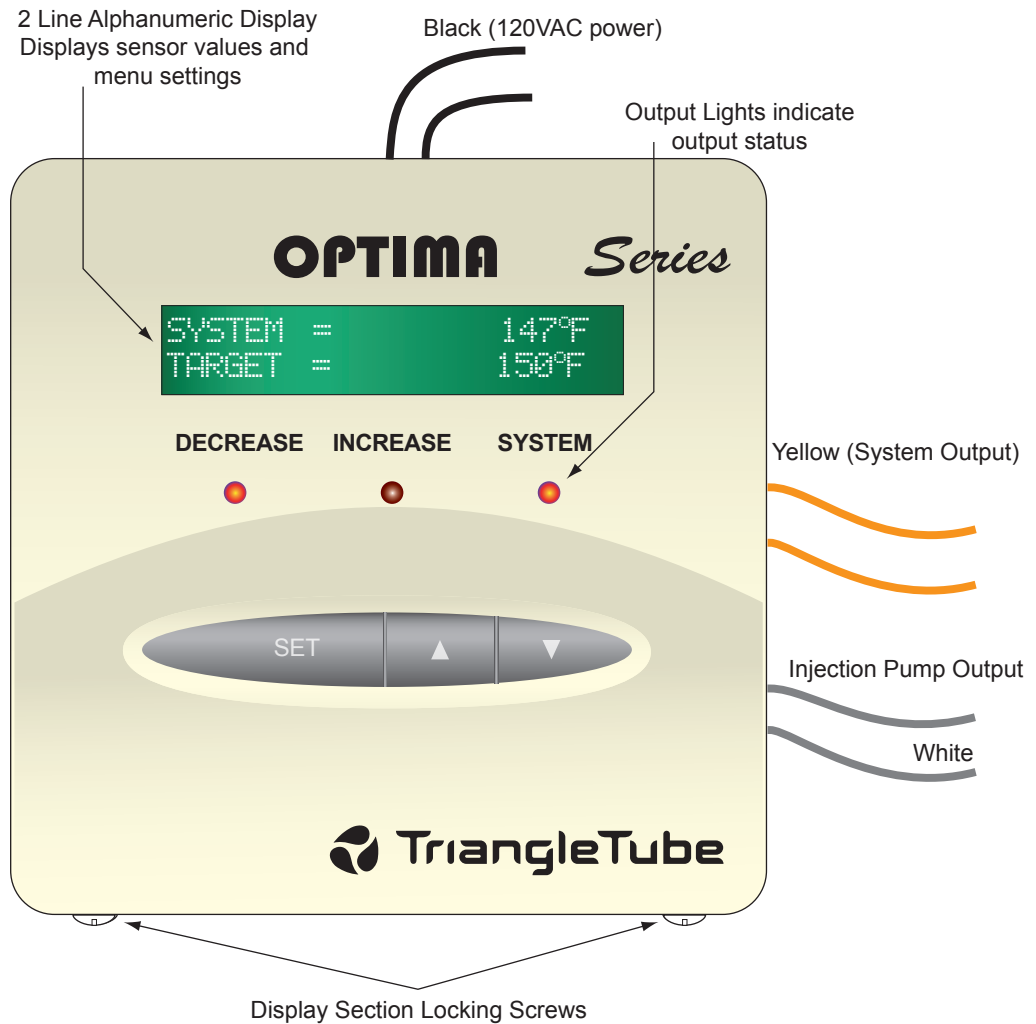


OPTIMA *Series*



⚠ WARNING

This Triangle Tube control is strictly an operating control. It **CANNOT** be used as a limit control. All equipment must have all safety and limit controls required by code. It is the responsibility of the installer to verify that all the safety and limits are working properly.

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Operating Concept

The SIM modulates the speed of an Injection Pump to precisely inject heat from the high temperature Primary Loop into the lower temperature Secondary Loop. As the speed of the pump increases, more hot water is sent into the Secondary Loop resulting in a warmer water temperature.

The SIM can operate in manual or automatic modes. In manual mode, the SIM will run the Injection Pump at a fixed speed for well balanced systems with a constant load. Automatic mode will allow the SIM to modulate the Injection Pump speed to maintain the Secondary Loop set point.

The SIM can be used to maintain either a fixed set point or operate using the outdoor reset function. The outdoor reset function utilizes fixed reset curves as well as providing the option for custom user defined heating curves. The included outdoor sensor can be used to provide an outdoor cutoff function in either set point or outdoor reset modes. The SIM also includes an external setback input which can be used to lower the set point when less heat is required such as on nights and weekends.

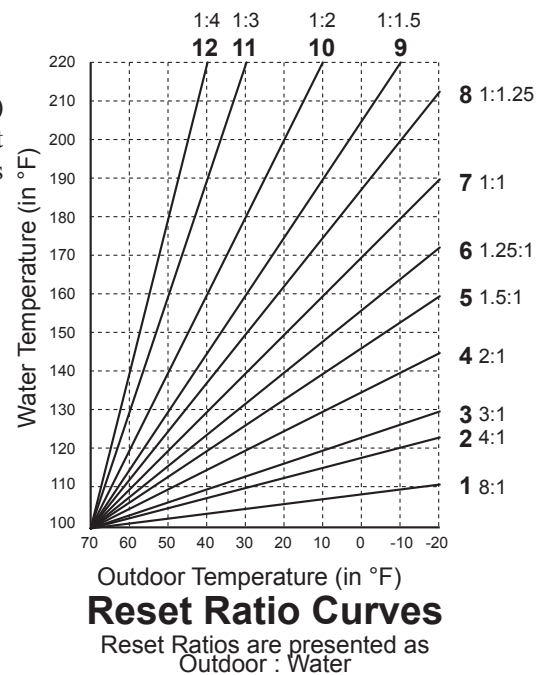
Outdoor Reset Concept

Because of the many different physical characteristics of buildings, and the type of radiation, i.e., baseboard or radiant, the heat loss varies. In one building, a 1-degree temperature change outdoors may require a change of 1 degree in heating water temperature; for another it may require a change of 2, 3, or even 4 degrees in order to gain the desired comfort level. This is known as the Reset Ratio. The Reset Ratio Chart shows the wide range of Reset Ratios available for the SIM.

The installer adjusts the SIM to a specific building by changing the Reset Ratio curve. With curve 4 (2:1 reset ratio) a 2-degree change in outdoor temperature will change the circulating hot water temperature by 1 degree; at curve 11 (1:3 reset ratio) an outdoor change of 1 degree will change the water temperature by 3 degrees. Most buildings with baseboard radiation require curve 6, 7, or 8. Radiant heat applications usually require a lower curve. An external T-Stat input can be used to shutdown the SIM when the thermostat is satisfied. Another, is a Setback input that will switch the heating system to a lower set point determined by the Set Back setting.

