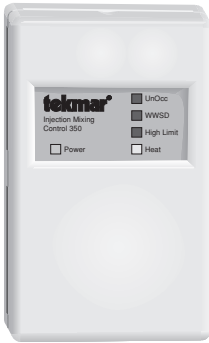


# tekmar® - Data Brochure

Injection Mixing Control 350

**D 350**

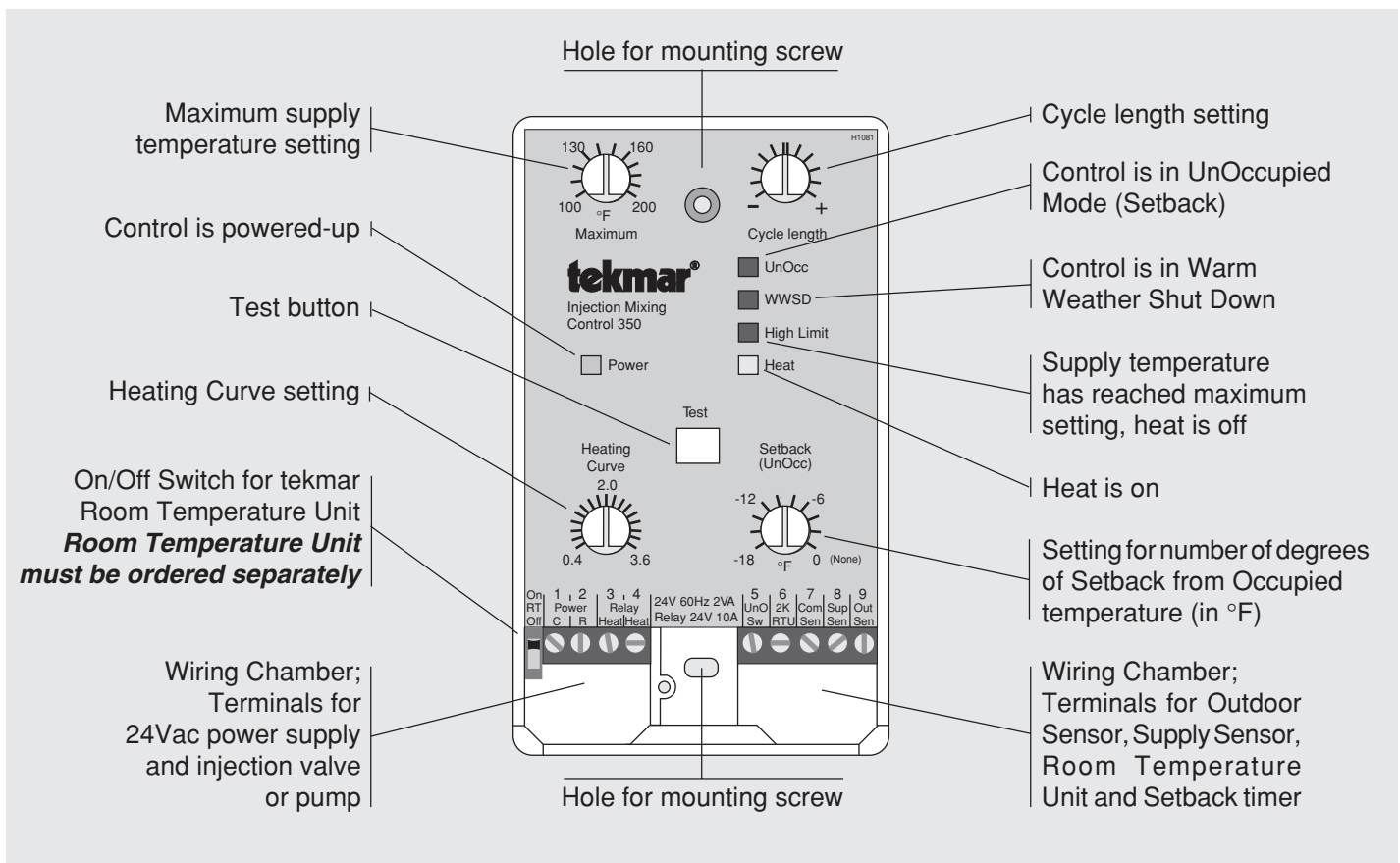
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The Injection Mixing Control 350 is an electronic outdoor reset control for a single hydronic heating zone. The control regulates the supply water temperature based on the outdoor and optionally the indoor air temperature, by operating an injection valve/pump. Hot water is injected in pulses through the valve/pump into the continually circulating water of the heating zone.

