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# Boiler/Heatpump Control 204
# Boiler & Domestic Hot Water Control 218

tekmar®
Control Systems

The tekmar Boiler/Heatpump Control (204) will regulate the supply water temperature of a heating system as a function of the outdoor and indoor air temperatures. The Boiler & Domestic Hot Water Control (218), in addition to regulating the supply water temperature of a heating system, will also regulate the generation of domestic hot water (DHW). The controls regulate the supply water temperature by varying the duty cycle (on time versus off time) of the boiler or heatpump. A 5 minute minimum off period helps prevent short, inefficient duty cycles and compressor overloading. When domestic hot water is required the Boiler & DHW Control turns off the heating system pump, turns on the DHW pump, and cycles the boiler or heatpump until the storage tank is up to temperature. The generation of domestic hot water takes priority over providing heat to the building, but during setback the DHW storage tank receives no heat from the boiler or heatpump. During warm weather the controls automatically shut the heating system down but the Boiler & DHW Control will continue to generate domestic hot water. Both controls have a quartz timer for programming a normal/setback schedule for the heating system. The programmable quartz timer in both controls has a self-charging 72 hour backup battery and can operate in either a 24-hour or a 7-day mode.


**type 204 includes:**

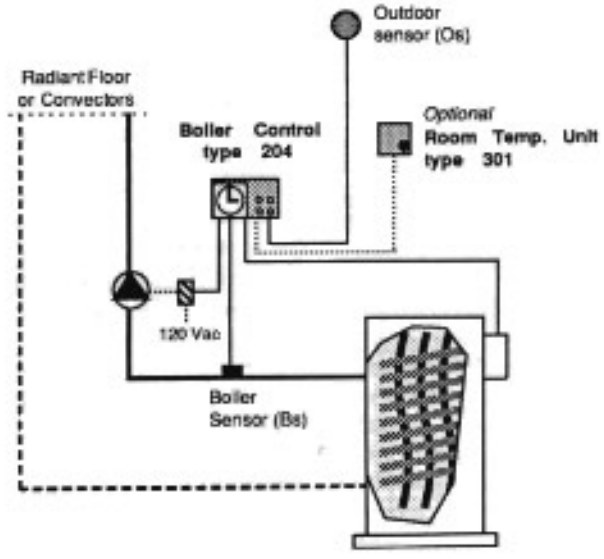
1. Boiler/Heatpump Control
2. Control Socket
3. Outdoor Sensor
4. Sensor


**type 218 includes:**

1. Boiler & Domestic Hot Water Control
2. Control Socket
3. Outdoor Sensor
4. Boiler Sensor
5. Domestic Hot Water Sensor

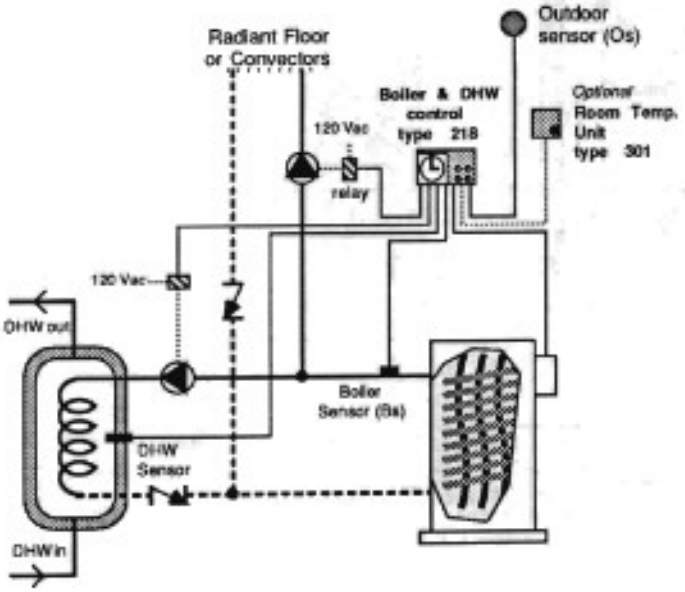
## Typical Applications:

1) type 204




For more details on this application see brochure T00 page 8.