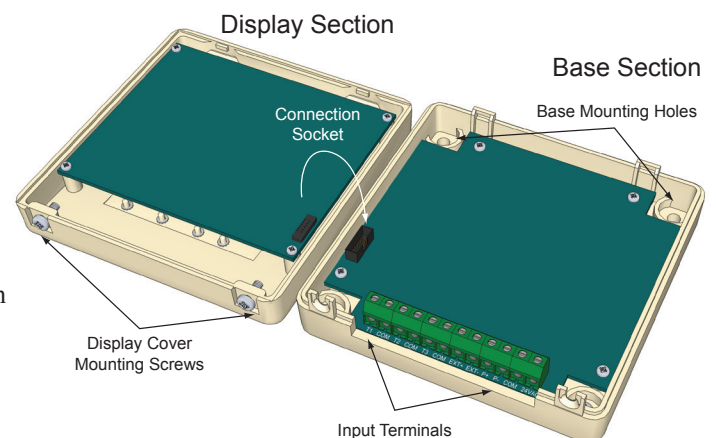
Type of Radiation in Building	Reset Ratio	Offset
Radiators (Steel & Cast Iron)	1.00 : 1.00 (S)	0°F
Baseboard (Finned copper tube & Cast Iron)	1.00 : 1.00 (S)	0°F
Radiant (High Mass/Concrete)	4.00 : 1.00 (S)	-10°F
Radiant (Low Mass/Joists)	2.00 : 1.00 (S)	-10°F
Fan Coils & Air Handlers	1.00 : 1.00 (S)	20°F

The Boiler Return water sensor and well are provided to avoid thermal shock to the boiler. If the sensor registers that the boiler return water is below the Minimum Return temperature setting, the SIM immediately lowers the Injection Pump speed to reduce the load on the boiler, allowing the return water temperature to rise.



Mounting the Controller

- The SIM is designed to mount on a 1900 (4"x4") electrical box.
- If additional room is needed for wiring use the extension skirt provided in the box.
- Place the SIM in a location near the equipment to be controlled.
- Mount the SIM indoors and away from excessive heat or cold.
- Partially unscrew the Display Cover Mounting screws. This allows for its removal.
- Lifting the Display Section away from the base will unplug it from the Base section.
- Proceed with the power and output wiring instructions.
- Use the screws provided to mount the SIM to the 1900 box or the extension skirt.
- Mount the Display Section back to the Base Section using Screws.

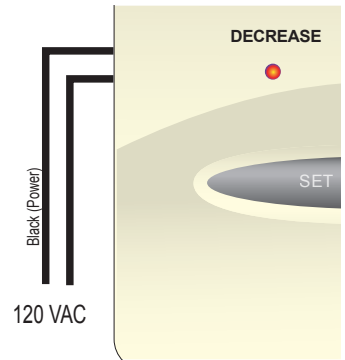


Wiring

Wiring Power Input

The SIM is designed to accept 120VAC using the two Black wires. Triangle-Tube recommends the installation of a Surge Suppressor and a Power Switch before the Power Line connection for safety and ease of service.

- Attach line voltage, 120VAC, to the two Black wires extending from the back of the SIM.



Wiring Input Terminals

System Sensor Installation (T1, COM)

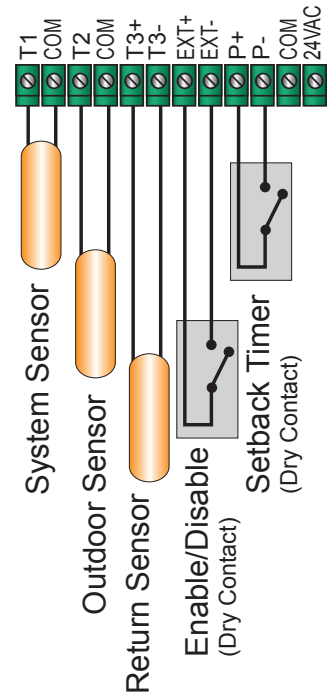
- Place the System sensor in the Secondary Loop past the pump where it will register the temperature of the loop before any takeoffs.
- Insert the Brass Tube sensor provided into a 3/8" ID 1/2" NPT immersion well or strap to the pipe and wrap with insulation.
- The sensor wires can be extended up to 500' using a shielded 2-conductor cable (Belden #8760 or equivalent (#18/2)). Connect the shield at the control COM terminal. Not at the sensor.
- Do not run sensor wires in conduit with line voltage wiring.

Boiler Return Sensor Installation (T3+, T3-)

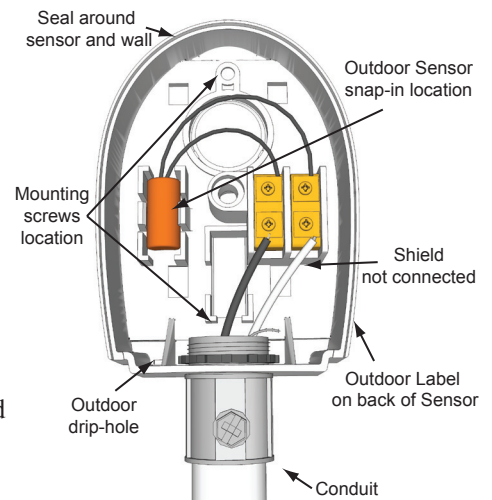
- The provided Boiler Return Sensor is designed to be installed in the provided 3/8" ID well.
- The sensor should be located where it will register the correct return from all loops to boiler.
- The sensor wires can be extended up to 500' by splicing it with shielded 2-conductor cable (Belden #8760 or equivalent (#18/2)).
- The sensor has no polarity. Connect either sensor wire to the front terminal marked T3+.
- Connect the other sensor wire and the shield to the front terminal marked T3-. Do not ground the shield at the sensor.
- Do not run sensor wires in conduit with line voltage wiring.

Outdoor Temperature Sensor Installation (T2, COM)

- The outdoor temperature sensor must be used when Outdoor Reset is selected as the Control Mode from the Startup menu. However, in Set Point mode, the outdoor temperature sensor is optional. When connected in that mode, it will be used as an input for the Outdoor Cutoff only.
- Only use the Triangle-Tube outdoor temperature sensor provided.
- Place the sensor in the shade on the north side of the building.
- Be sure the location is away from doors, windows, exhaust fans, vents, or other heat or cool sources.
- The sensor should be mounted approximately 10' feet above ground level.
- Adhere the Outdoor Label provided to the back of the sensor base.
- Use the Enclosure Base bottom knockout for the conduit. Use the conduit locknut to hold the conduit and enclosure base together. Screw the cover to the base.
- If screws are used to affix the enclosure to the wall, make sure to seal around the sensor and wall except from the bottom.
- The sensor wires can be extended up to 500' using shielded 2-conductor cable (Belden #8760 or equivalent (#18/2)).
- Cut the shield and do not connect it at the sensor end. Only connect it at the control end using the terminal marked COM.
- Do not run sensor wires in conduit with line voltage wiring.



Outdoor Sensor

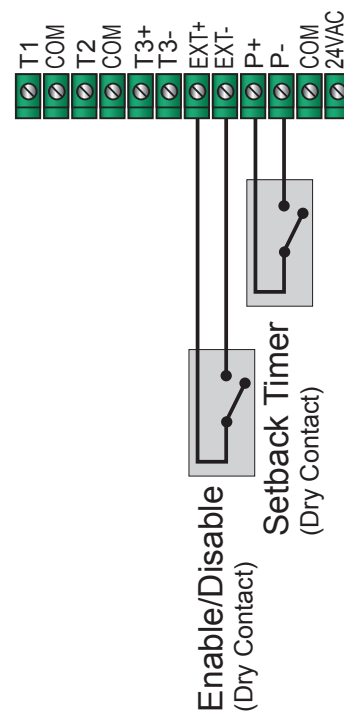


Wiring the Enable/Disable (EXT+, EXT-)

- The EXT_{\pm} terminals can be used to enable or disable the system by connecting it to a thermostat, external control, or a switch. It accepts dry contact input only. No voltage can be placed across these terminals.
- If no thermostat or control is connected to the EXT_{\pm} terminals, leave the jumper supplied connected. The SIM will not provide heat unless the EXT_{\pm} terminals are closed/shorted.

