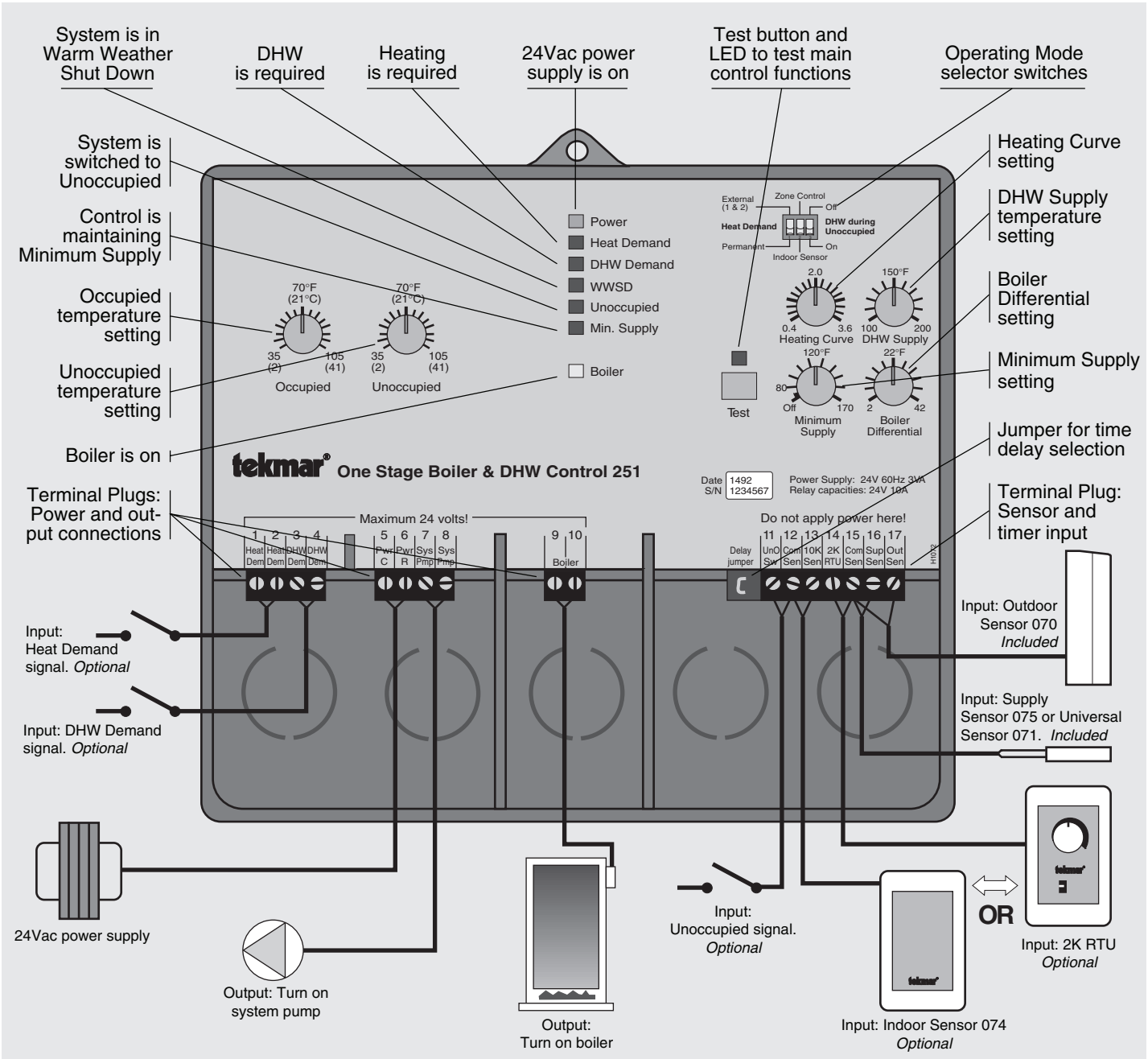
tekmar® - Data Brochure

One Stage Boiler & DHW Control 251

D 251

06/92

The tekmar One Stage Boiler & DHW Control 251 is a microprocessor-based control which regulates the supply water temperature from a single boiler based on the outdoor air temperature, and optionally, the indoor air temperature. When a demand signal from a Domestic Hot Water (DHW) system is present, the control will operate the boiler to regulate the supply water temperature at a selected DHW setpoint. The system pump is shut down when there is no DHW or Heat Demand signal or if the outdoor temperature is warm enough so that the system no longer requires heat (WWSD).



Outdoor Reset Strategy

Correct setting and shifting of the Heating Curve... the key to More Comfort and Energy Savings.

Heating Curve

As outdoor temperatures become colder, heat losses from a building increase, which requires the addition of more heat to prevent the indoor air temperature from also becoming colder. This tekmar reset control measures the outdoor temperature and as the outdoor temperature becomes colder, it balances the heat loss by making the heating supply water hotter.
The Heating Curve is used to calculate exactly how hot to make the supply water at different outdoor temperatures. It determines the number of degrees the supply water temperature is raised for each degree the outdoor temperature falls.

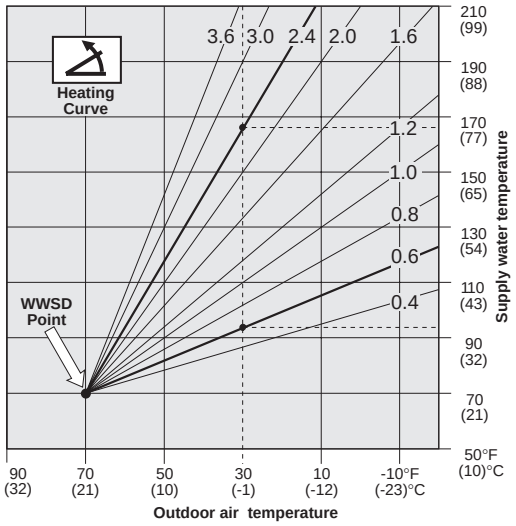
Setting the Heating Curve

Two examples of how the Heating Curve works are illustrated in the following diagram.

—With a 2.4 Curve, the supply water temperature is raised 2.4 degrees for every degree of outdoor temperature drop.
If: WWSD point = 70°F and Outdoor temperature = 30°F, then supply temperature = 166°F

—With a 0.6 Curve, the supply water temperature is raised 0.6 degrees for every degree of outdoor temperature drop.
If: WWSD point = 70°F and Outdoor temperature = 30°F, then supply temperature = 94°F

- *If the Heating Curve selected is too low;* the heating system will not supply hot enough water to keep the room temperature warm during colder weather.
- *If the Heating Curve selected is too high;* the supply water will be too hot for the conditions and the building will overheat during colder weather.

