DESCRIPTION THERMAL MODEL FOR BMR351

FLEX INC.

Contents

General

The model is an estimation for the thermal behavior of BMR351. The data from thermal verification is used as a reference to calibrate this 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:
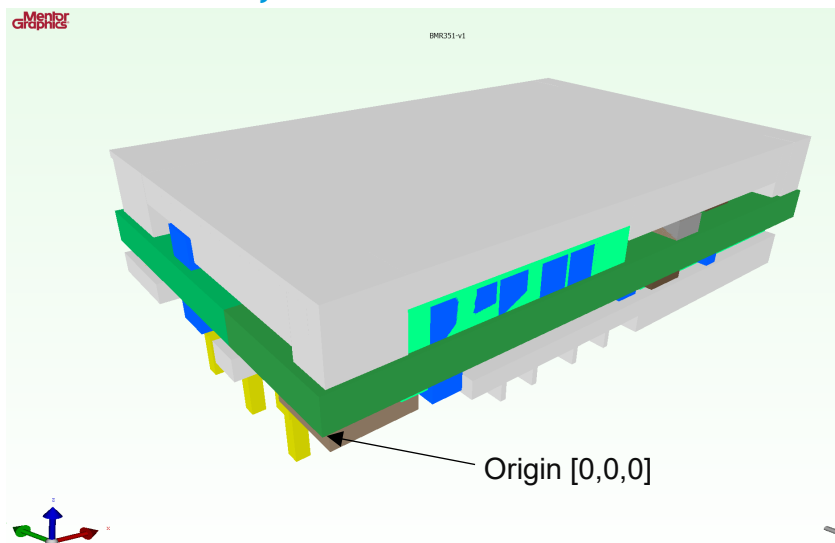
3D CAD Geometry

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*
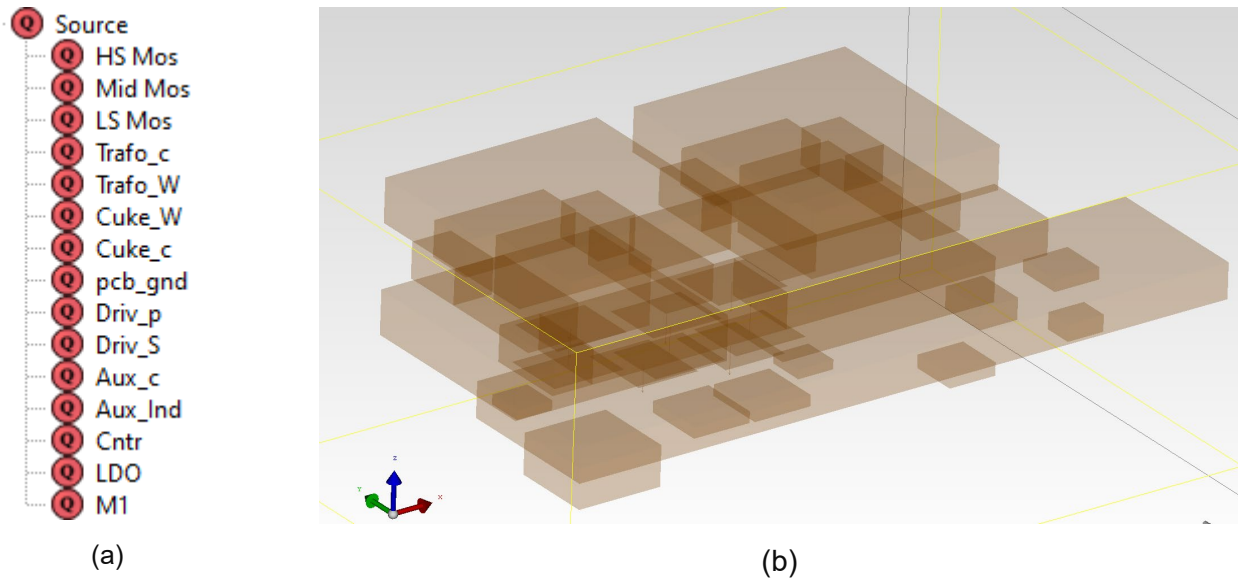

