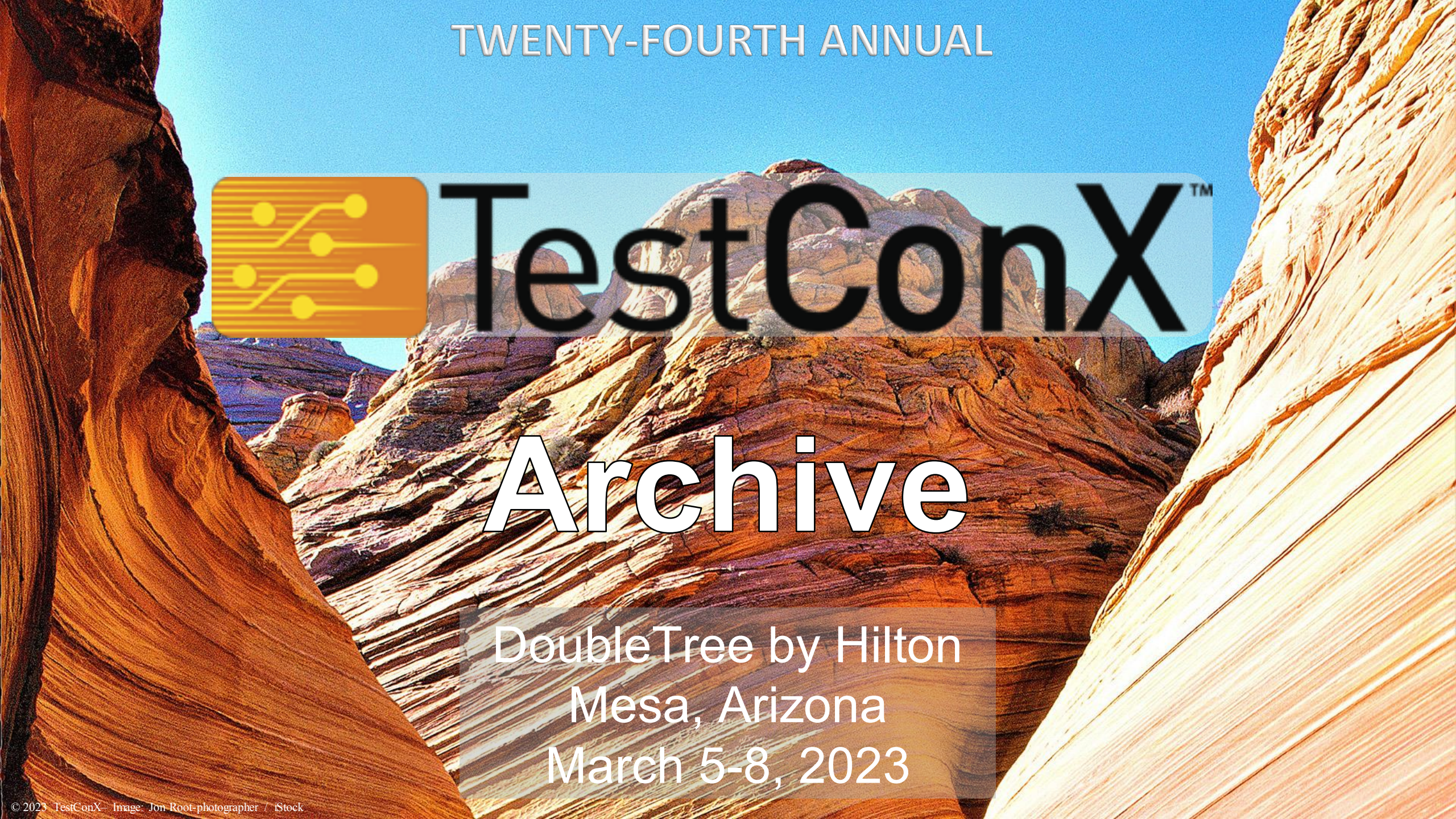

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Multi-disciplinary approach for the development of a MEMS Spring Probe for high frequency application

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Technoprobe S.p.A.

TestConX™

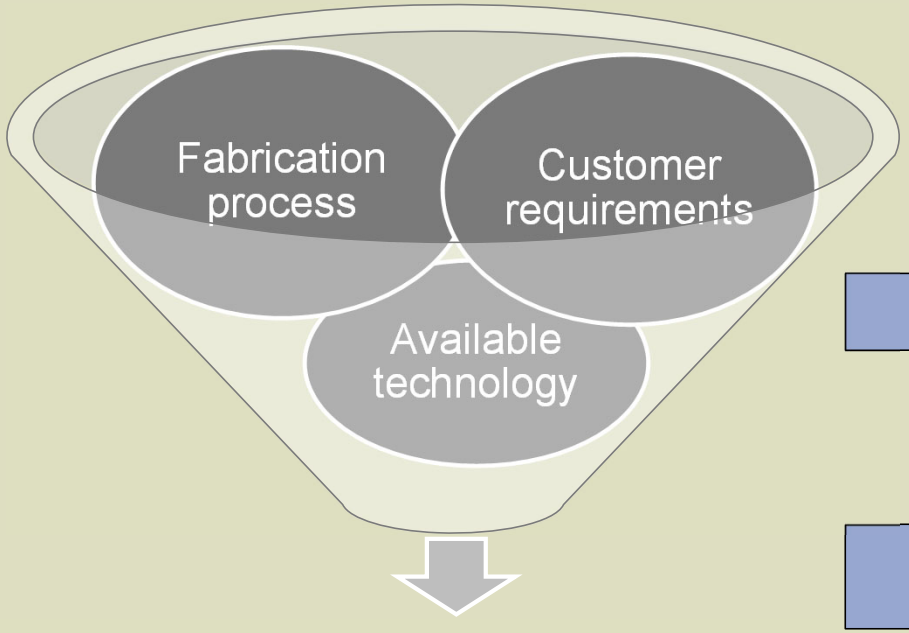
Mesa, Arizona • March 5–8, 2023

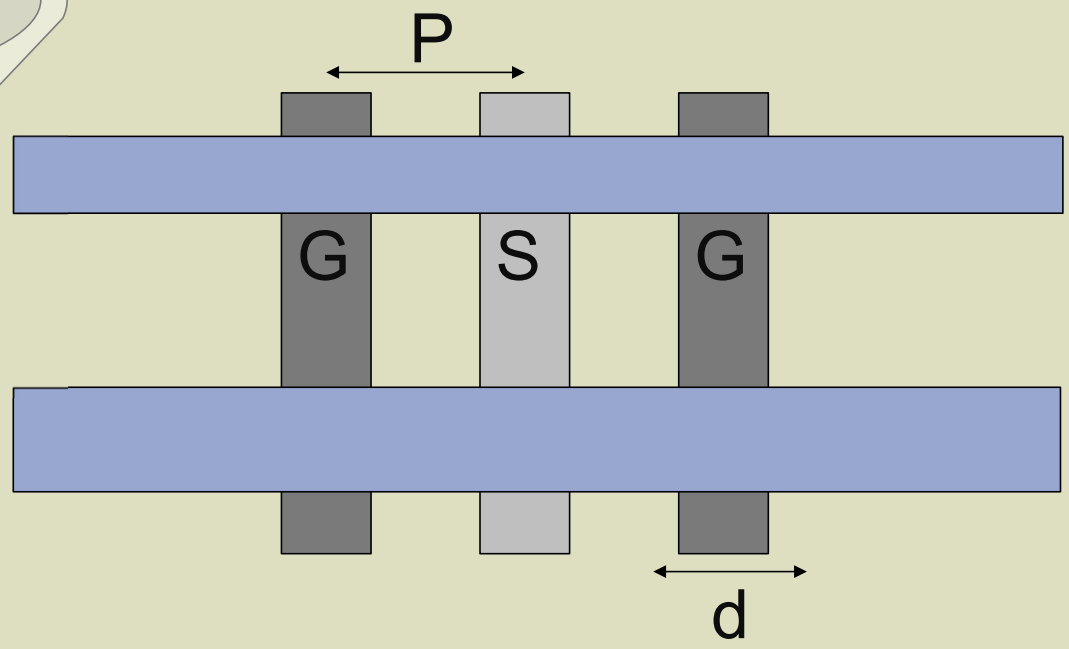
Introduction

- Process of continuous iteration
- Synergy
- Targets
  - 300 um pitch
  - Up to 35 GHz
  - Force > 8 g
  - Test height < 3 mm
  - Layout

