DESCRIPTION THERMAL MODEL FOR BMR 685 SERIES

FLEX POWER MODULES

Contents

General

The model is an estimation of the thermal behavior of BMR 685 0300, which is a through hole 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 685 family.

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

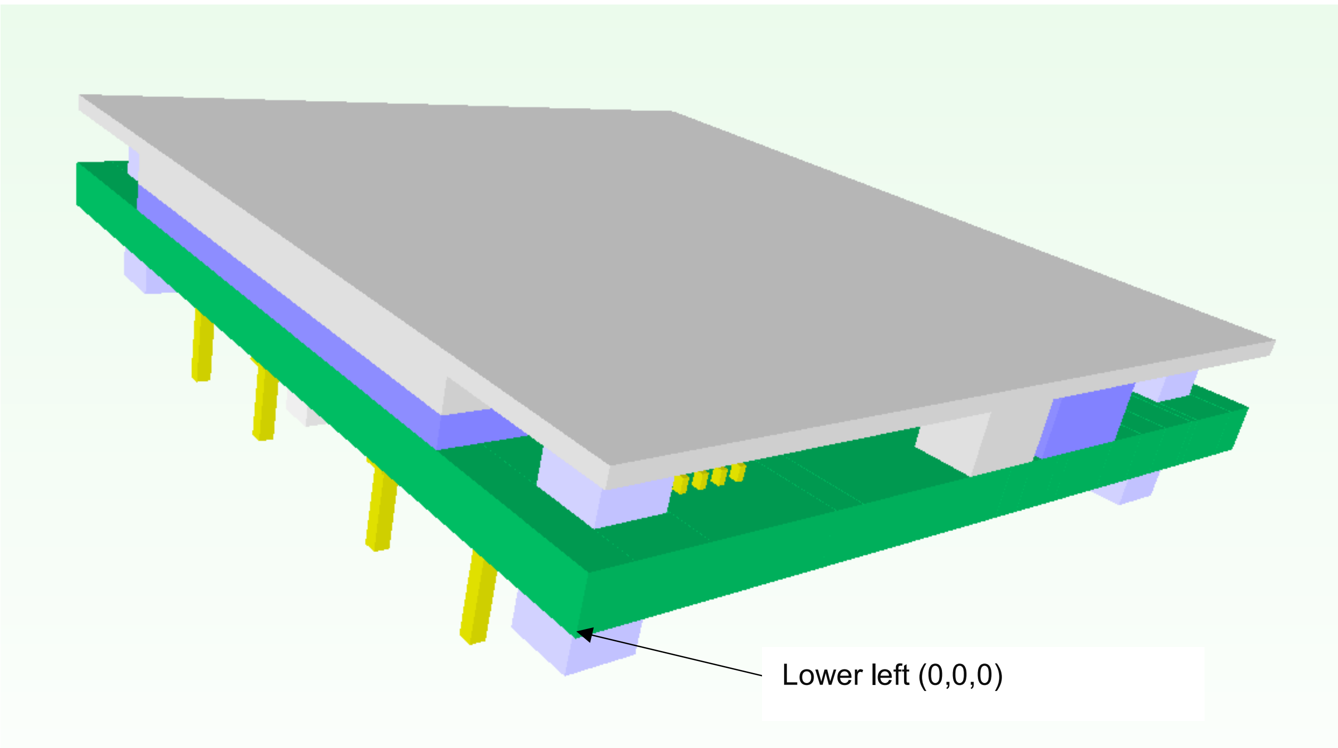

Figure 1

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 with resolution 9 of longest side. 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.

Passive component that are assumed not to contribute in a situation dominated by conduction, such as using heat sink or cold wall, are de-activated, but can be found and re-activated under COMPS node:

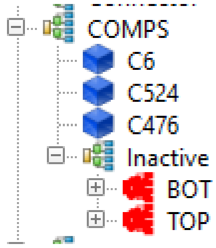

Figure 2 De-activated components in the COMPS node

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.*

Note that there are two sources with negative power. These are to compensate for cut-outs in the PCB, so that the total power loss remains correct.