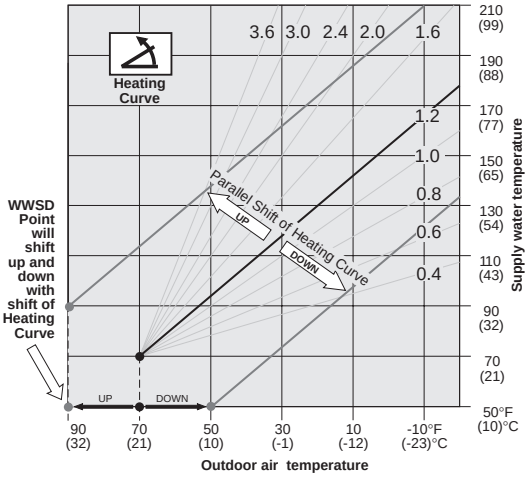


Warm Weather Shut Down (WWSD)

At warm outdoor temperatures, the indoor space of a building gains heat from the outdoors; additional heat is not required, and if the heating system is running (even on standby), enough excess heat can be produced to overheat the building, causing discomfort and wasting valuable energy.
This control shuts off the boiler and system pump when the outdoor temperature is above the WWSD point.

As outdoor temperatures get colder, there comes a point where the heat gain turns into heat loss; the heat loss causes the indoor temperature to fall below the comfort level, and the heating system must be turned on to start delivering heat.
To provide heat to the building, this control turns on the system pump and fires the boiler to deliver heat at the low output required by the Heating Curve near the WWSD point. If the outdoor temperature rises above the WWSD point, the control shuts the heating system off again; since the system was operating at a low heat output level, overheating and temperature swings in mild weather are avoided.

When the system is operating near the WWSD point and the building is too cold; the WWSD point should be raised.
When the system is operating near the WWSD point and the building is too warm; the WWSD point should be lowered.



Shifting the Heating Curve

(a) Manually, at the control:

The Occupied and Unoccupied dials on this control can shift the WWSD point up or down from 35 to 105°F (2 to 41°C).

(b) Automatically, using room temperature feedback:

In addition to a Supply Sensor and an Outdoor Sensor, this control can use a tekmar RTU, Zone Control or Indoor Sensor to provide room temperature feedback for added comfort and system flexibility.

The control still calculates a desired supply temperature based on the Heating Curve setting and the outdoor temperature.

If the air temperature in the room is too cold, the control will shift the heating curve (and WWSD point) *up,* which raises the supply temperature until the room warms up again.

If the air temperature in the room is too warm, the control will shift the heating curve (and WWSD point) *down,* which lowers the supply temperature until the room cools down.

A very cool room temperature can shift the curve far enough up to bring the control out of WWSD at warm outdoor temperatures.
A very warm room temperature can shift the curve far enough down to put the control into WWSD at cool outdoor temperatures.

Refer to the tekmar Essays E 001 and E 002 for more detailed information regarding control strategy and integration of control functions.

Sequence of Operation

When the One Stage Boiler & DHW Control 251 is powered-up, the "Power" light will come on and the control will cycle through an automatic test routine described in detail on pages 10 and 11 of this brochure. When the test routine is completed and no errors are detected, the control exits the test routine and enters the operating mode.

Once in operating mode, the control uses the Outdoor Sensor 070 to continually monitor the outdoor temperature, and either the Sensor 075 or the Universal Sensor 071 to continually monitor the system supply water temperature.

Indoor temperature can be monitored through the use of;

(a) - a tekmar 2k RTU or a tekmar Zone Control (switch selector switch to "Zone Control" position), **or**;

(b) - an Indoor Sensor 074 (switch selector switch to "Indoor Sensor" position).

While monitoring all of these temperatures, the control recognizes the following temperature conditions and inputs and will respond as described. During operation, the lights of the control will indicate operational status as illustrated.

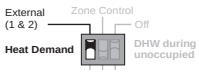
Heating Operation

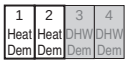
***Unoccupied* mode**

Connect (short circuit) terminals *UnO Sw — Com Sen* (11 and 12) together. The Occupied dial becomes inactive. The Unoccupied dial becomes active.

***Heat Demand* signal**

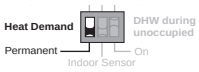
(a) - switch the Heat Demand switch to the "External (1 & 2)" position, and supply a **24Vac** signal to terminals *Heat Dem — Heat Dem* (1 and 2)





OR

(b) - switch the Heat Demand switch to the "Permanent" position.

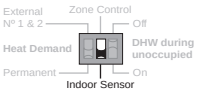


Occupied/Unoccupied dial function (no indoor temperature feedback)

The control will monitor the outdoor and supply temperatures. The Occupied or Unoccupied dial settings become the WWSD point. When the outdoor temperature is warmer than the setting of the Occupied dial, the control enters WWSD. When switched into Unoccupied mode, the "Unoccupied' light will come on, and the control will operate at the temperature of the Unoccupied dial setting.

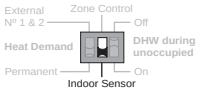
Indoor Sensor 074 function *Selector switch = Indoor Sensor*

The control will monitor the indoor, outdoor and supply temperatures, and shift the Heating Curve (and the WWSD point) up or down to fine adjust the system supply water temperature whenever the room temperature is different than the setting of the Occupied dial. When switched into Unoccupied mode, the "Unoccupied" light will come on, and the control operates at the temperature of the Unoccupied dial setting.



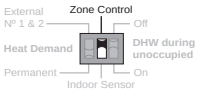
2K RTU function *Selector switch = Indoor Sensor*

The control will monitor the indoor, outdoor and supply temperatures, and shift the Heating Curve (and the WWSD point) up or down to fine adjust the system supply water temperature whenever the room temperature is different than the setting of the RTU dial. The Occupied and Unoccupied dials are not functional, and a setback RTU must be used if Unoccupied schedules are desired.



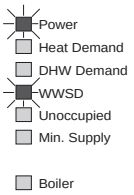
tekmar Zone Control function *Selector switch = Zone Control*

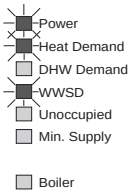
The control will monitor the indoor temperatures of all zones, as well as the outdoor and supply temperatures, and shift the Heating Curve (and the WWSD point) up or down to fine adjust the system supply water temperature for whichever zone requires the hottest supply water. The Occupied and Unoccupied dials are not functional.



WWSD function

When WWSD occurs, the "WWSD" light will come on, and the control will continue to monitor the outdoor temperature, supply temperature and indoor temperature (optional). Whenever 3 days pass with the control in uninterrupted WWSD, the pump will be cycled on for 20 seconds to help prevent it from seizing up.



