Design & Dev of a GPS antenna with LDS 3D MID's

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Amaury VEILLE
S2P (Smart Plastic Products)

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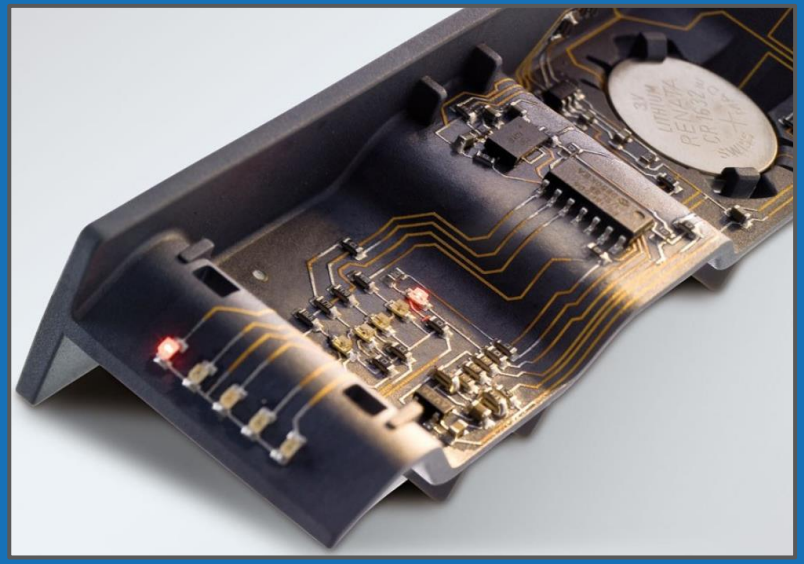
What about 3D MID's ?



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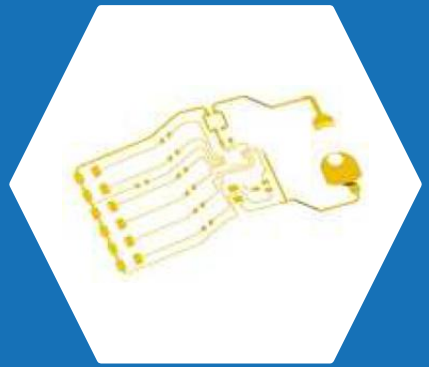
MIDs = Molded Interconnected Device

MIDs are combination of electronic functions with Plastic parts.

It gather 3 main functions:

- *Mechanical function*
- *3D Electronic interconnexions*
- *Packaging*

=



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MIDs = Molded Interconnected Device

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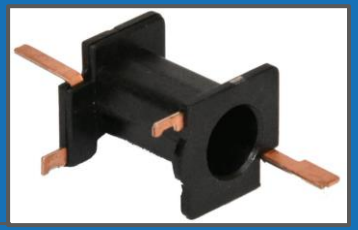


MIDs can be made with many process :

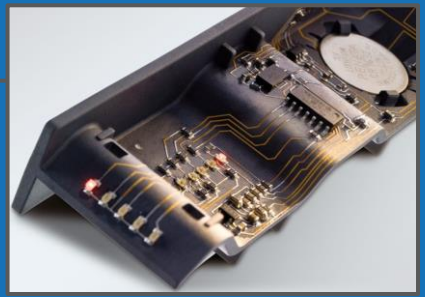
=> Overmolding of metal stamping tracks

=>2K molding of plastic conductor tracks

=> 3D Printing of tracks

=> IML / IMD (Electronic functionalized overmolded film)

=> LDS



=> ...

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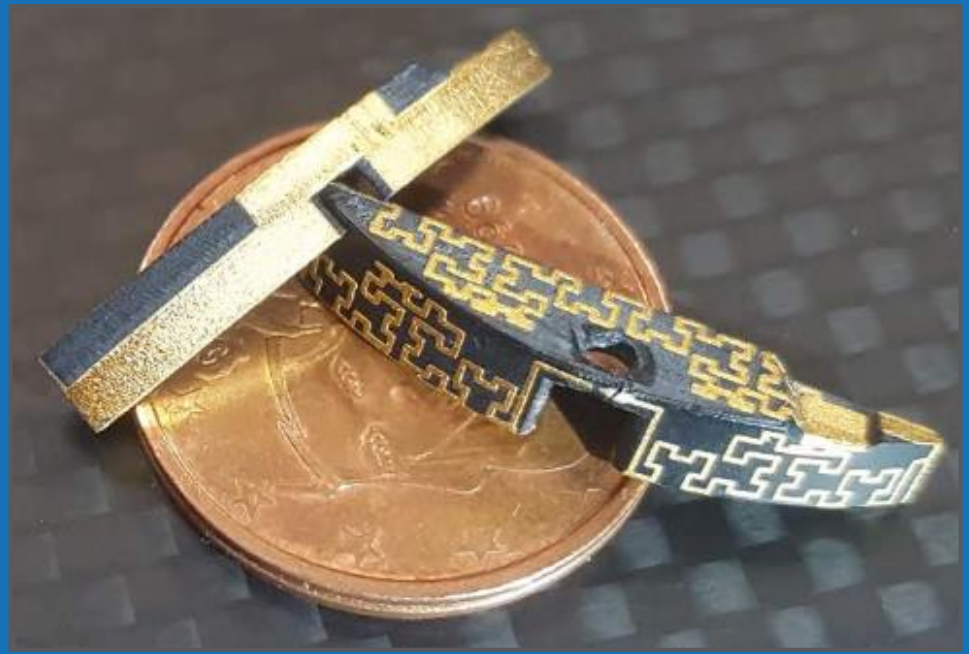
Let’s focus on LDS Techno



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LDS Technology

LDS (Laser Direct Structuring) is a process from LPKF-LDS

=> Detailed Process steps

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Injection molding of Plastic Carrier

