DESCRIPTION
THERMAL MODEL FOR
BMR 469 0000/001

FLEX POWER MODULES

Contents

General

The model is an estimation of the thermal behavior of BMR 469 0000/001, which is a surface mount design.

The model is intended for steady-state thermal simulations.

Model Description

The model is a readymade Flotherm 11.1 model. The model consists of four major components:

3D CAD Geometry

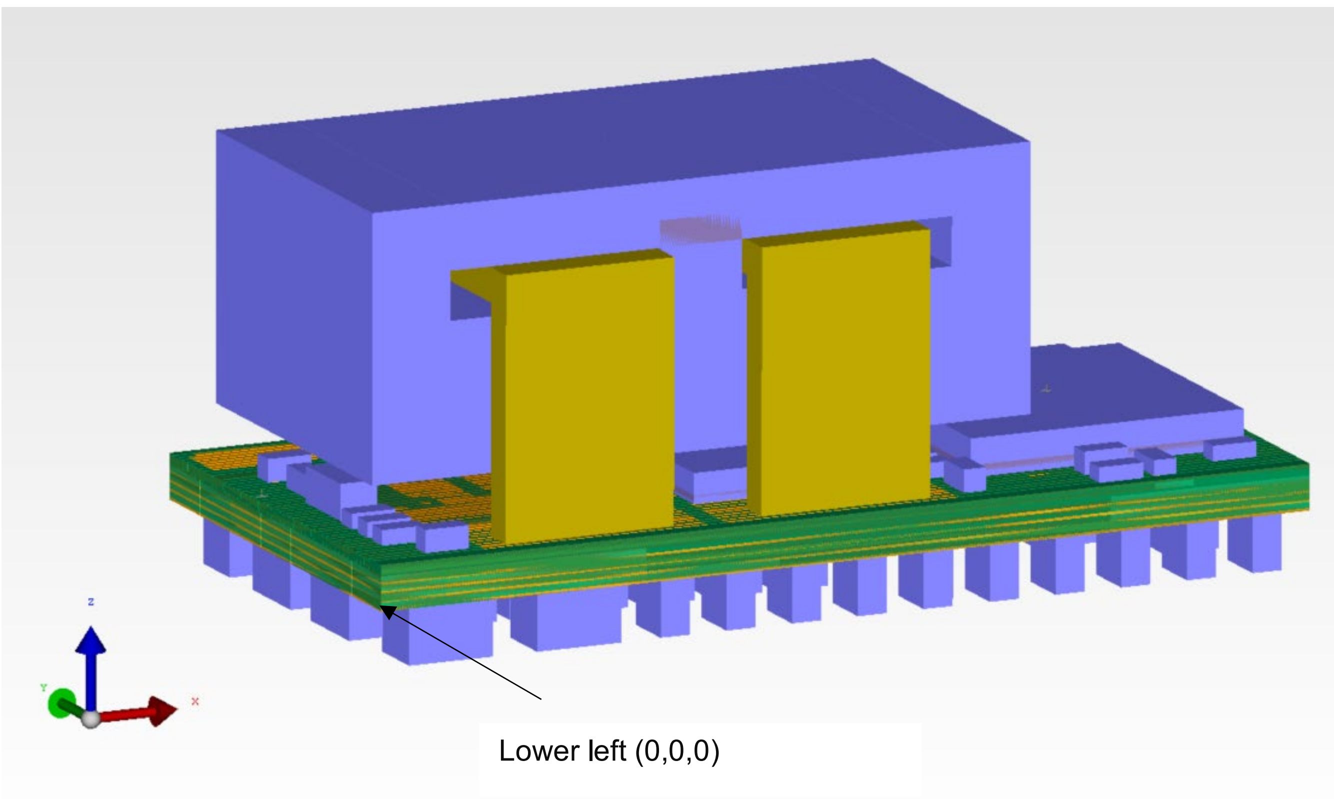


Figure 1

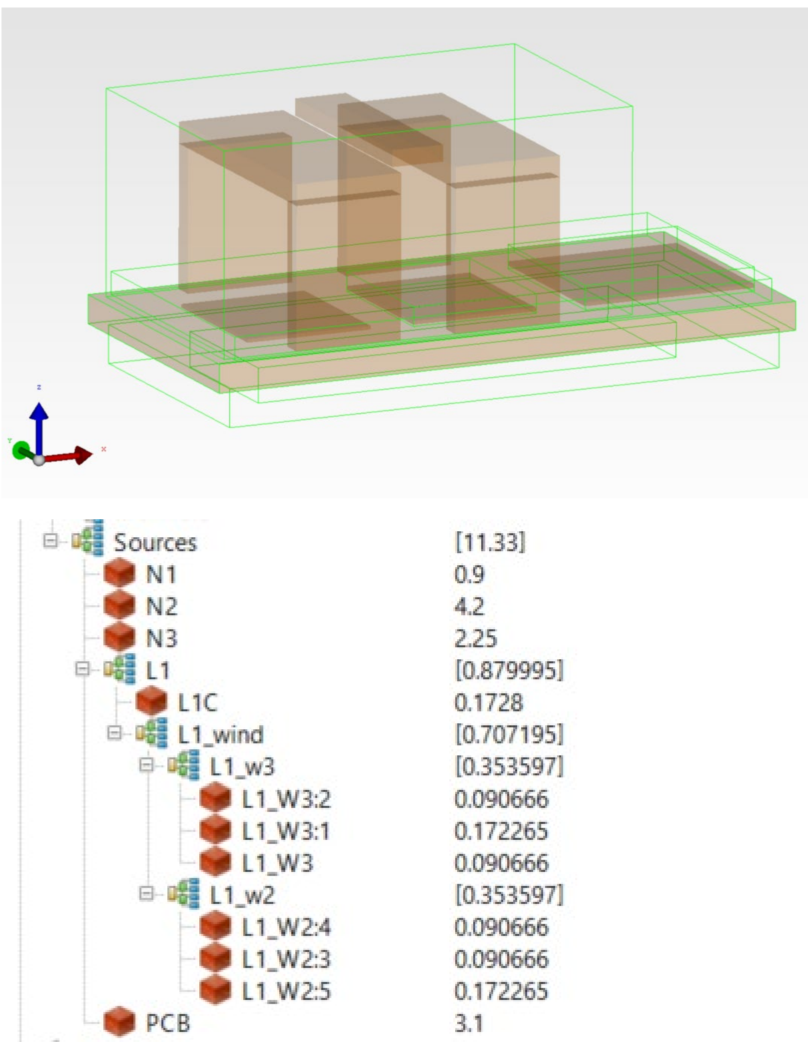
In the geometry most components are maintained per the original design but have been simplified in FloMCAD to cuboids. The PCB has been imported through FloEDA. In order to capture blind and buried vias, the via sets are used and processed as metal layers instead of dielectric layers with electrical vias.

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.*



Sources	[11.33]
N1	0.9
N2	4.2
N3	2.25
L1	[0.879995]
L1C	0.1728
L1_wind	[0.707195]
L1_w3	[0.353597]
L1_W3:2	0.090666
L1_W3:1	0.172265
L1_W3	0.090666
L1_w2	[0.353597]
L1_W2:4	0.090666
L1_W2:3	0.090666
L1_W2:5	0.172265
PCB	3.1

Figure 2 Domains of power losses. Picture showing default values for 1x80A, 1.0V

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.

