13. Heatsinks for Power Semiconductors

Captions of the Figures

Fig. 1 Thermal resistance heatsink to ambient R_{thha} (without contact thermal resistance case to heatsink R_{thch}) for natural air cooling as a function of the power dissipation P.

Fig. 2 Thermal resistance heatsink to ambient R_{thha} per semiconductor component (without contact thermal resistance case to heatsink R_{thch}) for natural air cooling as a function of the heatsink length l (with n semiconductor components on a single heatsink and/or R = 2 rows of heatsinks one on top of the other). Parameter: Power dissipation P per semiconductor component.

Fig. 3 Thermal resistance (of the entire) heatsink to ambient R_{thha} with n semiconductor components (modules) on a single heatsink as a function of the heatsink length l. Parameter: Total power dissipation P_{VTOT} of all semiconductor components together.

Fig. 4 Thermal resistance heatsink to ambient R_{thca} (without contact thermal resistance case to heatsink R_{thch}) for forced air cooling and pressure drop Δp, both as a function of the air flow V_{air}/t and air velocity v_{air}.

Fig. 5 Thermal resistance case to ambient R_{thca} at forced air cooling of capsule devices mounted to the heatsink having pole face diameters D, and pressure drop Δp, both as a function of the air flow V_{air}/t and air velocity v_{air}.

Fig. 6 Thermal resistance (of the entire) heatsink to ambient R_{thha} for forced air cooling with the recommended fan or at the given air velocity v_{air} (with n semiconductor components (modules) on a single heatsink) as a function of the heatsink length l.

Fig. 7 Thermal resistance (of the entire) heatsink to ambient R_{thha} with n semiconductor components (modules) on a single heatsink as a function of the air flow V_{air}/t and air velocity v_{air}.

Fig. 8 Pressure drop Δp for forced air cooling as a function of the air flow V_{air}/t at various heatsink lengths l. 1 mbar = 10 mm H_2O.

Fig. 9 Transient thermal impedance case to ambient Z_{thca} at natural air cooling of capsule devices mounted to the heatsink having pole face diameters D as a function of the time t elapsed after a step change in power dissipation. Parameter: Power dissipation P per semiconductor component.

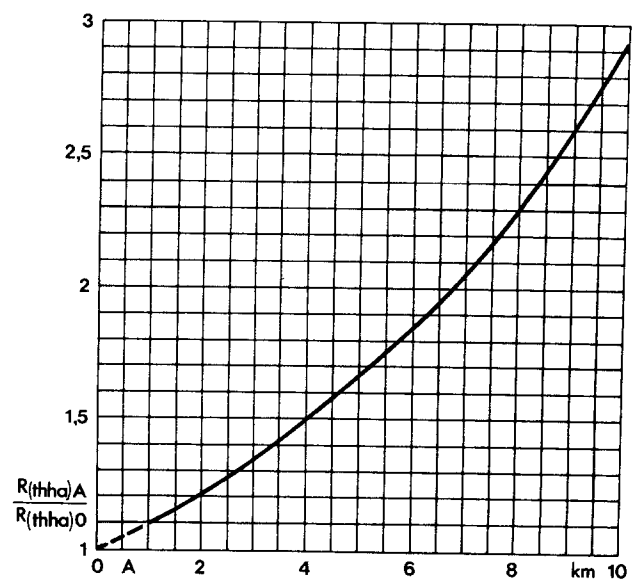
Fig. 10 Transient thermal impedance (of the entire) heatsink to ambient Z_{thha} with n semiconductor components (modules) on a single heatsink as a function of the time t elapsed after a step change in power dissipation. The curves P.../...F are valid for forced air cooling with the recommended fan. Parameters: Total power dissipation P_{VTOT} (for natural air cooling) and heatsink length l.

Fig. 11 Transient thermal impedance case to ambient Z_{thca} at forced air cooling of capsule devices mounted to the heatsink having pole face diameters D as a function of the time t elapsed after a step change in power dissipation. Parameter: air flow V_{air}/t.

Heatsink thermal resistances at operating altitudes of more than 1000 m above sea level

As it is well known, the density of air and with it the cooling effect decreases with the altitude. Consequently the thermal resistance of any air cooled heatsink increases with the operating altitude. Up to 1000 m this increase is negligible. For altitudes above 1000 m the ratio of the thermal resistance heatsink to ambient air at altitude A $R_{(thha)A}$ to the value at sea level $R_{(thha)O}$ is given in the following figure. It applies to any heatsink at natural cooling and also at forced air cooling.

The thermal resistances junction to case and case to heatsink are, of course, not influenced by the air density.

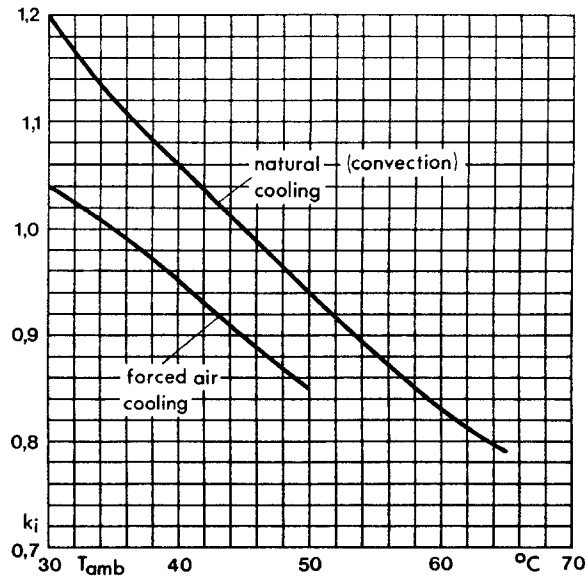


Ratio of the heatsink thermal resistance at altitude A $R_{(thha)A}$ to the value at sea level $R_{(thha)O}$.

Current ratings of the SEMISTACKs at various ambient temperatures

According of the IEC standards the current ratings of power semiconductor stacks and assemblies are given at 45 °C ambient temperature of natural cooling and 35 °C for forced air cooling.

The diagram gives the correction factor k_i for the output current I_{dN} or I_{RMSN} resp. for cooling air (ambient) temperatures T_{amb} deviating from these standard values.



Current rating factor k_j for SEMISTACKs versus cooling air (ambient) temperature T_{amb}.