TG-CJ-Li-20-20-06-PF Ceramic Heatsink CFD Thermal Performance Study

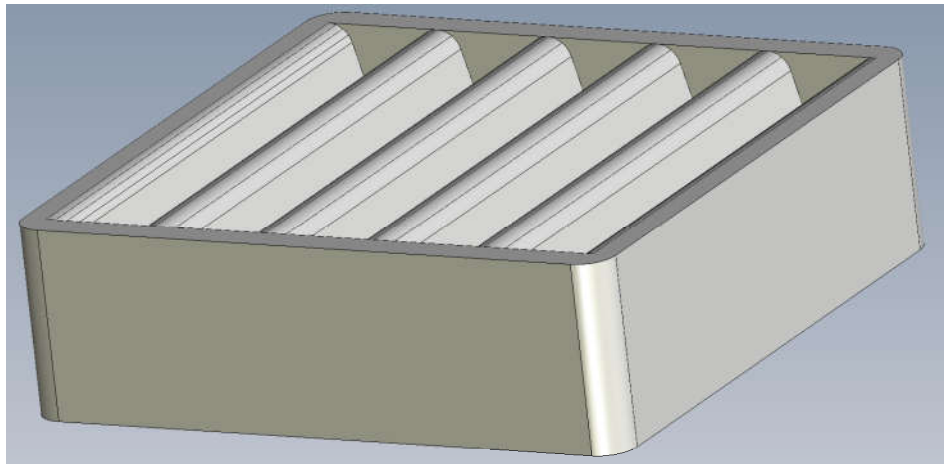
By

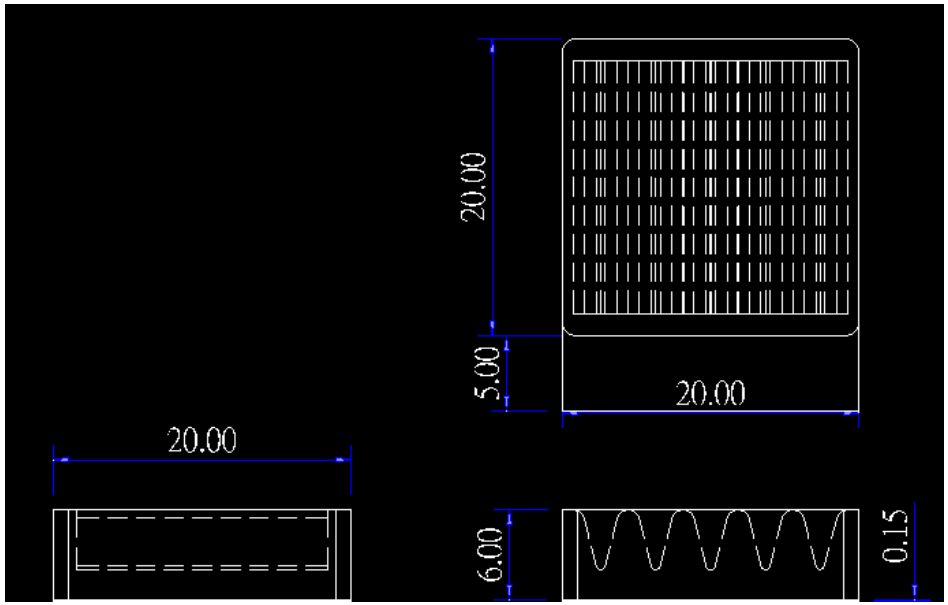
States Chiwanga & Philip Blazdell

TG-CJ-LI-20-20-06-PF Ceramic Heatsink Thermal Study

U5G-S20-06 Heatsink CAD Model

- The top images shows the CAD model of the ceramic heatsink used for CFD thermal study.
- The second image is a drawing of the same heatsink with dimensional details.
- Mechanical and thermal material properties were provided in a t-Global datasheet for TG-CJ-Li-20-20-06-PF; Ceramic Heat Spreader.