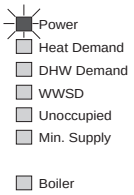


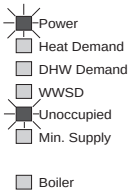
Unoccupied light may also be on

Outdoor temperature cold enough to require heating

No heat demand signal

When the outdoor temperature is colder than the WWSD point, the control will leave WWSD. Whenever the control leaves WWSD, the "WWSD" light will turn off and the control will continue to monitor the outdoor temperature, supply temperature and indoor temperature (optional), but no further control action will take place until there is a heat demand signal.





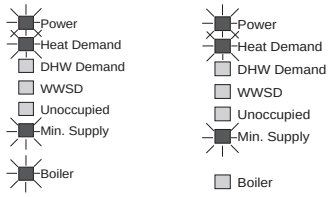
With Heat demand signal

The "Heat Demand" light will come on, the control will switch on the system pump and calculate the desired supply temperature based on the requirements of the Heating Curve or the Minimum Supply setting, whichever is highest.

Heating Operation (cont.) — Outdoor temperature cold enough to require heating

With boiler minimum setting higher than heating curve requirement

The "Min. Supply" and "Boiler" lights will come on and the control will switch on the boiler. The boiler will fire until the supply temperature reaches the minimum setting plus the differential setting. When this point is reached, the "Boiler" light will turn off and the boiler will be shut off. The "Min. Supply" light will stay on and the control will continue to cycle the boiler at the Minimum setting.

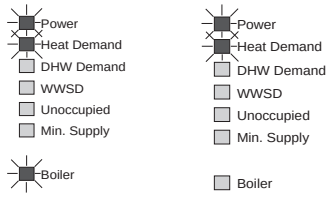


Unoccupied light may also be on

Outdoor temperature cold enough for heating curve operation

The "Boiler" light will come on and the control will fire the boiler. The boiler will fire until the supply temperature reaches the heating curve desired temperature plus one half the differential setting, where the "Boiler" light will turn off and the boiler will be shut off.

Note: Whenever the boiler is turned off, the control will keep it off until at least the minimum time delay has expired.

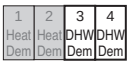


Unoccupied light may also be on

DHW Operation

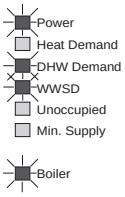
DHW mode

- A 24Vac DHW Demand signal must be applied to terminals *DHW Dem — DHW Dem* (3 and 4).
- The DHW Demand signal causes the control to monitor the supply temperature and respond as follows.



Control in WWSD

When switched into DHW mode, the "DHW Demand" light will come on and the control will switch on the system pump. If the supply temperature is lower than the setting of the DHW Supply dial, the "Boiler" light will come on and the control will switch on the boiler. The control will fire the boiler until the supply temperature reaches the DHW setting plus one half of the Differential setting, and will continue to operate the boiler at the DHW Supply setting until the DHW Demand signal is removed.

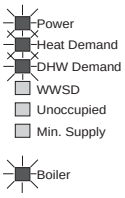


Unoccupied light may also be on

Control in heating operation

When the control is switched into DHW mode, the "DHW Demand" light will come on and the control will check to see if there is a Heat demand.

- With no heat demand, the control will operate the boiler at the DHW Supply setting.
- If there is a heat demand, the control will check the heating curve desired temperature against the DHW Supply temperature setting and operate the boiler at whichever is the hottest temperature.



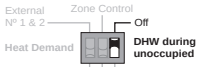
Unoccupied light may also be on

DHW during unoccupied *selector switch = On*

When in Unoccupied mode, the control will operate (as above), to generate DHW.

DHW during unoccupied *selector switch = Off*

DHW will not be generated in Unoccupied mode, even with a DHW Demand signal.



Installation

Caution

Improper installation and operation of this control could result in damage to 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.

Step One — Getting ready

Check the contents of this package. If any of the contents listed are missing or damaged, please refer to the Limited Warranty and Product Return Procedure on the back of this brochure and contact your wholesaler or tekmar sales agent for assistance.

Type 251 includes:
- One Control 251 • One Outdoor Sensor 070 • One Supply Sensor 075 or 071
- One Data Brochure D 251 • One Data Brochure D 001 • One Application Brochure A 251

Other information available:
- Essay E 001 • Essay E 002

Read Application Brochure A 251 and select the correct Application for your job.

Note:

Carefully read the details of the Application, and the Sequence of Operation sections in all applicable brochures to ensure that you have chosen the proper control, and you understand its functions within the operational requirements of your system.

Step Two — Mounting the base

The control should be removed from its base by pressing down on the release clip in the wiring chamber and sliding upwards on the control. The base is then mounted in accordance with the instructions in the Data Brochure D 001.

Step Three — Rough-in Wiring

All electrical wiring terminates in the control base wiring chamber. It has standard 7/8" (22mm) knock-outs that will accept common wiring hardware and conduit fittings. Before breaking out the knock-outs, check the wiring diagram and select those sections of the chamber with common voltages, since the safety dividers will later prevent wiring from crossing between sections. Standard 18AWG solid wire is recommended for all low voltage wiring to tekmar controls. Heavier guage wire may not fit properly into the terminal plugs, while lighter guage wire is too fragile and may also contribute too much resistance to the circuit.

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

- Install the Outdoor Sensor 070, and the Supply Sensor 075 or 071 according to the instructions in the Data Brochure D 001 and run the wiring back to the control.

Option: An Indoor Sensor 074, RTU or tekmar Zone Control can also be connected. See individual sensor instructions.

- Install the wiring from the other system components (Boiler, System Pump, Heat Demand & DHW Demand circuits) to the base.
- Install a 24Vac Class II transformer with a minimum 12VA rating close to the control, and run the wiring from the transformer to the base. *A Class II transformer must be used. Do not connect any of the transformer terminals to ground, as damage to the control may result.*

Step Four — Electrical connection to the control

Power and output connections

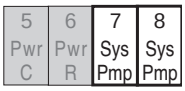
The installer should test to confirm that no voltage is present at any of the wires.

Maximum 24 Volts

- Install the control into the base, sliding it down until it snaps into place.
- All electrical connections are made directly to the plug terminals.
- Connect the 24Vac power supply from the secondary side of a 24Vac class II transformer to terminals *C — R* (5 and 6). *Do not connect either of the transformer terminals to ground.*

Connect the System Pump circuit to terminals *Sys Pmp — Sys Pmp* (7 and 8). These terminals lead to a 10 amp dry relay contact which closes when the control requires System Pump operation.