Wiring the Setback/Boost (P+, P-)

- The Setback can be used to provide a lower temperature Set Point when less heat is required.
- A typical use for Setback is to provide less system temperature during the night or on the weekends, but heat is still required.
- The Setback is activated by closing/shorting the P_{\pm} terminals using an external timer.
- The Setback can accept only dry-contact input. No voltage can be placed across these terminals.



Wiring Outputs

Wire Colors and Output Lights

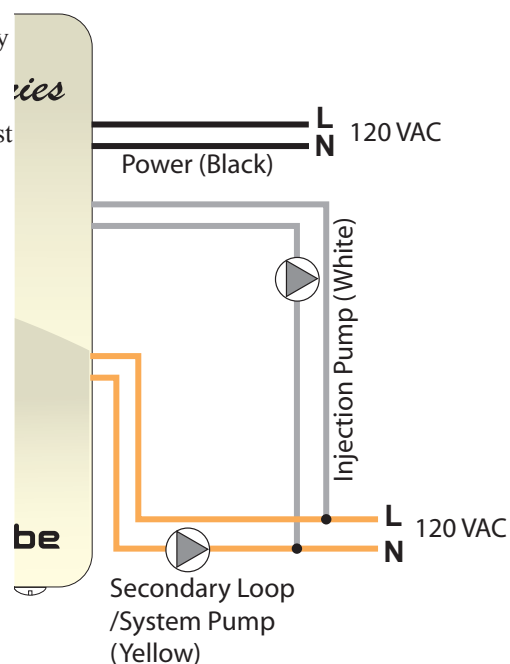
- The SIM has one N.O. S.P.S.T. (Single-pole single-throw) relay rated at 1A pilot load ($\frac{1}{8}$ HP) for System Pump operation.
- The SIM has three LED lights. The right most LED represents the System relay operation. When the relay energizes, its LED will turn on.
- The other two LEDs blink when the Injection Pump speed is increased or decreased.
- Both pump outputs are dry contacts only. They do not source any power.
- The two Yellow wires operate the System pump relay and the right LED.
- The two White wires operate the Injection Pump.

Wiring the System Pump

- The Secondary Loop/System pump is the one circulating the water in the Secondary Loop.
- The SIM will control the Secondary Loop / System Pump up to a maximum output of 1 Amp inductive or $\frac{1}{8}$ HP.
- Wire the two Yellow wires to the System Pump circuit.
- The SIM does not source any output power to the pump. The relay makes when energized to switch the power to the pump.

Wiring the Injection Pump

- The Injection Pump is the one installed on the Injection Loop between the Secondary Loop and the Boiler Loop. See "Piping Design" on page 6.
- The SIM will control the Injection Pump up to a maximum output of 1.2 Amp ($\frac{1}{8}$ HP) (i.e. B&G NRF-33, Taco 0010, Grundfos 26-64, or equivalent). The pump must be of the permanent split capacitor type.
- Connect the two White wires to the Injection Pump. They must be in series with the pump power. The signal cannot be wired through any pilot duty relay or pump starter.
- The SIM does not source any output power to the pump. A separate power source is required for pump operation. What the SIM does is change the electric signal powering the pump to achieve the desired speed needed to maintain the set point.
- After installing the Injection Pump, it is important to set the Minimum Speed Adjustment to guarantee Injection Pump flow at all levels. See "Minimum Speed Adjustment" on page 13.



Piping Design

When designing an injection system, it is important to completely isolate the Boiler Loop and the Secondary Loop to guarantee correct control and system operation. This can be achieved by following these simple rules:

- The Injection piping size must be at least one pipe size smaller than the Boiler Loop and the Secondary Loop piping.
- The distance between the Injection Loop tees on any of the other loops must not exceed 4 loop pipe diameters.
- Before the injection pipe tee, there must be a minimum of 8 pipe diameters upstream.
- After the Injection pipe tee, there must be a minimum of 4 pipe diameters downstream.
- A vertical drop of a minimum of one foot on each of the supply and return pipes of the Injection Loop will act as a thermal trap to prevent the Boiler Loop from supplying the Secondary Loop with heat when the Injection Pump is off.
- A circuit setter or globe or balancing valve can be used on the return leg of the Injection Loop to accurately balance the system.
- The Injection Pump must be of the permanent split capacitor type with a maximum ¾ HP.

⚠ WARNING

The Injection Pump and pipe size selection **MUST** be done properly by a qualified engineer or trained technician to insure proper operation and to prevent excessive or under heated zones as well as hazardous situations. The provided piping and pump sizing are general guidelines to help in general cost estimation.

Injection Pump and Pipe Size

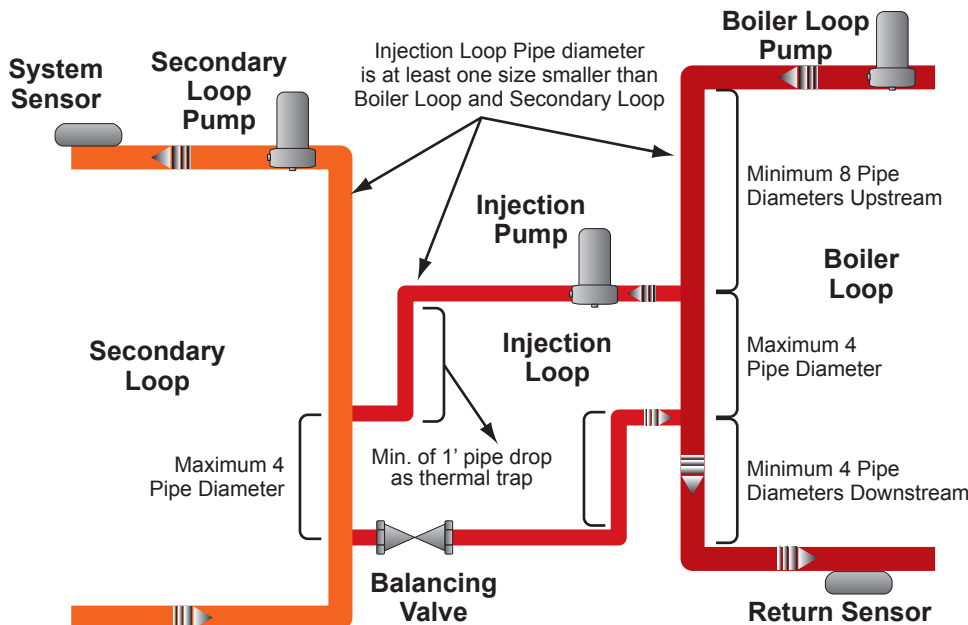
To size the system properly, start by calculating the Injection Heat Load. To select a permanent split capacitor pump, use the formula to calculate the Injection Flow Rate. Then, select a pump size, pipe size, and valve size based on the configuration provided.

- Total Injection Heat Load (Btu/Hr) for the secondary loop
- Boiler Loop Temperature (T_B)
- Secondary Loop Temperature (T_S)
- The design differential between the Secondary Loop supply and return temperatures (ΔT_S)
- Injection Flow Rate (Gal/Min)

$$\text{Injection Flow Rate} = \frac{\text{Injection Heating Load}}{500 \times (T_B - T_S + \Delta T_S)}$$

The Injection Pump, pipe size, and valve size combination can then be selected from the table.

