# THERMAL MODEL FOR
# BMR491XXXX/851
# BMR491XXXX/853

FLEX INC.

# Contents

# General

The model is an estimation for the thermal behavior of BMR491 series, which is a Through Hole Pin design. It is valid for the BMR491xxxx//851 and BMR491xxxx/853 variants. The Product's thermal verification report has been used as a reference.

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

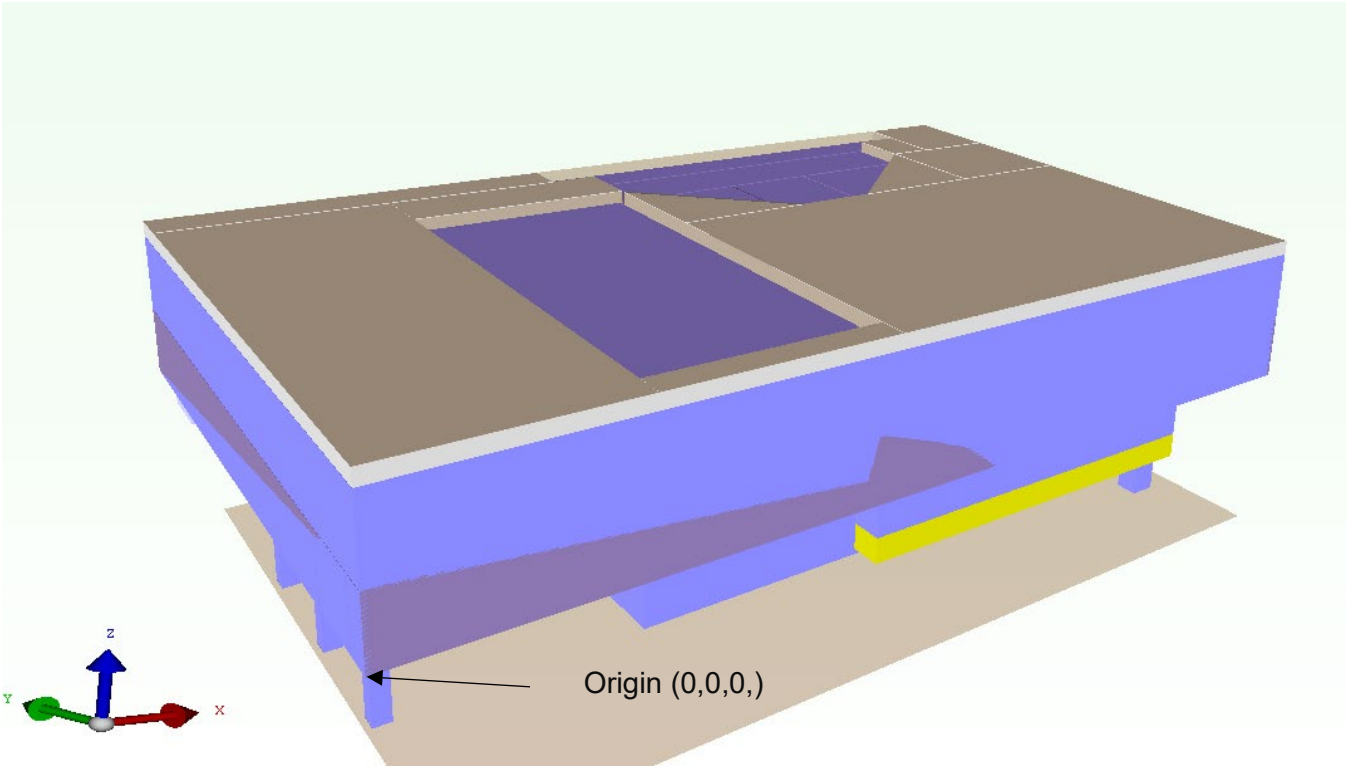


*Figure 1 Model origin in lower left corner of PCB and axis orientation.*

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 module total powers, are given in *Appendix 1 - Power Loss Distribution*

