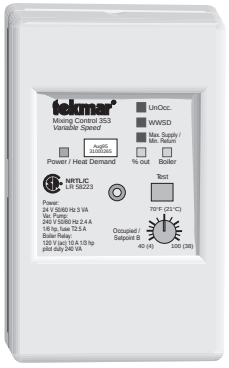
# tekmar® - Data Brochure

Mixing Control 353

**D 353**

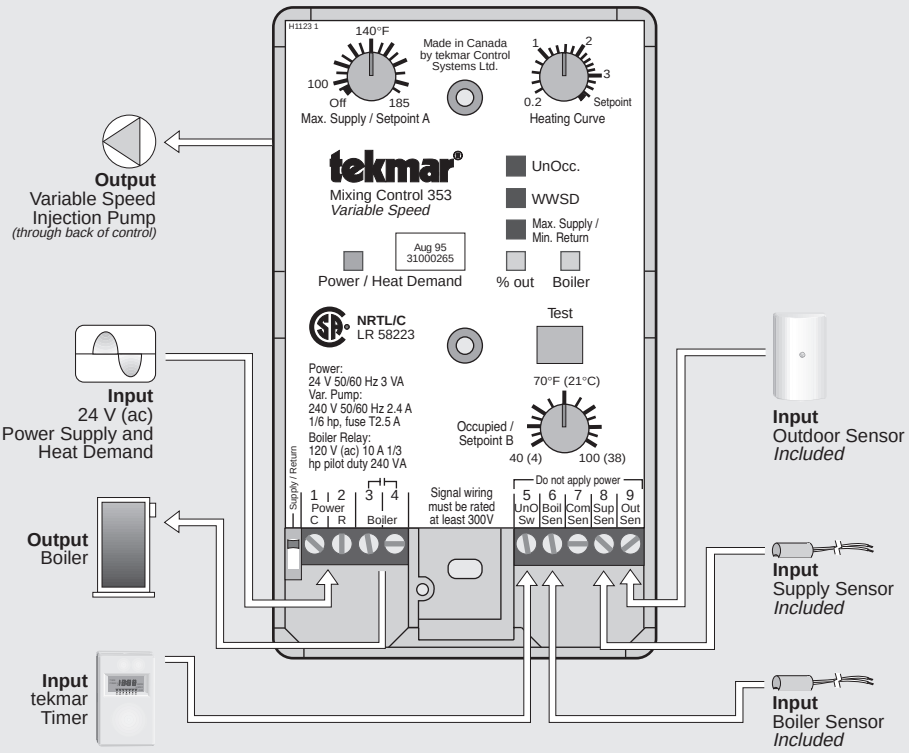
07/95



The Mixing Control 353 is a microprocessor-based PID control designed to regulate the supply water temperature to a heating system by controlling a boiler and the speed of an injection pump. The 353 can either control the system supply water temperature based on the outdoor air temperature (outdoor reset) or on a fixed temperature setting (setpoint control). A boiler sensor can be connected in order to prevent corrosion in the boiler due to flue gas condensation. If the 353 is controlling the boiler supply water temperature, the control continuously adjusts the boiler differential in order to optimize the firing cycles of the boiler, prevent large water temperature swings, and increase the efficiency of the system.

The 353 also includes features such as Warm Weather Shut Down (WWSD), Night Setback (UnOccupied period), and a maximum supply water temperature setting.



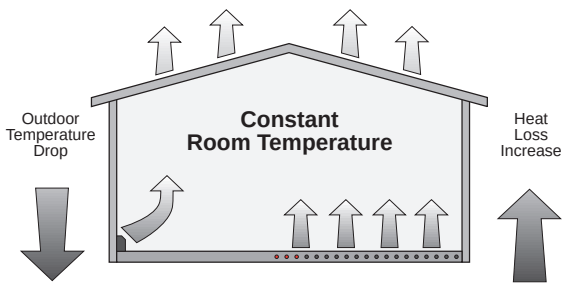



## Control Strategy

### OUTDOOR RESET

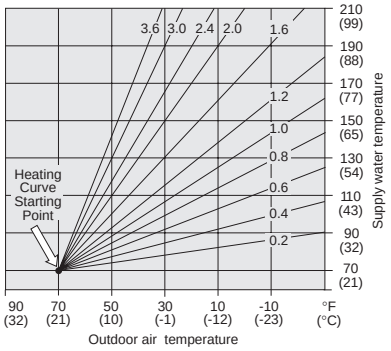
In order to properly control a hot water heating system, the heat supplied to the building must equal the heat lost by the building.

- The heat supplied to a building is proportional to the temperature of the water and the surface area of the heating element. A small surface area such as baseboard radiators requires a higher water temperature than a larger surface area such as radiant floors.
- The heat lost from a building is dependent on the outdoor temperature. As the outdoor temperature drops, the building heat loss increases.



