



Instruction Sheet

102-431

FuelMizer™ SR501-OR-4 Switching Relay with Outdoor Reset

SUPERSEDES: June 1, 2012

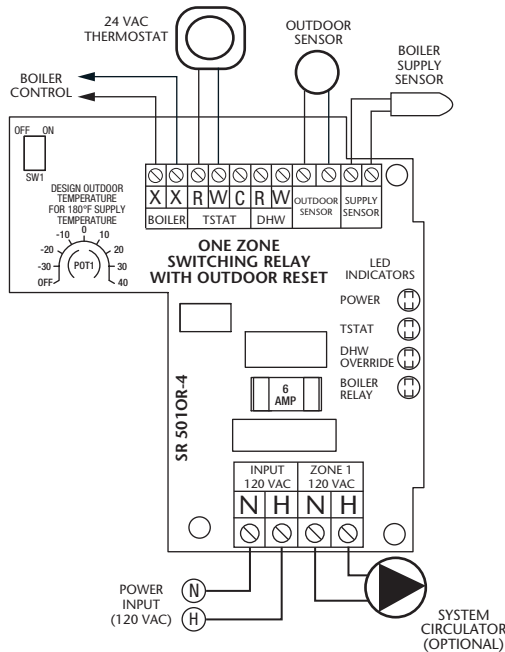
EFFECTIVE: June 15, 2012

Plant ID# 9300-2871

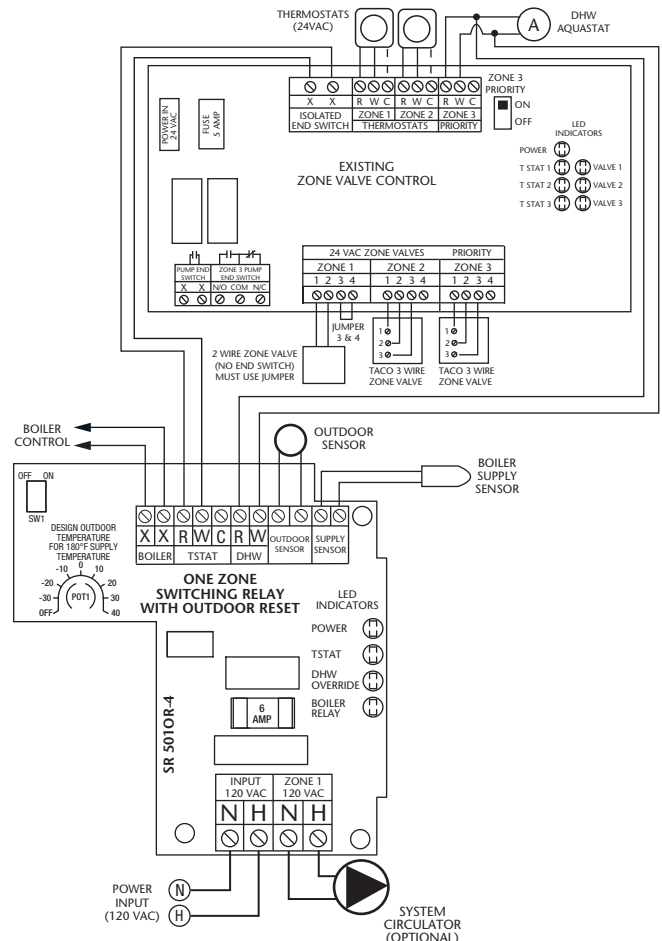
APPLICATION:

The SR501-OR is a microprocessor-based control designed to regulate the supply water temperature of a single boiler, based on the outdoor temperature. The SR501-OR is a boiler reset control and switching relay in one unit. The SR501-OR is ideal for retrofit application, but may also be used in new installations as well.

The SR501-OR includes functions such as automatic reset ratio calculation, warm weather shut down (WWSD), minimum boiler temperature setting, and boiler differential setting. The control also has boiler sensor and outdoor sensor error checking.



