



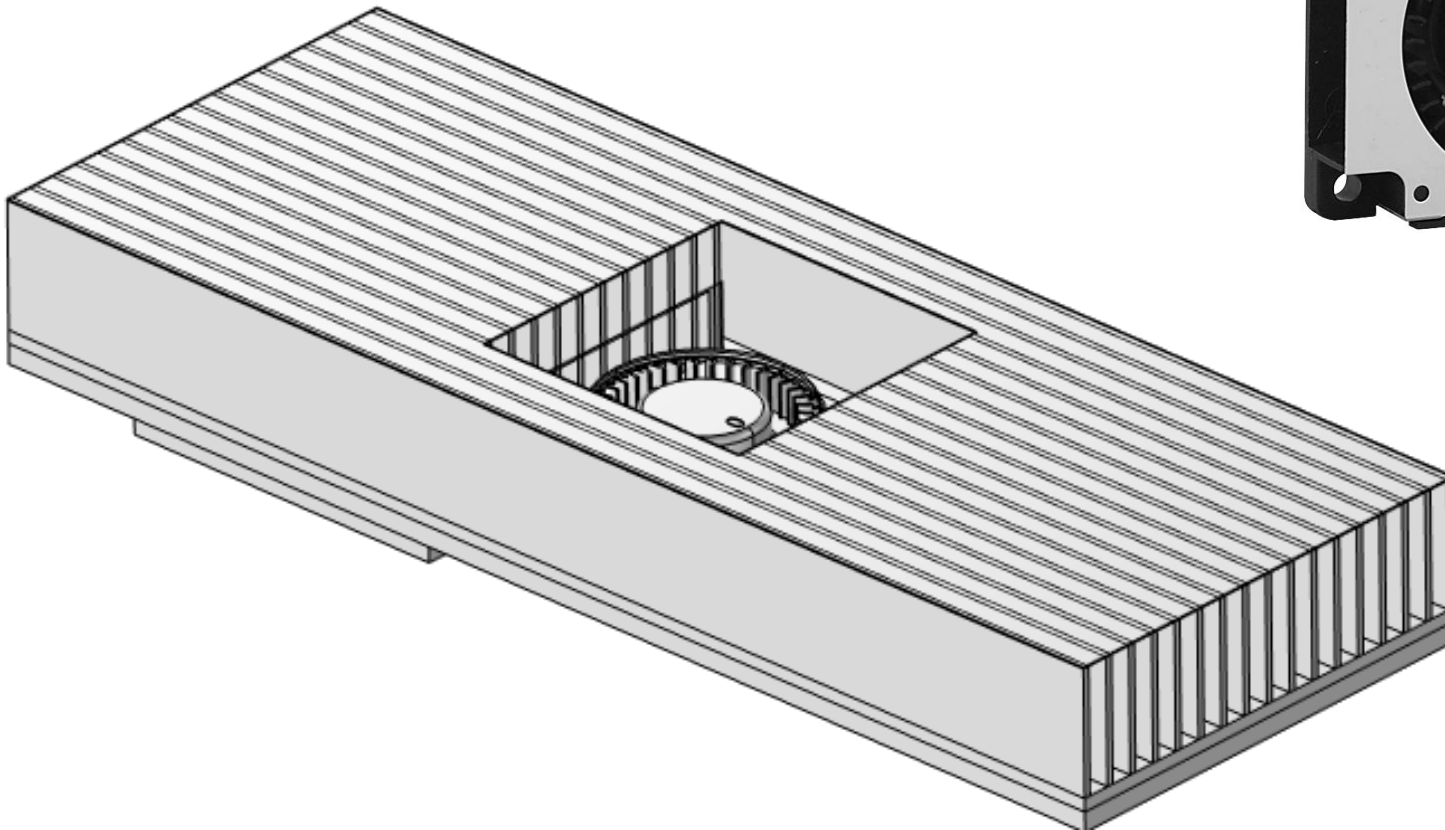
PCIe400 Thermal Model

Jean-Marc NAPPA on behalf of the LAPP team



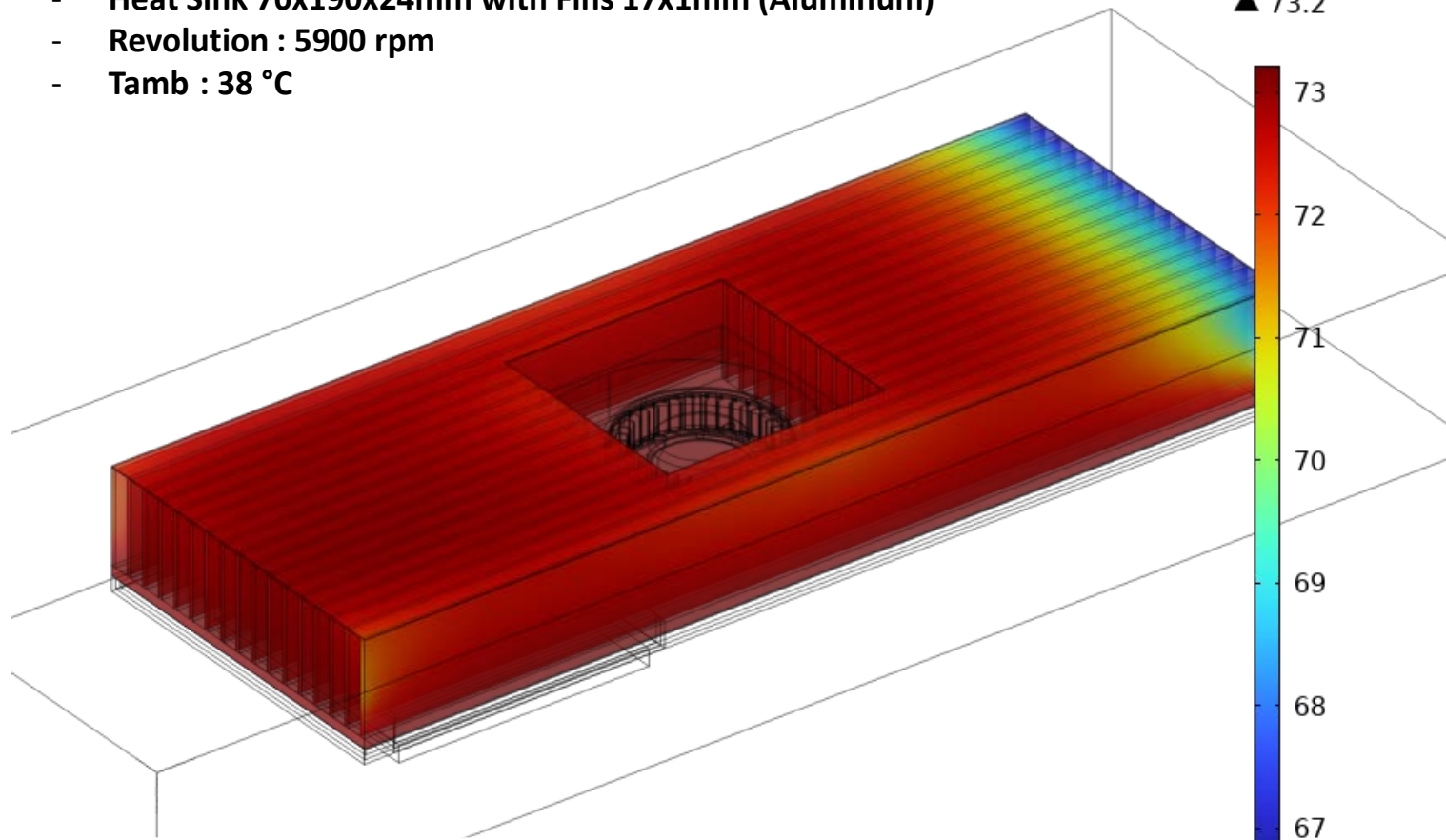
PCIe400 & Shell & Blower (Delta BFB04512HHA-C)