Introduction

Primitive Mechanical Structure

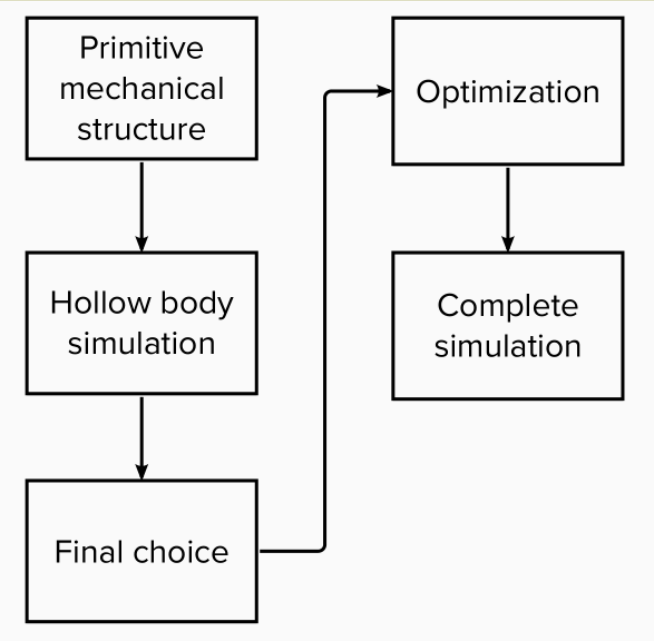




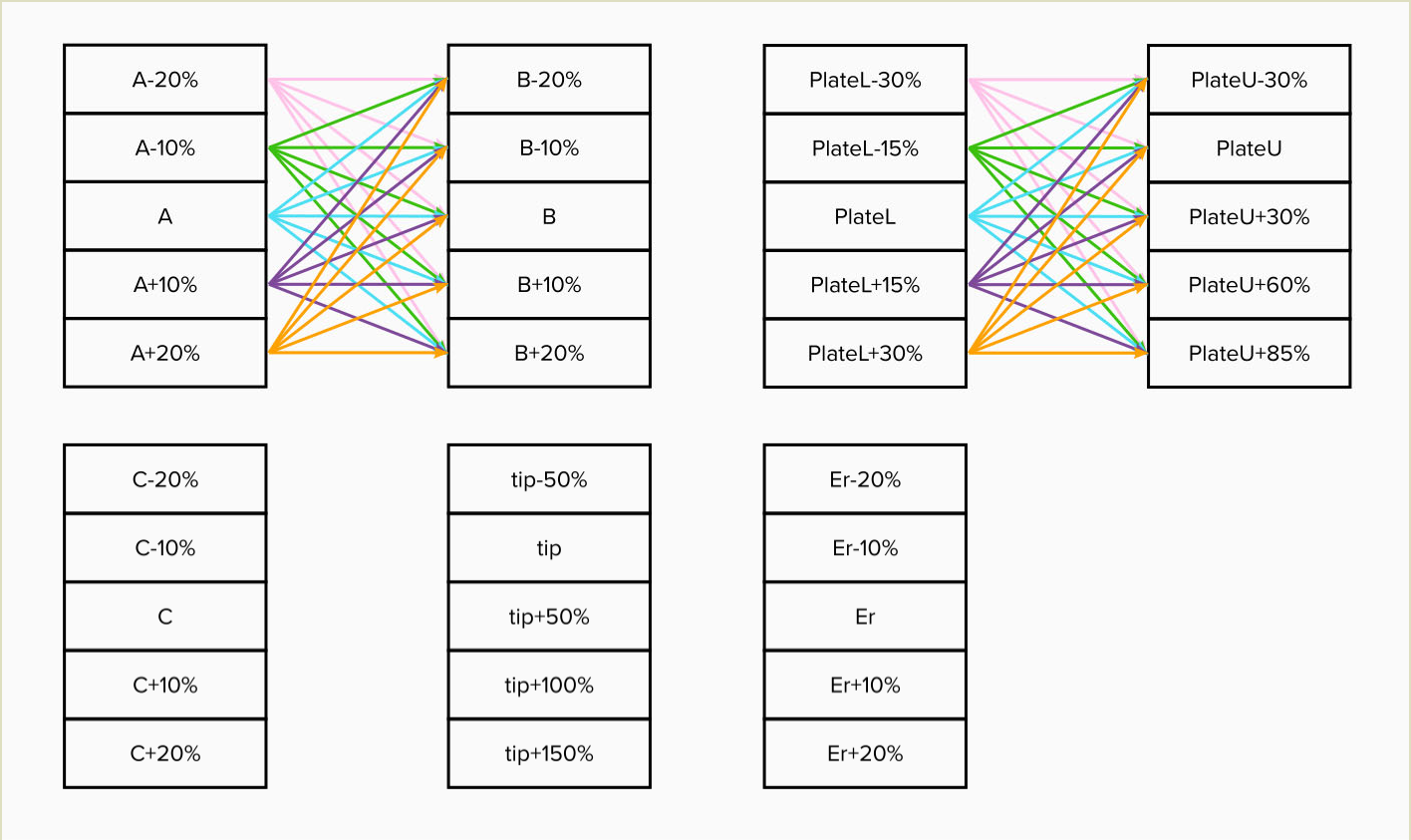
- Minimum pitch (P)
- Layout
- Max holes dimension (d)

Test method

- Parametrical variation
  - Body section
  - Tip section
  - Tip length
  - Mechanical structure
  - Material
- GSG vs GSSG comparison
  - Opposite trend
- Final choice is the **best ideal case** from this study



Test method


A-20%
A-10%
A
A+10%
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B-20%
B-10%
B
B+10%
B+20%
PlateL-30%
PlateL-15%
PlateL
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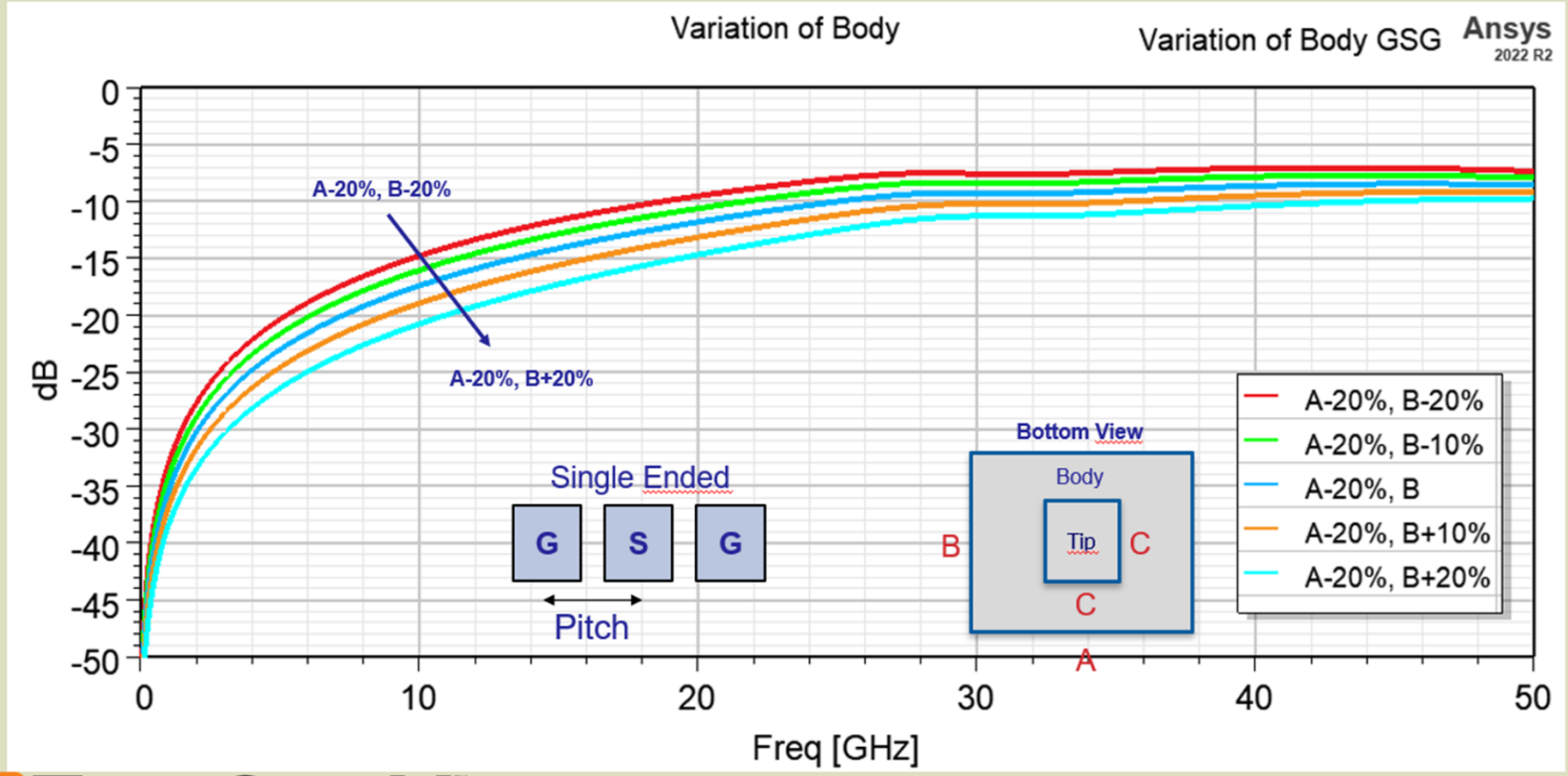
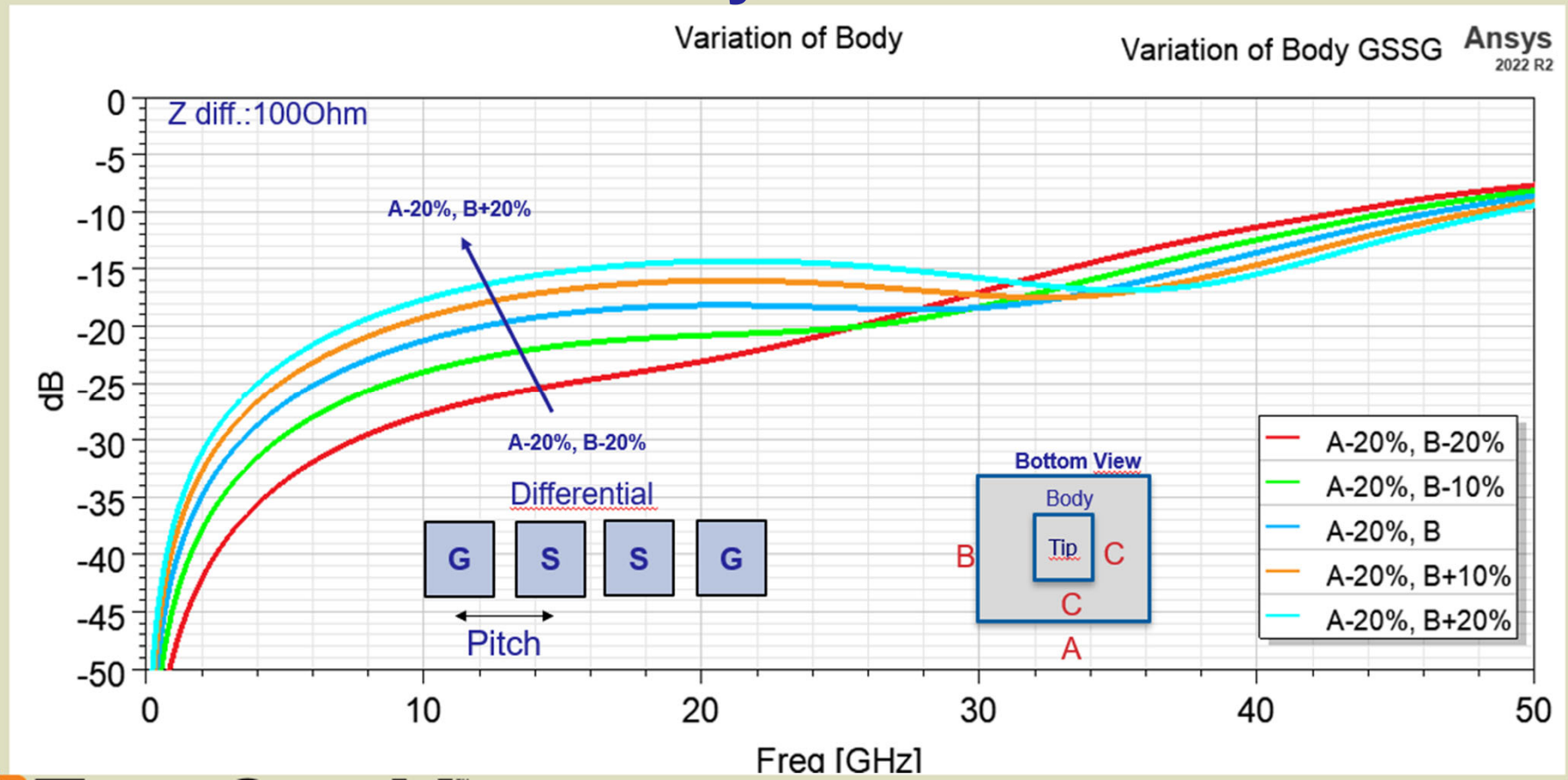
PlateL+30%
PlateU-30%
PlateU
PlateU+30%
PlateU+60%
PlateU+85%
C-20%
C-10%
C
C+10%
C+20%
tip-50%
tip
tip+50%
tip+100%
tip+150%
Er-20%
Er-10%
Er
Er+10%
Er+20%

