

# Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!



## User's Guide

### TEMPERATURE

- ☑ Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- ☑ Wire: Thermocouple, RTD & Thermistor
- ☑ Calibrators & Ice Point References
- ☑ Recorders, Controllers & Process Monitors
- ☑ Infrared Pyrometers

### PRESSURE, STRAIN AND FORCE

- ☑ Transducers & Strain Gauges
- ☑ Load Cells & Pressure Gauges
- ☑ Displacement Transducers
- ☑ Instrumentation & Accessories

### FLOW/LEVEL

- ☑ Rotameters, Gas Mass Flowmeters & Flow Computers
- ☑ Air Velocity Indicators
- ☑ Turbine/Paddlewheel Systems
- ☑ Totalizers & Batch Controllers

### pH/CONDUCTIVITY

- ☑ pH Electrodes, Testers & Accessories
- ☑ Benchtop/Laboratory Meters
- ☑ Controllers, Calibrators, Simulators & Pumps
- ☑ Industrial pH & Conductivity Equipment

### DATA ACQUISITION

- ☑ Data Acquisition & Engineering Software
- ☑ Communications-Based Acquisition Systems
- ☑ Plug-in Cards for Apple, IBM & Compatibles
- ☑ Datalogging Systems
- ☑ Recorders, Printers & Plotters

### HEATERS

- ☑ Heating Cable
- ☑ Cartridge & Strip Heaters
- ☑ Immersion & Band Heaters
- ☑ Flexible Heaters
- ☑ Laboratory Heaters

### ENVIRONMENTAL MONITORING AND CONTROL

- ☑ Metering & Control Instrumentation
- ☑ Refractometers
- ☑ Pumps & Tubing
- ☑ Air, Soil & Water Monitors
- ☑ Industrial Water & Wastewater Treatment
- ☑ pH, Conductivity & Dissolved Oxygen Instruments

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Ω OMEGA®  
<http://www.omega.com>  
e-mail: [info@omega.com](mailto:info@omega.com)



**SSR**  
**Solid State Relays**



**OMEGAnet® On-Line Service**  
<http://www.omega.com>

**Internet e-mail**  
[info@omega.com](mailto:info@omega.com)

**Servicing North America:**

**USA:** One Omega Drive, Box 4047  
ISO 9001 Certified Stamford, CT 06907-0047  
Tel: (203) 359-1660 FAX: (203) 359-7700  
e-mail: [info@omega.com](mailto:info@omega.com)

**Canada:** 976 Bergar  
Laval (Quebec) H7L 5A1  
Tel: (514) 856-6928 FAX: (514) 856-6886  
e-mail: [info@omega.ca](mailto:info@omega.ca)

**For immediate technical or application assistance:**

**USA and Canada:** Sales Service: 1-800-826-6342 / 1-800-TC-OMEGA<sup>SM</sup>  
Customer Service: 1-800-622-2378 / 1-800-622-BEST<sup>SM</sup>  
Engineering Service: 1-800-872-9436 / 1-800-USA-WHEN<sup>SM</sup>  
TELEX: 996404 EASYLINK: 62968934 CABLE: OMEGA

**Mexico and Latin America:** Tel: (001) 800-826-6342 FAX: (001) 203-359-7807  
En Español: (001) 203-359-7803 e-mail: [espanol@omega.com](mailto:espanol@omega.com)

**Servicing Europe:**

**Benelux:** Postbus 8034, 1180 LA Amstelveen, The Netherlands  
Tel: (31) 20 6418405 FAX: (31) 20 6434643  
Toll Free in Benelux: 0800 0993344  
e-mail: [nl@omega.com](mailto:nl@omega.com)

**Czech Republic:** ul. Rude armady 1868, 733 01 Karvina-Hranice  
Tel: 420 (69) 6311899 FAX: 420 (69) 6311114  
Toll Free: 0800-1-66342 e-mail: [czech@omega.com](mailto:czech@omega.com)

**France:** 9, rue Denis Papin, 78190 Trappes  
Tel: (33) 130-621-400 FAX: (33) 130-699-120  
Toll Free in France: 0800-4-06342  
e-mail: [france@omega.com](mailto:france@omega.com)

**Germany/Austria:** Daimlerstrasse 26, D-75392 Deckenpfronn, Germany  
Tel: 49 (07056) 3017 FAX: 49 (07056) 8540  
Toll Free in Germany: 0130 11 21 66  
e-mail: [info@omega.de](mailto:info@omega.de)

