KDT Project ***PowerizeD***

Get Ready to Become ***PowerizeD***

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Agenda

- What is **Powerize*D*** and what does it stand for
- ***PowerizeD*** – A complex structure broken down in 2 dimensions
- „I have a dream …“ - It‘s all about intelligence
- Sharing knowledge - But nobody wants to share

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PowerizeD
Digitalization of Power Electronic Applications within Key Technology Value Chains

From Goals and Megatrends to PowerizeD

Goals:

- Development of breakthrough technologies of digitalized and **intelligent power electronics**; to enable sustainable and resilient energy **generation**, **transmission** and **applications**

Megatrends addressed:

- Independence/Sovereignty, Sustainability, Electrification and Digitalization



Ambitions to fulfil the Digital Agenda

Boosting Design Productivity

* Design time will be reduced by **50%**

Achieve Highest Quality With Affordable Efforts

* Achieve a chip size reduction of **20%**

Provide Novel Products At Highly Competitive Costs

* Efficiencies up to **50%** above SotA
* Volume reductions reaching **30%** of SotA

Digitalisation As Key Enabler - Advancements On All Levels

* Enhanced power electronic products - more flexibility and functionality

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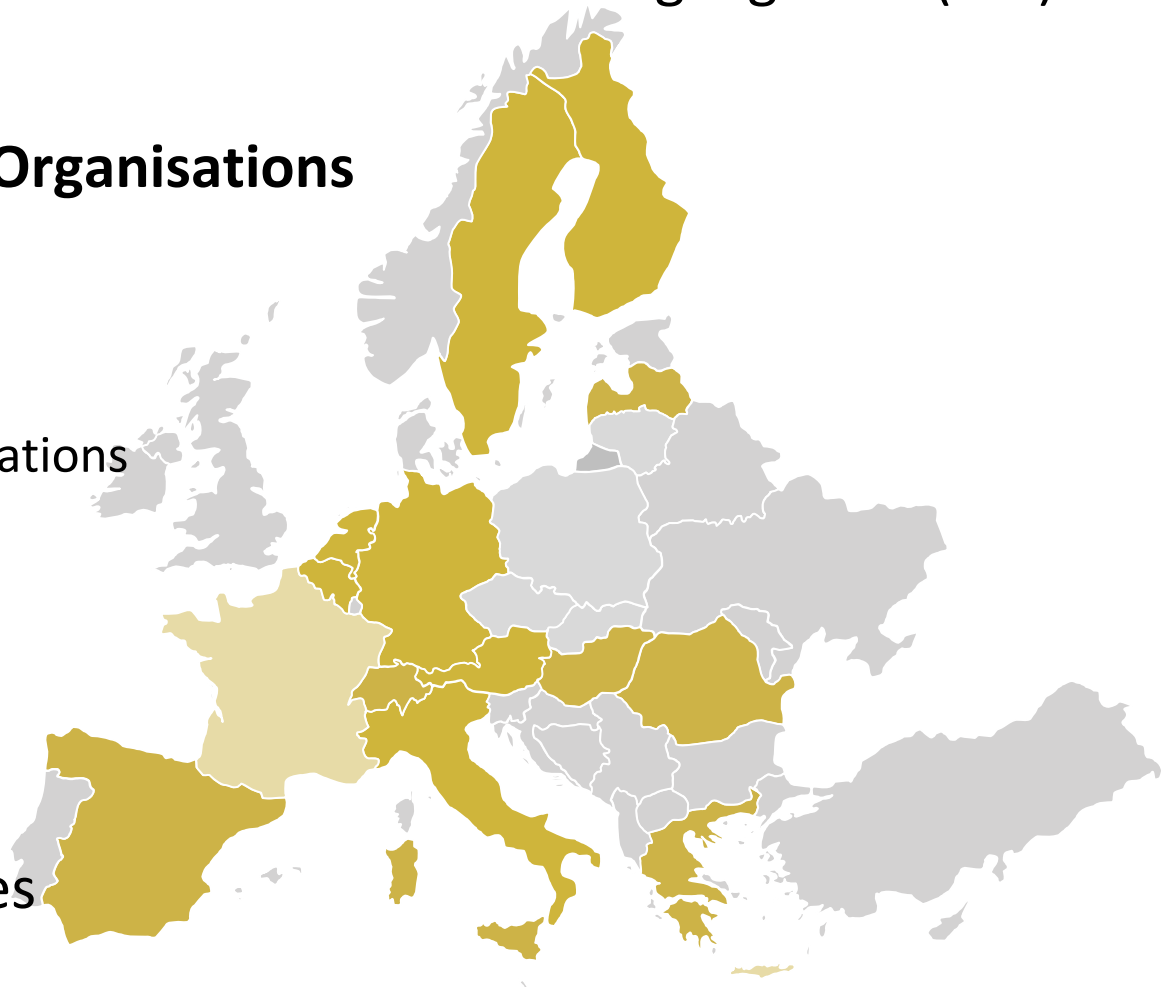
Overview **Framework, Timeline, Figures**