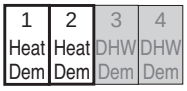
Note: The 251 is approved for low voltage only (Maximum 24Vac). The System Pump must be switched through an isolation relay approved for the line voltages required to operate the pump.



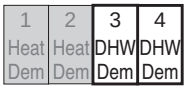
Connect the boiler circuit to terminals *Boiler* (9 and 10). These terminals lead to a 10 amp dry relay contact which closes when the control requires boiler operation. Boilers with a 24Vac control circuit can be switched directly through the control. If higher voltages are used, an isolation relay must be used.

Powered input connections

If a 24Vac external Heat Demand signal is used, (zone valve end switches, etc.) connect the wiring from the Heat Demand circuit to terminals *Heat Dem — Heat Dem* (1 and 2). When 24Vac is applied to these terminals, the control will recognize a "call for heat" from the system.



If a 24Vac DHW Demand signal is used, (aquastat, etc.) connect the wiring from the DHW Demand circuit to terminals *DHW Dem — DHW Dem* (3 and 4). When 24Vac is applied to these terminals, the control will recognize a "call for Domestic Hot Water" and switch into DHW mode.

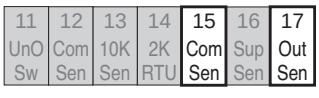


Sensor and <u>unpowered</u> input connections

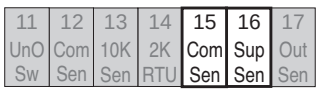
Power should never be applied to these terminals. Damage to the control will result.

Do not apply power here!

Connect the two wires from the Outdoor Sensor 070 to terminals *Com Sen — Out Sen* (15 and 17).

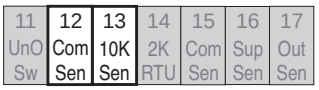


Connect the two wires from the Supply Sensor 075 or the Universal Sensor 071 to terminals *Com Sen — Sup Sen* (15 and 16).



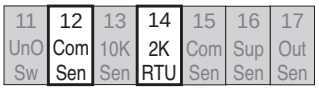
Option: Indoor temperature feedback sensor: ***(Choose one option only)***

(1) Connect the two wires from an Indoor Sensor 074 or a tekmar Zone Control (not 240) to terminals *Com Sen — 10K Sen* (12 and 13).



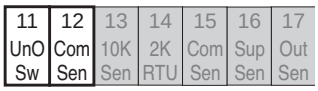
OR **OR**

(2) Connect the two wires from a tekmar 2K RTU, (305, 307, 308, or 310) or a tekmar 240 Zone Control to terminals *Com Sen — 2K RTU* (12 and 14).

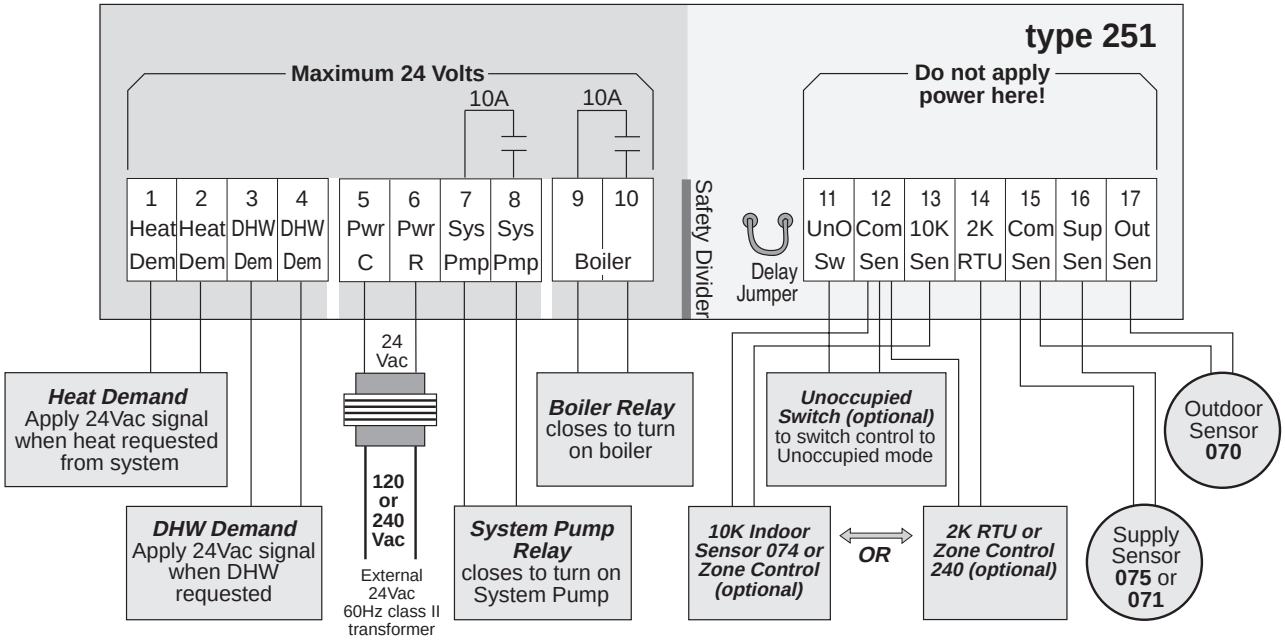


Option: Occupied/Unoccupied switch input:

Connect the two wires from the Occupied/Unoccupied dry contact switch, (timer, relay, etc.) to terminals *UnO Sen — Com Sen* (11 and 12).



Electrical connections to the terminal plugs of the 251 control. Control relays are shown in "power down" condition.

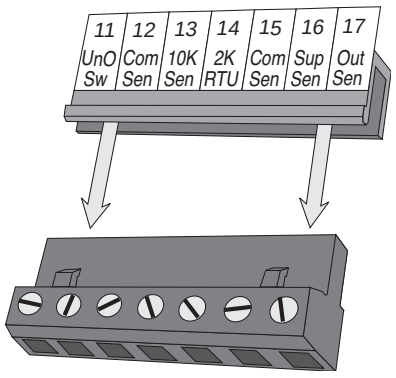


For a detailed wiring schematic of your specific application, refer to the Application Brochure A 251.

Step Five — Testing the wiring

Caution

- **These tests are to be performed using standard testing practices and procedures and should only be carried out by a properly trained and experienced technician.**
- **Before applying power to the control for testing, each terminal plug must be unplugged from its header on the control. Pull straight down to unplug.**
- **A good quality electrical test meter, capable of reading from at least 0 — 200 Volts AC, and at least 0 — 1,000,000 Ohms, is essential to properly test this control.**



Terminal plug disconnected from its header on the control

Test the sensors

- These tests must be made *before* turning on the power supply, and with the terminals unplugged.
- The sensors are to be tested according to the instructions in Brochure D 001.

