Power AC Solid State Relay SSRT

COMECO CONTROL & MEASUREMENT

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BS EN ISO 9001 Reg.No FM 40344

- **Zero-cross output switching**
- **Double thyristor output switch**
- **Up to 400 VAC operating voltage**
- **Up to 200 A switching RMS current**
- **Three input ranges**
- **4000 V input/output insulation**

SSRT Solid State Relays, manufactured by COMECO, are zero-cross operating electronic modules designed to switch single-phase AC power loads **up to 200 Arms**. The SSR modules are non-contact and convenient substitutes of power contact relays due to their higher switching frequency and practically complete absence of electromagnetic interference. The life and reliability of the SSR modules, compared to these of the contact relays, are much higher because there are no moving parts, noise, shocks, and vibration during the operation. The SSRT electronic relays can switch active loads up to 200 Arms or inductive loads up to 95 Arms at power voltage up to 400 VAC. The control input is optically isolated from the output and accepts AC or DC voltage signals. An operating LED indicates ON/OFF device status.

Technical specifications

Input			
Control voltage range	4...36 VDC	6...26 VAC/DC	100...240 VAC
Input current	5...12 mA	6...12 mA	6...12 mA
Turn-on/off voltage	3 VDC	4 VAC / 5 VDC	90 VAC
Reverse voltage protection	-32 VDC	-32 VDC	-

Output	
AC switching current (with proper heatsink)*	≤200 A_{rms}
Minimum holding current	200 mA
Non rep. surge current (t=10ms)	1700 A
Maximum leakage current	15 mA
Critical rate of current rise dI/dt	150 A/µs
I^2t value for fusing (t=10ms)	1125 A^2s
On-state voltage at rated current	1.6 V_{rms}
Critical off-state voltage rise dV/dt	500 V/µs
Operational frequency	45...65 Hz
Thermal resistance (junction-case)	0.14 °C/W

* We highly recommend using SSR at no more than 80% of maximum RMS current!

General specifications	
Max. operating AC voltage	400 VAC_{rms}
Min. operating AC voltage	24 VAC_{rms}
Rep. off-state peak voltage	1200 V_p
Non rep. off-state peak voltage	1300 V_p
Power factor	> 0.5
Operating temperature	-20...+65 °C
Storage temperature	-40...+85 °C
Standard heatsink, length	Aluminum, 150 mm
Insulation "input-output"	4000 VAC_{rms}
Insulation "output-case"	2500 VAC_{rms}
Protection	IP00
Input electrical connection	two-screw terminal
Output electrical connection	three M5 screws
Mounting	for optimized cooling
ON-indicating LED	ϕ3, red
Weight (with standard heatsink)	max. 350 g

Heatsink specifications

Max. RMS current / Ambient temperature ↓	**40 A**	**60 A**	**80 A**	**100 A**	**120 A**
20 °C	430 cm^2 / 150 mm	1300 cm^2 / 150 mm	1900 cm^2 / 180 mm	3800 cm^2 / 350 mm	5800 cm^2 / **
40 °C	720 cm^2 / 150 mm	2100 cm^2 / 200 mm	3300 cm^2 / 310 mm	6500 cm^2 / **	10000 cm^2 / **
60 °C	1500 cm^2 / 150 mm	4400 cm^2 / 410 mm	6900 cm^2 / **	13500 cm^2 / **	20400 cm^2 / **

