DESCRIPTION
THERMAL MODEL FOR
BMR313

FLEX INC.

Contents

General

The model is an estimation for the thermal behavior of BMR 313 single-source secondary FET (Nominal case scenario based on geometry's tolerances). The measurement data are used for the calibration of the thermal model.

The model is intended for steady-state thermal simulations.

Model Description

The model is a readymade Flotherm 11.1 model. It was created by importing a CAD model in STEP format through the MCAD bridge. Components that are not contributing to the heat transfer, have been removed from the geometry. The model consists of the four major components:

3D CAD Geometry

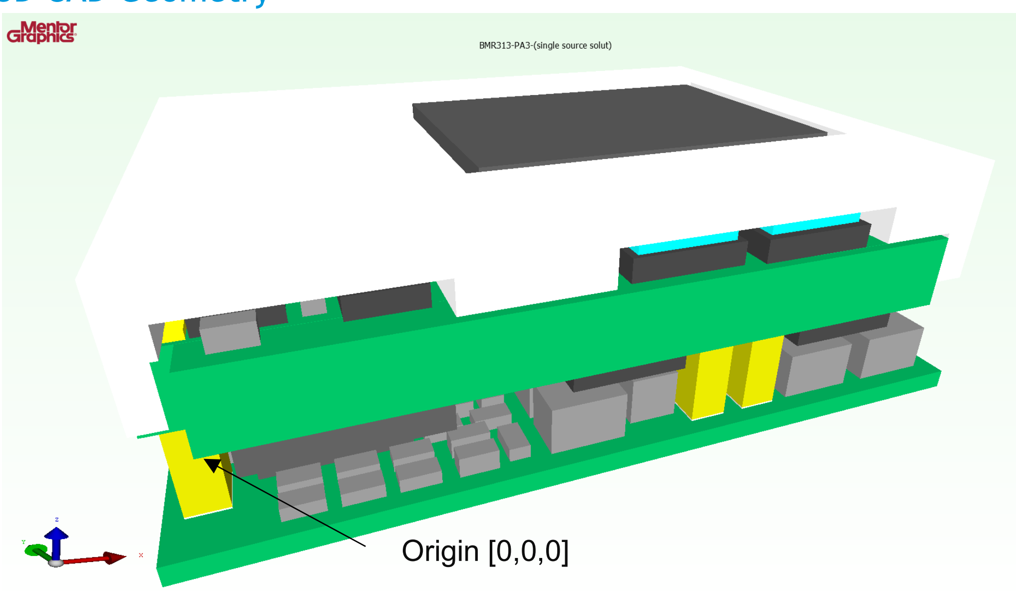


Figure 1. 3D geometry of the model

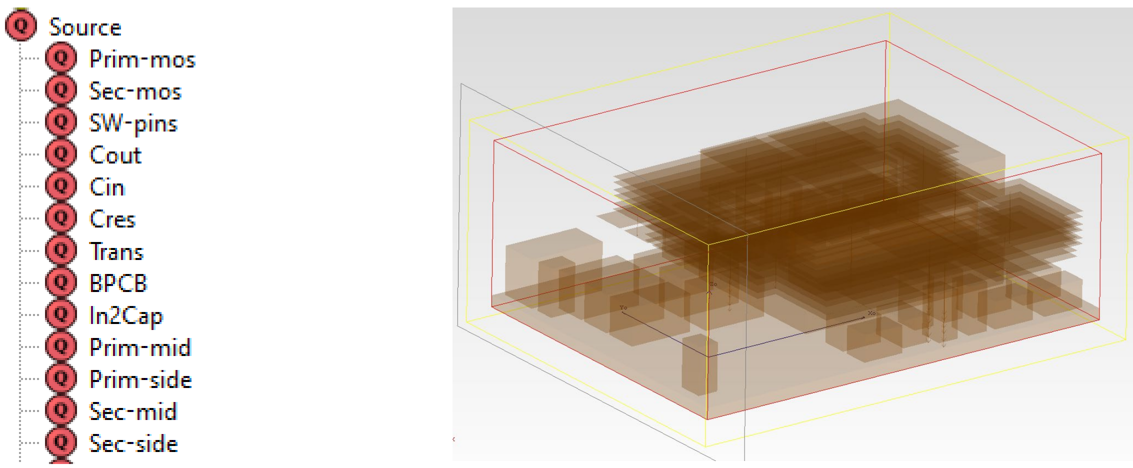
3D geometry is created by importing a CAD model in STEP format through the MCAD bridge. Components that are not contributing to the heat transfer have been removed from the geometry. The PCBs have been simplified to a bulk geometry where the copper layers and vias have been taken into consideration by assigning anisotropic material properties to the PCBs domains.