Laser structuring

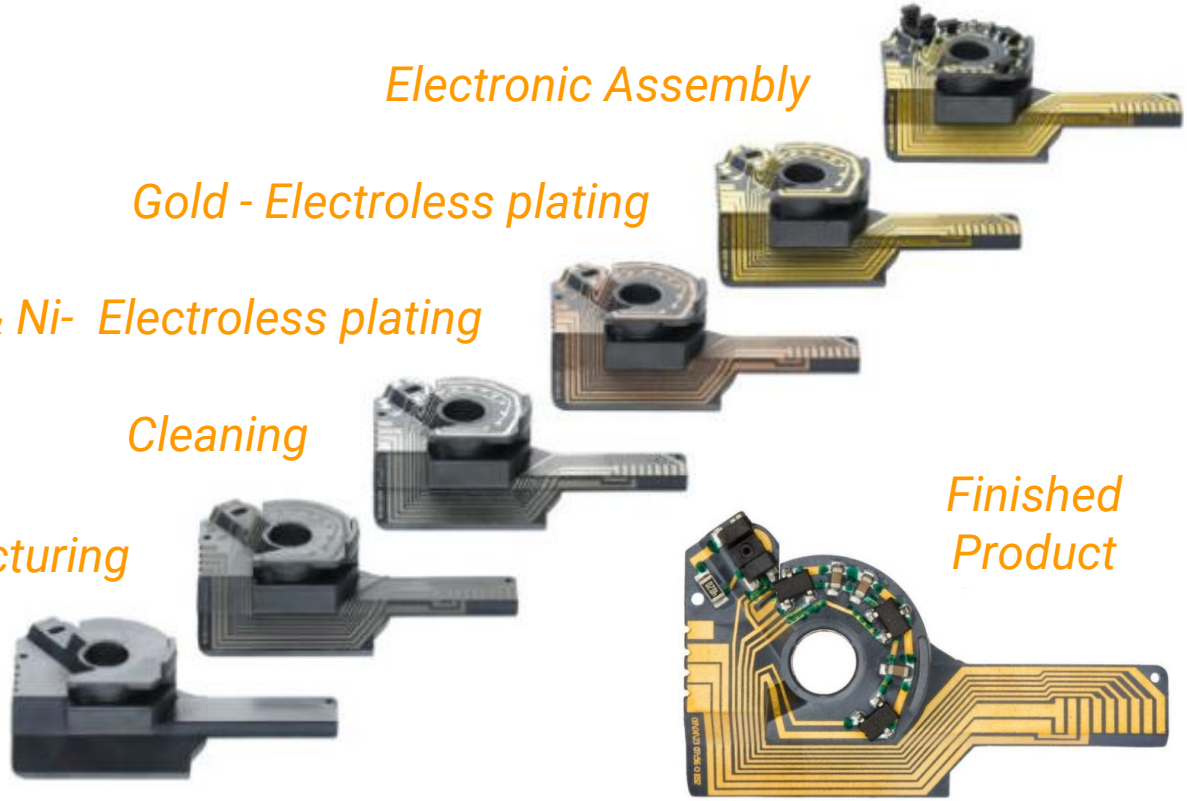
Cleaning

Cu & Ni- Electroless plating

Gold - Electroless plating

Electronic Assembly

Finished Product



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Design of LDS GPS Antenna

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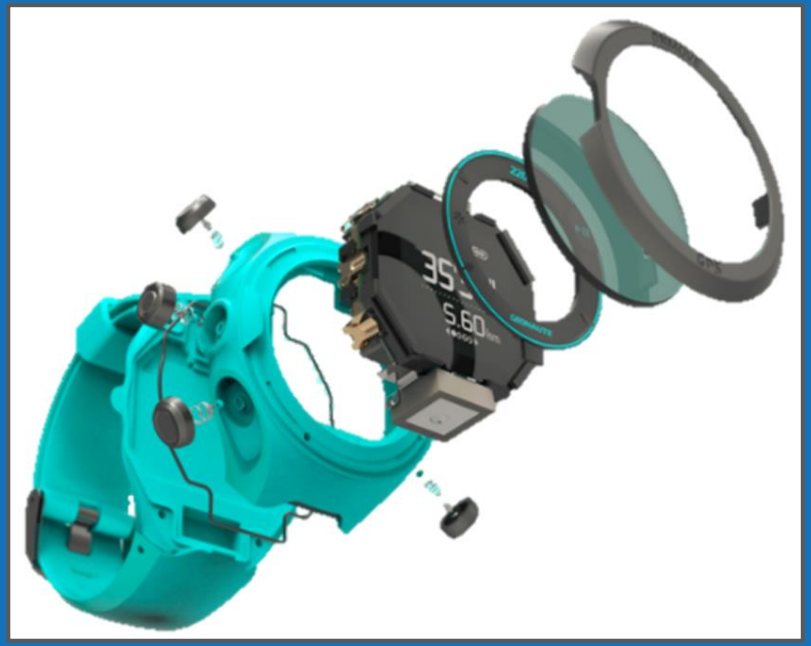
Where are we coming from?



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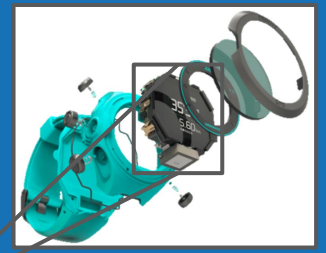
Design of LDS GPS Antenna

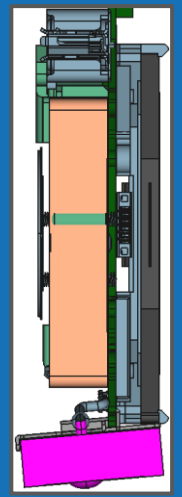
Initial solution = On shelf Ceramic patch antenna

DESIGN Impact

=> Dimensions = 12x12x5 mm

=> … how to fit a cube inside a Cylinder!!





	Thickness	Weight
Competitor	14,5 mm	41,2 g
Decathlon initial Patch concept	18,5 mm	56,5 g
Design Impact	**+ 4,1 mm**	**+ 15,3 g**
	+ 28%	**+ 38 %**

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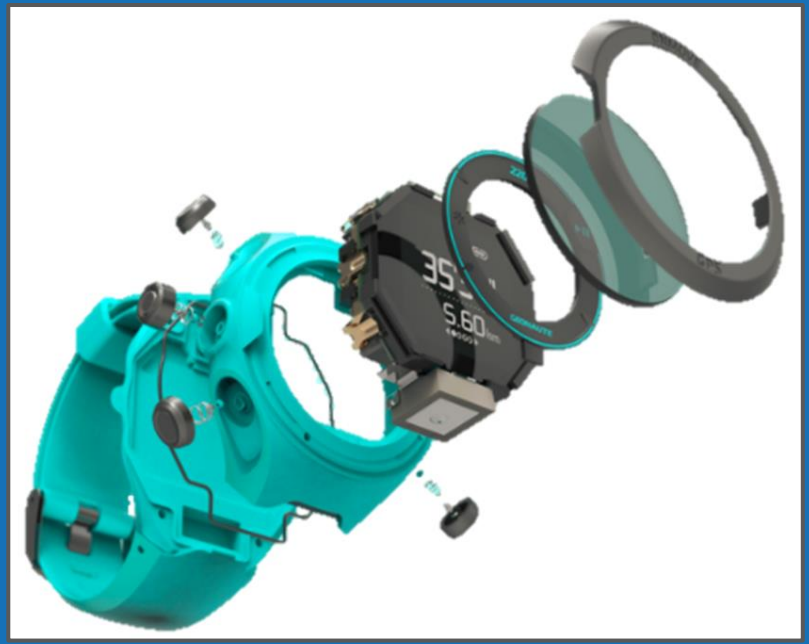
Design of LDS GPS Antenna