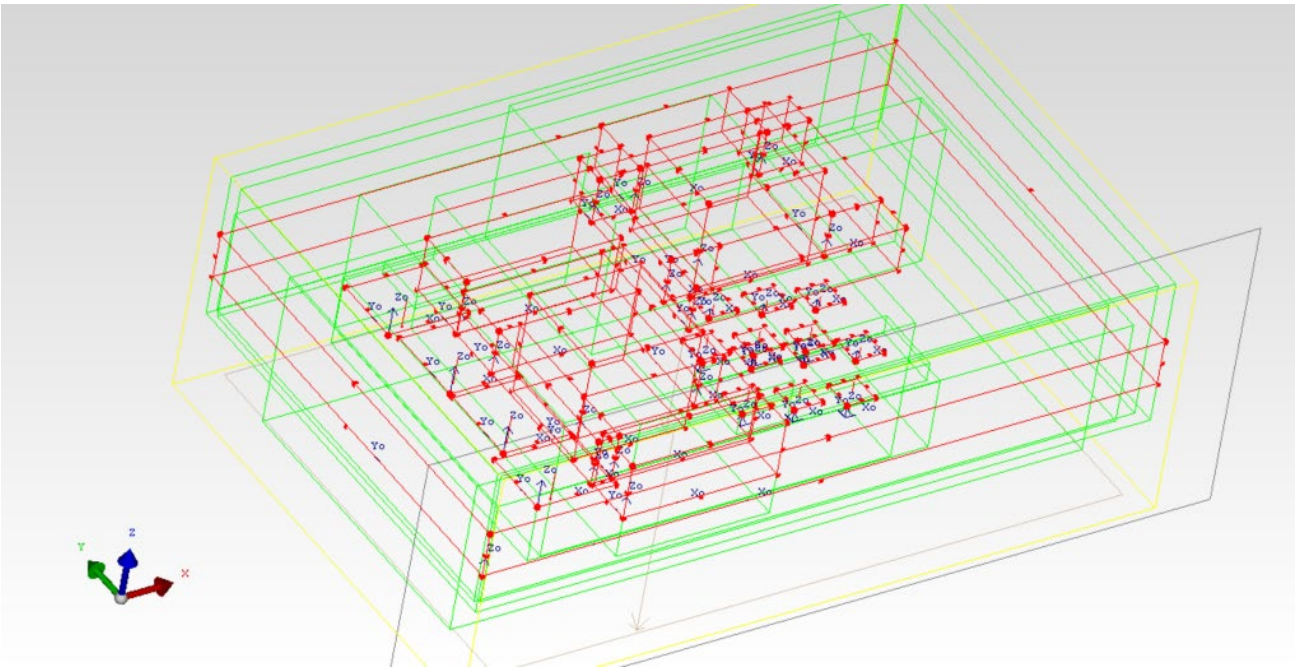

*Figure 2: Heat Sources*

## 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.

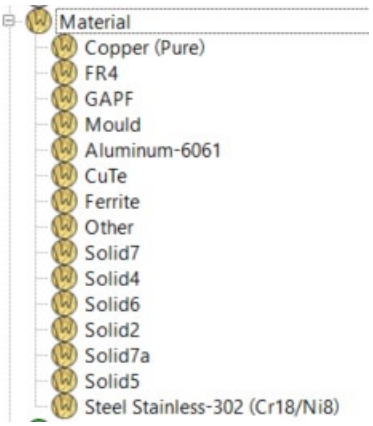


*Figure 3. Domains of material data*

**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:

Top view


Pin view

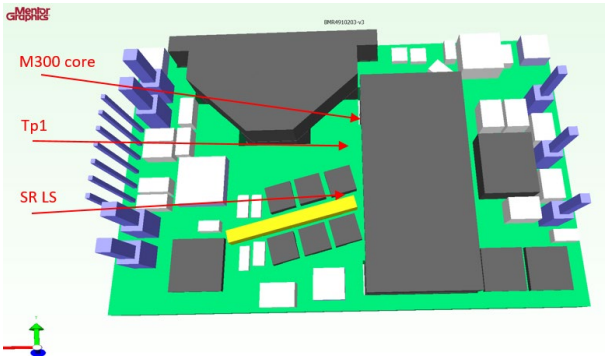


*Figure 4. Probe points.*

# Model Calibration

The model has been calibrated to give temperatures as similar as possible compared to a water-cooling