This reliable and versatile control has settings for: Heating Curve, Setback/UnOccupied temperature (*An external setback timer must be connected*), Maximum supply water temperature and Cycle length.

*A tekmar 2K RTU (Room Temperature Unit) must be ordered separately if air temperature feedback is required in the application.*



## Technical Data

### Technical Specifications

Dimension (h x w x d)	— 2-7/8" x 4-3/4" x 7/8" (74 x 120 x 22mm)
Weight	— 1.2 lb (0.6 kg)
Ambient	— 30 to 120°F (0 to 50°C) < 90% RH non-condensing
Power supply	— 20 to 28Vac, 60 Hz, 2 VA, class II transformer
Heat Relay capacity	— SPST, 24Vac, 10 Amps
Sensors	— 10 KΩ @ 77 ± 0.4°F (25 ± 0.2°C), curve 3 NTC thermistor accurate with up to 1000 ft (300m) of 18 gauge wire.
Control accuracy	— ± 0.5°F (± 0.3°C)

### Features

Indicator lights	— Power, UnOcc, WWSD, High Limit, Heat
Test button	— turns on Heat relay

### Settings

Heating Curve	— 0.4 to 3.6
Cycle length	— - to + (1:10 ratio)
Max. Supply Temp	— 100 to 200°F (38 to 93°C)
Occupied Temp/Room Temp Switch	— No RTU, RT switch "off" = 70°F RT switch "on" = 40 to 104°F (4 to 40°C) See brochures D 05, D 06
Setback (UnOcc)	— 0 to 18°F (0 to 10°C) less than Occupied temp

## Outdoor Reset Strategy

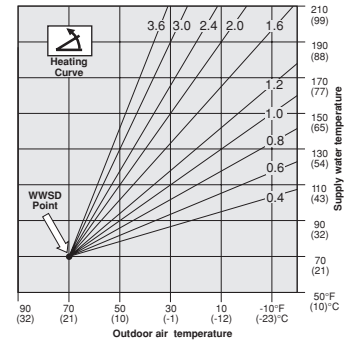
### Correct setting and shifting of the Heating Curve... the key to More Comfort and Energy Savings.

#### Heating Curve

As outdoor temperatures become colder, heat losses from the zone increase, requiring that more heat be added to prevent the indoor temperature from also becoming colder. This tekmar reset control measures the outdoor temperature and as it becomes colder, the heat loss is balanced by making the heating supply water to the zone 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.

- If the Heating Curve selected is too low; the heating system will not be able to raise the supply temperature high enough to keep the zone air temperature warm during colder weather.
- If the Heating Curve selected is too high; too much heat is delivered and the zone will overheat during colder weather.

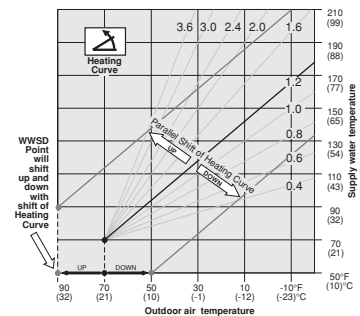


#### Warm Weather Shut Down (WWSD)

This control shuts off the injection valve/pump when the outdoor temperature is above the WWSD point and heat is no longer needed. WWSD of the heating zone helps to prevent overheating and increases comfort and energy savings. When the control has no Room Temperature Unit (RTU) connected to it, the WWSD point is fixed at 70°F (21°C).