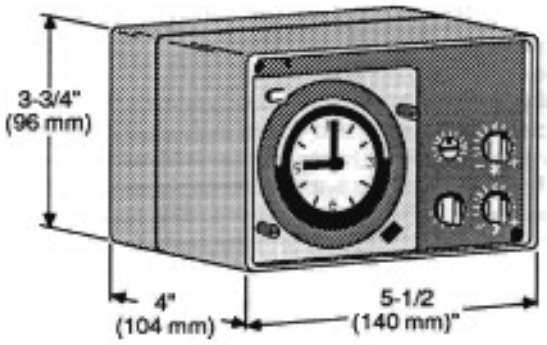
2) type 218




For more details on this application see brochure T00 page 9.

**Technical Data:**

| | |
|---|---|
| Relative Humidity | <95%, non-condensing |
| Temperature Range | 30 - 120 °F (0 - 50°C) |
| Power Supply | 21 - 28 Vac, 60 Hz, 6VA<br>Class 2 transformer |
| Weight | 1.5 lbs (0.7 kg) |




## Installation

### Mechanical Installation:

The socket which the electronic control plugs into can be mounted on a wall using screws. The wires from the sensors can either be routed through the punch-outs in the bottom of the socket, or through the punch-outs in the back of the socket.

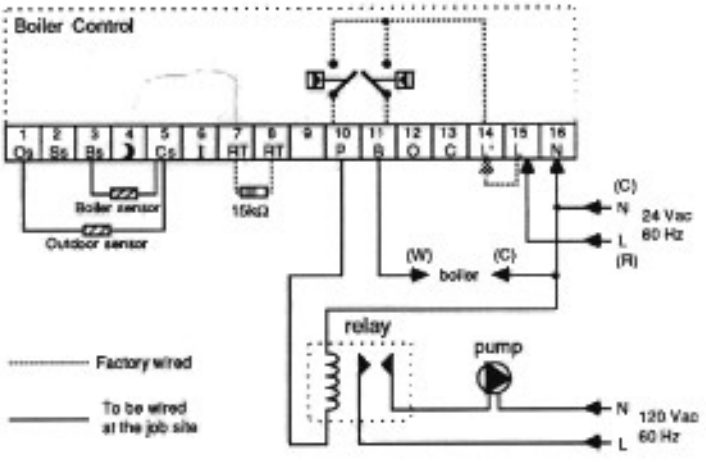
### Electrical Installation:

The tekmar® Electronic Control terminates the wires in a plug-in socket; no wires are directly connected to the control. This plug-in system simplifies installation and troubleshooting procedures. Terminals N & L (15 & 16) of the socket must be connected to the secondary side of a 24 Vac class 2 transformer. The total load of the control is approximately 3 VA.

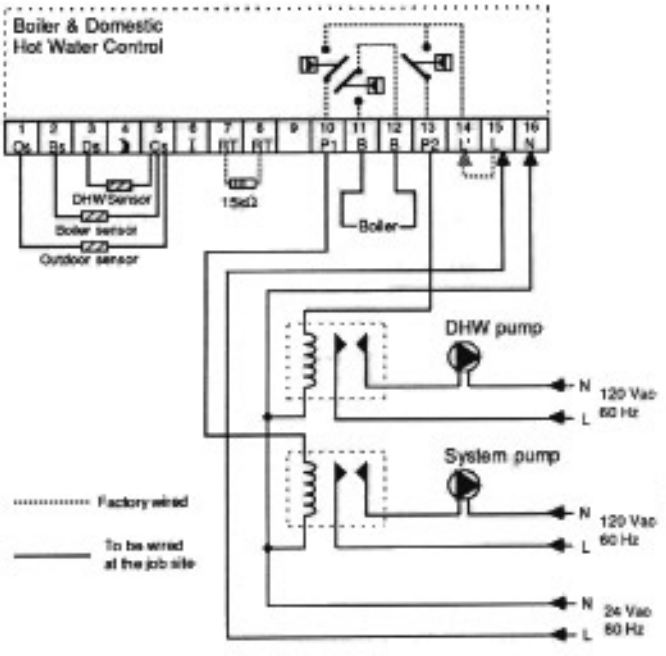
**5 minute minimum time delay between cycles**
The 5 minute minimum time delay between firing cycles of a heatpump or boiler is optional. The control is delivered from the factory with the delay enabled. To disable the time delay, install a wire from terminal 5 to terminal 6 in the control's socket.

