DESCRIPTION
THERMAL MODEL FOR
PKB4413DA SERIES

FLEX POWER MODULES

Contents

General

The model is based on and valid for PKB4413DA PIHS (internal no BMR 676 07/1101R1B), which is a Through Hole 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 family.

The model is intended for steady-state thermal simulations.

Model Description

The model is a readymade Flotherm 11.1 model. The geometry was created by importing a CAD model in STEP format through the MCAD bridge. The baseplate has been simplified to one cuboid. To compensate for the larger distance between baseplate and components, a scaled (higher) thermal conductivity has been assigned to the gapfiller in-between. Components that are not considered contributing to the heat flow have been removed. The PCB has been imported through FloEDA. Resolution of layers are 20 cells in longest direction, and maximum number of bands. The model consists of the four major components:

1. Cuboid version of the geometry
2. Domains of power loss
3. Domains of material properties
4. Predefined monitor points

3D CAD Geometry

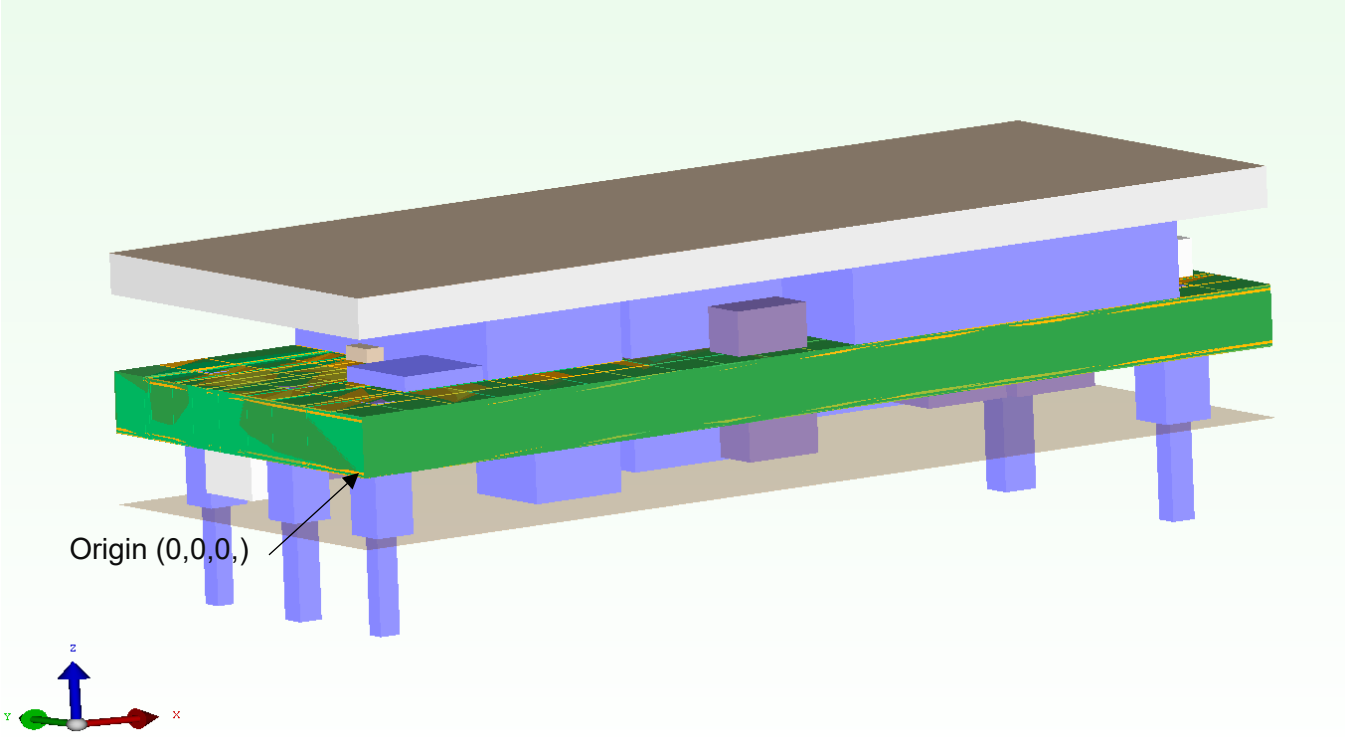


Figure 1 Model origin in lower left corner of PCB and axis orientation.