- FPGA 52x49x3.5mm
- Volume Air 275x100x35mm
- Air Flow : 1 m/s
- Heat source : 85 W
- Thermal Impedance $R_{\theta J-C}$: 0.031 °C/W
- Thermal Impedance $R_{\theta C-S}$: 0.007 °C/W



PCIe400 & Shell & Blower (Delta BFB04512HHA-C)

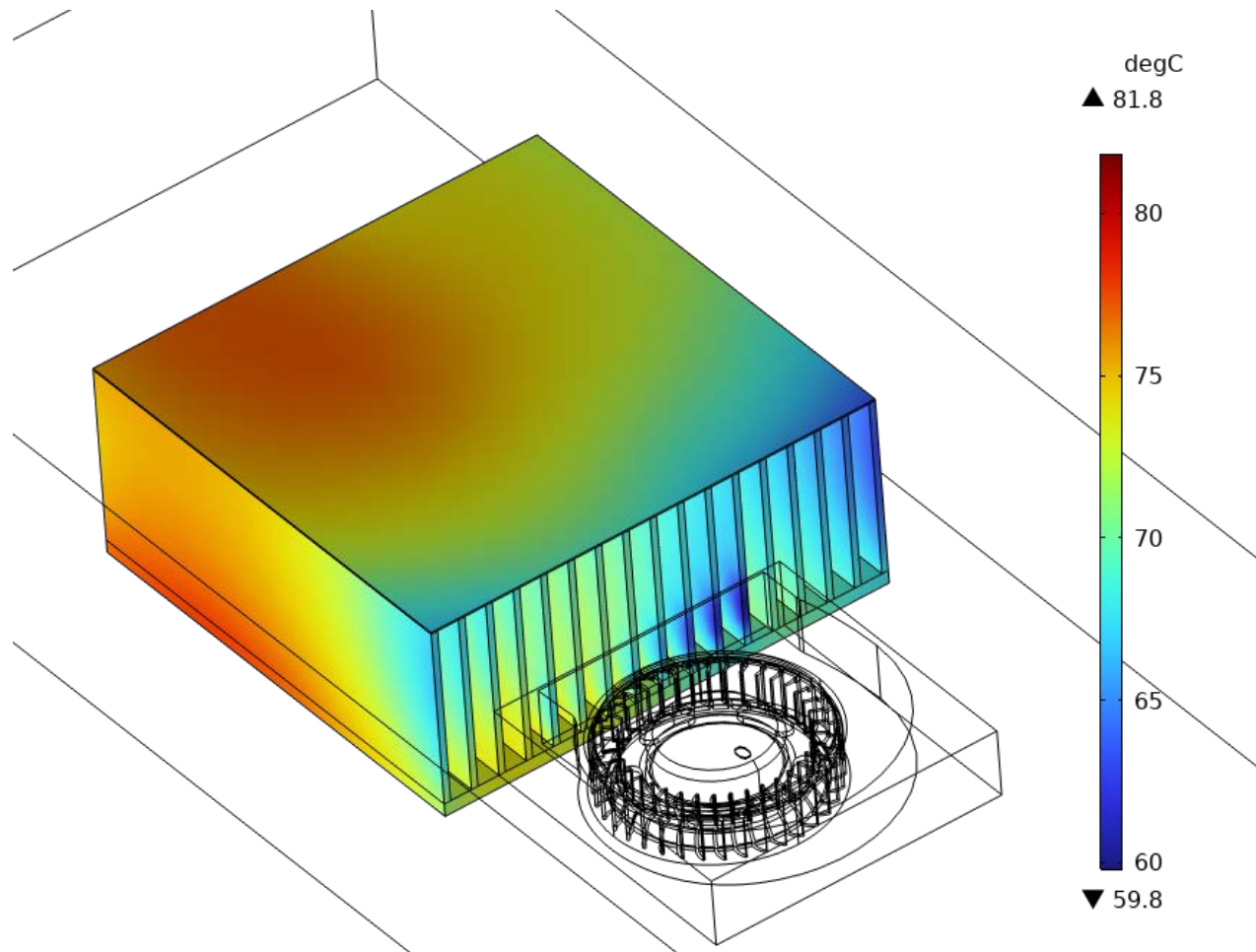
- Vapor Chamber 70x190x3mm with Encoche 56.3x52x5.4mm (Copper)
- Heat Sink 70x190x24mm with Fins 17x1mm (Aluminum)
- Revolution : 5900 rpm
- Tamb : 38 °C



T_moy (degC)	RiseT_moy (K)	R_sa_moy (degC/W)	Tj_moy (degC)
73.298	35.298	0.41527	76.528

PCIe400 & Shell & Blower (Delta BFB04512HHA-C)

- Heat Sink 70x70x27mm with Fins 17x1mm (Aluminum)
- Revolution : 5900 rpm



PCIe400 & Shell & Blower (Delta BFB04512HHA-C)