ONE ZONE INSTALLATION W/O INDIRECT DHW



MULTI-ZONE INSTALLATION WITH ZONE CONTROL, WITH INDIRECT DHW

CONTROL STRATEGY:

Outdoor Reset:

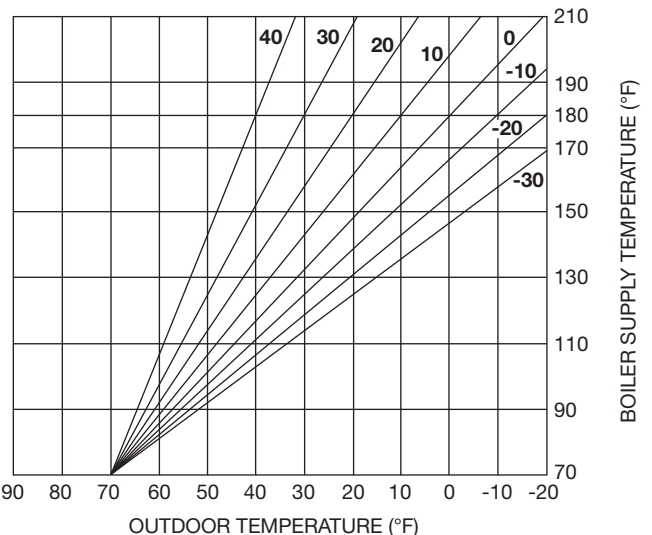
In order to properly control a hot water heating system, the heat supplied to the building must equal the heat lost by the building.

- The heat supplied to a building is proportional to the temperature of the supply 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 well as other factors. As the outdoor temperature drops, the building heat loss increases.

Reset Ratio:

Operation of a hot water heating system can generally be improved by modulating the supply water temperature as the outdoor temperature changes. Using this approach, the heat lost from the building is matched by the heat input to the building. The SR501-OR boiler reset control utilizes a reset ratio to set the relationship between outdoor temperature and supply water temperature. The reset ratio determines the amount the supply water temperature is raised for every 1° drop in outdoor air temperature, and it is determined from the starting point and the system design conditions. In order for the control to automatically determine the reset ratio, outdoor design conditions must be established. This is usually the typical coldest outdoor temperature or it can be set by using ASHARE standards for Design Outdoor Temperature for specific geographic locations.

BOILER SUPPLY TEMPERATURE vs. OUTDOOR TEMPERATURE (°F) FOR OUTDOOR DESIGN TEMPERATURES



Boiler Operation:

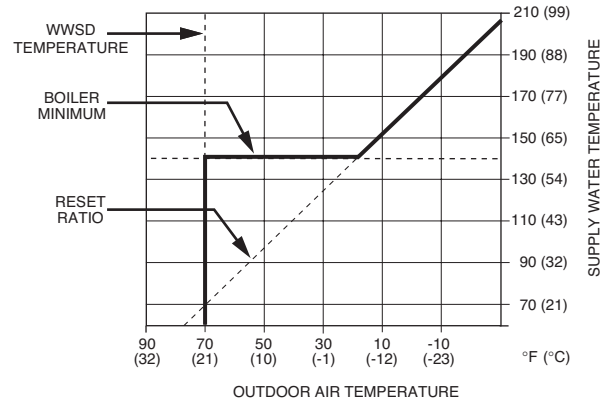
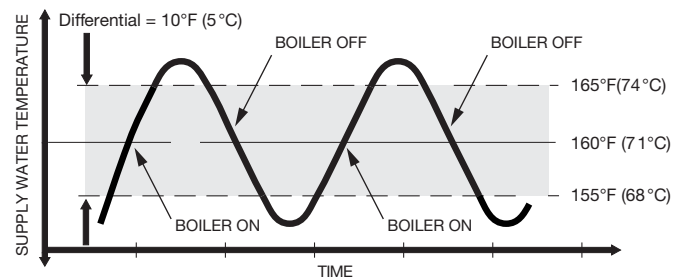
The supply water temperature from a boiler can be controlled by cycling the boiler on and off. Modulation of the boiler's operating temperature in hot water heating systems not only provides more comfort but also offers significant energy savings. The cooler the boiler runs, the more efficient it is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

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. This control can be set for two different boiler differentials, 10°F (6°C) or 20°F (12°C). This setting will help to achieve an appropriate balance between temperature swings and boiler efficiency.

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.



SEQUENCE OF OPERATION:

Powering Up the Control:

After the SR501-OR is powered up, the green power LED light will be on.

Heating Demand:

The SR501-OR receives a heating demand from thermostat or zone control end switch closure on the R and W thermostat terminals. The thermostat red LED light will also be turned on. The control can be setup for boiler temperature reset or ON – OFF boiler operation.

Reset Demand:

When the SR501-OR receives a heating demand the controls enable the boiler based on the reset curve. The Boiler Relay red LED light will be turned on when the boiler relay is energized.

DHW Demand:

When the SR501-OR receives a DHW demand the controls enable the boiler and ignore the boiler reset curve. The DHW Override red LED light will also be turned on.

Warm Weather Shut Down (WWSO):

When the outdoor temperature rises above 70°F (21°C), the control turns off the boiler. This function only applies for space heating and not DHW operation.

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 part of the control circuit.

Step One:

Check the contents of this package. If any of the contents listed are missing or damaged, please contact your sales representative for assistance. The SR501-OR includes:

SR501-OR Boiler Reset Control and Switching Relay Combination
One Outdoor Sensor
One Strap on Sensor
Instruction Sheet

Replacement sensors are available from Taco, Inc.:

Strap on Sensor – 9300-2044RP
Outdoor Sensor – 9300-2052RP

Boiler Operation:

When the SR501-OR has a reset demand, the system supply water temperature is controlled by turning the boiler on and off. The control calculates the target supply water temperature based on the outdoor temperature, and the settings that were entered. The boiler operates around a differential that is manually set by dip switch number 2. The control includes a minimum on and off time for the boiler, in order to minimize short cycling.

Maximum Boiler Supply:

The SR501-OR does not allow the boiler target temperature to exceed the boiler design temperature setting plus 10°F (6°C) up to a maximum of 225°F (107°C).

Minimum Boiler Supply:

The SR501-OR has a 140°F minimum boiler setting which is used in order to prevent corrosion from flue gas condensation. During mild outdoor conditions, the boiler cycles around the minimum boiler setting. This programmed function can be set to the OFF setting for condensing and electric boilers.

Note: Carefully read the details of the Sequence of Operation section in this brochure to ensure that you have chosen the proper control for your application.

Step Two:

Installing the Control:

The enclosure is to be mounted flush onto a wall or any ridge surface.

- The mounting holes in the enclosure accept #6 screws.
- Line voltage to enter from bottom of control and low voltage to enter from top of control.

Installing the Outdoor Sensor:

Note: The temperature sensor (thermistor) is built into the enclosure.

- Use one round or pan head screw to attach the base of the sensor to the wall.
- The sensor is wall mounted and the wiring enters through the bottom of the enclosure. The hole for the cable entry must face downward in order to prevent water from entering and filling the enclosure.

- The sensor should be mounted on a wall which best represents the heat load on the building (i.e. a northern wall for most buildings and a southern facing wall for buildings with large south facing glass areas). The sensor should not be installed near heat sources such as ventilation or window openings.
- The sensor should be installed at an elevation above the ground that will prevent accidental damage or tampering.
- Install the Outdoor Sensor and run the wiring back to the control mounting location.

Installing the Boiler Sensor:

Note: This sensor is designed to mount on a pipe or in a temperature immersion well.

- The sensor can be strapped directly to the pipe using the cable tie provided. Insulation should be placed around the sensor to reduce the effect of air currents on the sensor measurement.
- The Boiler Sensor should be placed downstream of a pump or after an elbow or similar fitting. This is especially important if large diameter pipes are used because the thermal stratification within the pipe can result in erroneous sensor readings. Proper sensor location requires that the fluid is thoroughly mixed within the pipe before it reaches the sensor.

Step Three:

Wiring to the Zone Control:

Line Voltage Connections –

Connect 120VAC incoming line voltage; Hot to the H terminal and Neutral to the N terminal.

Connect 120VAC circulator; HOT lead of circulator to Zone H terminal and Neutral lead of circulator to Zone N terminal.

Low Voltage Connections –

Connect thermostat or zone control end switch to the R and W thermostat terminals.

Connect the DHW aquastat to the R and W DHW override terminals (optional).

Connect boiler's T and T terminal to the X and X boiler end switch terminals.

Wiring the Sensors:

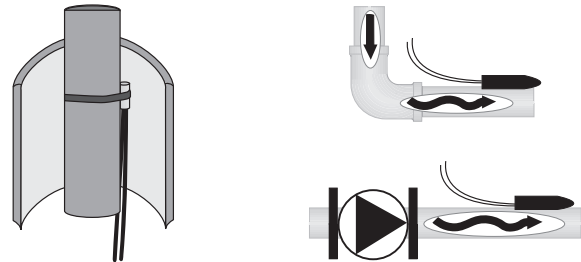
Do not apply power to these terminals as this will damage the control.

Outdoor Sensor

Connect the two wires from the Outdoor Sensor to the Outdoor Sensor terminals. The Outdoor Sensor measures the outdoor air temperature.

Boiler Sensor

Connect the two wires from the Boiler Sensor to the Supply Sensor terminals and insulate. The Boiler Sensor measures the supply water temperature going from the boiler to the system.



SETTINGS:

Before adjusting the settings, read through the sequence of operation to ensure that you understand how the control operates. The following page describes how to program these settings into the control once it has been powered up.

Step Four:

Outdoor Design Temperature:

The Outdoor Design setting is the outdoor temperature used in the heat loss calculation. It is set to the typical coldest outdoor temperature. Using a small screwdriver adjust the rest ratio knob to appropriate Outdoor Design Temperature. When set to OFF, the boiler temperature will not be reset and boiler will fire to high limit when there is a call for heat.

Boiler Minimum Supply Temperature (Dip Switch #1):

Most boilers require a minimum operating temperature to prevent corrosion from flue gas condensation. The minimum boiler dip switch should be set to ON (140°F) supply water temperature so boiler can operate without causing the boiler flue gases to condense. Consult the boiler manufacturer for recommended minimum boiler supply

temperatures. The dip switch can also be set to OFF (70°F) when condensation is not a concern.

Differential (Dip Switch #2):

The differential adjustment sets how far the actual boiler supply water temperature may deviate from the desired temperature before the boiler is turned on or off. This is a function of the water content of the boiler and the flow rate through the system pump relative to the heat output of the boiler. The differential can be set by dip switch #2, set to OFF for 10°F (6°C) or set to ON for 20°F (12°C).

Pump Operation (Dip Switch #3):

The pump operation is controlled by dip switch #3. When the dip switch is set to ON, the pump output will energize when thermostat or DHW calls for heat. When set to OFF, the pump will only come on when the thermostat calls for heat not the DHW.

Warm Weather Shut Down:

When the outdoor temperature rises above the 70°F (21°C), the control turns off the boiler. This function only applies for space heating and not DHW operation.

TROUBLESHOOTING:

Step Five:

As in any troubleshooting procedure, it is important to isolate a problem as much as possible before proceeding. The blinking error LED light greatly simplifies troubleshooting of the SR501-OR. If you suspect a wiring fault, return to step three and carefully check all external wiring and wiring connections.

Sensor Errors:

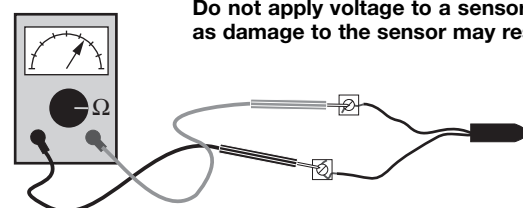
- If an outdoor sensor fault occurs, the SR501-OR will assume a fixed outdoor temperature of 32°F (0°C) and will target the appropriate supply water temperature. The Boiler light will blink twice every 5 seconds to indicate the outdoor sensor error.
- If a boiler sensor fault occurs, the SR501-OR turns the boiler off and the Boiler light will blink once every 5 seconds to indicate the boiler supply sensor error.

Adjustment of Settings:

- If the outdoor temperature is cold and the rooms are cold, increase the Outdoor Design setting by 5°F (3°C) per day.
- If the boiler is cycling too often, increase the Differential setting.

Testing the Sensors:

A good quality test meter capable of measuring up to 5,000 kΩ (1 k = 1000 Ω) is required to measure the sensor resistance. In addition to this, the actual temperature must be measured with either a good quality digital thermometer, or, if a thermometer is not available, a sec-



Do not apply voltage to a sensor at any time as damage to the sensor may result.

ond sensor can be placed alongside the one to be tested and the readings compared. First measure the temperature using the thermometer and then measure the resistance of the sensor at the control. The wires from the sensor must not be connected to the control while the test is performed. Using the chart below, estimate the temperature measured by the sensor. The sensor and thermometer readings should be close. If the test meter reads a very high resistance, there may be a broken

wire, a poor wiring connection or a defective sensor. If the resistance is very low, the wiring may be shorted, there may be moisture in the sensor or the sensor may be defective. To test for a defective sensor, measure the resistance directly at the sensor location.

| TEMPERATURE | | RESISTANCE |
|-------------|-----|------------|
| °F | °C | Ω |
| -30 | -34 | 234,196 |
| -20 | -29 | 165,180 |
| -10 | -23 | 118,018 |
| 0 | -18 | 85,362 |
| 10 | -12 | 62,465 |
| 20 | -7 | 46,218 |

| TEMPERATURE | | RESISTANCE |
|-------------|----|------------|
| °F | °C | Ω |
| 30 | -1 | 34,558 |
| 40 | 4 | 26,099 |
| 50 | 10 | 19,900 |
| 60 | 16 | 15,311 |
| 70 | 21 | 11,883 |
| 80 | 27 | 9,299 |

| TEMPERATURE | | RESISTANCE |
|-------------|----|------------|
| °F | °C | Ω |
| 90 | 32 | 7,334 |
| 100 | 38 | 5,828 |
| 110 | 43 | 4,665 |
| 120 | 49 | 3,760 |
| 130 | 54 | 3,050 |
| 140 | 60 | 2,490 |

| TEMPERATURE | | RESISTANCE |
|-------------|----|------------|
| °F | °C | Ω |
| 150 | 66 | 2,045 |
| 160 | 71 | 1,689 |
| 170 | 77 | 1,403 |
| 180 | 82 | 1,172 |
| 190 | 88 | 983 |
| 200 | 93 | 829 |

TECHNICAL DATA:

SR501-OR Boiler Reset Control Relay:

Control: Microprocessor PI control. **This is not a safety (limit) control.**
 Enclosure: TYPE 1
 Dimensions: 4¹/₄" W x 5¹/₄" H x 2³/₄" D
 Approvals: UL listed for US and Canada, Temperature Indicating and Regulating Equipment.
 Power Supply: 120/60/1 VAC, 12 amps maximum

Relays: Boiler Relay 1 amp @ 24 VAC
 Circulator Relay 1/3 HP (6 FLA, 36 LRA)
 Thermostat: 24 VAC Class 2 Output
 Sensors: NTC thermistor, 10 kΩ @ 77°F (25°C ±0.2°C) β=3892
 Outdoor Design Temp.: -30°F to 40°F (-35°C to 5°C)
 Boiler Minimum: 70°F or 140°F (21°C or 60°C)
 Differential: 10°F or 20°F (6°C or 12°C)
 WWSD: 70°F (21°C)

The installer must ensure that this control and its wiring are isolated and/or shielded from strong sources of electromagnetic noise. This device complies with part 15 of the FCC Rules. Operation is subject to

the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

WARNING: Wiring connections must be made in accordance with all applicable electrical codes. Use copper wire only. 120 VAC wiring must have a minimum temperature rating of 75°C. Failure to follow this instruction can result in personal injury or death and/or property damage. 12-18 gauge wire recommended for 120 VAC connections, 14-22 gauge wire for thermostat connections, and 14-22 gauge wire for 24 VAC source connections.

LIMITED WARRANTY STATEMENT

Taco, Inc. will repair or replace without charge (at the company's option) any product or part which is proven defective under normal use within three (3) years from the date of start-up or three (3) years and six (6) months from date of shipment (whichever occurs first).

In order to obtain service under this warranty, it is the responsibility of the purchaser to promptly notify the local Taco stocking distributor or Taco in writing and promptly deliver the subject product or part, delivery prepaid, to the stocking distributor. For assistance on warranty returns, the purchaser may either contact the local Taco stocking distributor or Taco. If the subject product or part contains no defect as covered in this warranty, the purchaser will be billed for parts and labor charges in effect at time of factory examination and repair.

Any Taco product or part not installed or operated in conformity with Taco instructions or which

has been subject to misuse, misapplication, the addition of petroleum-based fluids or certain chemical additives to the systems, or other abuse, will not be covered by this warranty.

If in doubt as to whether a particular substance is suitable for use with a Taco product or part, or for any application restrictions, consult the applicable Taco instruction sheets or contact Taco at [401-942-8000].

Taco reserves the right to provide replacement products and parts which are substantially similar in design and functionally equivalent to the defective product or part. Taco reserves the right to make changes in details of design, construction, or arrangement of materials of its products without notification.

TACO OFFERS THIS WARRANTY IN LIEU OF ALL OTHER EXPRESS WARRANTIES. ANY WARRANTY IMPLIED BY LAW INCLUDING WARRANTIES OF MERCHANTABILITY OR FIT-

NESS IS IN EFFECT ONLY FOR THE DURATION OF THE EXPRESS WARRANTY SET FORTH IN THE FIRST PARAGRAPH ABOVE.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR STATUTORY, OR ANY OTHER WARRANTY OBLIGATION ON THE PART OF TACO.

TACO WILL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF ITS PRODUCTS OR ANY INCIDENTAL COSTS OF REMOVING OR REPLACING DEFECTIVE PRODUCTS.

This warranty gives the purchaser specific rights, and the purchaser may have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts or on the exclusion of incidental or consequential damages, so these limitations or exclusions may not apply to you.

Do it Once. Do it Right.®

TACO, INC., 1160 Cranston Street, Cranston, RI 02920 Telephone: (401) 942-8000 FAX: (401) 942-2360.
TACO (Canada), Ltd., 8450 Lawson Road, Unit #3, Milton, Ontario L9T 0J8. Telephone: 905/564-9422. FAX: 905/564-9436.
 Visit our web site at: <http://www.taco-hvac.com>

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