DESCRIPTION THERMAL MODEL FOR BMR 490 SERIES

FLEX POWER MODULES

Contents

General

The model is based on and valid for BMR 490 3317, which is a Through Hole Pin design. The mechanical structure, PCB stack-up, components and materials are similar to other products in the same family, which means that this thermal model is applicable for several products within the BMR 490 family.

The model is intended for steady-state thermal simulations.

Model Description

The model consists of three parts:

- 3D CAD Geometry
- Domains of power loss distribution
- Domains of material data

Below are the parts described in detail.

3D CAD Geometry

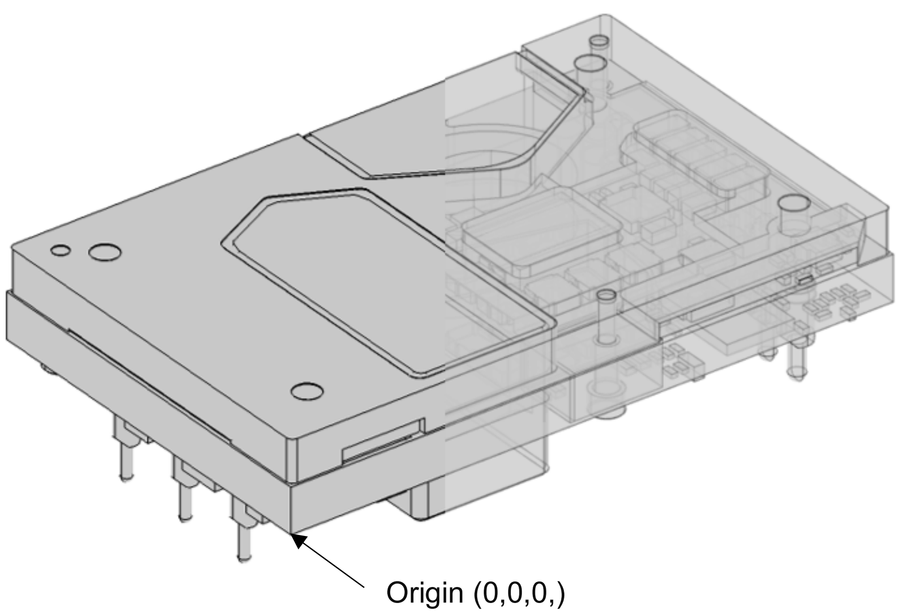

Figure 1

The geometry is to be found in Parasolid format in BMR490_simplified.zip

In the geometry all components are maintained as in the original design. The PCB has been simplified to a bulk geometry, whilst the copper layers and vias have been taken into consideration by giving non-uniform material characteristics to the PCB.

Origin has been placed so that [0,0,0] is in the lower left corner of the PCB.

Unit in file: [mm]

Domains of power loss distribution

There are several sources for power loss. The power loss for each of them, at certain combinations of module voltage and current, are given in *Appendix 1 - Power Loss Distribution*