test. In this detailed model all PCB and mechanical features are included.

Simulation temperatures are within ±3 [C] compared to measured values, except for <N419> where the value is within ±4.5 [C].

For the calibration the temperature of the top of the baseplate and ferrites was set to 82[C], and the bottom end of the pins to 75[C].

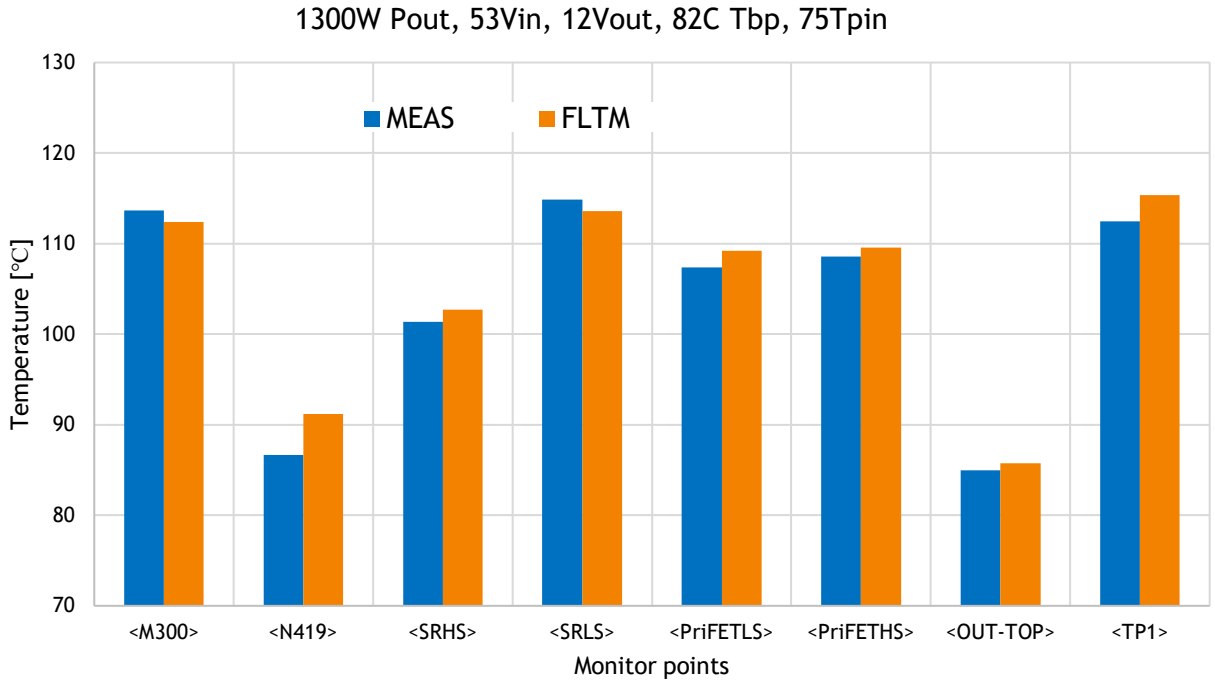


*Figure 5: Model calibration result, FLTM: Flotherm simulation results, MEAS: Measured results.*