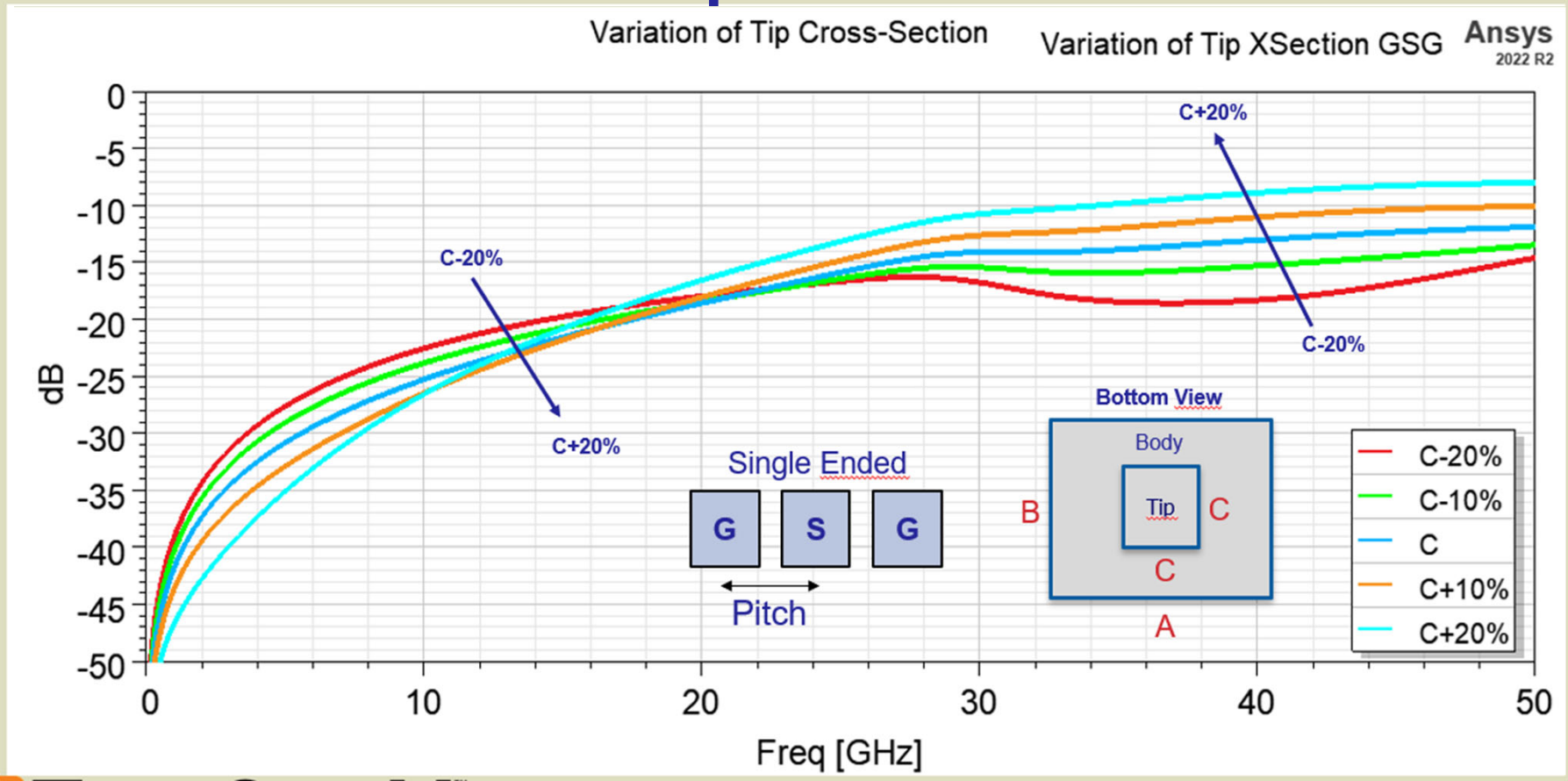
Variation of body dimensions GSG



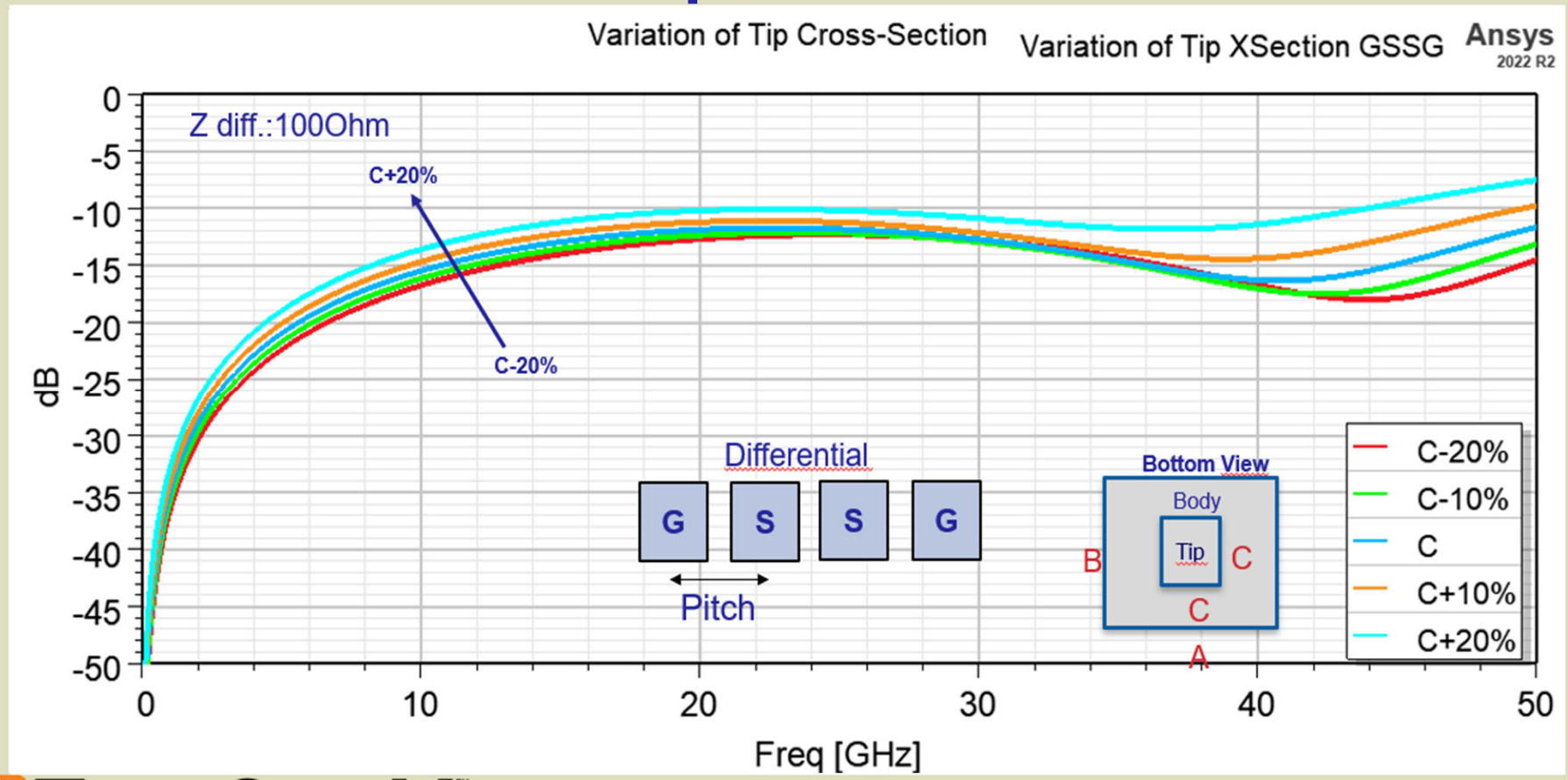
Variation of body dimensions GSSG



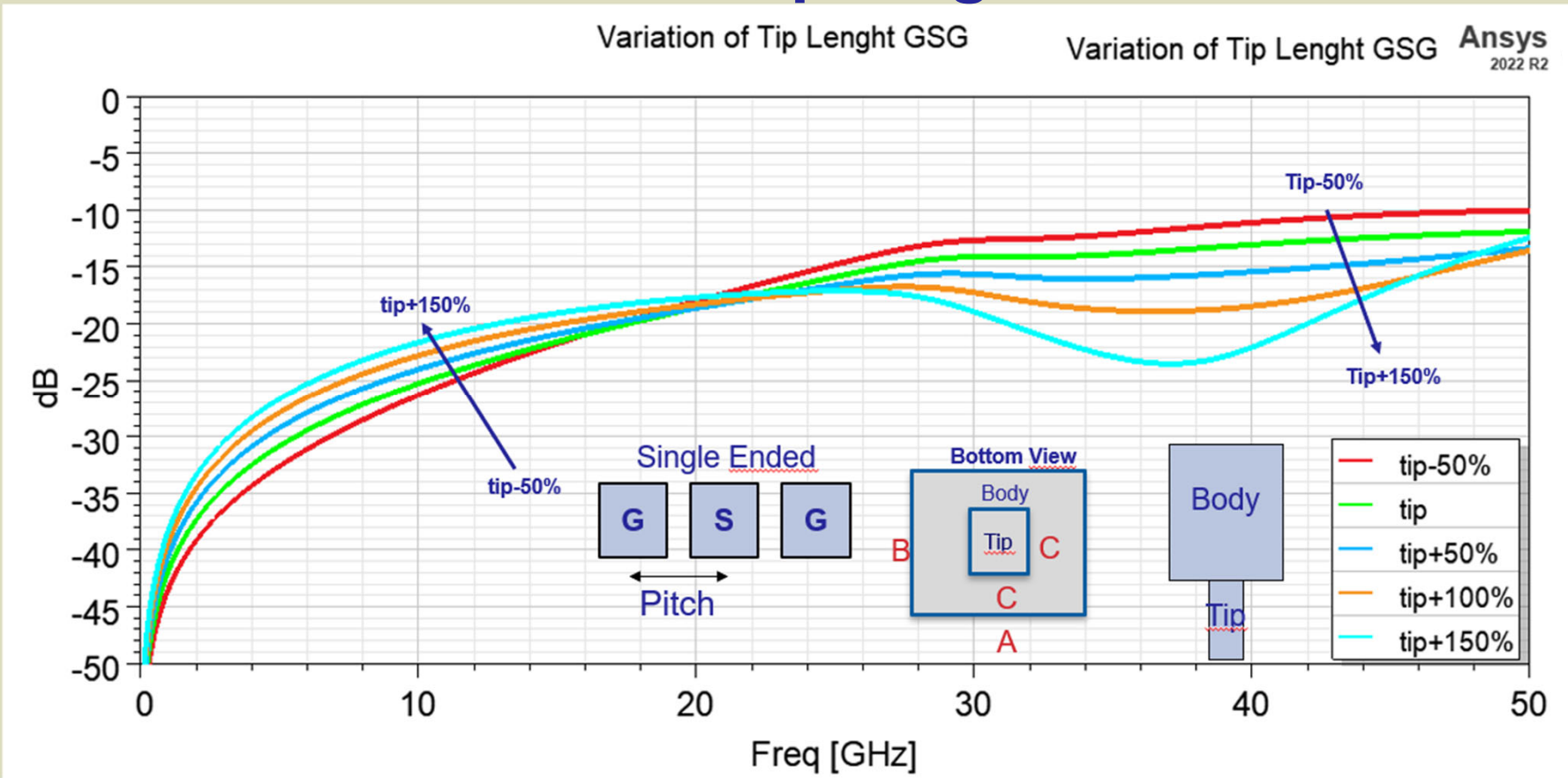
Variation of tip dimensions GSG