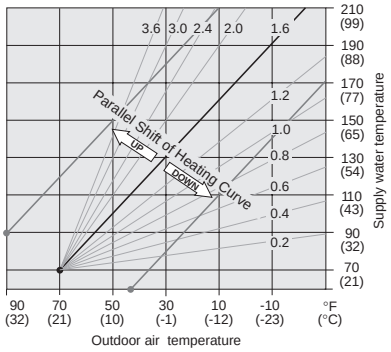
### *Heating Curve*

A hot water heating system can be accurately controlled by modulating the supply water temperature as the outdoor temperature changes. Using this approach, the heat lost from the building is exactly matched by the heat input to the building. A tekmar reset control utilizes a heating curve to set the relationship between outdoor temperature and supply water temperature. The heating curve determines the amount the supply water temperature is raised for every 1° drop in outdoor air temperature. The heating curve is sometimes called an outdoor reset ratio.




### *Heating Curve Parallel Shift*

All heating curves begin at the heating curve starting point. If the heating curve starting point is adjusted, the heating curve will be parallel shifted. The heating curve starting point is either set manually through a dial, or it is determined automatically by the control through indoor temperature feedback.




### *Warm Weather Shut Down (WWSD)*

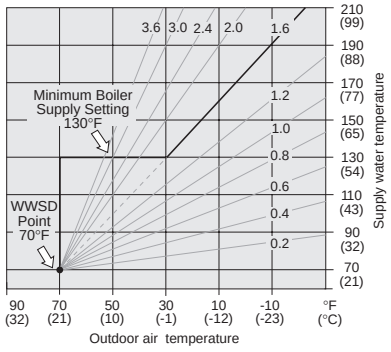
When the outdoor air temperature is equal to the heating curve starting point, no additional heat is required in the building and therefore the heating system can be shut down. The WWSD point is normally the same as the heating curve starting point.

## BOILER OPERATION

The supply water temperature from a boiler can be controlled by cycling the boiler on and off. Modulation of the boiler's operating temperature in hot water heating systems not only provides more comfort but also offers significant energy savings. The cooler the boiler runs, the more efficient it is due to less heat losses up the flue and reduced boiler jacket losses.

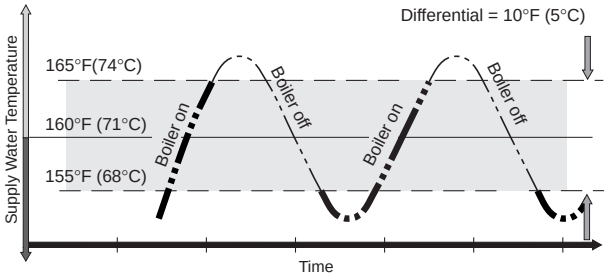
### *Minimum Boiler Supply*

Most boilers require a minimum supply water temperature in order to prevent corrosion from flue gas condensation. The control should therefore only modulate the boiler supply water temperature down to the boiler manufacturer's minimum recommended operating temperature. Some boilers are designed to condense and should be operated at low water temperatures as much as possible for maximum efficiency.



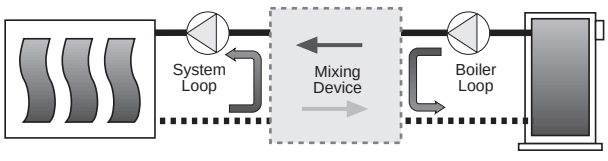

### *Boiler Differential*

An on / off boiler must be operated with a differential in order to prevent short cycling. When the supply water temperature drops below the bottom rail of the differential, the boiler is turned on. The boiler is then kept on until the supply water temperature rises above the top rail of the differential. If the differential is too wide, there can be large supply water temperature swings; however, if the differential is too narrow, the boiler short cycles and operates inefficiently. Some controls automatically calculate the boiler differential in order to achieve an appropriate balance between temperature swings and boiler efficiency. This also permits the control to adapt to changing loads and conditions.



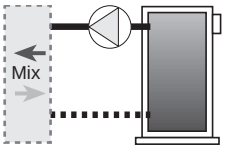

## MIXING OPERATION

The full range of water temperatures required through a heating season can be provided with a standard (non-condensing) boiler by incorporating a modulating mixing device into the system. Mixing valves or variable speed injection pumps are commonly used to modulate both the system supply water temperature and the boiler return water temperature. The modulation of water temperatures improves comfort in the building and also protects the boiler from cool return water. For more detailed information on mixing methods consult Essay E 021.




### *Boiler Protection*

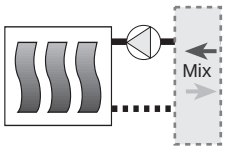
Cool water is often returned to the boiler from low temperature radiant floor heating systems or when the heating system is recovering from night setback. This cool boiler return water may cause the boiler to operate at such a low temperature that the flue gases condense. Alternatively, when the boiler surfaces are hot due to previous loads such as domestic hot water generation, the large temperature difference ($\Delta T$) between the



boiler and its return water can cause the boiler to become thermally shocked. Proper protection of the boiler under these circumstances requires a modulating mixing device that can temporarily reduce the heating load. This is normally accomplished by closing a valve or reducing the speed of an injection pump.