Injection Piping Rules

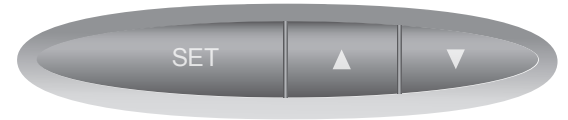


Injection Pump Selection Table

Injection Flow Rate (GPM)	Injection Loop Pipe Size (Inches)	Globe Valve/Balancing Valve/Circuit Setter Size (Inches)	Valve % Opening	Pump Size (or equivalent permanent split capacitor pump)
0 - 3.5	½"	½"	20%	Taco 007, Grundfos UP15-42, B&G NRF-22
4 - 5.5	½"	½"	100%	Taco 007, Grundfos UP15-42, B&G NRF-22
6 - 9	¾"	¾"	100%	Taco 007, Grundfos UP15-42, B&G NRF-22
10 - 14	1"	1"	100%	Taco 007, Grundfos UP15-42, B&G NRF-22
15 - 20	1 ¼"	1 ¼"	100%	Taco 007, Grundfos UP15-42, B&G NRF-22
21 - 24	1 ¼"	1 ¼"	100%	Taco 0010, Grundfos UP26-64, B&G NRF-33
25 - 30	1 ½"	1 ½"	100%	Taco 0010, Grundfos UP26-64, B&G NRF-33

The table information is based on 5 feet of injection pipe loop, 4 90° elbows, and 4 tees

v



Button and Navigating Menus

The SIM has three buttons.

- The SET button function varies. When the Default Screen is displayed, pressing the SET Button views the MENU. When in the menus and settings, the SET Button accepts the selected entry or setting value.
- When in the menus, pressing the Up and Down buttons will scroll through the menu options. They can be used to change the setting of a specific function. i.e., change the Set Point, Differential, or System Trim. In addition, when in the default screen, the Up and Down buttons will display the outdoor temperature and Outdoor Cutoff when no return sensor is available, or the outdoor temperature and the return temperature when an active return sensor is connected.
- At the end of every operation menu there is a <Back> option that allows the user to go back one menu level. If the SET Button was held down for three seconds on the <Back> option, the display will go back to the default screen.

Startup Options

When the control is initiated for the first time or after a manual reset, it will start its operation with the Startup Menu. Later, the Startup menu can be accessed as an option from the operation menu. An option must be accepted in each screen in the Startup Menu to move to the next level.

Display Unit

Options: °F, °C

Default: °F

 /<System Startup>/Display Unit

```
DISPLAY UNIT:
# F
C
```

- The SIM will offer two different temperature displays. If °F is selected, all temperatures will display in Fahrenheit. If °C is selected, all temperatures will display in Celsius.

Control Mode

Options: Outdoor Reset, Set Point

Default: Outdoor Reset

 /<System Startup>/Display Unit/Control Mode

```
CONTROL MODE:
# Outdoor Reset
Set Point
```

- The SIM has two heating logics. Outdoor Reset; varies the system set point/target based on outdoor temperature. This selection will add several menu options, Reset Ratio, Offset, Min Water temp, Max Water temp, and Outdoor Cutoff, to allow adjustment and fine tuning of the Reset Curve. In addition, a customized curve will be available for specialized applications.
- Set Point; Gives the installer the flexibility of selecting a fixed set point. The Outdoor Cutoff will be available if an outdoor temperature sensor is installed.

Sensor Fault

Options: Output On, Output Off

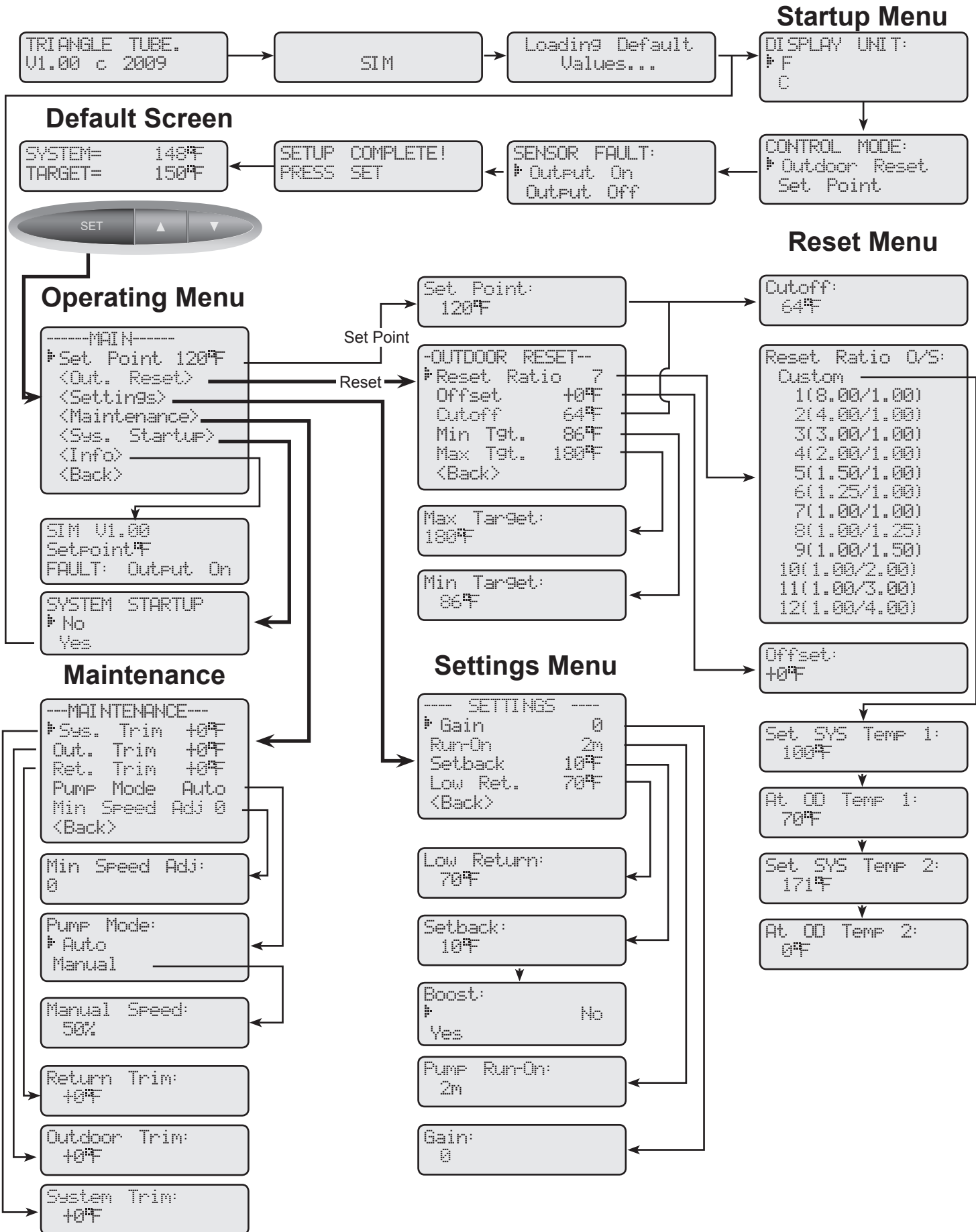
Default: Output On

 /<System Startup>/.../Sensor Fault

```
SENSOR FAULT:
# Output On
Output Off
```

- The Sensor Fault will determine the operating status of the output relays when a sensor reads Short or Open. On sensor fault the Set Point will indicate FAULT TGT=ON or OFF to indicate the condition of the output and the faulty sensor will read OPEN or SHORT to indicate the condition of the sensor.