(a)   (b)

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

Top View

Pins view
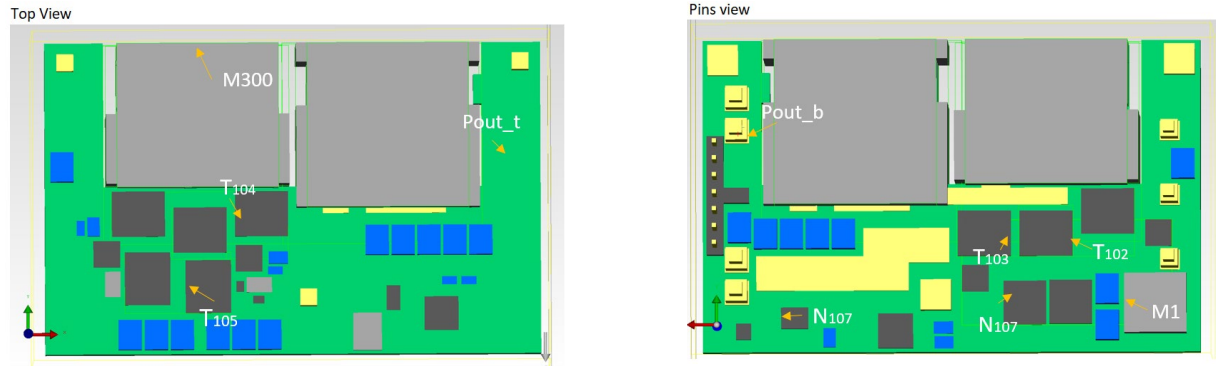
Figure 4. Monitor points in the model.

Model Calibration

The model has been calibrated to give temperatures as similar as the results from the thermal verification report in a case of 53V input, and 136A output where the temperatures on top cooling and host board are set to 90℃ and 85℃ respectively.

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

Figure 5: Model calibration result: meas –measured data, floth – Flotherm simulation results.

Model Usage

Import the *.pdml file into the desired project. Adjust the dissipated power by altering the thermal sources per
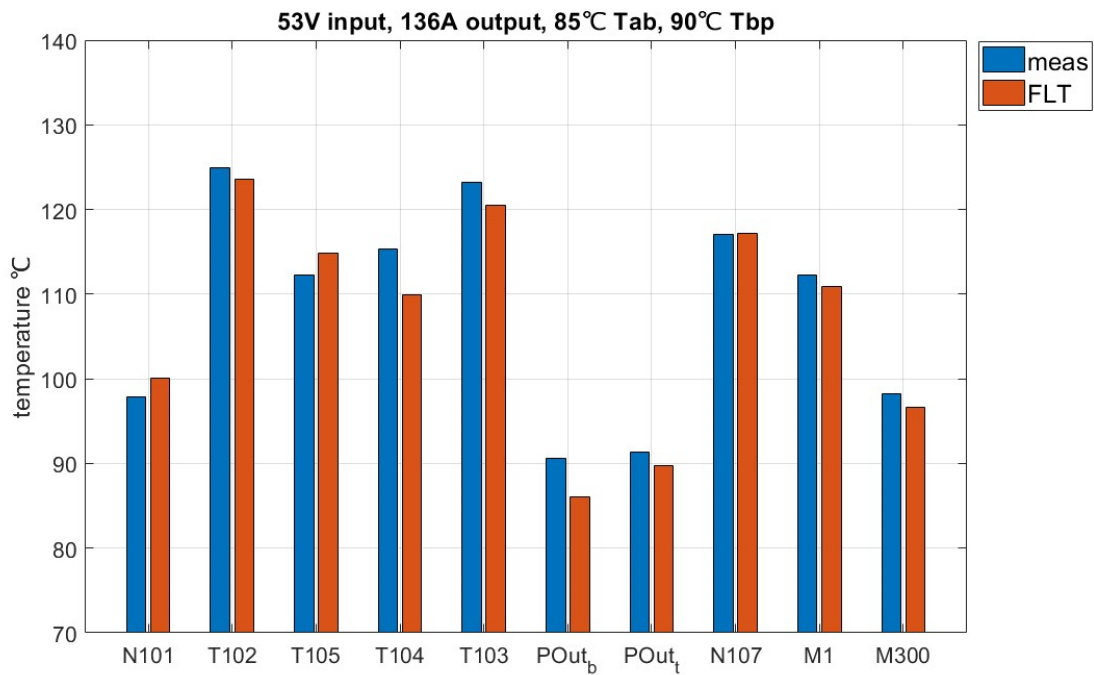
Figure 2, according to Appendix 1 - Power Loss Distribution. Default settings are for input 54V input and 136A output.