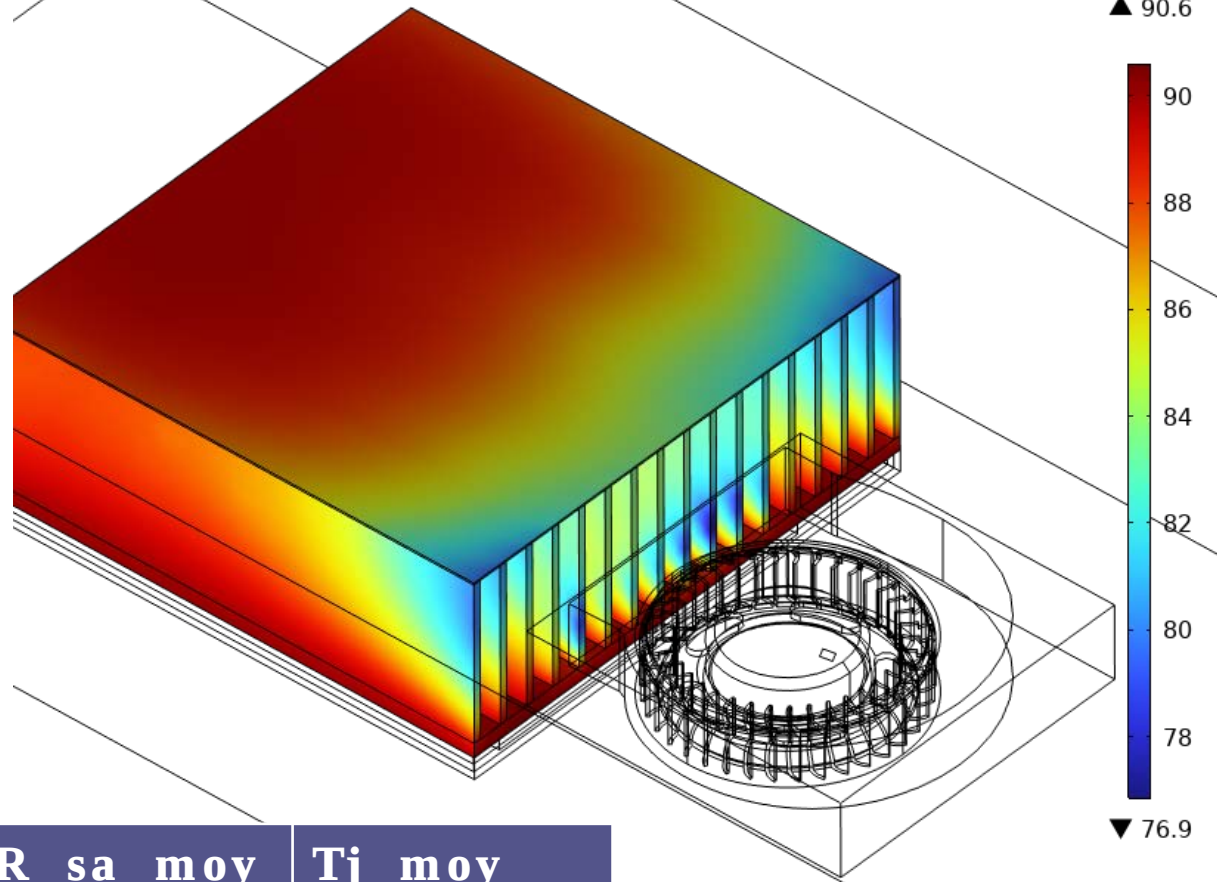
- Heat Sink 70x70x27mm with Fins 17x1mm (Aluminum)
- Revolution : 5900 rpm

Q_in (W)	U0 (m/s)	T_moy (degC)	RiseT_moy (K)	R_sa_moy (degC/W)	Tj_moy (degC)
85.000	0.0000	267.52	229.52	2.7002	270.75
85.000	1.0000	78.357	40.357	0.47479	81.587
85.000	2.0000	62.850	24.850	0.29235	66.080
85.000	3.0000	57.183	19.183	0.22568	60.413

Q_in (W)	U0 (m/s)	T_moy (degC)	RiseT_moy (K)	R_sa_moy (degC/W)	Tj_moy (degC)
160.00	1.0000	114.05	76.047	0.47529	120.13
160.00	2.0000	84.744	46.744	0.29215	90.824
160.00	3.0000	74.076	36.076	0.22548	80.156

PCIe400 & Shell & Blower (Delta BFB04512HHA-C)

- Vapor Chamber 70x70x3mm with Encoche 56.3x52x5.4mm (Copper)
- Heat Sink 70x70x24mm with Fins 17x1mm (Aluminum)
- Revolution : 5900 rpm
- Tamb : 38 °C
- Air Flow : 1 m/s
- Heat source : 85 W