Horizon Europe KDT Call 2021-1; Innovation Action addressing high TRL (5-8)

- Runtime **01.01.2023 – 31.12.2025**
- Large action, merging **61 Partner Organisations** from **13 European Countries**
  - 21 Large Entities
  - 17 Small and Medium Enterprises
  - 23 Research and Innovation Organisations



- Total Effort: 7111 Person Months
- Total Budget EU: € 72.752.838
- EU Funding: €18.333.394, doubled by the national authorities

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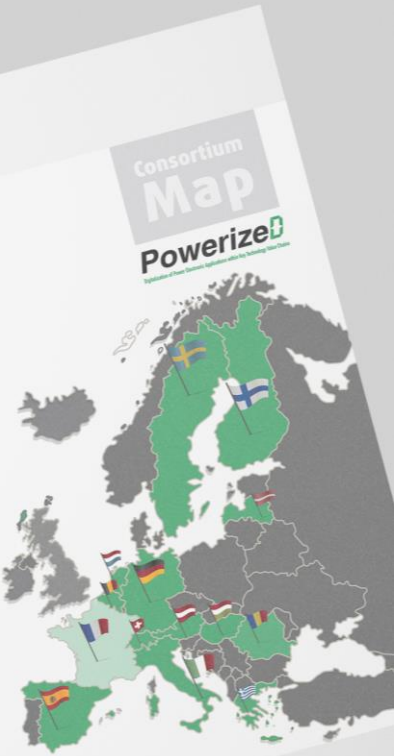

