



Plume Phone Meeting

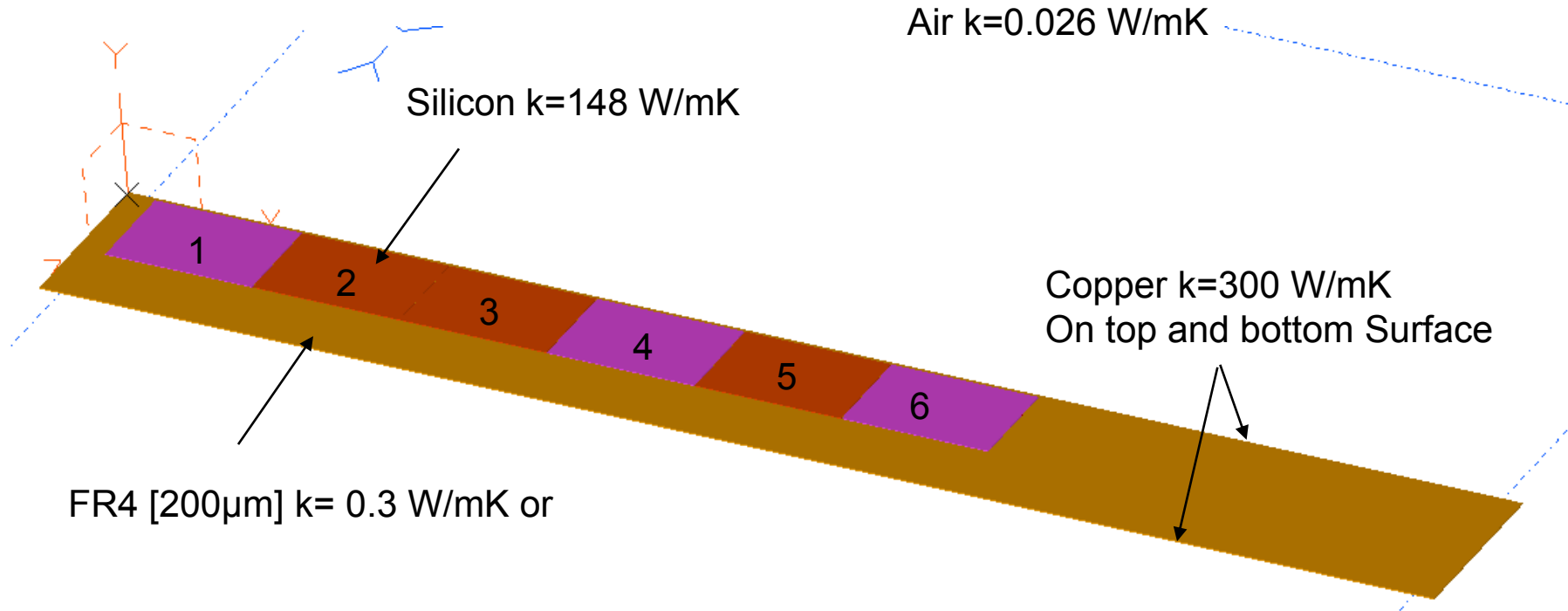
26.11.2010

1. Different size and power of the sensors
2. Results for FR4, Polyamide, Polyimide
3. Natural frequency of the ladder

Franziska Hegner
Hamburg
26. November 2010



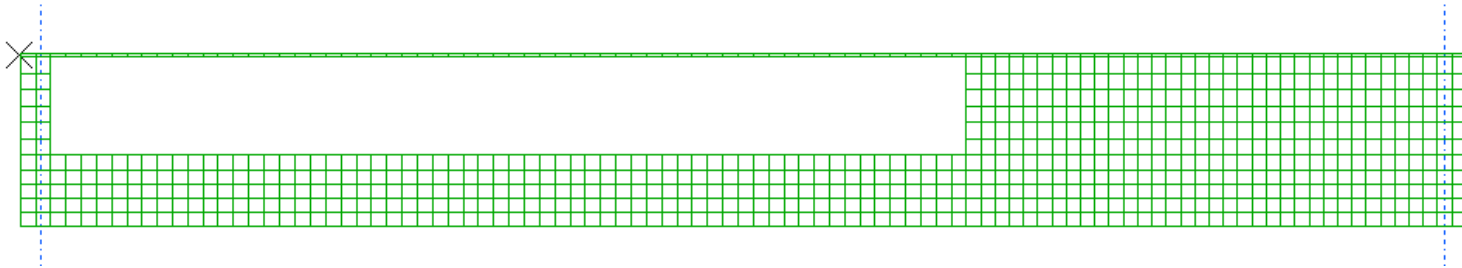
1. Different size and power of the sensors



