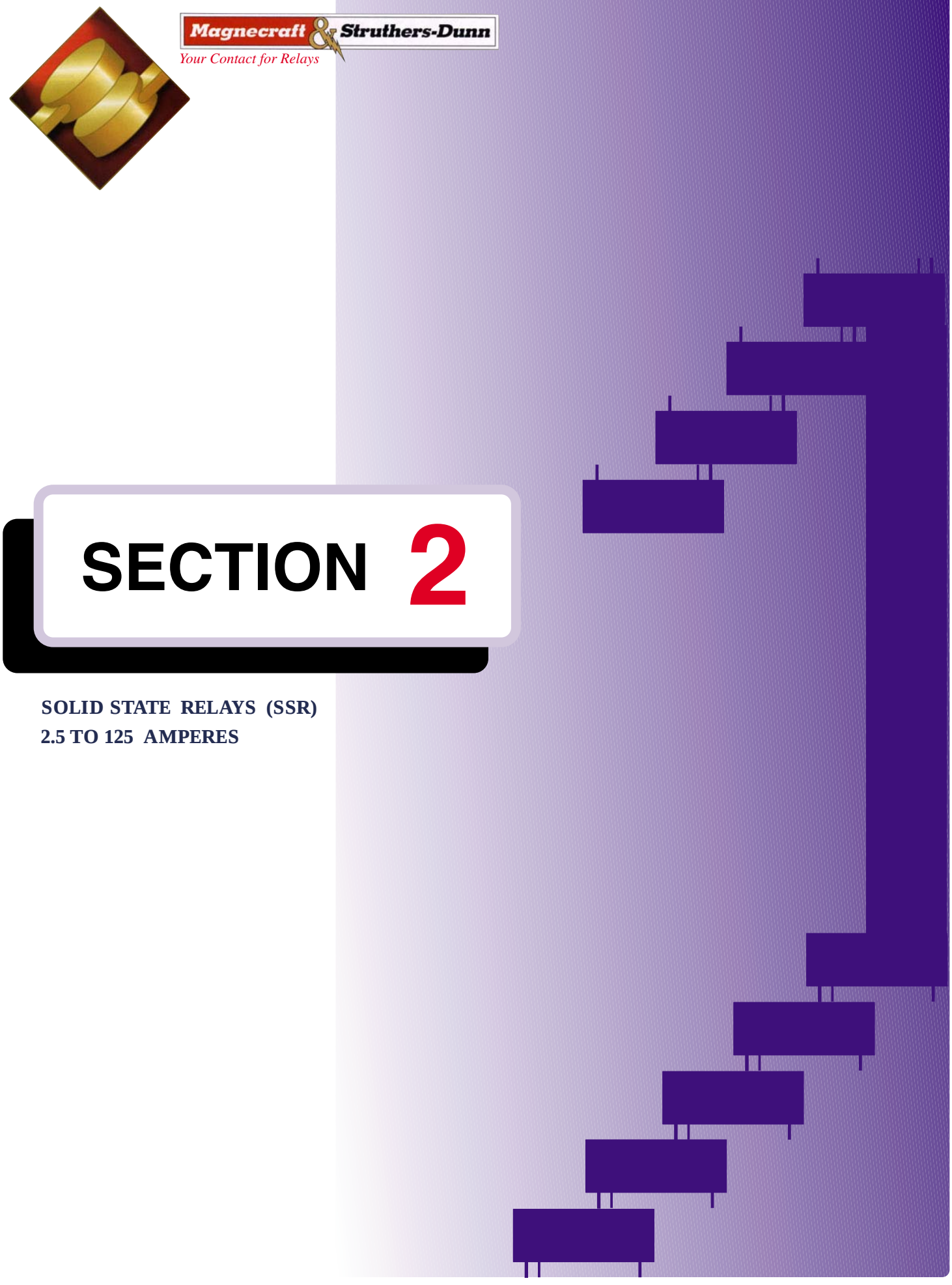
Magnecraft & Struthers-Dunn

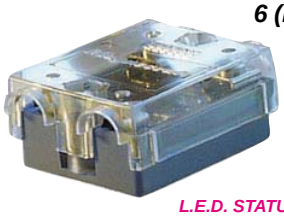
Your Contact for Relays



SECTION 2

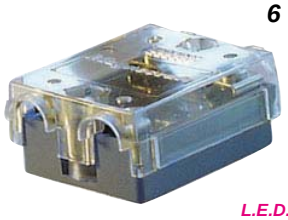
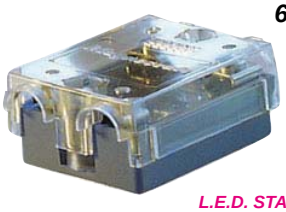
SOLID STATE RELAYS (SSR)
2.5 TO 125 AMPERES

SOLID STATE RELAYS

RELAY SERIES	SSRDIN	6 (ASX)	6 (DSX)
	 L.E.D. STATUS LAMP	 L.E.D. STATUS LAMP	 L.E.D. STATUS LAMP
	L W H 4.015 x 1.180 x 4.527	L W H 2.25 x 1.75 x 0.78	L W H 2.25 x 1.75 x 0.78
FEATURES	• AC & DC INPUT • AC OUTPUT • 10 OR 25 AMP LOADS • PHOTO ISOLATED, ZERO VOLTAGE SWITCHING • 4000V rms ISOLATION INPUT TO OUTPUT • INTERNAL RC (SNUBBER) NETWORK • RFI SUPPRESSION • INTEGRAL SAFETY COVER, AND HEATSINK. • DIN RAIL MOUNTING	• AC INPUT • AC OUTPUT • UP TO 125 AMP LOADS • PHOTO ISOLATED, ZERO VOLTAGE SWITCHING • 4000V rms ISOLATION INPUT TO OUTPUT • INTERNAL RC (SNUBBER) NETWORK • RFI SUPPRESSION • SAFETY COVER STANDARD	• DC INPUT • AC OUTPUT • UP TO 125 AMP LOADS • PHOTO ISOLATED, ZERO VOLTAGE SWITCHING • 4000V rms ISOLATION INPUT TO OUTPUT • INTERNAL RC (SNUBBER) NETWORK • RFI SUPPRESSION • SAFETY COVER STANDARD
OUTPUT DATA OUTPUT CONFIGURATION:	**SPST-NO**	**SPST-NO**	**SPST-NO**
