Airbus Crisa

MVPCU Innovative COTS Based PCU Solution for Telecommunications Market

CRISA

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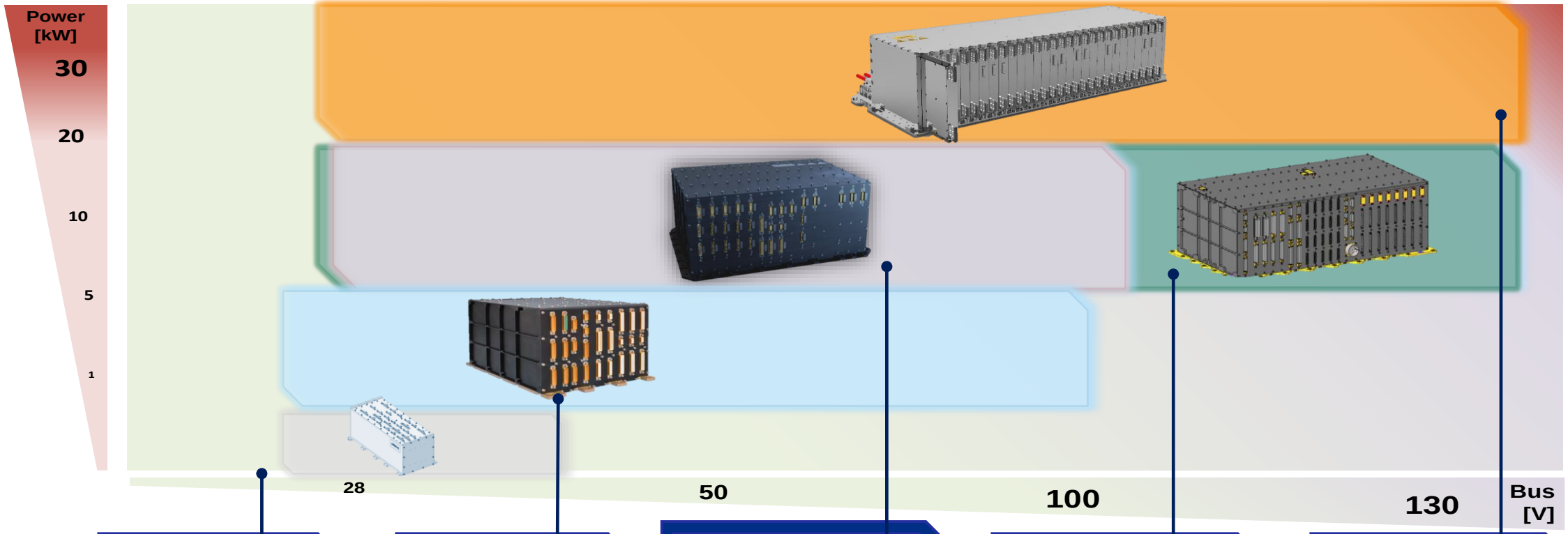
Airbus Crisa PCDU Portfolio



MEGA PCDU

- Unregulated 22-38V Bus
- 2 to 4kW power
- DET Si
- Distribution: Heaters / LCL / Fuses / Motor Drivers / Low Voltage

EVO PCDU

- Unregulated 22-37V Bus
- 0,5 to 4kW power
- DET si
- MPPT Si / MPPT GaN
- Distribution: Heaters / LCL / Deployment

MVPCU

- **Multi-voltage unit**
- **Regulated 100 V**
- **Regulated Secondaries**
- 8 kW **to 22 kW** power
- DET **GaN**
- **Digital control**

EVO HP PCDU

- Regulated 120V Bus
- Regulated Secondary Bus
- Unregulated Battery Bus
- DET GaN
- Distribution: Heater / LCL / Deployment / High Current LCLs

GHPS PCDU

- Regulated 120V Bus
- Isolated Secondary 120V and 28V Buses
- Up to 32kW power
- Distribution: Heaters / LCL / High Current active LCL / Return switches

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MultiVoltage Power Conditioning Unit (MVPCU): Pioneering New Space

- Up to **26 kW** in up to **3 power buses**:
  - High Power Bus (**HPB**) : regulated **100 V**
  - Regulated Secondary Bus (**RSB**) : up to **2 step down** buses
- **LEO**, **MEO**, **GEO** missions
- **High frequency S3R** solar array conditioning
- **MIL-STD-1553**
- **Li-Ion** battery management
- Based on **State of the art technologies:**
  - ✓ **GaN**
  - ✓ **Digital** control
  - ✓ Extensive use of **COTS**