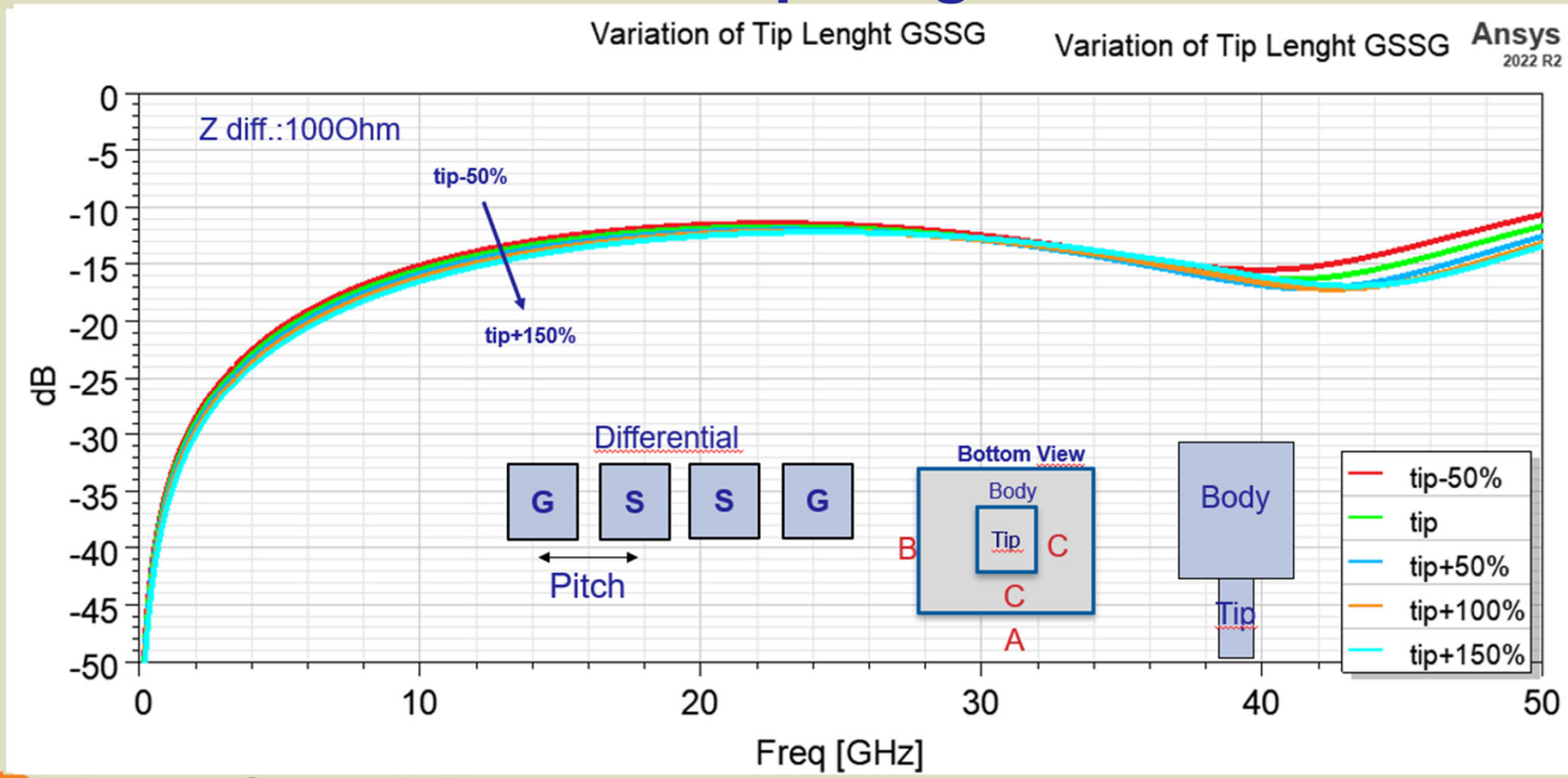
Variation of tip dimensions GSSG



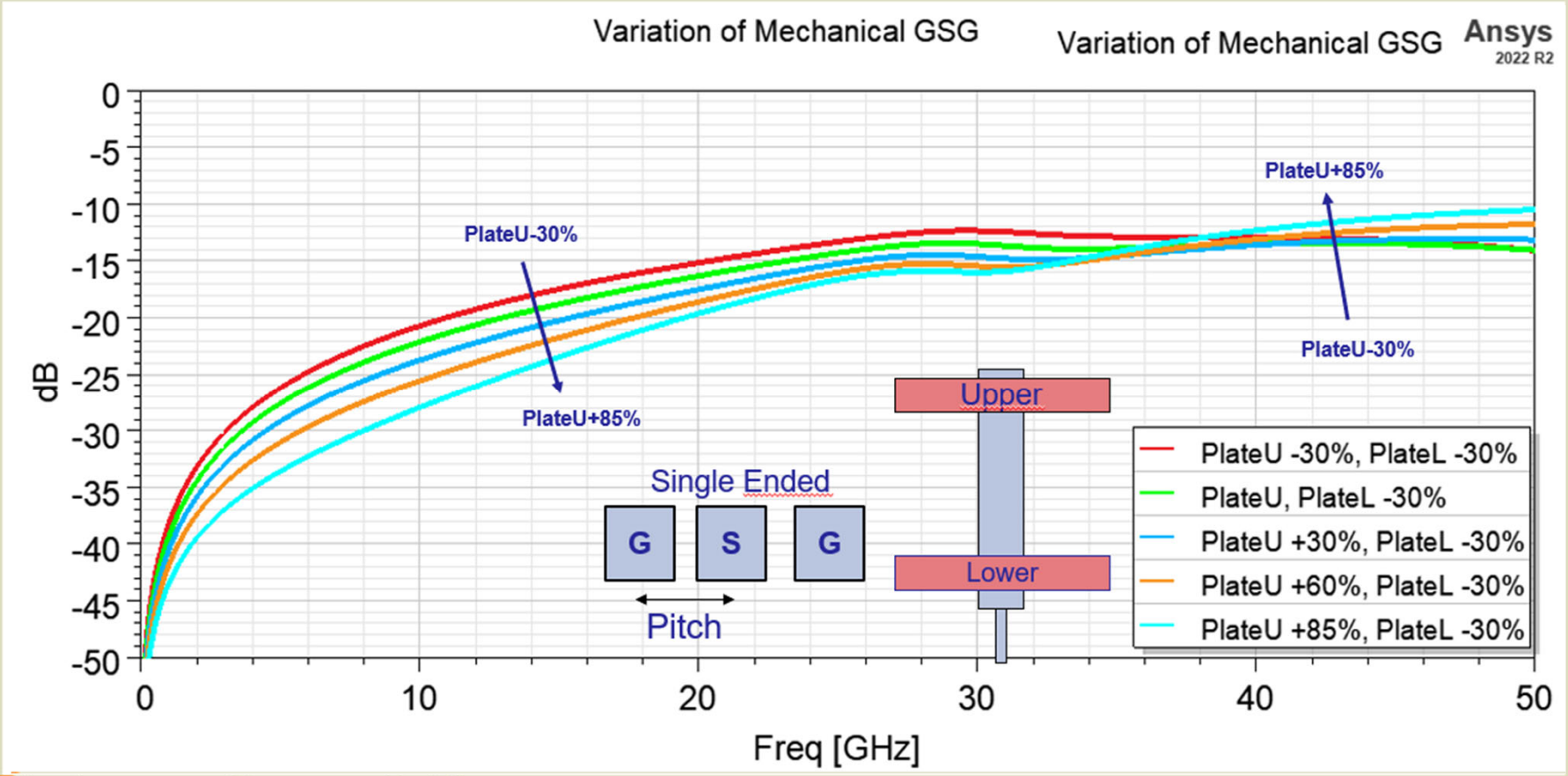
Variation of tip length GSG



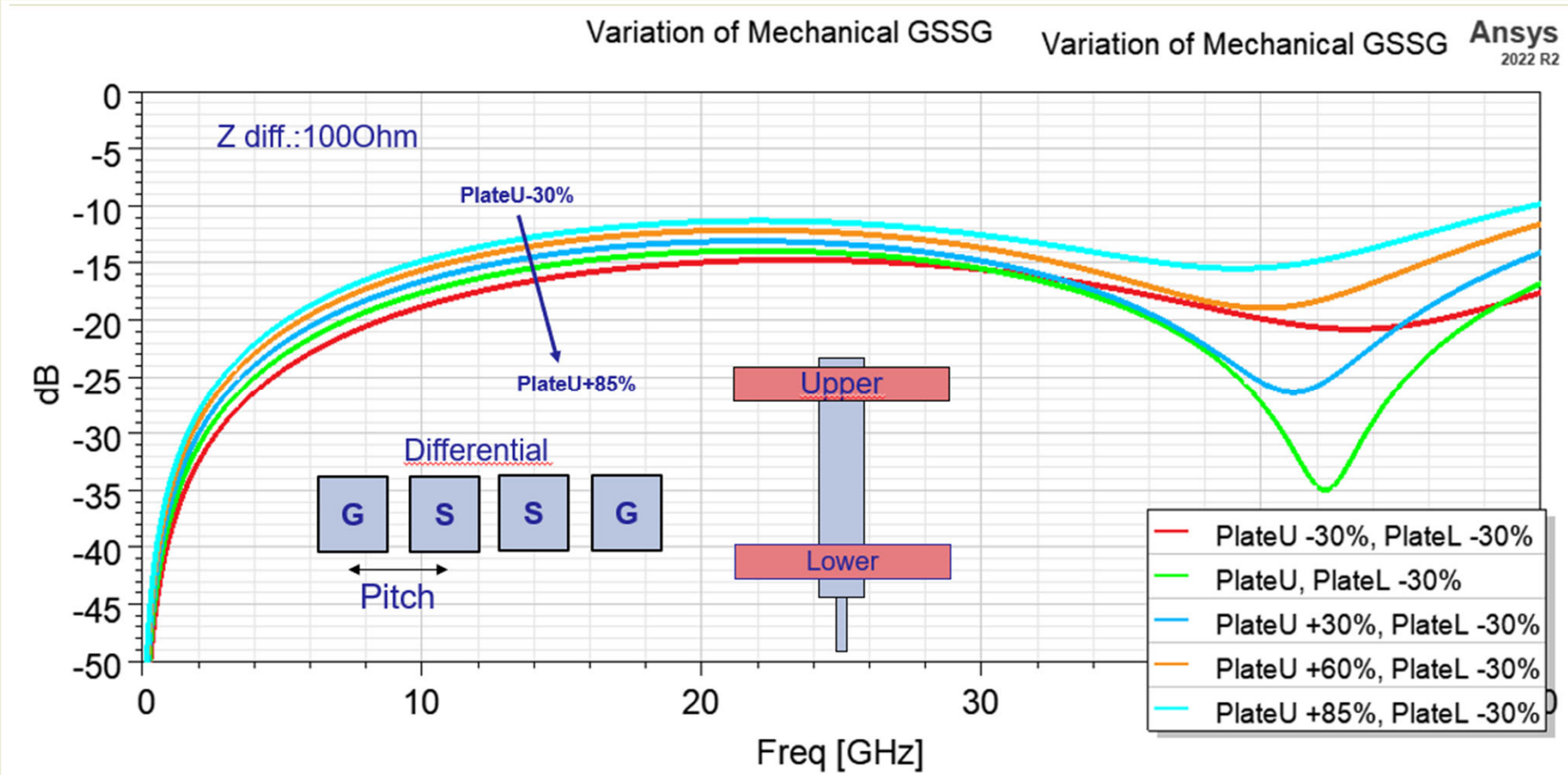
Variation of tip length GSSG



