Selecting a Suitable Heatsink

Due to the forward voltage drop of the output SCRs, solid state relays generate an internal power loss. The amount of power generated is a function of the load current. The manufacturer provides power loss curves, as shown in Fig 1. At normal load currents the power loss can be estimated at 1 Watt for every 1 Arms of load current.

Obviously the junction temperature Tj can be calculated if the power dissipation is known. The normal maximum allowable junction temperature is 125 degrees Centigrade. Most designs are based on providing a 10 degree Centigrade safety margin and use a heat sink to keep the junction temperature to 115 degrees Centigrade.

In order to maintain an acceptable power switch junction temperature, some form of heatsink must dissipate the heat generated by the power loss. For most printed circuit board types, the relay current rating is established by measuring the thermal impedance, from the dissipating elements to air, using the relay package as the heat sink. Some printed circuit board types are available with an integral heatsink; their ratings reflect the additional effects of the integral heatsink.

Panel mount relays usually require an external heatsink. The electrical analogy shown below identifies the primary thermal impedances in the path from junction to ambient air:

Tj = Power x (sum of thermal impedances) The relay manufacturer provides the thermal impedance junction to baseplate, and the heatsink manufacturer provides the thermal impedance heatsink to air.

However, the thermal impedance from baseplate to heatsink is determined by the assembly procedure used. It is important that the surface to which the relay is being assembled is clean, flat, bare metal (NOT PAINTED). If an anodized aluminum heatsink is used, the thermal impedance of the anodized surface may be acceptable, depending on the thickness of the anodize.

A thermal compound (or thermal pad) is needed to minimize the baseplate-to heatsink thermal impedance. In general a thermal compound will give the lowest thermal impedance, but it is very important to use a minimum of thermal compound – too much is almost as bad as none at all. One widely used technique is to apply a thin layer of compound and then apply pressure to the relay while rotating it back and forth to squeeze any excess compound out before attaching the relay to the mounting surface.

In some applications the relay will be mounted directly to a panel. This technique will work up to load currents

of 7 to 8 Arms depending on the panel material, ambient temperature, etc. In these cases it is absolutely essential to mount the relay to an un painted surface and use a good thermal compound. As a rule, the minimum per relay panel area should be 25 square inches.

Above these current levels some form of heatsink will be required. Determine heatsink thermal impedance using rating curves like those shown in Fig 1.
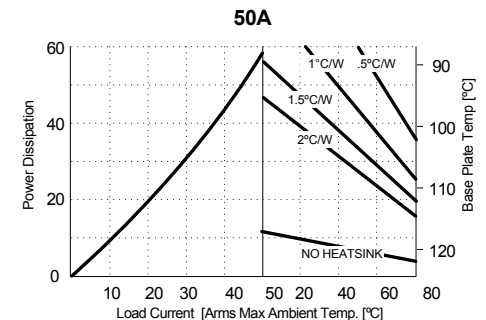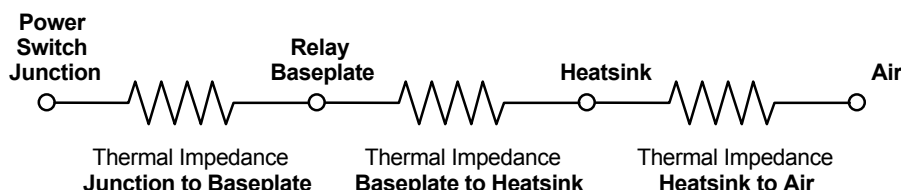

Fig 1

The figure shown is for a 50 Arms rated relay. Assume the load current is 30Arms, then in the left hand side of the curve the power dissipated is seen to be 31 Watts.

Reading across to the heatsink versus ambient temperature curves shows that an ambient of 40 degrees Centigrade requires a heatsink with a thermal impedance of 2 degrees Centigrade per Watt. However, to reduce the junction temperature to approximately 115 degrees Centigrade, a heatsink of about 1.5 degrees Centigrade would be more suitable. If the point of 31 Watts dissipation is read all the way to the right, then the maximum allowable baseplate temperature is shown for a

Power Switch Junction — Thermal Impedance **Junction to Baseplate** — Relay Baseplate — Thermal Impedance **Baseplate to Heatsink** — Heatsink — Thermal Impedance **Heatsink to Air** — Air

junction temperature of 125 degrees Centigrade. In the example discussed, this is 106 degrees Centigrade. However, to allow for the 10 degrees Centigrade safety factor, the baseplate temperature should not exceed 96 degrees Centigrade.

There are many sources for heat sinks, enabling designers to select one most suitable thermally and mechanically for the application.