- **Flight Qualified Unit**
- **26 kW FMs under recurrent production**

x2 Power Density

-50% Mass Volume

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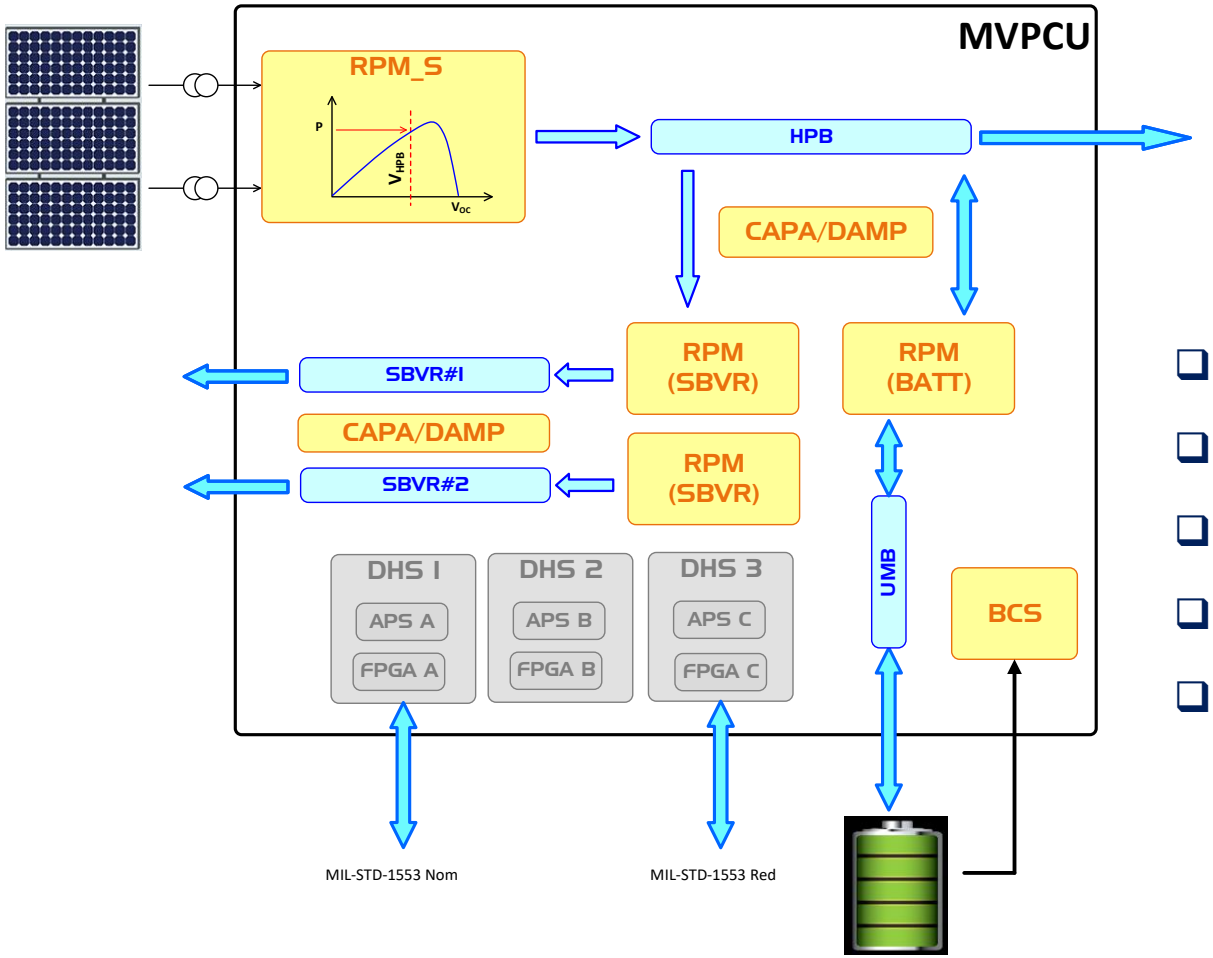
MVPCU Architecture



- **RPS_S :** Solar Array Reversible Power Module (RPM)
- **RPM (SBVR) :** RPM for Secondary Bus Voltage Regulator Module
- **RPM (BATT) :** RPM for Battery Module
- **BCS** : Battery Scanner Module
- **CAPA/DAMP :** Bus/Damping capacitance