PowerizeD Consortium Map

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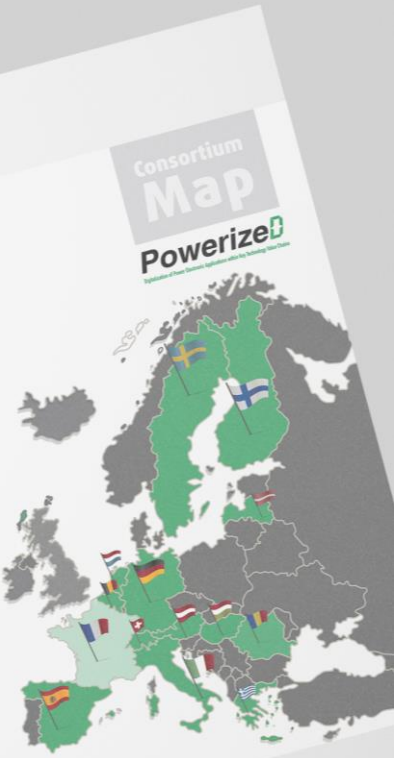
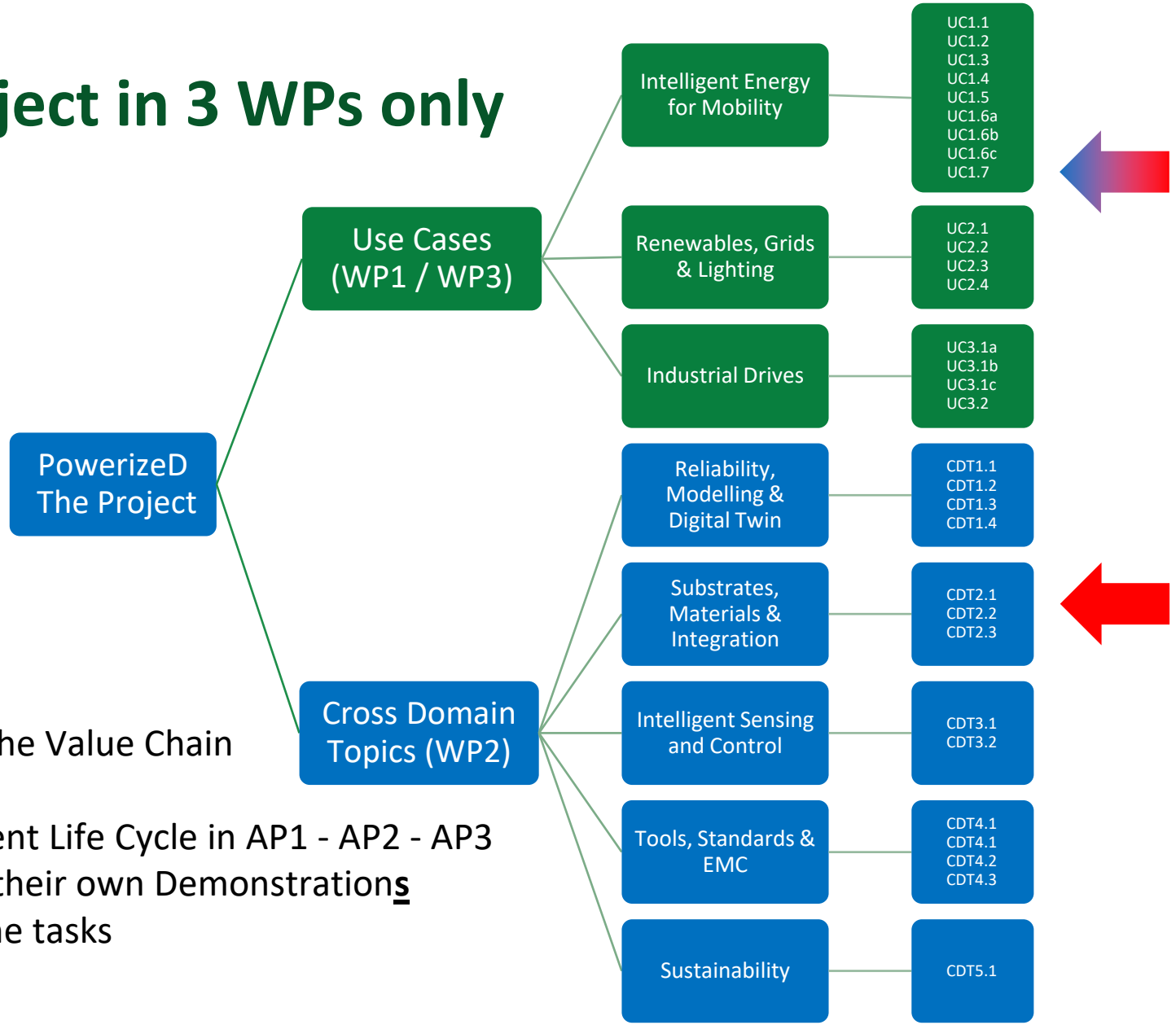


The whole Project in 3 WPs only



From Top to Bottom

- Development along the Value Chain within the UCs
- Along the Development Life Cycle in AP1 - AP2 - AP3
- **Each** Level results in their own Demonstration**s**
- Story telling within the tasks

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Application Areas, Domains & Use Cases

ECS KEY APPLICATION AREAS

- **Mobility**
- **Energy**

DOMAINS

- **Traction Industry**
- **Automotive Industry**
- **Energy Storage**
- **Energy Generation, and Usage**
- **Industrial Market**

USE CASES
UC#, Title

- **UC1.1** Railway Propulsion Systems
- **UC1.2** PEBB[1] for Traction Converters
- **UC1.3** PEBB[1] for DC/DC Converters
- **UC1.4** BE Drive Inverter for High Voltage
- **UC1.5** FCEV- Fuel Cell and PT Inverter
- **UC1.6a-c** Charger Systems
- **UC1.7** System of Systems
- **UC2.1** Flow Battery Power Electronics
- **UC2.2** PE for Green Hydrogen
- **UC2.3** LV DC Distribution Grid and LED Lighting
- **UC2.4** Home & mobile PV with storage
- **UC3.1a-c** Industrial Drives
- **UC3.2** Hyper-sensorised Digital Drive

