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Exploring AME

From Concept to Qualified Product

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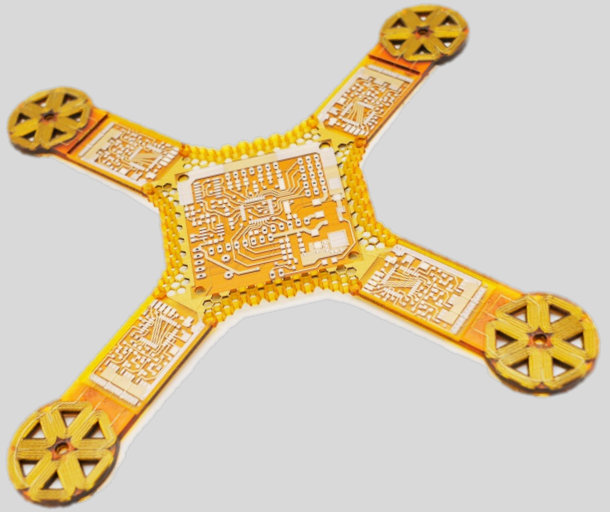
01 System Design Overview



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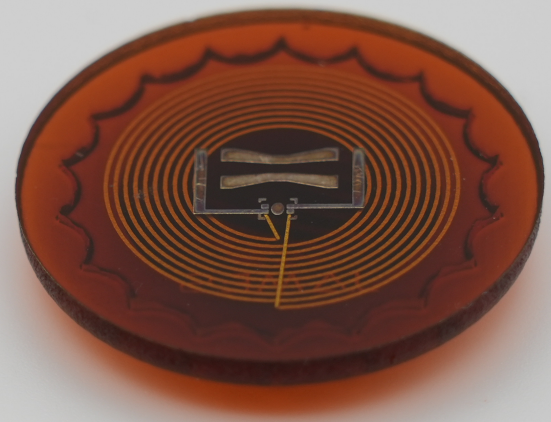
- System Design/Architecture (by CONOPS, the concept of operations): Providing a service (use case)
- Fixed system elements requirements:
    - Electrical performance parameters (relevant for specified service)
    - Mechanical performance (extracted from CONOPS needs)
    - Thermal parameters (extracted from CONOPS and driven by system internal hotspots)
    - Environmental parameters (driven by CONOPS and platform)
- Safety aspects (e.g. medical use; flying equipment; MIL)
- Cost aspects
- Logistic Aspects (maintenance concept/time to repair / obsolescence management -> time and efforts to make a system run again)
- Strategic Benefits: The more cost-effective service provided in a given space, the better!
    - Miniaturization/lightweight/performance/cost

02 SMART System Design with AM(E)

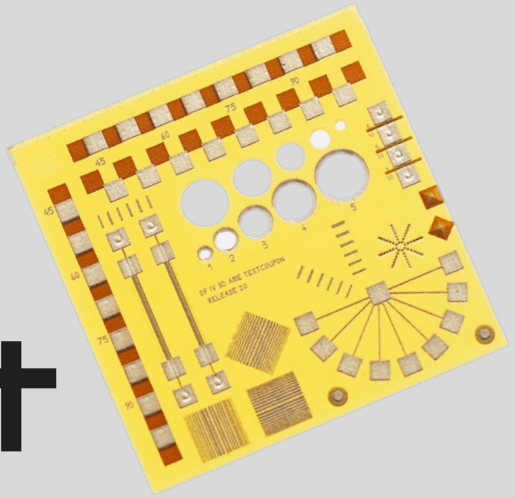
- System Design / Architecture (by CONOPS, the concept of operations): Providing a service (use case)
  - Utilizing relevant technologies and manufacturing methods that meet the requirement.

    Examples: COTs elements, new semiconductor technology, new electronic design, etc.

