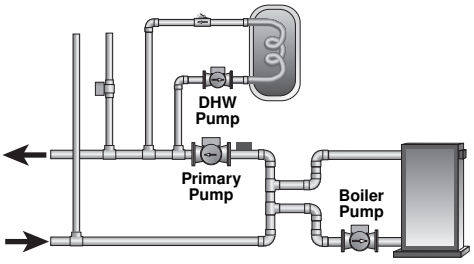


MODE 2

DHW Mode 3 - DHW in Primary / Secondary no Priority

When a *DHW Demand* is present, the *DHW Pmp/Vlv* contact terminals (7 and 8) is closed and the primary pump contact is closed.

This mode can be used if a DHW tank is piped in direct return and a DHW valve is installed.

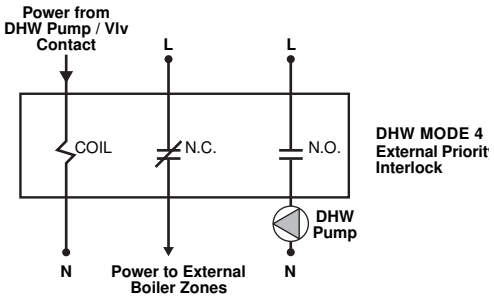


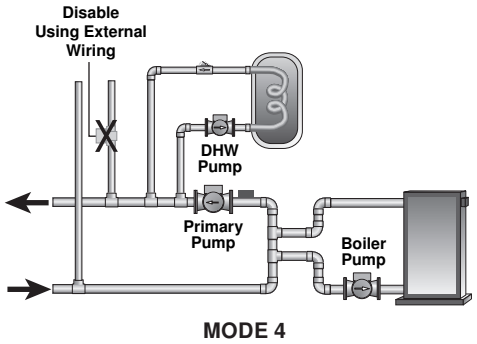
MODE 3

DHW Mode 4 - DHW in Primary / Secondary with Priority

When a *DHW Demand* is present, the *DHW Pmp/Vlv* contact terminals (7 and 8) is closed and the primary pump contact is closed. Priority can only be obtained using external wiring. During a priority override, the *DHW Pmp/Vlv* contact is opened until the heating system has recovered before returning to DHW operation.

This mode can be used if a DHW tank is piped in direct return and a DHW valve is installed.



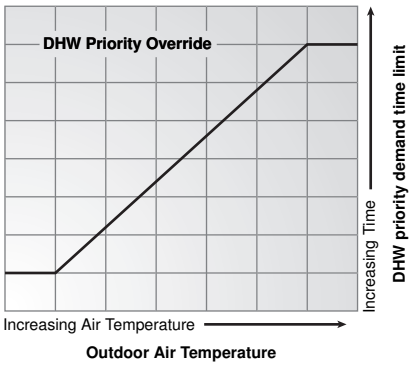


MODE 4

DHW PRIORITY OVERRIDE

The DHW Priority Override applies when DHW MODE is set to 2 or 4. To prevent the building from cooling off too much or the possibility of a potential freeze up during DHW priority, the control limits the amount of time for DHW priority. As the outdoor air temperature becomes colder, the length of time that the control provides DHW priority is reduced. Once the allowed time for priority has elapsed, the control overrides the DHW priority and resumes space heating.

To provide external DHW priority, the space heating zones must be interlocked with the *DHW Pmp/Vlv* contact. During demands, the *DHW Pmp/Vlv* contact must remove any power to all space heating zone valves or zone pumps.



CONDITIONAL DHW PRIORITY

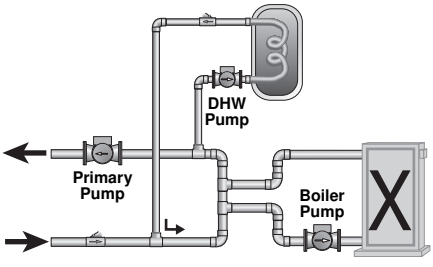
The Conditional DHW Priority Override applies when *DHW MODE* is set to *2* and *BOIL MIN* is not set to *OFF*. If the boiler supply temperature is maintained at or above the required temperature during DHW generation, this indicates that the boiler has enough capacity for DHW and possibly heating as well. As long as the boiler supply temperature is maintained near its target, DHW and heating occurs simultaneously.

DHW POST PURGE

After the *DHW Demand* is removed, the control performs a purge on the boiler. The control shuts off the boiler and continues to operate either the DHW pump or the DHW valve and the system and boiler pump if applicable. This purges the residual heat from the boiler into the DHW tank. The control continues this purge for a maximum of four 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 boiler supply temperature drops below the current boiler target temperature.

DHW MIXING PURGE

After DHW operation, the boiler is extremely hot. At the same time, the heating zones may have cooled off considerably after being off for a period of time. To avoid thermally shocking the boiler after DHW in parallel with priority (*DHW MODE 2*), the control shuts off the boiler, but continues to operate the DHW pump while restarting the heating system. This allows some of the DHW return water to mix with the cool return water from the zones and temper the boiler return water.



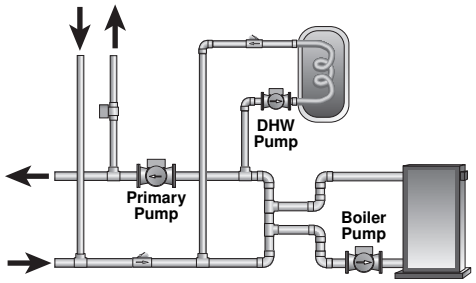
DHW DURING UNOCCUPIED

The control can either continue operation of the DHW system as it would during the occupied period or the control can ignore a call for DHW as long as the control is in the unoccupied mode. For this function to operate, the control must have the *Setback/None* DIP switch set to *Setback*.

DHW WITH LOW TEMPERATURE BOILERS

If DHW is to be incorporated into a low temperature system such as a radiant heating system, a mixing device is often installed to isolate the high DHW supply temperature from the lower system temperature. If a mixing device is not installed, high temperature water could be supplied to the low temperature system while trying to satisfy the DHW demand. This may result in damage to the low temperature heating system. The control is capable of providing DHW in such a system while maximizing the chance that the temperature in the heating system does not exceed its allowed *Boiler Maximum* setting.

To prevent high temperature water from being introduced into the heating system, flow to the space heating system must stop during a call for DHW. To do this, the control must be set to *DHW MODE 2 or DHW MODE 4* and *BOIL MIN* must be set to *OFF*.



