



RS121-1SHL, RS121-1SHL-2HL/SK, RS504 PHL, SA, ST, SP, SPR Differential Thermostats, Powered Anodes and Sensors

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The image displays several components: a printed circuit board labeled RS121 with various electronic components; a cylindrical metal part labeled POWERED ANODE; a rectangular control box labeled RS 504 DIFFERENTIAL THERMOSTAT with a UL logo and technical specifications; and four different sensor types labeled SP, SPR, ST, and SA, which are small metal probes with electrical leads.

RS121 Single and Dual Outputs

- UL Listed
- Linearity Circuitry for Inputs
- ON/OFF Differential Temperature Control
- High Temperature Control to prevent overheating storage tank (field-adjustable)
- Low Temperature Detection Circuit for recirculation freeze-protection (field-option)
- Low Temperature Detection Circuit for drain-down freeze-protection (field-option in RS121-1SHL - 2HL/SK)
- Signal Switching of Room Thermostat for 1st stage solar heating and second stage fossil fuel heating (field-option in RS121-1SHL-2HL/SK)
- Relay outputs (1/8 hp, or 6 amps resistive)
- Optional powered anode and driver circuit
- Optional remote digital readouts of temperature signals

RS504PHL Single Output Control

- UL Listed
- Linearity Circuitry for Inputs
- Proportional Pump Control varies the pump speed, while maintaining full torque, as the solar intensity changes
- High Temperature Control to prevent overheating the storage tank
- Low Temperature Detection Circuit for recirculation freeze-protection
- Solid State Output
- Efficient pump operation free of radio frequency interference
- Proportional controls should not be used in systems with high static head such as drain-back systems
- Optional powered anode and driver circuit
- Optional remote digital readouts of temperature signals

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SPECIFICATIONS COMMON TO THE RS121 AND THE RS504

Dimensions: 7.5" x 4.1" x 2.0"

Power Input: 120VAC 10%, 50/60Hz, 2 watts plus load

Weight: 2 lbs.

Mounting: #8 screws through the base of the control allows easy mounting to flat surfaces, or L-bracket provided with each control plus conduit allows easy mounting to Grundfos' stainless steel pumps.

Ambient Temperature: The control will operate within specifications from 0°C to 70°C (158°F).

Humidity: The control will operate within specifications in non-condensing humidity levels up to 95% relative humidity.

Linearity: As defined in adjacent section

RS504PHL ELECTRONIC SPECIFICATIONS

Output: 1/10 hp, or 3.5 amps resistive

P: Proportional Control starts the pump at low speed when the $\Delta T = 3.5^\circ\text{F} \pm 1^\circ\text{F}$

P: Proportional Control increases the pump speed to full when the collector sensor is 12°F higher than the storage sensor ($\Delta T > 12^\circ\text{F}$).

H: High Temperature Limit overrides the Proportional circuitry and will shut off the pump when the storage sensor reaches 160°F . The High Temperature Limit has no effect when the storage sensor is below 155°F .

L: Low Temperature Detection circuitry overrides both the Proportional and High Temperature control circuitry and activates the pump when the temperature of the collector sensor falls below $40^\circ\text{F} \pm 2^\circ\text{F}$. The Low Temperature circuitry returns control to the Proportional and High Limit circuitry when the collector sensor rises above $45^\circ\text{F} \pm 2^\circ\text{F}$.

UL LISTED with the following pumps: TACO: 007, 008 / MARCH: 809, 809HS / GRUNDFOS: UM25-18SU, UPS20-42FA, UP25-42SF, UP26-64F, UP25-64F

RS-121-1SHL ELECTRONIC SPECIFICATIONS

1 Output: 1/8 hp at 120VAC; or 6 amps resistive at 120VAC
(Note: Output is pre-wired to 120VAC)

S: Standard Differential Control turns on the pump when the collector sensor is at least $20^\circ\text{F} (\pm 2^\circ\text{F})$ hotter than the storage sensor. The S-function turns off the pump when the collector sensor is less than 3.5°F hotter than the storage sensor.

$\Delta T_{\text{on}} \geq 20^\circ\text{F} (\pm 2^\circ\text{F}); \Delta T_{\text{off}} \leq 3.5^\circ\text{F} (+ 1^\circ\text{F}, - 0.5^\circ\text{F})$

H: High Temperature Limit overrides the S-function and shuts off the pump when the storage sensor exceeds the High Limit. This limit is field-adjustable from 120°F to 250°F (= off). When the storage sensor falls 5°F below the High Limit setting, then control of the pump is determined by the S-function.

L: Low Temperature Detection Circuit overrides both the S and H functions, and turns on the pump when the collector sensor drops to $40^\circ\text{F} (\pm 2^\circ\text{F})$. When the collector sensor rises above $45^\circ\text{F} (\pm 2^\circ\text{F})$, then control of the pump is determined by the S and H function. This recirculation freeze protection is an option which can be disabled by simply removing a jumper in the field.

RS121-1SHL-2HL/SK ELECTRONIC SPECIFICATIONS

2 Outputs: 1/8 hp each, or 6 amps resistive each output.

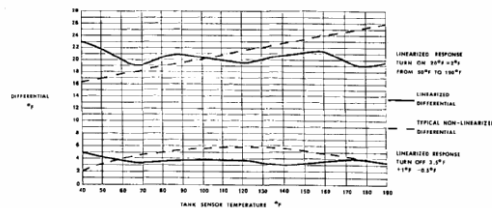
The -1SHL control functions available through the first output are identical to the single output RS121 except that pump operation is inhibited when the collector sensor reaches the 40°F Low Limit. This assures that the pump will not turn on when the drain valves have dumped the collector fluid.

The -2HL/SK control functions available through the second output can be selected in the field. The two options permit use of the second output to drain the collectors or to provide staging for solar space heating. In the **Drain-Down Configuration**, the NO/NC contacts of the second output of the RS121 may be wired to solenoid valves to drain the collectors when the collector sensor falls to the 40°F Low Limit, or when the storage sensor reaches the field adjustable High Limit. The High Limit may be set to 250°F to effectively eliminate the High Limit. Unlike the first output, the second output is not pre-wired to power. So 24VAC or 120VAC solenoid valves may be controlled by the contact closure of the second output.

In the **Space Heating Configuration**, the second output is connected in series with the room thermostat. The second output then sends the "call for heat" from the room thermostat to either the solar system or the back-up fossil fuel heater. The change-over from the solar system to the back-up heater occurs by de-energizing the second relay when the solar storage sensor falls below 105°F . When the storage sensor rises above 110°F , then the second relay is energized and will send a "call for heat" to the pump between the solar storage and the fan coil.

LINEARITY

The Electronic Linearization Circuit within the RS121 and RS504 compensates for the inherent thermister non-linearity which causes the turn-on and turn-off differentials of most solar controls to wander out of specification as the temperature of the storage tanks changes. In the RS121 and RS504, the ΔT_{on} and ΔT_{off} specifications are held constant by the linearity circuitry. This permits collection of more solar energy by lowering the turn-off differential to 3.5°F and holding it there over the operating range of typical solar water heaters. Note the comparison between the linearized RS121 and a typical competitive solar control.



POWERED ANODES CHARGED BY RHO SIGMA INNOVATION

Powered anodes inhibit corrosion of glass-lined water heaters where the lining has failed to cover the inner wall of the water heater. Use of powered anodes is common in commercial water heaters. Since it has been inconvenient to power the anodes in residential water heaters, this technology has not been available to home owners. Rho Sigma Innovation now conveniently powers anodes for extended corrosion protection of glass-lined water heaters.

Nationally, residential water heaters must be replaced every eleven years. Regionally, replacement may be necessary every three years. This has a powerful effect on the economics of solar energy installations. Corrosion in residential water heaters is presently inhibited by sacrificial anodes. These 3-4 foot long anodes, usually of magnesium composition, are inserted into glass-lined water heaters and screw into a fitting. The water heater is protected by a small, continuous electric current which flows from the anode to the areas on the inner wall of the tank which are not adequately covered by the glass lining. To generate the electric current, the magnesium in the anode is consumed. The anode is eventually sacrificed to protect the exposed portions of the tank. Then the corrosive power of the water attacks the wall of the tank, eventually causing a leak.

Rho Sigma technology offers the solar industry an alternative. A 3-inch ferrite anode may be screwed into the top of the tank and may be conveniently powered by Rho Sigma's RS121 and RS504 series of differential thermostats for solar water heaters. The ferrite of the powered anode is not sacrificed to generate the electric current. Instead, the electric current to protect the tank is generated by the Rho Sigma control. The RS121 and RS504 drive a constant current through the anode under all water conditions. This self-regulating, electronic adjustment by the Rho Sigma control to local water conditions should be compared to sacrificial anodes which generate high currents in highly conductive water, thus rapidly consuming the sacrificial anode, and generate inadequate currents in highly resistive water. Powered anodes are the most cost-effective improvement that can be made to solar domestic water heating systems. Contact Rho Sigma for the best ideas first. Patents pending. Engineering assistance available.

The SX-1 Freeze Detection Switch is a mercury-filled, normally closed switch which opens when the temperature falls to $40^\circ\text{F} \pm 2.0$. Several of these sensors may be placed in series with the collector sensor to provide redundant freeze detection in collector arrays. When any of the SX-1 switches open, the L-circuit in the RS121 and RS504 will initiate the freeze protection cycle. When all the SX-1 sensors and the collector sensor rise above 45°F , then the freeze protection cycle will end. The SX-1 sensor is designed for use in systems where the temperature is limited -20°F to 450°F .

Rho Sigma's SA, ST, SP and SPR Sensors are thermister sensors accurate to $\pm 1^\circ\text{C}$ from 0°C to 100°C . They should not be exposed to temperatures greater than 450°F . The sensors are electrically identical. The housings are designed for easy installation.

SA Sensor: Thermister epoxy sealed in a stainless steel housing.

ST Sensor: Copper housing with hole for bolting directly to collector plate or air duct.

SP Sensor: Rugged, brass housing with standard 1/2" NPT pipe thread for easy installation into pipe tee.

SPR Sensor: May be installed in the end of a pipe for insertion into a deep tank. Brass housing with standard 1/2" NPT pipe thread connection.