A780 Low Thermal Path Mounting application

In case of customer Ripple Current requirements with high demand, heat sink solutions can be used for longer life of A780 series.
EIC team analyzed the performance of A780 capacitors with heat sinked terminals, forecasting the behavior on possible applications of our customers. EIC suggestion is to apply a heat sink in contact with the PCB with the mounted electronic devices, as follows:

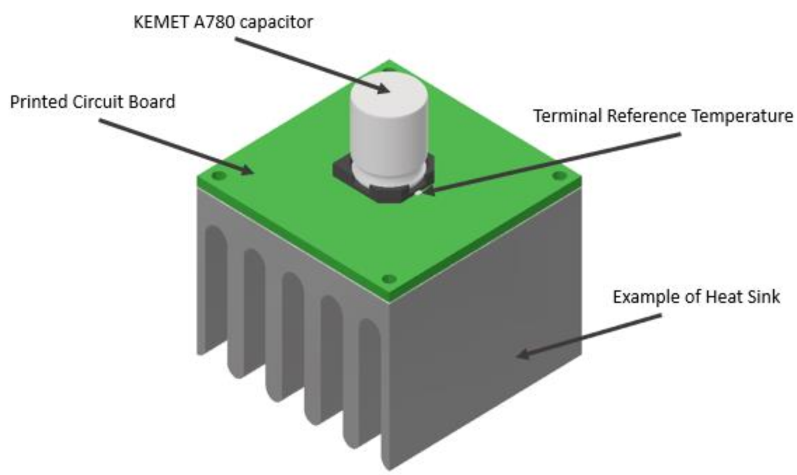


Figure 1 - KEMET A780 mounting example

In absence of forced air cooling, heat dissipation control can be improved by applying metallic heat-sink/radiator on the back side of the PCB. This can allow effective cooling of the system and higher ripple capability, consecutively. Thermal resistance of the PCB between capacitor terminals and the heat sink should be taken into account to thermal modelling to specific applications by the customers.

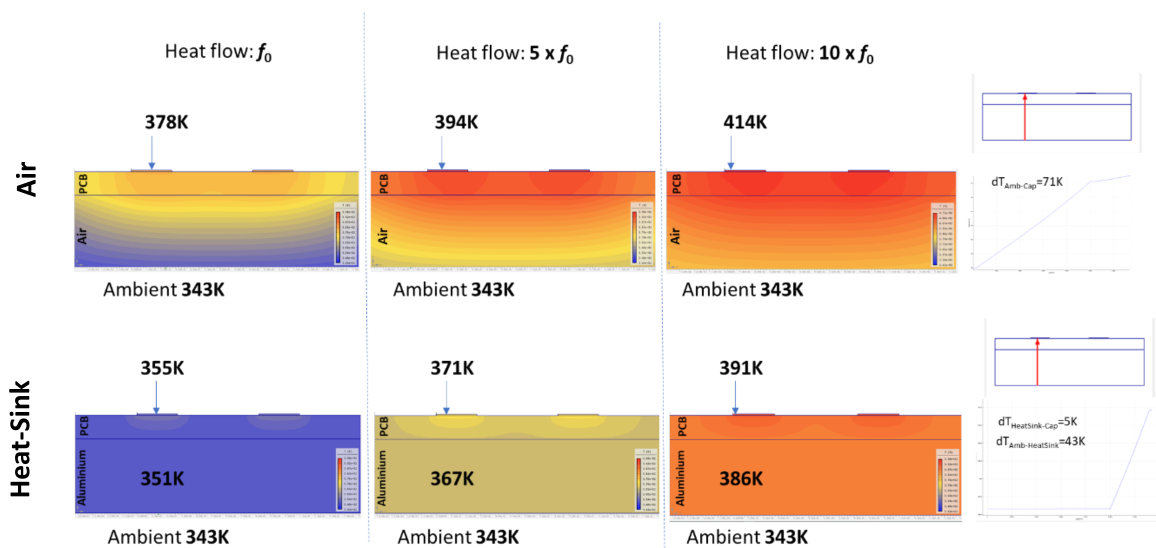


Figure 2 - PCB thermal profiles in Air without convection and with Aluminium Heat-Sink plate without forced cooling.
(PCB thickness 1.6mm; Top metallization thickness 100um; Top metallization width corresponds to the terminal positions of D10xL12 V-chip capacitor; Heat-sink thickness 5mm)