- Development along the Value Chain within the UCs
- Along the Development Life Cycle in AP1 - AP2 - AP3
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[1] Power Electronic Building Block

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Cross Domain Topics for Technology Development

Themes	Cross Domain Topics
Reliability, Modelling & Digital Twins	• CDT1.1 - Reliabilty • CDT1.2 - Modelling • CDT1.3 - Digital Twin • CDT1.4 - Federated Learning
Substrates, Materials & Integration	• CDT2.1 - Substrates • CDT2.2 - Materials • CDT2.3 - Integration
Intelligent Sensing and Control	• CDT3.1 - SW-related Control approaches • CDT3.2 - HW-related Sensing and Control approaches
Tools & Standards	• CDT4.1 - HW Tools • CDT4.2 - SW Tools • CDT4.3 - Measurement Equipment and Standards • CDT4.4 - EMC Prediction & Design Optimisation
Sustainability	• CDT5.1 - Sustainability - Comparison of Environmental Impacts

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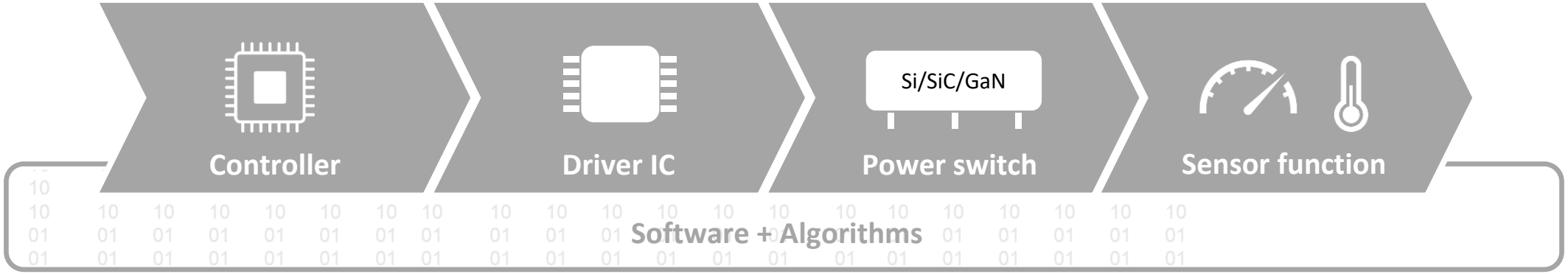
Power Systems It´s all about Intelligence



„I have a dream, where ….“

- Analogue Power Electronics become Digital
- Limiting borders disappear or are shifted

