Continental
The Future in Motion

TIE M+ 2023 Subject

Subject Development Committee
Finite Element Analysis Engineering Team
10 March 2023

BA Autonomous Mobility

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Introduction

- **Task description:**
  - Evaluate stresses and strain in the assembly parts after assembly process.
  - Determine assembly's resonating frequencies.
  - Determine the stresses in the steel parts and their fatigue life under random vibration loading.
- **Scope:** Evaluate the integrity of the sensor parts and the chip on PCB.
- **Requestor:** TIE M+ Organizing Committee
- **Inputs:**
  - CAD: TIE-M_Plus_CAD.stp → will be released on April 10th.
  - Material *.xml / Excel database and datasheets. → will be released on April 10th.

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Introduction

- As a simulation engineer you are required to perform the analysis according to the task requirement in the previous slide and given inputs.
- You must provide a presentation report respecting the given template (DEMO presentation can be used).
- Mechanical designers usually have follow-up questions to better understand their design and where they should make improvements. Briefly answer the questions on the last slide. If you need to, you can run extra simulations scenarios to answer the questions, however, you don’t need to document them.
- For extra points, answer the theory questions as well.

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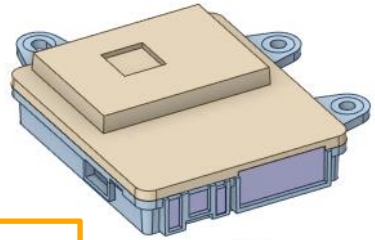
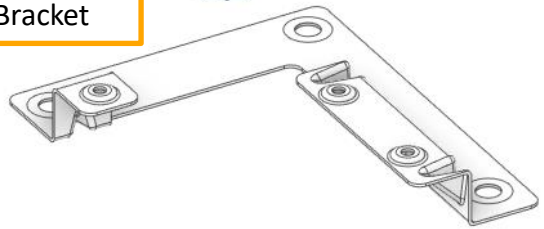
Assembly Description

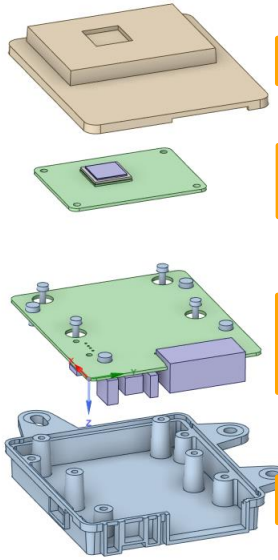
Sensor assembly



Bracket



Sensor Assembly & Materials



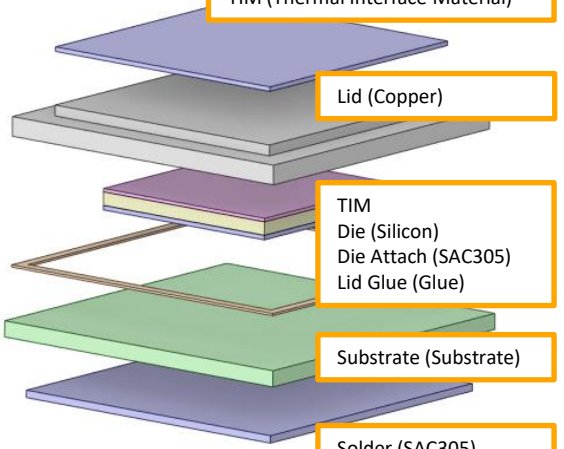
Cover (PBT-GF30)

Sensor PCB (PCB)
SoC (System-on-Chip)

Main PCB (PCB effective)
Connectors (LCP)
Screws (Steel)

Housing (AlSiCu3)

SoC Assembly & Materials



TIM (Thermal Interface Material)

Lid (Copper)

TIM
Die (Silicon)
Die Attach (SAC305)
Lid Glue (Glue)

Substrate (Substrate)

Solder (SAC305)

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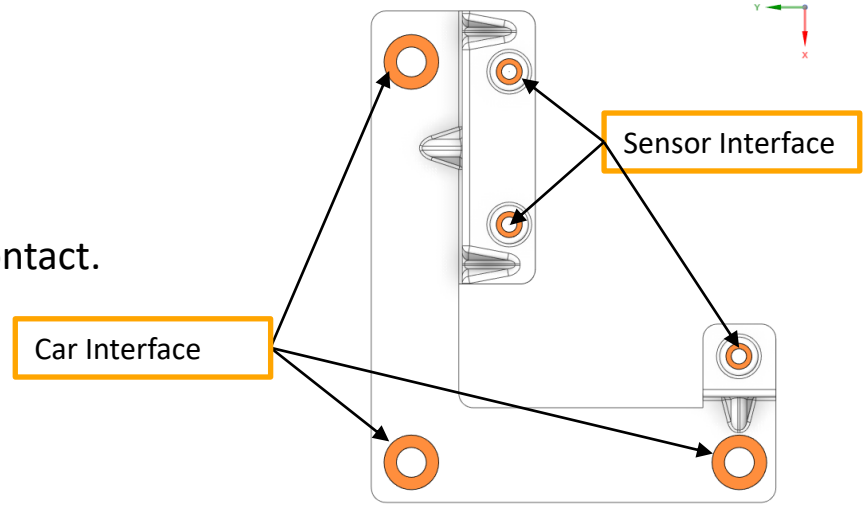
Boundary Conditions



- All parts in the SoC Assembly are tied / in bonded contact.
- Connectors are mounted on the PCB face.
- The screws fix both PCBs in the housing.
- The cover is welded on the housing.
- The sensor will be assembled through screws on the bracket. However, the designers did not provide the screws bodies. An idealization of the joint is expected.
- The bracket will be fixed with bolts on the car chassis. An idealization of the fixation is expected.

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External Loads

- Screw load: 1000N/screw.
- PSD profile according to Vibration Profile according to LV124 / ISO 16750-3 for components mounted on body.
- Global damping: 3%.

8.4.2.4 Vibration profile D (for components mounted on sprung masses (body))

Table 25: Test parameters, broadband random vibration for sprung masses

Excitation	Broadband random vibration	
Test duration for each dimensional axis	8 h	
Acceleration rms value	31,3 m/s²	
Vibration profile Figure 8	Frequency in Hz	Power spectral density in $(m/s^2)^2/Hz$
	5	0,884
	10	30
	400	0,2
	2000	0,2

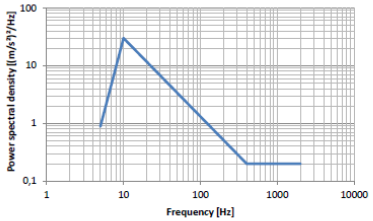

Figure 8: Vibration profile, broadband random vibration for sprung masses

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The designer has the following questions:

- Do you recommend a certain bolt grade to be used?
- How to reduce the resonating frequency of the assembly? Propose solutions:
  - If there are no limitations of space and fixation points to the car.
  - If the space in the car does not allow for other fixation points that the ones suggested.
- What do the first 6 vibration modes tell us?
- What do the Sigma Stress Levels in the Random Vibration Analysis mean?
- Will the assembly meet the test requirement from the standard: 8h vibration in each direction?

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Theory

- Draw a typical engineering stress-strain curve for a ductile material and mark the meaningful points on the curve.
- Determine the duration of a harmonic sweep from 5 to 2000Hz with an incremental rate of:
  - A. 60Hz/min
  - B. 1octave/min
- Make a graph of a constant sine acceleration signal from 5 to 2000 Hz. The signal amplitude is 3G.

Thank you
for your attention!