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.*

Some sources have negative values. Their function is to remove power loss at locations where no or little power loss occurs.

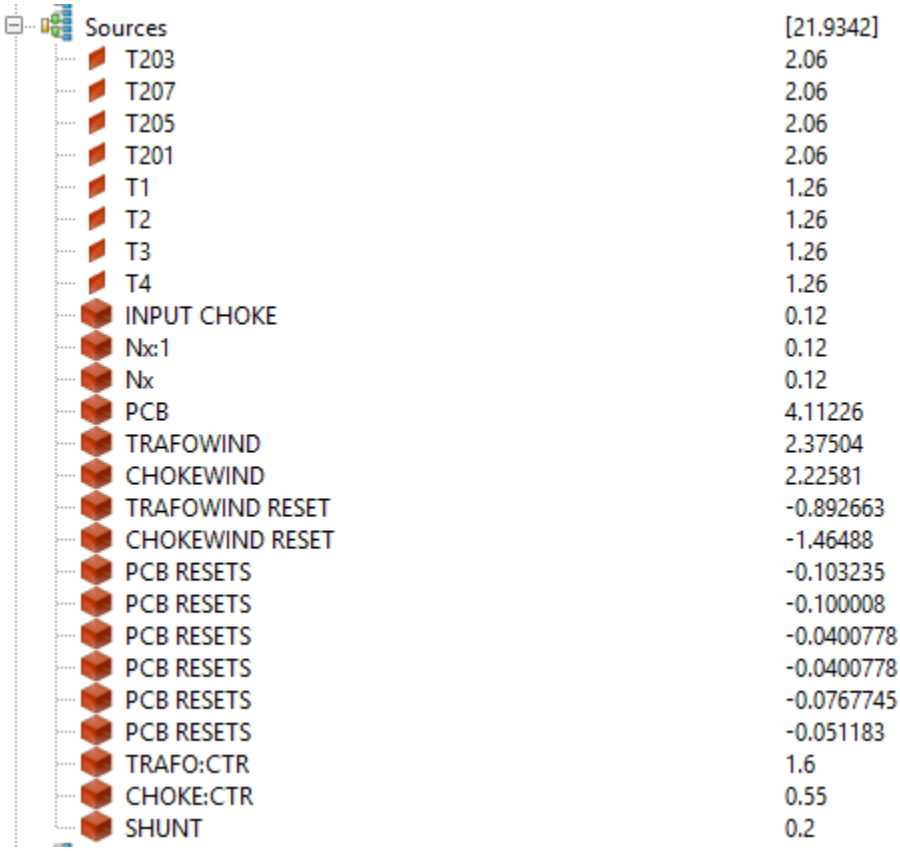


Figure 2: Heat Sources to be found as sources. Note the negative numbers. These are to cancel out power loss in areas with no or little power generation.

Domains of material data

There are several material domains. The heat conductivity for each of them is given either as isotropic or orthotropic values in x-,y-, and z-direction (x,y,z). Since the PCB was imported through FloEDA, the number of materials is large. The orthotropic properties are automatically generated by FloEDA.