LOAD VOLTAGE: LOAD CURRENT MAX.:	280, 660 VAC 10 & 25 AMPS	280, 560 OR 660 VAC 10 TO 125 AMPS	280, 560 OR 660 VAC 10 TO 125 AMPS
OUTPUT DEVICE: MINIMUM LOAD:	BACK TO BACK SCRS 50 TO 250 MILLIAMPS	BACK TO BACK SCRS 50 TO 500 MILLIAMPS	BACK TO BACK SCRS 50 TO 500 MILLIAMPS
INSULATION CHARACTERISTICS DIELECTRIC STRENGTH:	4000 V rms	4000 V rms	4000 V rms
INPUT DATA INPUT VOLTAGE RANGE:	90 TO 280 VAC, 3 TO 32 VDC	90 TO 280 VAC	3 TO 32 VDC
INPUT CURRENT:	16 mA TYPICAL	20 mA TYPICAL	16 mA TYPICAL
MUST TURN OFF VOLTAGE:	10 VAC OR 1 VDC	10 VAC	1 VDC
GENERAL DATA AMBIENT TEMPERATURE OPERATIONAL: STORAGE:	- 30˚C TO +80˚C - 40˚C TO +100˚C	- 40˚C TO +80˚C - 40˚C TO +100˚C	- 40˚C TO +80˚C - 40˚C TO +100˚C
RESPONSE TIME OPERATE MAX.: RELEASE MAX.: INSULATION RESISTANCE: TERMINALS:	AC: 40 mS, DC 10 mS AC: 80 mS, DC 10 mS $10^{10}\ \Omega$ SCREW	40 mS 80 mS $10^{10}\ \Omega$ SCREW	40 mS 80 mS $10^{10}\ \Omega$ SCREW
AGENCY APPROVALS	c UL us UL Recognized File No. E52197	c UL us UL Recognized File No. E52197 CE APPROVED ON SELECT MODELS	c UL us UL Recognized File No. E52197 CE APPROVED ON SELECT MODELS
PAGE NUMBER	PAGE 8	PAGE 9	PAGE 10

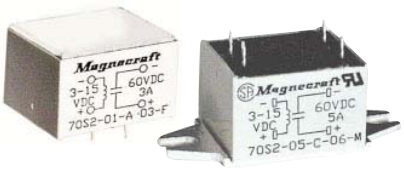
CONSULT FACTORY FOR OTHER CONFIGURATIONS

http://sacramentoelectronics.com (916) 441-4821 (800) 367-8800

6 (DDX)	6 (DTX)	6 (DTX)
 L.E.D. STATUS LAMP	 L.E.D. STATUS LAMP	 L.E.D. STATUS LAMP
L W H 2.25 x 1.75 x 0.78	**L W H** 2.25 x 1.75 x 0.78	**L W H** 2.25 x 1.75 x 0.78
• DC INPUT • DC OUTPUT • UP TO 40 AMP LOADS • ISOLATED, 2500 V rms ISOLATION INPUT TO OUTPUT • RFI SUPPRESSION • SAFETY COVER STANDARD • L.E.D. STATUS LAMP	• DC INPUT • AC OUTPUT • UP TO 40 AMP LOADS • PHOTO ISOLATED ZERO VOLTAGE SWITCHING • 4000 V rms ISOLATION INPUT TO OUTPUT • INTERNAL RC (SNUBBER) NETWORK • SAFETY COVER STANDARD	• DC INPUT • AC TRIAC OUTPUT • 10 AMP LOADS • PHOTO ISOLATED ZERO VOLTAGE SWITCHING • 4000V rms ISOLATION INPUT TO OUTPUT • INTERNAL RC (SNUBBER) NETWORK • RFI SUPPRESSION
SPST-NO	**SPST-NO, SPST-NC**	**DPST-NO**
200 VDC 12, 25 & 40 AMPS	280 OR 560 VAC 10, 25 OR 40 AMPS	280 VAC 10 AMPS
MOSFET 20 MILLIAMPS	TRIAC 50 TO 250 MILLIAMPS	TRIAC 50 MILLIAMPS
2500 V rms	4000 V rms	4000 V rms
3.5 TO 32 VDC 10 mA TYPICAL 1 VDC	3 TO 32 VDC 2 mA TYPICAL 1 VDC	3.5 TO 32 VDC 2 mA TYPICAL 1 VDC
- 40˚C TO +80˚C - 40˚C TO +100˚C	- 40˚C TO +80˚C - 40˚C TO +100˚C	- 40˚C TO +80˚C - 40˚C TO +100˚C
600 uSec 2.6 mSec $10^{10}\,\Omega$ SCREW	40 mS 80 mS $10^{10}\,\Omega$ SCREW	40 mS 80 mS $10^{10}\,\Omega$ QUICK CONNECTS
c UL us UL Recognized File No. E52197	c UL us UL Recognized File No. E52197	c UL us UL Recognized File No. E52197
PAGE 11	PAGE 12	PAGE 13

CONSULT FACTORY FOR OTHER CONFIGURATIONS

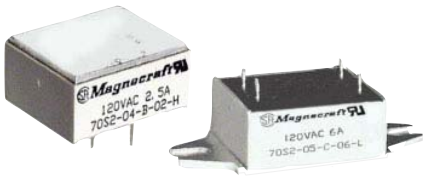
SOLID STATE RELAYS

RELAY SERIES	70S2 "V" STYLE	70S2 "N" & "S" STYLES	70S2 "F" & "M" STYLES
			
	L W H 1.70 x 0.400 x 1.00	L W H 2.20 x 1.00 x 0.864	L W H 2.20 x 1.00 x 0.85
FEATURES	• DC INPUT • AC OR DC OUTPUT • 3 AMP LOADS • OPTICALLY ISOLATED • SINGLE IN-LINE PACKAGE	• DC INPUT • AC OR DC OUTPUT • UP TO 25 AMP LOADS • OPTICALLY ISOLATED • COMPACT SIZE	• DC INPUT • AC OR DC OUTPUT • UP TO 10 AMP LOADS • OPTICALLY ISOLATED • PRINTED CIRCUIT TERM OR PANEL MOUNT
	FORMERLY GRAYHILL	**FORMERLY GRAYHILL**	**FORMERLY GRAYHILL**
OUTPUT DATA OUTPUT CONFIGURATION:	**SPST-NO**	**SPST-NO**	**SPST-NO**
LOAD VOLTAGE: LOAD CURRENT MAX.:	50, 140, 280 VAC,60 VDC 3 AMPS	140 OR 280 VAC,60 VDC 6, 12 OR 25 AMPS	140 OR 280 VAC OR 60 VDC 3,4,6 & 10 AMPS
OUTPUT DEVICE: MINIMUM LOAD:	TRIAC (AC) OR TRANSISTOR (DC) 65 MILLIAMPS	TRIAC (AC) OR TRANSISTOR (DC) 65 MILLIAMPS	TRIAC (AC) OR TRANSISTOR (DC) 65 MILLIAMPS
INSULATION CHARACTERISTICS DIELECTRIC STRENGTH:	2500 V rms	2500 V rms	2500 V rms
INPUT DATA INPUT VOLTAGE RANGE:	3 TO 32 VDC	3 TO 30 VDC	3 TO 30 VDC
INPUT CURRENT:	1.0 to 19 m A TYPICAL	1.0 TO 19 mA TYPICAL	1.0 TO 16 mA TYPICAL
MUST TURN OFF VOLTAGE:	1 VDC	1 VDC	1 VDC
GENERAL DATA AMBIENT TEMPERATURE OPERATIONAL: STORAGE:	- 40˚C TO +100˚C - 40˚C TO +125˚C	- 40˚C TO +100˚C - 40˚C TO +125˚C	- 40˚C TO +100˚C - 40˚C TO +125˚C
RESPONSE TIME OPERATE MAX.: RELEASE MAX.: INSULATION RESISTANCE: TERMINALS:	8.3 mS 8.3 mS $10^{10}\ \Omega$ PRINTED CIRCUIT	8.3 mS 8.3 mS $10^{10}\ \Omega$ QUICK CONNECTS OR SCREW	8.3 mS 8.3 mS $10^{10}\ \Omega$ PRINTED CIRCUIT
AGENCY APPROVALS	c UL us UL Recognized File No. E52197 168986 TUV on Selected models	c UL us UL Recognized File No. E52197 168986	c UL us UL Recognized File No. E52197 168986
PAGE NUMBER	PAGE 16	PAGE 17 - 18	PAGE 19 - 20