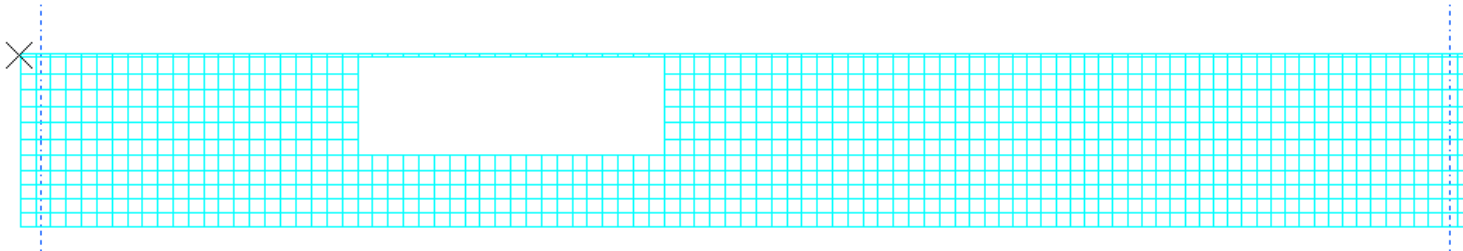
- > Dimensions: 206 x 24.55 x 0.2 mm

Meshing copper

- > Copper is modelised by 2D shell elements (dark green and cyan)



- > Copper on the top surface – 17 μ m

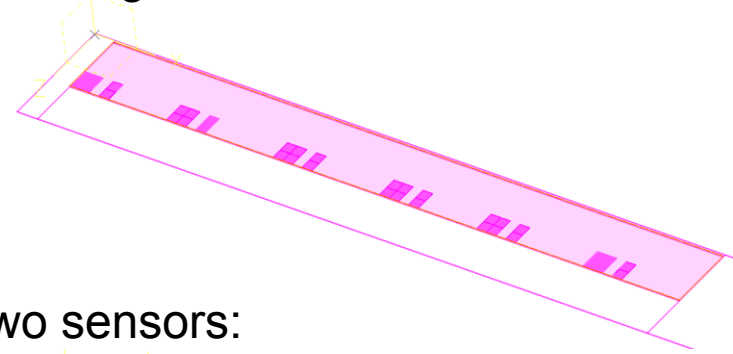


- > Copper on the bottom surface – 17 μ m

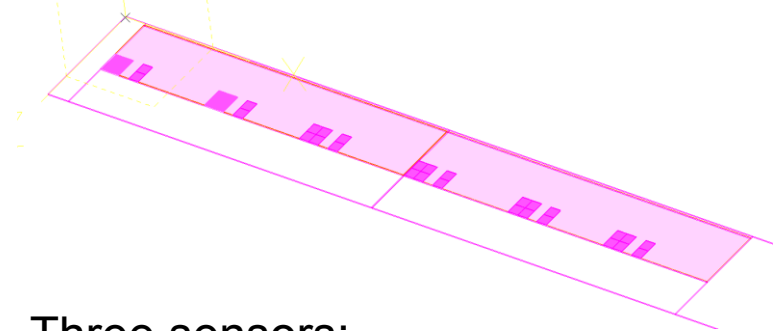
Size of the sensors

- > Ambient temperature
 - 20°C
- > Thermal B.C
 - Total load = 730 mW or 500mW
- > Free convective coupling
 - Free convection on the top of the board

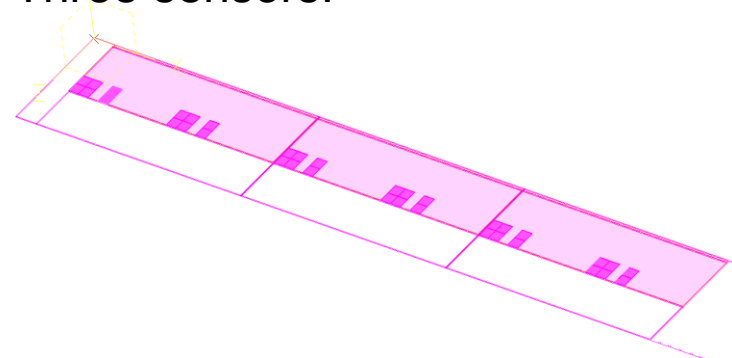
One long sensor:



Two sensors:

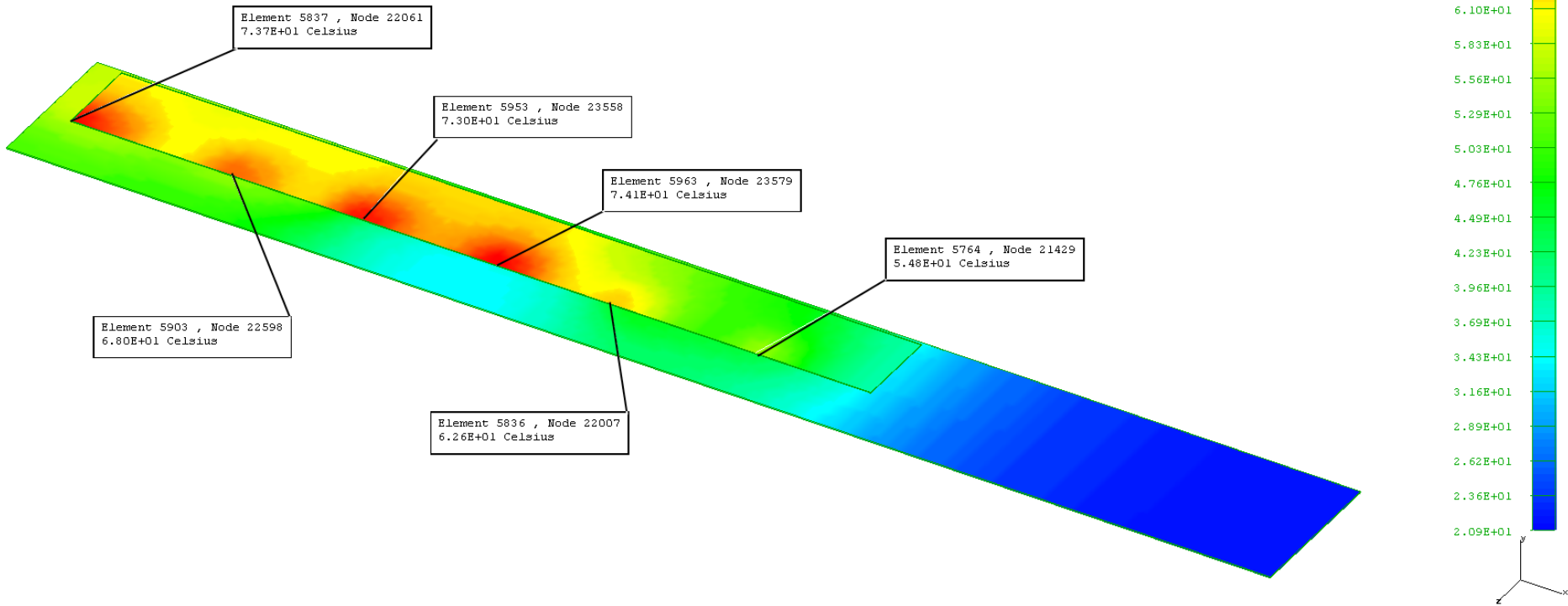


Three sensors:



Results: one sensor, 730 mW

Display 1
28.10.10 - 730mW
NODE TEMP
NODE TEMPERATURES
TEMPERATURE Scalar Unaveraged Top shell
Min: 2.09E+01 Celsius Max: 7.43E+01 Celsius
Part Coordinate System