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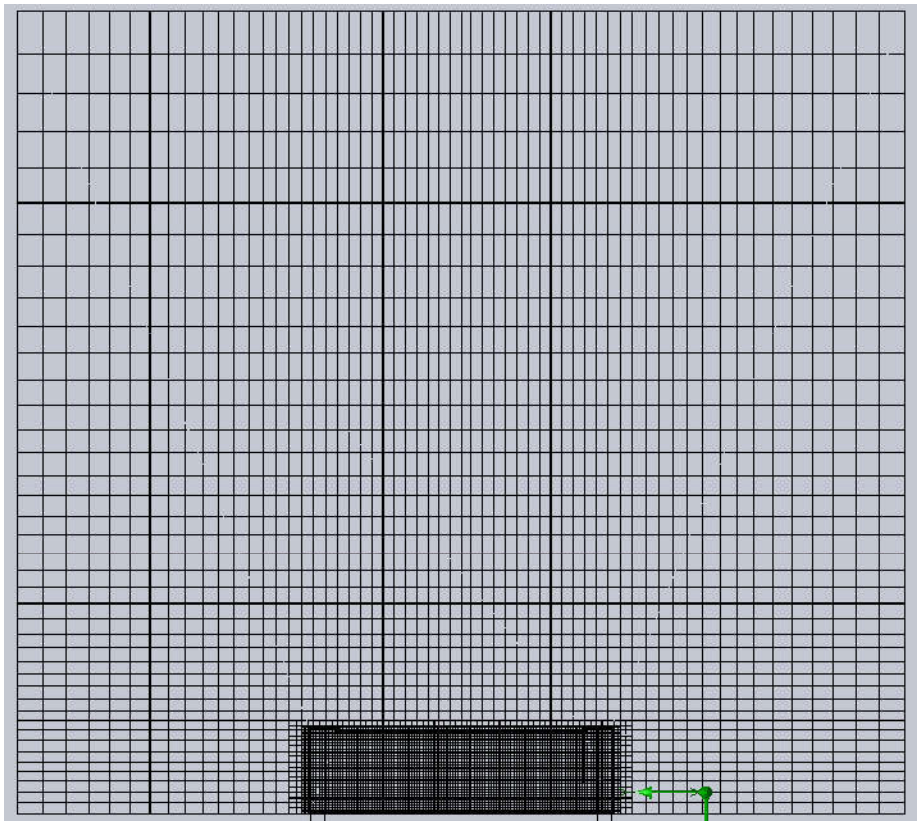
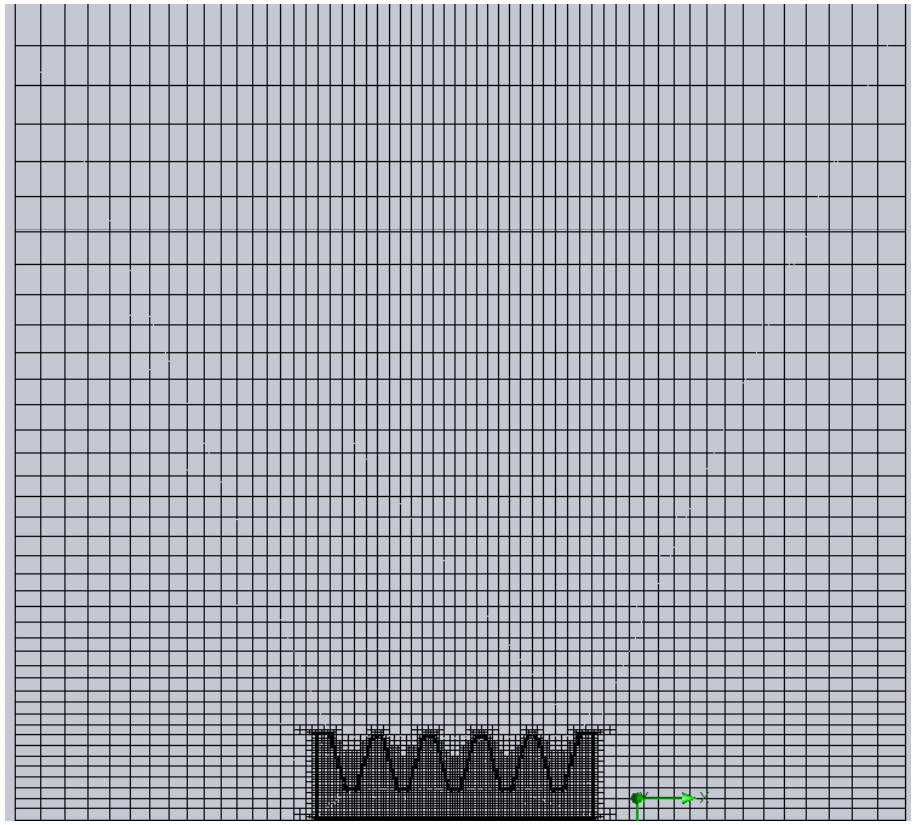
CFD Model Mesh