Menus



Outdoor Reset Mode

- When Output-On is selected, the SIM will energize the system relay when system temperature **Short** or **Open** and the outdoor temperature is below Outdoor Cutoff. However, if the outdoor temperature sensor fails and the outdoor temperature reads **Short** or **Open**, the SIM will change the Target Set Point to the Max Water Temperature.
- When Output-Off is selected, the SIM will stop the Injection Pump when the system temperature reads **Short** or **Open**. The System/Secondary Loop pump will remain energized for the Run-On delay then turn off. However, when the outdoor temperature sensor fails, reads **Short** or **Open**, the SIM will change the Target Set Point to be the Minimum Target.

Set Point Mode

- Output On, the SIM will energize the System relay and increase Injection Pump speed to 100% when the system temperature reads **Short** or **Open**.
- Output-Off, the SIM will de-energize the System relay and stop the Injection Pump when the system temperature reads **Short** or **Open**.
- The outdoor temperature **Short** or **Open** status will not affect the control operation in Set Point mode.

Setting the Control to Factory Default

To Reset the SIM control to its original factory defaults, power down the control. Hold down the SET and DOWN buttons while powering the control back up until the Loading Default Values screen appears. The Display will direct you to the Startup menu after the defaults are loaded to program the control.

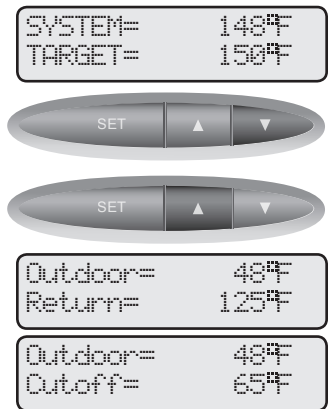


⚠ ALERT

When resetting the control to original factory defaults all control settings will be over written and will no longer exist.

Default Display

The default display will show the current Secondary Loop/System Temperature and the Target Temperature. In addition, by clicking the Up or Down button, the display will show the current Outdoor Temperature and the current Return Temperature, only if the return sensor is connected to T3± terminals. However, if no return sensor is connected, the control will display the current Outdoor Temperature and the Outdoor Cutoff on a click of the up or down buttons.



Operating Menu Options

To enter the menus, press the Set button .

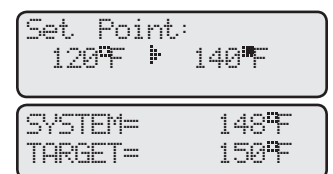
Set Point and Reset

Set Point

Options: From -10°F/-23°C to 230°F/110°C

Default: 120°F/49°C

/Set Point



(Available when Startup Control Mode = Set Point)

- The Set Point option provides the user with an adjustable fixed Target temperature to control the system. If an outdoor temperature sensor was connected, the next menu option will show Outdoor Cutoff, otherwise there will be no Outdoor Cutoff option.

Outdoor Reset

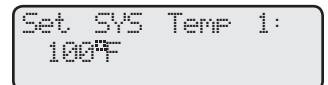
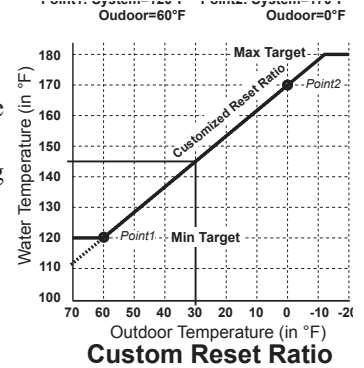
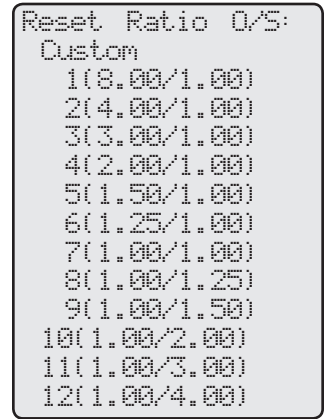
Options: From 1(8.00°/1.00°) to 12(1.00°/4.00°), Custom

Default: 7(1.00°/1.00°)

 /<Out. Reset>/Reset Ratio

(Available when Startup Control Mode = Outdoor Reset)

- The Reset Ratio determines how the Secondary Loop System temperature will vary with Outside temperature. With any of the ratios, the colder it becomes outside, the hotter the temperature of the system water. The Ratio is measured as; Outdoor : System Water temperature.
- With a 1.00 : 4.00 ratio, the System water temperature will increase rapidly as the outside temperature falls, hitting the maximum default target of 180°F at 50°F outdoor temperature. With a 4.00 : 1.00 ratio, the System water temperature will increase slowly as the outside temperature falls.
- The Reset Ratio controls the amount of heat that enters the heating system based on the outdoor temperature. A higher numbered Reset Ratio will result in a higher Calculated water temperature. If the application has radiant heat, a lower numbered Reset Ratio curve should be selected.
- If required: **Adjust the RESET RATIO in cold weather.** If the ambient building temperatures are too cold in cold weather, move the ratio to a higher selection. That is, if 1.00 : 1.00 was initially selected, change the selection to 1.00 : 1.25. If the building temperatures are too warm in cold weather, move the ratio to a lower selection. That is, if 1.00 : 1.00 was initially selected, change the selection to 1.25 : 1.00.
- The Custom option gives the user the capability of creating a specialized Reset Ratio curve. Setting two points on the Reset Ratio chart generates the customized curve. Each point requires a System Water Temperature and an outdoor temperature. The line connecting the two points will be the customized reset ratio.
- Reset Ratios are adjustable based on the building and application. See "Type of Radiation in Building" on page 3.



Custom Outdoor Reset Curve

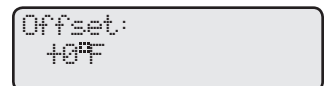
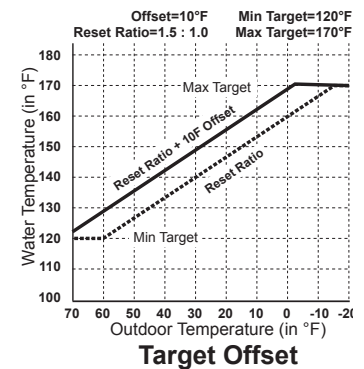
Options: Sys Temp 1, 2 (-10°F/-23°C) to (210°F/99°C) **Default:** 1(100°F/38°C), 2(171°F/77°C)

Options: Outdoor Temp 1, 2 (-10°F/-23°C) to (100°F/38°C) **Default:** 1(70°F/21°C), 2(0°F/-18°C)

 /<Out. Reset>/Reset Ratio/Custom

(Available when Startup Control Mode = Outdoor Reset)

- For situations where the provided reset ratios do not provide the perfect building heat-loss equilibrium, the customized option can be used.
- The Custom Reset Ratio is only available when Custom is selected from the Reset Ratio menu option. It provides the user with the capability of assigning two points on the reset ratio diagram and use the line that connects those two points as the customized reset ratio curve. Each of the two points will need a specific System and Outdoor temperature to identify it on the diagram.
- To Set the first point, specify Sys Temp 1, and OD Temp 1. Then, specify Sys Temp 2, and OD Temp 2, to set the second point on the curve. The two points can be any where on the line, not necessarily at the ends. As well, the slope can be in any direction.
- The chart shows an example of a customized curve 6 : 5 that do not exist in the standard curve options. If the outdoor temperature reaches 30°F, the system target will be 145°F.
- Remember that the Min Target and Max Target apply to all reset ratios including the customized reset ratio ones.