### *Maximum System Supply*

Some systems, such as hydronic radiant floor heating, usually operate at water temperatures that are below the minimum boiler supply temperature. This is due to the large surface area of the floors which radiate a significant amount of heat at low water temperatures. Floor heating systems also have a maximum floor surface temperature limit for occupant health reasons and to protect the materials within the floor. In such systems a modulating mixing device is normally required to limit the supply water temperature.



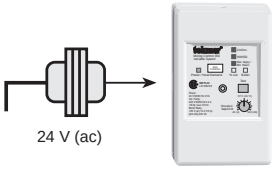

## UNOCCUPIED (NIGHT SETBACK)

During the night, or at times when people are not within the building, energy can be saved by lowering the building temperature for an UnOccupied (Night Setback) period.

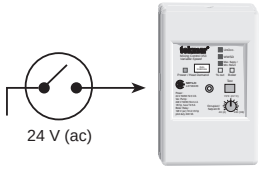
# Sequence of Operation

## POWERING UP THE CONTROL / HEAT DEMAND SIGNAL

The 353 receives a heat demand signal and turns on the green *Power*/ *Heat Demand* light whenever the control is powered up. At first, a certain combination of LEDs are turned on for 2 seconds to indicate the software version. Next, all red LEDs are held on for 4 seconds. Finally, the control begins normal operation.




Permanent Heat Demand



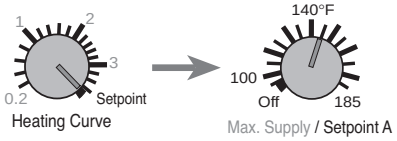

External Heat Demand

## OUTDOOR RESET / SETPOINT CONTROL

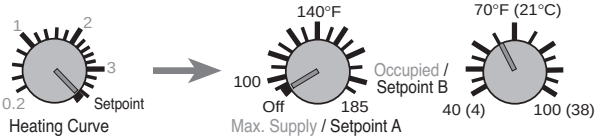
The 353 controls the supply water temperature based on either the outdoor temperature (outdoor reset) or a constant setpoint dial setting.

### *Setpoint Control*

When the *Heating Curve* dial is in the *Setpoint* position, the 353 ignores the outdoor temperature sensor and operates the variable speed injection pump in order to maintain the setpoint supply water temperature. The setpoint is set using either the *Setpoint A* dial, or, if the *Setpoint A* dial is in the *Off* position, using the *Setpoint B* dial.




**OR**

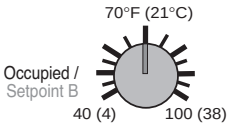



### *Outdoor Reset*

When the Heating Curve dial is set between 0.2 and 3.4, the 353 calculates the required supply water temperature based on the outdoor temperature, and it operates the variable speed injection pump in order to maintain that target supply water temperature.

### Occupied dial

The *Occupied* dial on the 353 sets the starting point of the heating curve and the WWSD point. If the Occupied dial is increased, the heating curve shifts up and if the Occupied dial is decreased, the heating curve shifts down.



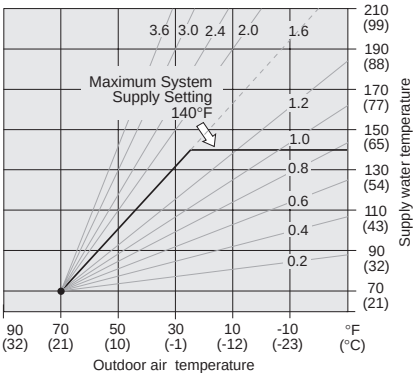

### Warm Weather Shut Down (WWSD)

When the outdoor temperature is warmer than the *Occupied* dial setting, the 353 turns on the *WWSD* light and turns off the *Boiler* relay and the variable speed injection pump. If the control is in Setpoint mode the WWSD feature is not operational. The 353 has a freeze protection feature that does not allow the supply water temperature to drop below 35°F (2°C) as long as there is a heat demand signal.

WWSD

### Maximum System Supply Temperature

The 353 has a *Max. Supply* dial that can be used to set a maximum system supply water temperature. If the supply water temperature approaches the *Max. Supply* dial setting, the control turns on the *Max. Supply* light and reduces the speed of the injection pump. If the *Max. Supply* dial is in the *Off* position, the 353 allows a maximum target supply water temperature of 212°F (100°C).