**United Kingdom:** One Omega Drive, River Bend Technology Centre  
ISO 9002 Certified Northbank, Irlam, Manchester  
M44 5EX, United Kingdom  
Tel: 44 (0) 161 777-6611 FAX: 44 (0) 161 777-6622  
Toll Free in United Kingdom: 0800-488-488  
e-mail: [info@omega.co.uk](mailto:info@omega.co.uk)

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The information contained in this document is believed to be correct, but OMEGA Engineering, Inc. accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

**WARNING:** These products are not designed for use in, and should not be used for, patient-connected applications.

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OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of 13 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

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**RETURN REQUESTS / INQUIRIES**

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR WARRANTY RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR NON-WARRANTY REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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## SPECIFICATIONS

### GENERAL SPECIFICATIONS<sup>(1)</sup>

PARAMETER	ALL DEVICES
Operating Temperature Range	-20° to +80°C
Storage Temperature Range	-40° to +80°C
Input to Output Isolation Voltage <sup>(2)</sup>	4000 Vrms
Input/Output to Ground Isolation Voltage	2500 Vrms
Capacitance Input to Output (Max)	8 pF
Line Frequency Range	47 to 63 Hz

### INPUT SPECIFICATIONS<sup>(1)</sup>

PARAMETER	AC SSR's	DC SSR's
Control Voltage	90-280 VAC	3-32 VDC
Drop Out Voltage	10 Vrms	1.0 VDC
Maximum Input Current <sup>(3)</sup>	10 mArms	34 mADC
Nominal Input Impedance <sup>(4)</sup>	40K Ohms	1K Ohms
Turn-On Time	20 ms	0.5 Cycle Max. <sup>(5)</sup>
Turn-Off Time	30 ms	0.5 Cycle Max.

### OUTPUT SPECIFICATIONS<sup>(1)</sup>

PARAMETER	SSR's						UNITS
Maximum On-State Current <sup>(6)</sup>	10	25	45	50	75	90	Arms
Minimum On-State Current	100	100	100	100	100	100	mArms
Maximum 1-Cycle Surge <sup>(7)</sup>	100	250	450	500	700	1000	Apeak
Maximum 1-Second Surge <sup>(8)</sup>	30	75	135	145	200	280	Apeak
On-State Voltage Drop <sup>(9)</sup>	1.6	1.6	1.6	1.6	1.6	1.6	Vpeak
12T (60 Hz)	200	260	840	1040	2345	3375	A <sup>2</sup> sec

#### FOOTNOTES

- (1) Specifications apply to T<sub>A</sub> - 30 to +80°C unless otherwise noted.
- (2) At T<sub>A</sub> of 25°C for one second, maximum leakage 1 mA.
- (3) At maximum input voltage.
- (4) Does not include impedance of coupler (voltage drop of 1.5 volts maximum).
- (5) 100µs for random turn-on (suffix "R") models.
- (6) With relay properly mounted on an adequate heatsink.
- (7) At T<sub>A</sub> of 25°C, non-repetitive.
- (8) At T<sub>A</sub> of 25°C.
- (9) At T<sub>A</sub> of 25°C and maximum on-state current.

## PRECAUTIONS

A number of essential safety precautions must be observed in the installation and use of a Solid State Relay (SSR).

The SSR's should be installed and serviced by qualified technicians familiar with high voltage and current circuits. Note that an SSR has a small leakage current when the contacts are "open". Normal failure condition is contacts "closed". A special Fast Blowing I<sup>2</sup>T fuse and a mechanical interrupt switch are recommended in the load circuit. In certain applications a mechanical interrupt switch should be installed in the control circuit.

### GENERAL DESCRIPTION

The OMEGA® Solid State Relays (SSR's) are a series of single-pole, normally open, solid state switching devices with no moving parts, capable of tens of millions of cycles of operation. It is designed to control 120V, 240V or 440V alternating current (VAC), and provides zero voltage switching and 2500VAC isolation between the load terminals and the control signal. A control signal (AC or DC input, depending on unit selected) causes the SSR to switch the AC load ON or OFF just as a conventional mechanical contact switch does but with none of the problems associated with moving contact relays, such as corrosion, pitting, arcing, radio frequency interference (RFI) and bounce. The result: much longer life for the SSR.

