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

The 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

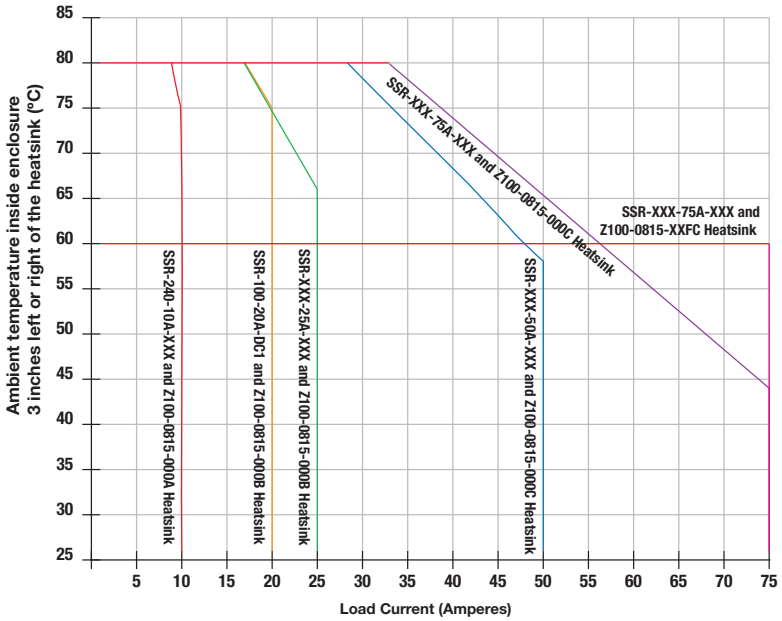
UL® recognized File #E151484 and #E73741
CSA certified up to 600VAC, File #LR700195
VDE 60950 License #40021401, File #1995500
up to 480VAC, CE- EN 60950 and RoHS

- 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

Ambient Temperature Operating Curve



120/240VAC						
Model Number	**SSR-240-10A-DC1**	**SSR-240-25A-DC1**	**SSR-240-50A-DC1**	**SSR-240-10A-AC1**	**SSR-240-25A-AC1**	**SSR-240-50A-AC1**
Current output	10A	25A	50A	10A	25A	50A
Nominal voltage	120/240VAC	120/240VAC	120/240VAC	120/240VAC	120/240VAC	120/240VAC
One cycle surge current	120A	250A	625A	120A	250A	625A
Max. I^2t for fusing	$60A^2$ seconds	$260A^2$ seconds	$1,620A^2$ seconds	$60A^2$ seconds	$260A^2$ seconds	$1,620A^2$ seconds
Thermal resistance	1.48° C/W	1.05° C/W	0.63° C/W	1.48° C/W	1.05° C/W	0.31° C/W
Ambient operating temperature	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)
Output (Max.)						
Voltage range	48-280VAC	48-280VAC	48-280VAC	48-280VAC	48-280VAC	48-280VAC
Over voltage rating	600V (peak)	600V (peak)	600V (peak)	600V (peak)	600V (peak)	600V (peak)
Off state leakage	10mA	10mA	10mA	10mA	10mA	10mA

120/240VAC			Random Fired Models			100VDC
Model Number	**SSR-240-75A-DC1**	**SSR-240-75A-AC1**	**SSR-480-50A-RND**	**SSR-480-75A-RND**	**SSR-240-10A-RND**	**SSR-100-20A-DC1**
Current output	75A	75A	50A	75A	10A	20A
Nominal voltage	120/240VAC	120/240VAC	480VAC	480VAC	120/240VAC	100VDC
One cycle surge current	1000A	1000A	625A	1000A	120A	42A (10ms)
Max. I^2t for fusing	$6000A^2$ seconds	$6000A^2$ seconds	$1,620A^2$ seconds	$6000A^2$ seconds	$60A^2$ seconds	N/A
Thermal resistance	0.31° C/W	0.31° C/W	0.63° C/W	0.31° C/W	1.48° C/W	1.06° C/W
Ambient operating temperature	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-4 to 176°F (-20 to 80°C)
Output (Max.)						
Voltage range	48-280VAC	48-280VAC	80-530VAC	80-530VAC	48-280VAC	0-100VDC
Over voltage rating	600V (peak)	600V (peak)	1200V (peak)	1200V (peak)	600V (peak)	N/A
Off state leakage	10mA	10mA	10mA	10mA	10mA	0.3mA VDC