## MIXING OPERATION

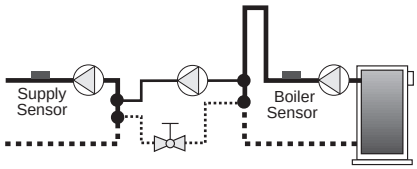
The 353 controls the supply water temperature by varying the speed of an injection pump. As the heating load increases, the 353 speeds up the pump and as the load decreases, the 353 slows down the pump. The *% out* light simulates the speed of the variable speed injection pump by flashing at different rates. For more information on variable speed pumping and piping arrangements see Essay E 021.

### *Boiler Control*

#### Boiler Sensor on the Boiler Supply

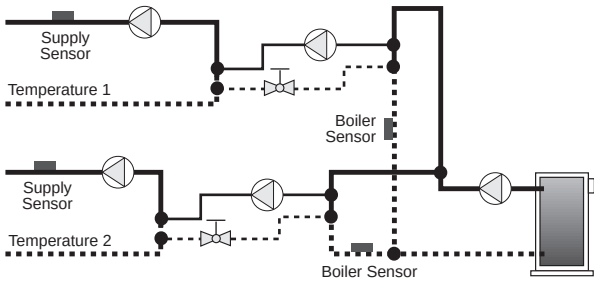
When the boiler sensor is installed on the supply side of the boiler loop, the DIP switch must be set to *Supply*. With both a system supply sensor and a boiler supply sensor, the

353 controls the boiler directly. The 353 automatically calculates the boiler differential based on the boiler response time to a given heating load. The 353 controls the boiler to maintain the boiler supply water at a sufficient temperature to satisfy the heating load. The *Boiler* light turns on whenever the boiler is in operation. In order to allow the control to operate properly, the boiler's aquastat should be set at least 30°F (17°C) above the system design supply water temperature. At no time does the 353 allow the target boiler supply temperature to exceed 212°F (100°C).




### Boiler Sensor on the Boiler Return

In heating systems that require multiple supply water temperatures, multiple 353 mixing controls may be used. The boiler sensor of each control must be installed on the boiler water return as shown in the diagram. By placing the boiler sensors on the return, each 353 is isolated and control interference is thereby avoided. For systems where the 353 provides a heat demand to an external multiple boiler control, the boiler sensor should also be installed on the return side of the boiler loop.




When heat is required in the heating system, the 353 turns on the *Boiler relay* once the speed of the injection pump is between 10% and 25%. This feature, and a 20 second time delay, are used to prevent the boiler from short cycling. The control turns the boiler off once the variable speed injection pump slows down to less than 5% of its maximum output for at least 3 minutes. The boiler's aquastat should be set to at least 20°F (11°C) above the system design supply water temperature.

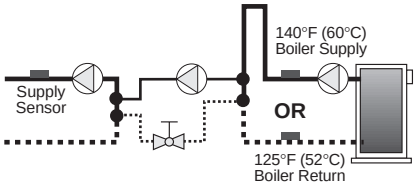
### No Boiler Sensor

If no boiler sensor is installed, the control operates the boiler in a similar manner as with the sensor located on the boiler return. Since no boiler water temperature feedback is available, the 353 cannot provide any boiler protection.

### *Boiler Protection*

When a boiler sensor is installed on the supply side of the boiler, the 353 ensures a minimum boiler supply water temperature of 140°F (60°C). If the water temperature approaches 140°F (60°C), the 353 turns on the *Min. Return* light and decreases the speed of the injection pump.

When a boiler sensor is installed on the return side of the boiler, the 353 ensures a minimum boiler return water temperature of 125°F (52°C). If the boiler return water temperature approaches 125°F (52°C), the 353 turns on the *Min. Return* light and decreases the speed of the variable speed injection pump.




### UNOCCUPIED MODE (NIGHT SETBACK)

The 353 can be switched into UnOccupied mode by closing an external switch or a timer relay that is wired to the control. When the 353 is in UnOccupied mode, the *UnOcc* light turns on and the *Occupied* dial setting is decreased by 9°F (5°C).




## Installation

***Caution***

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

### STEP ONE — GETTING READY

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

*Type 353 includes:*
- One Mixing Control 353
- One Outdoor Sensor 070
- Two Universal Sensors 071
- Data Brochures D 353, D 070, D 001
- Application Brochures A 353
- Essay E 021

*Other information available:*
- Essays

***Note*** *Carefully read the details of the Sequence of Operation sections in all applicable brochures to ensure that you have chosen the proper control for your application.*

### STEP TWO — MOUNTING

Install a 2" x 4" duplex electrical box in accordance with the instructions in the Data Brochure D 001. Ensure that the depth of the electrical box is enough to house all the wiring that will be in it.

## STEP THREE — ROUGH-IN WIRING

The variable speed injection pump wiring terminates in the electrical box. All other electrical wiring terminates in the two wiring chambers on the control. Determine whether the low voltage wiring enters the wiring chamber through the back or the bottom of the control. The wiring is roughed-in to the electrical box prior to installation of the control. (See Brochure D 001.) Standard 18 AWG solid wire is recommended for all low voltage wiring, and multi-strand 16 AWG wire is recommended for 120 V (ac) wiring.