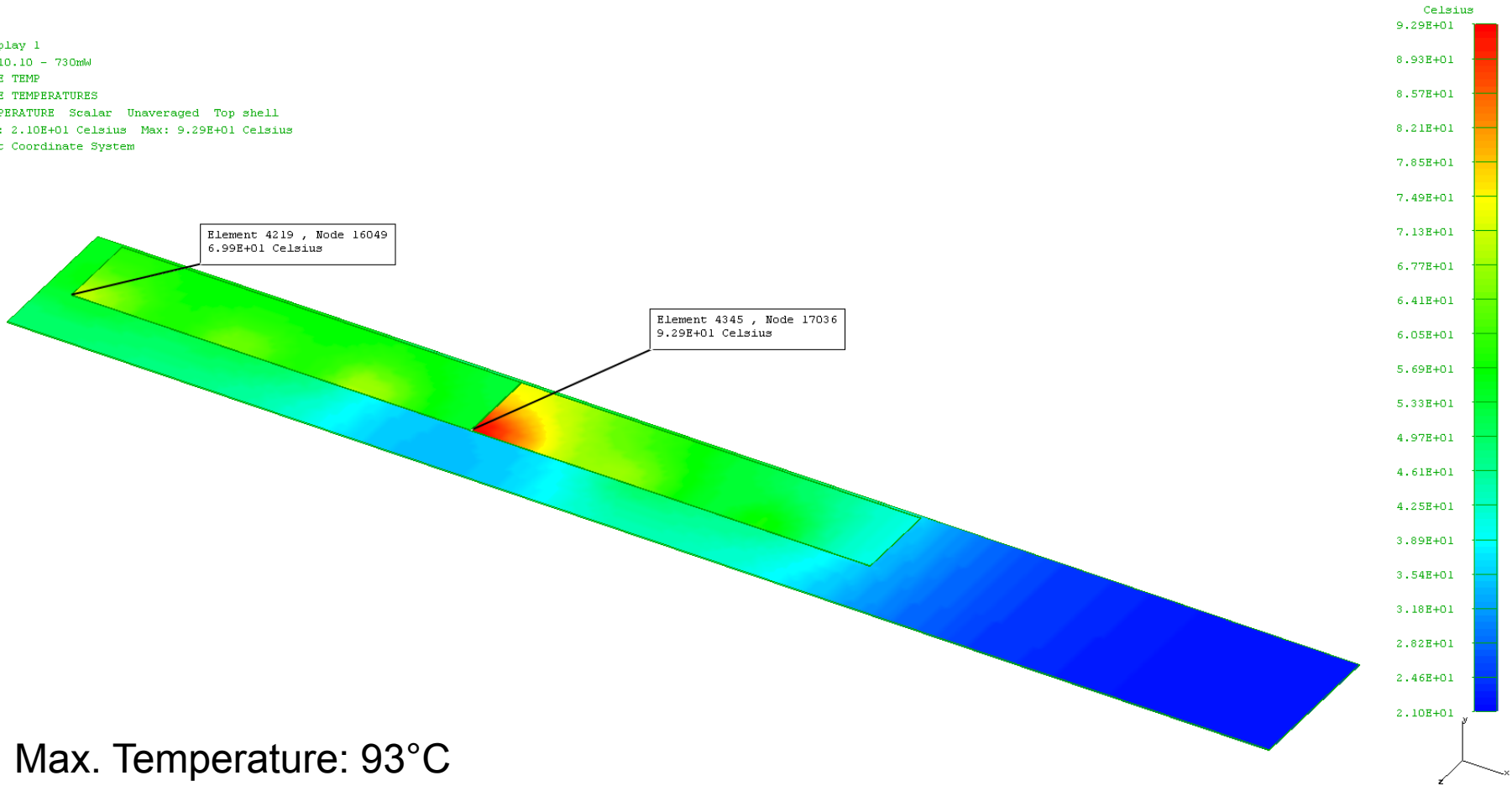


Max. Temperature: 74.3°C



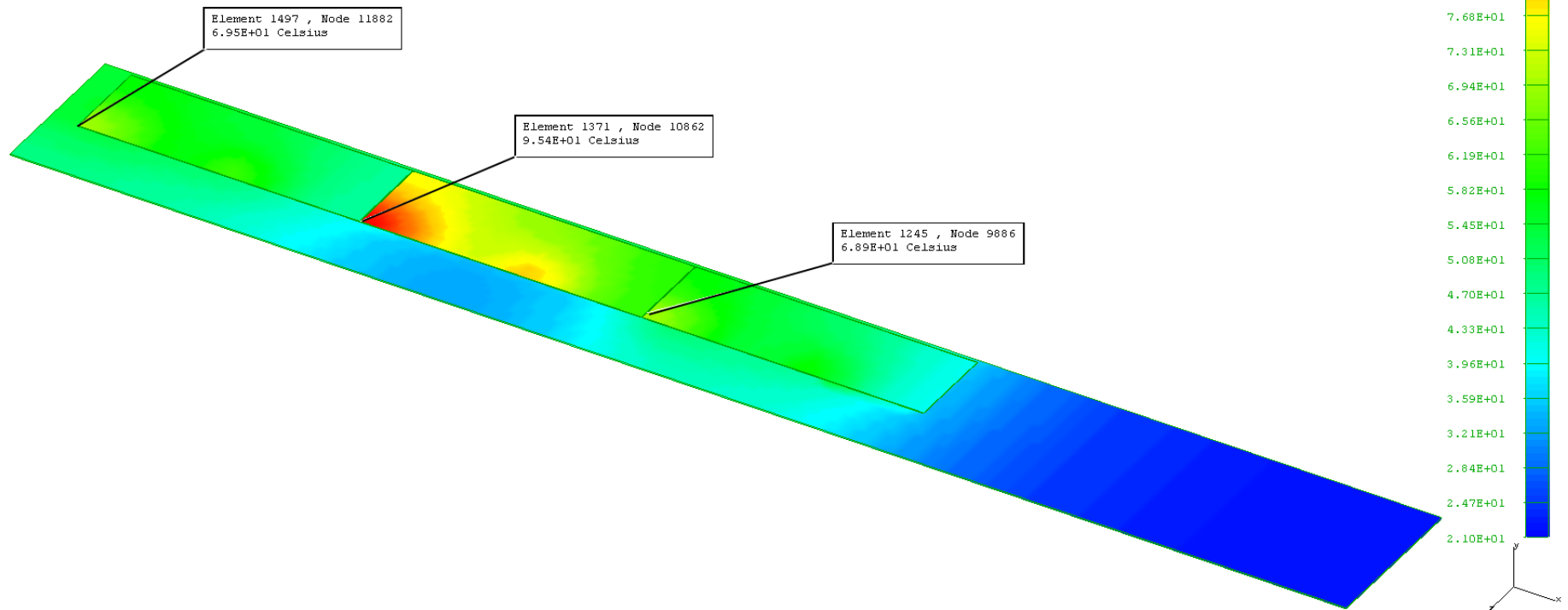
Results: two sensors, 730 mW

Display 1
28.10.10 - 730mW
NODE TEMP
NODE TEMPERATURES
TEMPERATURE Scalar Unaveraged Top shell
Min: 2.10E+01 Celsius Max: 9.29E+01 Celsius
Part Coordinate System



Results: three sensors, 730 mW

Display 1
28.10.10 - 730mW
NODE TEMPE
NODE TEMPERATURES
TEMPERATURE Scalar Unaveraged Top shell