**DHW Delay**
After the domestic hot water storage tank (DHW) has been heated up to temperature, the boiler will stop firing but the DHW pump will continue to circulate boiler water through the storage tank's heat exchanger for an additional 3 minutes before the control switches back to operation of the heating system.

type 204 wiring




type 218 wiring



## Installation of the Temperature Sensors:

Note: Each sensor is connected to the socket using a two conductor cable (e.g. 2 x 18 AWG). The overall length of each cable can be up to 1700 ft. (500m) but the sensor cable should not be run parallel to any power line or telephone cables.

1. **Boiler Sensor**
   Use the provided strap to fasten the boiler sensor to the (hot) boiler supply pipe approximately 20 in. (50 cm) beyond the output where the pipe exits the boiler. In order to obtain exact temperature measurements, the brass sensor surface must be in tight contact with the pipe. In control type 204, connect this sensor's 2-conductor cable to terminals 3 & 5. In control type 218 connect to terminals 2 & 5 of the control's socket.

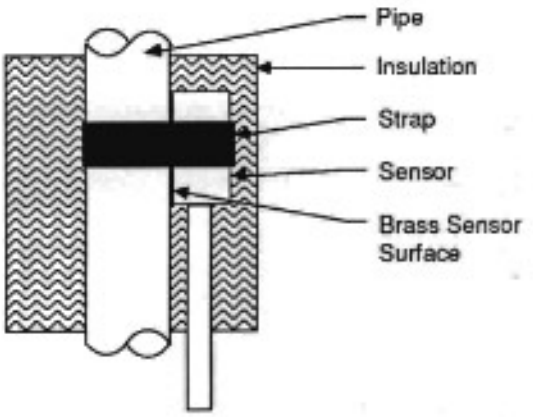
2. **Domestic Hot Water Sensor**
   The domestic hot water sensor is designed to be mounted in a 17/32" (13.5 mm) inside diameter well in the domestic hot water storage tank. The minimum inside well diameter can be 1/2" (13 mm). If the domestic hot water storage tank has no well, then the sensor must be strapped to the tank in an area that is the most representative of the DHW temperature; the sensor should not be mounted to the output pipe unless there is a continuous recirculation of water through the DHW tank. Connect this sensor's 2-conductor cable to terminals 3 & 5 of the control's socket.

3. **Outdoor Sensor**
   The outdoor sensor should be mounted on the side of the building where the main, occupied rooms are. It should not be mounted immediately above a window or ventilation opening. With two screws, attach the black base of the sensor to the wall. **The hole for the cable entry must face downward** so that moisture can drain out of the sensor. Connect a two conductor cable, from the outdoor sensor terminals to terminals 1 & 5 of the control's socket.

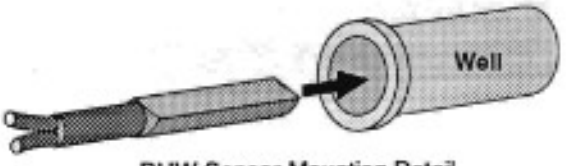
4. **Room Temperature Unit**
   The room temperature unit (RTU) is an optional piece of equipment for the Electronic Control. The RTU is normally installed on an interior wall of the main living area of the building. Do not mount the RTU near a heat source (e.g. a fireplace, sunlight through a window, etc.) or in a drafty area ( e.g. near an exterior door or a window).
   Using a screwdriver, gently pry the adjusting dial off the front of the RTU. The brown cover can now be removed from the black case. Fasten this base to the wall using two screws. Connect a two conductor cable to the RTU's terminal block. Replace the brown cover on the RTU and carefully push the adjusting dial back onto the shaft. Set the RTU to 68°F (20°C). Then, at the control's socket, remove the 15,000 ohm resistor from terminals 7 & 8 and connect the two conductor cable from the RTU to terminals 7 & 8 of the control's socket.

   **Operation of the Room Temperature Unit**

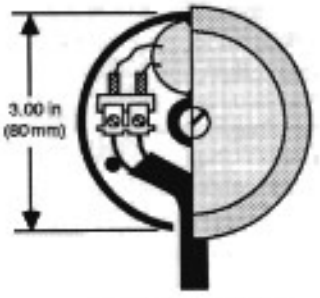
   The RTU is not a thermostat. Although it provides a remote adjustment for the user, the RTU is primarily a secondary source of temperature information for the Electronic Control. Whenever solar radiation, a fireplace, or any other heat source causes the room temperature to increase, the RTU causes the Electronic Control to immediately decrease the amount of heat supplied by the heating system. The RTU also enables the Electronic Control to overdrive the heating system for a short interval during heat-up from setback to normal room temperature. This action reduces the time required to restore normal room temperature. If even faster response is desired, install a jumper from terminals 4 to 7. This will cause hotter boiler water to enter the heat distribution system for a short time when going from setback into normal mode. **Install this jumper only if the system can tolerate hot boiler water.**