Origin has been placed so that [0,0,0] is in the lower left corner of the top 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 module total powers, are given in *Appendix 1 - Power Loss Distribution*



(a) (b)

Figure 2: Power loss setting: (a) list of heat sources, and (b) heat sources distribution in the model

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) per the following list.

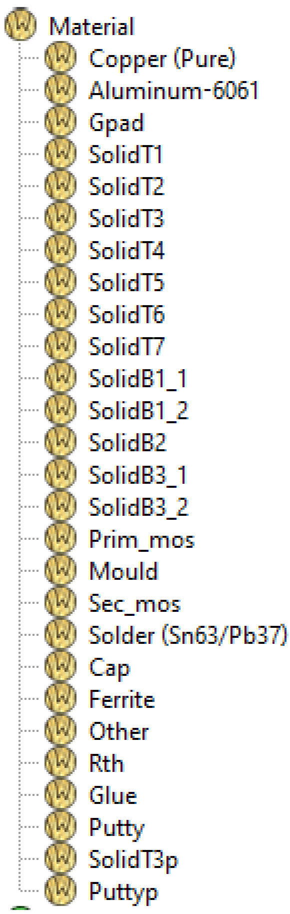
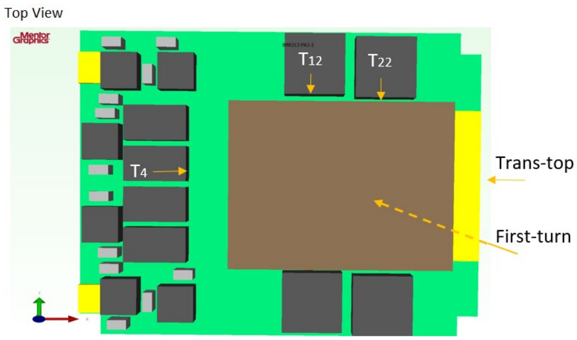


Figure 3. Domains of material data

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

Monitor points

The model comes with predefined monitor points. These monitor points are shown here



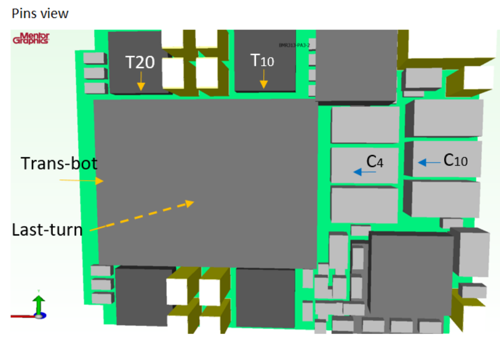


Figure 4. Monitor points in the model, (a) top view on the top PCB (b) bottom view of the top PCB.

Model Calibration

The model has been calibrated to give temperatures as similar as the results from the measured data model in a case of 43V and 54V input, and output power of 700W. Temperatures on baseplate and application board are set to 78-82°C and 105°C, respectively.

Flotherm simulation temperatures are within ± 5°C compared to the measured data (see Figure 5).