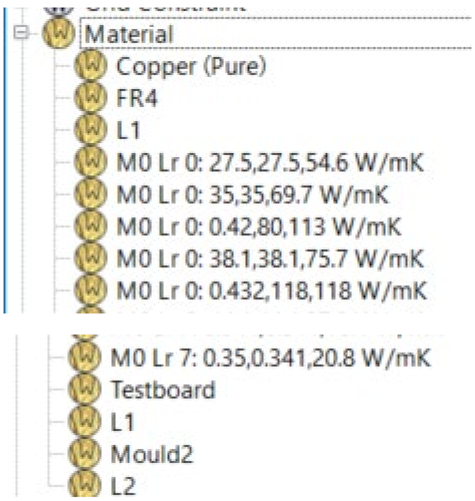


Figure 3: Materials

The material data labeled "M0 Lr <xx>:.." are from the FloEDA import of the PCB and are used in the PCB assembly TVA170106R2A.

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.

Grid

There are five pre-defined grid constraints. These are used according to

- Autogrid from FloEDA   Used localized in PCB TVA170106R2A
    - TVA170106R2A-X
    - TVA170106R2A-Y
    - TVA170106R2A-Z

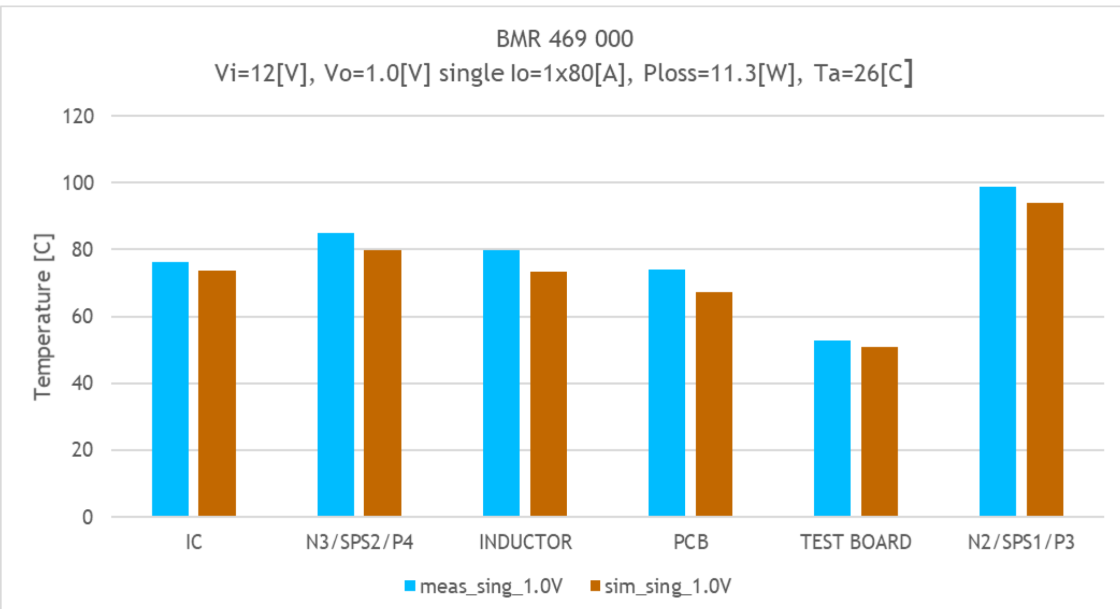
It is of course voluntarily to use the constraints. Make sure though that there are sufficient number of grids in the PINs to capture the heat flow through these.

A system bounding the model exactly have approximately 1.9 million cells. This number can probably be reduced significantly once the model is in place within its main model.

Model Calibration

The model has been calibrated to give temperatures as similar as possible for V_{in}=12[V], V_{out}=1 and 3.3[V], I_{out}=1x80[A] and 2x30[A], compared to thermal verification documents *10/102 65-BMR 469 0000/001 and 19/102 65-BMR469 0000/001*. For the calibration the module was placed onto a 254x254x1.6 [mm^3] testboard, with heat conductivity of k=(100,100,3) [W/m/K]. An enclosure with spacing 15 [mm] was placed around the testboard. Air direction was positive y.

Simulation temperatures are within ±3 [degC] compared to measured values. The simplified testboard has some impact on the accuracy of the single mode simulation.