- The heatsink CFD model mesh used to carry out the natural convection analysis is shown below.
- The model consists of a SOIC heat source, Li-98 thermal tape and TG-CJ-LI-20-20-06-PF ceramic heatsink and air domain /control volume.





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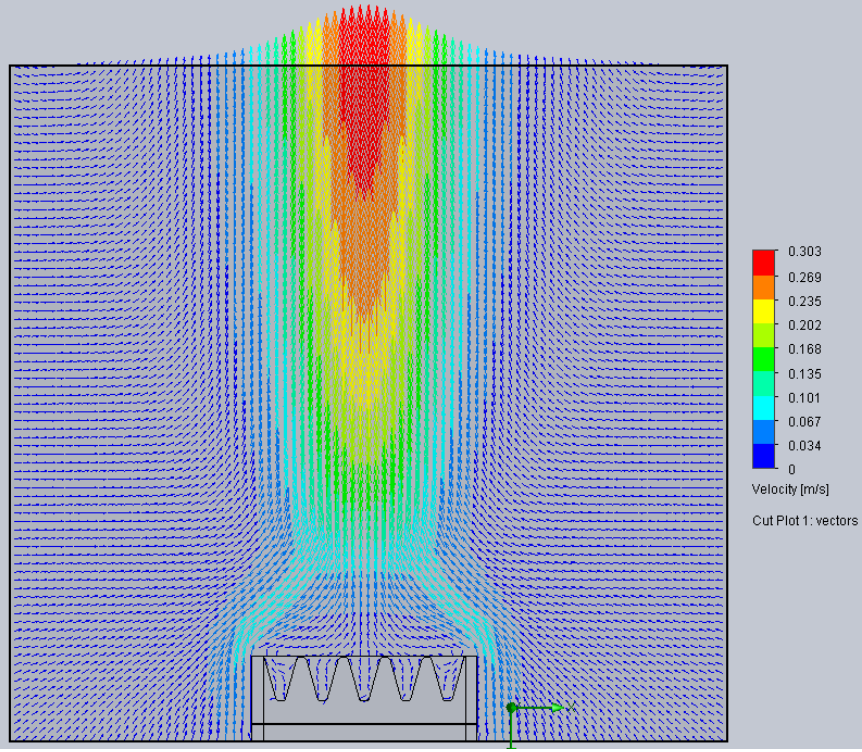
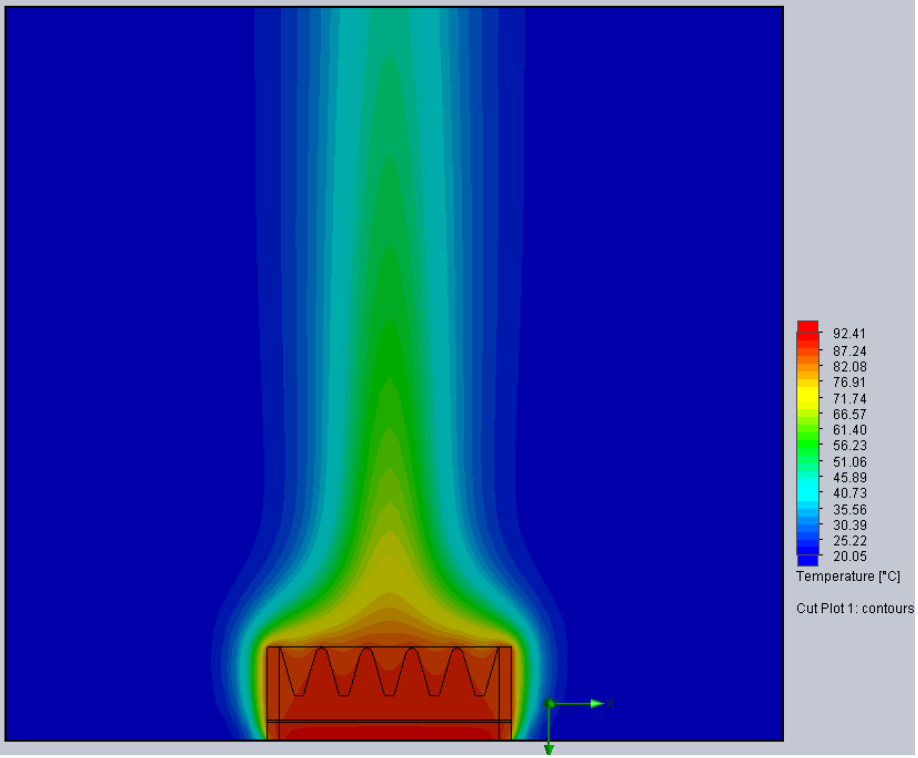
CFD Model Velocity & Temperature Results