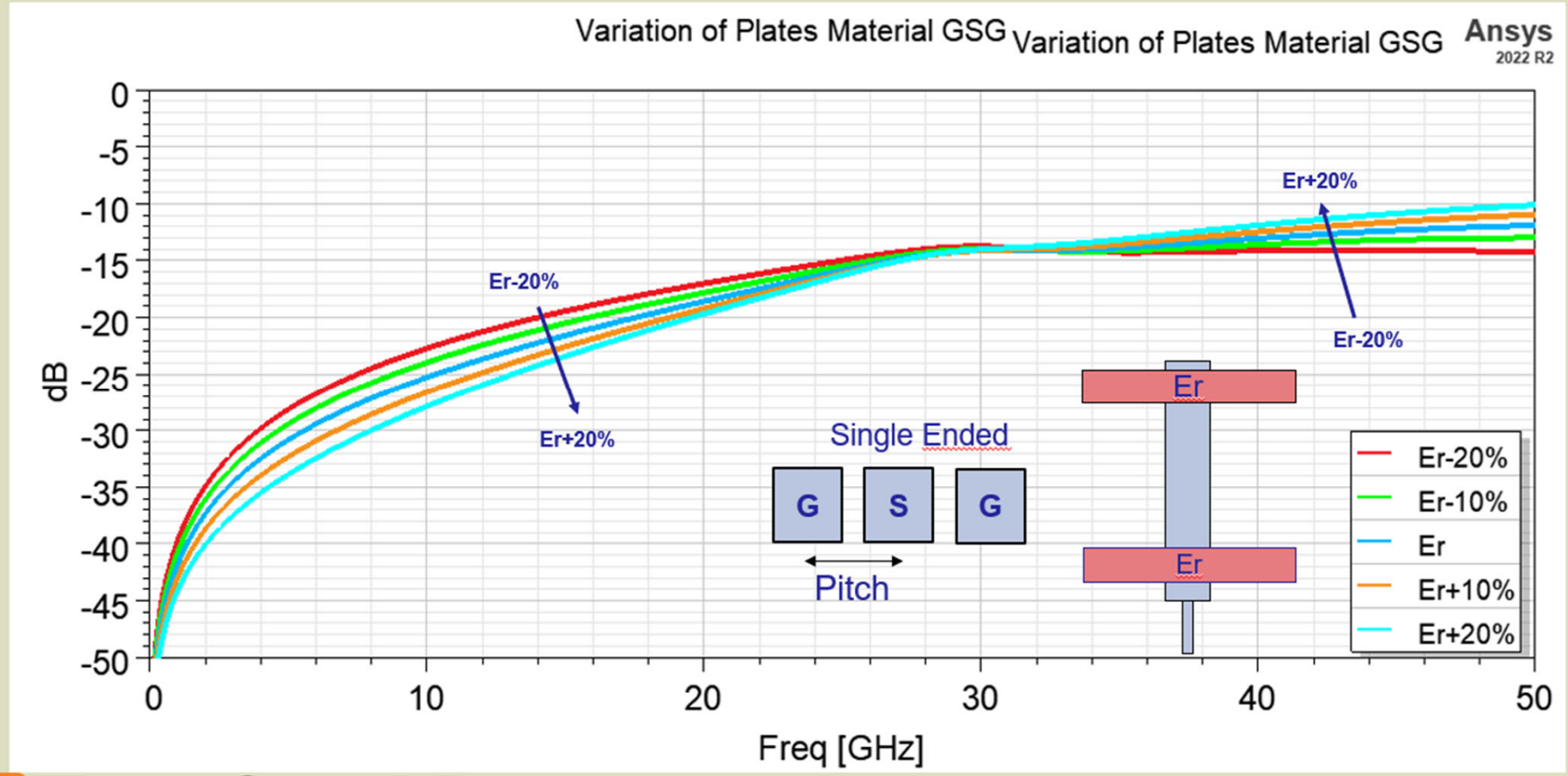
Variation of mechanical structure



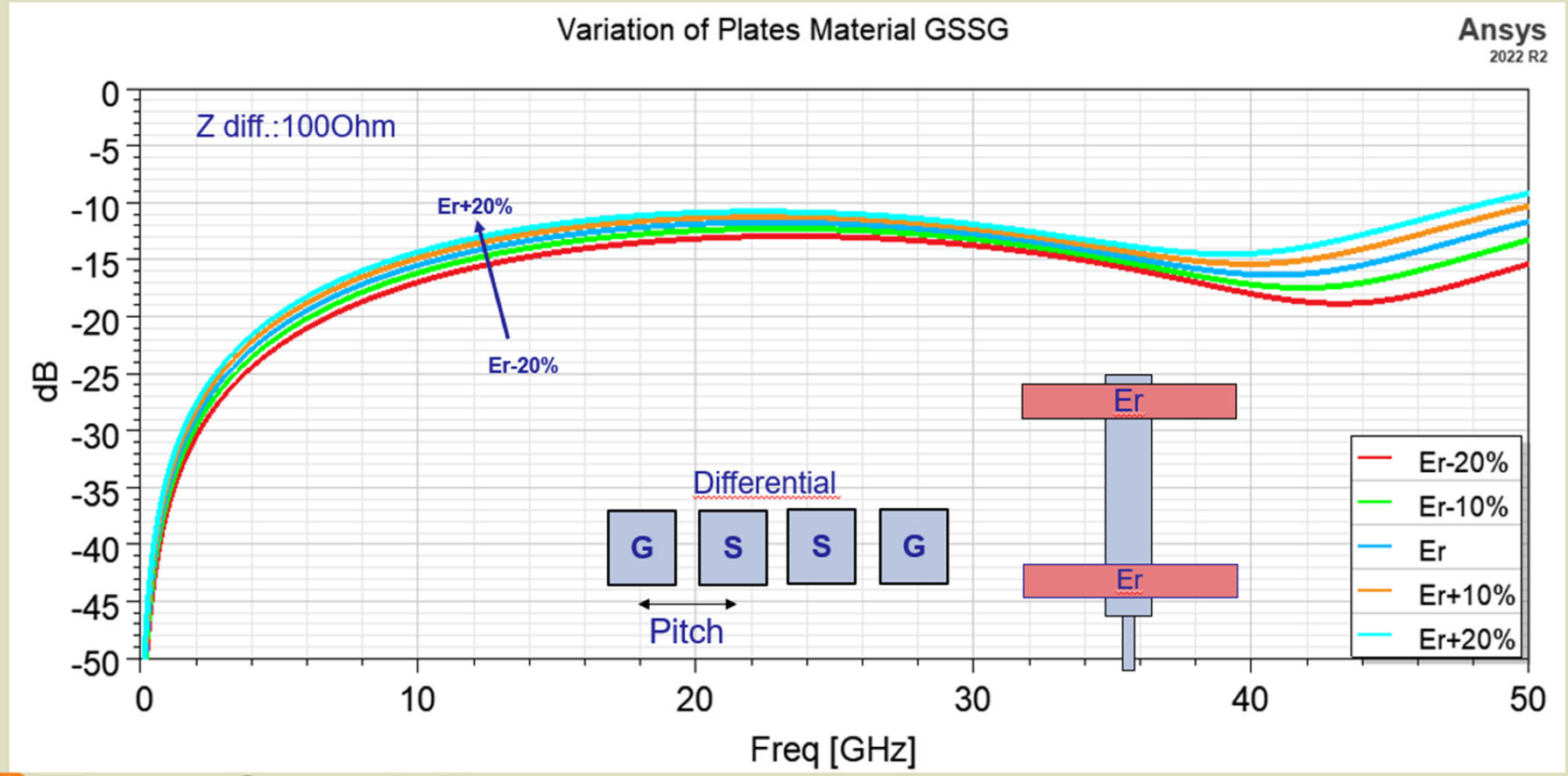
Variation of mechanical structure



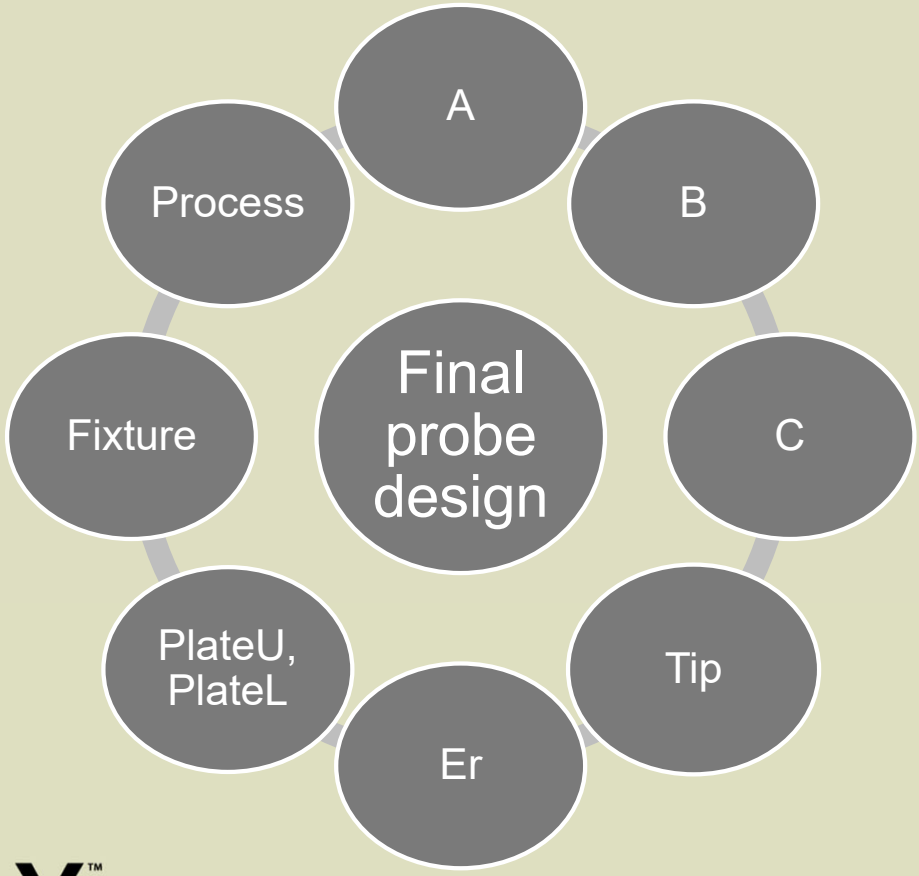