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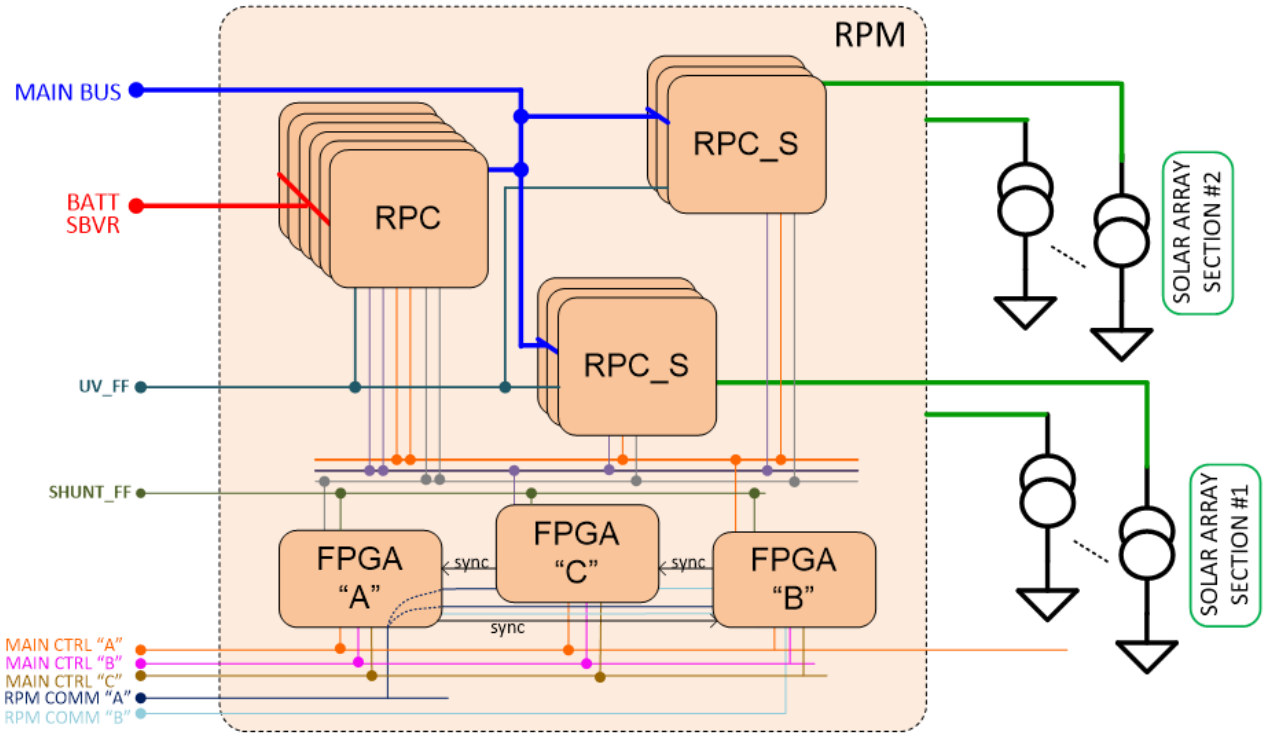
Reversible Power Module (RPM) Capabilities



Digital controlled **GaN** based step-up/step-down **DC/DC** reversible power converters (**RPC**) module able to generate **up to 3 power buses**

RPM Performances	
Number of DCDCs	12
Number of FPGAs	3
Groups of DCDC converters	x6 RPC for SBVR/Battery x3 RPC for Solar Array x3 RPC for Solar Array
Max. Output Current per RPC Converter	+/-6 A NOTE1
Failure mode	Maximum 2 DCDCs
SA Characteristics	
Number of SA sections	2
Maximum section Isc	23A (27A during 30 mins)
Maximum section Voc	135V (limited by DET operation)
SA capacitance Range	0 uF – 3 uF
SA inductance Range	0 µH – 2.7 uH
SA Resistance Range	0 mΩ – 800 mΩ

NOTE1: Output current depends on mission profile

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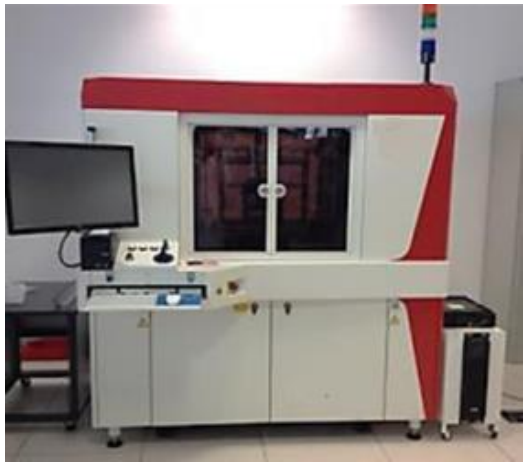
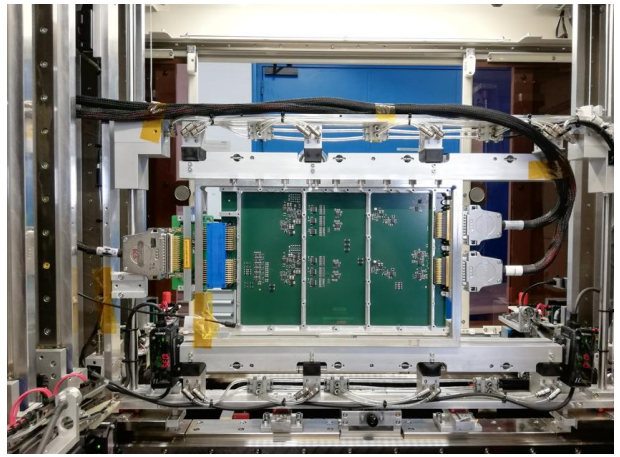
Industrial approach