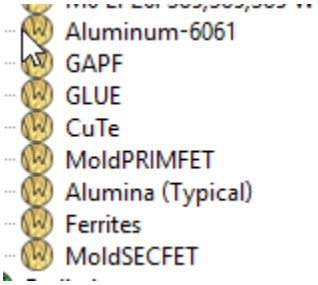
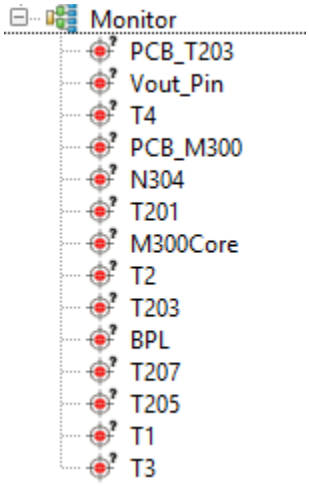


Figure 3. Domains of material data, in addition to the layer material patches in the PCB.

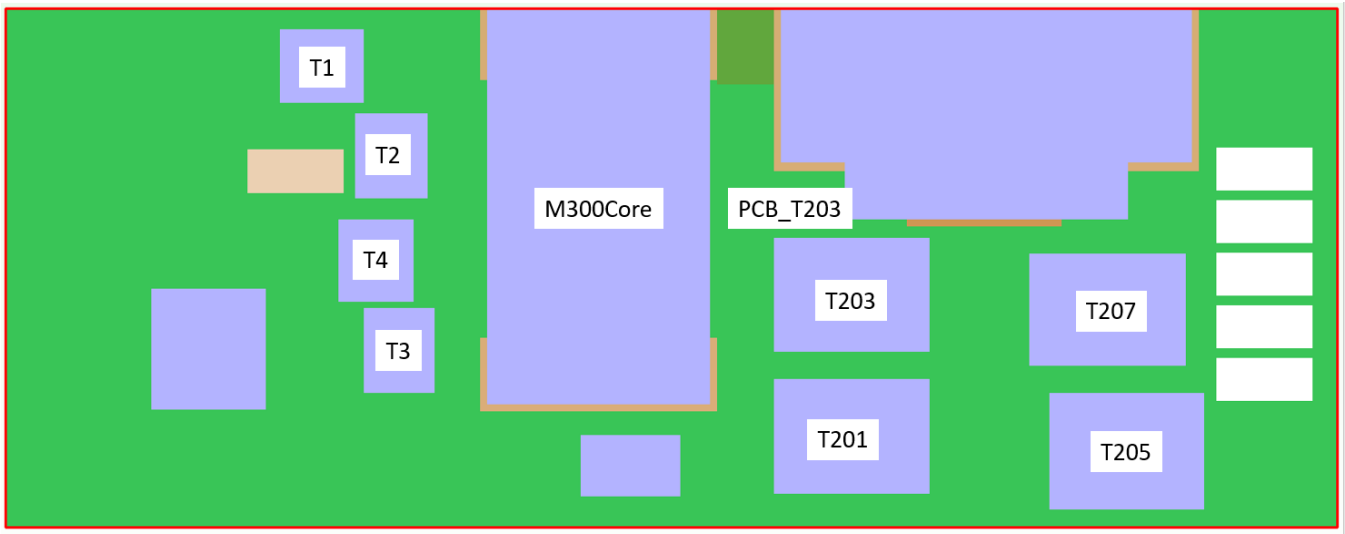
Note. The given heat conductivities are only intended to model the temperature distribution of the module in this application. The values should not be treated as physically true or transferable to other applications.

Monitor points

The model comes with predefined monitor points, which corresponds to the location in document 3/102 65-BMR 676 04 Rev A:



Note: Monitor points T1, T3, T205 and T207 are extra, not present in reference document.



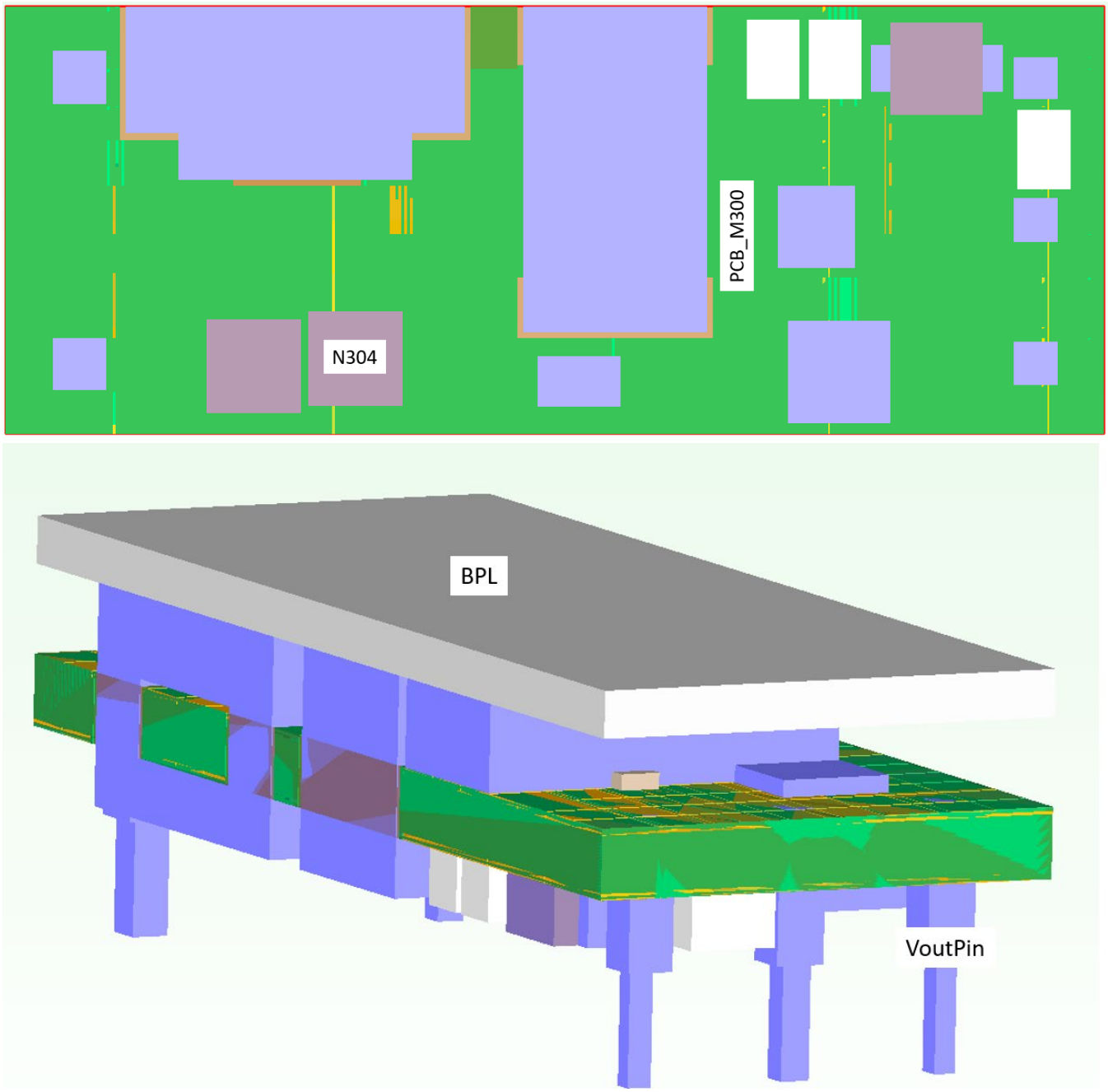
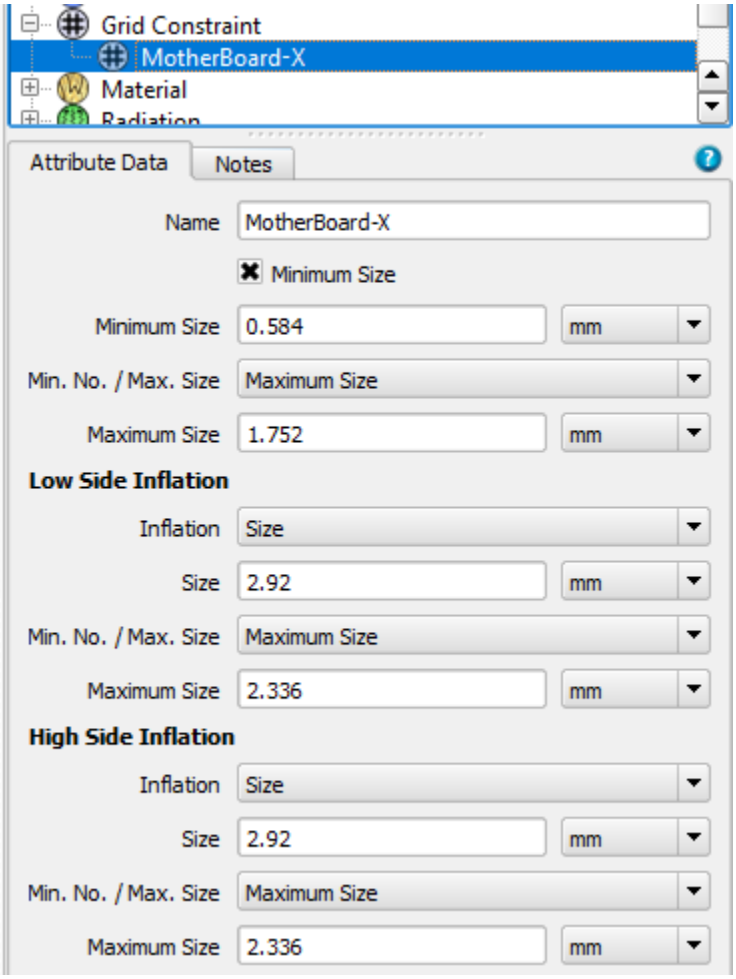