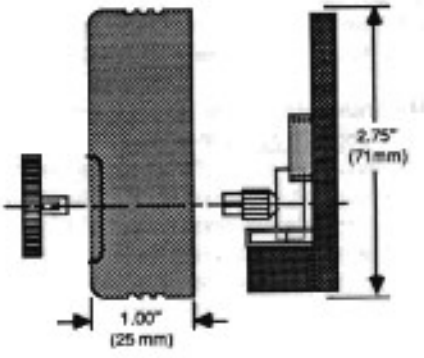
Sensor Mounting Detail



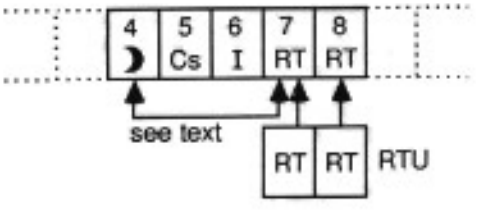
DHW Sensor Mounting Detail



Outdoor Sensor



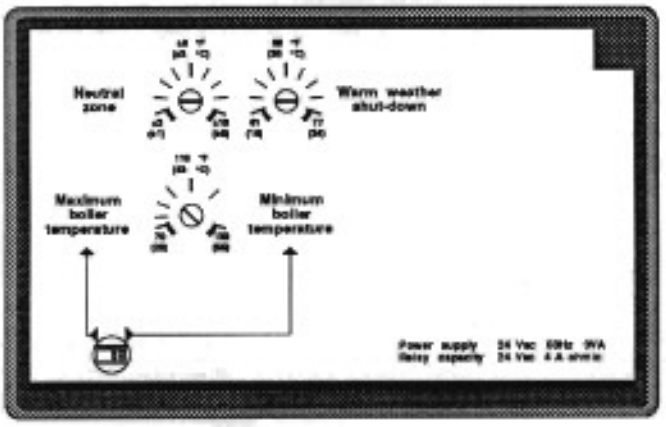
Room Temperature Unit



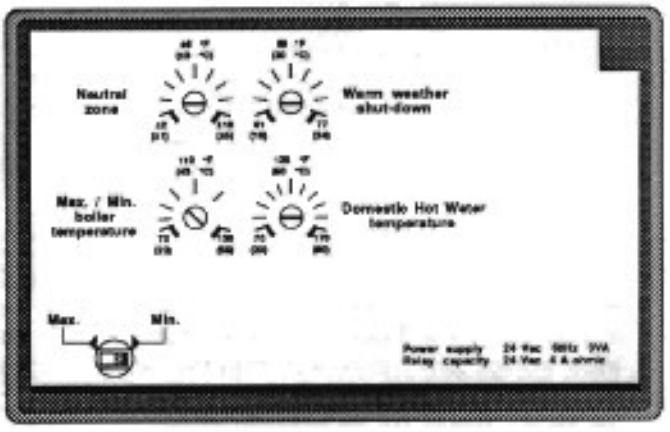
RTU Connection detail

# Adjustments

**On the back of the Control:**




type 204 rear adjustments




type 218 rear adjustments

1. **Neutral Zone**
   The neutral zone sets how much the actual supply water temperature may deviate from the desired temperature before the boiler is turned on or off. To prevent short cycling of the boiler, the Neutral Zone should be set slightly higher than one half the temperature rise through the boiler.

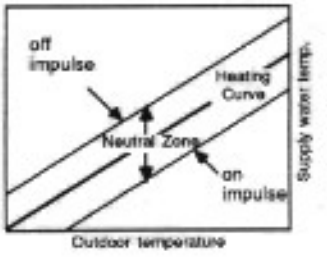
$$\text{Temperature Rise} = \frac{\text{Btu/hr}}{\text{US GPM} \times 500} \qquad \text{Eg: } \frac{90{,}000 \text{ Btu/hr}}{9 \text{ US GPM} \times 500} = 20°\text{F}$$

   The temperature rise is 20°F, so set the neutral zone to more than ±10°F.