Initial solution = On shelf Ceramic GPS patch antenna

GPS performance Impact

=> Component is not taking in account the environment of the product



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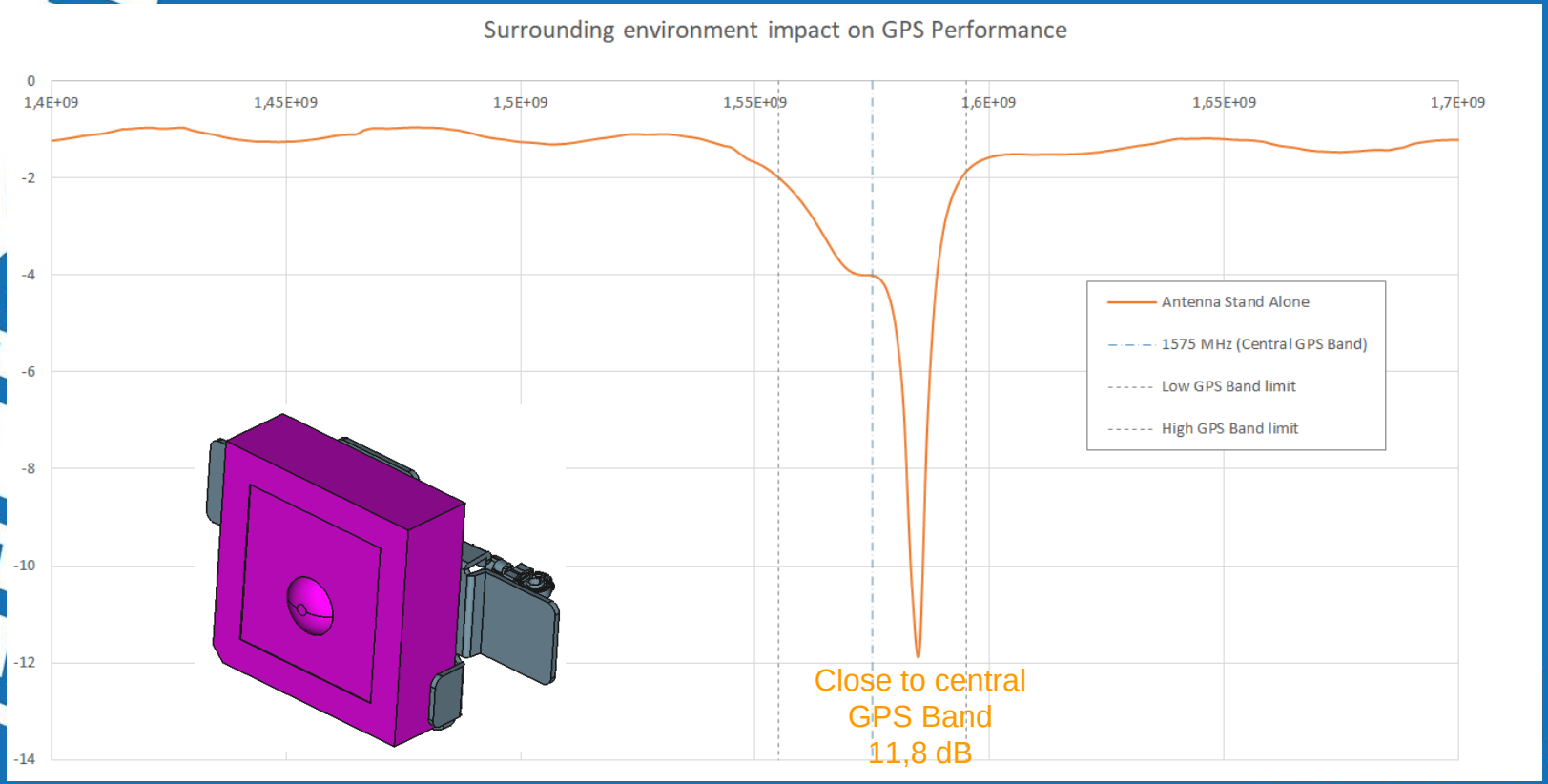
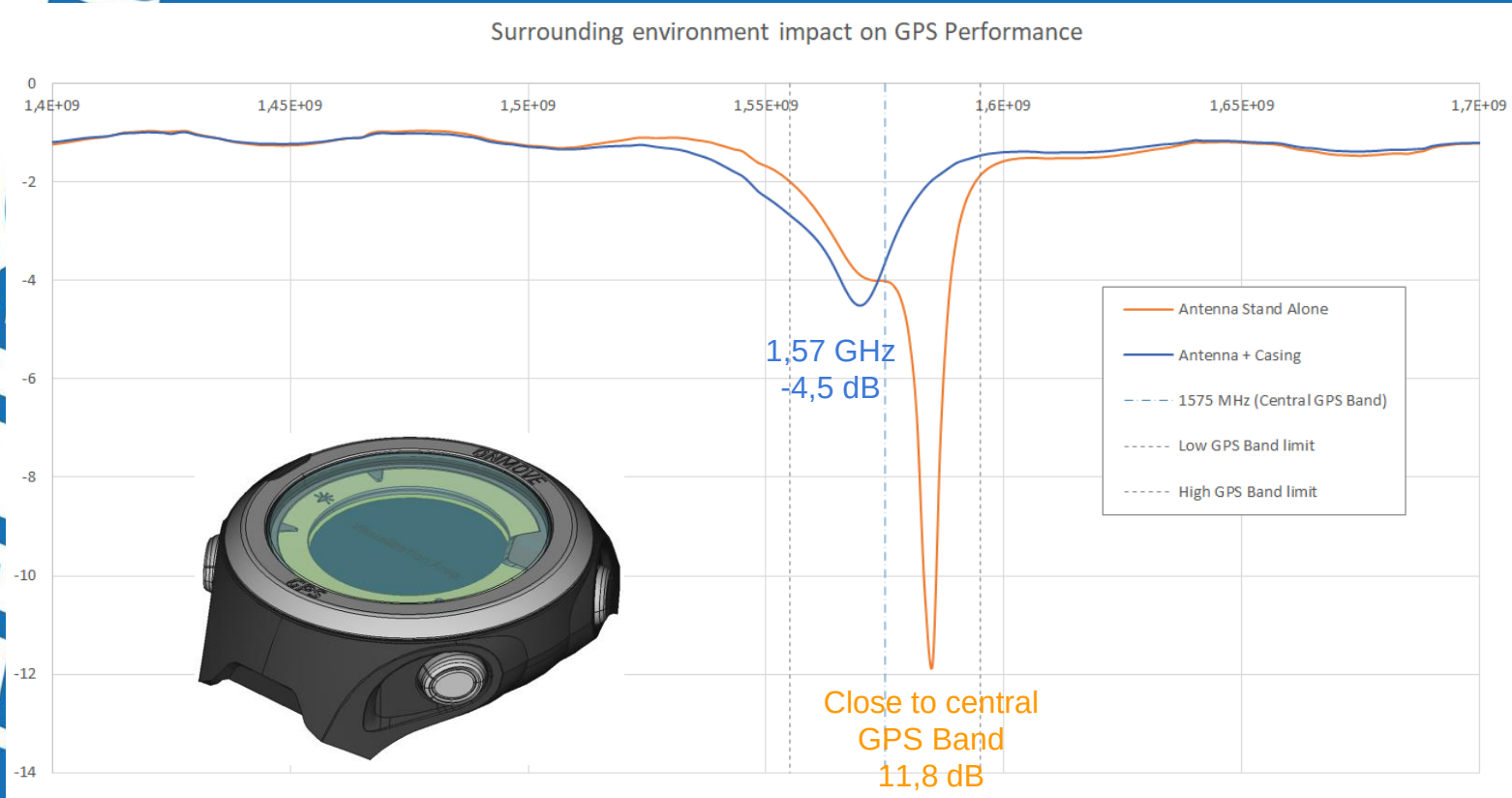
Design of LDS GPS Antenna