DHW Mode 2 Operation

On a call for DHW, the control provides DHW priority by shutting off the primary pump (*Prim P1*) for a period of time. This time is based on the outdoor air temperature as described in the DHW Priority Override section. However, if the *DHW Demand* is not satisfied within the allotted time, the boiler shuts off and the heat of the boiler is purged into the DHW tank.

Once the boiler supply temperature is sufficiently reduced, the *DHW Pmp/Vlv* contact shuts off. The heating system is turned on for a period of time to prevent the building from cooling off. After a period of heating, and if the *DHW Demand* is still present, the control shuts off the heating system and provides heat to the DHW tank once again.

For correct operation, close attention must be paid to the mechanical layout of the system. When the control turns off the primary pump (*Prim P1*), flow to the heating system must stop. If flow is not stopped, the temperature in the heating system can exceed the maximum desired temperature and can result in damage to the heating system.

DHW Mode 4 Operation

In DHW MODE 4, the space heating zones must be prevented from coming on during DHW demands using external wiring. This can be done using an external relay to remove power from zone pumps or zone valves while a DHW Demand is present. This external relay is interlocked with the *DHW Pmp/Vlv* contact.

During a DHW Demand, the control closes the primary pump (*Prim P1*) contact and the *DHW Pmp/Vlv* contact. Once the DHW Demand is removed, or during a DHW priority override, the *DHW Pmp/Vlv* contact is opened, and the external wiring should allow the space heating zones to operate.

There is no mixing purge available in DHW MODE 4. After DHW priority, the boiler supply water temperature may exceed the design water temperature of the space heating system and can result in damage to the heating system.

Installation

⚠ CAUTION

Improper installation and operation of this control could result in damage to the equipment and possibly even personal injury. It is your responsibility to ensure that this control is safely installed according to all applicable codes and standards. This electronic control is not intended for uses as a primary limit control. Other controls that are intended and certified as safety limits must be placed into the control circuit. Do not open the control. Refer to qualified personnel for servicing. Opening voids warranty and could result in damage to the equipment and possibly even personal injury.

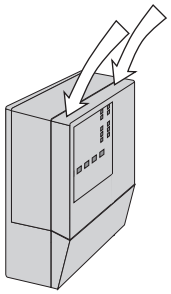
STEP ONE GETTING READY

Check the contents of this package. If any of the contents listed are missing or damaged, please contact your wholesaler or tekmar sales representative for assistance.

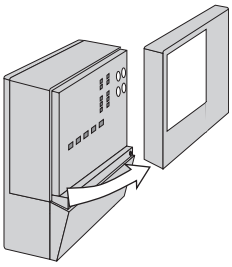
Type 410 includes: One Pavilion Control 410 (00263), One Outdoor Sensor 00228, One Boiler Sensor 00229, Data Brochure D 410.

Note: Carefully read the details of the Sequence of Operation to ensure that you have chosen the proper control for your application.

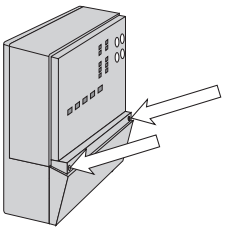
STEP TWO — MOUNTING THE BASE



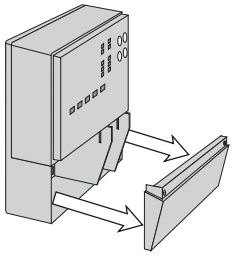
Press down at the fingertip grips on top of the front cover and pull out and down.



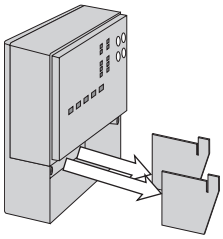
Lift the front cover up and away from the control.



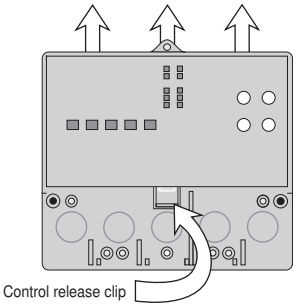
Loosen the screws at the front of the wiring cover.



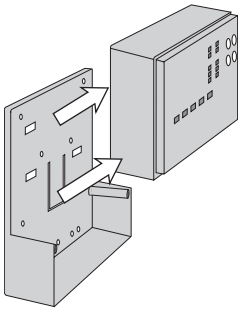
The wiring cover pulls straight out from the wiring chamber.



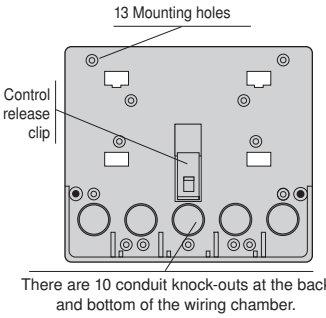
Remove the safety dividers from the wiring chamber by pulling them straight out of their grooves.



Press the control release clip on the base inside the wiring chamber and slide the control upwards.

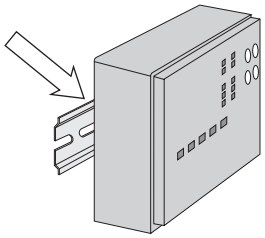


The control lifts up and away from the base.

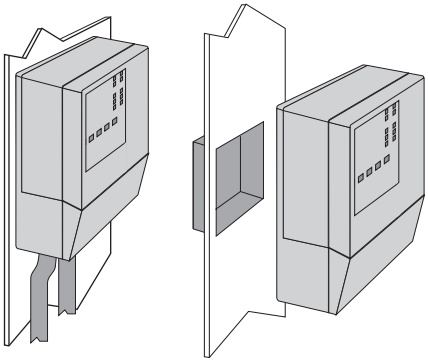


The base is ready for mounting.

The control can be mounted on a standard DIN rail. First remove the control from its base and then, using the hooks and spring clip on the back of the control, mount it onto the DIN rail. This will be a popular option for those who prefer to mount the control inside a larger electrical panel.



The wiring can enter the bottom or the back of the enclosure. Knock-outs provided in the base allow the wiring to be run in conduit up to the enclosure. The base also has holes that line up with the mounting holes of most common electrical boxes.