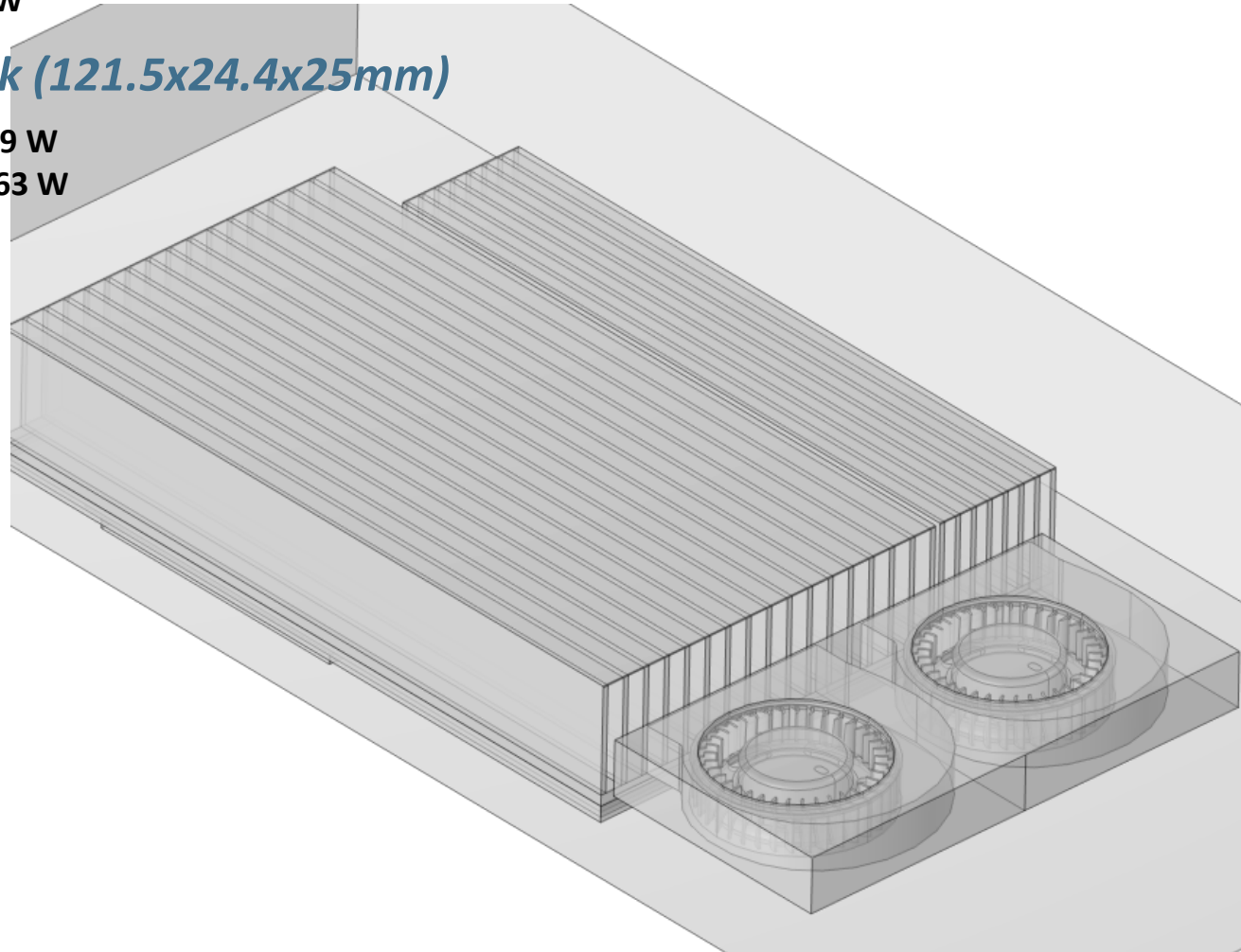
T_moy (degC)	RiseT_moy (K)	R_sa_moy (degC/W)	Tj_moy (degC)
90.695	52.695	0.61994	93.925

PCIe400 & Shell & Blower (Delta BFB04512HHA-C)

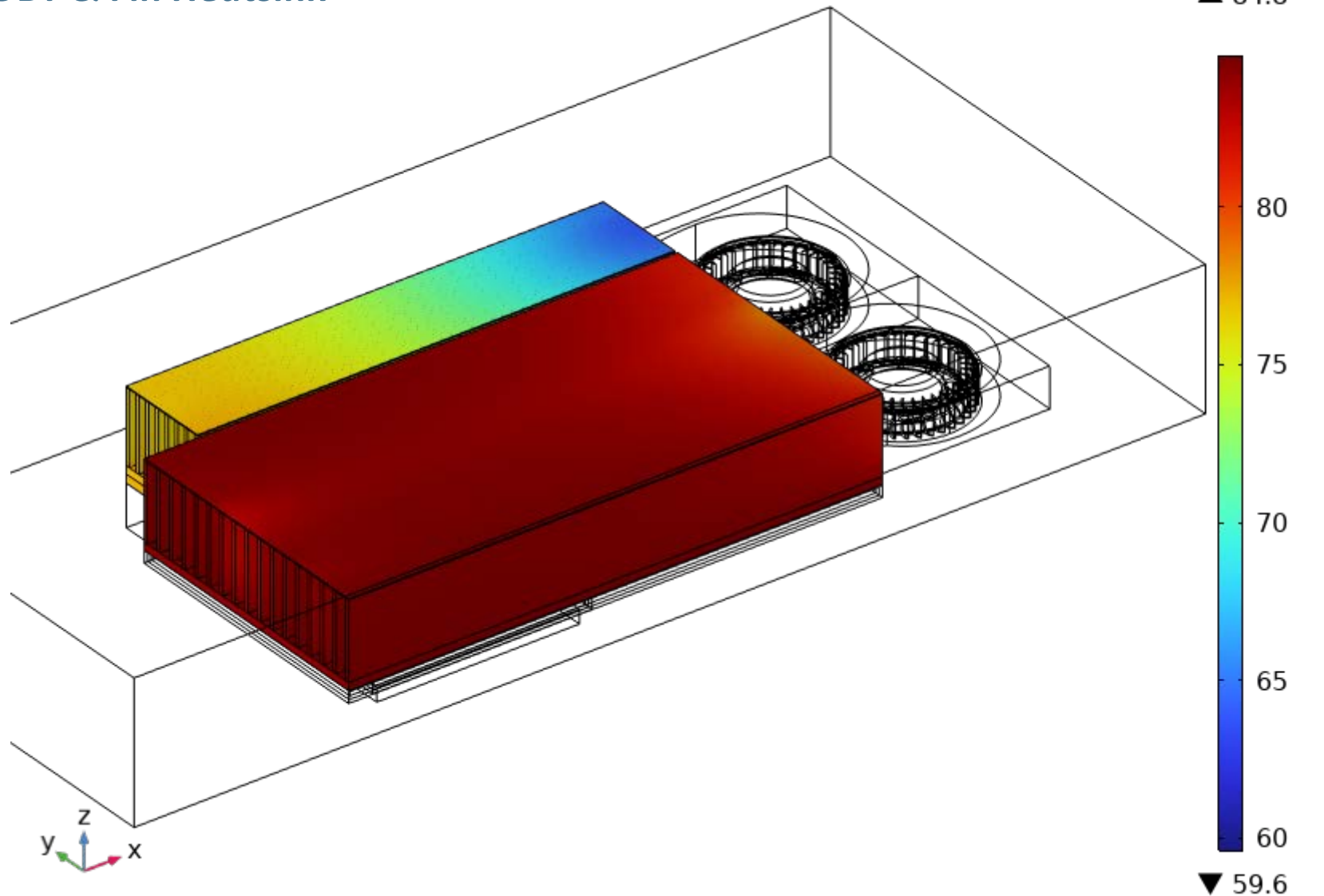
- Vapor Chamber 70x137x3mm with Encoche 56.3x52x5.4mm (Copper)
- Heat Sink 70x137x24mm with Fins 17x1mm (Aluminum)
- Revolution : 5900 rpm
- Heat source : 85 W

OBT & Fin Heatsink (121.5x24.4x25mm)

