

Flex Inc.

Thermal Model

BMR 3522200/031

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# General

The model is an estimation of the thermal behavior of BMR 3522200/031, which is a LA 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 352 family.

The model is intended for steady-state thermal simulations.

# Model Description

The model is a readymade Flotherm 2024 model provided as a pack-file to be imported as a project. User can then export relevant parts to be used in an application project. The model consists of three major components:

## 3D CAD Geometry

In the geometry most components are maintained per the original design, but some have been simplified in FloMCAD to cuboids and some simplified to 2-Resistor Models. For the accuracy of the simulation, the PCB imported traces and vias by importing EDA files. The glue has a great influence on heat dissipation, so the laying of glue is reasonably simplified according to the actual situation.

Unit in file: [mm]

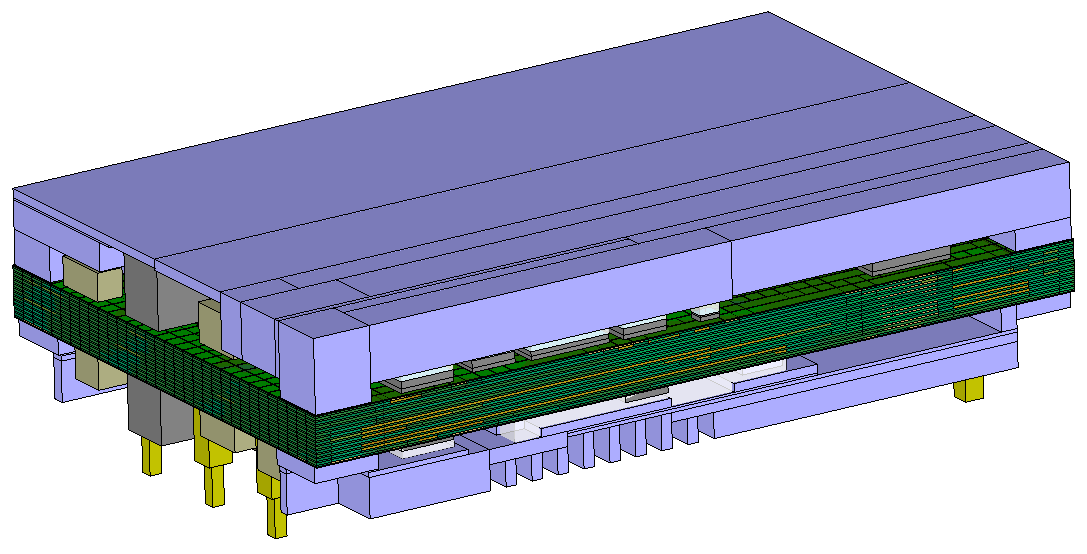
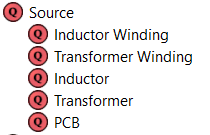
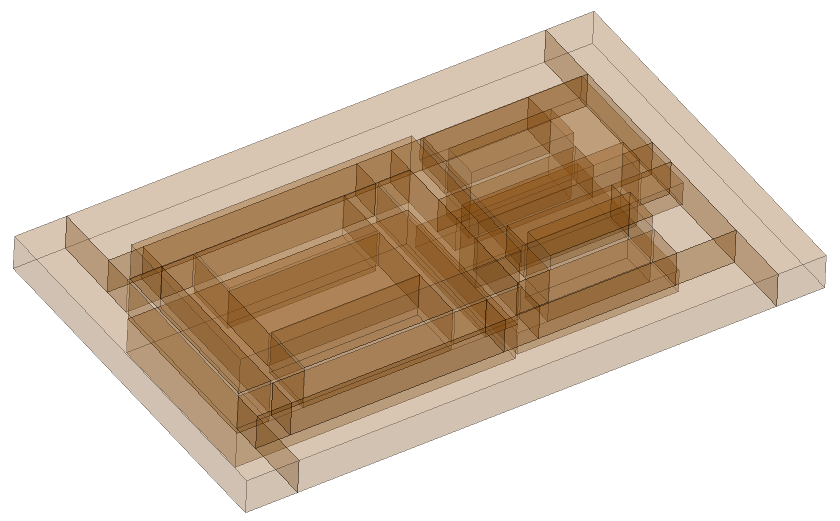


Figure 1

## Domains of power loss distribution

There are several sources for power loss, partly assigned by Sources, partly assigned by Cuboids, and partly by 2-Resistor Models. The power loss for each of them are given in [Appendix 1 - Power Loss Distribution](#_Appendix_1_-)



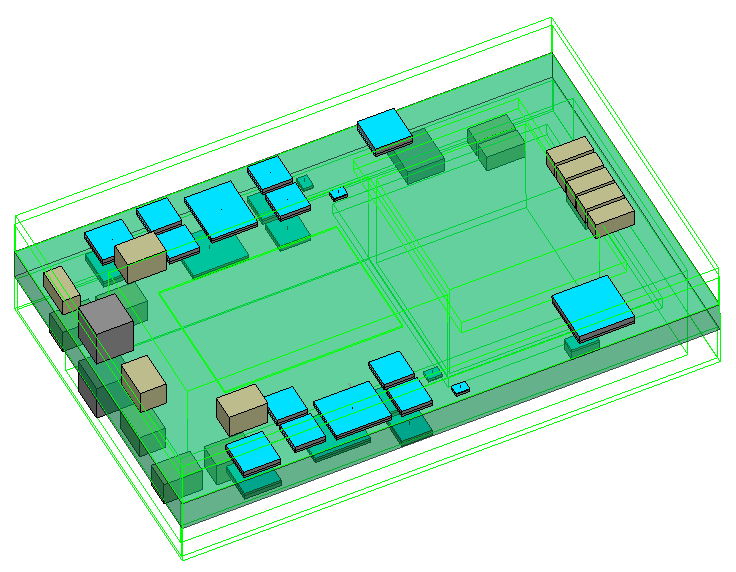
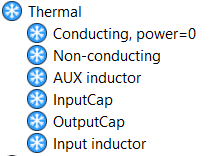
 

