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Mixing Valve Control 203
Mixing Valve & Boiler Control 205
Actuating Motor 216

tekmar®
Control Systems

The tekmar® Mixing Valve Control and Mixing Valve & Boiler Control, when used in conjunction with an Actuating Motor and a three or four-way mixing valve or Pump-Mixer-Block, precisely regulates the temperature of the water being supplied to a hydronic radiant floor (HRF), convector/radiator, or fan-coil heating system. This regulation is a function of the outdoor air temperature and, optionally, the indoor air temperature.

For a complete control system both an Actuating Motor and a control are required. The Actuating Motor is designed to attach easily to any of tekmar's mixing valves or Pump-Mixer-Blocks. Mixing Valve Control type 203, together with an Actuating Motor, will control the position of a mixing valve. For additional energy savings and system flexibility, Mixing Valve & Boiler Control type 205, which features a boiler control section, will reset the boiler's temperature according to the outdoor air temperature. Type 205 will also automatically shut down the boiler and pump whenever the outdoor air temperature rises above 70°F (20°C). With the two preceeding features one can expect up to an additional 5% annual energy savings.

type 203 includes:

1. Mixing Valve Control (PID)
2. Control Socket
3. Supply Sensor
4. Outdoor Sensor

type 205 includes:

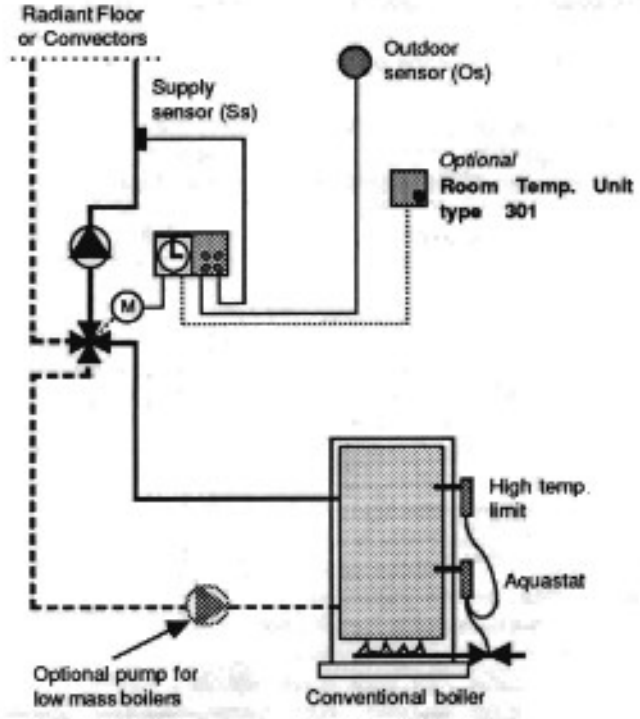
1. Mixing Valve & Boiler Control (PID & P)
2. Control Socket
3. Supply Sensor
4. Boiler Sensor
5. Outdoor Sensor

type 216 includes:

1. Actuating Motor
2. Motor Cover
3. Mounting Bolts
4. Cylindrical Coupling

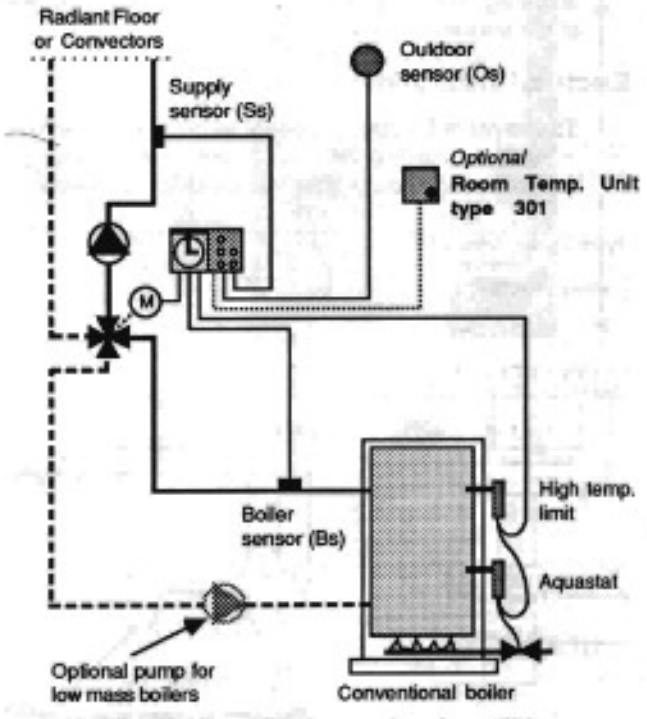
Typical Applications:

1) type 203 + type 216



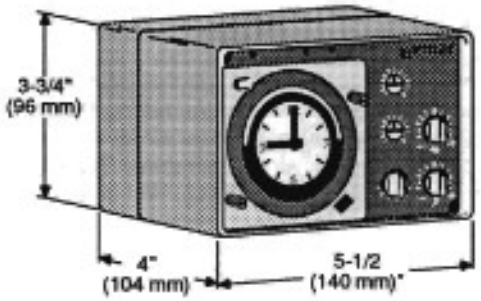
For more details on this application see brochure T00

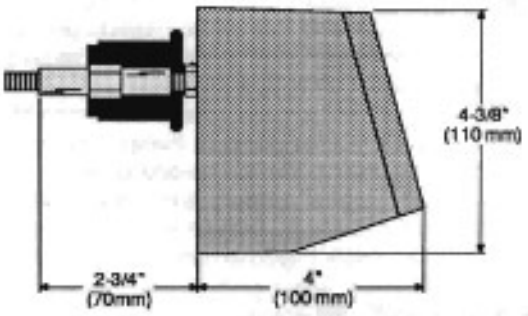
2) type 205 + type 216



For more details on this application see brochure T00

Dimensional Drawings:





Installation

Mechanical Installation:

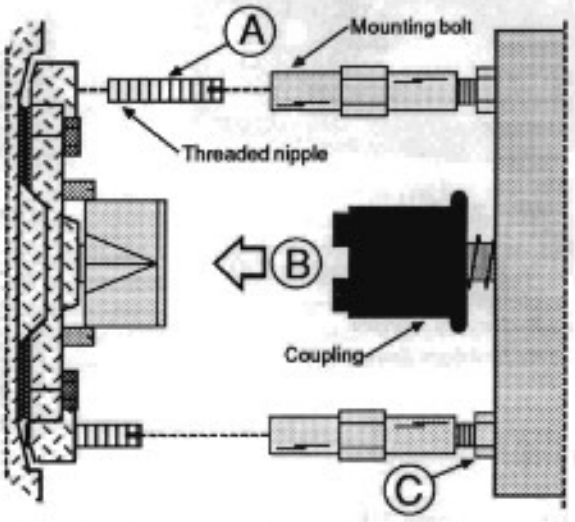
Actuating Motor

The Actuating Motor is easily attached to any of the tekmar® mixing valves or Pump-Mixer-Blocks.

A. Install the threaded nipples into the mixing valve or mixing valve portion of the Pump-Mixer-Block.

B. Position the Actuating Motor on the mixing valve. Thread the mounting bolts onto the nipples and tighten.

C. Align the center of the Actuating Motor with the center of the mixing valve, fitting the coupling into the mixing valve's handle. Tighten the adjustment nuts.



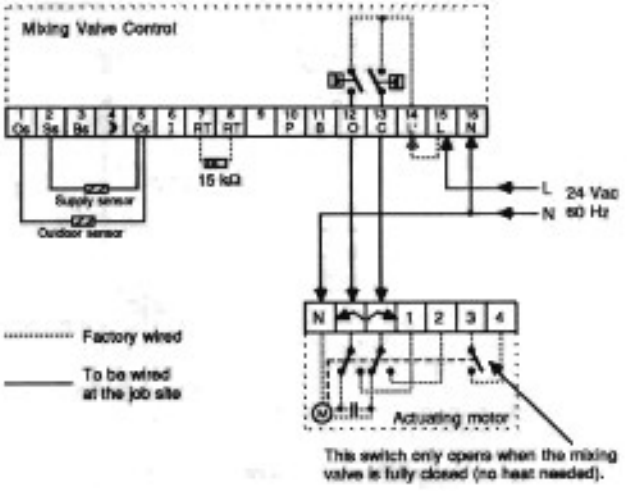
Electronic Control

The socket which the electronic control plugs into can be mounted on the wall using screws. The wires from the sensors and actuating motor 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.