- The LHS image shows velocity vector field results through the centre plane. The results were generated from a SOIC heat source of 1W power, in a 20°C ambient air temperature with the heatsink in a horizontal orientation (as shown).
- The RHS image shows a temperature plot result of the same plane (as the LHS image). The 20mm x 20mm x 1.5mm SOIC is predicted to have a maximum temperature of 92.4°C.

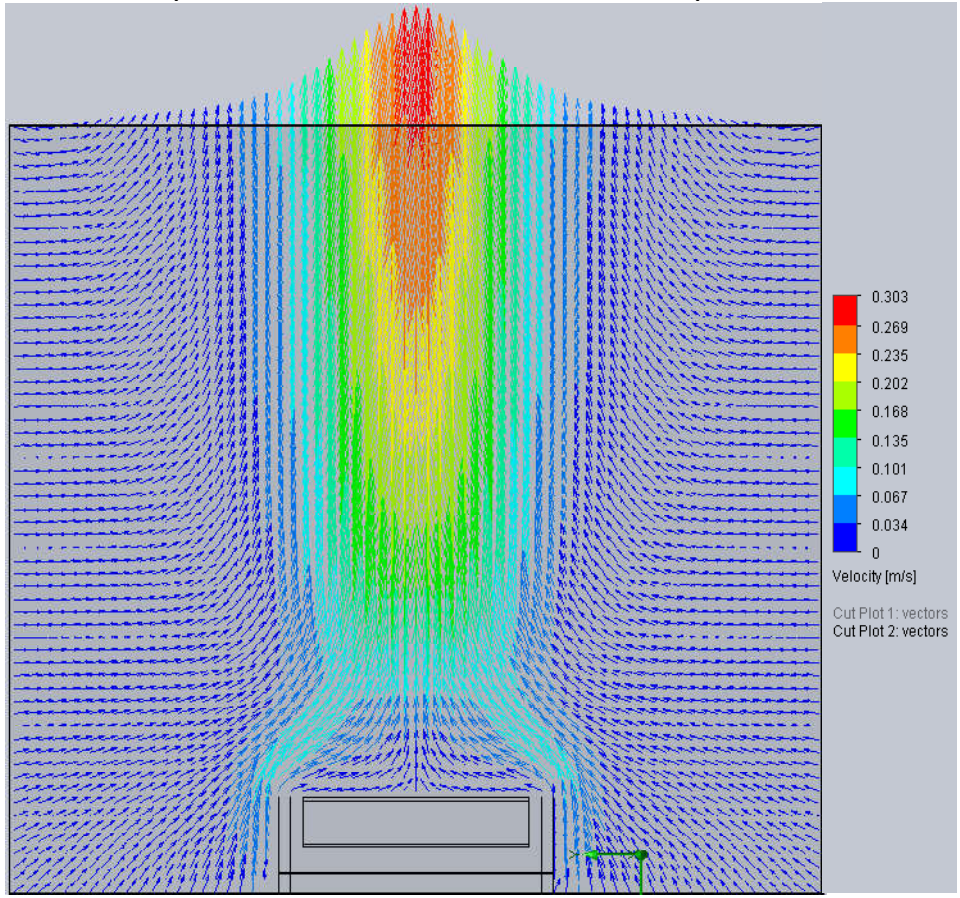


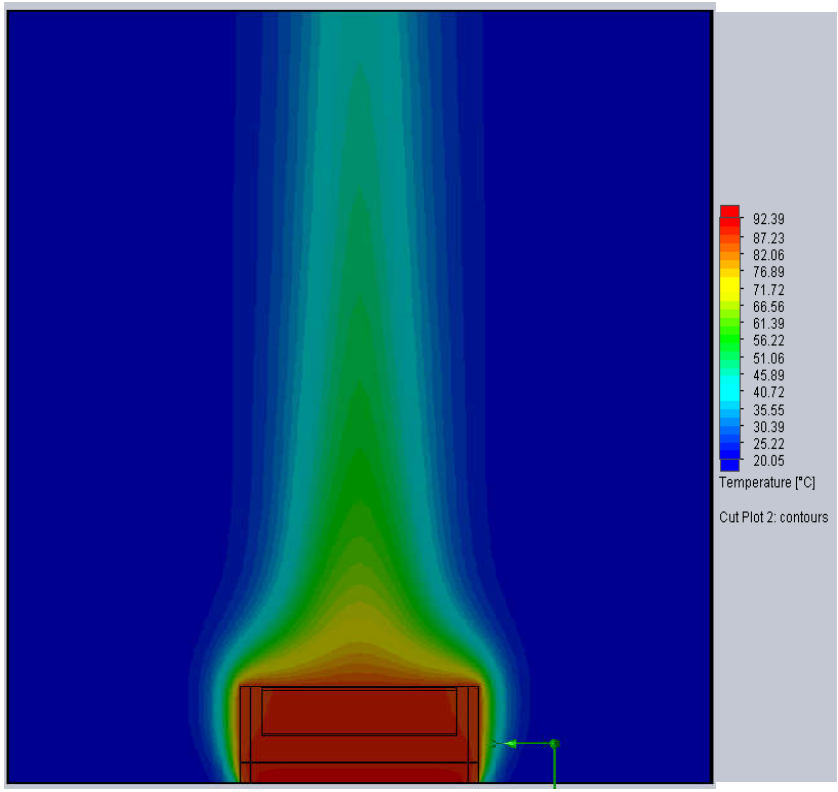


TG-CJ-LI-20-20-06-PF Ceramic Heatsink Thermal Study

CFD Model Velocity & Temperature Results

- The LHS image shows velocity vector field results through the centre plane of one the middle fins.
- The RHS image shows temperature plot result of the same plane (as the LHS image). The 20mm x 20mm x 1.5mm SOIC is predicted to have a maximum temperature of 92.4°C.