Approaches to improve A780 life and allow higher ripple current

Forced cooling of the heat dissipation system (Heat radiator) reduces total thermal resistance, which results in lower terminal temperature and improved ripple current capability of the capacitor. So, it is possible to control terminals temperature through forced heat-sink cooling system.

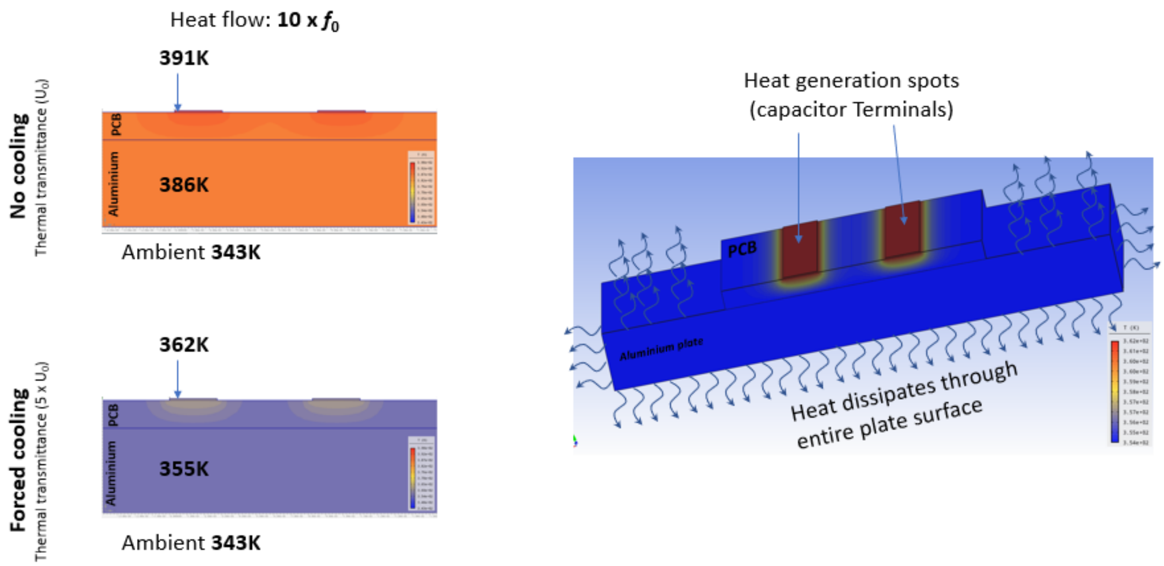


Figure 3 - PCB thermal profiles with Aluminium Heat-Sink plate with forced cooling
(PCB thickness 1.6mm; Top metallization thickness 100um; Top metallization width corresponds to the terminal positions of D10xL12 V-chip capacitor; Heat-sink thickness 5mm)

Thermal resistance of PCB is one of the main contributors in the total thermal resistance of the heat dissipation pathway. Thermal resistance of multilayers PCB can be significantly lower in comparison with single-layer ones of the same thickness, thus applications with a low thermal resistance multilayer PCB can be capable to higher ripple currents. In another words higher current can be applied at the same heat-sink temperature or lower terminal temperature can be assured at the same ripple current.