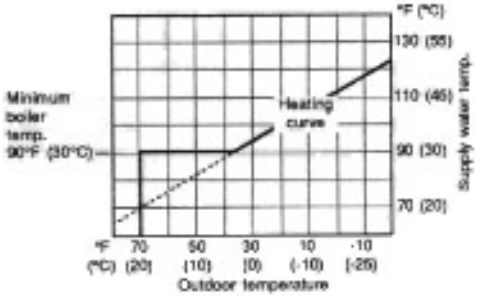
$$\text{Temperature Rise} = \frac{\text{Watts}}{\text{litres/hr} \times 1.16} \qquad \text{Eg: } \frac{9000 \text{ Watts}}{2000 \text{ l/hr} \times 1.16} = 4°\text{C}$$

   The temperature rise is 4°C, so set the neutral zone to more than ±2°C.

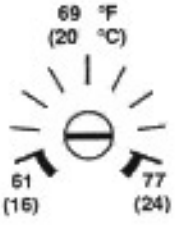
   If the Neutral Zone is set too low, the 5 minute delay between firing cycles will help to protect the boiler from short, inefficient cycles. To disable this time delay, see the section "Electrical Installation" on page 2.




2. **Minimum/Maximum Boiler Temperature**
   The range of adjustment is 70°F (20°C) to 130°F (55°C). This adjustment, depending on the position of the switch at the rear of the control, sets the maximum or minimum temperature of the boiler/heatpump. The minimum boiler adjustment should be set to the boiler manufacturer's specification for the minimum allowable operating temperature of the boiler to prevent problems from condensation of the exhaust gases. The maximum temperature limit is useful for heatpumps and condensing boilers.



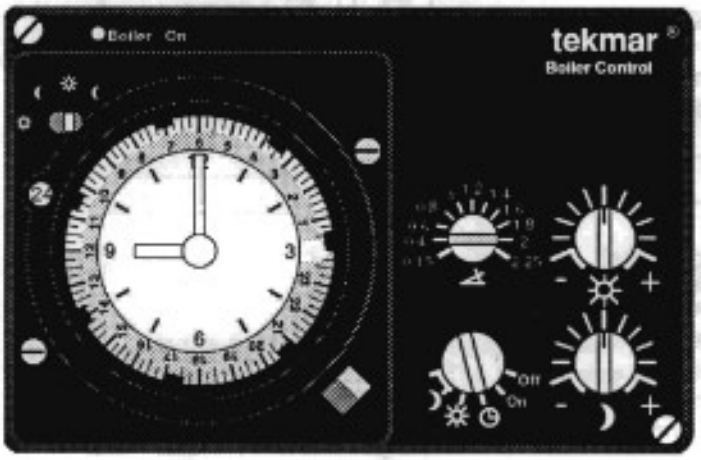

3. **Warm Weather Shut-Down**
   When the outdoor air temperature rises above this set-point, the control keeps the heating system off and only generates domestic hot water when it is needed. For increased energy savings during setback (night-time), the heating system is kept off until the outdoor air temperature is 28°F (15°C) below the setting of this adjustment. Eg. if the warm weather shut-down is set at 68°F (20°C) then the boiler won't turn on until the night-time temperature is below 40°F (5°C).




**Warm weather shut-down**

4. **Domestic Hot Water Temperature**
   Set the desired domestic hot water temperature using this adjustment. The adjustment range is 70°F (20°C) to 170°F (80°C).

## On the front of the Control:




type 204 front adjustments


type 218 front adjustments

### Heating Curves

The heating curve is the ratio of increase in supply water temperature to a corresponding decrease in the outdoor ambient temperature. The correct adjustment of the mixing valve and boiler heating curves is defined by the following formula:

$$\text{Heating curve} = \frac{\text{design supply temp. - room temperature}}{\text{room temp. - design outdoor temperature}}$$

### Example calculation

- Design outdoor temp. = -20°F (-30°C)
- Design room temp. = 70°F (20°C)
- Design supply temp. = 160°F (70°C)

$$\text{Boiler circuit heating curve} = \frac{160°F - 70°F}{70°F - (-20°F)} = \frac{70°C - 20°C}{20°C - (-30°C)} = 1.0$$

Thus the heating curve value should be set to 1 on the dial. Refer to table 2 for some suggested settings.