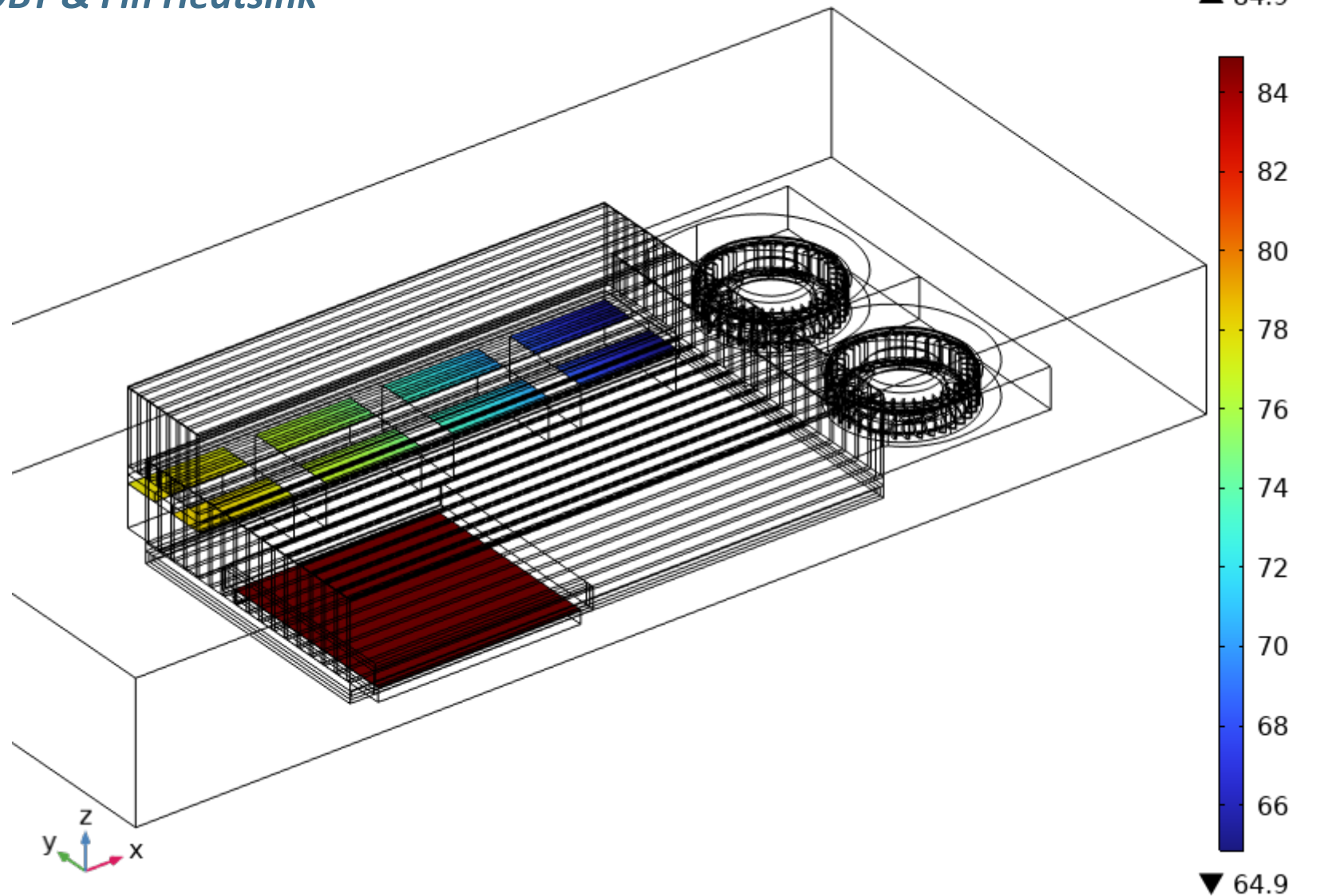
- Heat rate LD : 3.89 W
- Heat rate TIA : 3.63 W



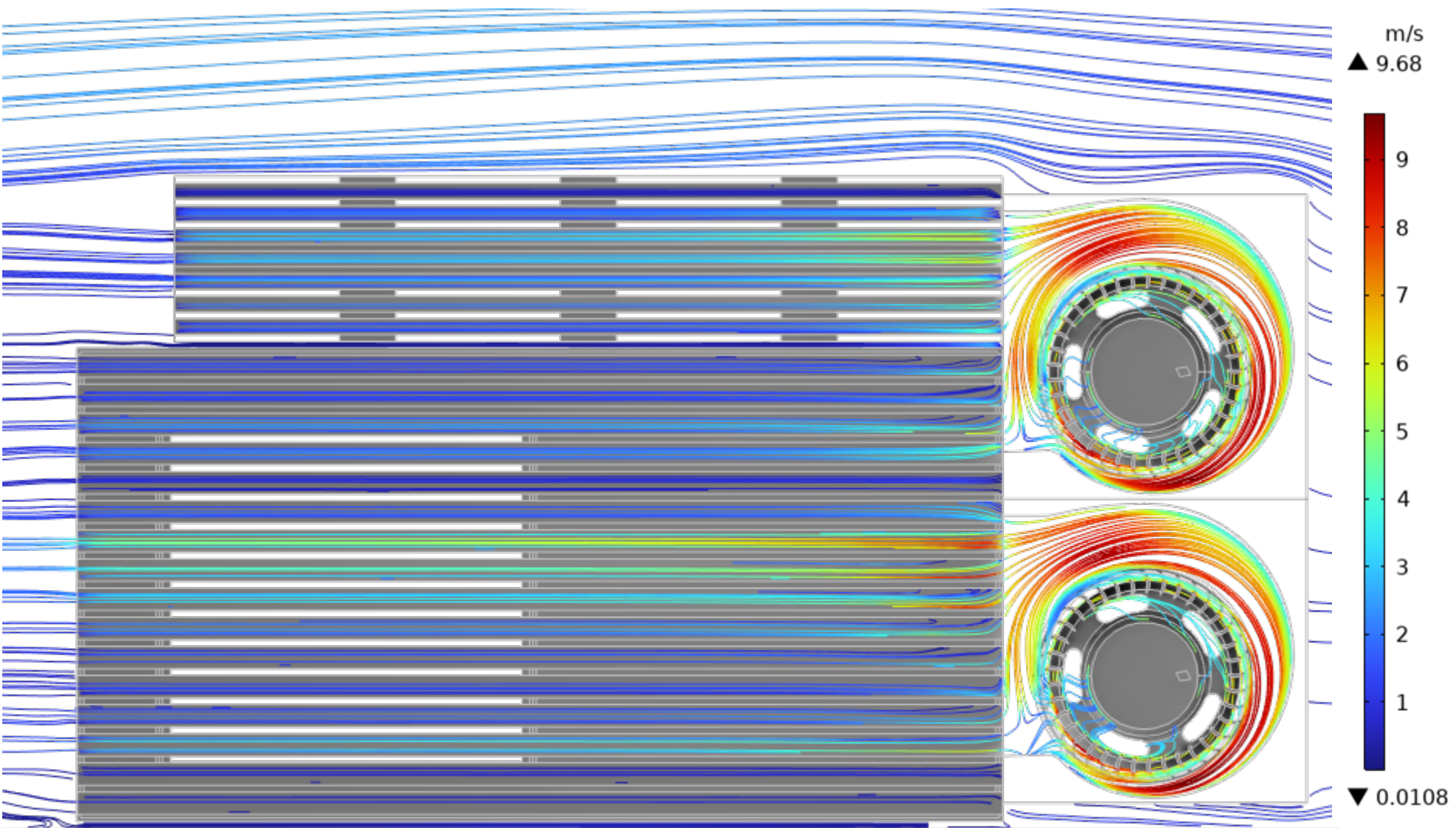
*PCIe400 & Shell & Blower (Delta BFB04512HHA-C)
OBT & Fin Heatsink*