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

The model has been constructed with SI units.

Reference
Data file BMR351.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   2023-03-10   New Document

Appendix 1 - Power Loss Distribution

Power loss distribution examples for BMR 320.

Condition: 54V input, 12.2V output, Output current:136A, 100C Tcomp (default setting in the pdml file!)

Domain	Number of domains/ boundaries	Domain volume [mm³]	per domain [W]	per volume [mW/mm³]	Subtotal power loss [W]
HS Mos	2		5.60		11.20
Mid Mos	2		4.20		8.40
LS Mos	4		1.50		6.00
TransC		2777		0.90	2.50
CukeC		3043		0.23	0.70
TransW		900		16.00	14.40
CukeW		904		8.30	7.50
PrimD	2		0.14		0.28
SecD	2		0.17		0.34
AuxC	1		0.40		0.40
AuxInd	1		0.30		0.30
LDO	1		0.15		0.15
InpCuke	1		0.15		0.15
Cntr	1		0.10		0.10
GND_pcb	1		6.00		6.00
				Total (W)	**58.40**

Condition: 54V input, 12.2V output, Output current:152A, 100C Tcomp

Domain	Number of domains/ boundaries	Domain volume [mm³]	per domain [W]	per volume [mW/mm³]	Subtotal power loss [W]
HS Mos	2		6.40		12.80
Mid Mos	2		5.30		10.60
LS Mos	4		1.90		7.60
TransC					2.50
CukeC					0.70
TransW					18.20
CukeW					9.40
PrimD	2		0.14		0.28
SecD	2		0.17		0.34
AuxC	1		0.40		0.40
AuxInd	1		0.30		0.30
LDO	1		0.15		0.15
InpCuke	1		0.20		0.20
Cntr	1		0.10		0.10
GND_pcb	1		7.00		7.00
				Total (W)	**70.57**

Condition: 54V input, 12.2V output, Output current:102A, 100C Tcomp

Domain	Number of domains/ boundaries	Domain volume [mm³]	per domain [W]	per volume [mW/mm³]	Subtotal power loss [W]
HS Mos	2		3.70		7.40
Mid Mos	2		2.50		5.00
LS Mos	4		0.90		3.60
TransC					2.50
CukeC					0.70
TransW					8.10
CukeW					4.20
PrimD	2		0.14		0.28
SecD	2		0.17		0.34
AuxC	1		0.40		0.40
AuxInd	1		0.30		0.30
LDO	1		0.15		0.15
InpCuke	1		0.09		0.09
Cntr	1		0.10		0.10
GND_pcb	1		3.30		3.30
				Total (W)	36.50

Condition: 54V input, 12.2V output, Output current:68A, 100C Tcomp

Domain	Number of domains/ boundaries	Domain volume [mm³]	per domain [W]	per volume [mW/mm³]	Subtotal power loss [W]
HS Mos	2		2.00		4.00
Mid Mos	2		1.40		2.80
LS Mos	4		0.475		1.90
TransC					2.50
CukeC					0.70
TransW					3.71
CukeW					1.87
PrimD	2		0.14		0.28
SecD	2		0.17		0.34
AuxC	1		0.40		0.40
AuxInd	1		0.30		0.30
LDO	1		0.15		0.15
InpCuke	1		0.04		0.04
Cntr	1		0.10		0.10
GND_pcb	1		1.50		1.50
				Total (W)	**20.60**