Solid State Relay

Solid State Relay Offers More For Less: Longer Heater Life at Lower Cost

Watlow® solid state relays (SSR) offer many of the advantages of solid state power controllers, yet at a lower cost. Watlow’s extensive knowledge in power controller design has led to the development of a special fast cycle input card that enables a SSR to operate from a standard 4-20mA instrumentation command signal. Test results have shown that a zero cross SSR in combination with the fast cycle card promotes better temperature control and longer heater life than slow cycle relays. Through a time proportional cycle rate of one tenth of a second heater life will be extended.

Both low and high voltage models are available from 24 up to 530VAC. All ac output models include back to back Silicon Controlled Rectifiers (SCRs) for a more rugged design than the traditional triac based SSR. The internal design allows it to handle high currents and the harsh electrical environments of heavy industry. Watlow also offers a switched VDC model for dc heating applications.

Watlow can provide all the components necessary for trouble-free operation. This includes two standard convenience items: a thermal foil to ensure proper thermal transfer from the relay to the heat sink and belville washers that ensure the relay is mounted with sufficient pressure for good heat transfer. Matched semiconductor fuses and heat sinks are available to complete the power switching package.

Features and Benefits

Fast cycle card
- Increases heater life
- Optimizes temperature control
- Allows for higher watt density heaters

Zero cross firing
- Results in minimal electrical noise

Back-to-back SCR design
- Withstands harsh or hostile industrial environments

UL® recognized File #E151484 and #E73741; CSA certified File #LR700195; VDE 60950 License #40021401, File #1995500 up to 480VAC
- Meets applications requiring agency approval
Specifications

Specifications Standard To All SSRs:

Dielectric Strength (Volts) 4000 RMS

Input, DC Control

Voltage range 3-32VDC
Typical input current 3.4 to 20mA
Turn on voltage (max.) 3VDC
Turn off voltage (min.) 1VDC

Input, AC Control

Voltage range 90-280VAC
Typical input current 2mA (typical) @ 120VAC
4mA (typical) @ 240VAC
Turn on voltage (max.) 90VAC
Turn off voltage (min.) 10VAC

AC Output (Max.)

Forward voltage drop 1.5VAC and 2.1VDC
Min. holding current (mA) 50mA
Turn on-off time (ms) up to 10ms (max.)
Frequency range 47 to 63Hz

120/240VAC

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<tr>
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<td>120/240VAC</td>
<td>120A</td>
<td>60A² seconds</td>
<td>1.48° C/W</td>
<td>-40 to 176°F (-40 to 80°C)</td>
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<td>50A</td>
<td>120/240VAC</td>
<td>625A</td>
<td>600A² seconds</td>
<td>0.63° C/W</td>
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Random Fired Models

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<td>SSR-480-50A-RND</td>
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<td>480VAC</td>
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<td>0.93° C/W</td>
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<td>SSR-480-50A-RND</td>
<td>75A</td>
<td>480VAC</td>
<td>250A</td>
<td>1,620A² seconds</td>
<td>0.93° C/W</td>
<td>-40 to 176°F (-40 to 80°C)</td>
<td>Voltage range: 48-280VAC</td>
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<tr>
<td>SSR-100-20A-DC1</td>
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<td>120V</td>
<td>1000A</td>
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<td>1.00° C/W</td>
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<td>0.3mA VDC</td>
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100VDC

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480 VAC

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Ambient Temperature Operating Curve
**Heater Life**
Watlow has extensively tested electric heating elements with a variety of power switching devices. Results prove that the life of an electric element dramatically increases when the on-off cycle time that is used to time-proportion the heater is kept at less than one second. This reduces the thermal expansion and contraction of the element and improves heater life as much as 20 times. This very fast cycle time controls temperature much more accurately and allows the use of higher watt density heating elements.

**Fast Cycle Card**
In order to obtain the very rapid cycling time required for longer heater life, accurate temperature control and higher watt densities, Watlow has developed a loop-powered firing card for SSRs. This card operates from a standard instrumentation signal of 4 to 20mA and controls solid state relays with a time proportional cycle rate of less than one second (4VAC cycles on and 4VAC cycles off at 50 percent power).

**Thermal Transfer**
A thermal foil is provided with each solid state relay for mounting on the base of the relay to improve heat transfer. In addition, two belville washers are supplied to provide the proper pressure for this transfer of heat. Use two #8-32 screws 0.625 in. (16 mm) long to secure the relay to the heat sink.

**Replacing Contactors or Mercury Displacement Relays (MDRs)**
Improvements in heater life and control accuracy can be achieved with SSRs operated with rapid cycle times as compared to slower operating electromechanical relays or even MDRs. When replacing these types of relays with the SSR, it is important to consider two aspects:

1. **Heat**
   Solid state devices require a small voltage to turn on, which is consumed as heat (approx. 1.5 volts x amps = watts). This heat must be removed from the device and is usually accomplished by mounting the relay on a heat sink.