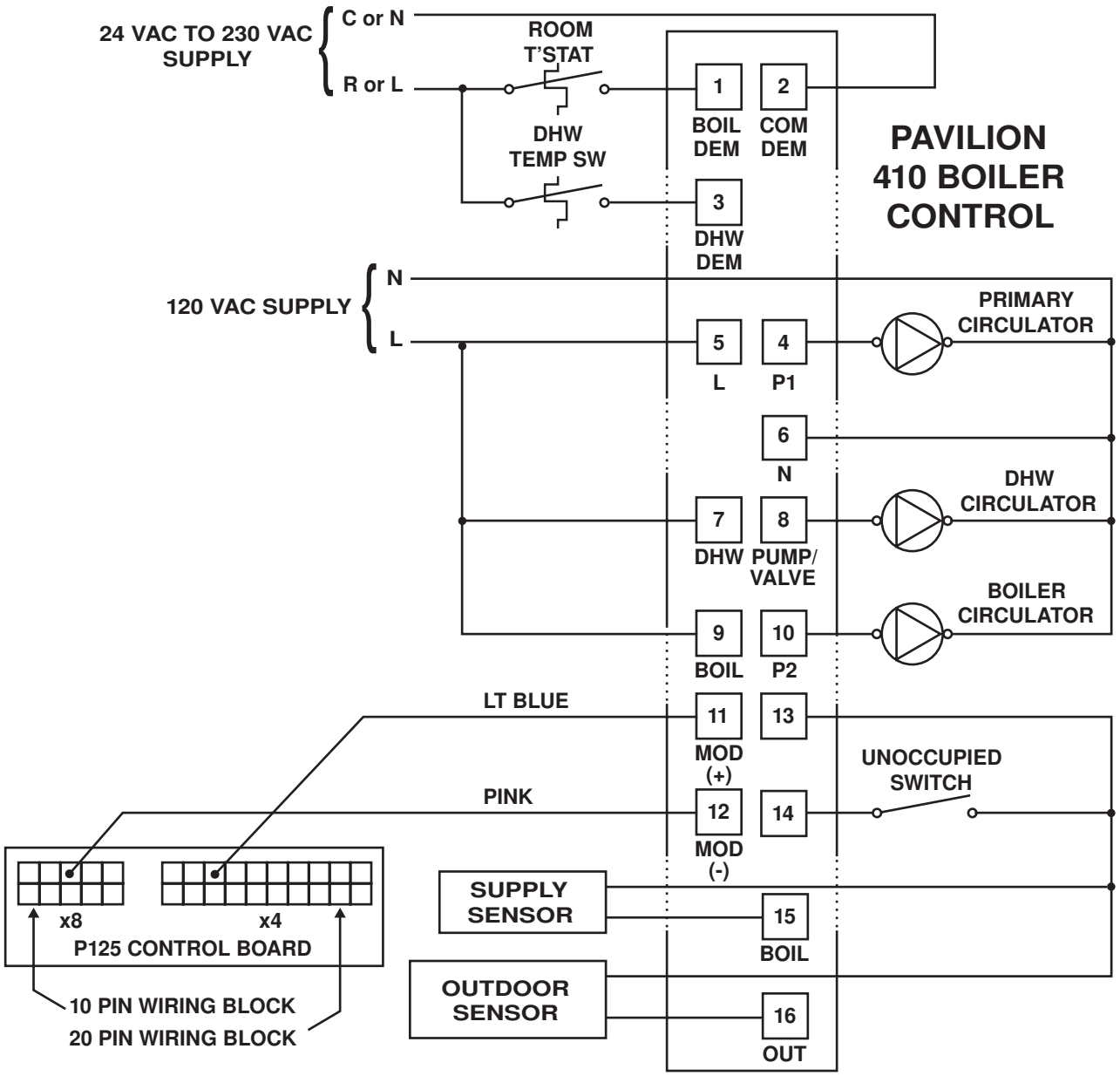


⚠ STEP THREE — ROUGH-IN WIRING

All electrical wiring terminates in the control base wiring chamber. The base has standard 7/8" (22 mm) knockouts, which accept common wiring hardware and conduit fittings. Before removing the knockouts, check the wiring diagram and select those sections of the chamber with common voltages. Do not allow the wiring to cross between sections, as the wires will interfere with safety dividers which should be installed at a later time.

Power must not be applied to any of the wires during the rough-in wiring stage.

- All wires are to be stripped to a length of 3/8" (9 mm) to ensure proper connection to the control.
- Install the Outdoor Sensor 00228 according to the installation instructions in this brochure and run the wiring back to the control.
- Install the Boiler Sensor 00229 according to the installation instructions in this brochure and run the wiring back to the control.
- Run wire from other system components (pumps, boilers, etc.) to the control.
- Run wires from the 115 V (ac) power to the control. Use a clean power source with a 15 A circuit to ensure proper operation. Multi-strand 16 AWG wire is recommended for all 115 V (ac) wiring due to its superior flexibility and ease of installation into the terminals.



Note: Refer to the Pinnacle boiler manual for control board parameter changes.

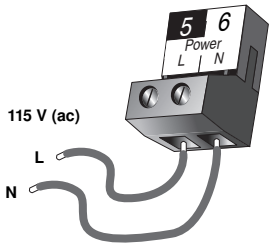
General

The installer should test to confirm that no voltage is present at any of the wires. Push the control into the base and slide it down until it snaps firmly into place.

⚠ *Powered Input Connections*

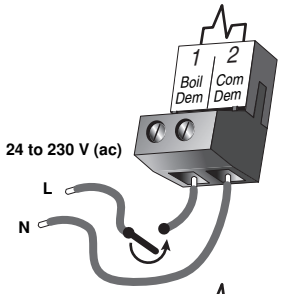
115 V (ac) Power

Connect the 115 V (ac) power supply to the *Power L* and *Power N* terminals (5 and 6). This connection provides power to the microprocessor and display of the control. As well, this connection provides power to the *Prim P1* terminal (4) from the *Power L* terminal (5).



Boiler Demand

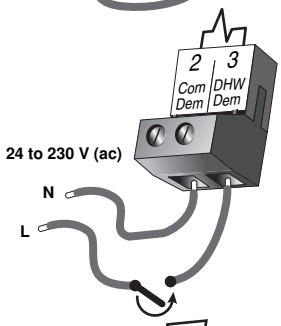
To generate a *Boiler Demand*, a voltage between 24 V (ac) and 230 V (ac) must be applied across the *Boil Dem* and *Com Dem* terminals (1 and 2).



DHW Demand

To generate a *DHW Demand*, a voltage between 24 V (ac) and 230 V (ac) must be applied across the *Com Dem* and *DHW Dem* terminals (2 and 3).

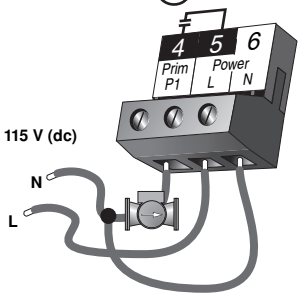
Caution: The same power supply must be used to power both the DHW Demand and the Boiler Demand circuits since they both share the *Com Dem* terminal.