Ceramic GPS patch antenna



Design of LDS GPS Antenna

Ceramic GPS patch antenna + Casing



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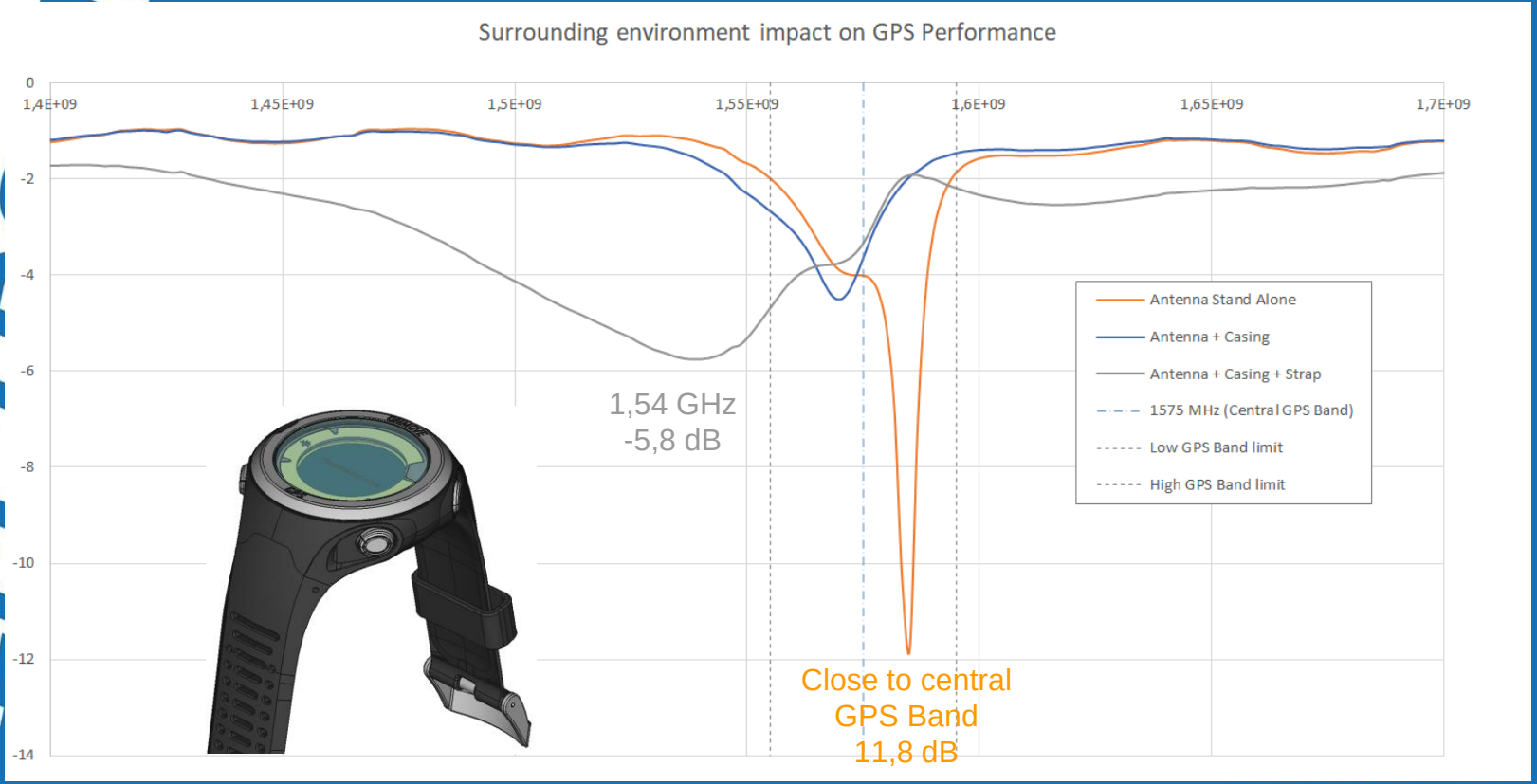
Ceramic GPS patch antenna + Casing + Strap



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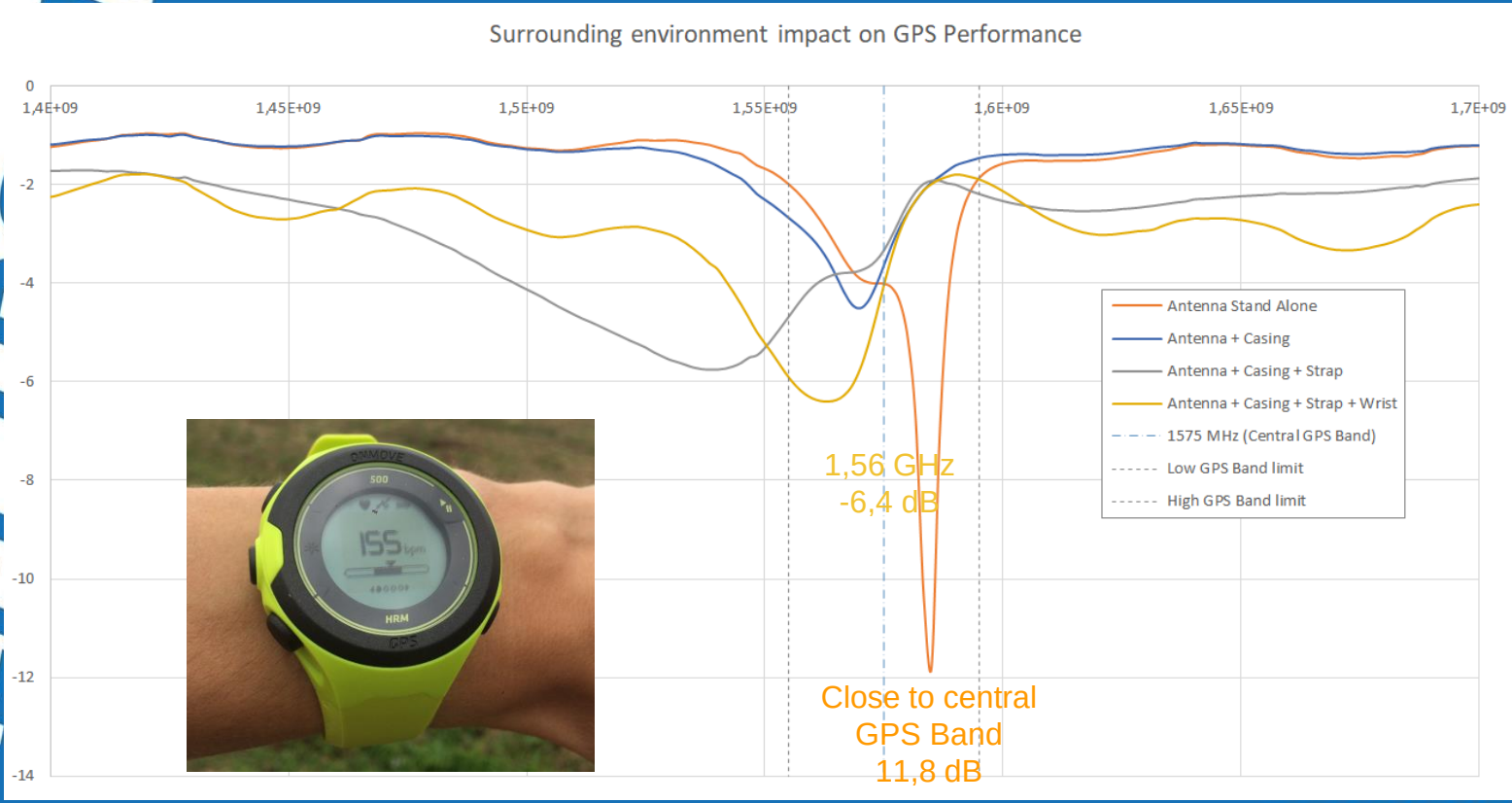
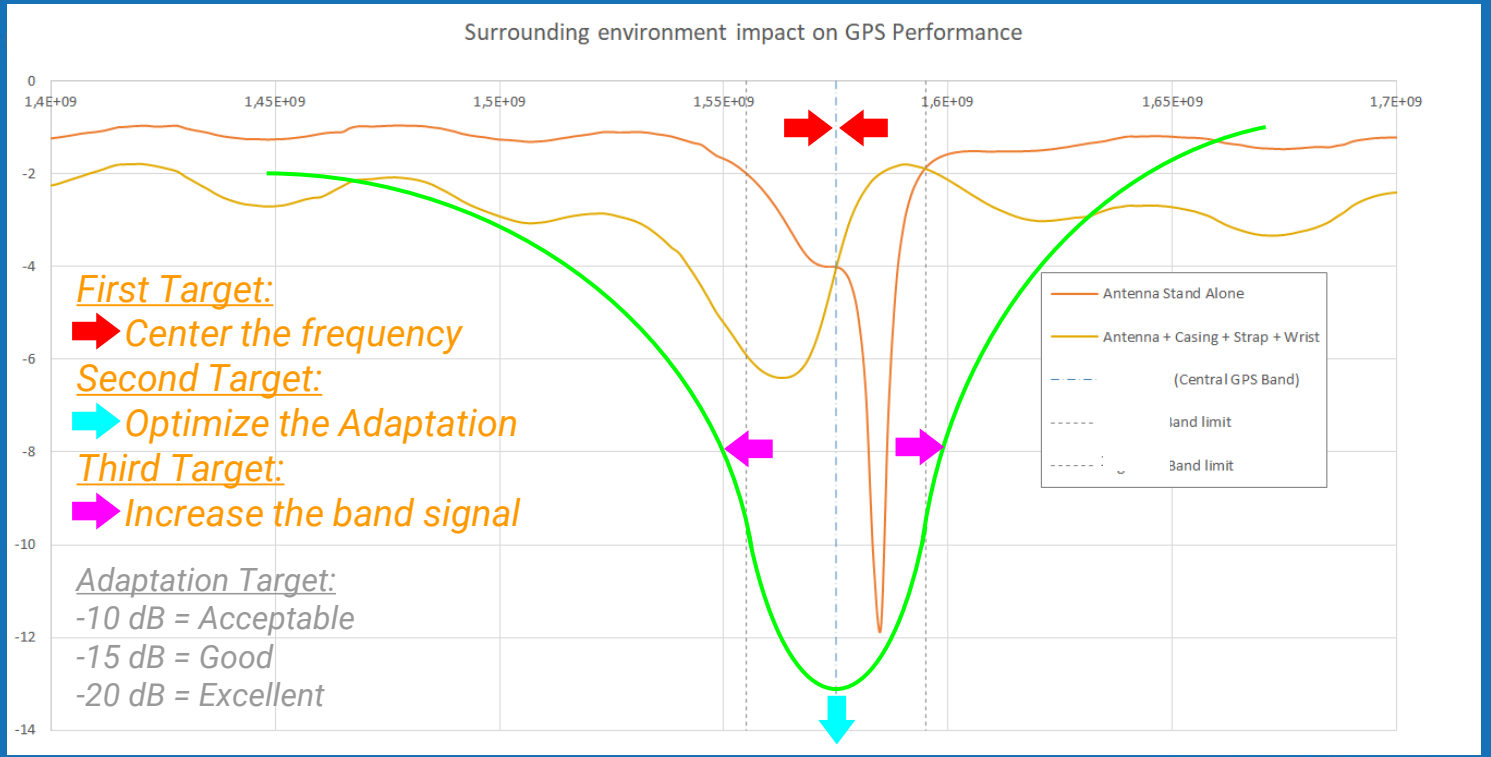
Ceramic GPS patch antenna + Casing + Strap + Wrist



Design of LDS GPS Antenna

Target of GPS Performance with surrounding environment

First Target is to center the frequency 1,585 GHz



How to improve the situation?

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3D Design of Plastic carrier & surrounding environment

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GPS - CST FEA Simulation

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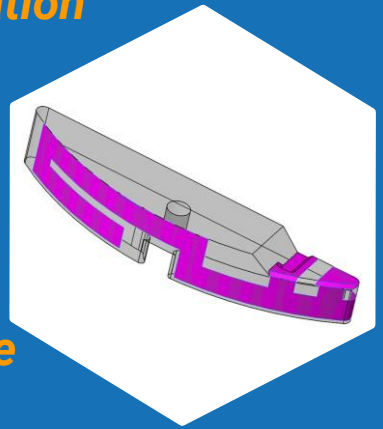
LDS CUSTOM made Antenna



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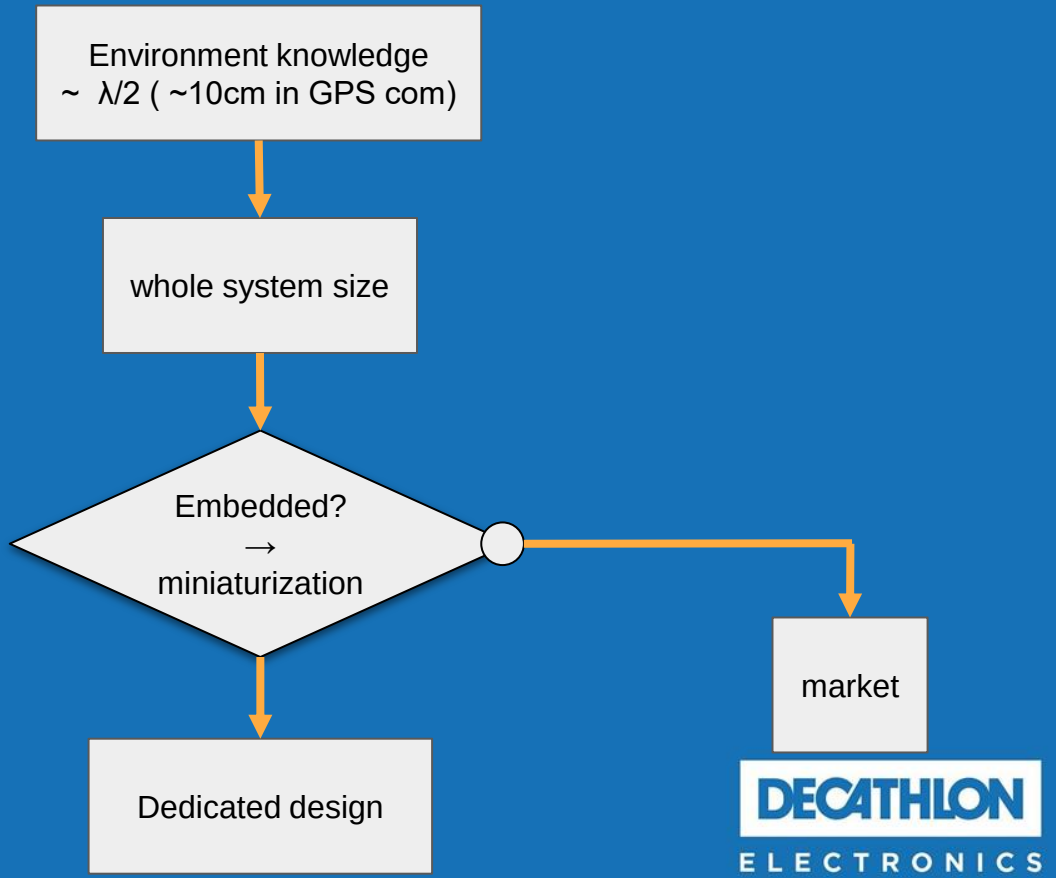
Design of LDS GPS Antenna