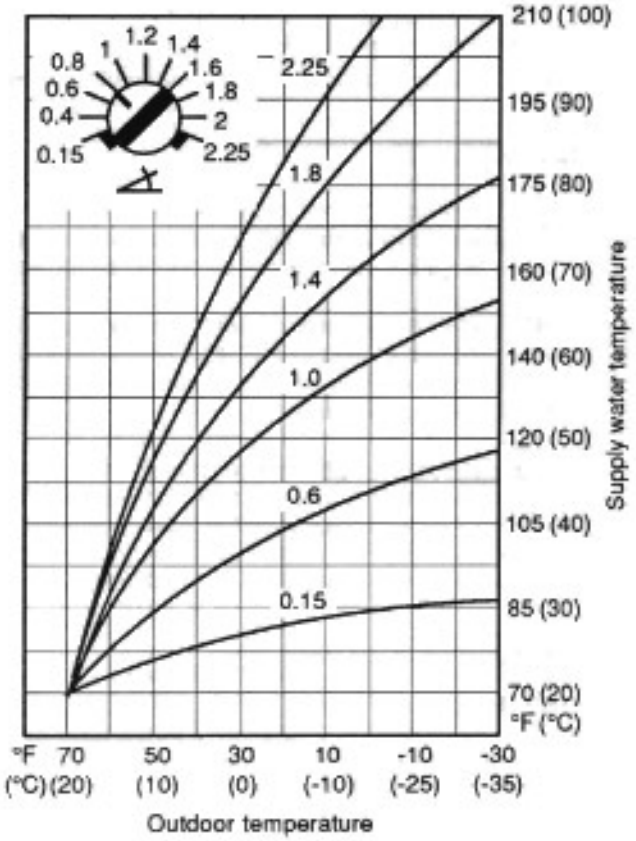
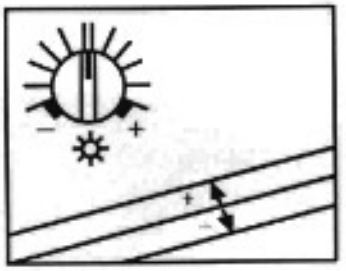


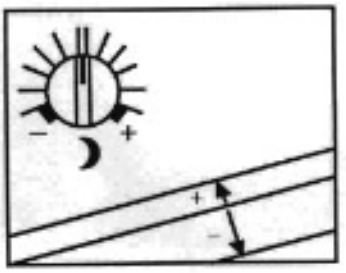

Table 2 **Some typical settings**

| Heat Source | Neutral Zone | Min/Max water temp. | Heating Curve |
|---|---|---|---|
| Conventional Boiler | ±6°F(±3°C) | Min 130°F | 1.3 |
| Condensing Boiler | ±6°F(±3°C) | Min 70°F | 1.0 |
| Heatpump | ±6°F(±3°C) | Max 130°F | 0.6 |

**Please perform the "Testing" procedure on page 7 before plugging in the control.**

## Adjustments for the User:





2. **Normal Operation**
The ☼ knob shifts the heating curve during normal operation. Shifting the heating curve causes the average room temperature to be increased or decreased. The "II" setting corresponds to the "as designed" condition. Adjusting the knob towards "+" or "-" changes the water temperature by approximately 4°F (2°C) per division.

3. **Setback Operation**
The ☽ knob shifts the heating curve during setback operation. In the setting 'II' the water temperature is 20°F (10°C) cooler than during normal (☼) operation. Adjusting the knob towards '+' increases the water temperature by 4°F (2°C) per division. Adjusting the knob towards '-' lowers the water temperature by 5°F (3°C) per division.

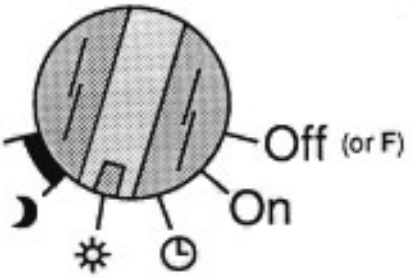
4. **Mode Selection**

**Testing/Servicing modes**

**Off** (or **F**) Off. The relays for the boiler & domestic hot water are kept off. The timer continues to operate so the correct time is maintained.