⚠ *Output Connections*

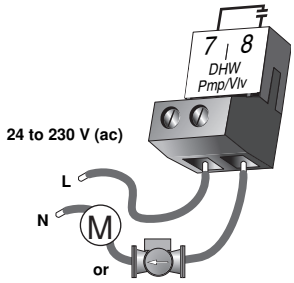
Primary Pump Contact (Prim P1)

The *Prim P1* output terminal (4) is a powered output. When the relay in the control closes, 115 V (ac) is provided to the *Prim P1* terminal (4) from the *Power L* terminal (5). To operate the primary pump, connect one side of the primary pump circuit to terminal (4) and the second side of the pump circuit to the neutral (*Power N*) side of the 115 V (ac) power supply.



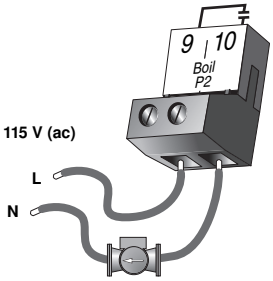
DHW Pmp / Vlv Contact

The *DHW Pmp/Vlv* terminals (7 and 8) are an isolated output. 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 DHW pump or the DHW valve. Since this is an isolated contact, it may switch a voltage between 24 V (ac) and 230 V (ac).



Boiler Pump Contact (Boil P2)

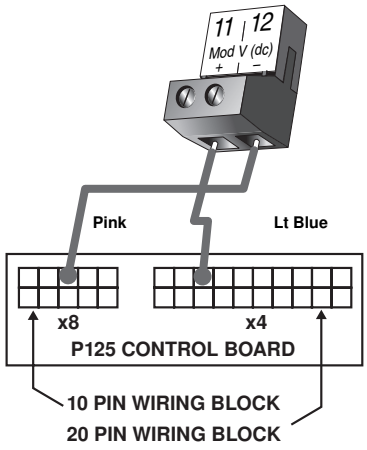
The *Boil P2* terminals (9 and 10) are isolated output in the control. There is no power available on these terminals from the control. These terminals are to be used as a switch to either make or break power to a boiler pump. Since this is an isolated contact, it may switch a voltage between 24 V (ac) and 230 V (ac).



Modulation Output

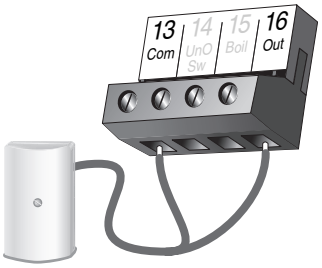
The Modulation Output *Mod V (dc)* terminals (11 and 12) provide a 0 - 5 V (dc) output to the P125 burner control board in the boiler.

Note: Refer to the Pinnacle boiler manual for control board parameter changes.



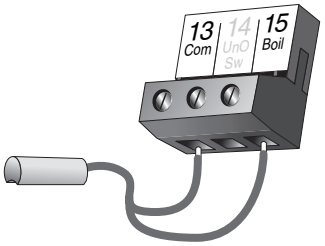
⚠ *Sensor and Unpowered Input Connections*

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



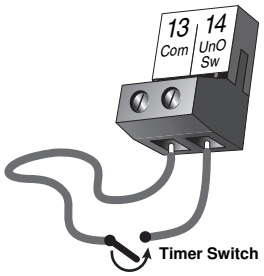
Outdoor Sensor 00228

Connect the two wires from the Outdoor Sensor to the *Com* and *Out* terminals (13 and 16). The outdoor sensor is used by the control to measure the outdoor air temperature.



Boiler Sensor 00229

Connect the two wires from the Boiler Sensor to the *Com* and *Boil* terminals (13 and 15). The boiler sensor is used by the control to measure the boiler supply water temperature.



UnOccupied Switch

If an external timer or switch is used, connect the two wires from the external switch to the *Com* and *UnO Sw* terminals (13 and 14). When these two terminals are shorted together, the control registers an unoccupied (*UNOCC*) signal.

STEP FIVE — TESTING THE WIRING

⚠ *General*

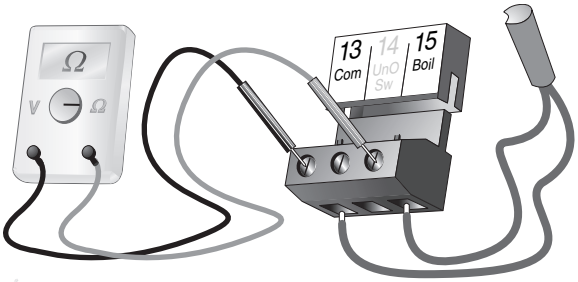
Each terminal block must be unplugged from its header on the control before power is applied for testing. To remove the terminal block, pull straight down from the control.

The following tests are to be 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 to 300 V (ac) and at least 0 to 2,000,000 **Ω**, is essential to properly test the wiring and sensors.

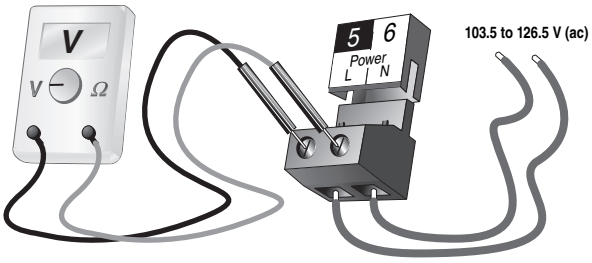
⚠ *Test The Sensors*

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. Where a digital thermometer is not available, a spare sensor can be strapped alongside the one to be tested and the readings compared. Test the sensors according to the instructions in this brochure.



⚠ *Test The Power Supply*

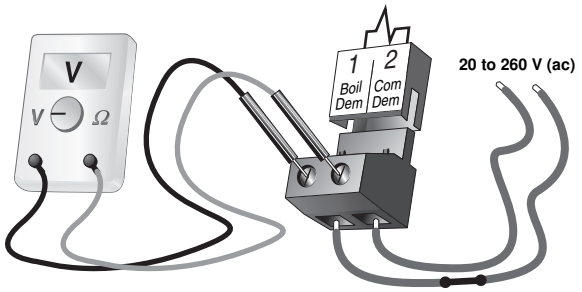
Make sure exposed wires and bare terminals are not in contact with other wires or grounded surfaces. Turn on the power and measure the voltage between the *Power L* and *Power N* terminals (5 and 6) using an AC voltmeter, the reading should be between 103.5 and 126.5 V (ac).