Antenna development diagram



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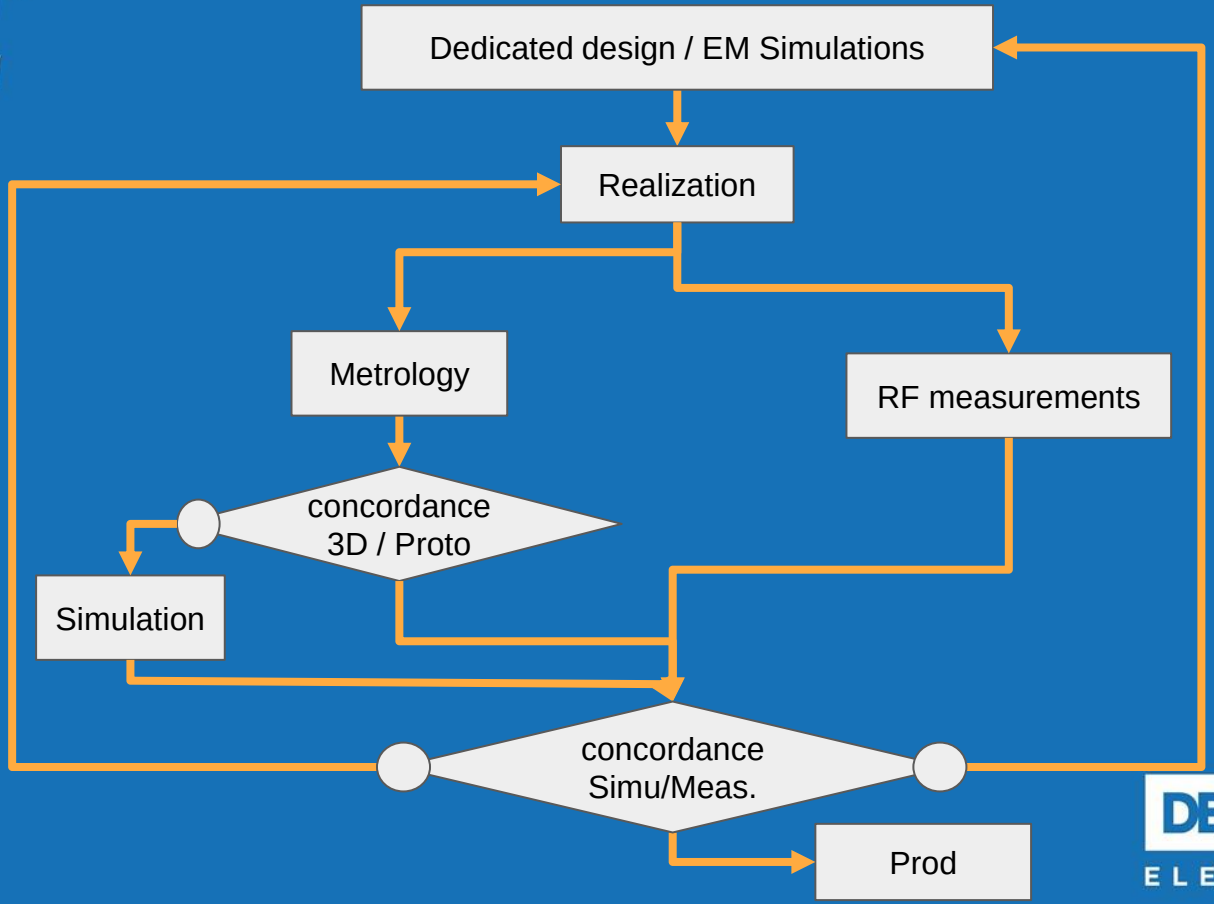
Antenna development diagram



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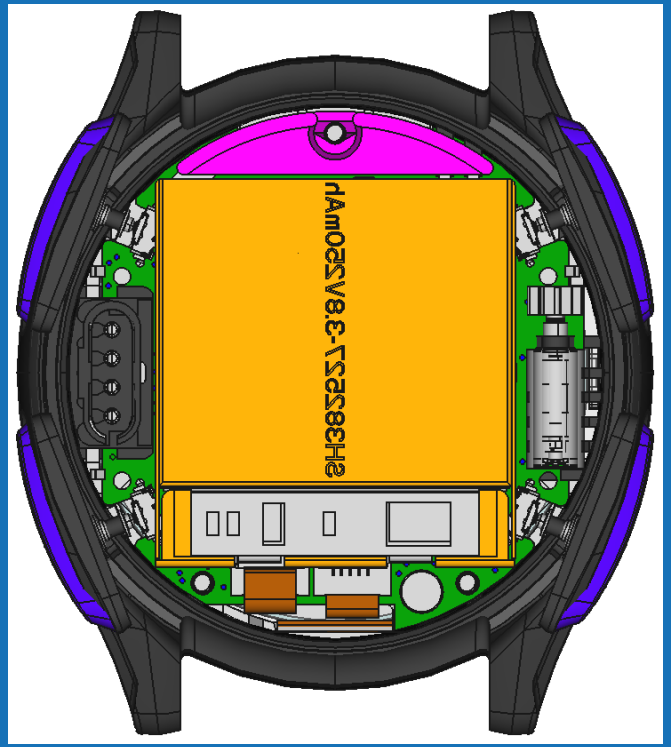
Design of LDS GPS Antenna

3D Design of Plastic carrier

=> Evaluation of the volume available in the product



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Design of LDS GPS Antenna

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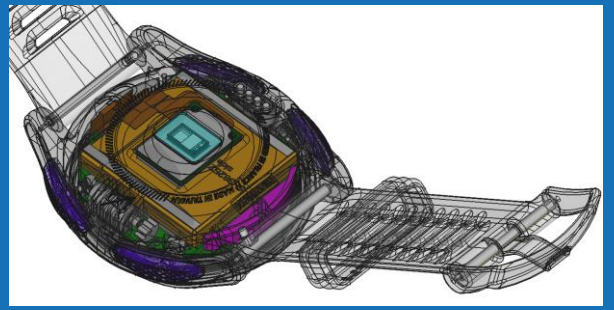
GPS - FEA Simulation (CST)

- **Mechanical Inputs**

  => 3D of all Mechanical components

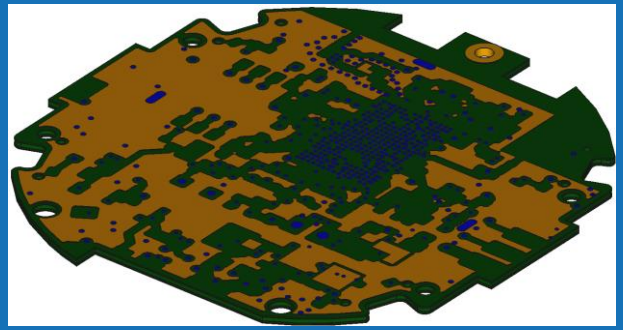
  => BOM (with all defined materials)