# 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 53[V], 1300[W].

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

BMR491E.pdml

## Product number and r-state history

Flex product number IPM 101 57, R1A 2019-12-14

## 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 | 2019-12-14 | New Document |
| B | 2019-12-20 | New power loss distribution. Source Nx added to model. Calibration info updated. |
| C | 2020-01-14 | Appendix 1 updated with 48[V] |
| D | 2020-01-16 | Appendix 1 updated with 900-882[W]. Model Usage and Reference updated. |
| E | 2020-04-07 | Appendix 1 updated with 750[W] |
| F | 2020-08-28 | Made for 4Oz version. |

| | | |
|---|---|---|
| G | 2020-09-10 | Appendix 1 updated with 1350[W]. |
| H | 2021-09-21 | Real data used as reference; model updated; power loss table added for 1300 [W]. |

# Appendix 1 - Power Loss Distribution

Power loss distribution examples for BMR491.

Condition: 48-53[V], 25[C], Output Power:434[W]

| Domain | Number of domains | Power loss per domain [W] | Power loss per volume [mW/mm$^3$] | Subtotal [W] |
|---|---|---|---|---|
| PRIMFET | 4 | 0.43 | - | 1.72 |
| SECFET | 12 | 0.26 | - | 3.12 |
| TRAFOWIND | 4 | - | 6.47 | 4.14 |
| TRAFO | 1 | 1.81 | - | 1.81 |
| CHOKEWIND | 6 | - | 0.65 | 0.55 |
| CHOKE | 1 | 0.60 | - | 0.60 |
| PCB | 1 | 0.06 | - | 0.06 |
| Nx | 4 | 0.4375 | - | 1.75 |
| Total [W] | | | | 13.75 |

Condition: 48-53[V], 25[C], Output Power:750[W]

| Domain | Number of domains | Power loss per domain [W] | Power loss per volume [mW/mm$^3$] | Subtotal [W] |
|---|---|---|---|---|
| PRIMFET | 4 | 1.19 | - | 4.76 |
| SECFET | 12 | 0.379 | - | 4.55 |
| TRAFOWIND | 4 | - | 7.15 | 4.576 |
| TRAFO | 1 | 4.13 | - | 4.13 |
| CHOKEWIND | 6 | - | 1.359 | 1.15 |
| CHOKE | 1 | 1.0 | - | 1.0 |
| PCB | 1 | 0.06 | - | 0.06 |
| Nx | 4 | 0.4375 | - | 1.75 |
| Total [W] | | | | 21.98 |

Condition: 48-53[V], 25[C], Output Power: 900-882[W]

| Domain | Number of domains | Power loss per domain [W] | Power loss per volume [mW/mm$^3$] | Subtotal [W] |
|---|---|---|---|---|
| PRIMFET | 4 | 1.65 | - | 6.60 |
| SECFET | 12 | 0.53 | - | 6.36 |
| TRAFOWIND | 4 | - | 10.36 | 6.63 |
| TRAFO | 1 | 4.13 | - | 4.13 |
| CHOKEWIND | 6 | - | 1.83 | 1.56 |
| CHOKE | 1 | 1 | - | 1 |
| PCB | 1 | 0.25 | - | 0.06 |
| Nx | 4 | 0.435 | - | 1.74 |
| Total [W] | | | | 28.27 |

Condition: 48-53[V], Output Power: 1300[W]

| Domain | Number of domains | Power loss per domain [W] | Power loss per volume [mW/mm$^3$] | Subtotal [W] |
|---|---|---|---|---|
| PRIMFET | 4 | 3.72 | - | 14.88 |
| SECFET | 12 | 1.19 | - | 14.25 |
| TRAFOWIND | 4 | - | 23.8 | 15.24 |
| TRAFO | 1 | 4.13 | - | 4.13 |
| CHOKEWIND | 6 | - | 6.11 | 5.20 |
| CHOKE | 1 | 2.5 | - | 2.5 |
| PCB | 1 | 0.5 | - | 0.5 |
| Nx | 4 | 0.435 | - | 1.74 |
| Total [W] | | | | 58.44 |