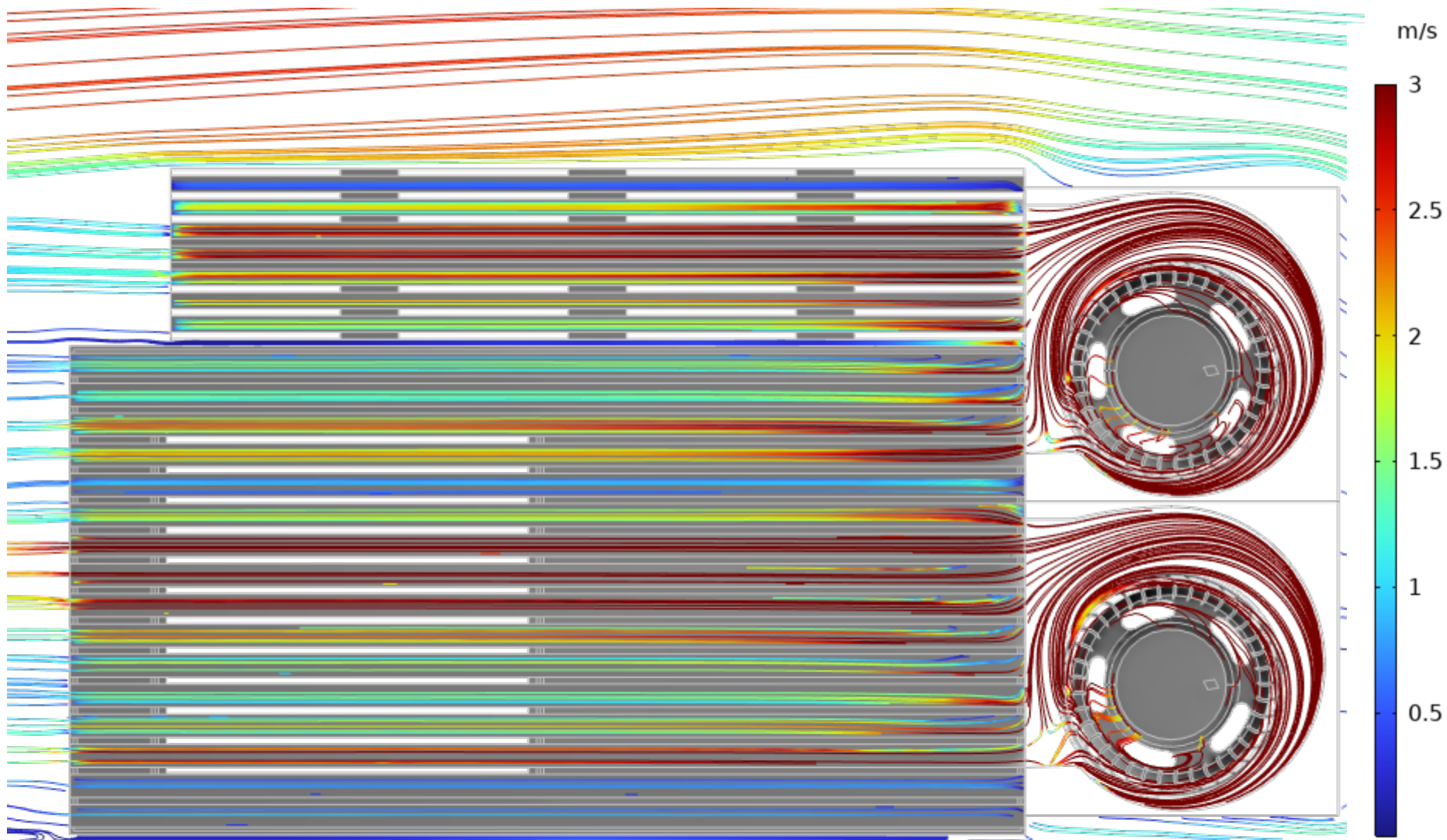
*PCIe400 & Shell & Blower (Delta BFB04512HHA-C)
OBT & Fin Heatsink*