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

- Install the variable speed injection pump and run the wiring to the electrical box.
- Install the Outdoor Sensor 070, the Supply Sensor 071, and the Boiler Sensor 071 according to the instructions in the Data Brochure D 070 and run the wiring back to the control mounting location.
- Run wiring from the other system components (boiler, etc.) to the control mounting location.
- Run wires from the 24 V (ac) power source or heat demand to the control mounting location. *Use a clean power source to ensure proper operation.*
- If a tekmar Timer 031 is used, follow the installation procedure provided in the Data Brochure D 031 and run the wiring back to the control mounting location.

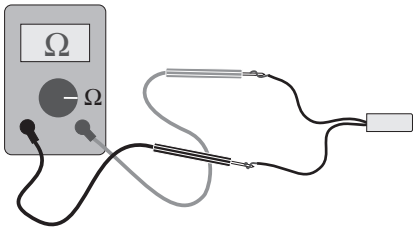
## STEP FOUR — TESTING THE WIRING

**No wires should be connected to the control during testing.**

A good quality electrical test meter, capable of reading from at least 0 — 200 V (ac) and at least 0 — 2,000,000 Ohms, is essential to properly test the wiring and sensors.

### *Test the Sensors*

Test the sensors according to the testing procedure in the Data Brochure D 070.




### *Test the Power Supply or Heat Demand*

Make sure exposed wires and bare terminals are not in contact with other wires or grounded surfaces. Turn on the power or provide a heat demand and measure the voltage across the 24 V (ac) leads. The voltmeter should read between 22 and 26 Volts.

### *Test the Outputs*

- Short the boiler wires and power up the boiler circuit; the boiler should fire. Remove the power from the boiler circuit.
- Short the variable speed injection pump wires and power up the pump circuit; the variable speed pump should run at full speed. Remove the power from the variable speed injection pump circuit.

## STEP FIVE — ELECTRICAL CONNECTIONS TO THE CONTROL

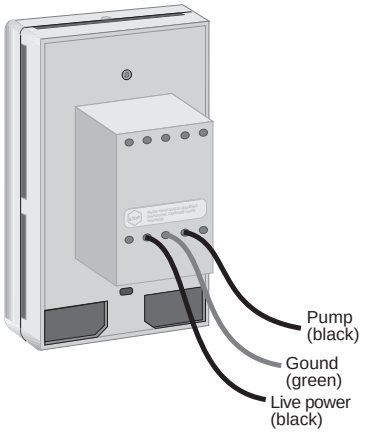
The installer should confirm that no voltage is present at any of the wires.

### *Output Connections*

#### Variable Speed Injection Pump

The 353 can vary the speed of a permanent capacitor impedance protected or equivalent pump motor that has a locked rotor current of less than 2.4 A. Most small wet rotor circulators are suitable as described in Essay E 021. *The variable speed output must not be used on pumps which have a centrifugal switch*. The 353 has an internal overload protection fuse which is rated at 2.5 A 240 V (ac). This fuse is not field replaceable. Contact your tekmar sales representative for details on the return and repair procedures if this fuse is blown.

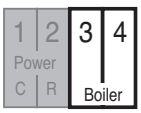
Connect one of the wires from the variable speed injection pump to one of the black wires from the back of the control. Connect the second black wire from the back to the live (L) side of the 120 V (ac) power source (L1 for a 240 V (ac) power source). The other wire on the variable speed injection pump must be connected to the neutral (N) side of the 120 V (ac) power supply (L2 for a 240 V (ac) power source). Connect the green wire on the back of the control to ground.




Insert the low voltage wiring into the wiring chambers on the control and mount the 353 on to the electrical box.

#### Boiler

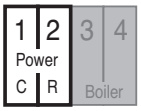
Connect the 120 V (ac) or 24 V (ac) boiler circuit to the *Boiler* relay (3 and 4) terminals. The 353 closes a dry relay contact between these terminals when boiler operation is required.




### *Powered Input Connections*

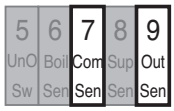
#### 24 V (ac) Power or Heat Demand

Connect the 24 V (ac) power supply or heat demand to terminals *Power C— R* (1 and 2) on the control.



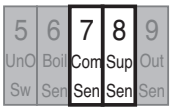
### *Sensor and Unpowered Input Connections*

***Do not apply power to these terminals at any time as this will damage the control.***



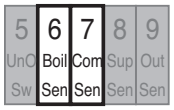

**Outdoor Sensor**

Connect the two wires from the Outdoor Sensor 070 directly to the *Com Sen — Out Sen* (7 and 9) terminals. The Outdoor Sensor measures the outdoor air temperature.