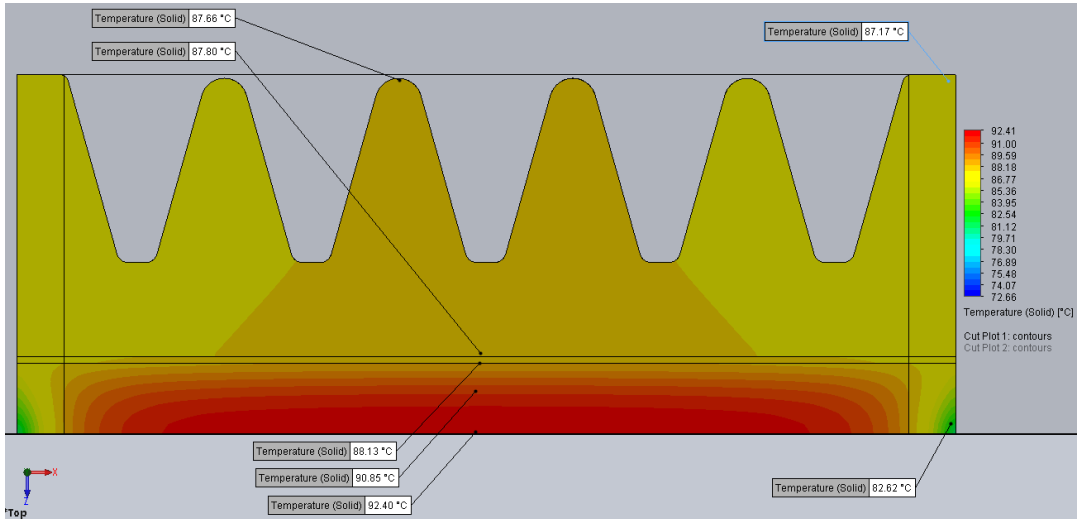


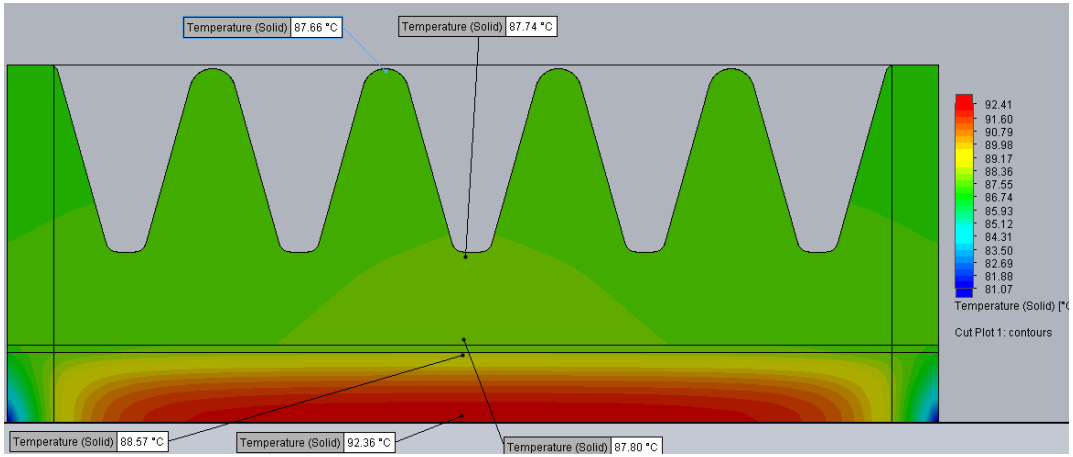


TG-CJ-LI-20-20-06-PF Ceramic Heatsink Thermal Study

Ceramic Heatsink Temperature Results

- The LHS images show predicted temperature of all solid parts analysed i.e. SOIC integrated circuit package, thermal interface tape and the ceramic heatsink.
- The lower image has a higher resolution temperature scale to enable more accurate prediction of temperature values to be extracted from the results and used to determine the required heatsink parameters such as its thermal resistance value.
- The predicted temperature drop across t-Global's 0.15mm thick Li-98 thermal tape was 0.77°C (from 88.57°C-87.80°C).
- The predicted temperature drop across the ceramic heatsink was 0.14°C (from 87.80°C-87.66°C).