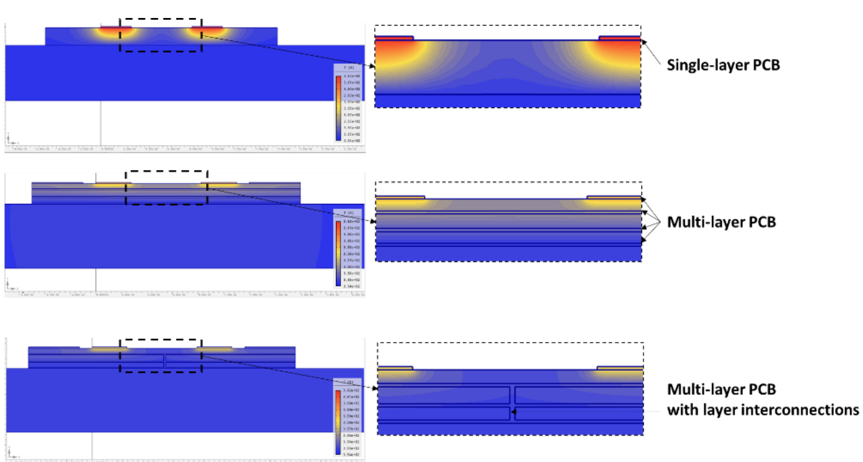


Figure 4 - Multi-layer PCB thermal profiles with Aluminium Heat-Sink plate with forced cooling
(PCB thickness 1.6mm; Top metallization thickness 100um; Top metallization width corresponds to the terminal positions of D10xL12 V-chip capacitor; Heat-sink thickness 5mm)

Application example - A780 Ripple Current capability test

During Ripple Current capability experiments were assembled on one side of a single-layer PCB with total thickness of 1.6mm and 100µm of the top metallized path thickness. Standard aluminium heat radiator was attached to the other side of the PCB to assure constant temperature on the capacitor terminals. Thermal paste was used to minimize the interface thermal resistance.

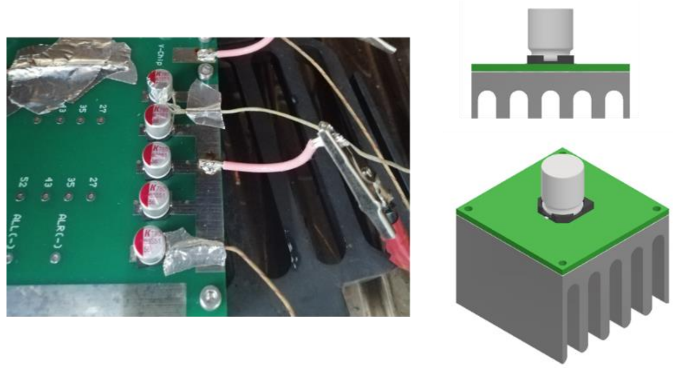


Figure 5 - Ripple Current capability validation set-up details

Please see more detailed information about the set-up in the Appendix.
Terminal temperature was used as a reference point to fix conditions and calculate ripple current capability for different lifetime values, as shown on figure 6.

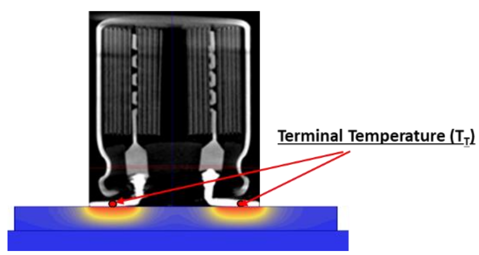


Figure 6 - Terminal Temperature (T_t) is used a reference in case of heat sink usage

Life time at specified ripple current values are assured if terminal temperature T_T is not exceeded.