Min: 2.10E+01 Celsius Max: 9.54E+01 Celsius
Part Coordinate System



Max. Temperature: 95.4°C



Summary of results

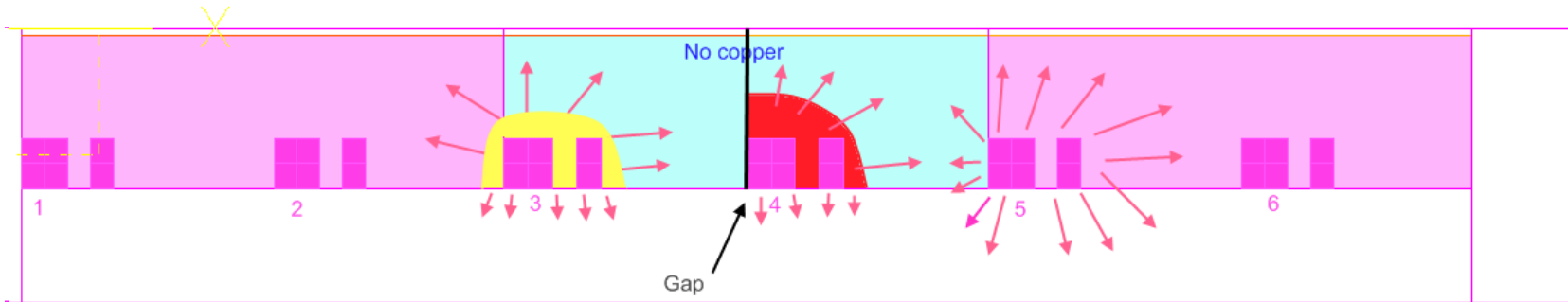
Sensor	Max Temperature in °C	
	730 mW	500 mW
One sensor	74.3	58.8
Two sensors	92.3 (Sensor 4)	71.8 (Sensor 4)
Three sensors	95.4 (Sensor 3)	73.8 (Sensor 3)
Six single sensors	90.5 (Sensor 3+4)	71.3 (Sensor 3+4)

(warmest sensor/s)



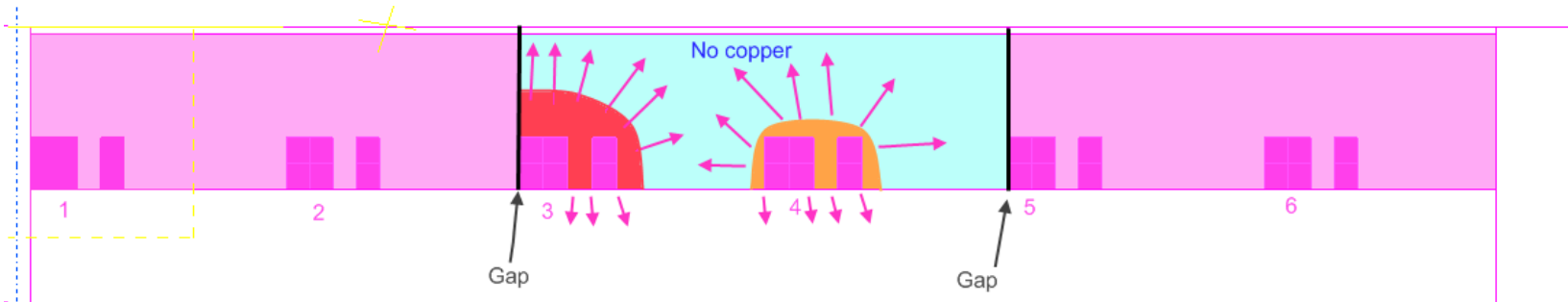
Option 2:

Sensor 4 is the warmest. The heat of sensor 5 is mostly dissipating through the bigger surface of the sensor and the copper which is underneath. The heat of sensor 3 also dissipates through the sensor surface and because of the distance to the (air-) gap the heat is not blocked in flow (like for sensor 4).



Option 3:

Sensor 3 and 4 are the warmest, because there is no copper underneath. Then the heat of sensor 3 can not dissipate in the direction of sensor 2 because of the (air-)gap. The heat can also not dissipate in the direction of sensor 4, because sensor 4 also produces heat (in direction of sensor 3).



2. FR4 vs. Polyamide vs. Polyimide

Sensor	Maximum temperature on Sensor in °C		
	FR4 0.3 W/mK 200µm	Polyamide 0.25 W/mK 50µm	Polyimide 0.12 W/mK 50µm
Sensor 6	54.3	54.9	55.9
Sensor 1	59.8	55.2	56.4
Sensor 4	87	90.2	91.2
Sensor 6	58.7	55.1	56.2
Sensor 1	67.7	63	64
Sensor 2	65.7	60	61.7
Sensor 3	90	91	91.8
Sensor 4	90	91	91.8
Sensor 5	65.8	60.8	61.7
Sensor 6	63.2	60	61



3. Natural frequency

Top and bottom View:



Dimensions of the model:

Length: 140mm

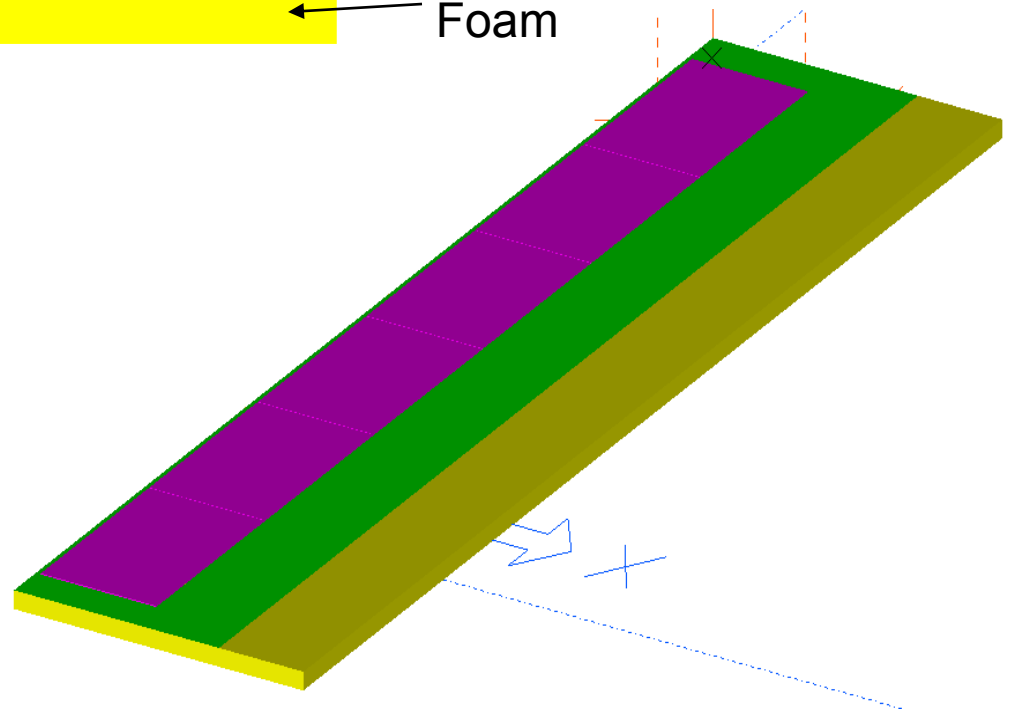
Wide: 34.65mm

Thickness of:

(yellow): 2mm

(magenta): 0.12mm

(green): 0.14mm



Properties of the isotropic materials

Material	Silicon	Copper	Foam SiC 8%	Kapton
E-Modulus in GPa	131	115	2,76	3.2
Poisson coefficient	0.33	0.35	0.33	0.35
Density in g/cm ³	2,33	8,92	3,21	1,43



Laminate

In the following you can see a laminate built up with the material Kapton and Copper.