⚠ *Test the Powered Inputs*

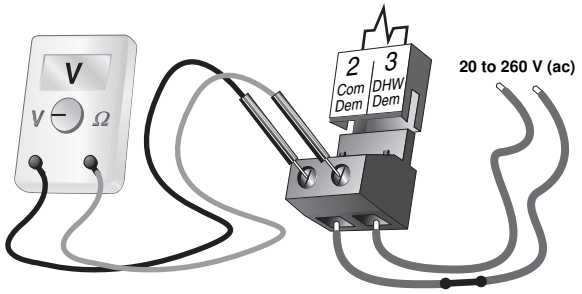
Boiler Demand

If a boiler demand is used, measure the voltage between the *Boil Dem* and *Com Dem* terminals (1 and 2). When the boiler demand device calls for heat, between 20 and 260 V (ac) should be measured at the terminals. When the boiler demand device is off, less than 5 V (ac) should be measured.



DHW Demand

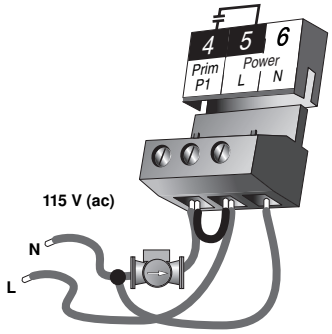
If a DHW demand is used, measure the voltage between the *Com Dem* and *DHW Dem* terminals (2 and 3). When the DHW demand device calls for heat, between 20 and 260 V (ac) should be measured at the terminals. When the DHW demand device is off, less than 5 V (ac) should be measured.



⚠ *Test The Outputs*

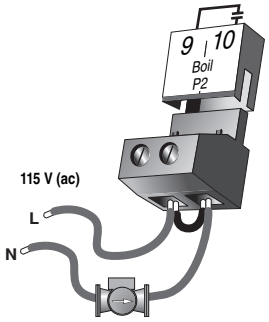
Primary Pump (Prim P1)

If a primary pump is connected to the *Prim P1* terminal (4), make sure that power to the terminal block is off and install a jumper between the *Power L* and *Prim P1* terminals (5 and 4). When power is applied to the *Power L* and *Power N* terminals (5 and 6), the primary pump should start. If the pump does not turn on, check the wiring between the terminal block and pump and refer to any installation or troubleshooting information supplied with the pump. If the pump operates properly, disconnect the power and remove the jumper.



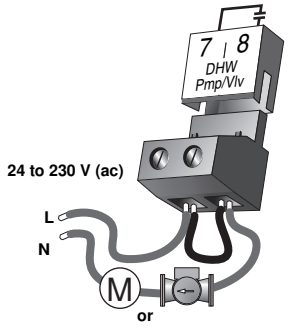
Boiler Pump (Boil P2)

If a boiler pump is connected to the *Boil P2* terminals (9 and 10), make sure that power to the terminal block is off and install a jumper between the terminals. When power is applied to circuit, the boiler pump should start. If the pump does not turn on, check the wiring between the terminal block and pump and refer to any installation or troubleshooting information supplied with the pump. If the pump operates properly, disconnect the power and remove the jumper.

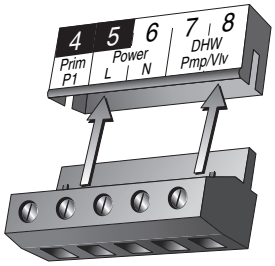


DHW Pump Or Valve (DHW Pmp / Vlv)

If a DHW pump or DHW valve is connected to the *DHW Pmp / Vlv* terminals (7 and 8), make sure the power to the pump or valve circuit is off and install a jumper between those terminals. When the DHW circuit is powered up, the DHW pump should turn on or the DHW valve should open completely. If the DHW pump or valve fails to operate, check the wiring between the terminals and the pump or valve and refer to any installation or troubleshooting information supplied with these devices. If the DHW pump or valve operates correctly, disconnect the power and remove the jumper.



⚠ *Connecting The Control*



Make sure all power to the devices and terminal blocks is off, and remove any remaining jumpers from the terminals.

Reconnect the terminal blocks to the control by carefully aligning them with their respective headers on the control, and then pushing the terminal blocks into the headers. The terminal blocks should snap firmly into place.

Install the supplied safety dividers between the unpowered sensor inputs and the powered or 115 V (ac) wiring chambers.

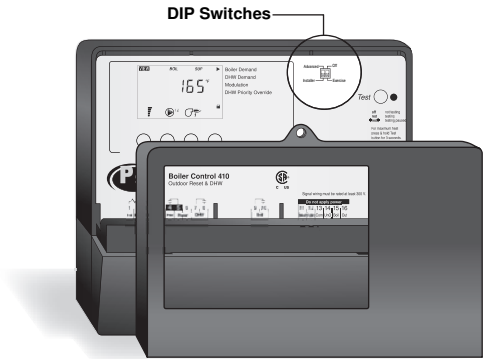
Apply power to the control. The operation of the control on power up is described in the Sequence of Operation section of the brochure.

⚠ *Test The Modulating Output*

If a modulating device is used, connect a voltmeter to the modulating output *Mod V (dc)* terminals (11 and 12) and observe the reading during operation. The initial percentage output is zero and the meter should read 0 V (dc). As the *BOIL Modulation* in the VIEW menu increases, the meter reading should increase until the *BOIL Modulation* reaches 100% at which point the meter should read 5 V (dc). When the 0 - 5 V (dc) modulation decreases, the meter should start at 5 V (dc) and eventually reach 0 V (dc) when the display shows 0% *BOIL Modulation*.

Dip Switch Settings

GENERAL



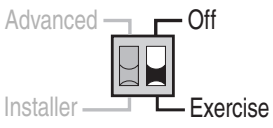
The DIP switch settings on the control are very important and should be set to the appropriate settings prior to making any adjustments to the control through the User Interface. The DIP switch settings change the items that are available to be viewed and / or adjusted in the User Interface.

If a DIP switch is changed while the control is powered up, the control responds to the change in setting by returning the display to the VIEW menu.