  => Resistivity of materials



- **Electronics Inputs**

  => 3D of GERBER of the PCBA



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Design of LDS GPS Antenna

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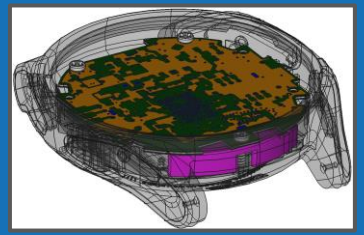
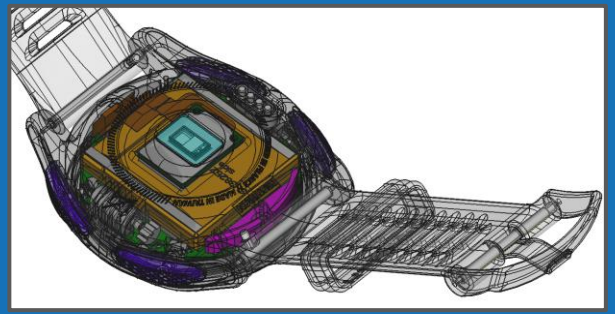
Simulation of the antenna

- *First step = Stand alone + PCBA + Light Meca*



- *Second step = Full component*



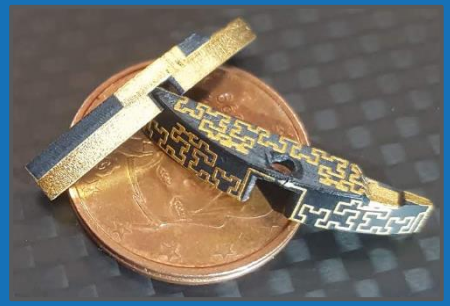
Each step is following the same process:

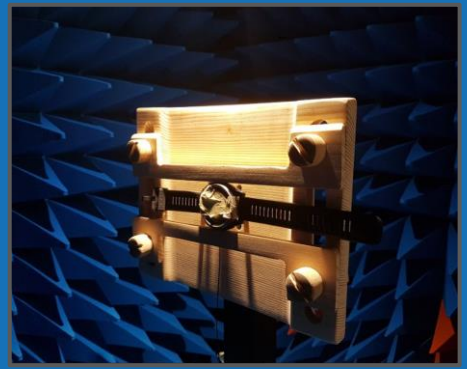
=> Simulation

=> Prototyping

=> Measurements

=> correlation of results





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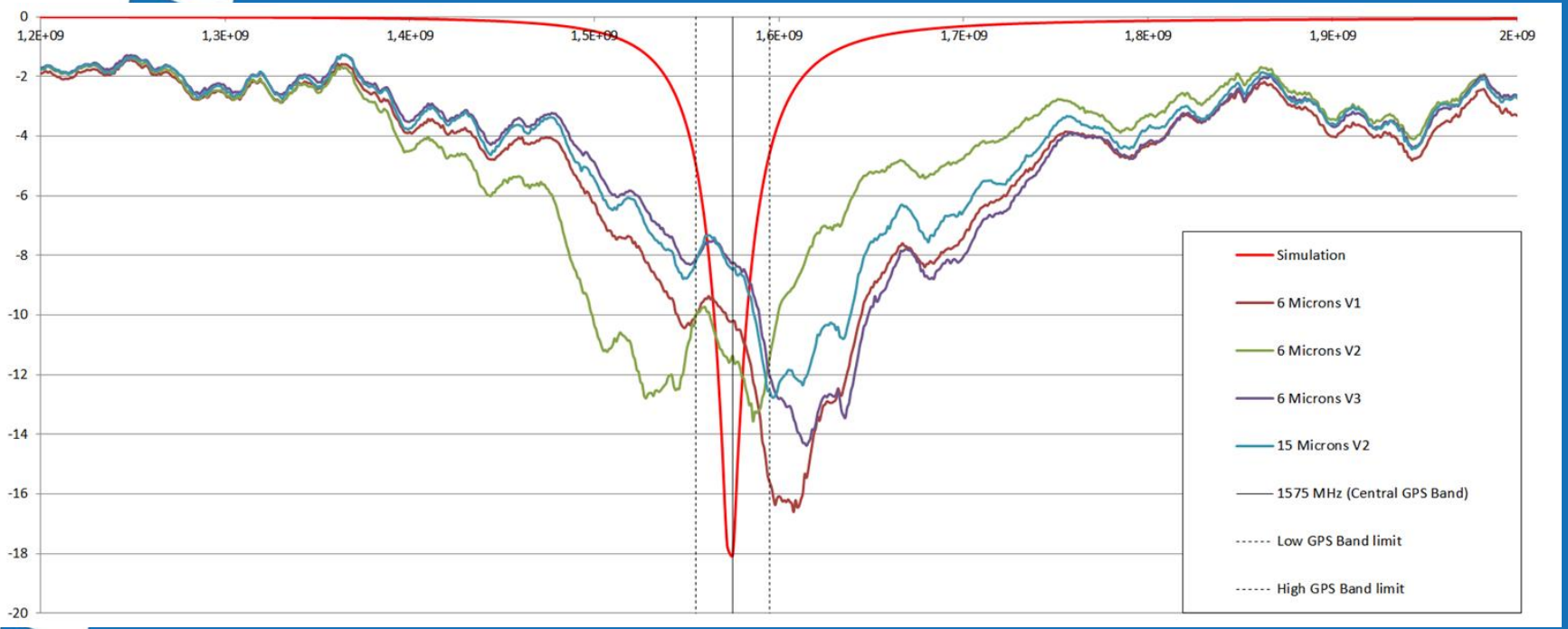
LDS GPS measurements inside anechoic chamber