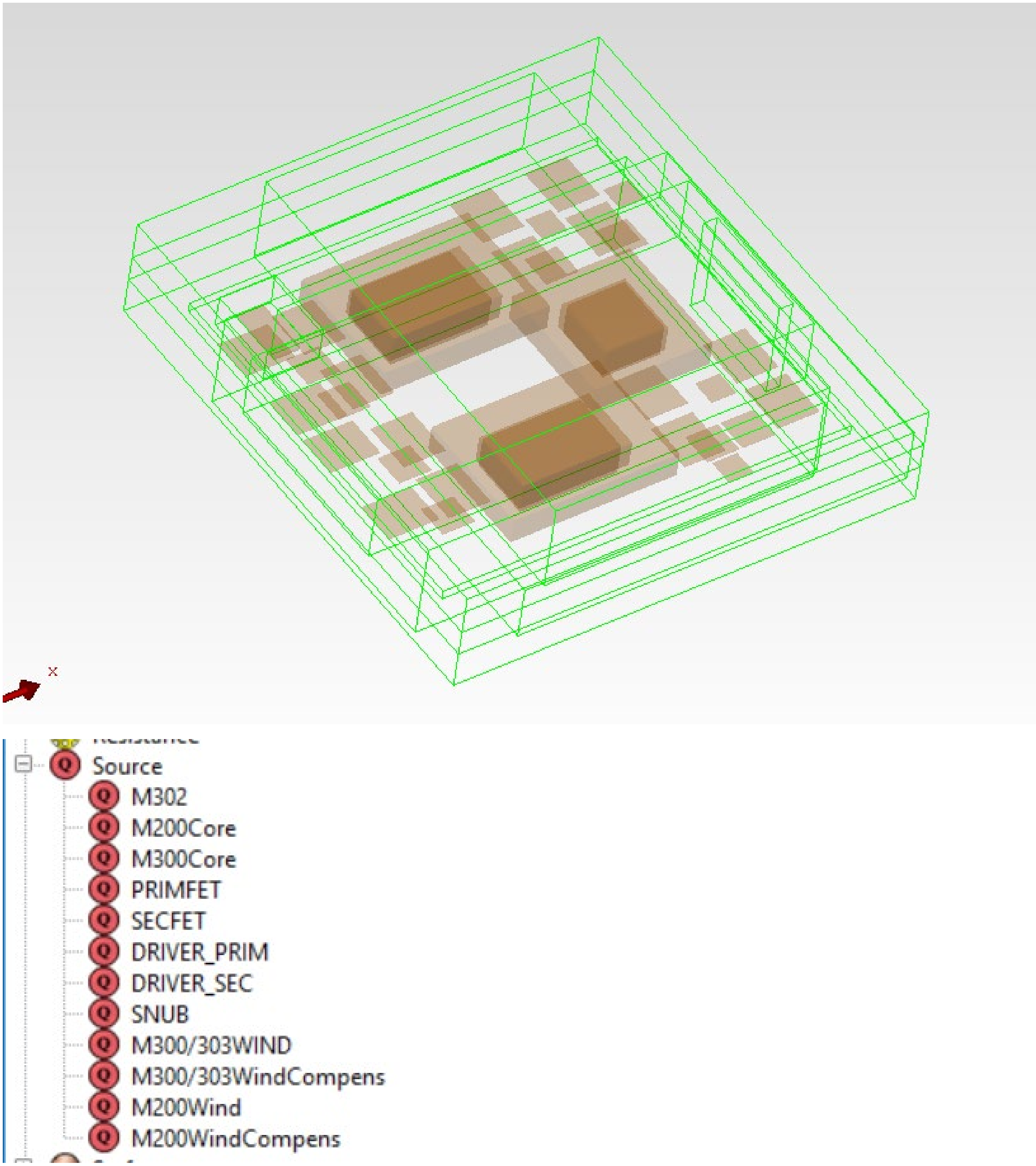

Figure 3 Domains of power losses

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.

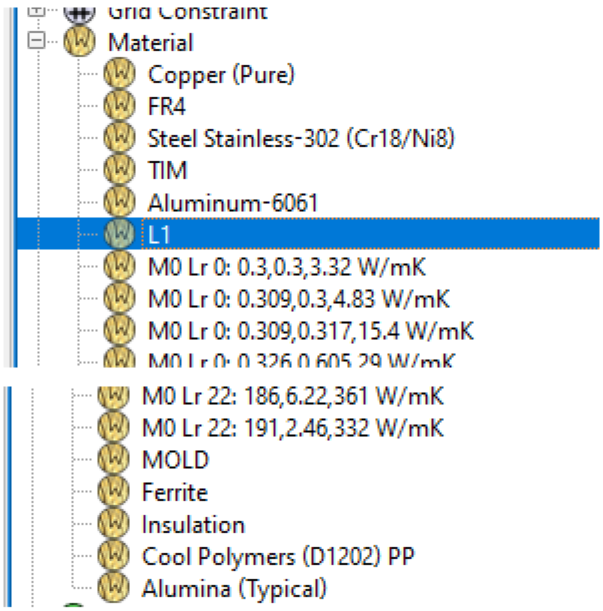

Figure 4: Materials

The material data labeled “M0 Lr <xx>:..” are from the FloEDA import of the PCB and are used in the PCB assembly TVA17107R2A.