#### Indoor Temperature Feedback

The WWSD point is usually the desired room temperature in the zone. Intermittant heat gains (from appliances, people, etc.) can change heat requirements enough so that the WWSD point may need fine tuning from time to time. Installing an RTU with this control offers automatic fine tuning by allowing the room temperature to influence the WWSD point by shifting the Heating Curve up or down. When an RTU is connected to the control and the RT switch is turned on, the WWSD point will be related to the setting of the RTU dial vs. the actual room temperature. As the RTU dial is turned up (or as the room temperature falls), the WWSD point — and thus the Heating Curve — will be shifted up and the room temperature will be raised, the opposite occurs as the RTU dial is turned down (or the room temperature rises).



## Sequence of Operation

- When the Injection Mixing Control 350 is powered-up; the "Power" light will come on, and the control will use its sensors to measure the outdoor temperature, the system supply water temperature and, if an RTU (Room Temperature Unit) is installed, the room temperature.
- If the outdoor temperature is warmer than the desired room temperature; the "WWSD" light will come on. The "Heat" light will be off.
- If the outdoor temperature is colder than the desired room temperature; the "WWSD" light will go out and the control will calculate the desired supply temperature based on the requirements of both the heating curve and the desired room temperature.
- If the average supply temperature is colder than the temperature required by the control; the "Heat" light will come on and the control will switch on an internal relay to close a set of dry contacts between terminals Heat — Heat (3 and 4). This energizes a valve or pump which injects hot water into the circulating water of the system loop, raising the average temperature of the supply water.
- When the average supply temperature becomes warmer than the temperature required by the control; the "Heat" light will go off and the contacts between terminals Heat — Heat (3 and 4) will open, turning off the injection valve/pump.
- If the supply temperature becomes warmer than the Maximum setting; the "High limit" light will come on and the "Heat" light will go off as the control opens the contacts between terminals Heat — Heat (3 and 4) to turn off the injection valve/pump. The control will not energize the injection valve/pump as long as the supply temperature is above the Maximum setting, but the system pump should continue to circulate the water.
- If the terminals UnO Sw — Com Sen (5 and 7) are shorted together; the "UnOcc" light will come on, the Heating Curve will be shifted down and the room temperature will be lowered by the number of degrees selected on the Setback dial.

**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 is energized, the system pump must operate to maintain continuous water flow across the supply temperature sensor. Refer to the Essays E 001 and E 002 for more detailed information regarding control strategy and integration of control functions.**

## 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 assure 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 350 includes:

- One electronic control, type 350
- One Outdoor Sensor 070
- One Supply Sensor 071 or 075
- One Data Brochure D 350
- One Data Brochure D 001
- One Application Brochure A 350

Other information available: Essay E 001 • Essay E 002

**Read Brochure A 350 for an Application example.**

**Note:** Carefully read the details of the Application Brochure and the Sequence of Operation section in this brochure to ensure that you have chosen the proper control, and understand its functions within the operational requirements of your system.

## Step Two **Mounting**

- The control is mounted in accordance with the instructions in the Data Brochure D 001.

## Step Three **Rough-in Wiring**

All electrical wiring terminates in the two wiring chambers at the bottom front of the control. See Brochure D 001.

**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 071, according to the instructions in Data Brochure D 001 and run the wiring back to the control. If an RTU is used, install the RTU and run the wiring back to the control.
- Install a 24Vac Class II transformer with a minimum 10VA rating to power the control, and run the wiring from the transformer to the control. *A Class II transformer must be used. Do not connect any of the transformer terminals to ground.*
- Install the wiring from the injection valve or the injection pump isolation relay to the control.

## Step Four **Testing and connecting the wiring**

- Caution**
- These tests are to be performed using standard testing practices and procedures and should only be carried out by properly trained and experienced personnel.
  - A good quality electrical test meter, capable of reading from at least 0—200 Volts AC, and at least 0—2,000,000 Ohms, is essential to properly test this control.
  - At no time should voltages in excess of 28Vac be measured at any of the wires connected to this control.