CONSULT FACTORY FOR OTHER CONFIGURATIONS

http://sacramentoelectronics.com (916) 441-4821 (800) 367-8800

70S2 " H " & " L " STYLES



L W H
1.20 x 1.00 x 0.520

- DC INPUT
- AC OUTPUT
- UP TO 6 AMP LOADS
- OPTICALLY ISOLATED
- PRINTED CIRCUIT TERMINAL OR PANEL MOUNT

FORMERLY GRAYHILL

SPST-NO

140 OR 280 VAC
2.5 OR 6 AMPS

TRIAC (AC) OR TRANSISTOR (DC)
65 MILLIAMPS

2500 V rms

3 TO 30 VDC

1.0 TO 18 mA TYPICAL

1 VDC

- 40˚C TO +100˚C
- 40˚C TO +125˚C

8.3 mS
8.3 mS
$10^{10}\Omega$
PRINTED CIRCUIT

c UL us
UL Recognized
File No. E52197

168986

PAGE 21 - 22

70S2 " K " STYLE

L W H
1.20 x 1.00 x 0.830

- DC INPUT
- AC OUTPUT
- UP TO 6 AMP LOADS
- OPTICALLY ISOLATED
- QUICK CONNECT TERMINAL OR PANEL MOUNT

FORMERLY GRAYHILL

SPST-NO

140 OR 280 VAC
4 AMPS

TRIAC (AC) OR TRANSISTOR (DC)
65 MILLIAMPS

3000 V rms

3 TO 30 VDC

1.0 TO 18 mA TYPICAL

1 VDC

- 40˚C TO +100˚C
- 40˚C TO +125˚C

8.3 mS
8.3 mS
$10^{10}\Omega$
PRINTED CIRCUIT

c UL us
UL Recognized
File No. E52197

168986

PAGE 23 - 24

226

L W H
1.50 X 0.670 X 0.600

- DC INPUT
- AC OUTPUT
- UP TO 7 AMP LOADS
- PHOTO ISOLATED
- RANDOM TURN-ON
- COMPATABLE WITH TTL GATES
- MOUNTS ON TO -3 TRANSISTOR HEAT SINKS

SPST-NO

140 OR 280 VAC
7 AMPS

TRIAC
50 MILLIAMPS

2500 V rms

5 & 12 VDC

10 mA TYPICAL

1.4 VDC

- 30˚C TO +80˚C
- 40˚C TO +100˚C

10 mS
60 mS
$10^{10}\Omega$
PRINTED CIRCUIT OR PUSH ON

UL Recognized
File No. E52197

PAGE 25

APPLICATION DATA

INTRODUCTION:

SOLID STATE RELAY (SSR) is a relay with isolated input and output, whose functions are achieved by means of electronic components without the use of moving parts as found in electromechanical relays.

PRINCIPLE OF OPERATION:

Solid State Relays are similar to electromechanical relays, in that both use a control circuit and a separate circuit for switching the load. When voltage is applied to the input of the SSR, the relay is energized by a light emitting diode. The light from the diode is beamed into a light sensitive semiconductor which, in the case of zero voltage crossover relays, conditions the control circuit to turn on the output solid state switch at the next zero voltage crossover. In the case of nonzero voltage crossover relays, the output solid state switch is turned on at the precise voltage occurring at the time. Removal of the input power disables the control circuit and the solid state switch is turned off when the load current passes through the zero point of its cycle.

APPLICATIONS:

Solid State Relays are specially suitable in many applications. Listed below are some typical applications.

INDUSTRIAL AUTOMATION

ALARM SYSTEMS

ELECTRONIC APPLIANCES

INDUSTRIAL APPLIANCES

MEDICAL EQUIPMENT

PACKING MACHINES

TOOLING MACHINGS

APPLICATION AND SELECTION CRITERIA FOR SOLID STATE RELAYS:

The Chart below indicates the areas in which SSR's (Solid State Relays) or EMR's (Electromechanical Relays) have better capabilities. (X) Indicates the Better choice.

	SSR	EMR
Long life	X	
Temperature cycling		X
Shock and vibration resistant	X	
Immunity to false operation due to transients		X
Generation of RFI, EMI	X	
Multipole		X
Multithrow (SPDT)		X
Size (includes Heat Sink) for equivalent load handling		X
Contact bounce	X	
Arcless switching	X	
Acoustic noise	X	
Zero voltage switching	X	
Ease of diagnosing malfunction		X
IC compatibility	X	
Immunity to humidity, salt spray & dirt	X	

LOAD CONSIDERATIONS

A major portion of application problems with SSR's result from operating conditions which specific loads impose upon an SSR. The following types of loads point out the potential problems that can occur with SSR's.

DC LOADS: All loads should be considered inductive and a diode should be placed across the load to absorb any inductive surge on turnoff.

RESISTIVE LOADS: Loads of constant value resistance are probably the simplest application of SSR's. Proper attention to the steady state current ratings and applied blocking voltage specifications normally will result in trouble-free operation.

LAMP LOADS: Incandescent lamp loads, though basically resistive, present some special problems. Because the resistance of a cold tungsten filament is about five to ten percent of the heated value, a large inrush current can occur. The period of the inrush current can range from one half cycle to several cycles, depending on the thermal time constant of the filament. It is essential to verify that this inrush current is within the surge specifications of the SSR. Also check that the lamp rating of the SSR is not exceeded. This is a UL rating based on the inrush of a typical lamp. Because of the unusually low filament resistance at the time of turn-on, a zero voltage turn-on characteristic is particularly desirable with tungsten lamps. It has been demonstrated that a zero voltage turn-on can extend the life of tungsten lamps by limiting inrush current.