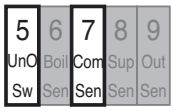

**Supply Sensor**

Connect the two wires from the Supply Sensor 071 directly to the *Com Sen — Sup Sen* (7 and 8) terminals. The Supply Sensor measures the water temperature supplied to the system.




**Boiler Sensor**

Connect the two wires from the boiler sensor directly to the *Boil Sen— Com Sen* (6 and 7) terminals. The boiler sensor measures the boiler loop water temperature.




**UnOccupied switch**

To set the 353 to UnOccupied mode, connect the two wires from the switch or timer to the *UnO Sw — Com Sen* (5 and 7) terminals on the control. For more information on the tekmar Timer 031, consult its Data Brochure D 031.

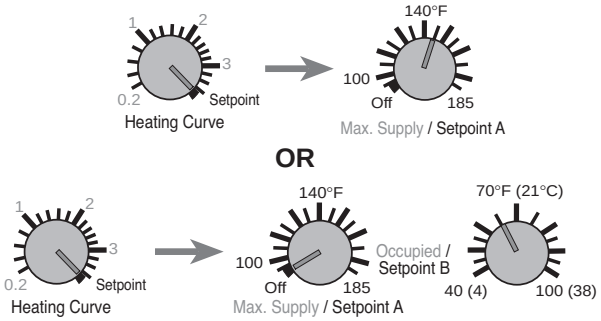

## Settings

Before adjusting the dial settings, read through the sequence of operation to ensure that you understand how the control operates.

### STEP SIX — ESSENTIAL CONTROL SETTINGS

#### *Setpoint A and Setpoint B Dial Settings*

To use the 353 as a setpoint control, set the *Heating Curve* dial to *Setpoint*. The desired setpoint temperature can be set using the *Setpoint A* and *Setpoint B* dials. If the desired setpoint temperature is between 100°F (38°C) and 185°F (85°C), the *Setpoint A* dial must be used. If the desired temperature is between 40°F (4°C) and 100°F (38°C), set the *Setpoint A* dial to the *Off* position and use the *Setpoint B* dial. The outdoor sensor does not need to be installed for setpoint operation.



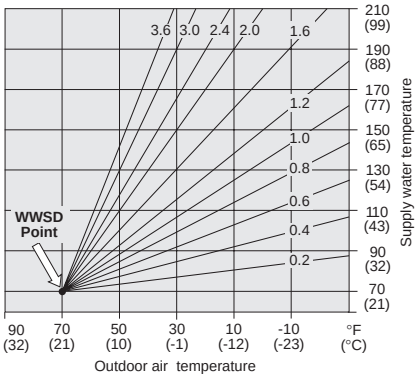

#### *Heating Curve*

During outdoor reset operation, the Heating Curve setting determines the number of degrees the supply water temperature is raised for each one degree drop in outdoor temperature. The *Heating Curve* dial position can be calculated from the following formula.

$$\text{Heating Curve} = \frac{\text{design supply temperature — occupied temperature}}{\text{occupied temperature — design outdoor temperature}}$$

Example: A system is designed to supply 120°F (49°C) water when the outdoor temperature is 10°F (-12°C). The Occupied temperature is 70°F (21°C).

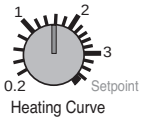
$$\text{Heating Curve} = \frac{120 - 70°F\ (49 - 21°C)}{70 - 10°F\ (21 - (-12°C))} = \frac{50°F\ (28°C)}{60°F\ (33°C)} = 0.8$$




If the design supply water temperature is unknown, the *Heating Curve* dial can be set to a trial value using the typical design supply temperatures given below.

Typical design supply temperatures:

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

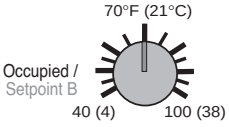



#### *Occupied Temperature*

The *Occupied* dial sets the WWSD point. It is normally set to the desired room temperature.

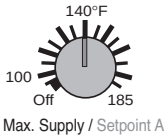
#### *Maximum System Supply*

If the 353 is used as an outdoor reset control, the 353 prevents the mixed supply water temperature from rising above the *Max. Supply* dial setting. The *Max. Supply* dial should be set to the maximum temperature allowed in the system loop. If the dial is set to *Off*, the 353



allows a maximum supply temperature of 212°F (100°C). There are many factors which may limit the allowable supply water temperature in a radiant floor heating slab; a few are provided below.

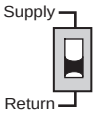
- Some tubing manufacturers recommend that their products not be operated continuously at temperatures exceeding 140°F (60°C). Consult the tubing manufacturer for more information.
- No where in the concrete should the temperature be maintained above 170°F (77°C).
- The surface temperature of a radiant floor heating slab should normally not exceed 85°F (29°C). The slab surface temperature is affected by the slab thermal resistance, the heating load, and the supply water temperature to the slab.