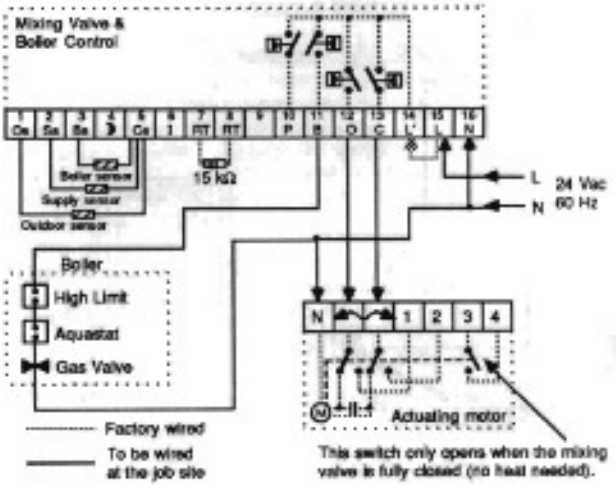
Electrical Installation:

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 and motor is approximately 6 VA.

type 203 + type 216



type 205 + type 216



Installation of the Temperature Sensors:

Note: Each sensor is connected to the control's 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. **Supply Sensor**
   Use the provided strap to fasten the supply sensor to the pipe approximately 20 in. (50 cm) beyond the output from the mixing valve. In order to obtain exact temperature measurements, the brass sensor surface must be in tight contact with the pipe. This sensor's 2-conductor cable is then connected to terminals 2 & 5 of the control's socket.

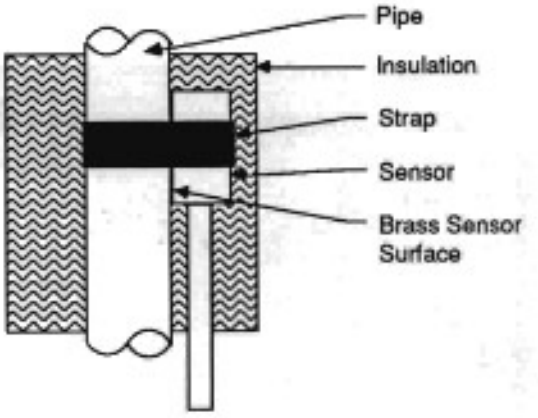
2. **Boiler Sensor**
   Use the provided strap to fasten the boiler sensor to the (hot) boiler supply pipe approximately 20 in. (50 cm) beyond the output where the pipe exits the boiler. In order to obtain exact temperature measurements, the brass sensor surface must be in tight contact with the pipe. This sensor's 2-conductor cable is then connected 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.

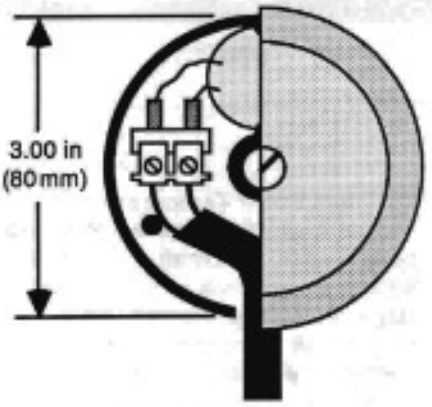
4. **Room Temperature Unit**
   The room temperature unit (RTU) is an optional piece of equipment for the electronic control. The RTU is normally installed on an interior wall of the main living area of the building. Do not mount the RTU near a heat source (e.g. a fireplace, sunlight through a window, 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