Offset

Options: From -40°F/-22°C to +40°F/+22°C

Default: 0°F/0°C

 /<Out. Reset>/Offset

(Available when Startup Control Mode = Outdoor Reset)

- The Offset setting lets you adjust the starting points of the Reset Ratio curves. This means that, regardless of the outdoor temperature or the Reset Ratio, when the Offset setting is changed, that change is directly added to or subtracted from the calculated Target. For example, if the Set Point temperature was 130°F and the Offset was changed from 0° to +10°, then the Set Point temperature would increase to 140°F.
- If required: **Adjust the Offset in mild weather.** If the ambient building temperatures are too warm in the mild weather, decrease the Offset. If the ambient building temperatures are too cold in the mild weather, increase the Offset. The rule of thumb for baseboard radiation is to change the Offset 4°F for every 1°F you wish to change the building temperatures. In radiant heat applications, change the Offset 1°F or 2°F for every 1°F you wish to change the building temperature.

Outdoor Cutoff

Options: Off, 30°F/-1°C to 75°F/24°C, On

 /Set Point/Cutoff

 /Set Point/<Out. Reset>/Cutoff

Default: 64°F/18°C
in Set Point
in Reset

Cutoff:
64°F

- In Set Point Mode, if the outdoor temperature sensor is installed (See "Outdoor Temperature Sensor Installation (T2, COM)" on page 4), the Outdoor Cutoff setting screen will automatically appear after the temperature Set Point has been selected and saved.
- The outdoor and cutoff temperatures can be viewed from the default screen by clicking the Up or Down buttons.
- When the outdoor temperature falls to the adjustable Outdoor Cutoff temperature, the SIM will control the System Pump relay and the Injection Pump output to provide heat.
- When the outdoor temperature rises to the Outdoor Cutoff plus a 2°F differential, the SIM will stop the Injection Pump. However, the System relay will remain energized for the Pump Run-On delay then turn off.
- The Outdoor Cutoff can be set from 30°F to 75°F. In addition, the Setting can be set to ON or OFF. If ON is selected, the System Relay will energize regardless of the outdoor temperature and the SIM will control the Injection Pump to hold the target temperature. If OFF is selected, the System relay and Injection Pump output will always be off.

Minimum Target

Options: From 70°F/21°C to 180°F/82°C

 /Set Point/<Out. Reset>/Min. Tgt

Default: 86°F/30°C

Min Target:
86°F

(Available when Startup Control Mode = Outdoor Reset)

- The Minimum Target Temperature must be set to the system design specification. The SIM will calculate the Target based on the outdoor temperature, the Reset Ratio, and the Offset value. The SIM will control the Injection Pump to hold either the calculated temperature or the Minimum Target Temperature whichever is higher.
- The Minimum Target Temperature must be at least 20°F lower than the Maximum Temperature (See next setting).

Maximum Target

Options: From 90°F/32°C to 240°F/116°C

 /Set Point/<Out. Reset>/Max. Tgt

Default: 180°F/82°C

Max Target:
180°F

(Available when Startup Control Mode = Outdoor Reset)

- This is the highest temperature heating water the SIM will circulate through the heating system.
- When using a radiation system, it should be set according to the tubing or floor manufacturer's specification.
- The Maximum Temperature must be at least 20°F higher than the Minimum Temperature.

Gain

Options: From -10 to +10

 /Settings>/Gain


Default: 0

Gain:
0

- The Gain adjusts the aggressiveness of the SIM PID logic. It controls the amount of change in the speed of Injection Pump when the Secondary Loop temperature differs from the Set Point. It is based on the rate of change.
A Gain of 0 is a good starting point for all systems.
- If during normal load conditions, the Secondary Loop temperature tends to oscillate significantly, decrease the Gain by two numbers (for example, from 0 to -2). Wait for at least 15 minutes before evaluating effect on the system.
- If during normal load conditions the Secondary Loop temperature tends to remain consistently below the Set Point (or consistently above the Set Point), increase the Gain by two numbers (for example, from 0 to 2). Wait for at least 15 minutes before evaluating the effect on the system.

Run-On

Options: From 0 min to 60 min

 /Settings>/Run On

Default: 2 min

Pump Run-On:
2m

- The Run-On applies only to the System relay (Secondary Loop Pump).
- The System relay will energize whenever the outdoor temperature is below the Outdoor Cutoff. When the outdoor temperature increases 2°F above the Outdoor Cutoff, the SYS relay will stay on for a period set by the System Run-On. This allows the Pump to dissipate the residual heat within the system back into the building.
- The Run-On time should be set based on the size and type of the piping and pumps.

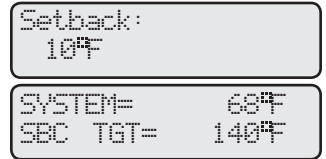
Setback

Options: From 0F°/0C° to 80F°/44C°

Default: 10F°/6C°

 /Settings>/Setback.

- The Setback feature can be used to provide the SIM with a lower temperature set point when less heat is required.
- The lower set point will appear on the main display indicating SBC TGT=.
- For example; when the calculated temperature is 160°F and the Setback is set to 20F°, a setback call will change the set point to (160°F - 20F°) 140°F.
- A typical use for Setback is to provide less system temperature to a building during the night or on the weekends when the building is not occupied, but heat is still required.
- The Setback is activated by closing/shorting the P± terminals using an external timer.




Setback Timer
(Dry Contact)

Boost

Options: Yes, No

Default: No

 /Settings>/Setback/Boost.


- The morning Boost is designed to return the building to comfortable ambient temperatures after the Setback period. The SIM will accomplish this by running elevated water temperatures (will add Setback setting to calculated water temperature) for 30 minutes after the opening of the setback terminals P±. That is, if the normal set point at a specific outdoor was 145°F and the Setback setting was 20F°, the boost will raise the system calculated temperature to 165°F for 30 minutes after the setback.



Low Return

Options: From 70°F/21°C to 180°F/77°C

Default: 70°F/21°C

 /Settings>/Low Return


(Requires Return Sensor Installation)

- Some boilers require that the return temperature not drop below a specific temperature to eliminate condensation of flue gases. In the event of low boiler return water temperatures, the Low Return setting can be used to help in a speed recovery.
- If the SIM registers that the temperature of the boiler return is below the Low Return setting, it will immediately reduce the Injection Pump speed by half and not allow the speed to increase again until the return temperature rises to the Low Return setting. This means that the SIM will decrease the load on the Boiler Loop, but will still provide some heat to the Secondary Loop.
- If the minimum return water temperature is not specified by the boiler manufacturer or if the Secondary Loop size is such that it will have little impact on the Boiler Loop temperature, the Boiler Return sensor must not be installed or set the Low return to a very low value (i.e. 70°F). Otherwise, set the Low Return to the boiler manufacturer's specification.