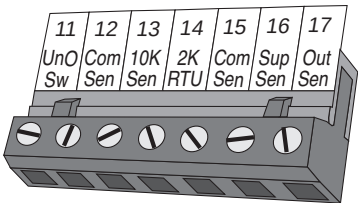
Test the power supply

Make sure exposed wiring or bare terminals are not in contact with any other wires or grounded surfaces. Turn on the power to the transformer and use an AC voltmeter to measure the voltage between terminals *C — R* (5 and 6). 22 to 26 Volts AC should be measured at these terminals.

Test the powered inputs

If an external Heat Demand signal is used, power up the Heat Demand circuit and supply a Heat Demand signal to the control. Use an AC voltmeter to measure the voltage between terminals *Heat Dem — Heat Dem* (1 and 2). 22 to 26 Volts AC should be measured at these terminals.

If a DHW Demand signal is used, power up the DHW Demand circuit and supply a DHW Demand signal to the control. Use an AC voltmeter to measure the voltage between terminals *DHW Dem — DHW Dem* (3 and 4). 22 to 26 Volts AC should be measured at these terminals.



Terminal plug pushed into its header on the control

If a System Pump circuit is connected to the *Sys Pmp — Sys Pmp* (7 and 8) terminals; make sure power to the circuit is off and install a jumper in the terminal plug between terminals 7 and 8. When the circuit is powered-up, the pump should operate. If it does not come on, check the circuit wiring for errors and ensure that it is powered up and the voltage is correct. Check the devices in the circuit (pump, switching relay, etc.) for faults. If the pump operates properly when the circuit is powered up, disconnect the power, remove the jumper and proceed to the next step.

Make sure power to the Boiler circuit is off and install a jumper in the terminal plug between the *Boiler* (9 and 10) terminals. When the circuit is powered-up, the boiler should operate. If it does not come on, check the circuit wiring for errors and ensure that it is powered up and the voltage is correct. Check the devices in the circuit (limits, flow switches, etc.) for faults. If the boiler operates properly when the circuit is powered up, disconnect the power, remove the jumper and proceed to the next step.

Connect the control

Turn the power off and make sure all test jumpers have been removed from the plugs.

Connect the plugs to the control by carefully aligning them with their respective headers and pushing them upwards into the headers. The plugs should snap firmly into place.

The control is now ready for set-up and operation.

Caution

The tekmar One Stage Boiler & DHW Control 251 is an operating control and is not certified or intended for use as a safety device. Under no circumstances should safety limit devices be left disconnected after installation of this control. The installer shall check all applicable code requirements and obtain necessary inspections to ensure that the installation is in compliance with those requirements.

Settings

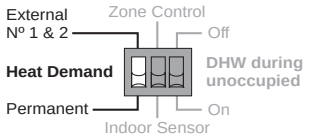
Step Six — Essential control settings

To obtain the best operation from a reset control, it is important to measure the system supply temperature as accurately as possible. Whenever the control receives a heat demand signal, the system pump must be operated to maintain continuous water flow past the supply temperature sensor.

For specific application details refer to Application Brochure A 251.
A more detailed technical description of the effect of control settings on overall system operation is described in the tekmar Essay, E 002.

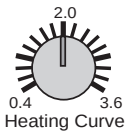
Heat Demand switch

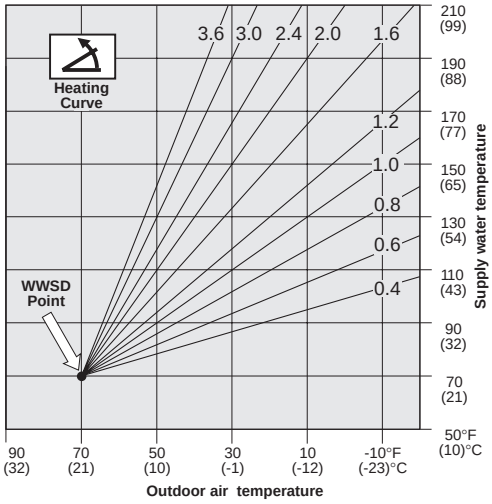
When the heating system uses zone valve end switches or some other means of delivering an external heat demand signal to terminals *Heat Dem — Heat Dem* (1 and 2), set this selector switch to "External (1 & 2)" and the control will only be enabled when it recieves a 24Vac signal from the heat demand circuit. If an external heat demand signal is not used, set the switch to "Permanent", and the control will be enabled all the time.



Heating Curve

As outdoor temperatures drop, heat losses from a space become greater and the heating system supply water temperature must be raised to maintain a constant room temperature. The heating curve value describes how many degrees the supply water temperature is raised for a one degree drop in outdoor temperature. The supply temperature starts to increase when the outdoor temperature falls below the WWSD point. To calculate the correct setting for the Heating Curve, use the following formula.





Heating Curve = $\frac{\text{design supply temperature – room temperature}}{\text{room temperature – design outdoor temperature}}$

For example:

- **design outdoor temperature = 5°F (-15°C)**
- **room temperature = 70°F (21°C)**
- **design supply temperature = 160°F (71°C)**

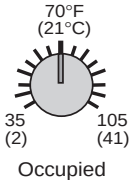
Heating Curve = $\frac{160°F - 70°F}{70°F - 5°F}$ = $\frac{90°F}{65°F}$ = 1.4

For more information regarding the Heating Curve, refer to page 2 of this brochure. If the actual designed supply water temperature for a system is unknown, a trial setting can be calculated using these typical supply temperatures:

- Fan coils …180° to 210°F (82° to 99°C)
- Baseboard convectors …160° to 190°F (71° to 88°C)
- Hydronic radiant floors …100° to 130°F (38° to 54°C).

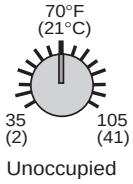
Occupied temperature

When there is no room temperature feedback to the control, the Occupied dial setting determines the starting point of the heating curve (WWSD point) and the Heating Curve setting will reset the water temperature as described in the Heating Curve instructions above.
When an Indoor Sensor 074 is connected to the control, the Occupied dial setting becomes the actual controlled temperature of the room. This valuable feature allows the control to compensate for an incorrectly set heating curve or for unexpected internal heat gains or losses. If the room temperature is too high or too low, the indoor sensor allows the heating curve to be shifted up or down accordingly.
When a tekmar Zone Control or 2K RTU (Room Temperature Unit) is connected to the control, the RTU setting becomes the controlled temperature and the Occupied dial becomes inactive.