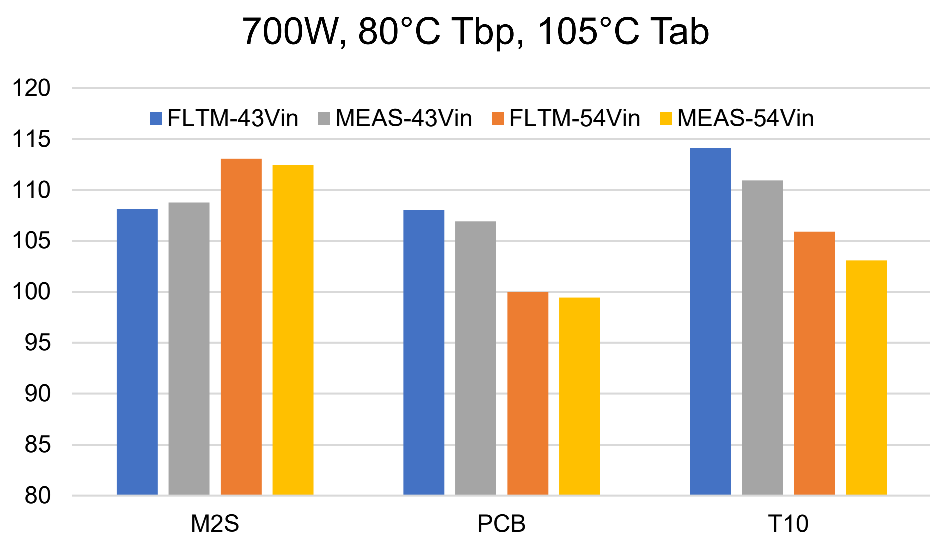


Figure 5: Model calibration result: MEAS – measured values, FLTM – Flotherm simulation results.

Model Usage

Import the *.pdml file into the desired project. Adjust the dissipated power by altering the thermal sources per

Figure 2, according to Appendix 1 - Power Loss Distribution. Default settings are for input voltage 43V input, 10.8V output, and 700W output.

If the model is rotated, make sure that the orientation of the orthotropic materials properties is 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

Data file BMR313.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	2022-10-10	New Document
B	2024-01-16	minor changes

Appendix 1 - Power Loss Distribution

Power loss distribution examples for BMR 313.

Condition: 43V input, 10.8V output, Output Power:700W (default setting).

Domain	Number of domains/ boundaries	Domain volume [mm^3]	per domain [W]	per volume [mW/mm^3]	Subtotal power loss [W]
Prim-mos	4		0.610		2.44
Sec-mos	8		0.85		6.80
Cout	14		0.041		0.58
Cin	3		0.163		0.49
Cres	3		0.097		0.29
Trans	1	527		1.88	0.99
BPCB	1		1.7		1.7
In2Cap	3		0.083		0.25
Prim-mid	21		0.110		2.31
Prim-side	12		0.449		5.38
Sec-mid	21		0.165		3.47
Sec-side	12		0.675		8.10
SW-pins	8		0.105		0.84
				Total (W)	**33.64**

Condition: 40V input, 10V output, Output Power:700W.

Domain	Number of domains/ boundaries	Domain volume [mm^3]	per domain [W]	per volume [mW/mm^3]	Subtotal power loss [W]
Prim-mos	4		0.82		3.28
Sec-mos	8		1.03		8.24
Cout	14		0.049		0.68
Cin	3		0.187		0.56
Cres	3		0.11		0.33
Trans	1	527		1.46	0.77
BPCB	1		2.00		2.00
In2Cap	3		0.097		0.29
Prim-mid	21		0.129		2.70
Prim-side	12		0.525		6.3
Sec-mid	21		0.194		4.08
Sec-side	12		0.793		9.52
SW-pins	8		0.123		0.98
				Total (W)	**39.73**

Condition: 54V input, 13.5V output, Output Power:700W.

Domain	Number of domains/ boundaries	Domain volume [mm^3]	per domain [W]	per volume [mW/mm^3]	Subtotal power loss [W]
Prim-mos	4		0.500		2.00
Sec-mos	8		0.660		5.28
Cout	14		0.027		0.38
Cin	3		0.103		0.31
Cres	3		0.060		0.18
Trans	1	527		4.17	2.20
BPCB	1		1.20		1.20
In2Cap	3		0.096		0.29
Prim-mid	21		0.078		1.632
Prim-side	12		0.317		3.808
Sec-mid	21		0.114		2.388
Sec-side	12		0.464		5.572
SW-pins	8		0.025		0.20
				Total (W)	**25.44**

Power loss calculator

The default power loss setting is made for 10.8V/65A output. For any other conditions, first, the load current should be calculated. Then, the loss in any component can be calculated from the below equation:

$$loss_2 = Loss_1 * (ratio\ of\ load\ current)^2$$

Note: The loss in the transformer is not load dependent!