*PCIe400 & Shell & Blower (Delta BFB04512HHA-C)
OBT & Fin Heatsink*



*PCIe400 & Shell & Blower (Delta BFB04512HHA-C)
OBT & Fin Heatsink*



PCle400 & Shell & Blower (Delta BFB04512HHA-C) OBT & Fin Heatsink

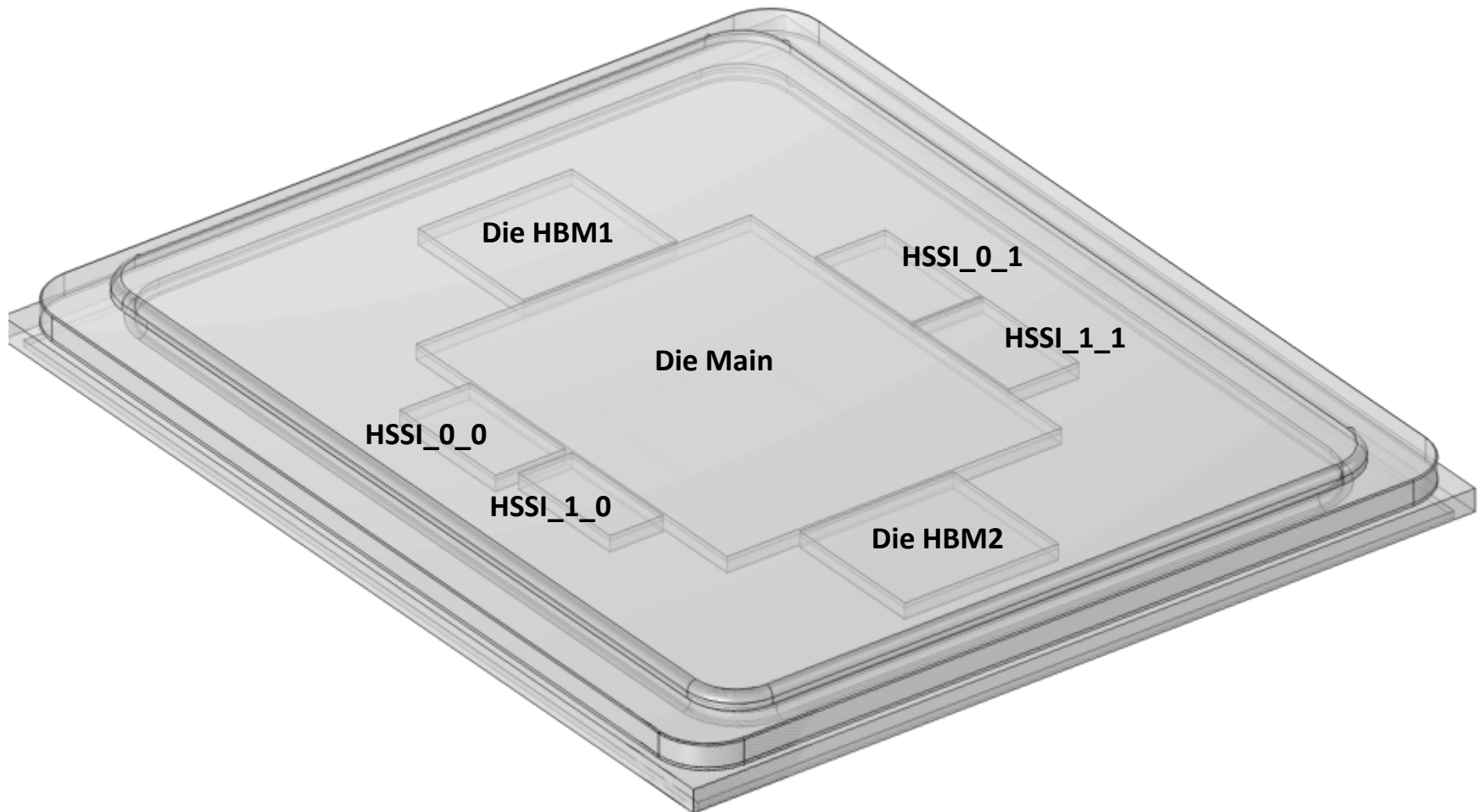
- Tamb : 38 °C
- Air Flow : 1 m/s

T_moy (degC)	RiseT_moy (K)	R_sa_moy (degC/W)	Tj_moy (degC)
84.902	46.902	0.55179	88.132

T1_moy (degC)	T2_moy (degC)	T3_moy (degC)	T4_moy (degC)
78.930	76.700	72.882	67.658