Heatsink surface / length (COMECO type) at 105°C heatsink temperature

** Requires additional forced (fan) cooling!

HEATSINKS AND SSRs

Adequate heatsinking, including consideration of air temperature and flow, is essential to the proper operation of a solid-state relay (SSR). It is necessary that the user provide an effective means of removing heat from the SSR package. The importance of using a proper heat sink cannot be overstressed, since it directly affects the maximum usable load current and/or maximum allowable ambient temperature. Lack of attention to this detail can result in improper switching (lockup) or even total destruction of the SSR. Up to 90% of the problems with SSRs are directly related to heat. All SSRs develop heat as a result of a forward voltage drop through the junction of the output device. Beyond a point, heat will cause a lowering (or derating) of the load current that can be handled by the SSR. "Heatsinks" are used to create a method of removing heat away from the relay, thus allowing higher current operation. With loads of less than 4 Amps, cooling by free flowing convection or forced air currents around the unit is usually sufficient. Loads greater than 4 Amps will require heat sinks. We recommend mounting our units on the heatsinks listed on the reverse page. However, when this is not possible, and units are to be mounted to some other heatsinking object with surface (for Aluminium) calculated as described on the reverse page. Material heat conductivity should be also kept in mind. In comparison, twice the amount of steel and four times the amount of stainless steel would be needed to achieve the same effect. Units should not be mounted in an enclosed area without proper airflow. Units should also never be mounted to a plastic base or to painted surfaces. The heat sink should be positioned with the fins in a vertical position with an unimpeded airflow. The vertical mounting will aid in heat dissipation in that heat may rise from the heat sink unobstructed. Any panel mount SSR must be mounted to a clean, bare (non-painted) surface that is free of oxidation. Silicone (thermal) grease should be placed on the metal base of the relay before mounting to a metal surface. Heat Transfer is affected by the thickness of the thermal compound, uniformity of application and how firmly the relay is attached to the heatsink. Note that a thicker layer of thermal compound actually decreases heat transmission. Care must be taken when mounting multiple SSRs in a confined area. SSRs should be mounted on individual heatsinks whenever possible. Panel mount SSRs should never be operated without proper Heat Sinking or in Free Air, as they will THERMALLY SELF-DESTRUCT UNDER LOAD. If the base temperature does not exceed 45 °C under normal operating conditions, the SSR is operating in an optimal thermal environment. If this temperature is exceeded the relay's current handling ability must either be thermally improved by the use of a heatsink, or greater airflow must be provided over the device through the use of a fan. Some cases may require the selection of a higher current output SSR and thermally derating the device accordingly. Remember that the heatsink removes the heat from the SSR and transfers that heat to the air in the electrical enclosure. In turn, this air must circulate and transfer its heat to the outside ambient. Providing vents and/or forced ventilation are a good way to accomplish this. All SSRs are capable of running at full rated power (with proper heatsink), **however it is strongly suggested that they be used at no more than 80% power**, to provide a safety margin in case of higher than expected Voltage, Temperature, dirt on the heatsink, etc.

PROTECTIVE MEASURES AND ELECTRICAL NOISE

SSRs generally do not fail due to electrical noise, unless they happen to mistrigger during a point in the line cycle when an excessively high current surge might occur. Usually, a malfunction due to noise is only temporary, such as turning on when the SSR should be off, and vice-versa. By its very nature, noise is difficult to define, being generated by the randomness of contact bounce and arcing motor commutators, etc. Noise, more properly defined as Electromagnetic Interference (EMI), affects the SSR by feeding signals into the sensitive parts of the circuit, such as the SCR. A built-in snubber RC network across the output is effective in reducing sensitivity to noise, especially at lower frequencies.

Metal oxide varistors (MOV)

The metal oxide varistor was developed about the same time as the SSR and has subsequently become a trustworthy companion of the SSR, providing much needed protection in some of its more hostile environments. An MOV can be used as follows: across the incoming line to suppress external transients before they enter the system; across the load to suppress load generated transients; or more frequently, across the SSR to protect it from all transient sources. In the latter case, the MOV can be conveniently mounted to the same SSR output terminals as the load wiring. An MOV can be used effectively across such loads as transformers and switching power supplies where spikes too fast to be absorbed by the transformer itself may be fed back into the primary (SSR load) winding. Used within its ratings, the MOV will most likely outlive its associated equipment and provide low cost protective insurance for the SSR.