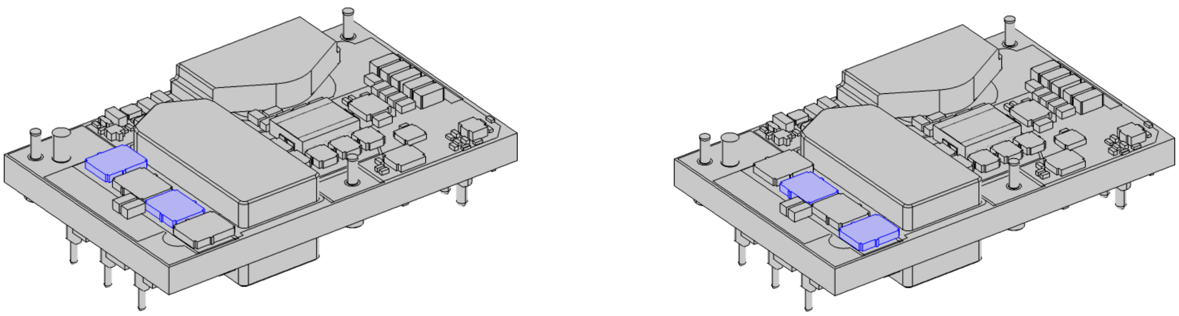

Figure 2: T1T4 (left) T2T3 (right

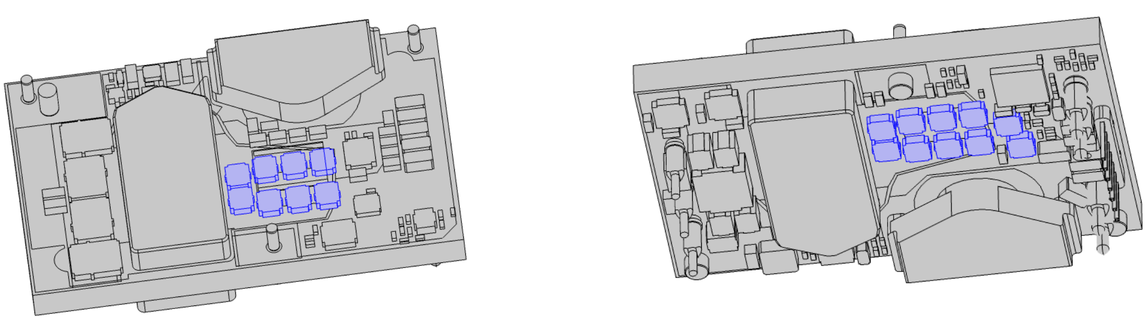

Figure 3: SECFET

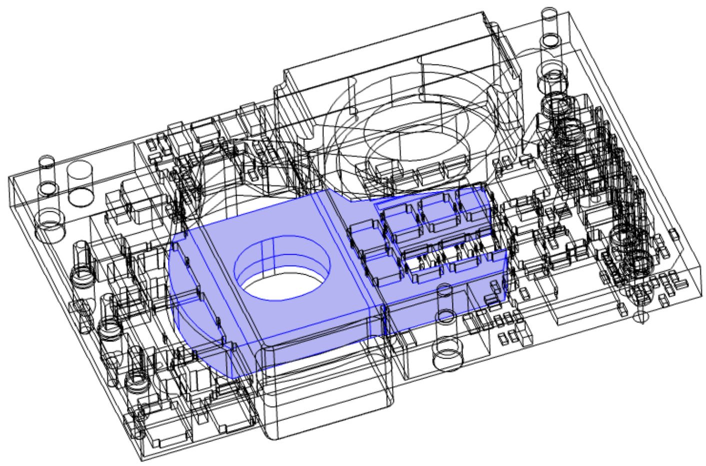

Figure 4: TRAFOWIND

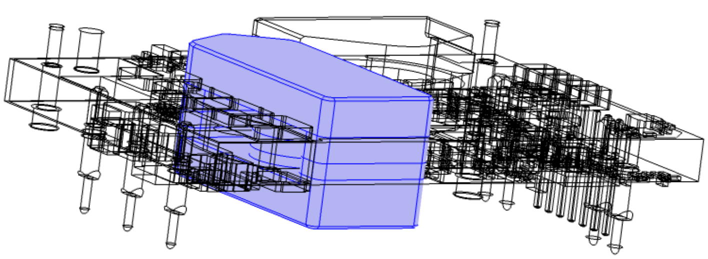

Figure 5: TRAFO

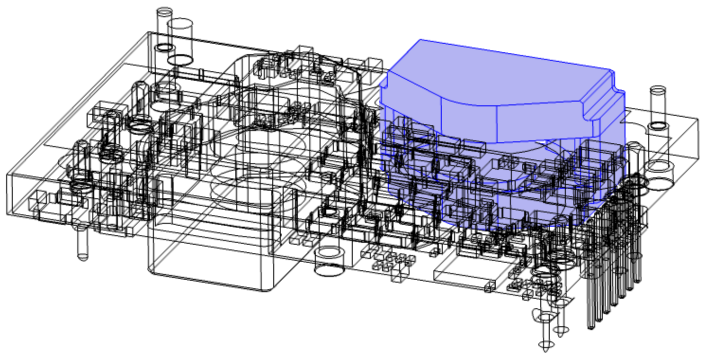

Figure 6: CHOKE

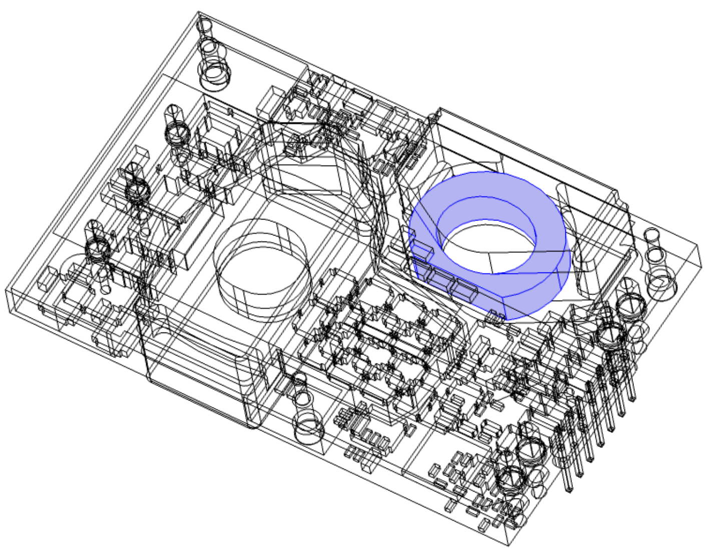