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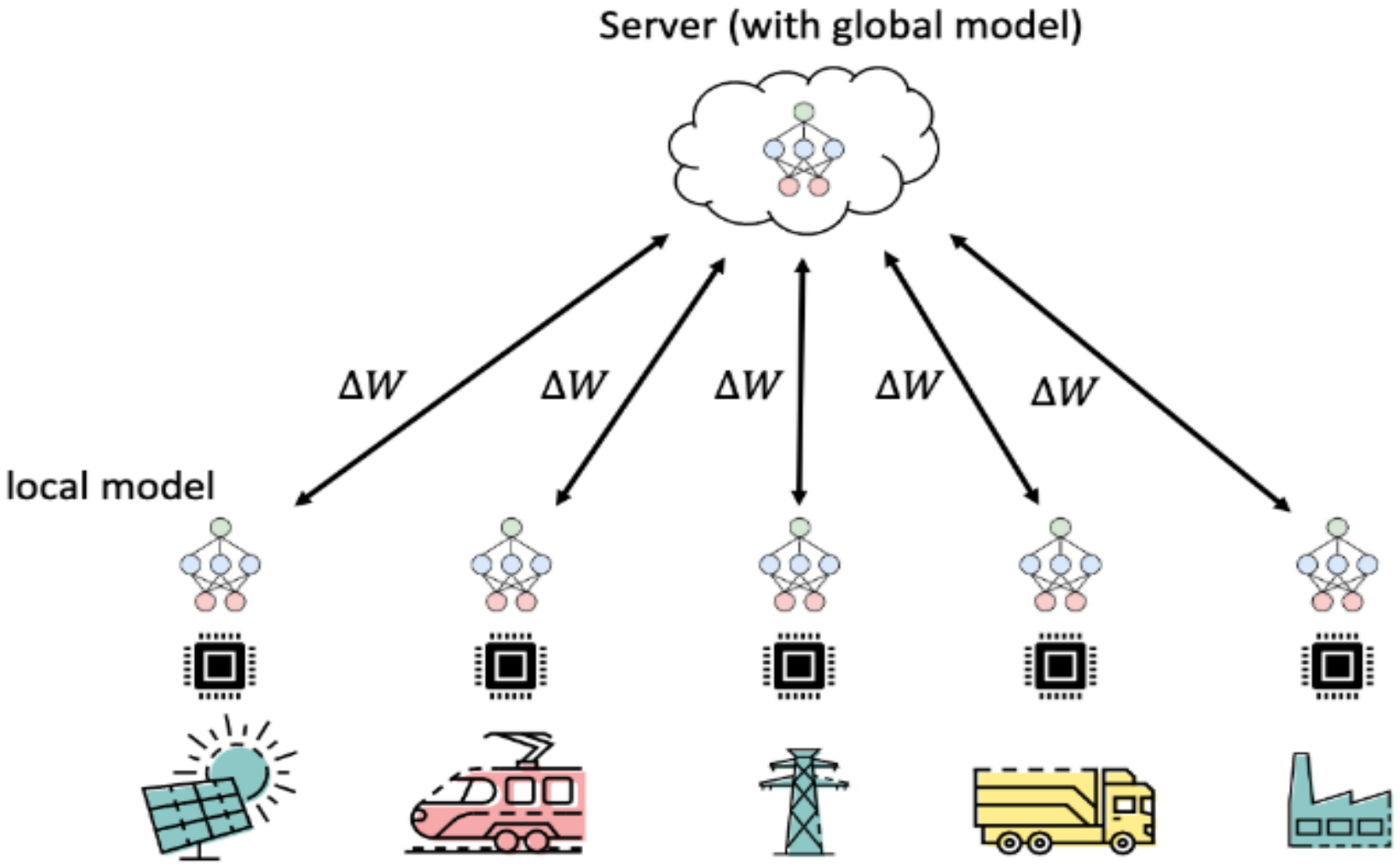
Sharing Knowledge

Federated Learning to overcome Big Data



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Summary and Message from the Powerize*D* Coordinator

- **Exchange and optimisation of models and digital twins, but not of confidential data.**

- ***PowerizeD***
  - digitalise the analogue power electronics
  - from devices up to the systems.

CDT2.1
Substrates

Partners

- University of Bologna
- Infineon AG
- Serigroup
- Berlin Nanotest
- EK
- BME
- ETH Zurich

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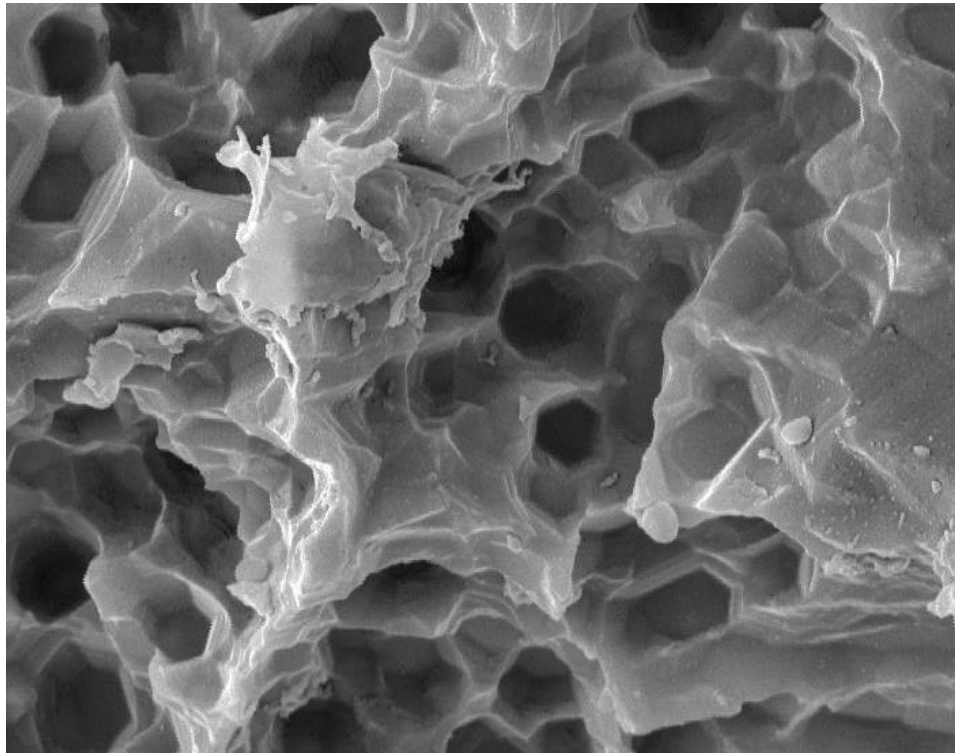
Focus on IMS substrates