Simulation FPGA Agilex

- Dimension 56x66x4.824mm



Simulation FPGA Agilex

Thermal Analysis

Configuration

Calculation mode: Find cooling solution for maximum junction temperature limit

Apply additional margin: 0%

ISD Mode: Not supported

Constraints

Junction temperature, T_J (°C): N/A

Ambient temperature, T_A (°C): 40

Cooling solution, Ψ_{CA} (°C/W): N/A

Max. junction temperature limit, T_{J-MAX} (°C): 85

Results

Max. thermal resistance, Ψ_{JC} (°C/W): 0.067

Recommended ambient temperature, T_A (°C): 40

Recommended cooling solution, Ψ_{CA} (°C/W): 0.222

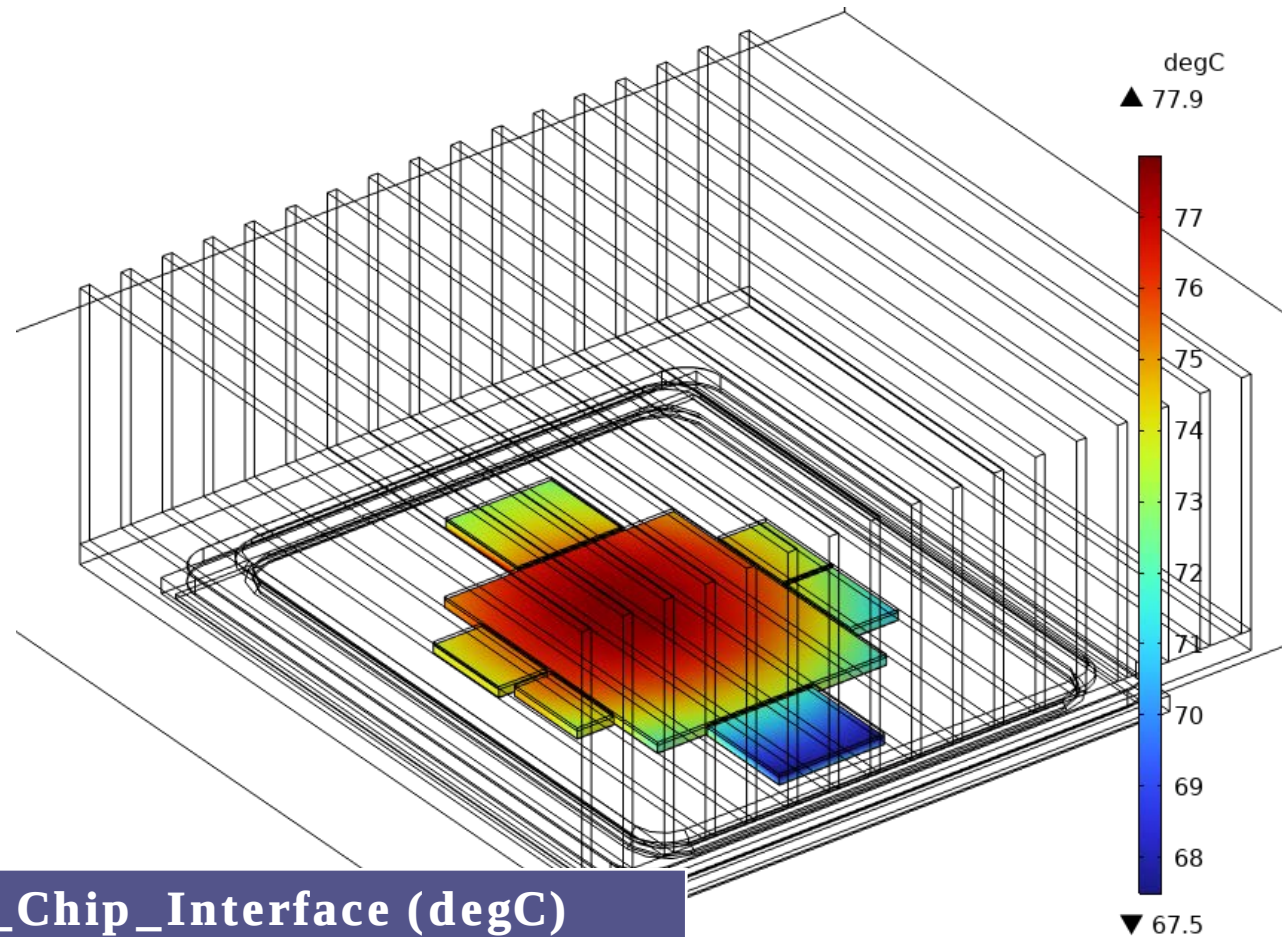
Total Power (W): 155.925

	Die	Power (W)	Margin	
			Temperature Margin ($\Delta^\circ\text{C}$)	Power Margin (ΔW)
1	FPGA Core	113.542	1.03E-07	2.59E-07
2	HSSI_0_0	7.341	8.847	1.796
3	HSSI_1_0	10.079	3.222	0.777
4	HSSI_0_1	6.861	9.606	1.862
5	HSSI_1_1	4.940	10.756	1.552
6	u50_hbm2e	6.577	1.862	0.284
7	u51_hbm2e	6.585	1.723	0.262

Die	Power (W)	Power (W)
FPGA core	113.542	61.896
HSSI_0_0	7.341	4.002
HSSI_1_0	10.079	5.494
HSSI_0_1	6.861	3.740
HSSI_1_1	4.94	2.693
u50_Hbm2e	6.577	3.585
u51_hbm2e	6.585	3.590
TOTAL	155.925	85

Simulation FPGA Agilex

- Heat Sink 70x70x25mm with Fins 17x1mm (Aluminum)
- T_{amb} : 38 °C
- Air Flow : 2 m/s
- Heat source : 85 W



T_Chip_Die (degC)

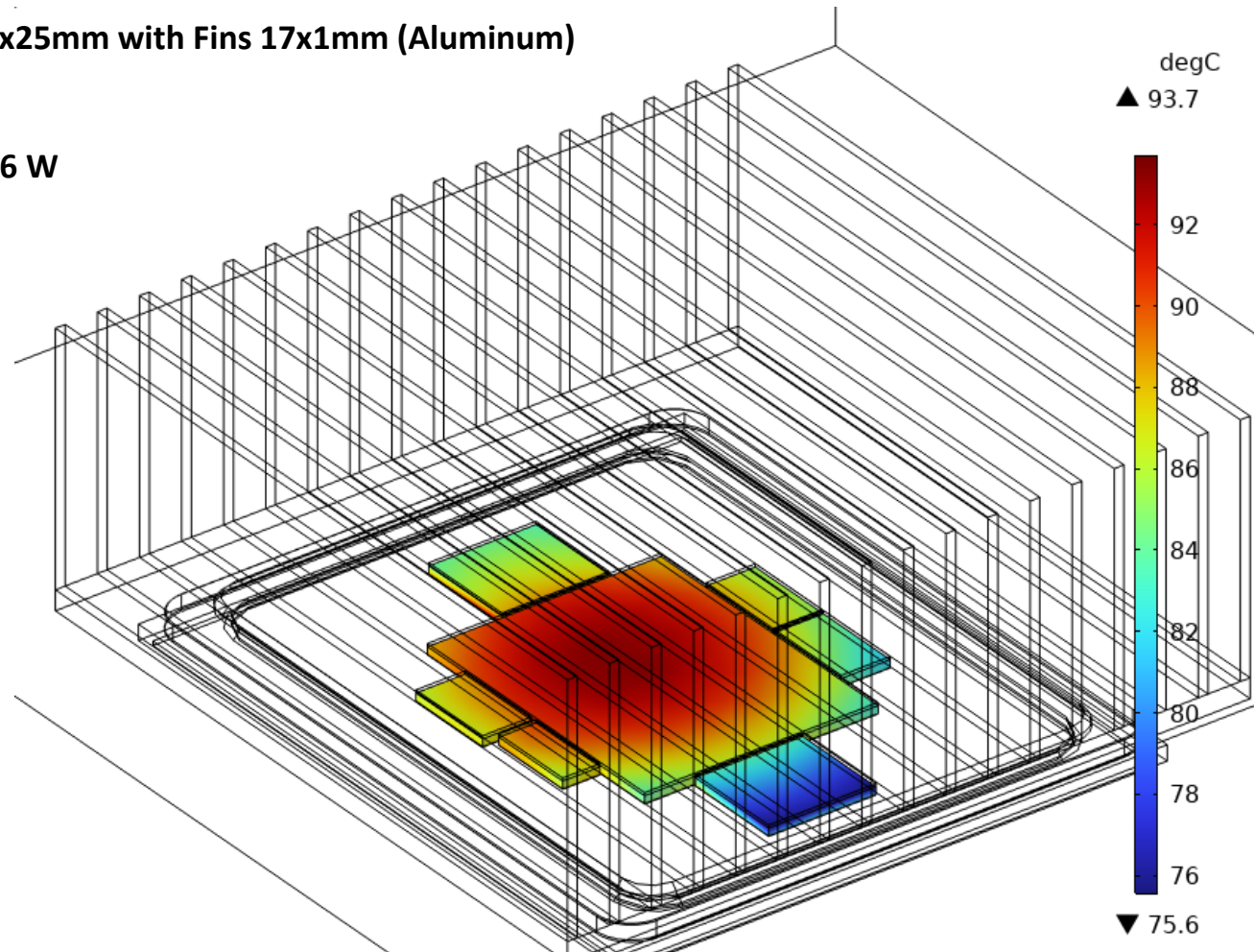
75.218

T_Chip_Interface (degC)

71.150

Simulation FPGA Agilex

- Heat Sink 70x70x25mm with Fins 17x1mm (Aluminum)
- Tamb : 38 °C
- Air Flow : 3 m/s
- Heat source : 156 W



T_Chip_Die (degC)

88.971

T_Chip_Interface (degC)

81.542