### Test the sensors

- This test must be performed *before* power is applied to the control and *before* the external sensors are connected to the terminal strip. Test the sensors 070, 071/075 according to the instructions printed in the enclosed Data brochure D 001. If an RTU is used, test it according to the installation instructions enclosed with the RTU. (Brochure D 05 or D 06)

### Test the Power Supply

- Ensure that the wires from the power supply transformer are not touching each other, any other wires, or ground. Turn on the power and, using an AC voltmeter, you should measure between 20 and 28 volts at the secondary side of the transformer.
- Turn off the power and complete the electrical connections to the control.

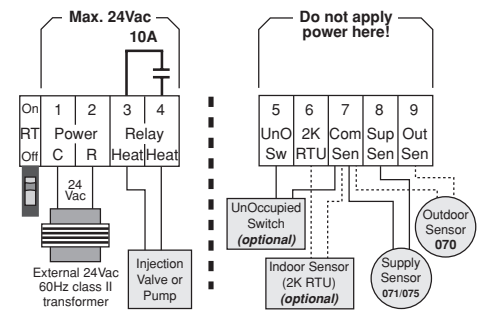
### Power and output connections; **Caution, Maximum 24 Volts**

- Connect the transformer wires to terminals *C — R* (1 & 2)
- Connect the injection valve or pump relay to terminals *Heat — Heat* (3 & 4).

### Sensor connections; **Caution, voltage is never applied to these terminals**

- Connect Outdoor Sensor 070 to terminals *Com Sen — Out Sen* (7 & 9).
- Connect Supply Sensor 071/075 to terminals *Com Sen — Sup Sen* (7 & 8).
- If an RTU is to be used, switch the RT switch to the "on" position and connect the RTU to terminals *2K RTU — Com Sen* (6 & 7).
- If a setback timer is to be used, connect the timer dry contacts to terminals *UnO Sw — Com Sen* (5 & 7).

*Note: Only 2 x 18 AWG conductors will fit in a single terminal. If more are to be connected, the installer will have to connect the wires together with a small wire nut in a "pigtail" connection or use lighter gauge wire. (minimum 22 AWG)*

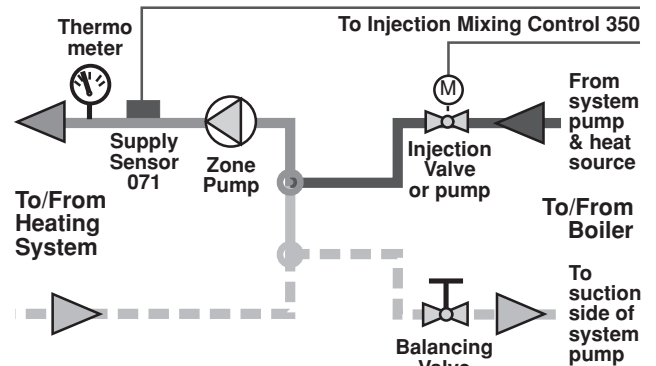


**For a detailed wiring schematic of your specific application, refer to the Application Brochure A 350**

## Step five **Balancing the system**

**For additional applications and plumbing arrangements, see brochure A 350**

- Close the balancing valve.
- Manually operate the zone pump and heat source.
- Power up the control. The "Power" light should turn on. The "High limit" light must be off.
- Set the Maximum dial to the system design supply water temperature.
- Manually operate the injection valve/pump to run continually.
- Over a 3 minute period, slowly open the balancing valve until the "High limit" light turns on.
- Let the system stabilize for at least 3 minutes.
- Close the balancing valve slowly until the "High limit" light turns off.
- Set the supply temperature limit at least 10°F (6°C) above its present setting (the design supply water temperature of the system) to prevent short cycling of the injection valve/pump on cold days.