    Determining if providing the specified service is feasible.
- Increasing relevance of AM in mechanical production
  - Enabling high complex form factors, lightweight design, eco-efficiency, and improved performance. This trend is unavoidable.
- AME still falls short of expectations and demands
  - Challenges in achieving functionalized form factors, lightweight design, and full performance in a single step
- SMART System Designs leverage additive constraints to meet requirements
  - Adapting different system elements, materials, and processes to preform the service
  - Optimizing material performance and process for the best outcome



03 J.A.M.E.S Vision of AME Environment



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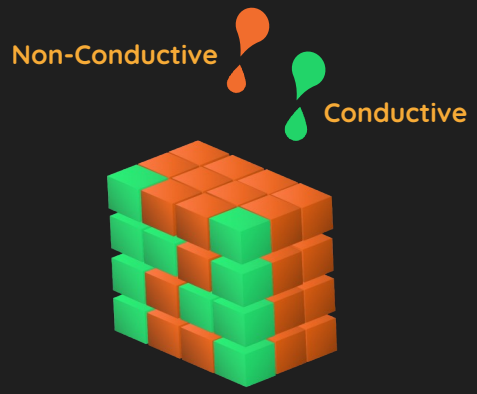


AME material portfolio

Design abilities

- Electronical and mechanical functionality
- eCAD & mCAD
- Simulation tools

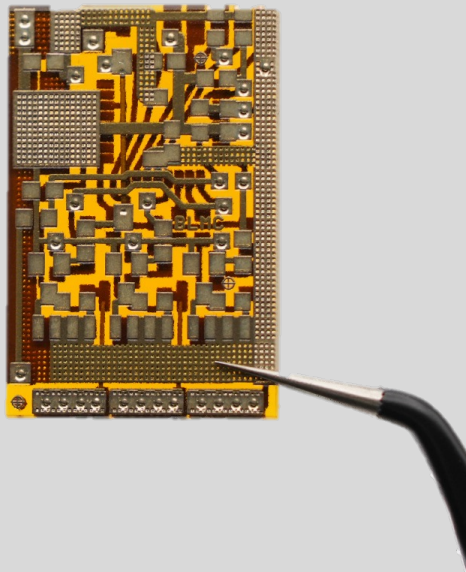
AME processes & 3D printer facilities

- Process combinations
- Suitable to fit requirements
- Reproducibility

New AME products

- Combination of different materials and AME processes
- Increased technology readiness level
- Long term stability
- Fitting to the needs

04 Bringing 3D-Printed Electronics to Product Level



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Needs for production

- AME design (digital twin)
- Printer facility
- Machine & Process (reproducibility)
- Material
- Process handling (design processing -> realization output)
- Verification/Test & documentation
- Shipping AME-Part for product use
- Ready for Verification Test in System

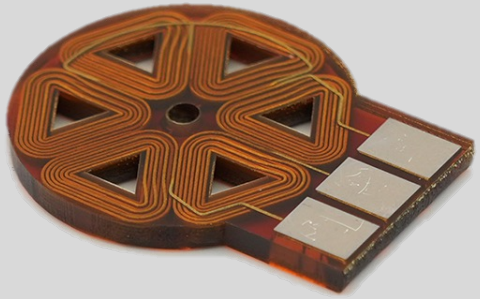
Qualification Demands

- ✓ 3D-Design simulated by knowing the AME-Process
- ✓ Available
- ✓ Reproducibility verified
- ✓ Full parametrized
- ✓ Stable and verified
- ✓ Verified by test specification and test protocol
- ✓ Established

Additional

- Permanent quality check by Test Coupons

05 Ensuring AME Parts-Producibility for the Long Term



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Handling with New Machines Materials Processes