Variation of materials GSG



Variation of materials GSSG

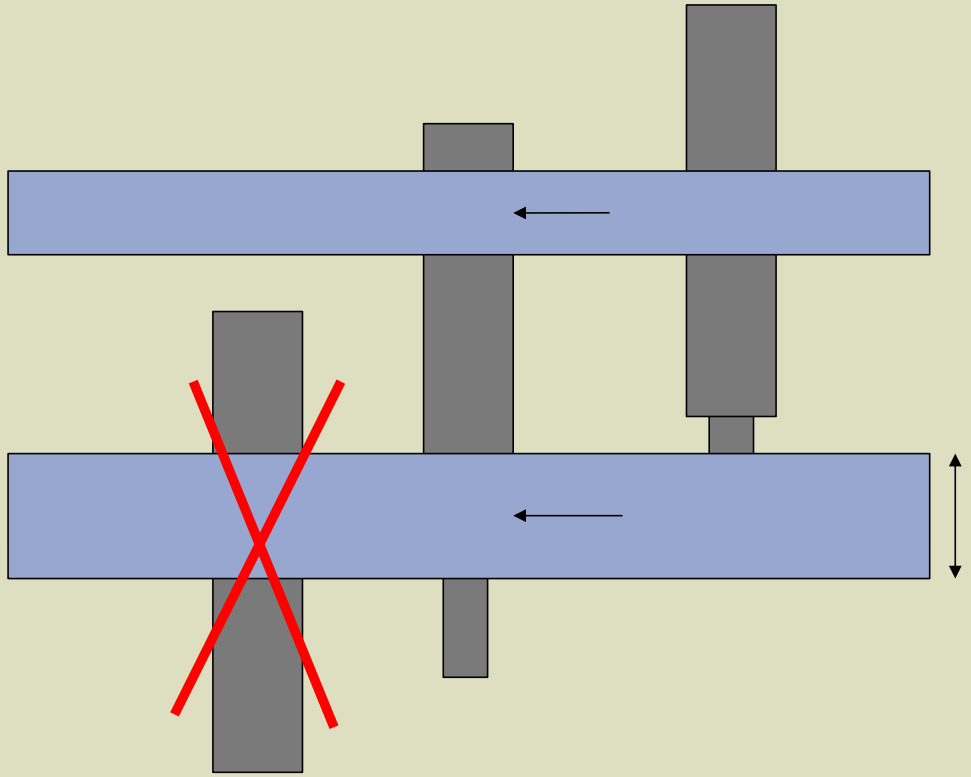


Final choice



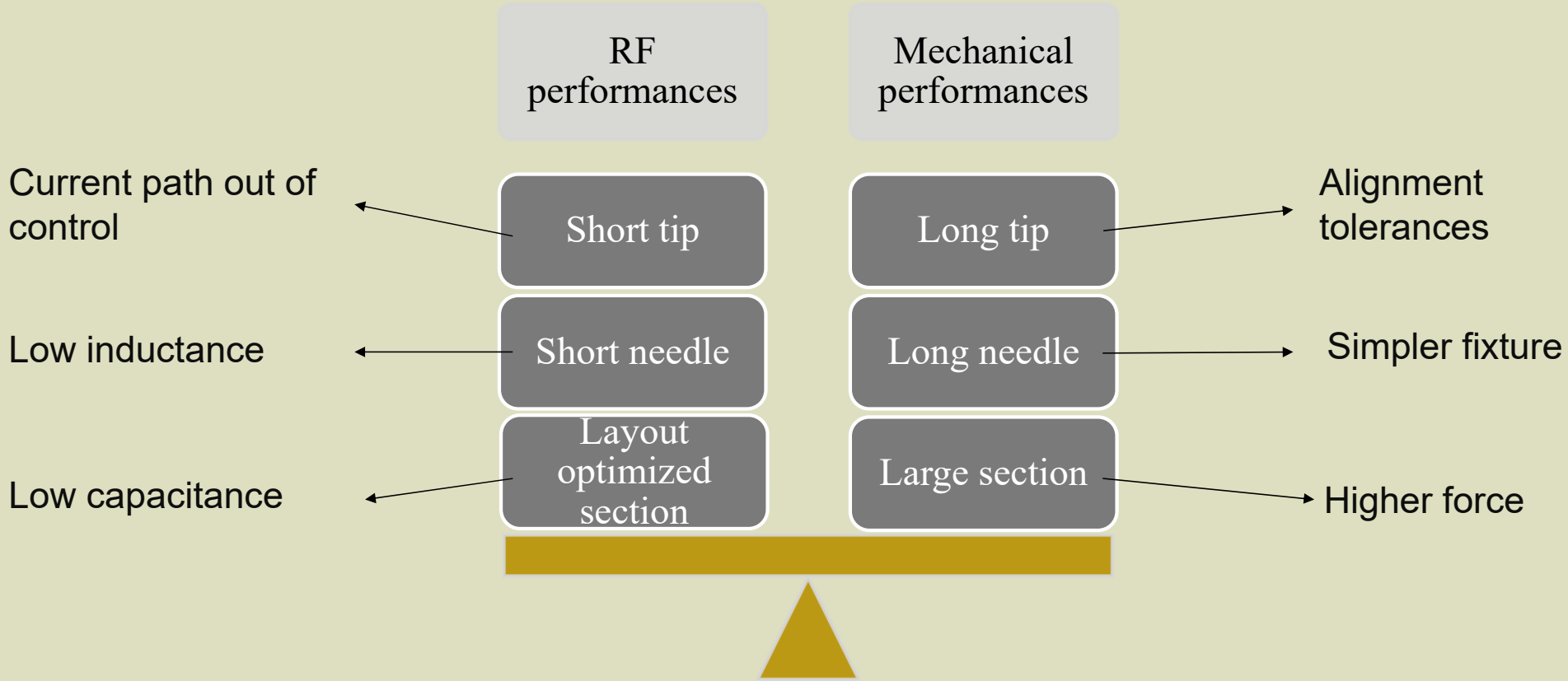
Trade off between GSG and GSSG

Final optimization