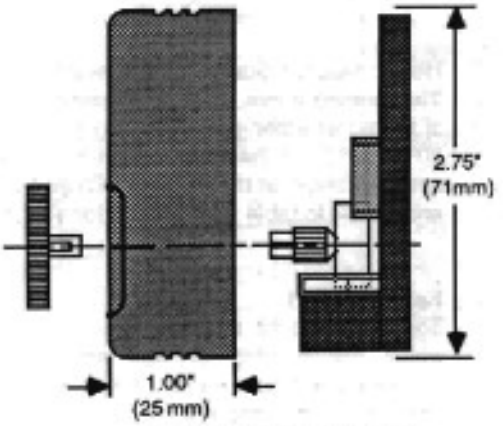
The RTU is not a thermostat. Although it provides a remote adjustment for the user, the RTU is primarily a secondary source of temperature information for the electronic control. Whenever solar radiation, a fireplace, or any other heat source causes the room temperature to increase, the RTU causes the 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 of the control's socket. This will cause hot, unmixed 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, unmixed boiler water.**



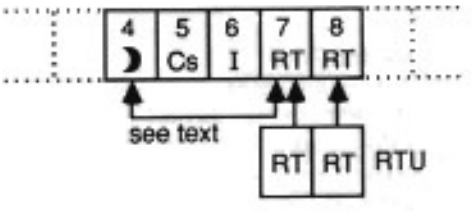
Sensor Mounting Detail



Outdoor Sensor



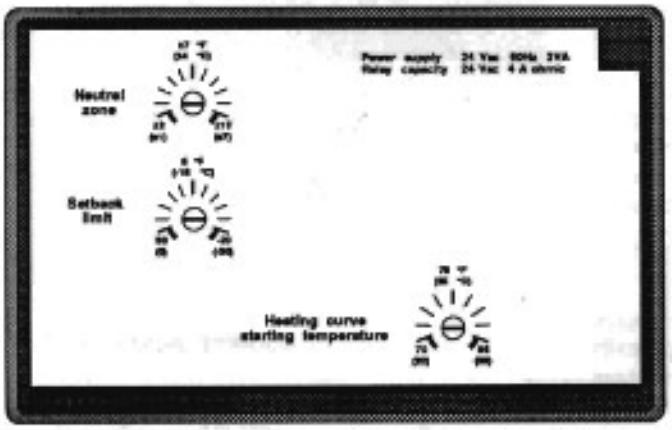
Room Temperature Unit



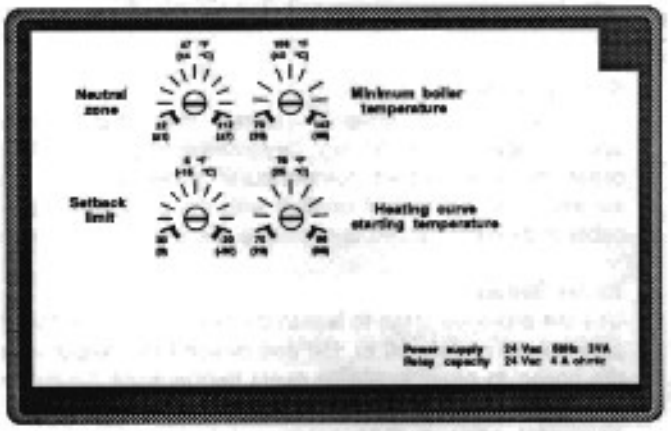
RTU Connection detail

Adjustments

On the back of the Control:



type 203 rear adjustments



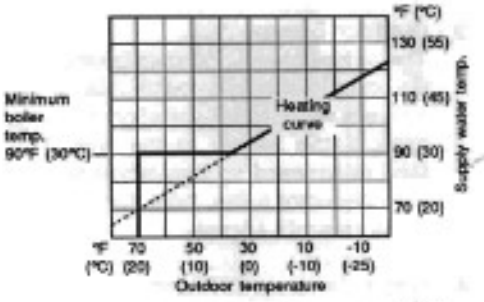
type 205 rear adjustments

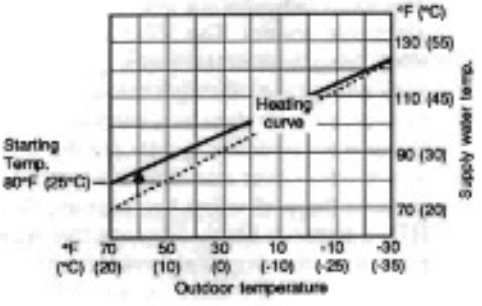
1. **Minimum Boiler Temperature**
   The minimum boiler temperature adjustment will prevent the operating boiler water temperature from dropping below the setting of this adjustment and thus protect the boiler from a condensation problem. The range of adjustment is 70°F (20°C) to 140°F (60°C). This is only valid if the outdoor air temperature is below 70°F (20°C). If the outdoor air temperature is above 70°F (20°C), warm weather shut down occurs and the boiler & pump relays are off. The minimum boiler adjustment should be set to the boiler manufacturer's specification for the minimum allowable operating temperature of the boiler.

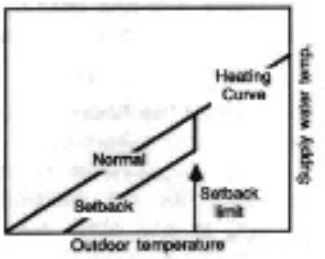
2. **Heating Curve Starting Temperature**
   The heating curve starting temperature adjustment sets the temperature of the water entering the heating system when the outdoor temperature is 70°F (20°C). If the correct heating curve starting point is unknown, it is better to begin at the 70°F (20°C) end and work towards the 85°F (30°C) end. Refer to table 2 on page 5 for suggested settings.

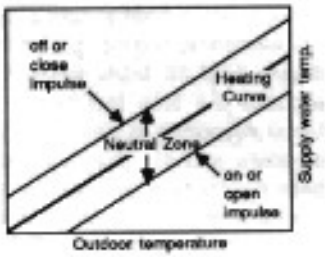
3. **Setback Limit**
   The setback limit adjustment sets the minimum outdoor temperature at which the heating system setback will still occur. If the outdoor temperature drops below the setting of this adjustment, then setback will not occur. The range of this adjustment is 30°F (0°C) to -20°F (-30°C). Generally, the setback limit setting should be the same as the outdoor design temperature.

4. **Neutral Zone**
   The neutral zone is a measure of how much the actual supply water temperature may deviate from the desired temperature before the mixing valve is adjusted or the boiler turned on or off. The neutral zone of the boiler portion of the control is fixed at ±5°F (±3°C) while that of the mixing valve portion is adjustable from ±2°F (±1°C) to ±10°F (±5°C). In the event of unsteady mixing valve behavior, increase the neutral zone. Refer to table 2 on page 5 for suggested settings.

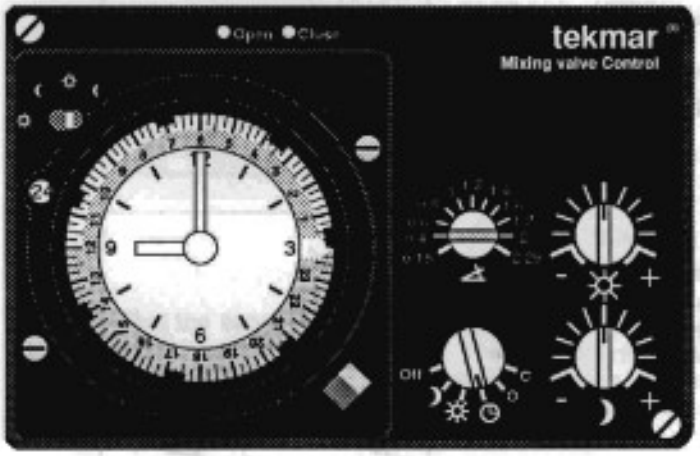








On the front of the Control:



type 203 front adjustments

type 205 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

This example will demonstrate how to calculate the heating curve values for both the mixing valve and boiler portions of the control. The mixing valve heating curves are identical for both the type 203 & 205 while the boiler heating curve is unique to type 205 only.