Figure 4. Thermocouple location.

Grid

The model has one predefined grid constraint, inherited from FloEDA. It is used in PCB to keep aspect ratio low. Of course, this constraint is optional to use. Elsewhere we have tried to align in space as many domains as possible, to allow for an easy gridding.



Model Calibration

The model has been calibrated to give temperatures as similar as possible compared to thermal verification document 3/102 65-BMR 674 07 Rev A, for V_{in}=52.5[V], V_{out}=12.0[V], I_{out}=30[A], I_{in}=7.3[A], at 1[m/s]. Calculations were done with a set temperature of 44.8[C] on the pins, and 69[C] on the top of baseplate.

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

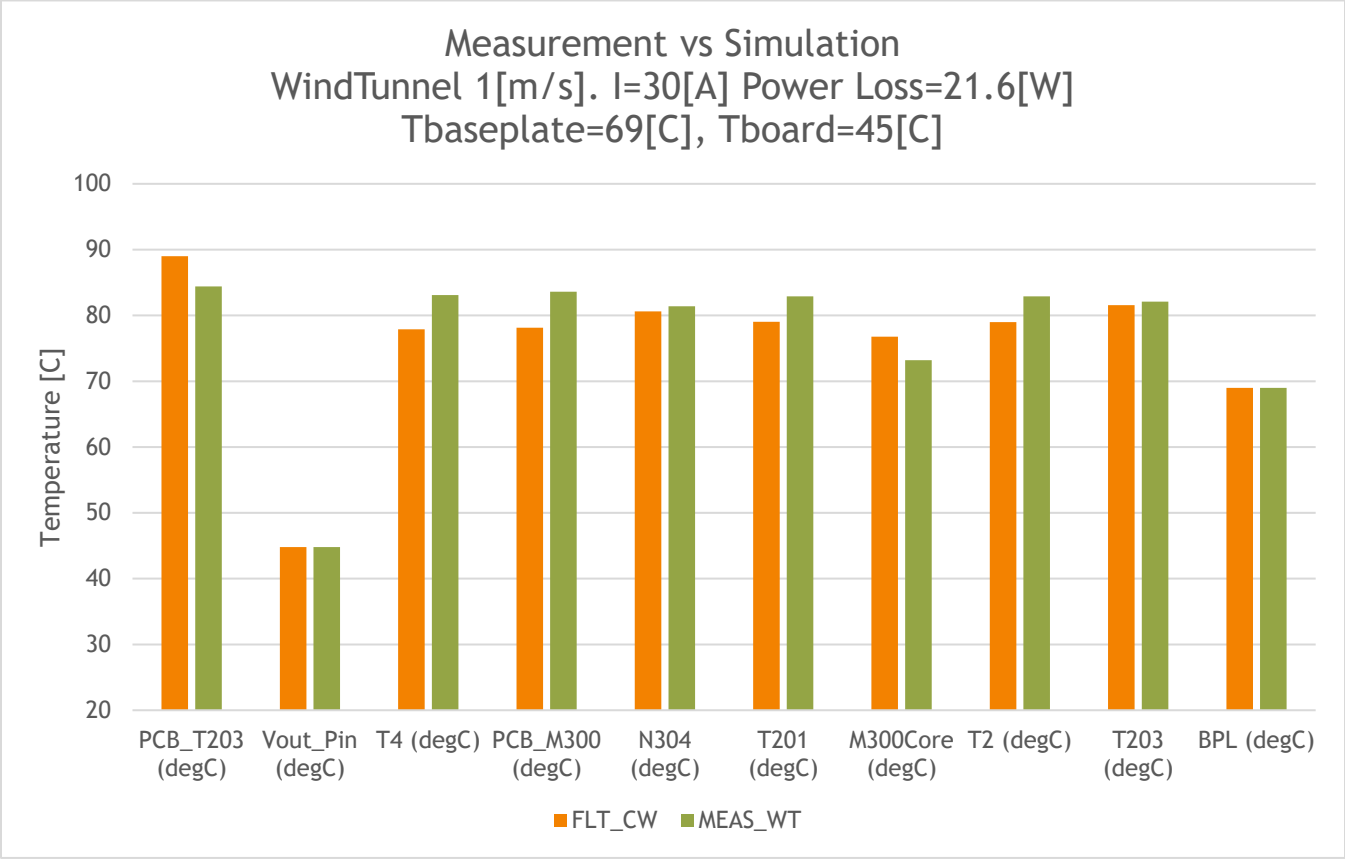


Figure 5: Model calibration result. Meas_WT=Measured values in wind tunnel. FLT_CW=This model, Flotherm, Conduction only.

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 21.9[W] output power.

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

Thermal report 3/102 65-BMR 674 07 Rev A

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	2020-04-22	New Document

Appendix 1 - Power Loss Distribution

Power loss distribution example for BMR 676 07/1101.

V_{in}= 52.5[V] V_{out}= 12.0[V] I_{in}= 7.3[A] I_{out}= 5.8A]

Domain	Number of domains	Domain volume [mm^3]	Per domain [W]	Per volume [mW/mm^3]	Total [W]
PRIMFET	4		1.26		5.04
SECFET	4		2.06		8.24
TRAFO	1		1.6		1.6
CHOKE	1		0.55		0.55
TRAFOWIND	1			4.89	2.38
CHOKEWIND	1			8.67	2.23
TRAFOWIND RESET	1			-5.85	-0.89
CHOKEWIND RESET	1			-9.6	-1.46
PCB	1			0.94	4.11
PCB RESETS	6			-0.94	-0.411
Nx	2		0.12		0.24
SHUNT	1		0.2		0.2
INPUT CHOKE	1		0.12		0.12
Total [W]					**21.9**