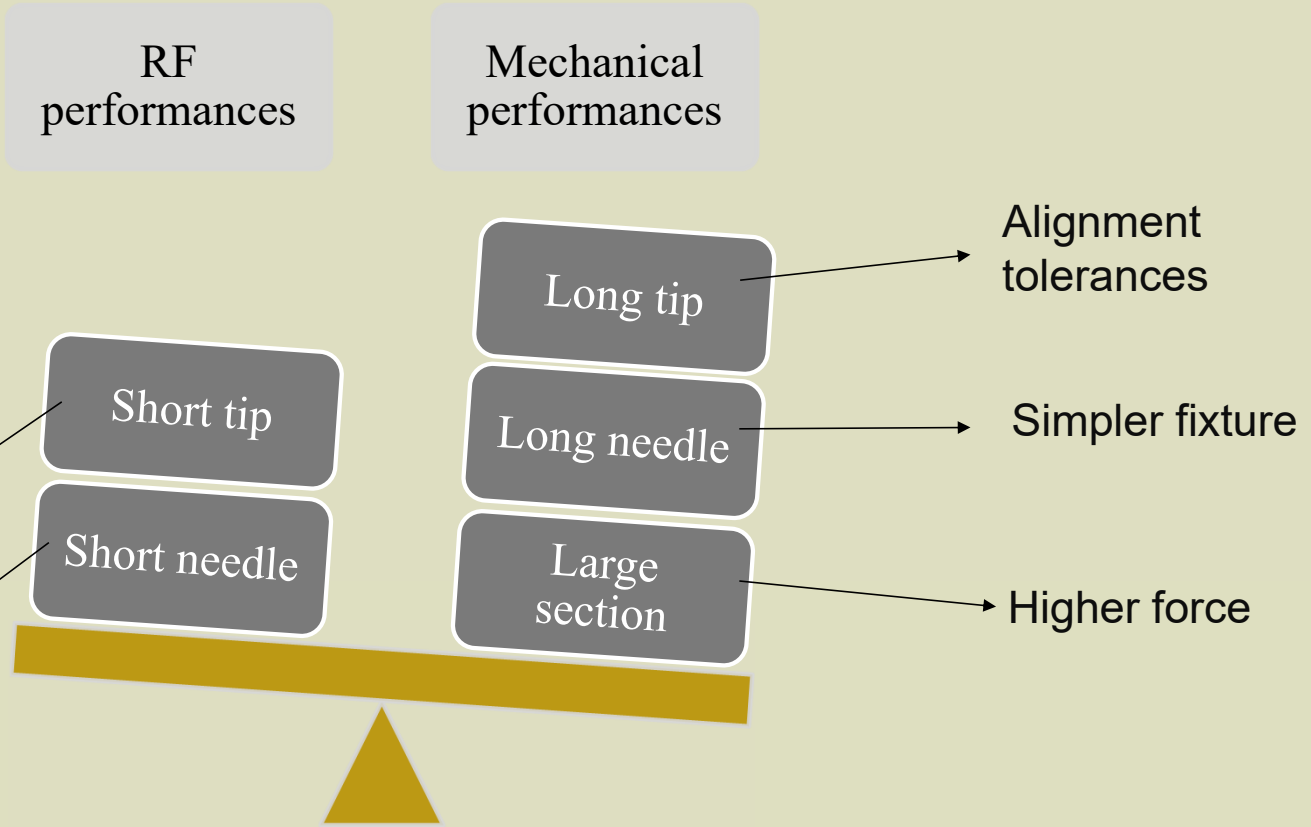
- Avoid falling down of the probe (from both sides)
- Ease of assembly / disassembly
- Avoid warpage
- Electrical-improving features
- Stresses ok to achieve high fatigue life
- Manufacturing limits