APPLICATION DATA

CAPACITIVE LOADS: Caution must be used with low impedance capacitive loads to verify that the di/dt capabilities are not exceeded. The di/dt of a discharged capacitive load without external limiting impedance can approach infinity. Zero voltage turn-on is a particularly valuable means of limiting di/dt with capacitive loads.

MOTORS: Motors frequently have severe inrush currents during starting and can impose unusual voltages during turnoff. The inrush currents connected to mechanical loads having high starting torque or inertia should be carefully determined to verify that they are within the surge capabilities of the SSR. A current shunt and oscilloscope should be used to examine the duration of the inrush current. Motor starting may frequently reoccur at short intervals and the affect of repetitive inrush currents on the thermal operating point of an SSR must be considered. Check the motor operating current and locked rotor current versus the SSR motor rating. The possibility of abnormally stalled rotor conditions which draw much higher than normal currents should be considered. An extended stalled rotor condition may require an oversized SSR or fuse protection. The generated EMF of certain motors can require an SSR to have a blocking voltage greater than might be expected from steady state line voltage. The voltage applied to an SSR by a motor circuit during turnoff should be examined with an oscilloscope to verify hat the applied voltages are safely below the specified SSR blocking voltages. Otherwise lock-on or erratic turnoff of the motor may occur. Some motor circuits may require higher than normal blocking voltage, transient limiting devices, or other techniques to control the voltage which must be blocked by an SSR during deceleration or direction reversal.

TRANSFORMERS:

In controlling transformers, the characteristics of the secondary load should be considered because it reflects the effective load on the SSR. Voltage transients from secondary load circuits, similarly, are frequently transformed and can be imposed on the SSR. Transformers present a special problem in that, depending on the state of the transformer flux at the time of turnoff, the transformer may saturate during the first half-cycle of subsequent applied voltage. This saturation can impose a very large current (Commonly ten to one hundred times rated primary current) on the SSR and exceed its half-cycle surge rating.

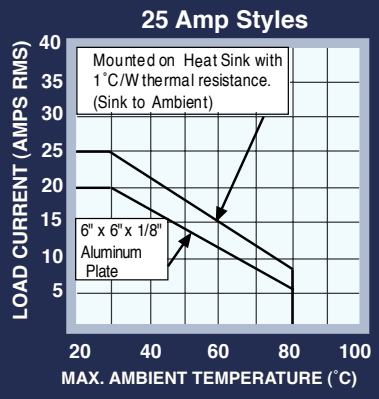
SSR's having random turn-on may have a better chance of survival than a zero voltage turn-on device for they commonly require the transformer to support only a portion of the first half-cycle of the voltage. On the other hand, a random turn-on device will frequently close at the essentially zero voltage point (start of the half-cycle) and then the SSR must sustain the worst-case saturation current. A zero voltage turn-on device has the advantage that it turns on in a known, predictable mode and will normally immediately demonstrate (dependent on turnoff flux polarity) the worst-case condition. The use of an oscilloscope is recommended to verify that the half-cycle surge capability of the SSR is not exceeded. The severity of the transformer saturation problem varies greatly, dependent on the magnetic material of the transformer, saturated primary impedance, line impedance, etc.

A safe rule of thumb in applying an SSR to a transformer primary is to select an SSR having a half-cycle current surge rating (RMS) greater than the maximum applied line voltage (RMS) divided by the transformer primary resistance. The primary resistance is usually easily measured and can be relied on as a minimum impedance limiting the first half-cycle of inrush current. The presence of some residual flux plus the saturated reactance of the primary will then further limit, in the worst case, the half-cycle surge safely within the surge rating of the SSR.

SELECTING THE PROPER SSR

NOMINAL LOAD CURRENT: Initially select a relay whose current rating exceeds the normal load current. Using the load current vs, temperature charts for that relay, check the actual current capacity at the ambient temperature to which the relay will be subjected.