Surge ratings

There are very few completely surgeless SSR loads. Next to improper heatsinking, surge current is one of the most common causes of SSR failure. Overstress of this type can also seriously impair the life of the SSR. Therefore, in a new application, it would be wise to carefully examine the surge characteristic of the load and then select a device that can adequately handle the inrush as well as the steady state condition, while also meeting the lifetime requirements. In addition to the actual surge ratings given for SSR's, the rate of rise of surge current (di/dt) is also a factor in AC triac types. Exceeding its value may result in destruction of the device. As a guide, the amperes-per-microsecond (di/dt) withstand capabilities are typically in the order of their single cycle surge ratings. The highest surge current rating of an SSR is typically 10 times the steady-state RMS value, and it is given as the maximum peak current for one line cycle. It should be noted that a surge of this magnitude is allowable only 100 times during the SSR's lifetime. Furthermore, control of conduction may be momentarily lost due to a surge. This means that it may not be possible to turn off the SSR by removal of control power both during and immediately after the surge. The output triac must regain its blocking capability and the junction temperature allowed to return to its steady state value before reapplication of the surge current, which may take several seconds. It should be noted that the preceding cautionary notes apply only to the extreme limits where the SSR should not be designed to operate anyway.

Fusing

Fast 'Semiconductor Fuses' are the only reliable way to protect SSRs. They are also referred to as current-limiting fuses, providing extremely fast opening while restricting let-through current far below the fault current that could destroy the semiconductor. This type of fuse tends to be expensive, but it does provide a means of fully protecting SSRs against high current overloads where survival of the SSR is of prime importance. An I^2t fuse rating (ampere-squared seconds) is useful in aiding in the proper design of SSR fusing. This rating is the benchmark for a SSRs ability to handle a shorted output condition. We recommend a circuit protection through the use of a properly selected I^2t (semiconductor fuse). Devices such as electromechanical circuit breakers and slow blow fuses cannot react quickly enough to protect the SSR in a shorted condition and are not recommended! Fast blow type fuses may be appropriate for some applications. Every SSR has an I^2t rating (see reverse). The procedure is to select a fuse with an I^2t let-through rating that is less than the I^2t capability of the SSR for the same duration. I^2t relates directly to the published fuse characteristics. System designers who are considering using I^2t fuses should consult a good technical manual dealing with the application of these fuses when designing their systems.

SSR APPLICATIONS

Solid State Relays (SSRs) cannot always be applied in exactly the same way as Electromechanical (EMRs) and when such is the case, caution should be taken.

Inductive Loads

While most SSR loads, even lamps, include some inductance, its effect with resistive loads is usually negligible. Only those loads that utilise magnetics to perform their function, such as transformers and chokes (windings), are likely to have any significant influence on SSR operation. These loads can create large current surges and the SSR should be derated accordingly. ***

Transformer Switching

Extremely high current surges are commonly associated with transformers, especially those with a penchant for saturation. The zero voltage turn on feature of standard SSRs can increase this possibility and might require that special precautions be taken. The zero current turn off characteristic of SSRs, while minimising the problem, will not prevent it. From the practical and economic standpoint, the best choice may still be a standard SSR, overrated to withstand huge surges. ***

Motor Switching

Dynamic loads such as motors and solenoids, etc., can create special problems for SSRs. High initial surge current is drawn because their stationary impedance is usually very low. As a motor rotates, it develops a back EMF that reduces the flow of current. This same back EMF can also add to the applied line voltage and create 'over-voltage' conditions during turn off. Most of the surge reducing techniques discussed earlier can also be applied to motors. It should be noted that over-voltage caused by capacitive voltage doubling or back EMF from the motor cannot be effectively dealt with by adding voltage-transient suppressors. Suppressors such as Metal Oxide Varistors (MOVs) are typically designed for brief high voltage spikes and may be destroyed by sustained high-energy conduction. It is therefore important that SSRs are chosen to withstand the highest expected sustained voltage excursion. ***

Lamp Switching

The inrush current characteristic of incandescent (tungsten filament) lamps is somewhat similar to the surge characteristic of the triac used in AC SSR outputs, making them a good match. The typical ten times steady state ratings which apply to both from a cold start allow many SSRs to switch lamps with current ratings close to their own steady state ratings.
CAUTION: Using SSRs for driving mercury, fluorescent, or HID lamps should be avoided!

***Please call Technical Support for additional Suggestions!