Advanced / Installer

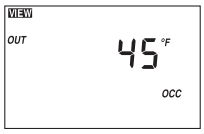
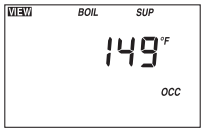
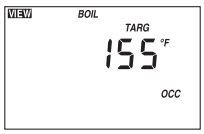
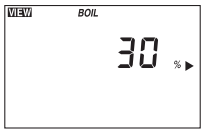
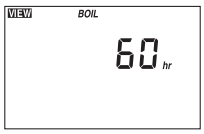
The *Advanced / Installer* DIP switch selects the access level of the control. In the *Installer* access level, a limited number of items may be viewed and / or adjusted. In the *Advanced* access level, all items may be viewed and / or adjusted.

Off / Exercise

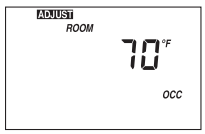
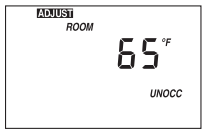
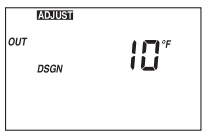
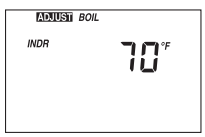
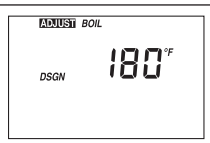


The *Off / Exercise* DIP switch selects whether or not the control is to exercise the primary pump and boiler pumps. If the DIP switch is set to *Exercise*, the pumps are operated for 10 seconds after every three days of inactivity.

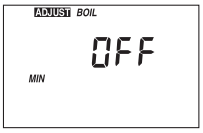
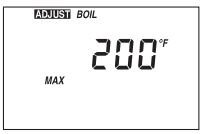
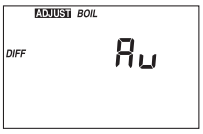
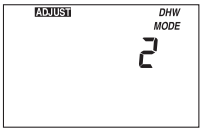
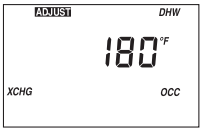
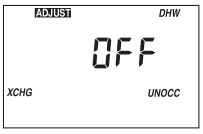
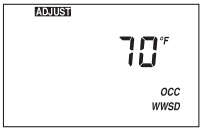
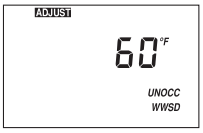
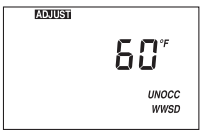
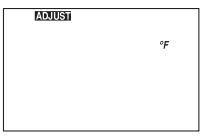
View Menu (1 of 1)

Display	Installer	Advanced	Description	Range
	●	●	**Outdoor** Current outdoor air temperature as measured by the outdoor sensor.	-76 to 149°F (-60 to 65°C)
	●	●	**Boiler Supply** Current boiler supply water temperature as measured by the boiler supply sensor.	-22 to 266°F (-30 to 130°C)
		●	**Boiler Target** Boiler target temperature is the temperature the control is currently trying to maintain at the boiler supply sensor +/- ½ of the differential.	– – –, 35 to 230°F (– – –, 2 to 110°C)
		●	**Boiler Modulation** Current percent modulation of the boiler's burner.	0 to 100%
		●	**Boiler Hours** The total running time of the boiler since this item was last cleared. To clear this item, press the ▲ and ▼ button simultaneously while viewing this item.	0 to 1999 hr

Adjust Menu (1 of 2)

Display	Installer	Advanced	Description	Range	Actual Setting
	●	●	**Room Occupied** The desired room air temperature during the occupied period.	35 to 100°F (2 to 38°C) Default = 70°F (21°C)	
	●	●	**Room Unoccupied** The desired room air temperature during the unoccupied period.	35 to 100°F (2 to 38°C, OFF) Default = 65°F (18°C)	
	●	●	**Outdoor Design** The design outdoor air temperature used in the heat loss calculations for the heating system.	-60 to 45°F (-51 to 7°C) Default = 10°F (-12°C)	
		●	**Boiler Indoor** The design indoor air temperature used in the heat loss calculation for the heating system.	35 to 100°F (2 to 38°C) Default = 70°F (21°C)	
	●	●	**Boiler Design** The design supply water temperature used in the heat loss calculations for the heating system.	70 to 220°F (21 to 104°C) Default = 180°F (82°C)	

Adjust Menu (2 of 2)

Display	Installer	Advanced	Description	Range	Actual Setting
		●	**Boiler Minimum** The minimum allowed boiler target temperature.	OFF, 80 to 180°F (OFF, 27 to 82°C) Default = OFF	
		●	**Boiler Maximum** The maximum allowed boiler target temperature.	120 to 225°F, OFF (49 to 107°C, OFF) Default = 200°F (93°C)	
		●	**Boiler Differential** The temperature differential that the control is to use when it is operating the boiler(s).	Au, 2 to 42°F (Au, 1 to 23°C) Default = Au	
		●	**DHW Mode** Selects the DHW mode of operation.	**1** (parallel, no priority), **2** (parallel, priority), **3** (pri-sec, no priority), **4** (pri-sec, priority) Default = **2**	
		●	**DHW Exchange Occupied** The minimum boiler supply temperature to the DHW heat exchanger during the Occupied period.	OFF, 100 to 220°F (OFF, 38 to 104°C) Default = 180°F (82°C)	
		●	**DHW Exchange Unoccupied** Selects whether or not a DHW demand will be responded to during the UnOccupied period.	OFF, On Default = OFF	
		●	**WWSD Occupied** The system's warm weather shut down temperature during the Occupied period.	35 to 100°F, OFF (2 to 38°C, OFF) Default = 70°F (21°C)	
		●	**WWSD Unoccupied** The system's warm weather shut down temperature during the Unoccupied period.	35 to 100°F, OFF (2 to 38°C, OFF) Default = 60°F (16°C)	
		●	**WWSD Unoccupied** The system's warm weather shut down temperature during the Unoccupied period.	35 to 100°F, OFF (2 to 38°C, OFF) Default = 60°F (16°C)	
		●	**Primary Pump Purge** The maximum length of time that the primary pump will continue to operate after the boiler demand has been removed.	OFF, 0:10 to 19:55 minutes (5 second increments) Default = 0:20 min	
		●	**Boiler Pump Purge** The length of time that the boiler pump will continue to run after the last stage in the boiler has turned off. This item is only available in operating MODE 2.	OFF, 0:10 to 19:55 minutes (5 second increments) Default = 0:20 min	
		●	The units of measure that all of the temperatures are to be displayed in by the control.	°F, °C Default = °F	

Testing the Control

The control has a built-in test routine that is used to test the main control functions. The control continually monitors the sensors and displays an error message whenever a fault is found. See the following pages for a list of the control's error messages and possible causes. When the ***Test*** button is pressed, the *Test* light is turned on. The individual outputs and relays are tested in the following test sequence.

off not testing
red testing
red testing paused

TEST SEQUENCE

Each step in the test sequence lasts 10 seconds.