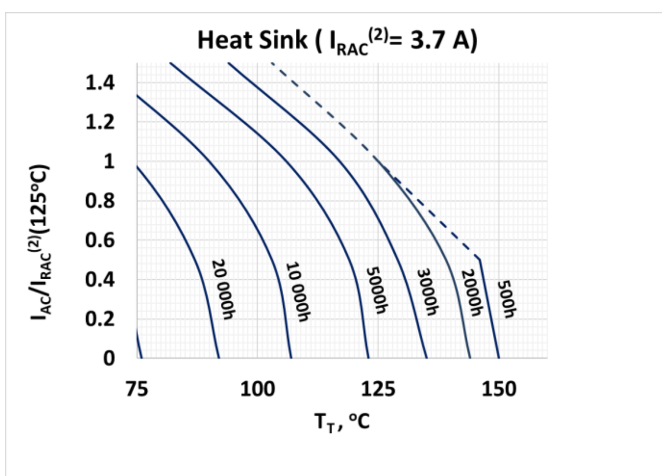
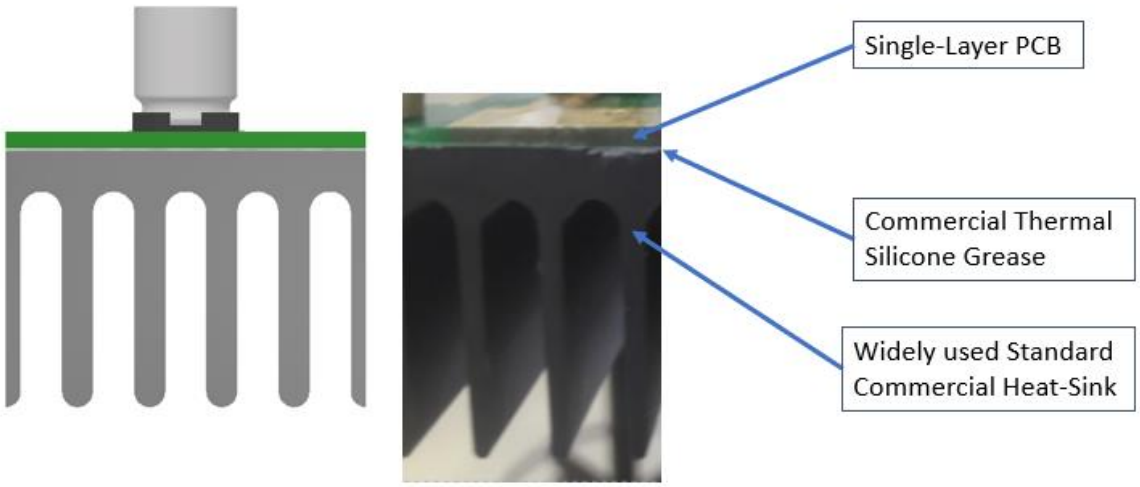


Figure 7 - Operational life, when using a low thermal resistance path, at terminal temperature T_T and ripple current IAC applied

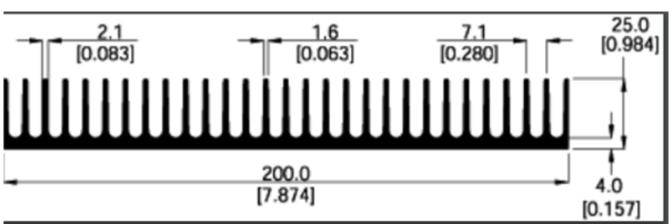
I_{RAC} (2) corresponds to maximum Ripple Current specified for each case and should be consulted in Table 1 of datasheet of KEMET A780 series. The dashed lines correspond to the maximum ripple current allowed for each case. As an example, 135°C on terminal does not allow to apply Ripple Current more than corresponds to IAC/IRAC (2)=0.8.

Appendix:



Heat Sink Specifications

Characteristic	Value
Dimensions (See detailed dimensions below)	200 x 200 x 25 mm
Thermal Resistance	0.5 K/W
Material	Aluminum
Color	Black



Thermal Paste Specifications

Characteristic	Value
Thermal Conductivity	2.7 W/m.K
Specific gravity	2.5 g/cm^3
Color	Grey
Application Temperature	-30°C to +300°C
Dielectric Constant	5.1