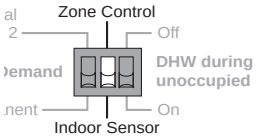
Unoccupied temperature

The Unoccupied dial operates in the same way as the Occupied dial.
When the terminals *UnO Sw — Com Sen* (11 and 12) are shorted out, the control switches from operating at the Occupied dial setting to operating at the Unoccupied dial setting. When a tekmar Zone Control or 2K RTU (Room Temperature Unit) is connected to the control, the RTU setting becomes the controlled temperature and the Unoccupied dial becomes inactive.



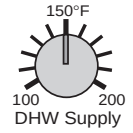
Zone Control/Indoor Sensor switch

When this selector switch is in the "Indoor Sensor" position, and a tekmar Indoor Sensor 074 or a tekmar 2K RTU is connected, the control receives room temperature feedback from the Indoor Sensor or RTU and the Occupied/Unoccupied dials operate as described above.
When the switch is in the "Zone Control" position, and a tekmar Zone Control is connected, the control receives information from the Zone Control that allows the heating curve to be shifted so the supply water temperature is hot enough to satisfy the requirements of the zone with the highest heat demand.



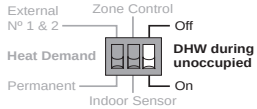
DHW Supply

When the control receives a 24Vac DHW Demand signal, this dial becomes active. The control will elevate the supply temperature to the temperature setting of the DHW dial. The Heating Curve or Minimum Supply setting has priority over this function if either one requires hotter water.



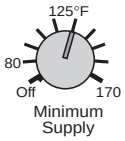
DHW during Unoccupied mode

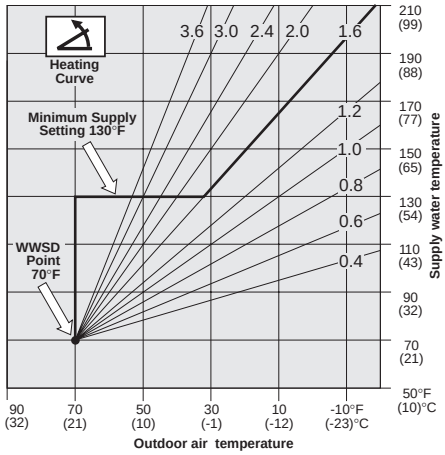
When this selector switch is in the "On" position, DHW will continue to be generated when the control is switched into the Unoccupied mode and a DHW Demand signal is received. When the switch is in the "Off" position, the DHW mode becomes inactive when the control is in Unoccupied mode and the control will ignore any DHW Demand signal.



Minimum Supply Temperature

This dial should be set according to the requirements specified by the boiler manufacturer. Many boilers require a minimum operating temperature to prevent corrosion from flue gas condensation. The control raises the supply temperature to the Minimum setting when the outdoor temperature drops below the WWSD point, and holds it there until the outdoor temperature becomes cold enough to require operation on the heating curve. When an Indoor Sensor 074 or 2K RTU is installed in a room and the selector switch set for "Indoor Sensor", the control will cycle the boiler on and off at the Minimum Supply temperature to prevent overheating of the room.

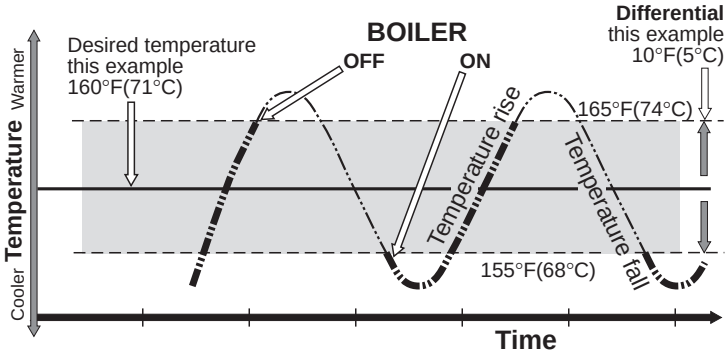




Typical Minimum Boiler Operating Temperatures: • Steel Tube Boilers …140° to 180°F (60° to 82°C) • Cast Iron Boilers …130° to 150°F (54° to 66°C) • Copper Tube Boilers …105° to 150°F (41° to 66°C) • Condensing or Electric Boilers …Off

Boiler Differential and Time Delay

The Boiler Differential adjustment sets how much the actual supply water temperature may deviate from the desired temperature before the boiler is turned on or off, and is determined by the flow rate through the boiler relative to the amount of heat produced by the boiler. To prevent short operating cycles of the boiler, the control has a minimum time delay of 30 seconds between firing cycles. This time can be lengthened to 3.3 minutes by cutting the jumper wire beside terminal 11 in the wiring chamber (just behind the faceplate decal). On an installation where flow rates are known, the Boiler Differential can be calculated as follows.



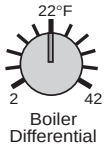
Boiler Differential = $\frac{\text{Btu/hr}}{\text{US GPM x 500}}$

For example: $\frac{\text{100,000 Btu/hr}}{\text{20 US GPM x 500}}$ = 10°F (6°C)

The boiler will turn on when the actual temperature falls 5°F (3°C) below the desired temperature and will turn off when the actual temperature rises 5°F (3°C) above the desired temperature.

OR

Trial setting = 22°F if flow rates are unknown



Test button

The control can be made to cycle through a test routine whenever the Test button is pushed. The test can be halted at certain times by pushing the button a second time. For details of the test routine, refer to the description starting on page 10.

Indicator lights

There are eight LEDs on the front of the control that will aid in testing and troubleshooting. During normal operation, these lights indicate the following functions:

Power light on	• the 24Vac power supply has been connected and the control is energized.
Heat Demand light on	• the control is receiving a 24Vac external Heat Demand signal at terminals *Heat Dem — Heat Dem* (1 and 2) or the Heat Demand selector switch is in the "Permanent" position.
DHW Demand light on	• the control is receiving a 24Vac DHW Demand signal at terminals *DHW Dem — DHW Dem* (3 and 4).
WWSD light on	• the outdoor temperature is above the WWSD point and the control has shut the heating system off.
Unoccupied light on	• the terminals *Uno Sw —Com Sen* (11 and 12) are shorted together, switching the control into Unoccupied (setback) mode.
Min. Supply light on	• the control has calculated that it must operate the boiler to maintain the Minimum Supply temperature; the outdoor temperature is not cold enough for Heating Curve operation.
Boiler light on	• the boiler relay is on, closing the contacts between the *Boiler* (9 and 10) terminals.
Test light on	• the control is going through the programmed test routine.