Final optimization



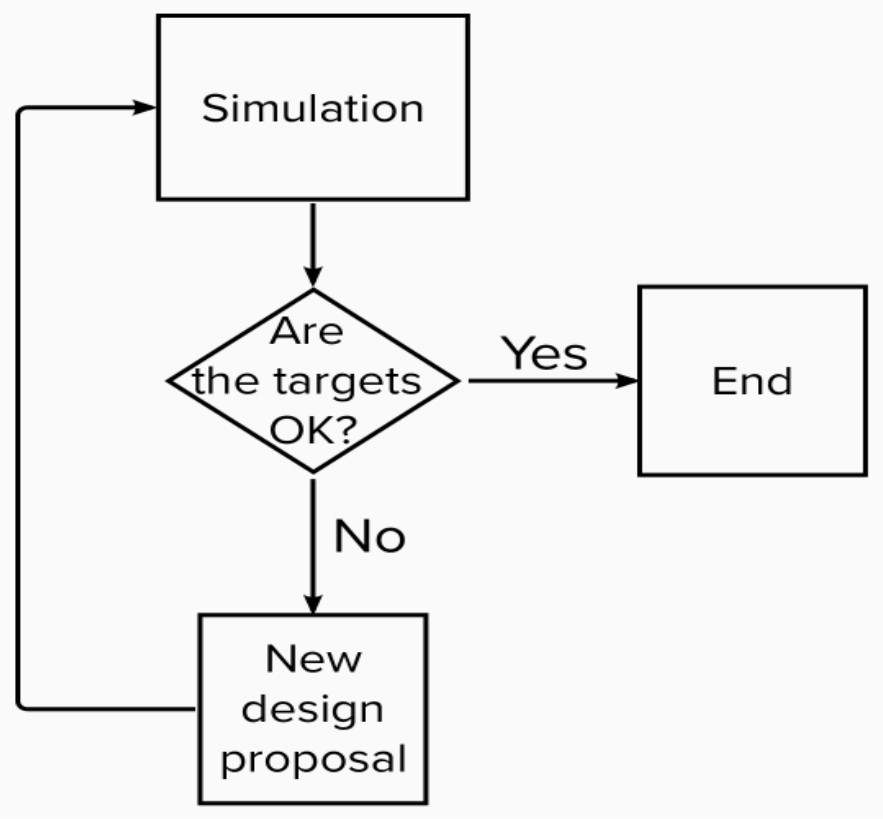
Final optimization

e.g. the real layout is more similar to GSSG: the large section required is worsening RF performances



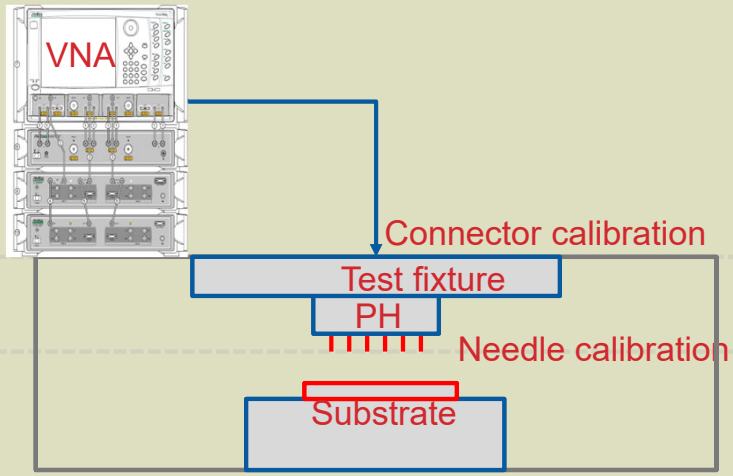
Complete simulation

- Final probe design
- Final socket design
- Customer layout

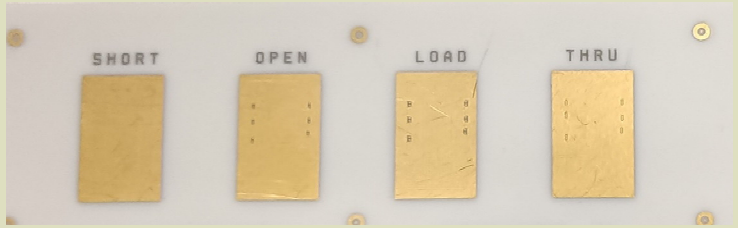


Measuring Method: 2-tier technique

- In order to measure the RF performance a test fixture is built.
- The technique used is a 2-tier calibration: two 1-Port SOL (short-open-load) calibration are performed, one at connector plane and one at needle plane. S-parameters of what is between these two planes are then obtained.
- Needle calibration is perfomed with a custom made calibration substrate.

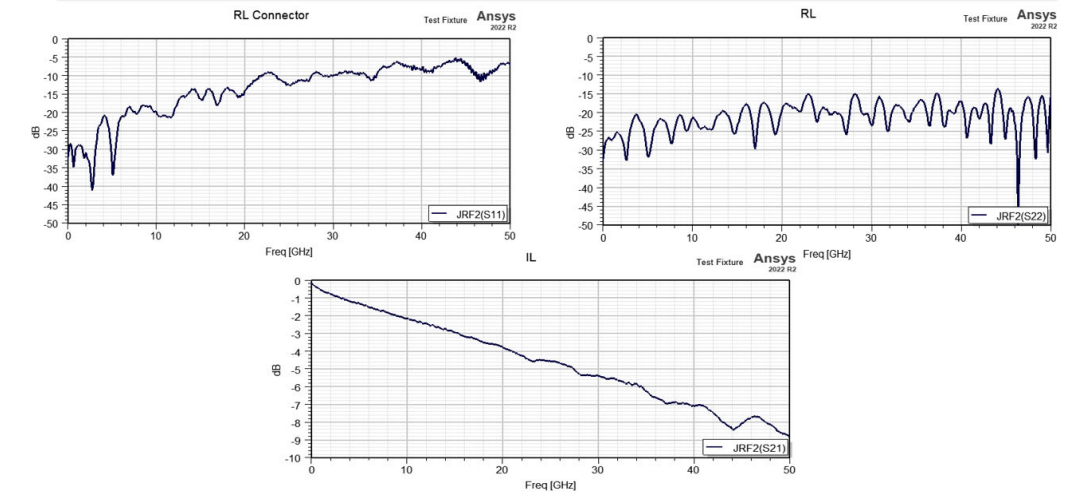


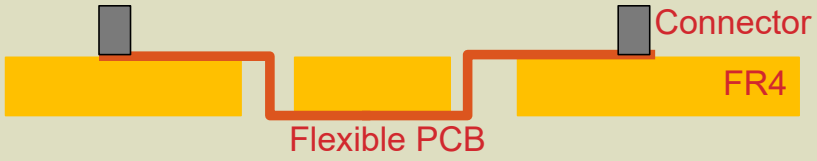
Substrate

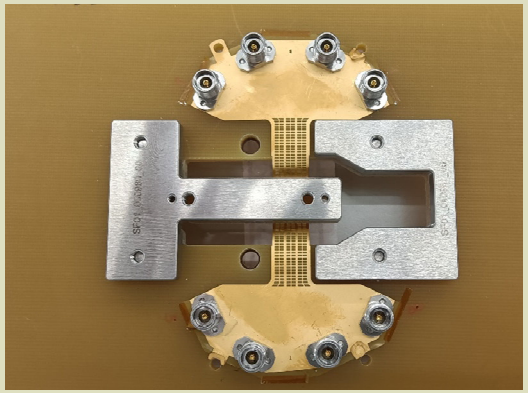


Test Fixture

- Test fixture is composed by a flexible PCB over a FR4 support to give mechanical robustness.
- Below the S-parameters of the test fixture alone:

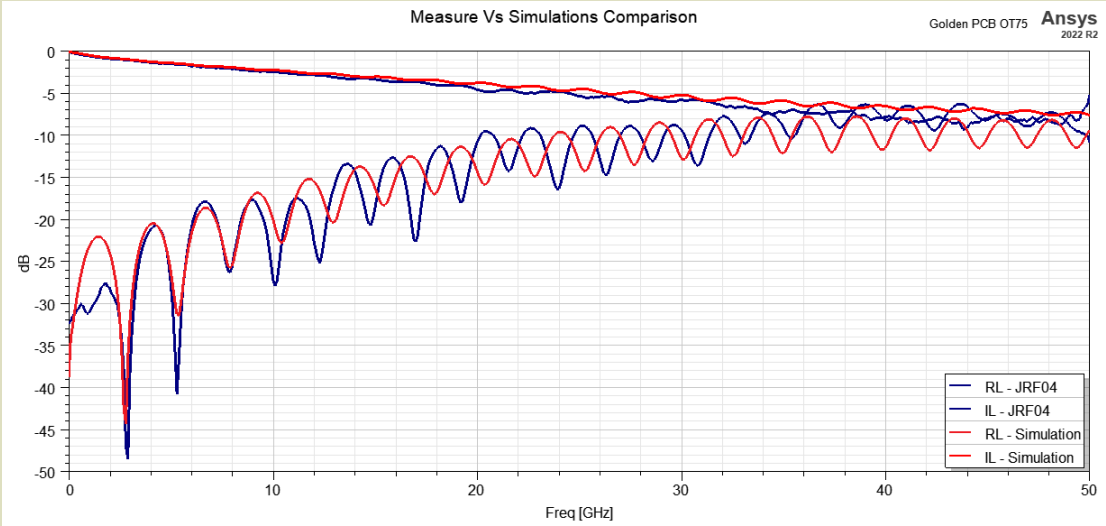






Measurement comparison

- Below the comparison between measurements and simulation of the total structure.



- It's shown good agreement between them.

Conclusion

Developing a new MEMS Spring Probe for RF applications: