PCIe40
Thermal Model

Jean-Marc NAPPA on behalf of the LAPP team

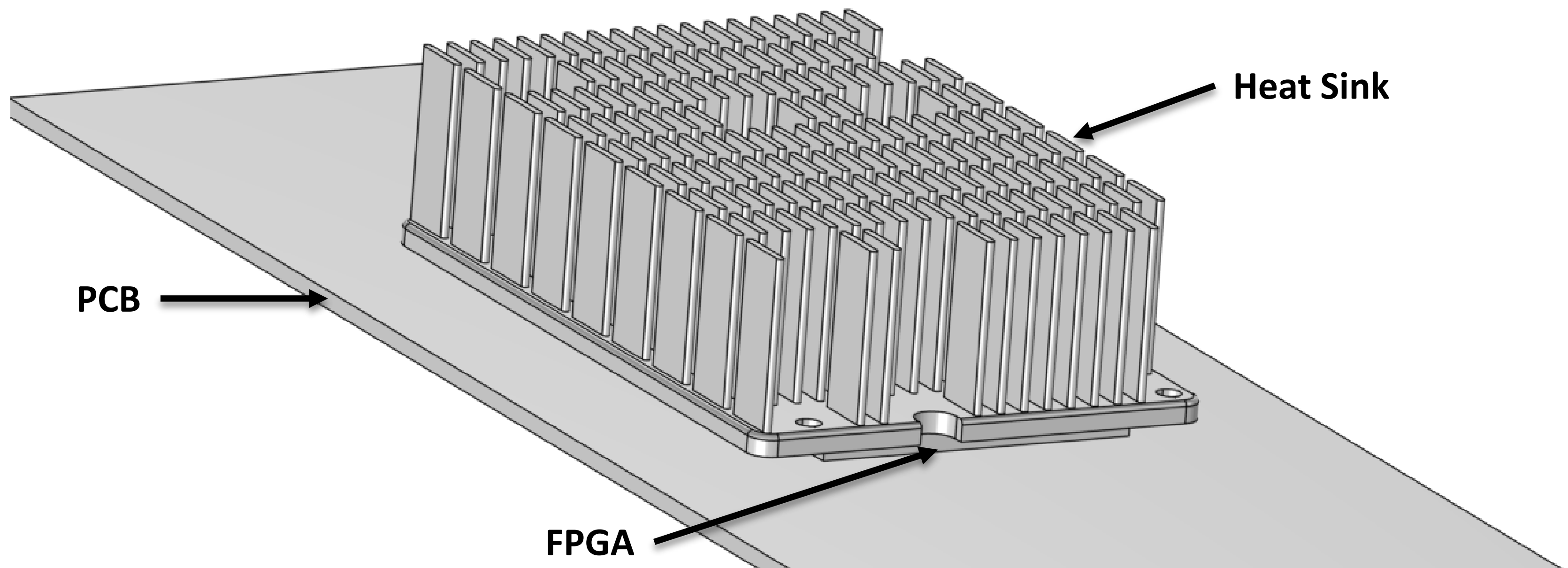
General

The model is an estimation for the thermal behavior of FPGA Heat Sink, which is a PCIe40 design.

Model Description

The model is a readymade COMSOL 6.0 model.

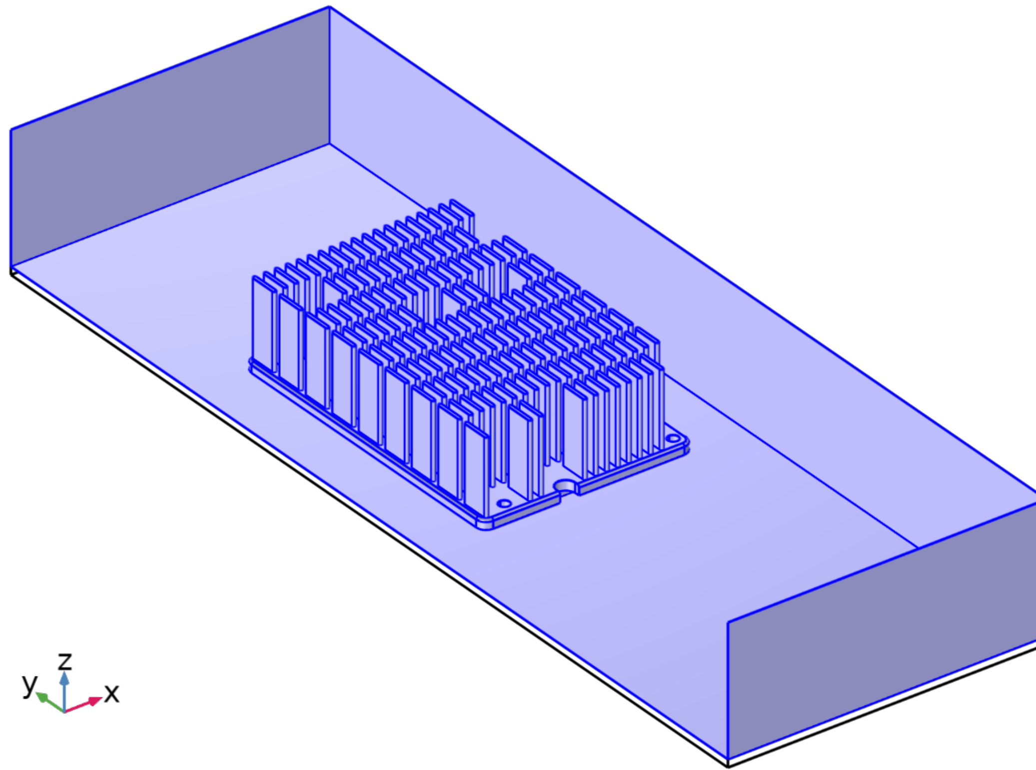
3D CAD Geometry



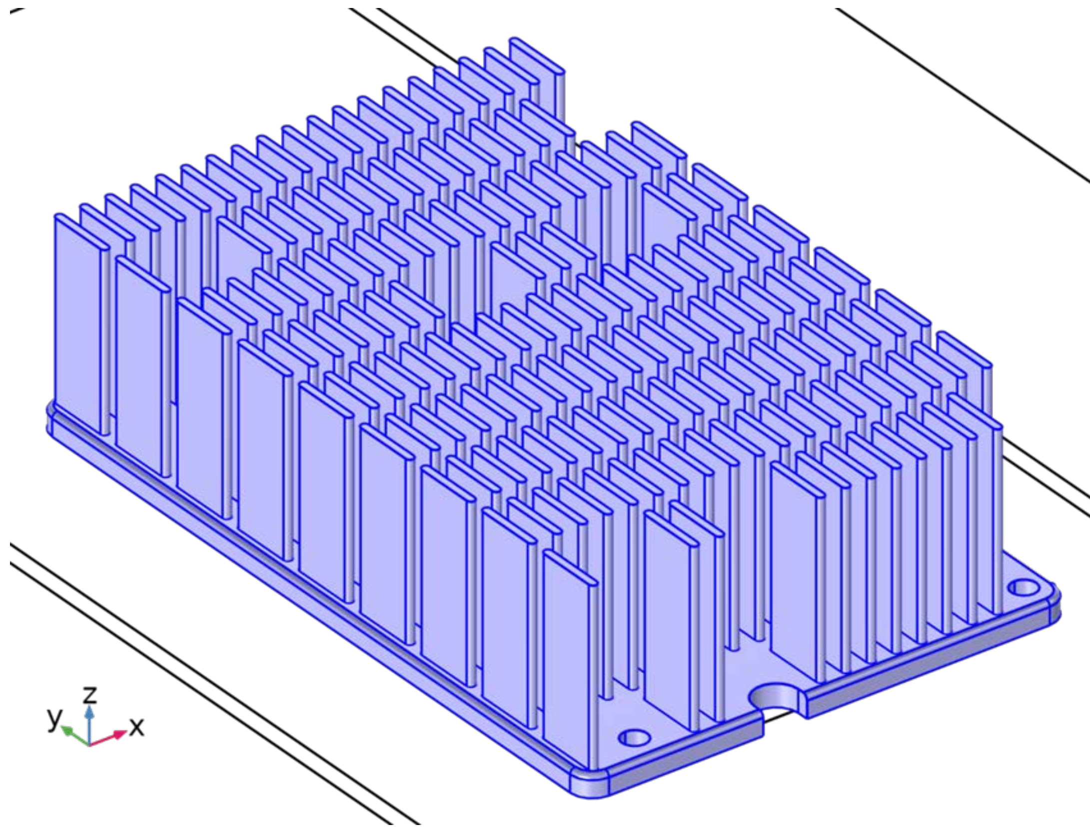
Definitions:

- **FBGA : 10AX115S3F45E2SG**
- **Thermal Pad : Tpcm585 or Tpcm7200**
- **Heat Sink : S08DZV07**
- **PCB thickness: 2.4 mm**
- **Air dimensions : 30x10x4 cm**

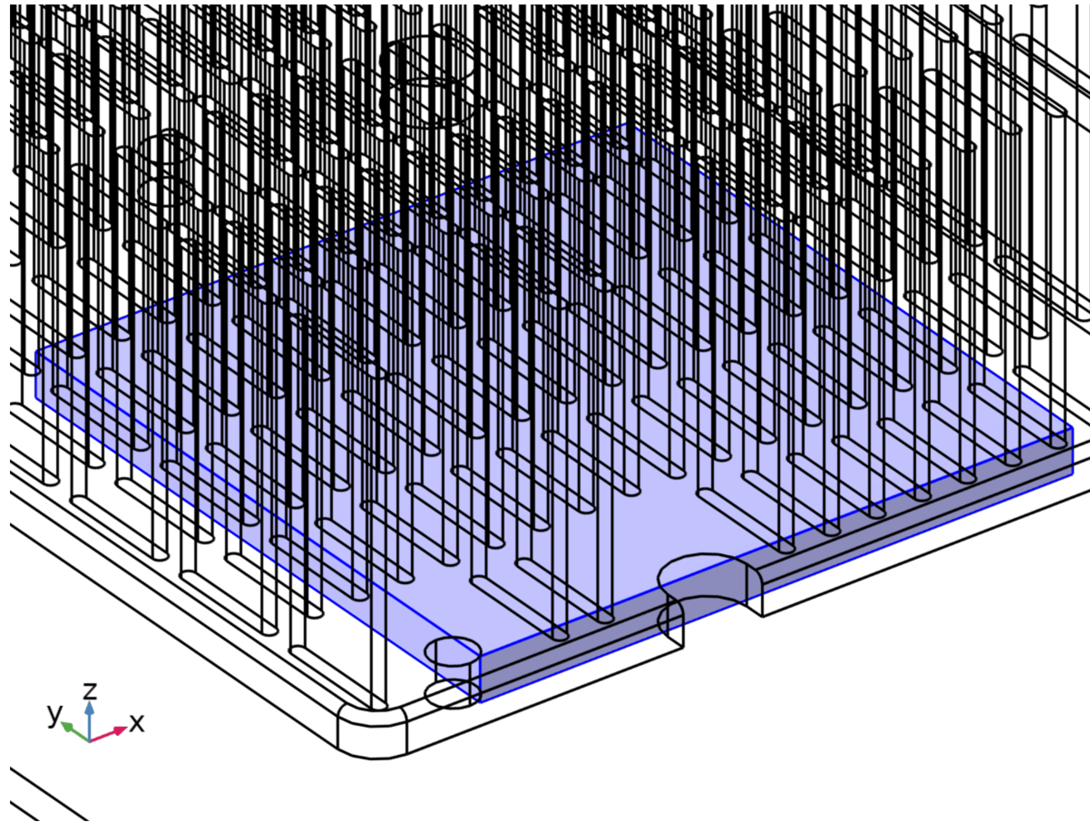
Air



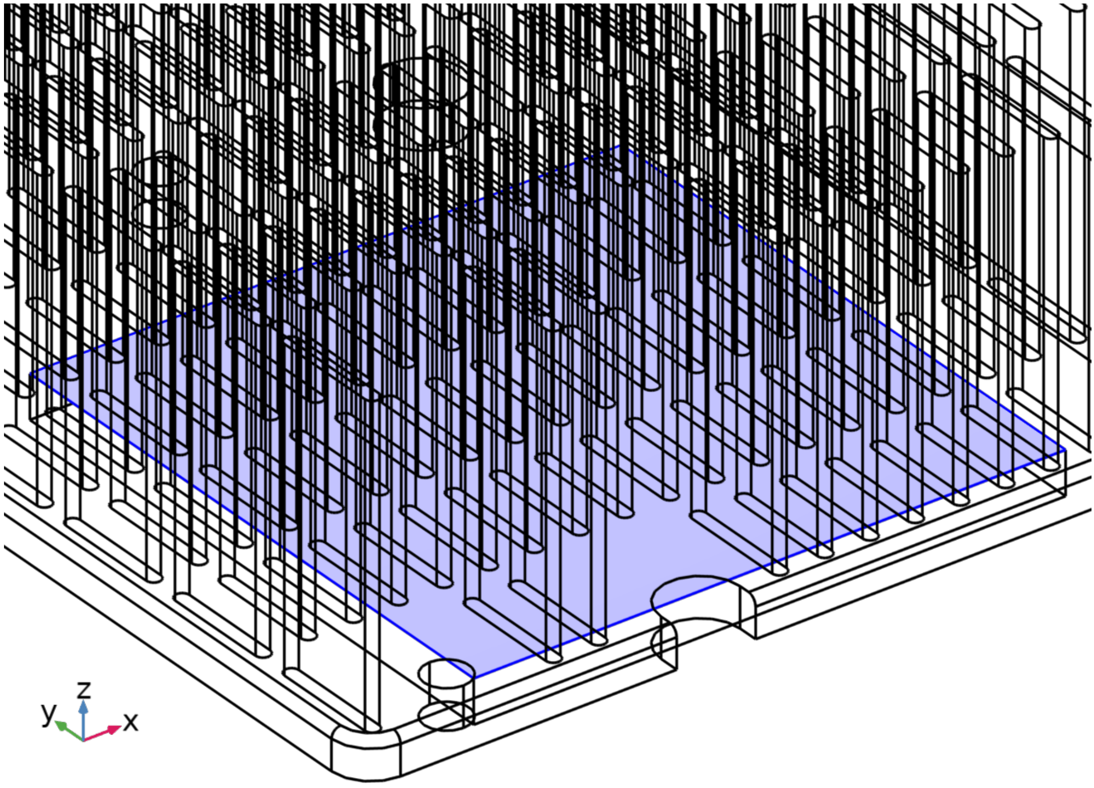
Heat Sink



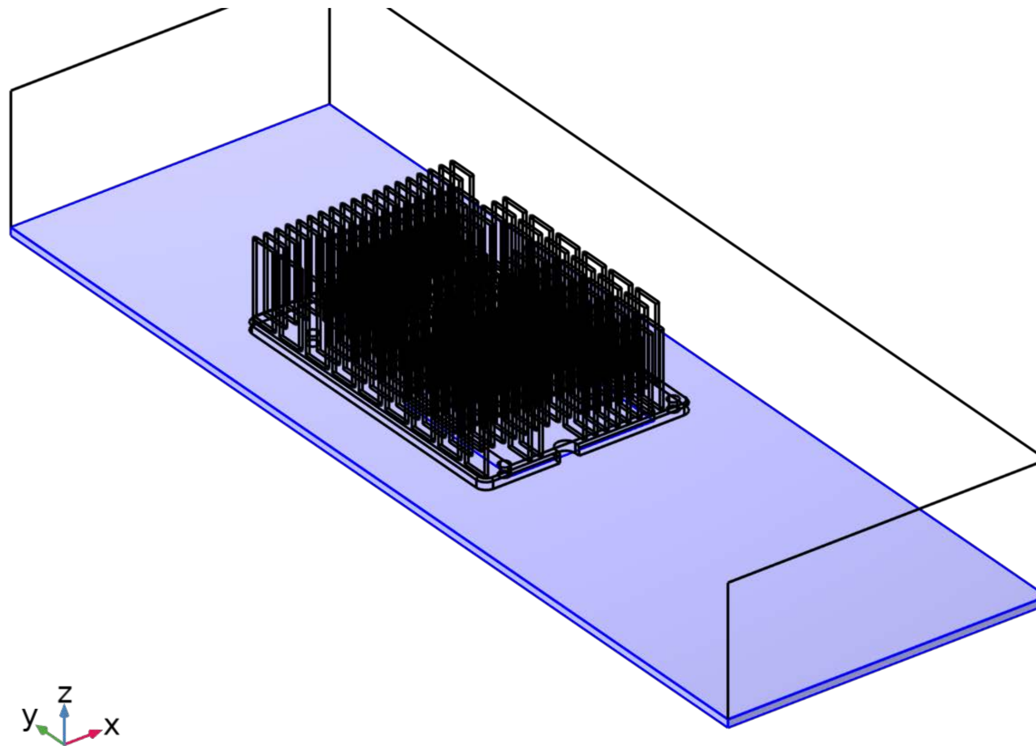
FPGA



Thermal Pad



PCB



Matériaux

Aluminum : Heat Sink

- **Heat capacity at constant pressure: 900 J/(kg·K)**
- **Thermal conductivity: 238 W/(m·K)**
- **Density: 2700 kg/m^3**

Silica glass : FPGA

- **Heat capacity at constant pressure: 703 J/(kg·K)**
- **Thermal conductivity: 1.38 W/(m·K)**
- **Density: 2203 kg/m^3**

Thermal grease : Thermal Pad

- **Thermal conductivity for Tpcm585 : 3.8 W/(m·K)**
- **Thermal conductivity for Tpcm7200: 7.5 W/(m·K)**

FR4 : PCB

- **Heat capacity at constant pressure: 1369 J/(kg·K)**
- **Thermal conductivity: 0.3 W/(m·K)**
- **Density: 1900 kg/m^{3}f**

Heat Transfert in Solids and Fuilds

Heat Source

- Total power dissipated by the electronic chip FPGA: 60 W

Thermal Contact

- Thermal Pad thickness: 127 µm

Heat Flux

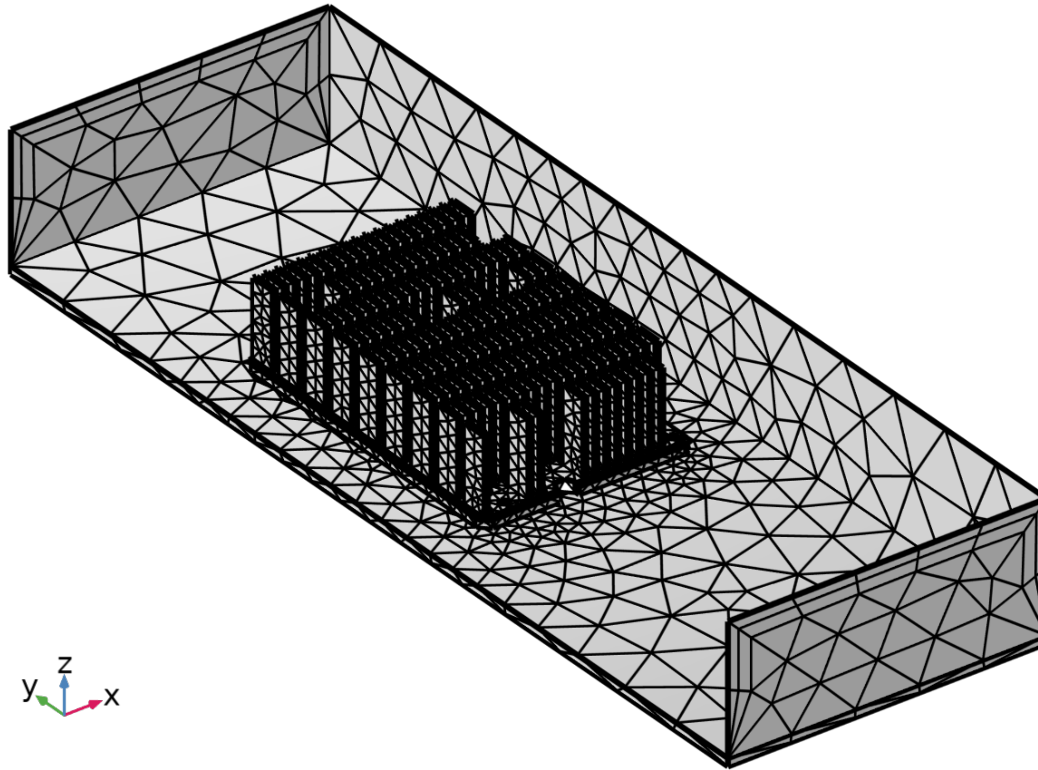
- Heat Transfer coefficient: 10 W/(m^2·K)

Laminar Flow

Inlet

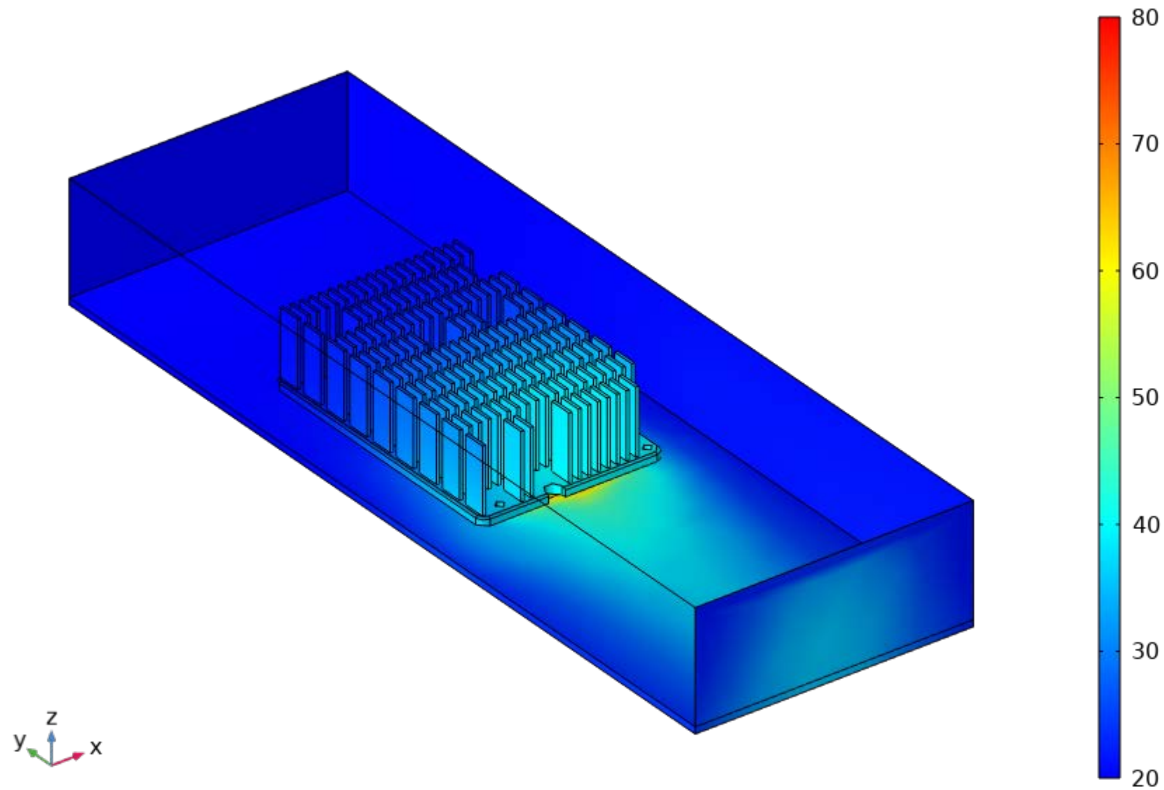
- Flow rate (unit of volumetric airflow): 17.22 CFM (400 LFM or 0.008127 m^3/s)

Mesh

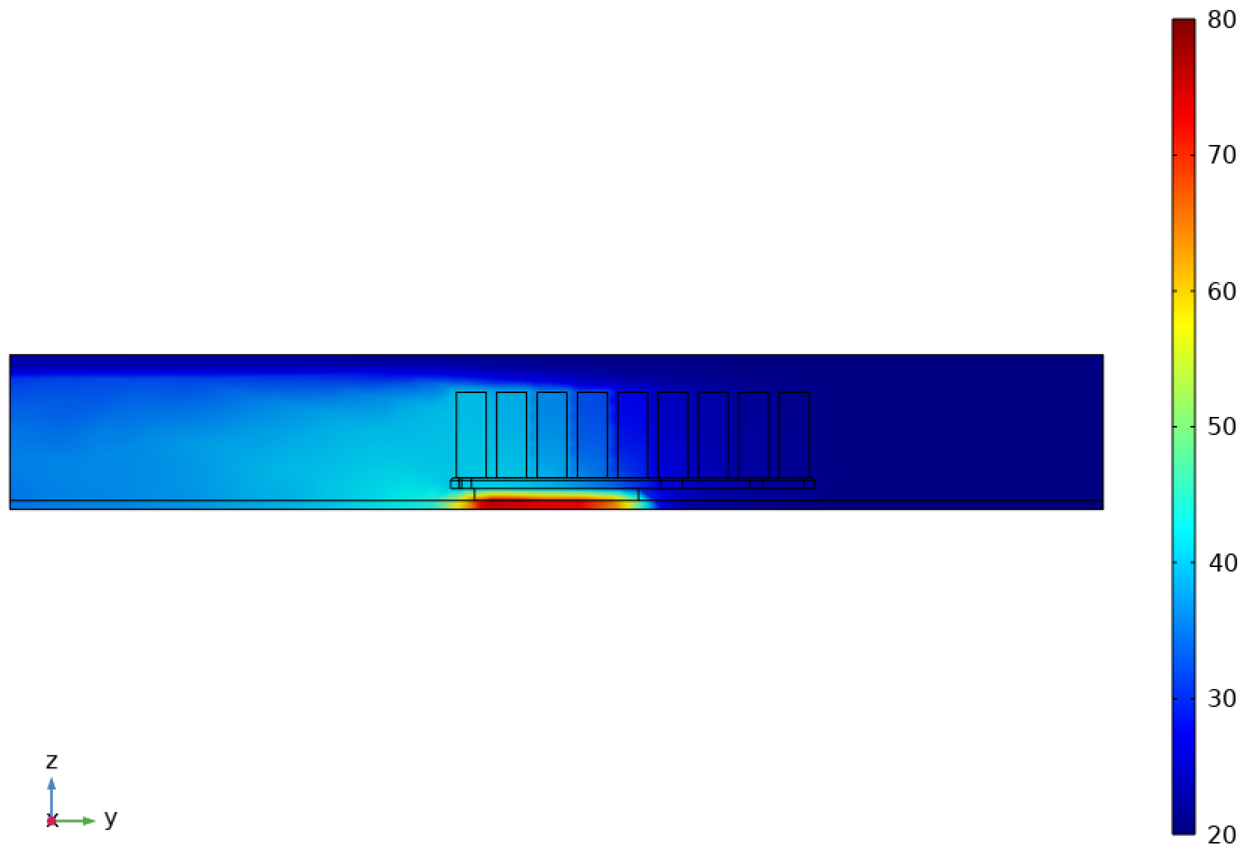


Results

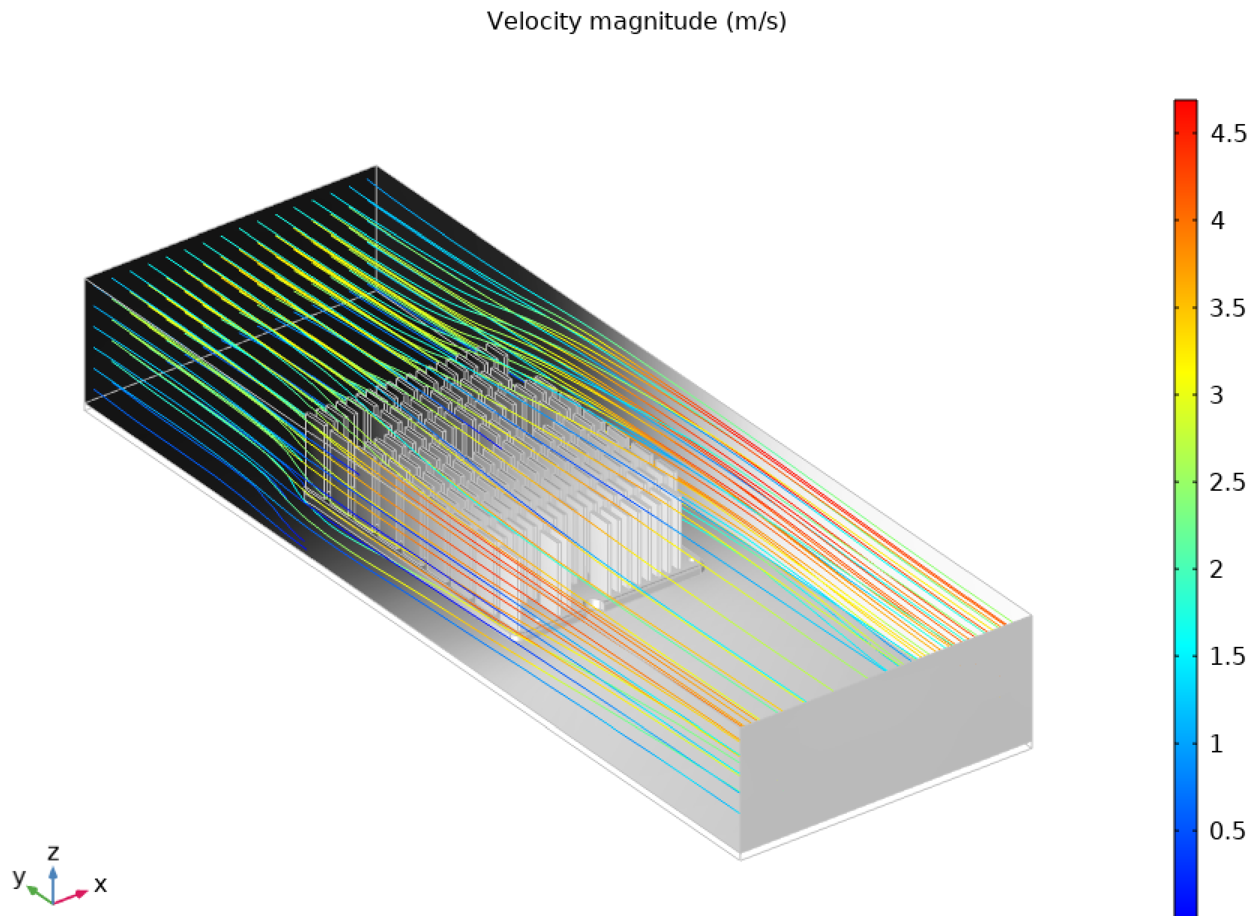
- **Temperature FPGA with Tcpm585 : 55.81 degC**
- **Temperature FPGA with Tcpm7200: 55.21 degC**



Results



Results



PCIe400
Thermal Model

Jean-Marc NAPPA on behalf of the LAPP team

Heat Transfert in Solids and Fuilds

Heat Source

- Total power dissipated by the electronic chip FPGA: 160 W

Thermal Contact

- Thermal Pad thickness: 127 µm

Heat Flux

- Heat Transfer coefficient: 10 W/(m^2·K)

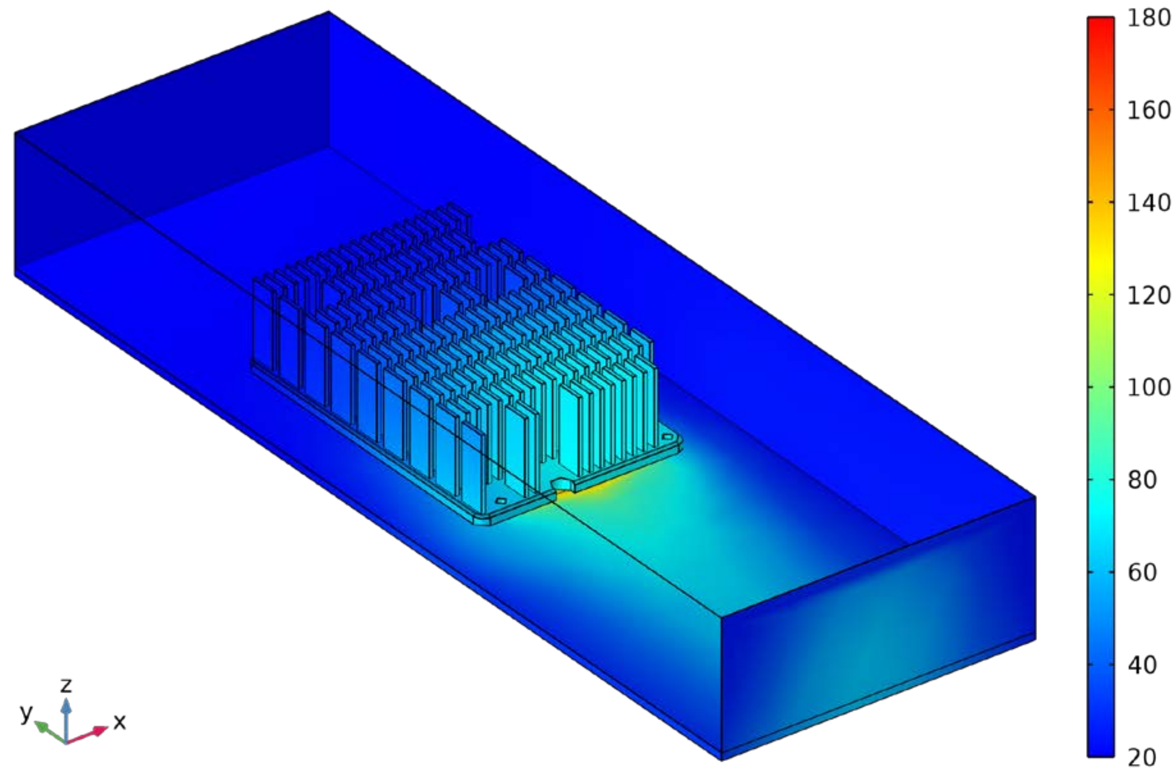
Laminar Flow

Inlet

- Flow rate (unit of volumetric airflow): 17.22 CFM (400 LF or 0.008127 m^3/s)

Results

- **Temperature FPGA with Tcpm585 : 116.42 degC**
- **Temperature FPGA with Tcpm7200: 115.92 degC**



Heat Transfert in Solids and Fuilds

Heat Source

- Total power dissipated by the electronic chip FPGA: 160 W

Thermal Contact

- Thermal Pad thickness: 127 µm

Heat Flux

- Heat Transfer coefficient: 10 W/(m²·K)

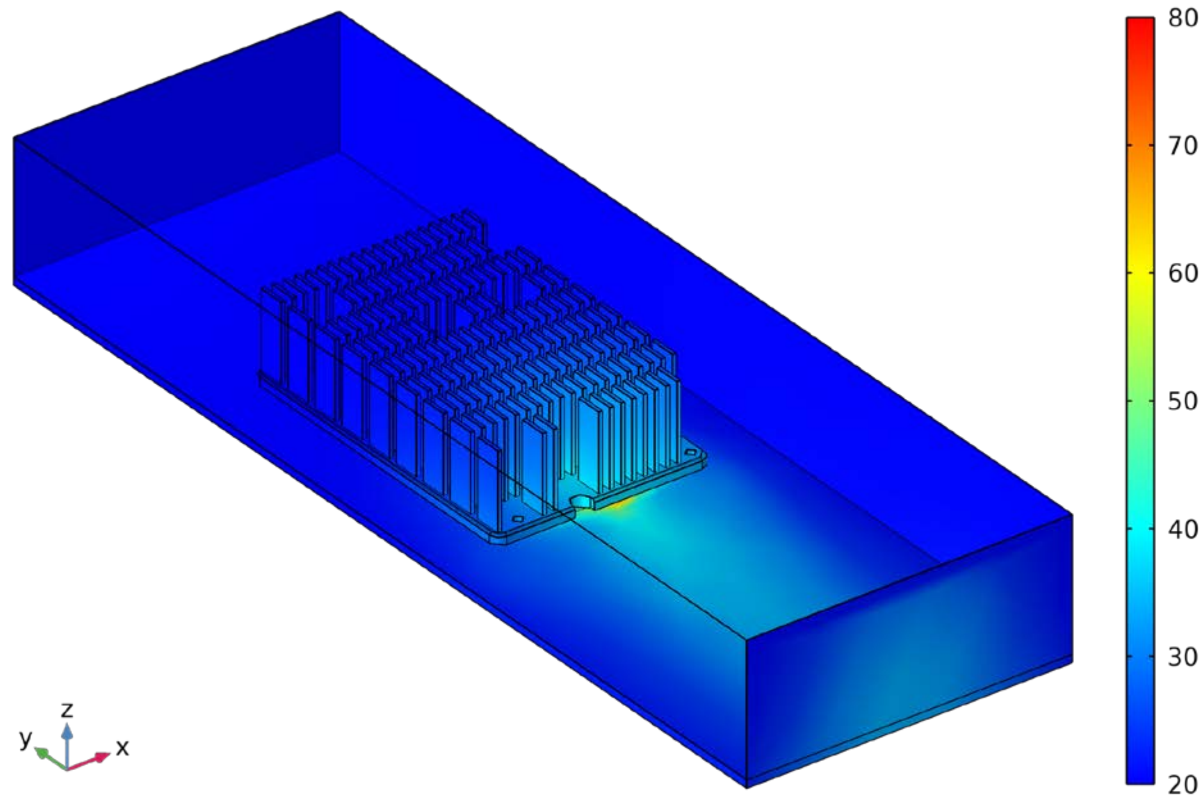
Laminar Flow

Inlet

- Flow rate (unit of volumetric airflow): 62 CFM (1440 LFM or 0.029261 m³/s)

Results

- Temperature FPGA with Tcpm585 : 85.031 degC
- Temperature FPGA with Tcpm7200: 85.025 degC



Specification technique to move forward

- **PCB Design 3D Model (Cadence Allegro)**
- **Specification FPGA**
- **Envelope 3D from heat sink**
- **Front panel 3D model 3D**
- **Chassis (speed fan, position, model 3D)**
- **COMSOL Simulation License (~ 2k€/year)**