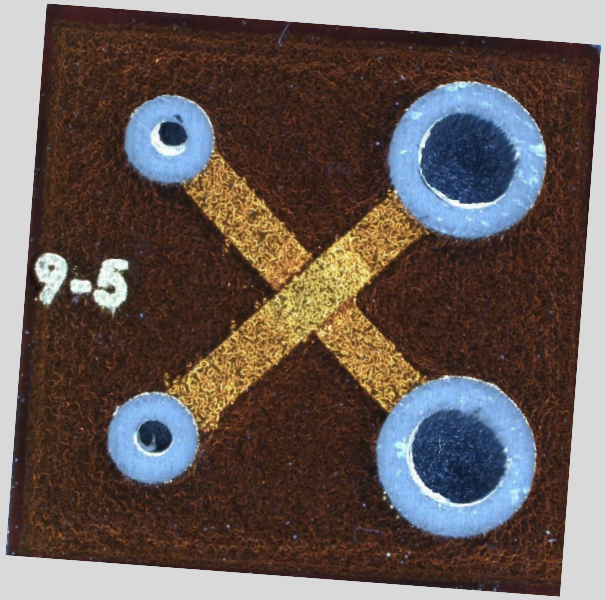
Producibility of the existing design with

- New printer generation and process
- Newly available material

Ensuring the realization of digital AME-Design while

- Maintaining or improving original requirements through verification tests by the test specification
- Ensuring stable and verified process through verification of reproducibility

06 Showcase Application: AME Inlay



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AM/AME Preparations

- Antenna Design simulation for AM-Bare Metal and AME-Inlay (including fallback)

- Fast prototyping
- Optimized for lightweight
- Optimized for RF performance
- Optimized for easy assembly
- Early demonstrator

Handover to Project

- RF Simulation Data
- Optimization Support
- Test Demonstrator

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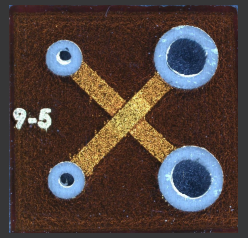

- AME Consultant
- Early-stage Functionality Test Samples Provider
- Moderator between Industry Needs and Process Stability Issues for PO Nano Dimension

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Performance Test & Verification

- ✓ Antenna RF Test
- ✓ Chemical / Environmental Tests
- ✓ Assembly Optimization
- ✓ Additional Samples
- ✓ Coating Analysis for Additional Stability
- ✓ Test Specification (EDO)

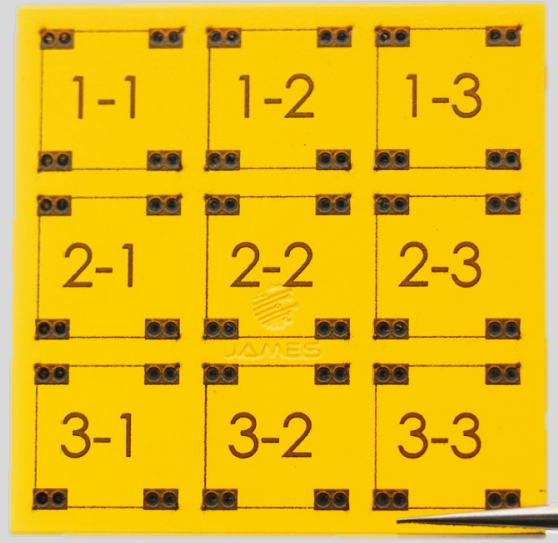
- RoHS conformity of AME Inlay
- Documentation: Test Reports
- Test specification support
- Design of AME Test Coupons for reproducibility checks

Certified AME Parts Manufacturing

- Project risk mitigation prioritizes PCB fallback.
- Certification for quality: Is it needed?
- AME-Part as a second source for traditional PCB with a certificate...

- Supporting steps of qualification needs with purchase orders.

07 AME Outlook



- Challenges in qualifying 3D-printed electronics at the product level
- Additional steps for verifying AME reproducibility and stability, approved by process owners and printer manufacturers
- Integration of AME into system design
- Establishing an independent manufacturing source for risk mitigation and obsolescence
- Exploring norming and standardization (e.g., IPC) in the industry
- Collaboration among industry printed electronic designers, and 3D-printed electronic suppliers for achieving product-level AME (TRL9)

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