## Settings

**Heating Curve** To calculate the correct setting for the heating curve, use the following formula:

- For example:
- Design outdoor temperature = 10°F (-12°C)
  - Design room temperature = 70°F (21°C)
- = 0.8
- Design supply temperature = 120°F (49°C)

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

$$\text{Heating curve} = \frac{120^{\circ}\text{F} - 70^{\circ}\text{F}}{70^{\circ}\text{F} - 10^{\circ}\text{F}} = \frac{50^{\circ}\text{F}}{60^{\circ}\text{F}} = 0.8$$

If the system design supply water temperature is unknown, a trial setting can be calculated using these typical supply temperatures:

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

### Maximum supply water temperature limit (Maximum)

This adjustment limits the average system supply temperature of the zone. When the supply water temperature exceeds this limit, the injection valve/pump will be turned off and the "High limit" light will come on. Consult the heating component manufacturer for their recommended maximum supply temperatures. Typical settings are: Hydronic radiant floor systems — 140°F (60°C), Baseboard systems — 190°F (90°C). The High limit setting is made when balancing the system.

### Cycle Length

The length of time the injection valve or pump stays on and how frequently it comes on is a function of both the response time of the heating zone and the Cycle Length adjustment on the control. Normally the Cycle Length adjustment can be set in the middle of its range. If unreasonably short or frequent operation of the injection valve/pump is observed, increase the adjustment towards its "+" position. If the valve/pump is not operated often enough — causing the supply temperature to go through large fluctuations — decrease the adjustment towards its "-" position.

### Occupied Temperature

When the RT switch is "off", the type 350 controls supply temperature based on the outdoor temperature, the heating curve setting and a 70°F fixed WWSD point, which means the Occupied temperature should remain close to 70°F. If internal heat gains or losses become a significant factor, a 2K RTU should be installed and the RT switch set to "on". The RTU dial setting will determine the Occupied temperature, and will allow the Occupied temperature to be adjusted at the RTU position.

### Setback (UnOcc)

When the terminals *UnO Sw — Com Sen* (5 & 7) are shorted together by a setback timer, manual switch, etc., the Occupied temperature will be lowered by the number of degrees selected on the Setback dial. For example: RTU dial setting = 68°F, Setback dial = -6°F. Whenever terminals 5 & 7 are shorted, the room temperature will drop to 62°F and be maintained at that temperature.

## Testing and Troubleshooting

There are five L.E.D.s on the front of the control that will aid in testing and troubleshooting.

The L.E.D.s indicate the following functions:

- **Power light on** — The 24Vac power source has been connected and the control is energized.
- **UnOcc light on** — Terminals 5 & 7 are shorted out, the control is in setback and the Setback dial is active.
- **High limit light on** — The supply sensor is hotter than the setting on the Maximum dial; close off the balancing valve more.
- **WWSD light on** — The outdoor temperature is warmer than the Occupied setting so that the control is in Warm Weather Shut Down and will not turn on the injection valve/pump..
- **Heat light on** — The contacts are closed between terminals *Heat* (3 and 4). The injection valve/pump should be on.
- **In addition to the L.E.D.s, this control has a Test button which turns on its heat relay.**

When the Test button is pushed and held down, the internal relay is energized, causing the "Heat" light to come on with the injection valve/pump. If the "Heat" light comes on but the valve/pump does not operate, check to see that all components are properly installed and fully operational and that there is power to the circuit. Check that the wiring and plumbing are as shown in the application drawing for your system. Check the wiring from the control to the valve/pump that is not working and if further information is needed, consult the manufacturer's installation and troubleshooting instructions for these components.

### Before you leave

- Install the wiring cover over the wiring chamber and secure it with the screw provided.
- Place the front cover on the control to cover the setting dials and snap it into place.
- 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 of this control within the system to the end user and anyone else who may be operating the system.

## 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 unauthorized 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 Authorization (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.

<b>In North America:</b>	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
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