For the mixing valve

- Design outdoor temp. = -20°F (-30°C)
- Design room temp. = 70°F (20°C)
- Design supply temp. = 124°F (50°C)

$$\text{Mixing valve heating curve} = \frac{124°F - 70°F}{70°F - (-20°F)} = \frac{50°C - 20°C}{20°C - (-30°C)} = 0.6$$

For the boiler portion of the control

- 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 mixing valve heating curve is set to 0.6 and the boiler heating curve is set to 1.0. **Please perform the "Testing" procedure on page 7 before plugging in the control.**

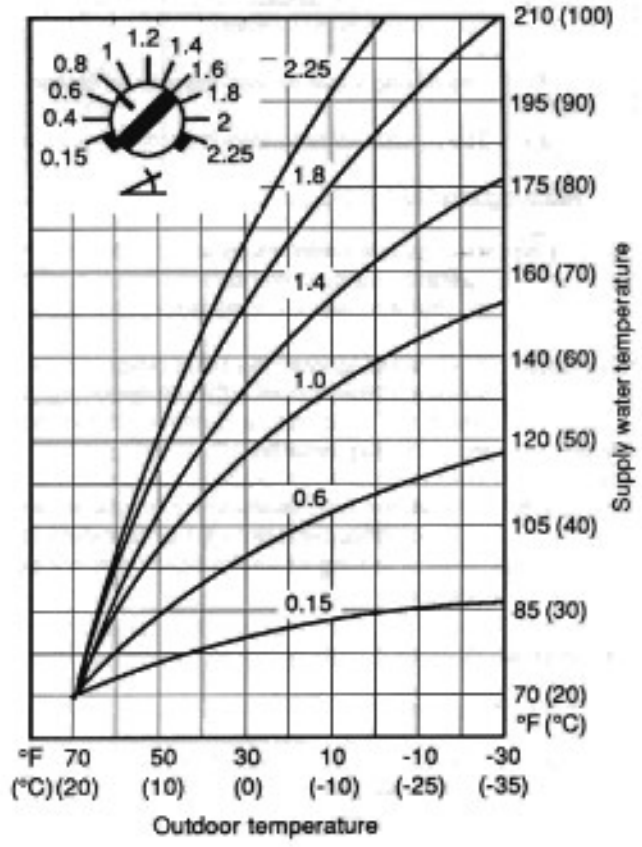
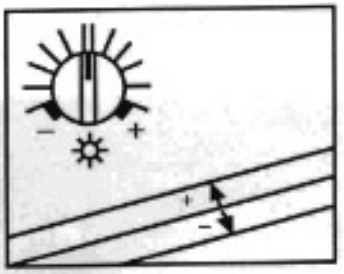
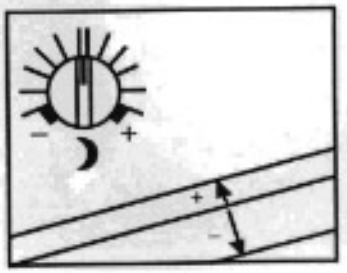


Table 2 **Some typical settings**

Heating System	Neutral Zone	Heating Curve Starting Temp.	Heating Curve
Radiant floor	±2°F(±1°C)	70°F(20°C)	0.7
Convectors	±2°F(±1°C)	75°F(24°C)	1.5
Fan coil	±3°F(±1.5°C)	80°F(27°C)	1.5

Adjustments for the User:





1. **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.

2. **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.

3. **Mode Selection**

   Testing/Servicing modes

   Off (or **F**) Off. The mixing valve stays where it is, regardless of what happens in the system. The timer continues to operate so the correct time is maintained.

   C The mixing valve rotates towards its closed position.

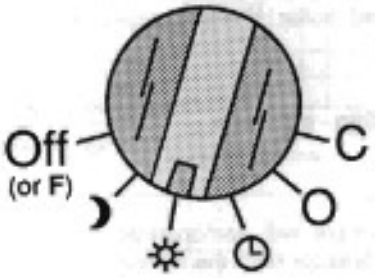
   O The mixing valve rotates towards its open position.

   Running modes

   ◷ 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).