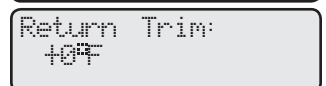
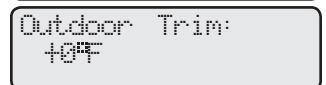
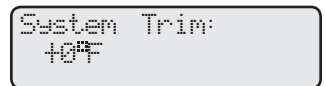
System, Outdoor, and Boiler Return Trim

Options: From -20F°/-11C° to +20F°/+11C°

Default: 0F°/0C°

 /<Maintenance>/Sys. Trm, Out. Trim, or Ret. Trim

- The Triangle-Tube temperature sensors are very accurate. However, sometime it might be beneficial to adjust the values to match an existing system. The System, Outdoor, and Boiler Return Sensor Trim values adjust the respective sensor readings using positive or negative values.
- Do not adjust the Outdoor Trim to match the TV as temperature values vary drastically between weather stations and the sensor location.



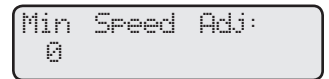
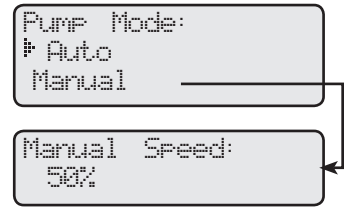
Pump Mode

Options: Auto, Manual

 /<Maintenance>/Pump Mode

Default: Auto

- For the SIM to control the Injection Pump using its PID logic, the Pump Mode must be set to Auto. This allows the SIM to modulate the pump.
- However, if the system is properly balanced based on a fixed Boiler Loop temperature and a fixed Secondary Loop temperature and a constant fixed load, then using the Manual Mode might be better suited. Also, the Manual Mode can be used to adjust and test for the Minimum Speed Adjustment allowed to guarantee flow at all pump speeds. See next setting.
- In Manual Mode, no set point or reset value will be observed. The first line of the display will show the current Secondary Loop temperature (System) and the second line will always indicate the manual speed percentage Manual 50%.
- If Manual Mode was set to 0%, the Injection Pump will not operate and the display will show Manual Off as an error.



Minimum Speed Adjustment

Options: From -5 to +5

 /<Maintenance>/Min Speed

Default: 0

- This is the slowest speed at which the SIM is allowed to run the Injection Pump. The SIM will modulate the Injection Pump starting from the Minimum Speed Adjustment and all the way to the full speed of that pump.
- To set the Minimum Speed Adjustment, first put the Pump Mode to Manual at 5%. Then, set the Minimum Speed Adjustment to the lowest value so that flow can be achieved. Then set the Pump Mode to Auto again for normal operation.
- If the Secondary Loop never reaches its target set point, it could be an indication of a low Minimum Speed Adjustment. In this case, increase the value by two and wait for at least 15 minutes before evaluating the system.



Enable/Disable (Dry Contact)

Enable/Disable Input

- The SIM will provide heat only if the EXT± terminals are shorted. If no external equipment or switch is connected to these terminals, leave the factory installed jumper.
- When the terminals are OPEN, the Target will display TSTAT OPEN.
- The Enable /Disable terminals can be used as a Summer/Winter switch when connected to an external control.



 **ALERT**

On a sensor fault while the Enable/Disable terminals are open, the control will follow the Enable /Disable state regardless of the sensor fault condition.

Troubleshooting

No Display or LED Lights

Check the power to the SIM. The SIM requires 120VAC power to the Black wires. Turn the power off and back on to restore the display. If unsuccessful, make sure the Display Cover of the control is securely mounted to the Base.

System or Outdoor Reads OPEN or SHORT

If Open, short the sensor input terminals. The display should read **SHORT**. If it doesn't, the SIM may be damaged.

If Short, remove the wires from the input terminals. The display should read **OPEN**. If it doesn't, the SIM may be damaged.

System or Outdoor Reads an Incorrect Temperature

Remove the wires from the input terminals. The display should change to read **OPEN**. If it doesn't, the SIM may be damaged.

Take an ohm reading across the detached sensor wires. The ohm reading should correspond to the Temperature Sensor Chart. If the difference is within 5°F adjust the Trim for the sensor. Otherwise, the sensor may be damaged.

No Heat - All LEDs are OFF

Check the outdoor temperature and Outdoor Cutoff readings. If the outdoor temperature is above the Outdoor Cutoff, the SIM will not give heat. If the display shows **TSTAT OPEN** then, check the **EXT±** terminals. If the **EXT±** terminals are not jumped together, the SIM will not give heat. Finally, if the display shows **MANUAL OFF** then, the Pump Mode has been set to Manual with a speed of 0%. Change Pump Mode to **AUTO**. See "Pump Mode" on page 13.

No Heat - System Pump LED ON - Pump Not Running

Remove any connections to the Yellow wires for the Heating System Pump. Test for continuity across the pair of Yellow wires. If the wires are continuous, the SIM is calling for the Secondary Loop/System Pump to run and the problem is not with the SIM. Check the power source and the pump to determine why it is not circulating.

No Heat - System Pump LED ON - Pump Running

Check that the boiler (or other hot water source) is providing hot water to the Boiler Loop and no valve obstruction between the Boiler Loop and the Injection Loop. Check that the Injection Pump is running by measuring the pipe temperatures on the Injection Loop and the Secondary Loop. Check the Minimum Speed Adjustment. If the Minimum Speed Adjustment is set too low, the pump motor might not have the torque to maintain its operation. See "Minimum Speed Adjustment" on page 13.

Too Little Heat

First check that the outdoor temperature sensor reads a temperature not Short or Open. If it does and Sensor Fault has been set to Output Off, the SIM will try to maintain the Minimum Target temperature. Follow the System or Outdoor Reads Open or Short section. Repair or replace the faulty sensor. Otherwise, if all sensor readings are accurate, check if the Target temperature is the same as the Maximum Target. If so, check the Maximum Target has not been set too low for the system (DO NOT increase the Maximum Target without consulting the installer or tubing/flooring manufacturer). Finally, adjust the Reset Ratio or Offset to increase the temperature of the circulating hot water. Note that, depending on the type of radiation, it may take several hours before the ambient temperature increases.

Too Much Heat

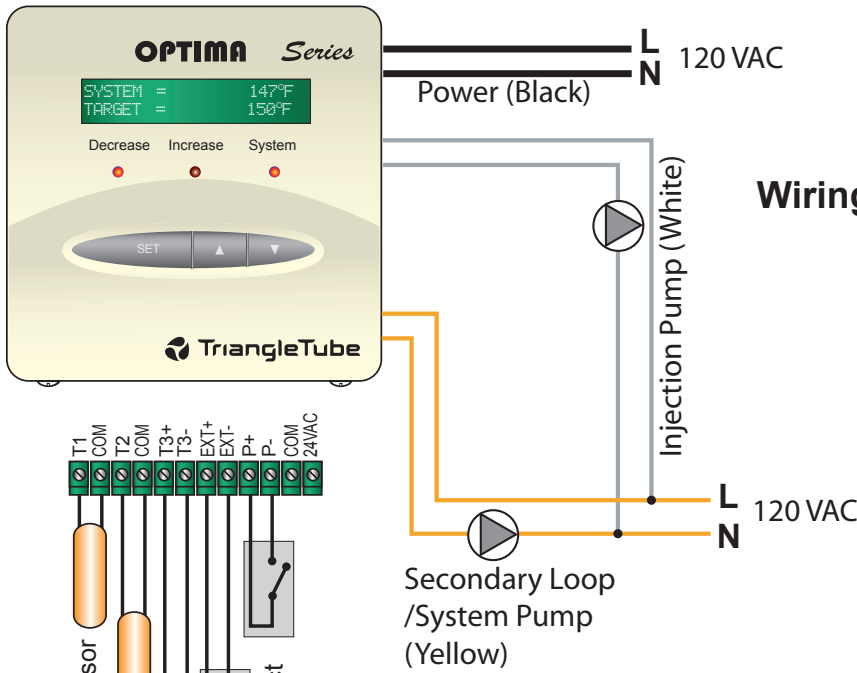
Check if the Outdoor or System temperature is not reading **Short** or **Open**. Follow the System or Outdoor Reads Open or Short section. If Sensor Fault was set to **Output ON**, the SIM will provide excess heat to the building injection zone. Repair or replace the faulty sensor. Otherwise, if all sensor readings are accurate, adjust the Reset Ratio or Offset to decrease the temperature of the circulating hot water.