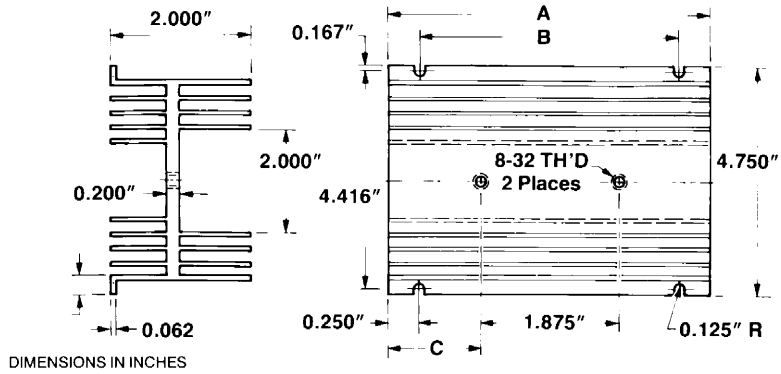
The SSR is designed around a pair of SCR's mounted on a heat-spreading metal base to eliminate thermal fatigue failures. To dissipate the heat developed naturally in an SSR due to a nominal voltage drop across the device, the SSR must be mounted on a Finned Heat Sink (FHS), or on a metal plate of adequate size (see Section 4). It is advisable to install an SSR where the ambient temperature is relatively low because its current-switching rating is decreased as its temperature increases.

Control resistance heaters up to 40 kW use solid state relays in conjunction with lower-rated temperature controllers. Three-phase loads can be controlled using 2 or 3 SSR's. Use 3 SSR's for Y-phase loads using a neutral line. Three solid state relays are also used when there is no neutral load to provide redundancy and extra assurance of control. Two SSR's will control "delta" loads with no neutral line.

### FINNED HEAT SINKS (FHS)

The Finned Heat Sinks (FHS) are anodized, aluminum fabrications which come complete with tapped mounting holes, a thermal compound, and screws to mount the SSR.

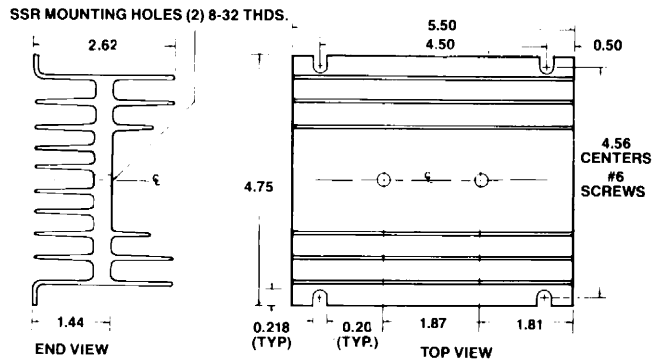
#### FHS-1 and FHS-2 Heat Sink



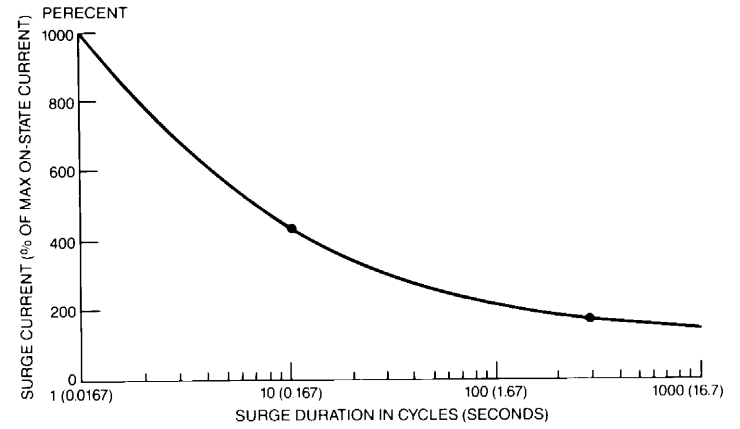
	A	B	C	THERMAL RATING
FHS-1	3.00"	2.50"	0.56"	2°C/W
FHS-2	5.50"	5.00"	1.81"	1.2°C/W