Figure 2 Domains of power losses

## 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.

**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.

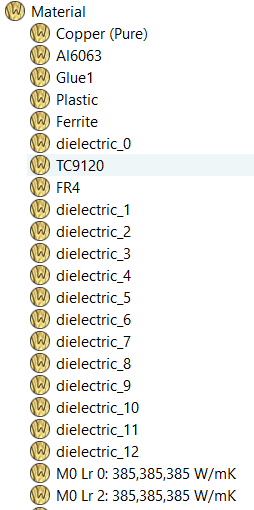


Figure 3: Materials

# Model Calibration

The model has been calibrated to give temperatures as similar as possible for Vin=54[V], Vout=12[V], Iout=167[A], compared to thermal verification document 1-10265-BMR Thermal Test Report from Input to Output*.* Total Ploss=57.2[W].

The result of the calibration is show in the figure below:

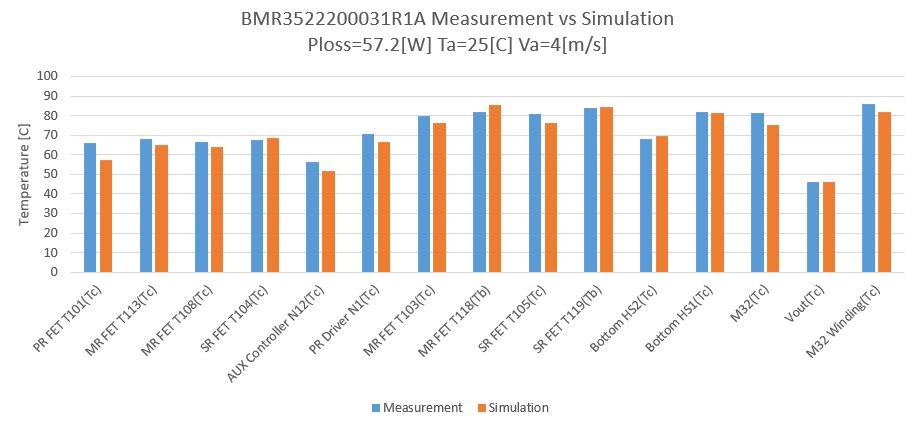


Figure 4: Result of calibration

# Model Usage

Load the pack file. Export the BMR3522200/031R1A assembly in desired format, then import this into desired project.

Assign power losses per table in [Appendix 1 - Power Loss Distribution](#_Appendix_1_-) to the sources in section *Domains of power loss distribution*. Default settings are for Vin=54[V], Vout=12[V], Iout=167[A], T≈100[C]

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, which corresponds to the measured points in the thermal verification. These temperatures are not intended for pass/fail criteria.

# Additional Information

Model has been constructed with SI units.

## Reference

Wind tunnel report 1-10265-BMR352 Thermal Test Report from Post to Neg.pdf  
Flotherm model *BMR3522200031.pack*

## Product number and r-state history

*BMR3522200031*

## 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

|  |  |  |
| --- | --- | --- |
| **Revision** | **Revision information** | **Date** |
| A | New document | 2024-10-16 |
|  |  |  |
|  |  |  |

# Appendix 1 - Power Loss Distribution

Power loss example for BMR3522200031 for Vin=54[V], Vout=12[V], Iout=167[A], T≈100[C]

|  |  |  |  |
| --- | --- | --- | --- |
| **Sources** | **Number of domains** | **Per domain [W]** | **Total [W]** |
| Inductor winding | 1 | 9.07 | 9.07 |
| Transformer winding | 1 | 10.746 | 10.746 |
| Transformer core | 1 | 4.4 | 4.4 |
| Inductor core | 1 | 2.6 | 2.6 |
| SR FET | 8 | 1.393 | 11.144 |
| SR driver | 4 | 0.18 | 0.72 |
| PR FET | 4 | 0.724 | 2.896 |
| MR FET | 4 | 2.048 | 8.192 |
| PR driver | 4 | 0.218 | 0.872 |
| Input cap | 11 | 0.01 | 0.11 |
| Output cap | 8 | 0.013 | 0.104 |
| LDO | 1 | 0.155 | 0.155 |
| Controller | 1 | 0.08 | 0.08 |
| AUX controller | 1 | 0.35 | 0.35 |
| AUX Inductor | 1 | 0.3 | 0.3 |
| Input Inductor | 2 | 0.166 | 0.332 |
| PCB Trace | 1 | 5.122 | 5.122 |
| Total |  |  | 57.2 |

# Appendix 2 - 2-Resistor Model Regression

The simulation data can be fitted within +/- 3 [C] using the following 2-Resistor Model:

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | **Symbol** | **Values** | **Unit** |
| Thermal resistance junction to case(top) | Rjc | 1.23 | K/W |
| Thermal resistance junction to board | Rjb | 2.24 | K/W |

The 2-Resistor Model is obtained by simulating two cold plate tests on the top and bottom of power module, and the parameters were deduced using regression methods. Since this module is not a complete package, there is a deviation in the simulation using the 2R model, although we made great efforts to reduce the error.