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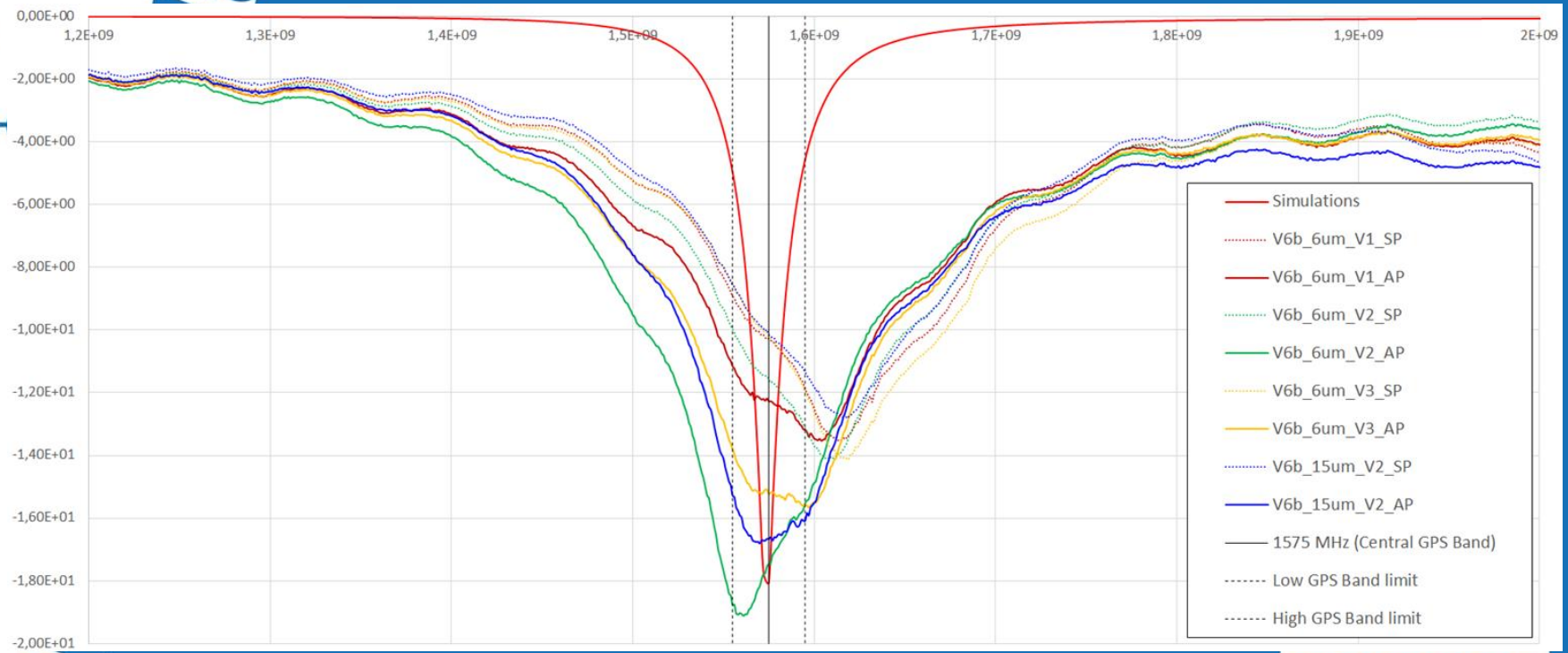
LDS GPS measurements with wrist



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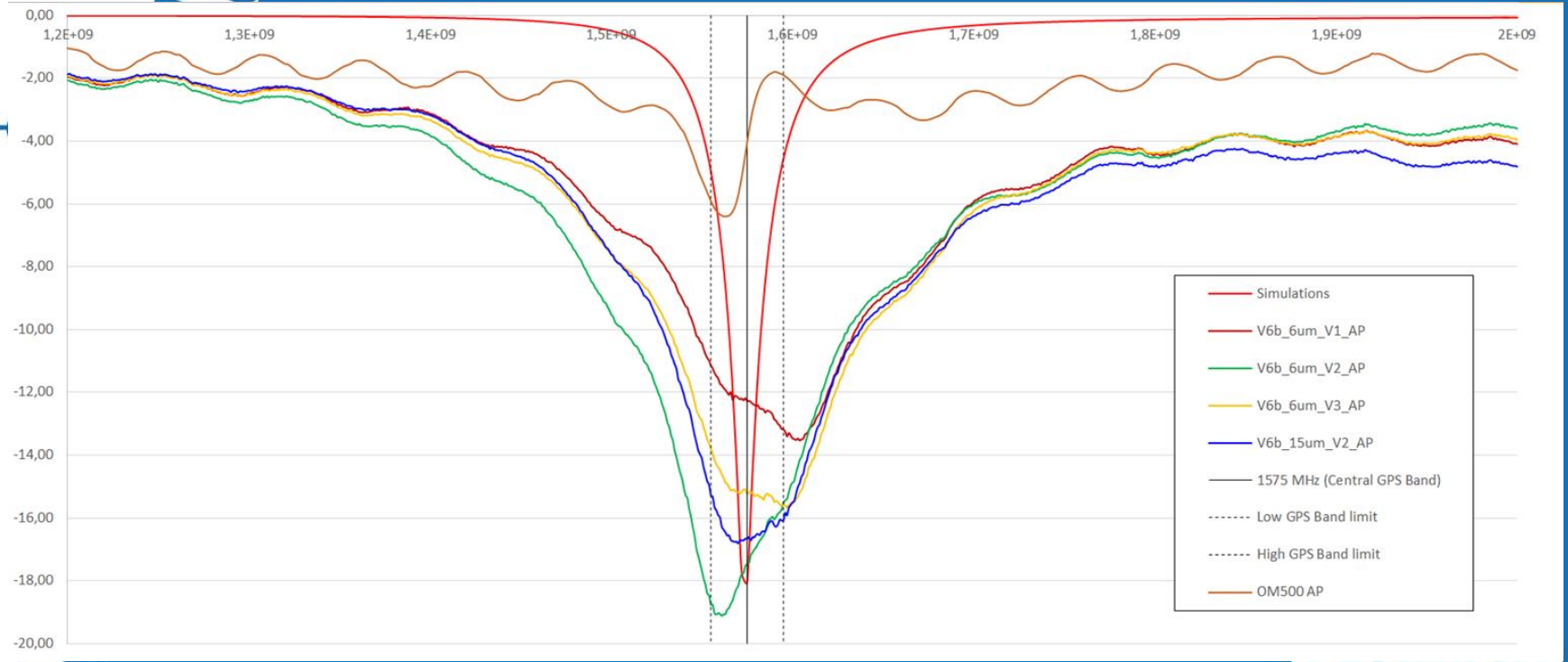
LDS GPS performance results compared with OM500



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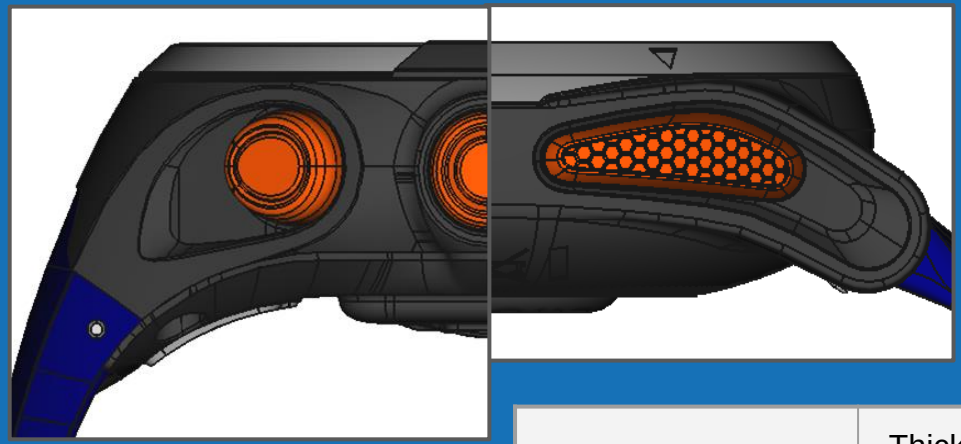
Reduction of size
Thickness of OM 500



	Thickness	Weight
Initial form factor	18,5 mm	56,5 g
New GPS watch	15 mm	42,2 g
Optimization	**- 20%**	**- 25 %**

	Thickness	Weight
Competitor	14,5 mm	41,2 g
New GPS watch	15 mm	42,2 g
Design Impact	**+ 0,5 mm**	**+ 1,0 g**
	+ 3,5%	**+ 2,5 %**

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Thank You

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