FHS-1/FHS-2 Heat Sink

#### FHS-6 Heat Sink (0.7°C/W Thermal Rating)

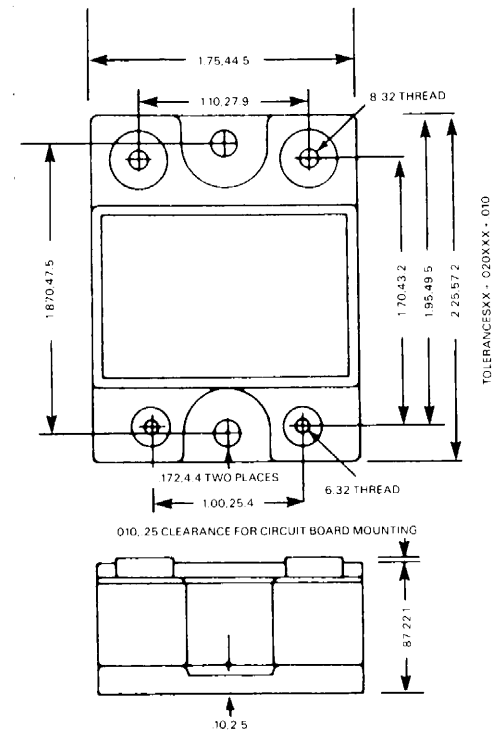


FHS-6 Heat Sink



Surge Current/Time

#### SSR DIMENSIONS



SSR Dimensions

**ELECTRICAL SPECIFICATIONS**

Output-AC Load							
Model No.	Nominal AC Line Voltage	Nominal Load Current	Max. Contact Voltage Drop	Max. Off-State Leakage (25°C max. ambient)			Dissipation Watts/Amps
				120VAC	240VAC	440VAC	
SSR240AC10	24 to 280VAC	10 A	1.6V	7.5 mA	15 mA	N/A	1.6
SSR240AC25		25 A		7.5 mA	15 mA		1.3
SSR240AC45		45 A		7.5 mA	15 mA		0.9
SSR240AC75		75 A		7.5 mA	15 mA		**
SSR240AC90	90 A	7.5 mA	15 mA	**	**		
SSR240DC10	24 to 280VAC	10 A	1.6V	7.5 mA	15 mA	N/A	1.6
SSR240DC25		25 A		7.5 mA	15 mA		1.3
SSR240DC45		45 A		7.5 mA	15 mA		0.9
SSR240DC75		75 A		7.5 mA	15 mA		**
SSR240DC90	90 A	7.5 mA	15 mA	**	**		
SSR440AC50	36 to 480VAC	50 A	1.6V	4 mA	8 mA	15 mA	**
SSR440AC75		75 A		4 mA	8 mA	15 mA	**
SSR440AC90		90 A		4 mA	8 mA	15 mA	**
SSR440DC50	36 to 480VAC	50 A	1.6V	4 mA	8 mA	15 mA	**
SSR440DC75		75 A		4 mA	8 mA	15 mA	**
SSR440DC90		90 A		4 mA	8 mA	15 mA	**

\* Transients above 500V should be suppressed.

**ELECTRICAL SPECIFICATIONS**

Model No.	Type	Input-Control Signal				Input & Output Peak Repetitive Voltage Min.*
		Control Signal Voltage	Control Signal Turn-on	Control Signal Turn-off	Signal Input Impedance	
SSR240AC10	AC Control Signal	90 to 280VAC	90VAC	10VAC	40 kΩ	500V
SSR240AC25						
SSR240AC45						
SSR240AC75						
SSR240AC90	90 to 280VAC	90VAC	10VAC	40 kΩ	500V	
SSR240DC10	DC Control Signal	3 to 32VDC	3VDC	1VDC	1 kΩ	500V
SSR240DC25						
SSR240DC45						
SSR240DC75						
SSR240DC90	90 to 280VAC	90VAC	10VAC	40 kΩ	1200V	
SSR440AC50	AC Control Signal	90 to 280VAC	90VAC	10VAC	40 kΩ	1200V
SSR440AC75						
SSR440AC90						
SSR440DC50	DC Control Signal	3 to 32VDC	3VDC	1VDC	1 kΩ	1200V
SSR440DC75						
SSR440DC90						

The following SSRs are available from OMEGA Engineering.