- Epoxy + micro-sized ceramic particles

- Pros
  - Cheaper
  - More flexible
  - Multi-layer systems

- Cons
  - Lower thermal conductivity
  - Aging?
  - Other?

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Materials

Reference

- Al_2O_3
- SiN

Candidate IMS Manufacturers

- At present, I cannot share this info, sorry

Silicone gel

Tests

Aging

- Thermal
- Thermal + high humidity

Dielectric characterization

- Dielectric spectroscopy
- Space charge accumulation (PEA Technique)
- Conductivity
- Breakdown voltage
  - AC, AC+DC
- Partial Discharge Inception Voltage
  - AC, AC+DC

Thermal characterization

- In-plane conductivity
- Out-of-plane conductivity
- Discrete devices

Dielectric spectroscopy

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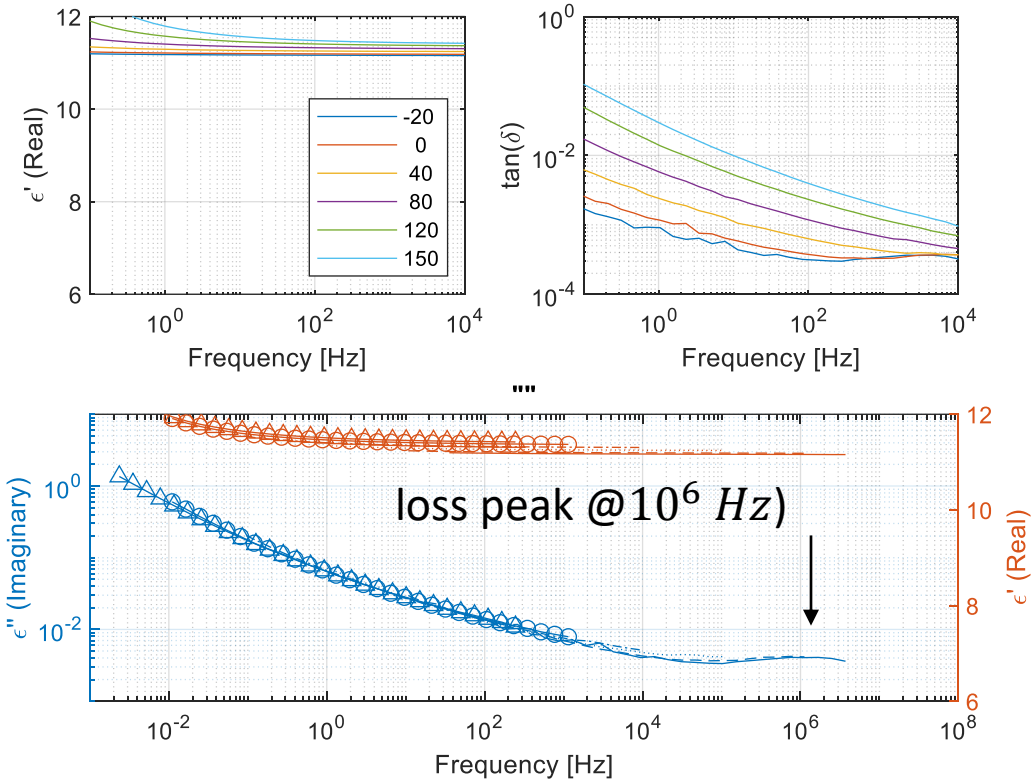
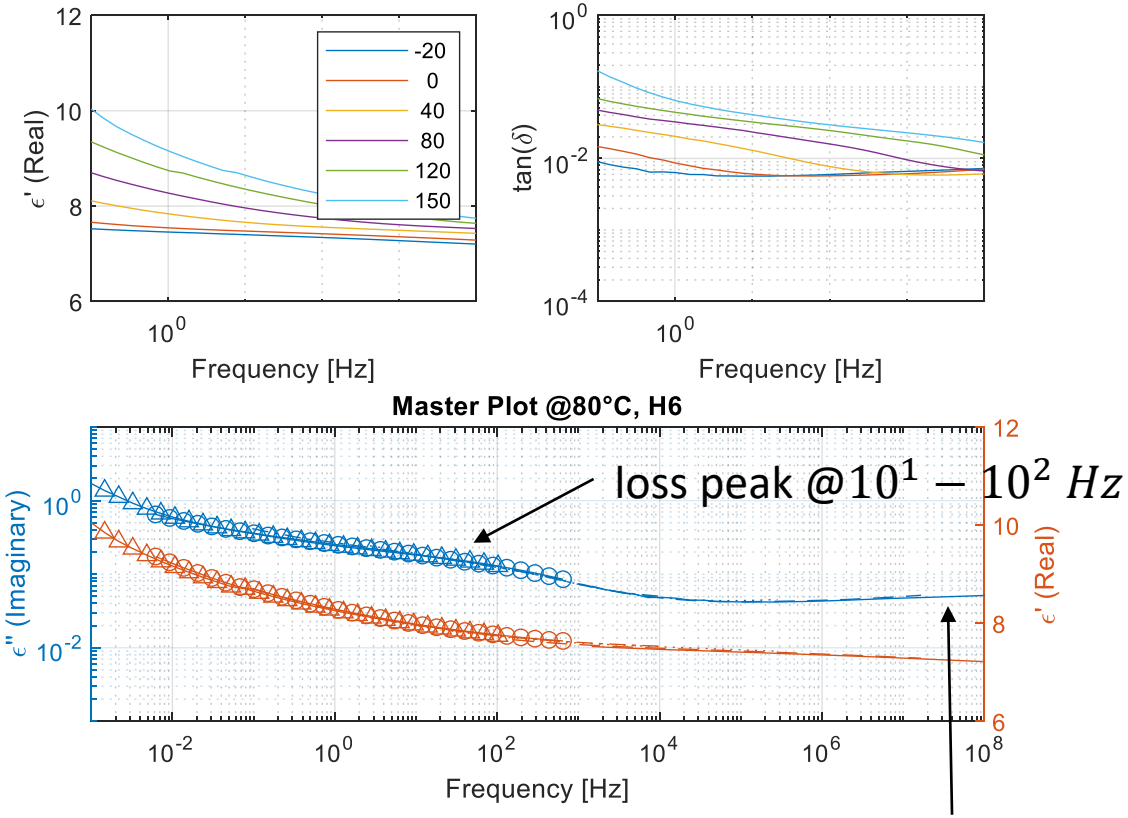
Dielectric spectroscopy