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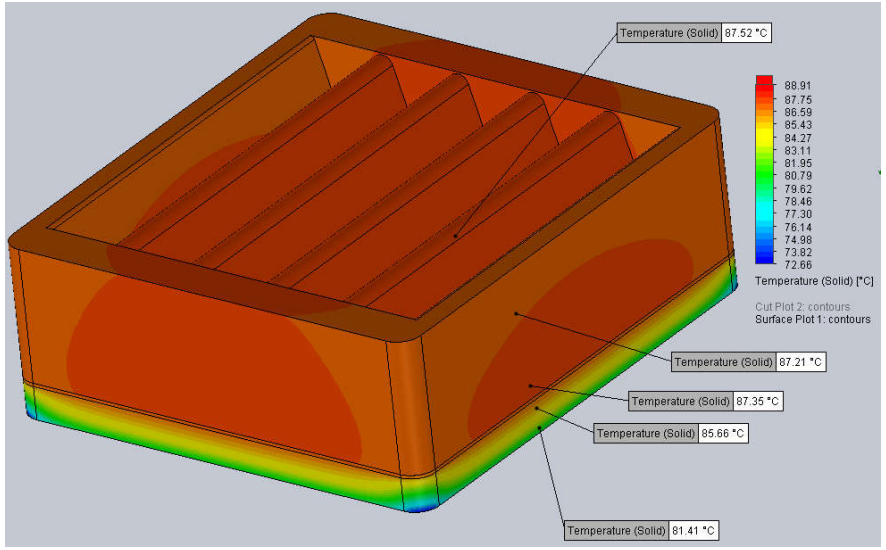
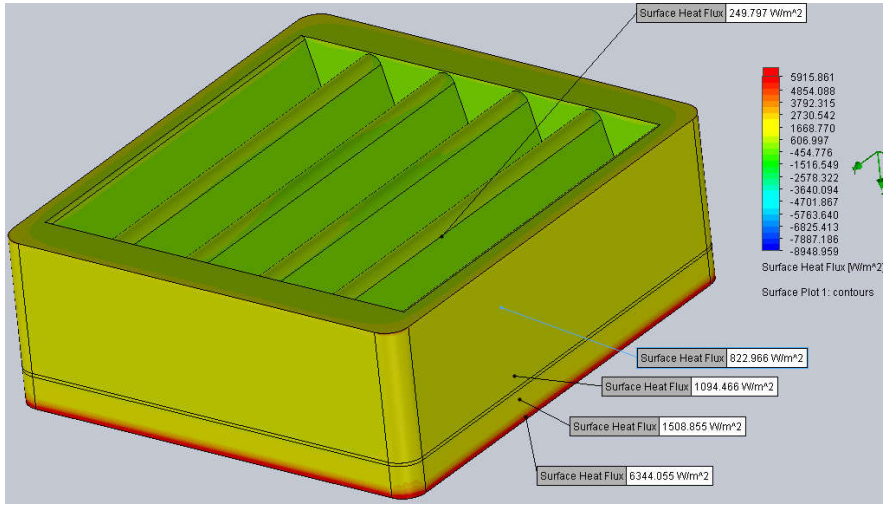