The screenshot displays the 'Modify Laminate' window with a toolbar at the top containing icons for various operations and a 'Normal' orientation dropdown. Below the toolbar is a table with columns for ID, Thickness, Angle, and Material. To the right of this table is a larger table with columns for Thickness, Angle, Ply, and Material, which includes a visual stack of colored layers (blue and yellow) and a legend for Fe, Al, and Cu. At the bottom of the window, a box indicates the total number of plies and the total thickness.

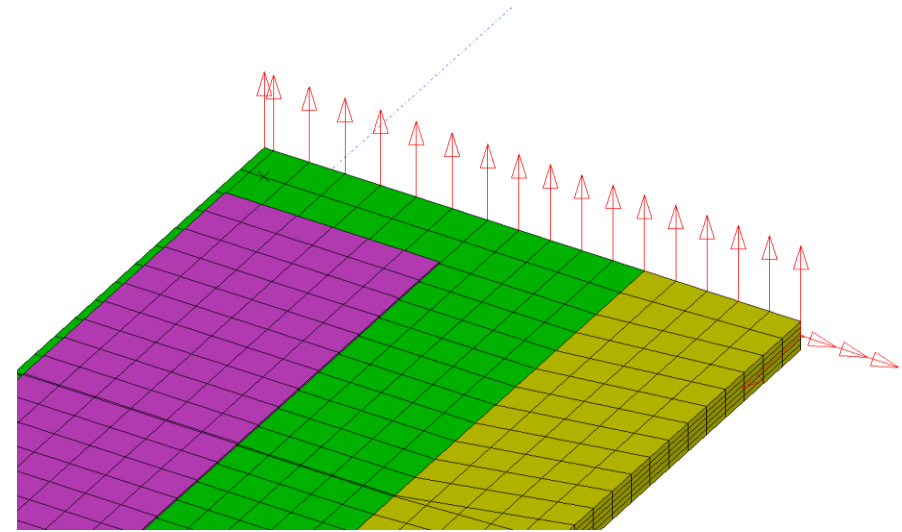
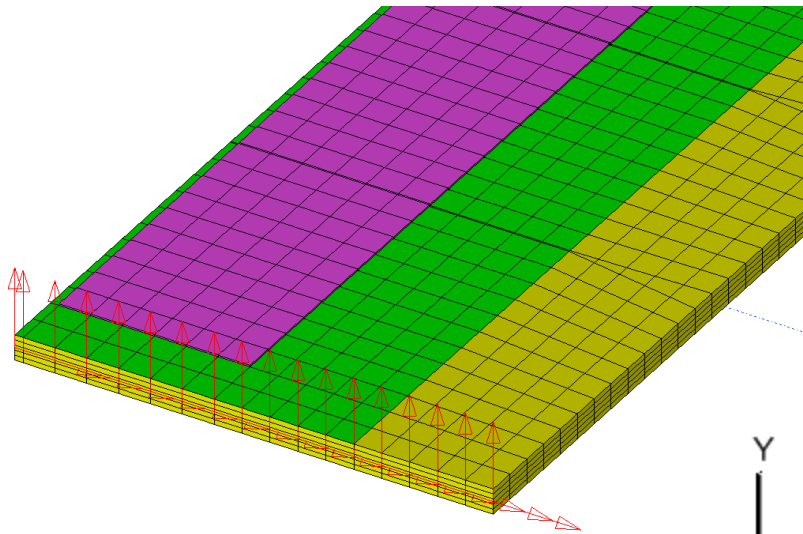
ID	Thickness	Angle	Material
5	0.0375	+0	POLYIMIDE
4	0.02	+0	KUPFER_WIDERSTAND
3	0.025	+0	POLYIMIDE
2	0.02	+0	KUPFER_WIDERSTAND
1	0.0375	+0	POLYIMIDE

Thickness	Angle	Ply	Material
0.0375	+0	5	POLYIMIDE
0.02	+0	4	KUPFER_WIDERSTAND
0.025	+0	3	POLYIMIDE
0.02	+0	2	KUPFER_WIDERSTAND
0.0375	+0	1	POLYIMIDE

Number of plies: 5
Total thickness: 0.14 mm



Boundary Conditions



> One end:

Translation: X – fixed

Y – fixed

Z – free

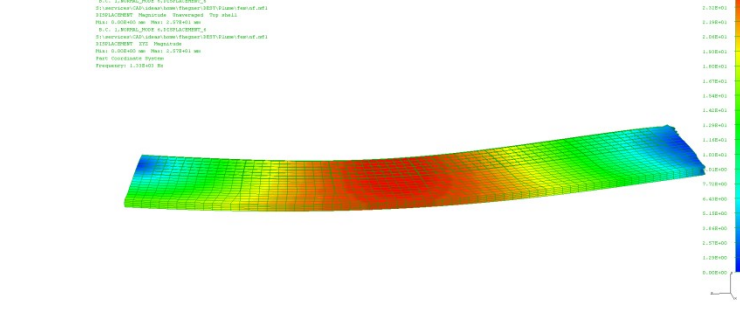
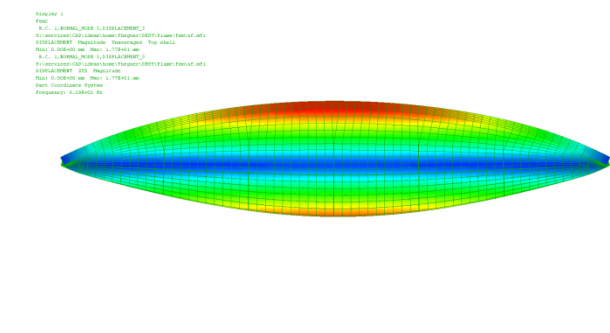
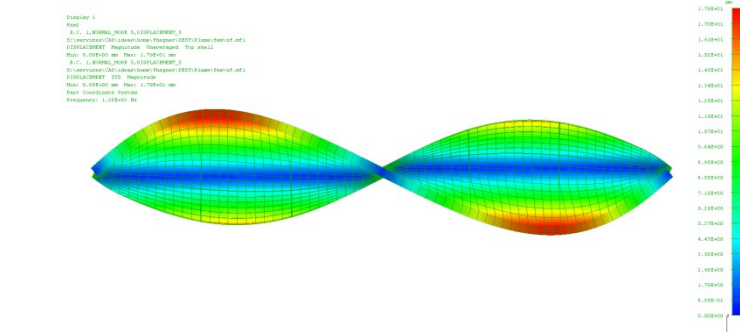
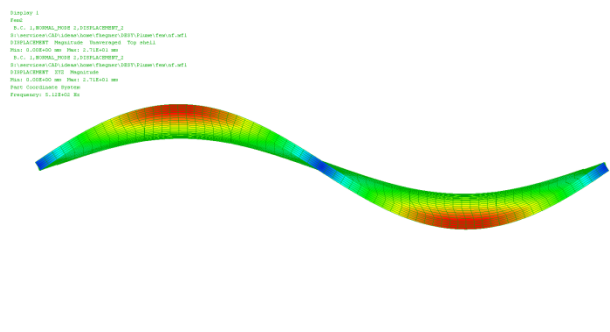
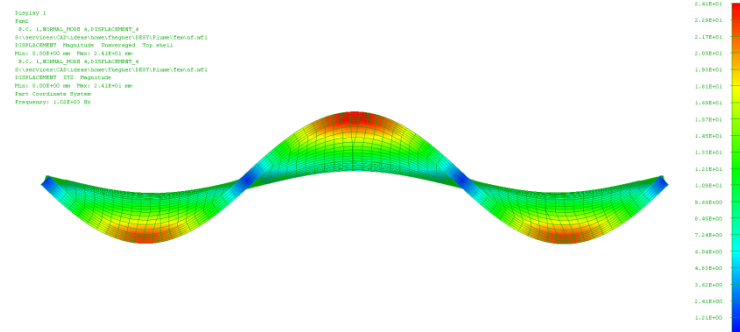
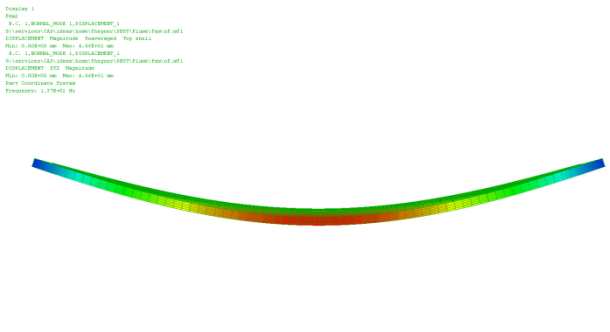
Rotation: all free

> One end:

Translation: all fixed

Rotation: all free

Modes of Model



- > not simulated are
 - The glue between sensors and laminate
 - The glue between the foam and the laminate

- > The laminate is modelled as a shell mesh
- > The foam and the sensors are modelled as solid meshes
- > The first mode is 137 Hz
- > The position of the laminate and the sensors is mirrored