PART NUMBER	DESCRIPTION	NOMINAL LOAD CURRENT (AC AMPS)
SSR240AC10	AC Control Signal (240VAC line)	10
SSR240AC25		25
SSR240AC45		45
SSR240AC75		75
SSR240AC90		90
SSR240DC10	DC Control Signal (240VAC line)	10
SSR240DC25		25
SSR240DC45		45
SSR240DC75		75
SSR240DC90		90
SSR440AC50	AC Control Signal (440VAC line)	50
SSR440AC75		75
SSR440AC90		90
SSR440DC50	DC Control Signal (440VAC line)	50
SSR440DC75		75
SSR440DC90		90

Load resistors, fuses, fuse blocks, and finned heat sinks are available from OMEGA Engineering as required.

### MOUNTING THE SSR

The SSR assembly (including heat sink) can be located close to the load, minimizing the lengths of power cables. The actuating device, such as a temperature controller, can then be located in an area more convenient to the operator.

The FHS on which the SSR is to be mounted has been pre-drilled and tapped, and is supplied with mounting screws and OMEGA's OT-201 thermal compound. Apply this compound liberally on the bottom of the SSR and mount the SSR securely to the heat sink with the mounting screws. OT-201 is a high-thermal conductivity compound specifically formulated to improved heat transfer between two surfaces. It's thermal conductivity is 16.5 (Btu-in)/(ft<sup>2</sup>-hr-°F), with a maximum operating temperature of 400 °F.

The best location for the SSR is an open area with unrestricted air movement. The FHS should be mounted on a vertical surface with the fins vertical. If it is mounted with the fins horizontal, or on a horizontal surface, the thermal coefficient must be de-rated by 20%. For air flow, allow at least ½ in. clearance at each end and 1 in. on the sides.

### FUSE PROTECTION

The load side of the SSR should be protected by a Fast-Blowing I<sup>2</sup>T fuse. Recommended fuses and part numbers are given in below. Although a semiconductor relay is designed for virtually countless operation cycles, it can be destroyed by an over-voltage or a short circuit, unless protected adequately by the fast fuse.

Table 3-1 shows the part numbers of the fuses and fuse blocks that can be used with each of the SSR's. Lower rated fast-blow fuses may be used if the current being controlled is below the rated capacity of the SSR. Bussman or equivalent fuses should be used. It is essential that a proper fast-blow (I<sup>2</sup>T) fuse is used. SSR's normal failure mode on overloaded circuits is closed contacts (ON-STATE).

SSR PART NUMBER	MAXIMUM CURRENT CAPACITY	FUSE PART NUMBER	FUSE BLOCK PART NUMBER
SSR240AC10	10 Amps AC	KAX-10	FB-1, FB-2, FB-3
SSR240AC25	25 Amps AC	KAX-25	FB-1, FB-2, FB-3
SSR240AC45	45 Amps AC	KAX-45	BS101
SSR240AC75	75 Amps AC	KBH-70	BS101
SSR240AC90	90 Amps AC	KBH-90	BS101
SSR240DC10	10 Amps AC	KAX-10	FB-1, FB-2, FB-3
SSR240DC25	25 Amps AC	KAX-25	FB-1, FB-2, FB-3
SSR240DC45	45 Amps AC	KAX-45	BS101
SSR240DC75	75 Amps AC	KBH-70	BS101
SSR240DC90	90 Amps AC	KBH-90	BS101
SSR440AC50	50 Amps AC	KBH-50	BS101
SSR440AC75	75 Amps AC	KBH-70	BS101
SSR440AC90	90 Amps AC	KBH-90	BS101
SSR440DC50	50 Amps AC	KBH-50	BS101
SSR440DC75	75 Amps AC	KBH-70	BS101
SSR440DC90	90 Amps AC	KBH-90	BS101

### LEAKAGE CURRENT

In the OFF state, all SSR's have a small leakage current through their contacts, typically 5 to 15 milliamperes (mA). As a result, a voltage potential will always exist on the LOAD SIDE, even when the "contacts" are "open". The voltage level is a function of the load resistance. In accordance with  $E = IR$ , the voltage level equals leakage current times load resistance.

The voltage level will rise to FULL LINE VOLTAGE under NO LOAD (open circuit) or high resistance conditions. Under normal operating conditions, however, it is very small. A 120-Watt (W) load has a resistance of 1 ohm. With "open contacts", a leakage current of 15mA will cause 15mV across the load ( $E = 15mA \times 1 \text{ ohm}$ ). A mechanical switch is recommended between the AC power source and the SSR to provide electric isolation for servicing the load.