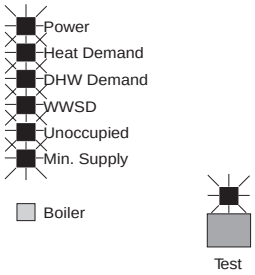
Testing the Control Functions

Step Seven — Operational test of control functions - Test button

The One Stage Boiler & DHW Control 251 has a Test button which can be used to test all of the main control functions at any time. When the control is initially powered-up, or when the Test button is pushed, the control automatically runs through the following test procedure. If a fault is detected, some of the indicator lights will flash an Error Message. These Error Messages are listed on page 11.

All lights on

On power-up, and at the start of each test routine, all of the red status lights are switched on for approximately 5 seconds. During this time the control searches for sensor faults and, if no faults are found, proceeds to the next step. If a sensor fault exists, the control exits the test routine and indicates the fault by flashing some of the lights in an error message. These Error Messages are listed on page 11.



Power light on — Test light on

The control turns on the system pump for 10 seconds and:

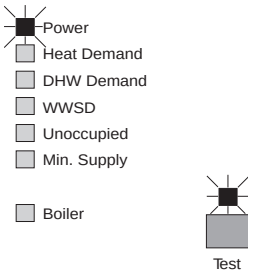
(a) — cycles to the next step.

OR

(b) — During the 10 seconds, *if there is a Heat Demand or DHW Demand signal*, **and** the Test button is pressed; the test routine will be halted, the "Test" light will flash, and the control will be held in a pause mode for 5 minutes. During the 5 minutes, the pump will remain on. After the 5 minutes, the control will automatically exit the test routine and return to normal operating mode.

If there is no Heat Demand or DHW Demand, the control will not allow a pause and will cycle to the next step of the test routine.

Pushing the Test button during the 5 minute pause will allow the control to cycle to the next step of the test routine.



Heat Demand and/or DHW Demand lights may also be on

Power light on — Test light on — Boiler light on

The system pump is running; the control turns on the boiler for 10 seconds and:

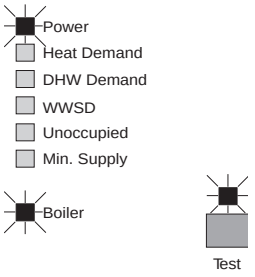
(a) — returns to normal operating mode.

OR

(b) — During the 10 seconds, *if there is a Heat Demand or DHW Demand signal*, **and** the Test button is pressed; the test routine will be halted, the "Test" light will flash, and the control will be held in a pause mode for 5 minutes. During the 5 minutes, the pump and boiler will remain on. After the 5 minutes, the control will automatically exit the test routine and return to normal operating mode.

If there is no Heat Demand or DHW Demand, the control will not allow a pause and will exit the test routine, returning to normal operating mode.

Pushing the Test button during the 5 minute pause will allow the control to exit the test routine.



Heat Demand and/or DHW Demand lights may also be on

Note;
Whenever the control exits the test routine, there is an automatic 10 second delay before the control can be made to re-enter the test routine. Pushing the Test button during this 10 second period will have no effect on the control.

Power light on — Test light off

The control has exited the test routine, entered the operating mode and will function according to the sequence of operation described on pages 2 and 3. *One or more of the other indicator lights may also be on.* Refer to pages 2 and 3 for a description of the indicator lights under operating conditions.

Step Eight — Troubleshooting

As in any troubleshooting procedure, it is important to isolate a problem as much as possible before proceeding. The Error Messages and Test button greatly simplify troubleshooting of the 251.

If a fault occurs during operating mode or during the test routine and the control is flashing an Error Message, identify the fault from the look-up table at the bottom of this page and then follow standard testing procedures to confirm the problem.

If you suspect a wiring fault, return to steps four and five and carefully check all external wiring and wiring connections.

Notes:

If the Outdoor Sensor develops either a short circuit or an open circuit, the control is programmed to calculate the outdoor temperature at -8°F (-22°C) and control the supply temperature accordingly.

The control is programmed to shut the boiler down before the supply temperature can reach a maximum allowable supply water temperature of 248°F (120°C).

If the Supply Sensor develops either a short circuit or an open circuit, the control is programmed to shut down the boiler to prevent overheating.

After any repair has been completed, press the test button to allow the control to cycle through the test routine. This will allow you to confirm that correct operation has been restored.

Step Nine — Before you leave

Install the wiring cover over the wiring chamber and secure it to the base with the two screws provided. Place the front cover on the control to cover the setting dials and snap it into place. Install a lock if security is required.

Place this brochure, and all other brochures relating to the installation, in the protective plastic bag supplied with the control. Place the bag in a conspicuous location near the control for future reference.

It is important to explain the operation and maintainance of this control and of the system to the end user and anyone else who may be operating the system.

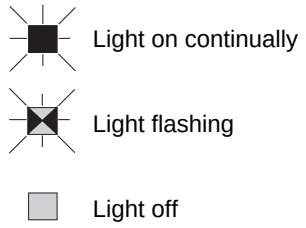
Error Messages

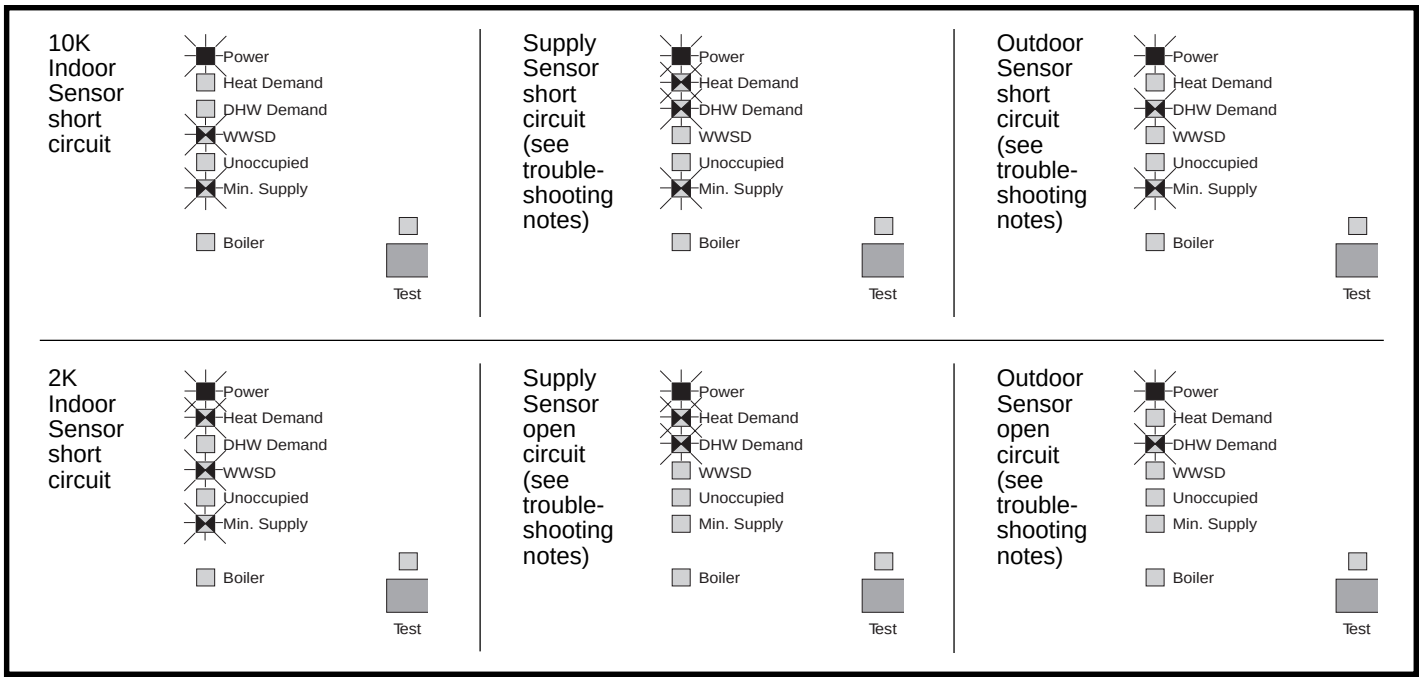
Whenever a fault is detected in any of the sensors, the indicator lights will flash in specific ways to indicate the problem.