As an example, the chart shows that a 25 ampere relay provided with a suitable heat sink can safely carry a maximum of 22 amperes continuously at 40˚C ambient. Since heat degrades the components ability to carry current, every effort should be made to keep the operating temperature of the SSR as low as possible.



APPLICATION DATA

PROTECTING THE OUTPUT SWITCH:

An SCR is a four layer semiconductor having 3 terminals: Cathode, anode and Gate. Normally it blocks current in both the forward and reverse directions. The SCR is triggered on in the forward direction by a small gate current. The SCR remains on until load current decreases to a value less than necessary to maintain the SCR in the on state. When switching AC, two SCRS are connected in inverse parallel.

A Triac also has 3 terminals, like the SCR, it normally blocks current in both directions; but may be triggered in either direction by a small gate current

Both SCR's and Triacs are members of the thyristor family. Therefore, we use this term to denote both devices.

There are 4 ways to put a thyristor into a conducting mode. Only one method is desirable and the other three are the source of most application problems.

The 4 methods of Thyristor turn-on are -

A. Gate Turn-on: By injecting a controlled current into the gate (the desired method).

B. Forward Breakover Turn-on: A voltage in excess of the Breakover (or Peak Blocking) voltage across thyristor.

C. DV/DT turn-on: A voltage which rises faster than the Thyristor can tolerate, and still remain in the off state.

D. Thermal Turn-on: Allowing the temperature of the thyristor to go beyond the value sufficient to cause excessive leakage current, causing turn-on and possible thermal runaway.

The last three methods can be protected against as follows. In those situations where high peak voltage transients occur, effective protection can be obtained by using metal oxide varistors (MOV). The MOV is a bidirectional voltage sensitive device that has low impedance when its design voltage threshold is exceeded.

HEAT SINKING:

It is important to select the right size heat sink for your applications. SSR's will typically generate 1.2 watts per amp of load current. The total wattage times the thermal resistance equal the temperature. For example a 25 amps SSR with a 20 amps load applied dissipates 24 watts when mounted on a aluminum plate 6" X 6" X 1/8" with thermal grease applied between the SSR base and aluminum plate. 20 amps x 1.2 watts / amp = 24 watts. 24 watts x 1˚C / watts = 24˚C rise.

FUSING:

The SSR has a I^2T rating which is a measure of the amount of energy it can safely handle without damage. The I^2T rating of the fuse is a measure of the amount of energy the fuse will pass to the SSR. To protect the SSR, an inline fuse rating should be less than that of the SSR. An SSR exposed to a surge greater than its non-repetitive rating will normally fail as a shorted unit.

EXPRESSIONS USED IN SPECIFICATIONS

$\frac{dv}{dt}$	Equals the maximum permissable rate of change of voltage in volts/microseconds
V =	Line Voltage
I =	Load Current
PF=	Load Power Factor
F =	Line Frequency
L =	Inductance in Henrys
C =	Capacitance in Microfarads
R_1&R_2 =	Resistance in Ohms

SOLID STATE RELAY SELECTION CHART

CONTROL VOLTAGE	LOAD VOLTAGE	MOUNTING	LOAD CURRENT AMPS (2 3 4 5 6 10 12 25 40 50 75 90 125)	PAGE
3 - 30VDC	240 VAC or 60 VDC	PC BOARD	H PACK	21 - 22
			L PACK	21 - 22
			F PACK	19 - 20
		PC BOARD (SIP)	V PACK	16
		SOCKET	K PACK	23 - 24
		PANEL	M PACK	19 - 20
			N PACK	17 - 18
			S PACK	17 - 18
	200 VDC	PANEL	W6 series (DDX	12
	600 VAC		W6 series (DSX)	11
	480 VAC		W6 series (DTX)	13 - 14
	600 VAC	DIN/PANEL	SSR-DIN-DC	8
			SSR-DIN-AC	8
		PANEL	W6 series (ASX)	10
90 - 280VAC	5 or 12 VDC	PC/PUSH ON TERM.	W226	25