250°F/120°C Temperature Sensor Chart

TEMPERATURE		Value (in Ohms)
°F	°C	
OPEN		150000
-30	-34	117720
-20	-29	82823
-10	-23	59076
0	-18	42683
10	-12	31215
20	-7	23089
25	-4	19939
30	-1	17264
35	2	14985
40	4	13040
45	7	11374
50	10	9944
55	13	8714
60	16	7653
70	21	5941
80	27	4649
90	32	3667

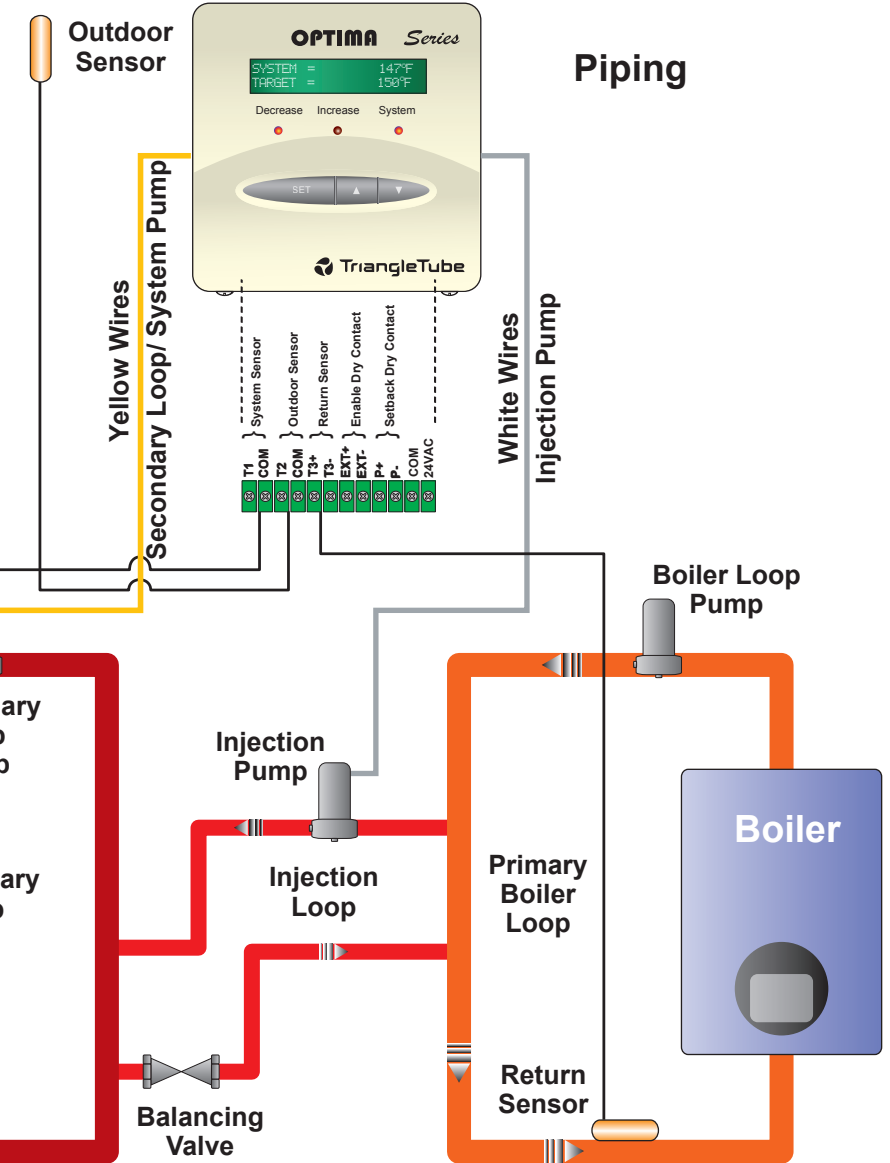
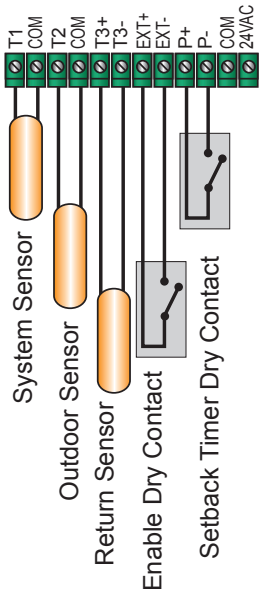
TEMPERATURE		Value (in Ohms)
°F	°C	
100	38	2914
110	43	2332
120	49	1879
130	54	1524
140	60	1243
150	66	1021
160	71	842
170	77	699
180	82	583
190	88	489
200	93	412
210	99	349
220	104	297
230	110	253
240	116	217
250	121	187
SHORT		100

SIM Piping and Wiring Diagrams



Wiring

NOTE: The diagrams are conceptual only. Triangle-Tube is aware that each installation is unique, however, the diagrams in this document are to represent control operation concept. It is the installer responsibility to comply with local codes and to install safety controls.



Piping

Specifications

Voltage Input:	120 VAC 60 Hz(2 Black wires)
Power Consumption:	5 VA Max
Operating Temperature:	20°F/-7°C to 120°F/49°C
Operating Humidity:	20% to 80%
Dimensions:	4"W x 4"H x 2½"
Weight:	1 pound
Display:	Back Lite (2 rows x 16 char. each) Alphanumeric
Display Units:	Fahrenheit (°F) and Celsius (°C)
Outputs:	Yellow wires = System Pump
Output Relay Ratings:	1 Amp inductive (Maximum of ⅛ HP), 6Amp resistive at 120 VAC 60 Hz
Pump Run-On:	0 to 60 minutes
Injection Output Ratings:	1.5A inductive (Maximum 1/8HP) at 120VAC 50-60Hz
Injection Pump Speed:	+0% to 100%
Control Modes:	Outdoor Reset, Set Point
Reset Ratios:	12 Standard ranging 8:1 to 1:4 (Outdoor: System), and one Custom
Offset:	-40°F/-22°C to 40°F/+22°C
Minimum Target:	70°F/21°C to 180°F/82°C
Maximum Target:	90°F/32°C to 240°F/116°C
Set Point:	-10°F/-23°C to 230°F/110°C
Minimum Boiler Return:	70°F/21°C to 180°F/77°C
Setback:	0°F/0°C to 80°F/44°C
Boost:	Yes (30Min), No
Sensor Fault Operating Options:	Output On or Output Off
Sensor Operating Range:	-35°F/-37°C to 250°F/121°C
LED:	1 represents the System Output Relay (2 represent the Injection Pump increase and decrease speed)
Buttons:	3 (Set, Up, Down)
Enable/Disable:	Terminals EXT+, EXT-
Setback Input:	Terminals P+, P-