**On** The boiler relay is turned on regardless of temperature.

**Running modes**



6 - position mode switch

The control switches between normal (☼) and setback (☽) operation according to the timer program. **A blue lug begins a setback period and a red lug ends it.**

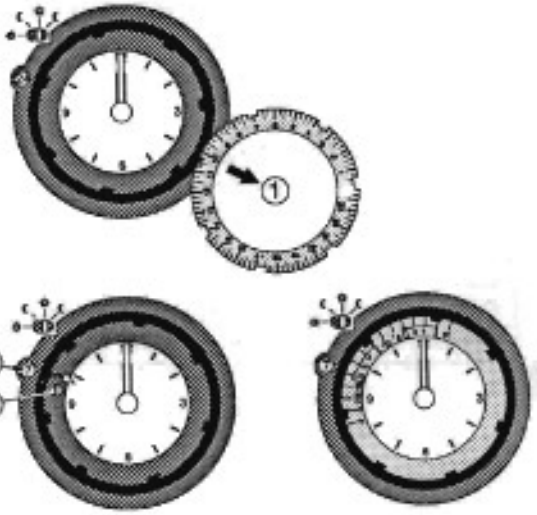
☼ The control ignores the timer program and leaves the heating system at the normal (☼) temperature. This setting is used when no temperature setback is desired during a special occasion (eg. a party).

☽ The control ignores the timer program and leaves the heating system at the setback (☽) temperature. We recommend you use this setting when the building is not occupied (eg. during holidays).

4. **Programming of the timer**

**7-day Program**

The timer is supplied from the factory with a 24-hour dial which can be changed to a 7-day dial by the following procedure:




1. Set the time to 24.00 hours (12 midnight)
2. Take the timer ring out of its recess. (1)
3. Turn the screw (2) clockwise until the number '7' appears in the window (3).
4. Turn the timer ring over and insert it such that the corresponding week-day ( I = Sunday, II = Monday. . .) is adjacent to the window (3).
5. Set the timer to the correct time and program the setback periods.

**Setting the timer to the correct time**
Turn the large hand clockwise until the correct time on the ring is pointed to by the switch in the upper left hand corner.

**Programming the setback periods**
The beginning of a setback period is set by a blue lug. A red lug ends the setback period.

The clock here is set to 9:00 a.m. as indicated by the timer ring, not 21.00 hours (9 p.m.).

## Testing and Troubleshooting

**Testing:**

**If any of the following tests fail, check that the insulation on the wires is not preventing proper connection to the terminals.**

**Step 1 Test the sensors**

Using an ohmmeter, measure the resistance between terminals 1 & 5, 2 & 5, and (type 218) 3 & 5. The table below lists the expected resistance values at various sensor temperatures. The resistance between ground (the pipes) and any terminals 1 to 8 should be greater than 1,000,000 ohms. No voltage should be present between any of these terminals and ground.

| Sensor temperature | | Resistance | Sensor temperature | | Resistance | Sensor temperature | | Resistance |
|---|---|---|---|---|---|---|---|---|
| °F | °C | ohms | °F | °C | ohms | °F | °C | ohms |
| -50 | -45 | 59,000 | 50 | 10 | 3,700 | 150 | 65 | 500 |
| -30 | -35 | 33,000 | 70 | 20 | 2,400 | 170 | 76 | 360 |
| -10 | -23 | 17,000 | 90 | 32 | 1,500 | 190 | 88 | 250 |
| 10 | -12 | 10,000 | 110 | 43 | 1,000 | 210 | 100 | 180 |
| 30 | 0 | 5,600 | 130 | 54 | 720 | 230 | 110 | 140 |

**Step 2 Test the RTU**

Using an ohmmeter, measure the resistance between terminal 7 and terminal 8. The resistance should be between 10,000 and 20,000 ohms when the adjusting dial of the Room Temperature Unit (RTU) is set at 68°F (20°C).

**Step 3 Test the power supply**

Turn on power to the transformer. Using an AC voltmeter, measure the voltage between terminals 15 & 16 and 14 & 16. The voltage should be between 22 and 28 volt AC.

**Step 4 Test the pumps**

Bridge terminal 10 to terminal 14. The heating system pump should turn on. If it does not, then the pump's relay is incorrecly wired to the control. For control type 218 only, bridging terminal 13 to 14 should turn on the DHW pump. If if does not then the DHW pump's relay is incorrectly wired to the control.

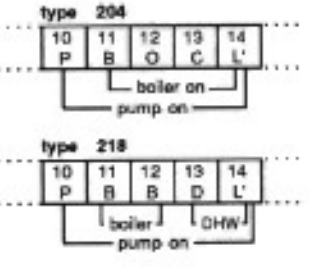
**Step 5 Test the boiler**

During the following test insert a wire from terminal 10 to terminal 14 (turn on the system pump) so that there is water flowing through the boiler. For control type 204, bridging terminal 11 to terminal 14 should turn the boiler on. For control type 218 bridging terminal 11 to 12 should turn on the boiler. If the boiler does not turned on then the boiler is incorrectly wired to the control.