### *DIP Switch Setting*

**Supply / Return**

When multiple 353 mixing controls are used or when the 353 provides a heat demand to a multiple boiler control, the boiler sensor must be installed on the boiler return side of the boiler loop. The DIP switch on the control must then be set to *Return*. If a single control is used, install the boiler sensor on the supply side of the boiler and set the DIP Switch to *Supply*. If no boiler sensor is installed, the DIP switch may be set to either position.




## Testing the Control

### STEP SEVEN — OPERATIONAL TEST OF CONTROL FUNCTIONS

The main control functions on the 353 can be tested by pressing and holding the *Test* button. While the *Test* button is pressed, the *Boiler* relay closes and the variable speed injection pump turns on to 100% of its output speed. Once the *Test* button is released, the output relays return to normal operation.


### *Indicator Lights "On"*

| | |
|---|---|
| *Power / Heat Demand* | • 24 V (ac) heat demand signal or power is applied to the 353. |
| *UnOcc.* | • The control is in UnOccupied (Night Setback) mode. |
| *WWSD* | • Heat is not required in the heating system. |
| *Max. Supply / Min. Return* | • The supply water temperature is approaching the *Max. Supply* dial setting. |
| | • The boiler supply water temperature or the boiler return water temperature is approaching the minimum temperature allowed by the control. |
| *% Out* | • This light indicates the speed of the variable speed injection pump by flashing at different rates. |
| *Boiler* | • The relay contacts between *Boiler – Boiler* (3 and 4) are closed and the boiler should be on. |

### 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 353. When the control is flashing an Error Message, identify the fault from the look-up table on page 8 and follow standard testing procedures to confirm the problem. If you suspect a wiring fault, return to steps three, four and five, and carefully check all external wiring and wiring connections.

### *Sensor and Internal Faults*

- If the boiler sensor circuit shorts, the 353 displays an error message and turns the *Boiler* relay off.
- If a supply sensor fault occurs, the 353 displays an error message and turns the variable speed pump and the boiler off.
- If an outdoor sensor fault occurs during outdoor reset operation, the 353 will assume a fixed outdoor temperature of 32°F (0°C) and will supply the appropriate supply water temperature. An error message is displayed. During setpoint operation the 353 will only display an error message when the outdoor sensor circuit has a short.
- If the enclosure overheats, the 353 turns off the variable speed injection pump and displays an error message until it cools down.
- If an internal control fault occurs, the 353 displays an error message. Press the *Test* button to clear the error message. If the error message remains, the control must be returned for repair.

### *Adjustment of Settings*

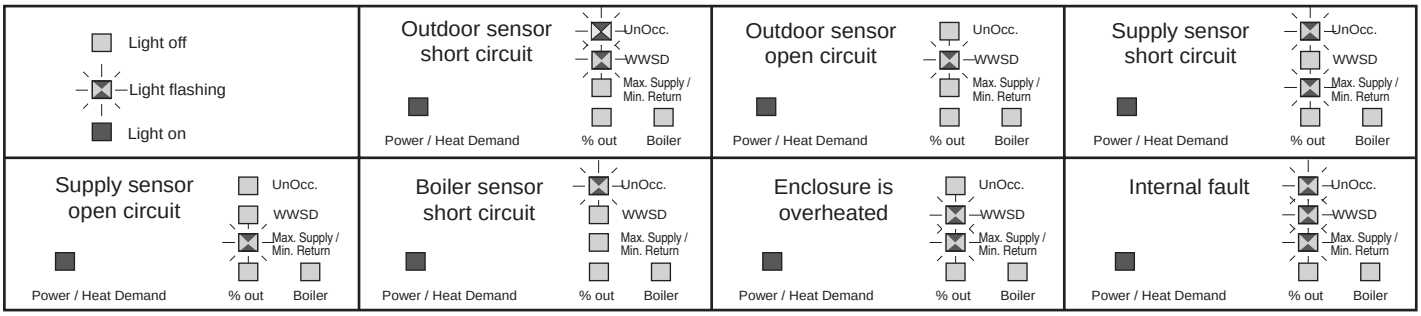
- If the outdoor air temperature is near the *Occupied* dial setting and the rooms are cold, increase the *Occupied* dial setting. If the rooms are too hot, decrease the *Occupied* dial setting.
- If the outdoor air temperature is cold and the rooms are cold, increase the Heating Curve dial setting by 0.1 per day.

### STEP NINE — 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 to anyone else who may be operating the system.

## Error Messages

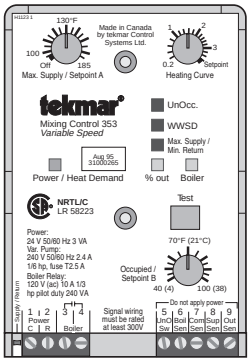
Whenever a fault is detected in any of the sensors, the indicator lights will flash in a specific way, to indicate the location of the problem. For detailed sensor testing instructions see Data Brochure D 070.