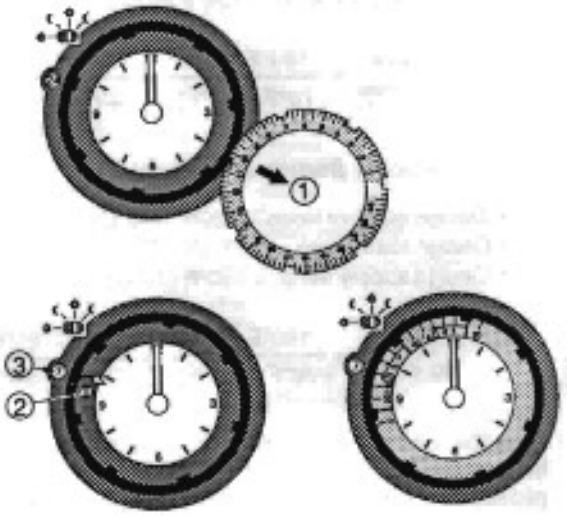
6 - position mode switch

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 (if connected) 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

If the RTU is connected, then with 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 Actuating Motor

Bridge terminal 12 to terminal 14. The Actuating Motor should open the mixing valve. Close the valve by bridging terminal 13 to 14. If the motor does not operate in either direction, then check that power is supplied to terminals 14 and 16 and that the wires from terminals 12, 13 and 16 to the motor are connected. If the motor still does not operate, then it must be replaced.
Note: The Actuating Motor requires 3.5 minutes to rotate the mixing valve from closed to open.

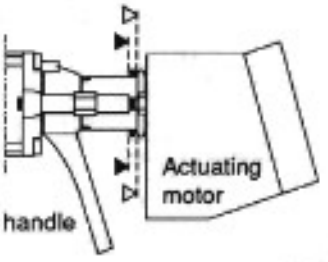
Step 5 Test the boiler

If the electronic control is a type 205, then the control also operates the boiler. A wire bridge from terminal 11 to terminal 14 should turn the boiler on; if it doesn't 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 **O**; the 'open' light should come on and the Actuating Motor should turn the mixing valve towards the open position. Similarly, when the mode selector is switched to **C** the mixing valve should turn towards the closed position. Switch the mode selector to ◷ and the control should bring the 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 mixing valve can be manually operated once the Actuating Motor is disengaged. To disengage the cylindrical coupling of the Actuating Motor from the handle of the mixing valve, pull the coupling towards the Actuating Motor and turn the mixing valve handle. Turn the handle towards "0" to close the mixing valve and towards "9" to open it. For type 223, bridge terminals 11 to 14 to operate the boiler (by its aquastat).



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 the building is too warm during the night then the setback limit adjustment may have to be decreased. Generally this adjustment is set to the design outdoor temperature.
5. If a condensing type of boiler is used, the minimum boiler temperature adjustment (type 205 only) could be set too high. It should be set at 70°F (20°C) for a condensing type of boiler.
6. If it is warm outside then unplug the control and turn the heating curve starting temperature down 5°F (3°C). 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.
7. Go through the six steps of the preceeding 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 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. Is the pump operating?
4. Check that the temperature sensors are all properly installed. (See page 3.)
5. Check the position of the mixing valve; if it is fully open then the boiler is not hot enough; the boiler's heating curve may be set too low, and/or the boiler's aquastat may be set too low.
6. If the building is too cool during the night then the setback limit adjustment may have to be increased. Generally this adjustment is set to the design outdoor temperature.
7. If it is warm outside then unplug the control and turn the heating curve starting temperature up 5°F (3°C). 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 preceeding test procedure on page 7.

The timer doesn't operate

1. Does O and C (open & close) on the mode switch work? (ie. is the control's power supply ok?).
2. If the electronic control is operating the mixing valve correctly, then only the timer needs to be repaired. Turn the two fastening screws 1/4 turn counter-clockwise and carefully pull the timer out of the electronic control. Unplug the connector. When installing the timer, ensure that the red dot on the connector aligns with the red dot on the timer. Turn the fastening screws CW.

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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