**Step 6 Test the control**

Plug the control into the socket. Switch the mode selector to position to **On**; the 'Boiler On' light should come on and the boiler should fire. Switch the mode selector to ◷ and the control should bring the boiler & heating system up to the required operating temperature. If the control does not perform as stated, then it should be sent to tekmar for repair.

**Manual Operation** The boiler and pumps can be manually operated once the control is removed from its socket. Turn the pumps on by bridging terminal 10 to 14. Set the boiler's aquastat at the required supply water temperature. For control type 204, bridge terminal 11 to 14 to fire the boiler, and for control type 218, bridge terminal 11 to 12 to fire the boiler.



**Troubleshooting:** **Perform the following checks until the problem is solved.**

**The building is too warm**

1. Check that the ☼ dial on the control and the adjustment dial on the Room Temperature Unit are set at their normal settings, i.e. center scale ("II") and 68°F (20°C) respectively.
2. Check that the timer shows the correct time of day (and day of week if in the 7-day mode). Is the timer programmed for the present building useage? Is the mode switch in the ◷ position?
3. Check that the temperature sensors are all properly installed. (See page 3.).
4. If a condensing type of boiler is used, the minimum boiler temperature adjustment could be set too high. It should be set at 70°F (20°C) for a condensing type of boiler.
5. If it is warm outside then the warm weather shut down may be set too high. If it is cold outside then disconnect the RTU, replace the 15kΩ resistor, and adjust the heating curve 10% every 2 hours until the desired room temperature is maintained during normal (daytime) operation. Re-install the RTU.
6. Go through the six steps of the test procedure on page 7.

**The building is too cool**

1. Check that the ☼ dial on the control and the adjustment dial on the Room Temperature Unit are set at their normal settings, i.e. center scale (II) and 68°F (20°C) respectively.
2. Check that the timer shows the correct time of day (and day of week if in the 7-day mode). Is the timer programmed for the present building useage? Is the mode switch in the ◷ position?
3. Are the pumps operating?
4. Check that the temperature sensors are all properly installed. (See page 3.)
5. If the control has its boiler relay continually on, yet the boiler does not fire continually, then the aquastat on the boiler must be set to a higher temperature.
6. If the building is too cool during the night then the warm weather shut down may need to be increased. Note: The setback warm weather shut down is 27°F (15°C) below the daytime setting.
7. If it is warm outside, the warm weather shut down may be set too low. If it is cold outside then disconnect the RTU, replace the 15kΩ resistor, and adjust the heating curve 10% every 2 hours until the desired room temperature is maintained during normal (daytime) operation. Re-install the RTU.
8. Go through the six steps of the test procedure on page 7.

**DHW not the correct Temperature**

1. Is the timer programmed for the present building usage? DHW is not generated during setback.
2. Check the setting of the DHW temperature adjustment and that the DHW sensor is installed properly.
3. Check that the boiler's aquastat is set higher than the desired DHW temperature.

## Limited Warranty

tekmar Control Systems (tekmar®) warrants to the original purchaser, each tekmar product against defects in workmanship and materials, when the product is installed by a qualified person and used in compliance with tekmar's instructions. This warranty covers the cost of parts and labor provided by tekmar to correct defects in material and/or workmanship, but does not cover parts or labor to remove, transport or reinstall the 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 unauthorized repair or alterations.

In case of defect, malfunction or failure to conform to warranty, tekmar Control Systems will, for 24 months from the date of invoice or for 12 months from the date of installation of the product, whichever occurs first, repair or exchange,at tekmar's option, the defective product. The warranty is not in effect until the warranty card has been filled out and returned to tekmar Control Systems. Any express or implied warranty which the purchaser may have, including merchantibility 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, whichever occurs first.

**Warranty Procedure**

The installer or other qualified service person must, at the owner's expense, determine which component has failed. If an actuating motor, electronic control, mixing valve, pump, sensor, or other tekmar component requires repair, only that component, together with the proof of purchase of the tekmar equipment must be returned to the original purchaser. In order for tekmar to process any warranty claim, the type number and fabrication number of the product and your name and address must be included with the defective component or product.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