## Technical Data

### Mixing Control 353 *Variable Speed*

| | | |
|---|---|---|
| Literature | — | D 353, A 353, D 001, D 070, E 021, Essays |
| Control | — | Microprocessor PID control; This is **not a safety (limit) control**. |
| Packaged weight | — | 1.1 lb. (500 g), Enclosure D, PVC plastic |
| Dimensions | — | 4-3/4" H x 2-7/8" W x 1-7/8" D (120 x 73 x 48 mm) |
| Approvals | — | CSA NRTL / C, meets ICES & FCC regulations for EMI/RFI. |
| Ambient conditions | — | Indoor use only, 32 to 122°F (0 to 50°C), < 90% RH non-condensing. |
| Power supply | — | Class 2, 24 V ±10% 50/60 Hz 3 VA |
| Variable Pump | — | 240 V 50/60 Hz 2.4 A 1/6 hp, fuse T2.5 A 250 V |
| Relay | — | 120 V (ac) 10 A 1/3 hp, pilot duty 240 VA |
| Sensors included: | — | NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) ß=3892 Outdoor Sensor 070 and 2 of Universal Sensor 071 |
| *Occupied / Setpoint B* | — | 40 to 100°F (4 to 38°C) |
| *Heating Curve* | — | 0.2 to 3.4, Setpoint |
| *Max. Supply / Setpoint A* | — | Off, 100 to 185°F (Off, 38 to 85°C) |




The installer must ensure that this control and its wiring are isolated and/or shielded from strong sources of electromagnetic noise. Conversely, this Class B digital apparatus complies with Part 15 of the FCC Rules and meets all requirements of the Canadian Interference-Causing Equipment Regulations. However, if this control does cause harmful interference to radio or television reception, which can be determined by turning the control off and on, the user is encouraged to try to correct the interference by reorienting or relocating the receiving antenna, relocating the receiver with respect to this control, and/or connecting the control to a different circuit from that to which the receiver is connected.
Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

## Limited Warranty and Product Return Procedure

**Limited Warranty** ***The liability of tekmar Control Systems Ltd. and tekmar Control Systems, Inc. ("tekmar") under this warranty is limited. Please read and understand the conditions appearing herein.***

tekmar warrants each tekmar product against defects in workmanship and materials, when the product is installed and used in compliance with tekmar's instructions. The warranty period is for a period of twenty-four (24) months from the production date if the product is not installed during that period, or twelve (12) months from the documented date of installation if installed within twenty-four (24) months from the production date, but in any event the warranty period shall not extend beyond thirty-six (36) months from the production date. During the warranty period, tekmar will, at its discretion, either repair at no charge, exchange or give credit for the defective product, provided the product is returned to tekmar.

The liability of tekmar shall be limited to the cost of parts and labour provided by tekmar to correct defects in materials and / or work-manship or to the exchange of the defective product for a replacement product or to the granting of credit limited to the original cost of the product, at tekmar's discretion, and such repair, exchange or credit shall be deemed to be the sole remedy available from tekmar. This warranty does not cover the cost of the parts or labour to remove or to transport the defective product, or to reinstall the repaired or replacement product. Returned products that are not defective are not covered by this warranty.

This warranty does not apply if the product has been damaged by accident, abuse, misuse, negligence, fire, Act of God, or has been damaged by modifications, alterations or attachments made subsequent to purchase which have not been authorized by tekmar, or if the product was not installed in compliance with the local codes and ordinances, or if due to defective installation of the product.

**The warranty applicable to a product is as set out in the statement of warranty policy (the "Warranty") above, receipt of which is hereby acknowledged. The liability of tekmar is limited to those obligations identified in the warranty as obligations of tekmar. The warranty is understood to be in substitution for any loss, costs or damages for which tekmar might otherwise be liable at law or in equity and in particular, in lieu of any liability for fundamental breach of contract.**

**tekmar disclaims any responsibility for losses, expenses, inconveniences, or any special, indirect, secondary, incidental or consequential damages arising from ownership or use of any items subject to any claim hereunder, regardless of whether such claim is stated in contract, tort or strict product liability.**

**This warranty is in lieu of all other warranties, express or implied, including, without limitation, warranties of merchantability, fitness for a particular purpose, durability or description of the product, its non-infringement of any relevant patents or trademarks, and its compliance with or non-violation of any applicable environmental, health or safety legislation. No implied warranties shall extend beyond twenty-four (24) months from the production date.**

Some states or provinces do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state or province to province.

**Product Return Procedures** Products that are believed to have defects in workmanship or materials must be returned, together with a written description of the defect, to the tekmar representative for that territory. If the address of the representative is not known, please request it from tekmar at the telephone number listed below.


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