During the test routine, if a demand from the system is present, the test sequence may be paused by pressing the ***Test*** button. If the ***Test*** button is not pressed again for 5 minutes while the test sequence is paused, the control exits the entire test routine. If the test sequence is paused, the ***Test*** button can be pressed again to advance to the next step. This can also be used to rapidly advance through the test sequence. To reach the desired step, repeatedly press and release the ***Test*** button until the appropriate device and segment in the display turn on.

Step 1 – The primary pump contact is closed.

Step 2 – The boiler pump contact is closed.

Step 3 – The modulation output is set to the minimum modulation percentage.

Step 4 – If there is a demand present, the modulation output increases to 100% Modulation.

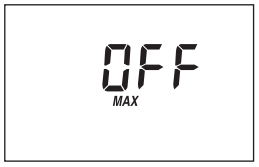
Step 5 – If there is a demand present, the modulation output decreases to the minimum modulation percentage.

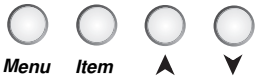
Step 6 – The modulation output decreases to 0% and the boiler pump contact is opened.
– If DHW MODE is set to 1 or 2, the DHW Pmp / Vlv contact is closed and the primary pump contact is opened.
– If DHW MODE is set to 3 or 4, the DHW Pmp / Vlv contact is closed and the primary pump contact remains closed.

Step 7 – After the test sequence is completed, the control resumes its normal operation.

MAX HEAT

The control has a function called Max Heat. In this mode, the control turns on and operates the system up to the maximum set temperatures as long as there is a demand for heat. The control continues to operate in this mode for up to 24 hours or until the ***Item***, ***Menu*** or ***Test*** button is pressed. This mode may be used for running all circulators during system start-up in order to purge air from the piping. To enable the Max Heat feature, use the following procedure.



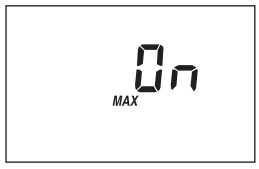


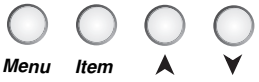
1) Press and hold the ***Test*** button for more than 3 seconds. At this point, the control flashes the MAX segment and displays the word OFF

2) Using the ▲ or ▼ buttons, select the word On. After 3 seconds, the control turns on all outputs. However, the max heat mode is still limited by the *BOIL MAX* setting.

3) To cancel the Max Heat mode, press the ***Item***, ***Menu***, or ***Test*** button.

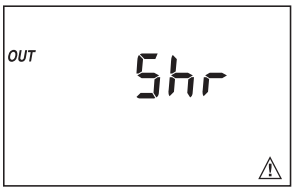
4) Once the Max Heat mode has either ended or is cancelled, the control resumes normal operation.



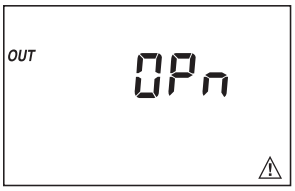


Error Messages (1 of 1)

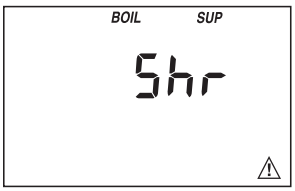
The control was unable to read a piece of information stored in its memory. Because of this, the control was required to reload the factory settings into all of the items in the ADJUST menu. The control will stop operation until all of the items in the ADJUST menu of the control have been checked by the user or installer.
Note: The *Advanced / Installer* DIP switch must be set to *Advanced* in order to clear the error.



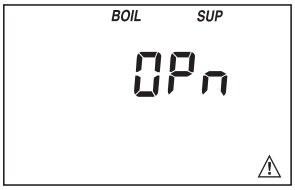
The control is no longer able to read the outdoor sensor due to a short circuit. In this case the control assumes an outdoor temperature of 32°F (0°C) and continues operation. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.



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. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.



The control is no longer able to read the boiler supply sensor due to a short circuit. The control will not operate the boiler(s) until the sensor is repaired. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.



The control is no longer able to read the boiler supply sensor due to an open circuit. The control will not operate the boiler(s) until the sensor is repaired. To clear the error message from the control after the sensor has been repaired, press either the ***Menu*** or ***Item*** button.

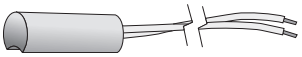
10K Sensors

OUTDOOR SENSOR 00228

The Outdoor Sensor includes a 10 kΩ thermistor which provides an accurate measurement of the outdoor temperature. The sensor is protected by a white U.V. resistant PVC plastic enclosure.

BOILER SENSOR 00229

The Boiler Sensor has a zinc sleeve for fast response and a wide operating range. The sensor is supplied with 10” (250 mm) of two conductor wire.

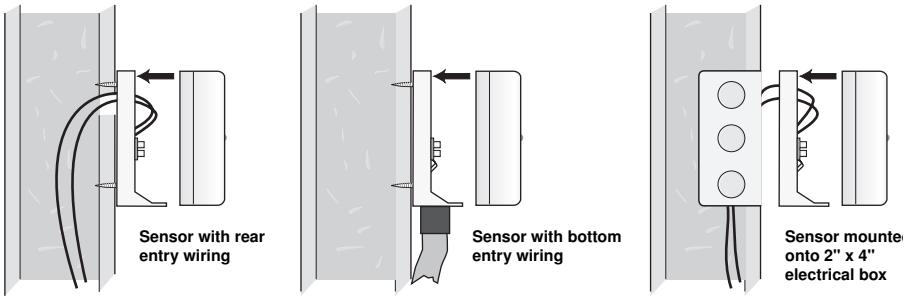


Installation - Outdoor Sensor 00228

STEP ONE — MOUNTING THE SENSOR

Note: The temperature sensor (thermistor) is built into the sensor enclosure.

- Remove the screw and pull the front cover off the sensor enclosure.
- The sensor can either be mounted directly onto a wall or a 2” x 4” electrical box. When the sensor is wall mounted, the wiring should enter through the back or bottom of the enclosure. Do not mount the sensor with the conduit knockout facing upwards as rain could enter the enclosure and damage the sensor.
- In order to prevent heat transmitted through the wall from affecting the sensor reading, it may be necessary to install an insulating barrier behind the enclosure.
- The sensor should be mounted on a wall which best represents the heat load on the building (a northern wall for most buildings and a southern facing wall for buildings with large south facing glass areas). The sensor should not be exposed to heat sources such as ventilation or window openings.
- The sensor should be installed at an elevation above the ground that will prevent accidental damage or tampering.