480 VAC						
Model Number	**SSR-480-25A-DC1**	**SSR-480-50A-DC1**	**SSR-480-75A-DC1**	**SSR-480-25A-AC1**	**SSR-480-50A-AC1**	**SSR-480-75A-AC1**
Current output	25A	50A	75A	25A	50A	75A
Nominal voltage	480VAC	480VAC	480VAC	480VAC	480VAC	480VAC
One cycle surge current	250A	625A	1000A	250A	625A	1000A
Max. I^2t for fusing	$260A^2$ seconds	$1,620A^2$ seconds	$6,000A^2$ seconds	$260A^2$ seconds	$1,620A^2$ seconds	$6,000A^2$ seconds
Thermal resistance	1.02° C/W	0.63° C/W	0.31° C/W	1.02° C/W	0.63° C/W	0.31° C/W
Ambient operating temperature	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)	-40 to 176°F (-40 to 80°C)
Output (Max.)						
Voltage range	48-530VAC	48-530VAC	48-530VAC	48-530VAC	48-530VAC	48-530VAC
Over voltage rating	1200V (peak)	1200V (peak)	1200V (peak)	1200V (peak)	1200V (peak)	1200V (peak)
Off state leakage	10mA	10mA	10mA	10mA	10mA	10mA

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)

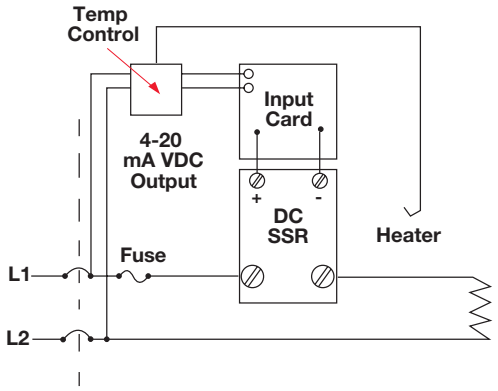
Improvements in heater life and control accuracy can be achieved with SSRs operated with rapid cycle times as compared to slower operating electromechanical relays or even MDRs. When replacing these types of relays with the SSR, it is important to consider two aspects:

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



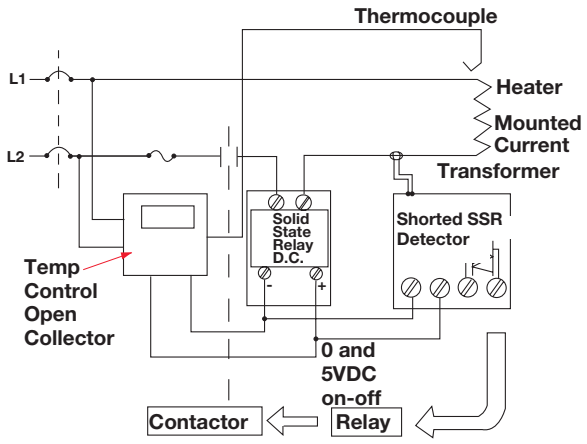
Shorted SSR Alarm

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.