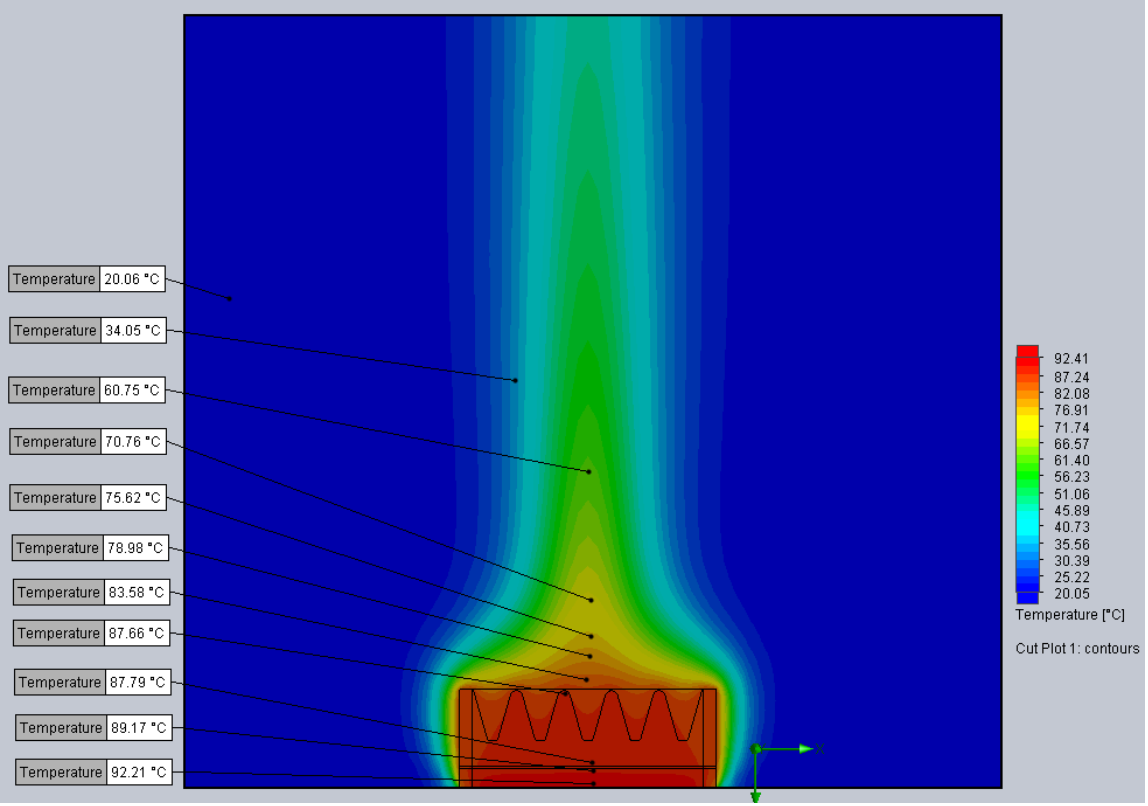
TG-CJ-LI-20-20-06-PF Ceramic Heatsink Thermal Study

CFD Model Temperature Results

- The predicted natural convection thermal resistance (base to air) of TG-CJ-LI-20-20-06-PF Ceramic heatsink, in horizontal orientation is 67.7°C/W.

- This compares well with published data for similar t-Global ceramic heatsinks such as the 20 x 20 x 06 conventional heatsink (refer to earlier report; “Ceramic Heatsinks Thermal Performance Data Study” dated Dec 2015. The recorded thermal resistance was 77°C/W.

- The 10°C/W difference in performance can be accounted for by the additional fins surface area due to the additional walls.



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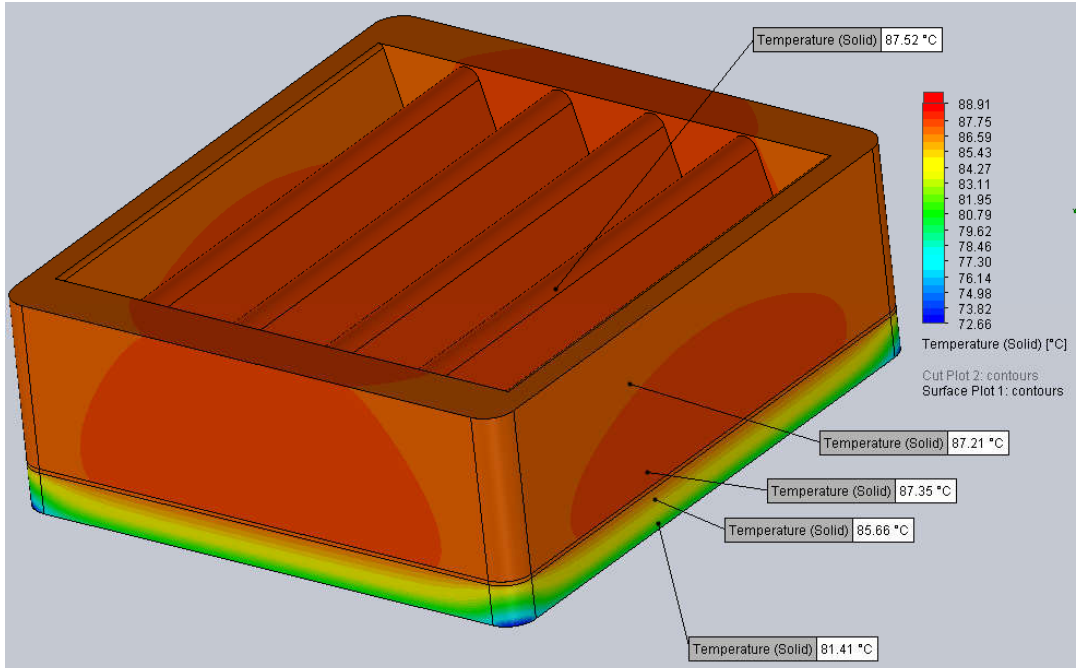
Conclusions

- The predicted natural convection thermal resistance (base to air) of TG-CJ-LI-20-20-06-PFCeramic heatsink, in horizontal orientation is 67.7°C/W.
- The design has obvious advantages in terms of increased surface area available for heat dissipation. There is a 10°C/W improvement compared to a conventional extrusion type ceramic heatsink.
- However, this design has a restriction in that for forced convection cases, the airflow needs to be directed in a plane perpendicular to the heatsink base i.e. needs to impinge on the base. Parallel airflow would not the as effective.



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Analysis performed by
Cambridge Engineering Analysis & Design (**CEAD**)

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APPENDIX A

Material density = 3.75g/cm^3