Figure 7: CHOKEWIND

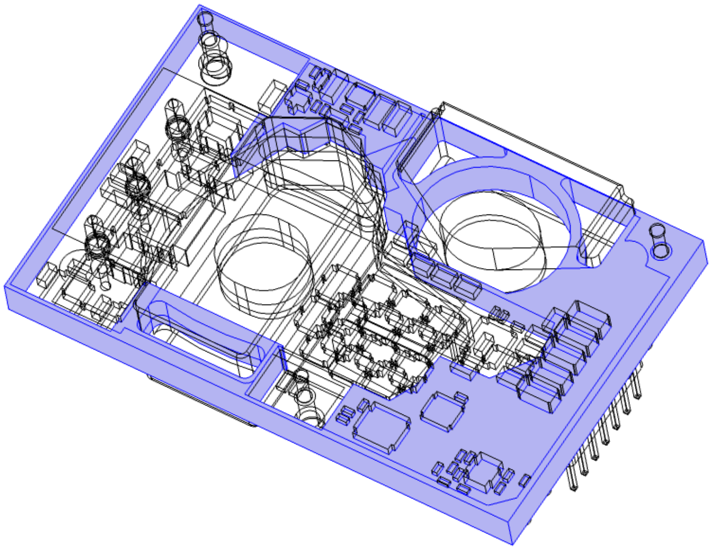

Figure 8: PCB

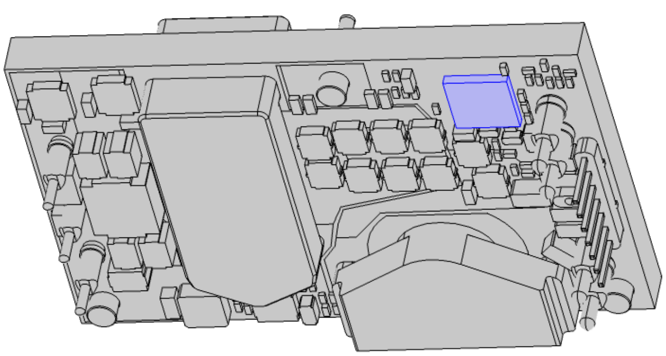

Figure 9: PWM

Domains of material data

There are several material domains. The heat conductivity for each of them is given either as isotropic, or anisotropic values in x-,y-, and z-direction (x,y,z) in the figures following.