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 TVA17107R2A
  - TVA17107R2A-X
  - TVA17107R2A-Y
  - TVA17107R2A-Z
- Grid Constraint: min10 — Maximum size 1 [mm] used localized in z-direction in PINS
- Grid Constraint: 0 — Maximum size 0.2[mm] used localized between PCB and Baseplate

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 1.76 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}=48[V], V_{out}=49.9[V], I_{out}=25.9[A], compared to thermal verification document *Cold Wall_chart_template BMR685 1300W 2020-12-17*. According to the measurement settings, the temperature of baseplate, BPL, was set to 100[C] and the pin temperature at the mounting level set to 105[C]

Simulation temperatures are within ±3 [degC] compared to measured values.

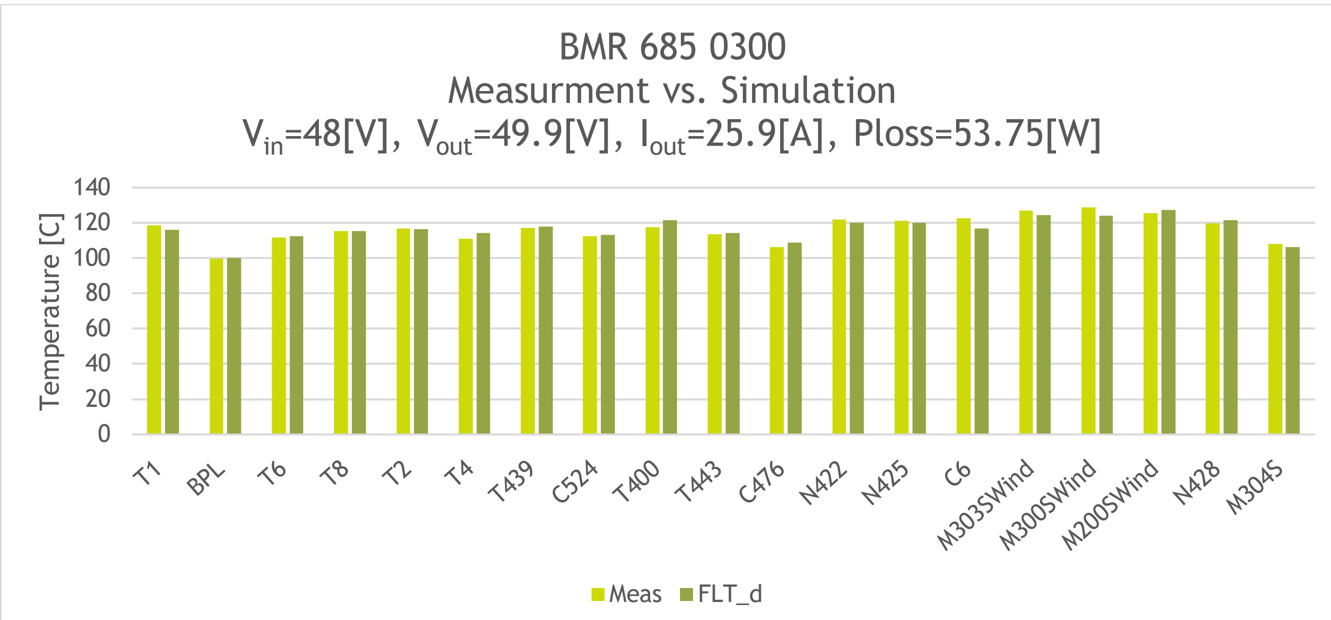

Figure 5: Model calibration result

Model Usage

Import the *.pdml file into the desired project.

Depending on the simulation needs, for example if a convective cooling is significant, it is possible to re-activate the passive components. Especially the bottom group, COMPS->Inactive->BOT, can have an impact on the air flow underneath the module.

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}=48[V], V_{out}=49.9[V], I_{out}=25.9[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 report *Cold Wall_chart_template BMR685 1300W 2020-12-17*

BMR 6850300A.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	2020-12-29	New document

flex

Appendix 1 - Power Loss Distribution

Power loss distribution example for BMR 685.

V_{in}=48[V], V_{out}=49.8[V], I_{out}=25.9[A], I_{in}=28[A], T≈100[C]

Domain	Number of domains	Power loss per domain [W]	Power loss per volume [mW/mm^3]	Subtotal [W]
M302	1	1.145	-	1.145
M200Core	1	0.045	-	0.045
M300Core	2	0.864	-	1.728
PRIMFET	8	1.9625	-	15.7
SECFET	8	2.48575	-	19.886
DRIVER_PRIM	4	0.155	-	0.62
DRIVER_SEC	4	0.14	-	0.56
SNUB	4	0.45	-	1.8
M300/303WIND	2	-	6.511711	13.21
M300/303WindCompens	2	-	-6.511711	-4.619
M200Wind	1	-	7.117292	5.136
M200WindCompens	1	-	-7.117292	-1.462
Total [W]				53.7