The following look-up table describes each error condition and shows the flashing light sequence that results.

After repairing the problem, press the test button to cycle the control through the test routine. This will confirm that the fault has been repaired and that correct control action has been restored.

For detailed Sensor testing instructions see Data Brochure D 001.





Technical Data

Technical Specifications

Dimension (h x w x d)	— 6-5/8" x 7-9/16" x 2-13/16" (170 x 193 x 72mm)
Weight	— 2.9 lbs (1.3 Kg)
Ambient	— 30 to 160°F (0 to 70°C), < 95% RH non-condensing
Power supply	— 24Vac ± 10%, 60Hz, 3VA class II
Relay capacity	— SPST, 24Vac, 10 Amps
Sensors	— Sensor 075 or Universal Sensor 071
	— Outdoor Sensor 070. Sensors are accurate with up to 500 feet (150m) 18AWG cable
Control accuracy	— ± 1°F (± 0.5°C)

Features

8 Indicator lights	— Power, Heat Demand, DHW Demand, WWSD, Unoccupied, Min. Supply, Boiler, Test
System pump output	— Isolated SPST relay contacts close on DHW Demand or when heating is required
Boiler output	— Isolated SPST relay contacts close to operate the heat source
Test button	— Initiates and controls pre-programmed test run
Error message display	— Sensor faults are indicated by flashing light codes

Settings

Heating Curve	— 0.4 to 3.6
DHW Supply	— 100 to 200°F (38 to 93°C)
Minimum Supply	— Off, 80 to 170°F (Off, 27 to 77°C)
Boiler Differential	— 2 to 42°F (1 to 23°C)
Occupied	— 35 to 105°F (2 to 41°C)
Unoccupied	— 35 to 105°F (2 to 41°C)
Delay Jumper	— 30 seconds or 3.3 minutes
Heat Demand switch	— External 24Vac signal or permanent internal signal
Zone Control/Sensor switch	— Input from tekmar Zone Control or Indoor Sensor 074
DHW Unoccupied switch	— Generation/No generation of DHW during Unoccupied mode

Limited Warranty and Product Return Procedure

Limited Warranty: tekmar warrants to the original purchaser each tekmar product against defects in workmanship and materials when the product is installed and used in compliance with tekmar's instructions. This limited warranty covers the cost of parts and labour provided by tekmar to correct defects in materials and/or workmanship. Returned products that are fully operational are not considered a warranty case. tekmar also does not cover parts or labour to remove, transport or reinstall a defective product. tekmar will not be liable for any damage other than repair or replacement of the defective part or parts and such repair or replacement shall be deemed to be the sole remedy from tekmar. This warranty shall not apply to any defects caused or repairs required as a result of unreasonable or negligent use, neglect, accident, improper installation, or unauthorised repair or alterations. In case of defect, malfunction or failure to conform to warranty, tekmar will, for a warranty period of 24 months from the date of invoice to the original purchaser or 12 months from the date of installation of the product, whichever occurs first, repair, exchange or give credit for the defective product. Any express or implied warranty which the purchaser may have, including merchantability and fitness for a particular purpose, shall not extend beyond 24 months from the date of invoice or 12 months from the date of installation of the product, whichever occurs first.

Replacements: tekmar can send replacement products if requested. All replacements are invoiced. Any possible credit for the replacement will only be issued once the replaced product has been returned to tekmar.

Product Return Procedure: Products that are believed to have failed must be returned to tekmar Control Systems Ltd. 4611-23rd Street, Vernon B.C. Canada V1T 4K7 when agreed to by tekmar. The installer or other qualified service person must, at the owner's expense, determine which component has failed. The product must be returned complete with all of its components (sensors, base, etc.). Products must be returned together with the proof of purchase to the original purchaser who then returns the product to tekmar after receiving a Return Goods Authorisation (RGA) number from tekmar.

Please include the following information with the product: The full address of the original purchaser, the RGA number and a description of the problem.

From the U.S.A., in order to avoid customs charges, products must be returned via US Post with the package clearly marked with the RGA number, product type and the statement "Canadian Product returned for repair". For shipping purposes the product can be valued at one half list price.

1) If returned during the warranty period and the product is defective, tekmar will issue full credit for the returned product less cost of missing parts.
2) If returned during the warranty period and the product is fully operational, tekmar will return the product to the original purchaser for a testing cost of $30.00 plus postage.
3) If returned during the warranty period and the product is not damaged and is fully operational, tekmar can take back the product for a return charge of 40% of the product's net value. This request has to be specified otherwise the product will be returned with a testing cost of $30.00 plus postage.
4) If returned after the warranty period and the product needs repair, tekmar will repair and return the product. Repair and postage costs will be invoiced. tekmar's repair costs are calculated at $30.00 / hour plus the cost of parts. If the repair costs will be more than $60.00 a repair estimate will be sent to the original purchaser.

In North America: tekmar Control Systems Ltd ., Canada
tekmar Control Systems, Inc., USA
Head office: 4611 - 23rd Street
Vernon, B.C. Canada V1T 4K7
Tel. (604) 545-7749 Fax. (604) 545-0650