2. **Failure Mode**
   Solid state devices should last for many years when properly protected with voltage snubbers, mounted on appropriate heat sinks and when fused with semiconductor fuses against the high currents caused by electrical shorts. Watlow’s SSRs include an internal voltage snubber. However, if the unit fails, the most probable condition will be a short. Mechanical relays also have a good probability of failing short. In all cases where uncontrolled full power can cause damage, it is recommended that a high limit temperature controller and contactor be used for protection.

**Wiring Diagrams**

**Single-Phase Fast Cycle Input Card**

**Shorted SSR Alarm**
The most prevalent concern when using solid state relays is the possibility of a relay failing in a shorted condition. With this in mind, Watlow has designed a cost effective “Shorted SSR Alarm”.

The device monitors the output (current through the heater) and activates a triac (alarm) if there is no command signal from the temperature controller. The triac can be wired to a bell, or to a normally closed latching relay to remove power to the heater.

The shorted SSR alarm is not a substitute for an agency-approved high-temperature limit device.

**Single-Phase Shorted SSR Detector**

**Note:** Semiconductor power switching devices are not legal for over temperature limit or safety devices. For limit and safety devices you must have a positive mechanical break of all electrically hot legs simultaneously.
Heat Sink Dimensions by Part Number

<table>
<thead>
<tr>
<th>Code Number</th>
<th>Descriptor</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z100-0815-000A</td>
<td>18A</td>
<td>A: 1.8 (46) B: 3.25 (82.6) C: 3.7 (94) D: N/A E: 1.9 (48)</td>
</tr>
<tr>
<td>Z100-0815-000B</td>
<td>35A</td>
<td>A: 1.91 (48.5) B: 3.2 (81) C: 3.25 (82.6) D: 3.7 (94) E: 1.81 (46) F: 2.9 (74)</td>
</tr>
<tr>
<td>Z100-0815-000C</td>
<td>55A</td>
<td>A: 1.89 (48) B: 3.2 (81) C: 5.45 (138.4) D: 5.89 (149.6) E: 1.81 (46) F: 3.6 (91)</td>
</tr>
<tr>
<td>Z100-0815-XXFC*</td>
<td>75A</td>
<td>A: 1.89 (48) B: 3.2 (81) C: 5.45 (138.4) D: 7.16 (181.9) E: 1.81 (46) F: 3.6 (91)</td>
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*Fan cooled

Ordering Information

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<tr>
<th>Voltage</th>
<th>Current</th>
<th>Control Voltage</th>
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<tr>
<td>100</td>
<td>10A</td>
<td>SSR - 18A</td>
</tr>
<tr>
<td>240</td>
<td>20A</td>
<td>SSR - 35A</td>
</tr>
<tr>
<td>480</td>
<td>25A</td>
<td>SSR - 55A</td>
</tr>
<tr>
<td>100</td>
<td>10A</td>
<td>SSR - 75A</td>
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Voltage

- 100 = 0 to 100VDC (20A model only)
- 240 = 24 to 240VAC
- 480 = 24 to 530VAC

Current

- 10 = 10A
- 20 = 20A (100 VDC model only)
- 25 = 25A
- 40 = 40A
- 50 = 50A
- 75 = 75A

Control Voltage

- DC1 = 3 to 32VDC (see specifications)
- AC1 = 90 to 280VAC
- RND = 3 to 32VDC (10, 50 and 75A models only)

Note: Relay will also include thermal foil, two belville washers and #8-32 screws for mounting to a heat sink.

Heat Sinks (sold separately)

- Z100-0815-000A = 18A or 2.2°C/watt
- Z100-0815-000B = 35A or 1.1°C/watt
- Z100-0815-000C = 55A or 0.6°C/watt
- Z100-0815-12FC = 75A or 0.16°C/watt (120VAC fan)
- Z100-0815-24FC = 75A or 0.16°C/watt (240VAC fan)

Fast Cycle Input Card and Shorted SSR Alarm Card

For direct mounting on zero cross dc input solid state relay.

- RPC-5399-42-000 = Fast cycle input card, 4 to 20mA input
- RPC-5386-0000 = Shorted SSR alarm card

Sub Cycle Fuses - I2T (sold separately)

Recommended and available with holders.

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1-800-WATLOW2 • www.watlow.com • inquiry@watlow.com

International Technical Sales Offices: Australia, +61 3 9335 6449 • China, +86 21 3532 8532 • France, +33 1 41 32 79 70
Germany, +49 (0) 72 93 / 94 00-0 • India, +91 40 6661 2700 • Italy, +39 024588841 • Japan, +81 3 3518 6630 • Korea, +82 2 2628 5770
Malaysia, +60 3 8076 8745 • Mexico, +52 442 217 6235 • Singapore, +65 6773 9488 • Spain, +34 91 675 12 92
Taiwan, +886 7 288 5168 • United Kingdom, +44 (0) 115 964 0777