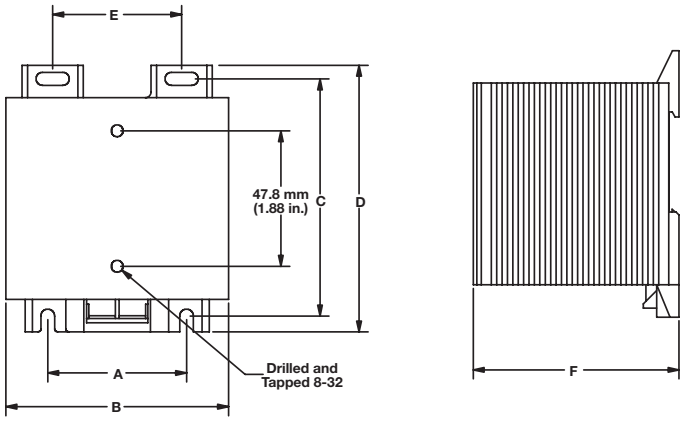
The shorted SSR alarm is not a substitute for an agency-approved high-temperature limit device.

Single-Phase Shorted SSR Detector

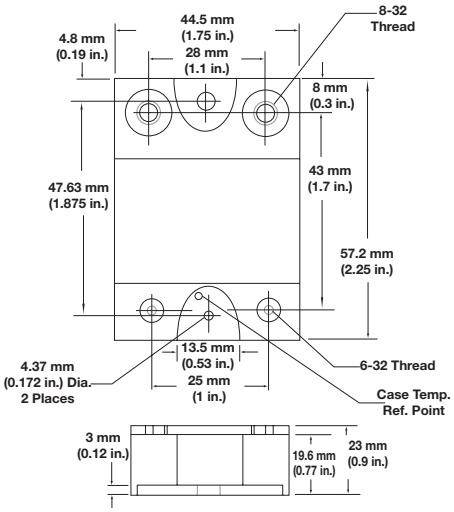


Note: Semiconductor power switching devices are not legal for over temperature limit or safety devices. For limit and safety devices you must have a positive mechanical break of all electrically hot legs simultaneously.

Dimensions - Heat Sink



Dimensions - Solid State Relay



Heat Sink Dimensions by Part Number

Code Number	Descriptor	Dimensions											
		A		B		C		D		E		F	
		in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)
Z100-0815-000A	18A	N/A		1.8	(46)	3.25	(82.6)	3.7	(94)	N/A		1.9	(48)
Z100-0815-000B	35A	1.91	(48.5)	3.2	(81)	3.25	(82.6)	3.7	(94)	1.81	(46)	2.9	(74)
Z100-0815-000C	55A	1.89	(48)	3.2	(81)	5.45	(138.4)	5.89	(149.6)	1.81	(46)	3.6	(91)
Z100-0815-XXFC*	75A	1.89	(48)	3.2	(81)	5.45	(138.4)	7.16	(181.9)	1.81	(46)	3.6	(91)

*Fan cooled

Ordering Information

①②③	④⑤⑥	⑦⑧	⑨	⑩⑪⑫
	Voltage	Current		Control Voltage
SSR	–	–	A	

④⑤⑥	Voltage
100 =	0 to 100VDC (20A model with DC1 control only)
240 =	48 to 280VAC
480 =	48 to 530VAC

⑦⑧	Current
10 =	10A (240V models only)
20 =	20A (100VDC model only)
25 =	25A
40 =	40A (240V models only)
50 =	50A
75 =	75A

⑩⑪⑫	Control Voltage
DC1 =	3 to 32VDC (see specifications)
AC1 =	90 to 280VAC
RND =	3 to 32VDC (10A/240V, 50A/480V, 75A/480V models only)

Note: Relay will also include thermal foil, two belville washers and #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)

Sub Cycle Fuses - I²T (sold separately)
Recommended and available with holders.

Powered by Possibility

To be automatically connected to the nearest North American Technical Sales Office:

1-800-WATLOW2 • www.watlow.com

International Technical Sales Offices:

Austria	+43 6244 20129 0	**India**	+91 40 6661 2700	**Mexico**	+52 442 256 2200
China	+86 21 3532 8532	**Italy**	+39 02 458 8841	**Singapore**	+65 6773 9488
France	+33 1 41 32 79 70	**Japan**	+81 3 3518 6630	**Spain**	+34 91 675 1292
Germany	+49 7253 9400 0	**Korea**	+82 2 2169 2600	**Taiwan**	+886 7 288 5168
				UK	+44 115 964 0777