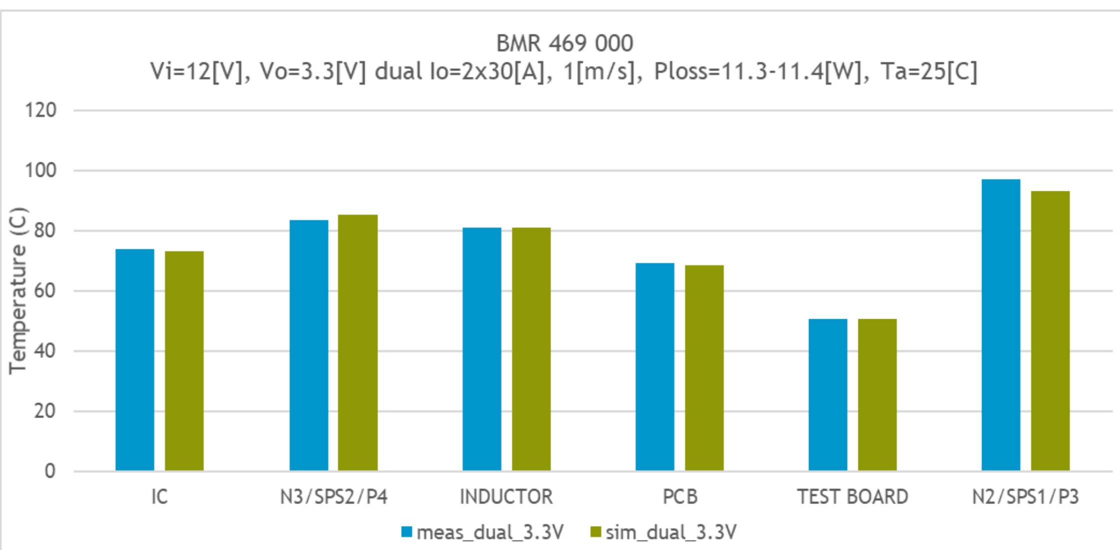


Figure 4: Model calibration results

Model Usage

Import the *.pdml file 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*. Default settings are for V_{in}=12[V], V_{out}=3.3[V], I_{out}=2x30[A]

If the model is rotated, make sure that the orientation of the orthotropic materials properties are preserved (also rotated).

Do not change the order of power sources and geometry objects, as this can change the power and material settings.

The module temperatures can be monitored in predefined monitor points.

Additional Information

Model has been constructed with SI units.

Reference

Thermal reports *10/102 65-BMR469 0000/001 Rev C, 19/102 65-BMR469 0000/001 Rev A*

BMR4690000/001A.pdml

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	2021-08-31	New document

Appendix 1 - Power Loss Distribution

Power loss distribution example for BMR 469 0000/001.

V_{in}=12[V], V_{out}=1.0[V], I_{out}=1x80[A], I_{in}=7.7[A], T≈80-100[C]

Domain	Number of domains	Power loss per domain [W]	Power loss per volume [mW/mm^3]	Subtotal [W]
L1_w2	3	-	3.65	0.35
N1	1	0.7	-	0.7
N2	1	4.2	-	4.2
N3	1	2.25	-	2.25
PCB	1	3.3	-	3.3
L1_core	1	0.1728	-	0.1728
L1_w3	3	-	3.65	0.35
Total [W]				11.33

V_{in}=12[V], V_{out}=3.3[V], I_{out}=2x30[A], I_{in}=17.6[A], T≈80-100[C]

Domain	Number of domains	Power loss per domain [W]	Power loss per volume [mW/mm^3]	Subtotal [W]
L1_w2	3	-	1	0.097
N1	1	0.9	-	0.9
N2	1	4.1	-	4.1
N3	1	3.4	-	3.4
PCB	1	2.264	-	2.264
L1_core	1	0.47	-	0.47
L1_w3	3	-	1	0.097
Total [W]				11.33