Al_2O_3



IMS



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Space charge

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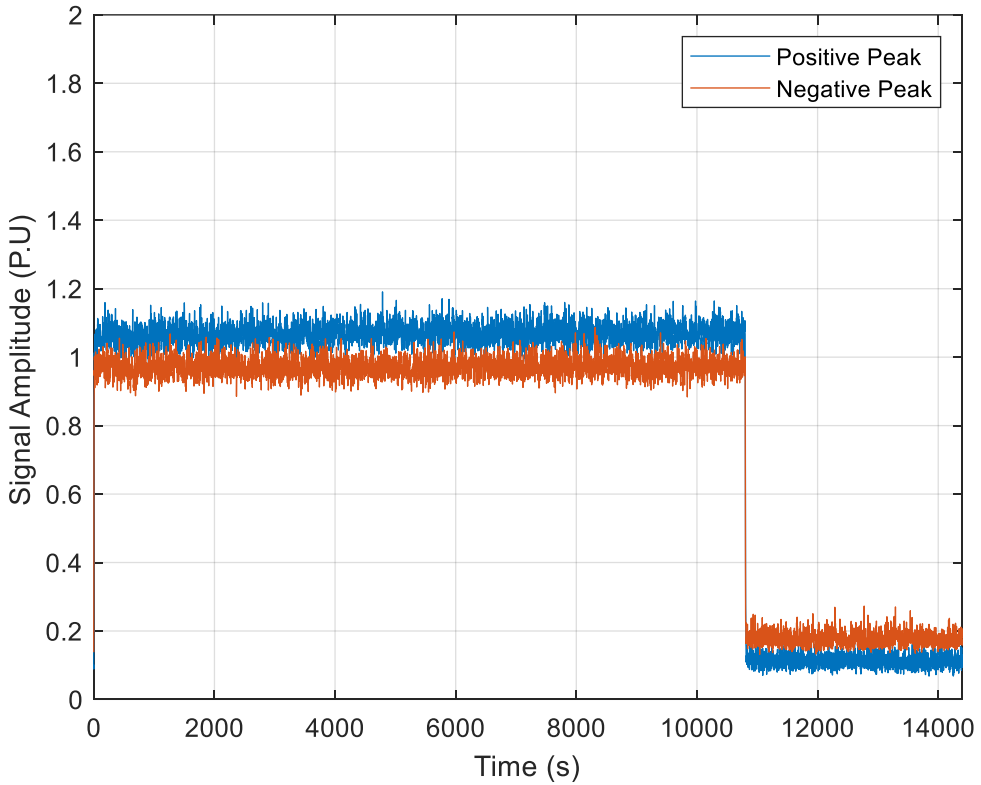
Space charge (10 kV/mm)

Al_2O_3



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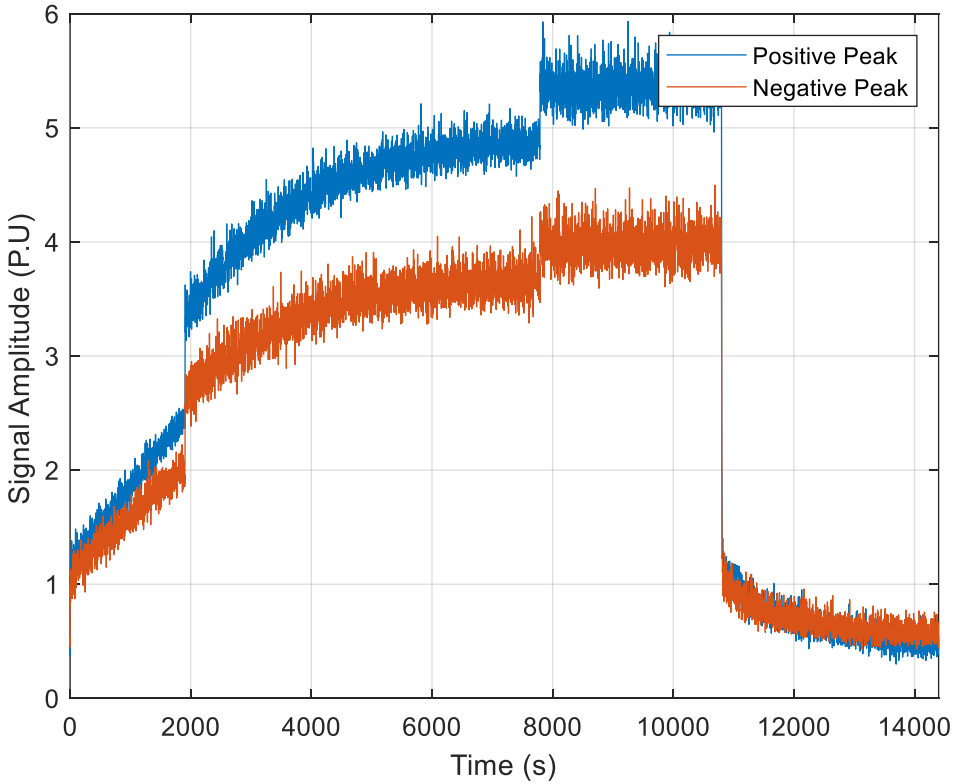

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