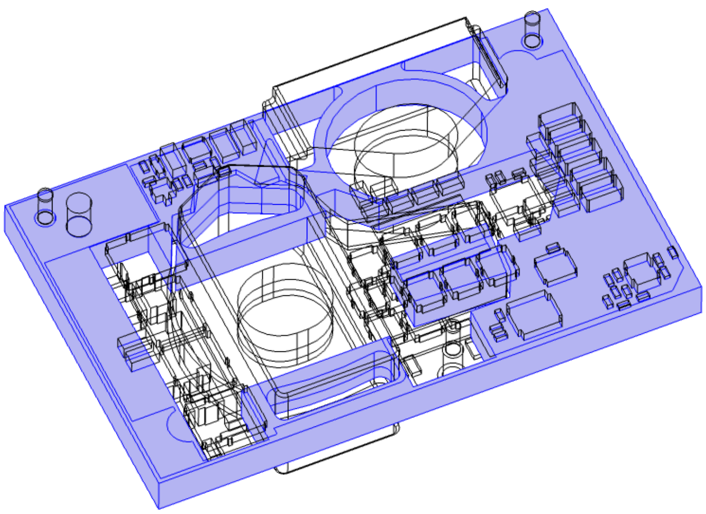

Figure 10: Solid1.1 Heat Conductivity (120,120,1.1) [W/m/K]

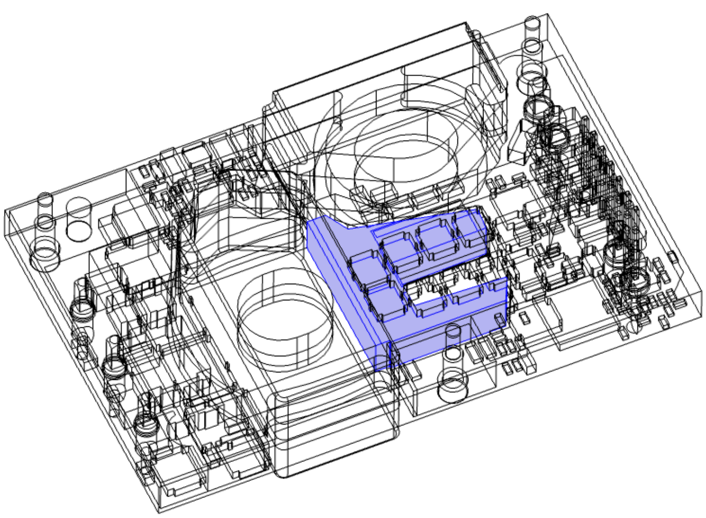

Figure 11: Solid5.9 Heat Conductivity (120,120,5.9) [W/m/K]

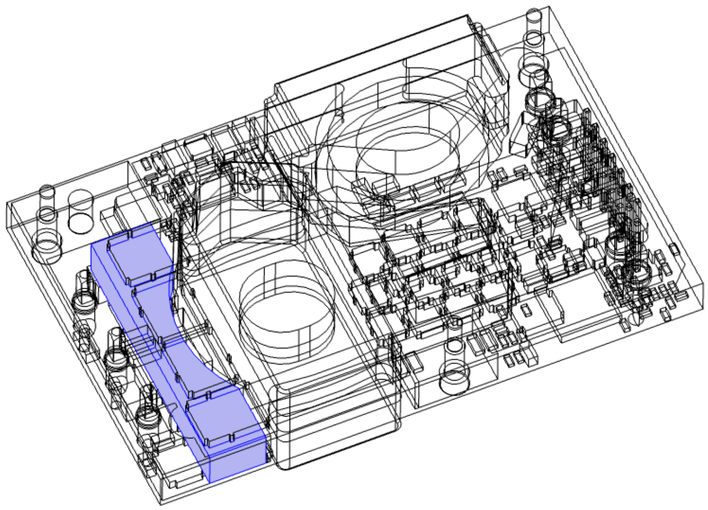

Figure 12: Solid9.7 Heat Conductivity (120,120,9.7) [W/m/K]

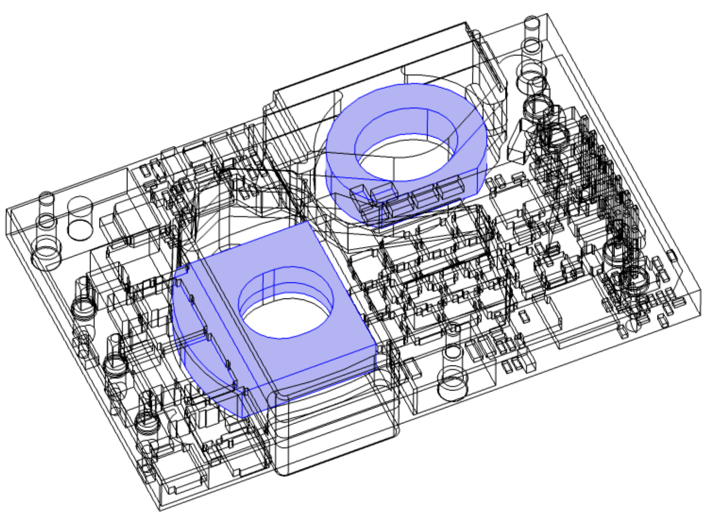

Figure 13: Solid0.6 Heat Conductivity (120,120,0.6) [W/m/K]

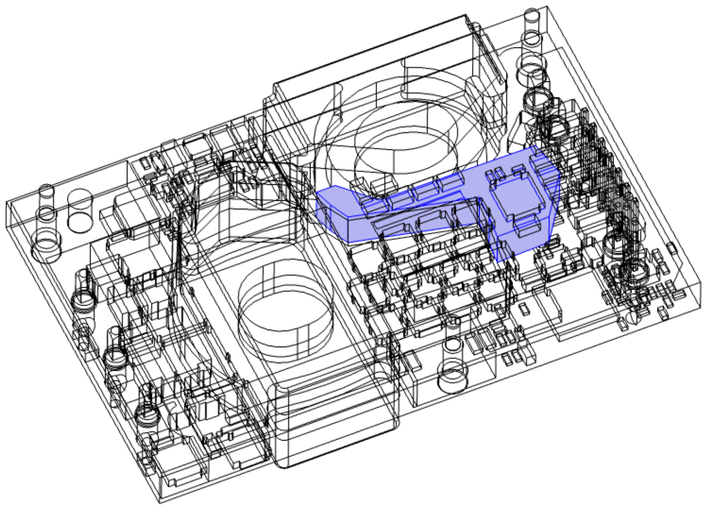

Figure 14: Solid6.7 Heat Conductivity (120,120,6.7) [W/m/K]

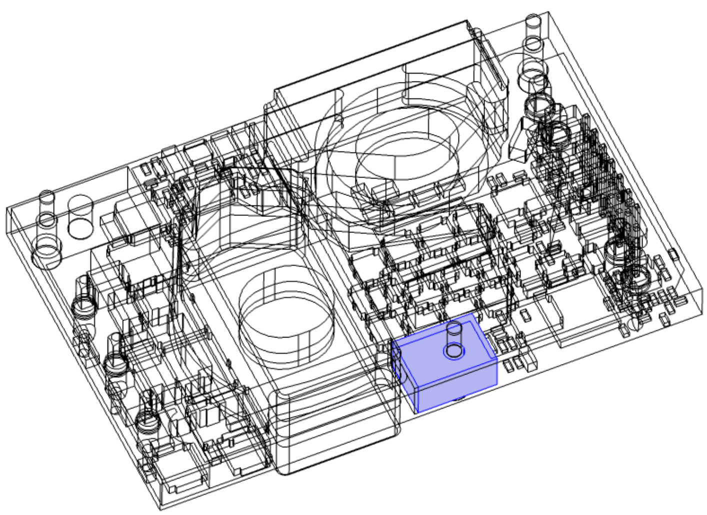

Figure 15: Solid3.4 Heat Conductivity (120,120,3.4) [W/m/K]

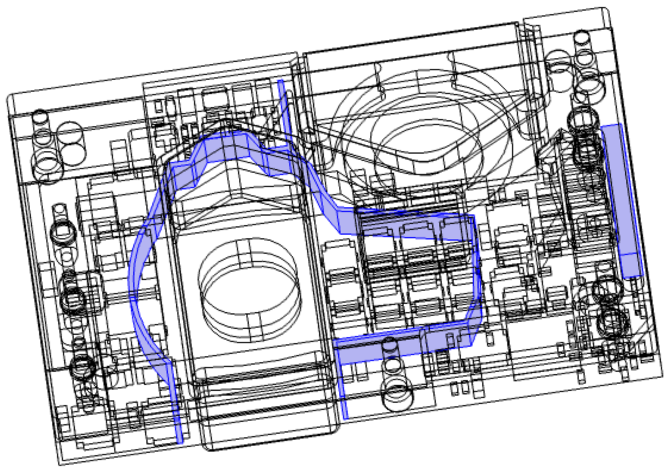

Figure 16: Solid0.6 Heat Conductivity (0.6) [W/m/K]

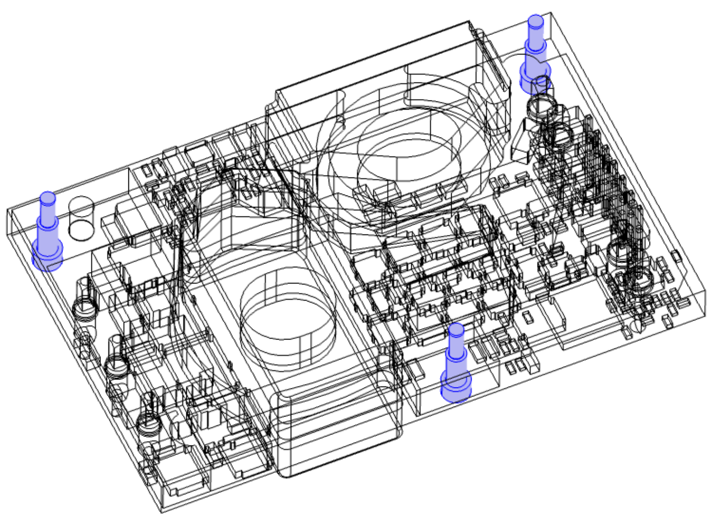

Figure 17: Solid Screw. Heat Conductivity (0.1,0,1,240) [W/m/K]

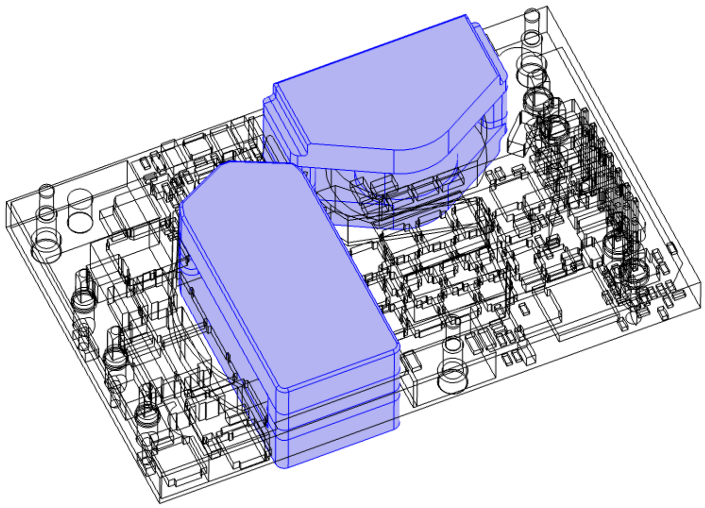

Figure 18: Solid Ferrites. Heat Conductivity (5,5,0.5) [W/m/K]

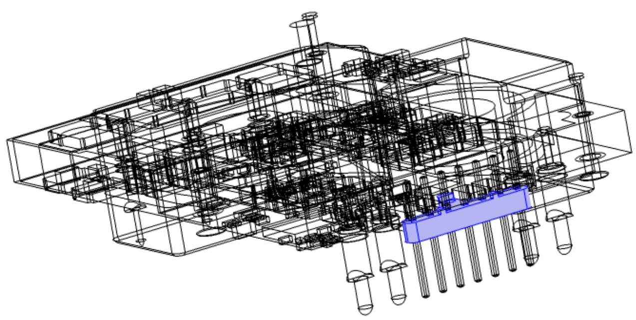

Figure 19: Solid FIXTURE Heat Conductivity (0.26) [W/m/K]

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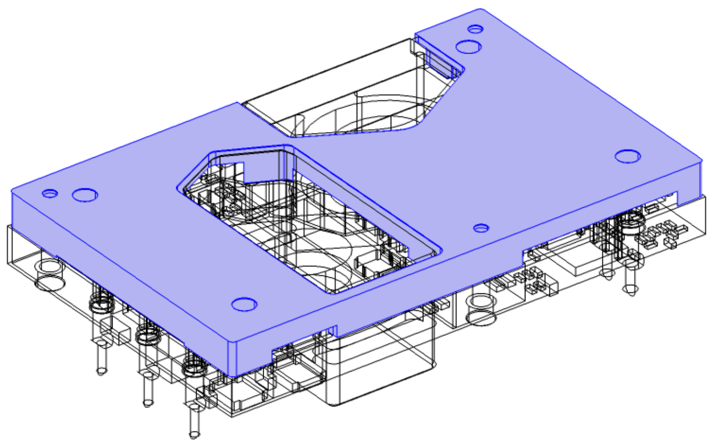

Figure 20: Solid BASEPLATE Heat Conductivity (201) [W/m/K]

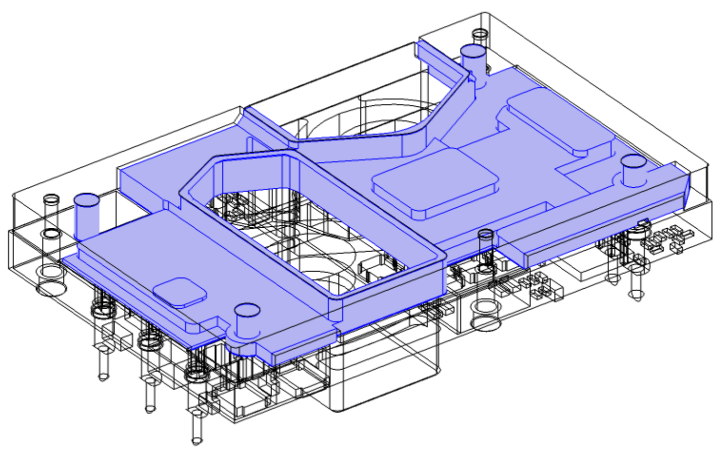

Figure 21: Solid GAPFILLER Heat Conductivity (2) [W/m/K]

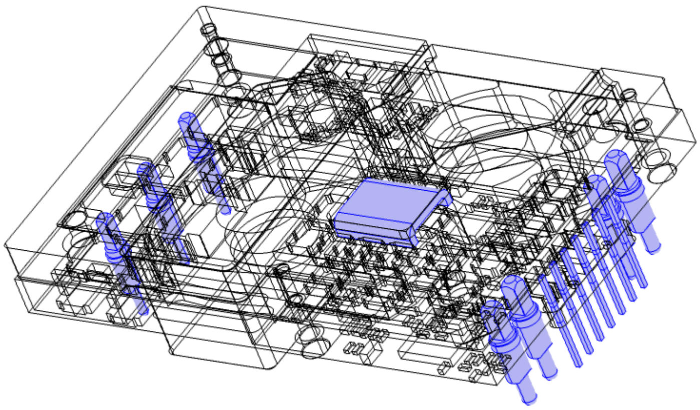

Figure 22: Solid PINS&HEATSPREADER Heat Conductivity (355) [W/m/K]

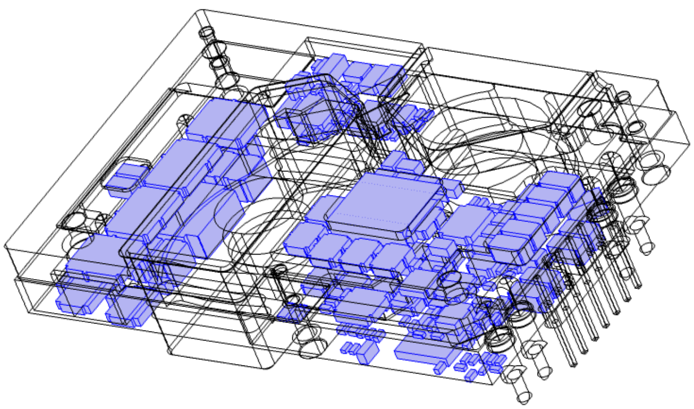

Figure 23: Solid COMPS (Remaining Heat Conductivity (30) [W/m/K]

Note. The given heat conductivity is only intended to model the temperature distribution of the module in this application. The values should not be treated as physical true or transferable to other applications.

Model Calibration

The model has been calibrated to give temperatures as similar as possible for V_{in}=54[V], V_{out}=12[V], I=96[A], 4 [m/s], compared to thermal verification document BMR490 R1A.ods. A simplified testboard with kxy=150[W/(m*K)] were used. Testboard dimensions=254*254 [mm^2]. Spacing in z-direction= 45[mm]

For air velocity calculations a low Re k-ε turbulence model was applied, using COMSOL Multiphysics 5.4. Default settings were used and coarse mesh size. Solver used algebraic multigrid method.

COMSOL Multiphysics 5.4 was also used for the heat transfer calculations.

Direction of air for the calibration, per document BMR490 R1A, is in the y-direction.

Simulation temperatures are within ±3.8 [degC] compared to measured values.

Figure 24: Model calibration result.

Model Usage

Import the geometry in Parasolid format x_b, from BMR490_simplified.zip into the desired project.

Assign power losses per table in *Appendix 1 - Power Loss Distribution* to the domains in section *Domains of power loss distribution*. If requested to run a different power loss within the same voltage and current, it is possible to scale the individual values.

Set the heat conductivity per Figure 10 to Figure 23 to the domains showed in *Domains of material data*. Please make sure the non-uniform values are given in the correct direction so that the model z-corresponds to z-direction in your coordinate system.

Additional Information

Model has been constructed with SI units.

Reference

Thermal report BMR490 R1A.ods

Product number and r-state history

Flex product number IPM 101 51, R1A 2019-05-27

Disclaimer

The model and model documentation described herein are provided for the sole purpose of facilitating thermal modeling of a structure where the referenced product is included. It should not and cannot be interpreted neither as a detailed description of the product itself, nor as a statement of the product's performance.

The model has been constructed on a best effort basis, but we cannot accept liability for any discrepancy between model predictions and actual values.

Revision history

A	2019-05-27	New Document

Appendix 1 - Power Loss Distribution

Power loss distribution example for BMR 490.

V_{in}= 54V V_{out}= 12V I_{out}=96A

Domain	Power loss per domain (W)	Number of domains	Subtotal power loss (W)
T1T4	3.5	2	7
T2T3	2.8	2	5.6
SECFET	0.665	16	10.64
TRAFOWIND	4.9	1	4.9
TRAFO	4	1	4
CHOKEWIND	1.7	1	1.7
CHOKE	4	1	4
PCB	3	1	3
PWM	0.41	1	0.41
		Total (W)	**41.25**