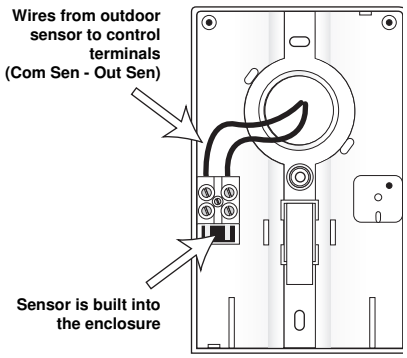


STEP TWO — WIRING AND TESTING THE SENSOR

- Connect 18 AWG or similar wire to the two terminals provided in the enclosure and run the wires from the sensor to the control. Do not run the wires parallel to telephone or power cables. If the sensor wires are located in an area with strong sources of electromagnetic interference (EMI), shielded cable or twisted pair should be used or the wires can be run in a grounded metal conduit. If using shielded cable, the shield wire should be connected to the Com Sen terminal on the control and not to earth ground.

- Follow the sensor testing instruction in this brochure and connect the wires to the control.

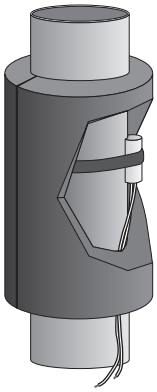
- Replace the front cover of the sensor enclosure



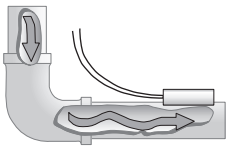
Installation - Boiler Sensor 00229

STEP ONE — MOUNTING THE SENSOR

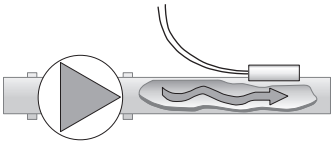
Note: The Boiler Sensor is designed to mount on a pipe or in a temperature immersion well.



The Boiler Sensor can be strapped directly to the pipe using the cable tie provided. Insulation should be placed around the sensor to reduce the effect of air currents on the sensor measurement.



The Boiler Sensor should be placed downstream of a pump or after an elbow or similar fitting. This is especially important if large diameter pipes are used as the thermal stratification within the pipe can result in erroneous sensor readings. Proper sensor location requires that the fluid is thoroughly mixed within the pipe before it reaches the sensor.



STEP TWO — WIRING AND TESTING THE SENSOR

Caution: Do not run sensor wires parallel to telephone or power cables. If the sensor wires are located in an area with strong sources of electromagnetic interference, shielded cable or twisted pair should be used or the wires can be run in a grounded metal conduit. If using shielded cable, the shield wire should be connected to the Com Sen terminal on the control and not to earth ground.

- It is necessary to connect 18 AWG wire to the two sensor wires. Marrettes can be used to hold the wires together.
- Follow the sensor testing instructions given in this brochure and then connect the wires to the control.

Using a Temperature Well

If the Boiler Sensor is mounted onto 1" (25 mm) diameter L type copper pipe, there is approximately an 8 second delay between a sudden change in water temperature and the time the sensor measures the temperature change. This delay increases considerably when mild steel (black iron) pipe is used. In general, it is recommended that a temperature well be used for steel pipe of diameter greater than 1-1/4" (32 mm). Temperature wells are also recommended when large diameter pipes are used and fluid stratification is present.

Sensor Testing Instructions

A good quality test meter capable of measuring up to 5,000 kΩ (1 kΩ = 1000 Ω) is required to measure the sensor resistance. In addition to this, the actual temperature must be measured with either a good quality digital thermometer, or if a thermometer is not available, a second sensor can be placed alongside the one to be tested and the readings compared.

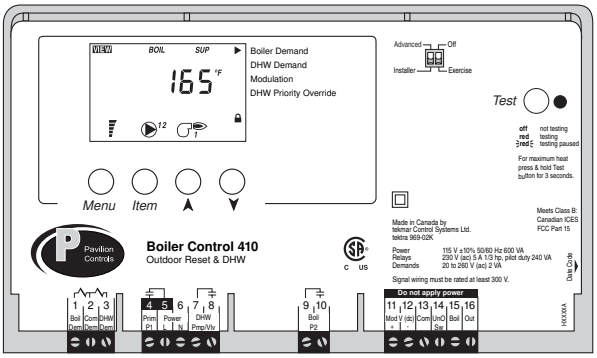
First measure the temperature using the thermometer and then measure the resistance of the sensor at the control. The wires from the sensor must not be connected to the control while the test is performed. Using the chart below, estimate the temperature measured by the sensor. The sensor and thermometer readings should be close. If the test 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.

Do not apply voltage to a sensor at any time as damage to the sensor may result.

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

Pavilion Control 410 (00263)

Literature	—	D 410
Control	—	Microprocessor PID control; This is **not a safety (limit) control**.
Enclosure	—	Black PVC plastic
Dimensions	—	6-5/8” H x 7-9/16” W x 2-13/16” D (170 x 193 x 72 mm)
Approvals	—	CSA C US, meets ICES & FCC regulations for EMI/RFI.
Ambient conditions	—	Indoor use only, 32 to 122°F (0 to 50°C), < 90% RH non-condensing.
Power supply	—	115 V (ac) ±10% 50/60 Hz 600 VA
Relay capacity	—	230 V (ac) 5 A 1/3 hp pilot duty 240 VA
Modulation Output	—	0-5 V (dc)
Demands	—	20 to 260 V (ac) 2 VA
Sensors included	—	NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) ß=3892 Outdoor Sensor 00228 and Boiler Sensor 00229

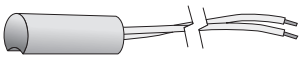


Outdoor Sensor 00228

Enclosure	—	White PVC plastic
Dimensions	—	4-1/2” H x 2-7/8” W x 1-1/2” D (73 x 114 x 38 mm)
Approvals	—	CSA C US, UL listed
Operating range	—	-60 to 140°F (-50 to 60°C)
Sensor	—	NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C), ß=3892

Boiler Sensor 00229

Enclosure Wire	—	Zinc sleeve, 10” (250 mm) 20 AWG XPE wire
Dimensions	—	3/8” OD x 3/4” (9.5 OD x 19 mm)
Approvals	—	CSA C US, UL listed
Operating range	—	-60 to 255°F (-50 to 125°C)
Sensor	—	NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C), ß=3892



Pavilion Controls

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