- Board **acceptance** tests are performed with an **automatic board testing**.
- **Major advantages**:
  - ✓ Reduction of Test Duration (<6h)
  - ✓ Mitigation of Human Errors
  - ✓ Increase of Test Coverage
- **Reducing unit lead times**

Automatic Board Testing Machine





Airbus Crisa Launchers and Next Space (LNS) production line

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Enhanced features thanks to digital control

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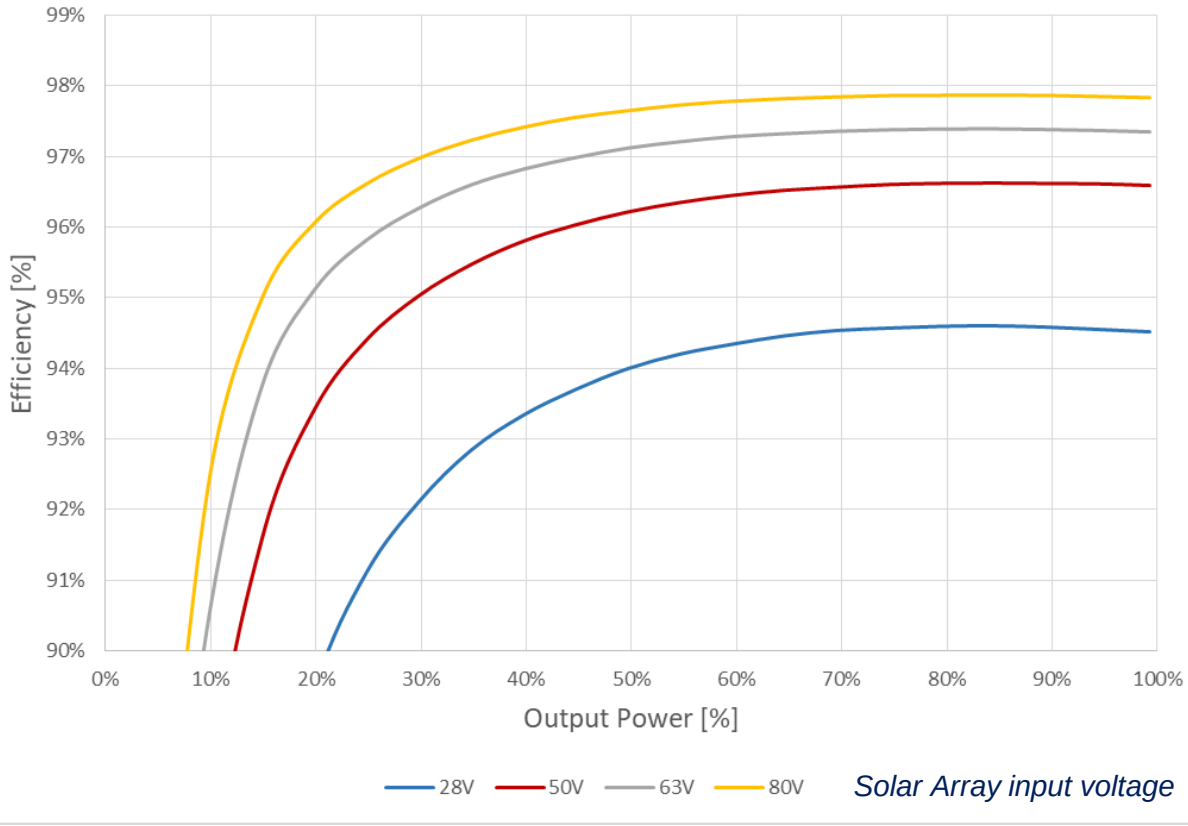
RPC power efficiency

- RPC **efficiency** improved using **GaN** technology.
- **Smart** and innovative packaging for **heat drainage**.
- **x2 power density** [W/mm^3].
- **RPC** (sections connected) efficiency of **99,5%**
- **SBVR/BCDR** mode of **98%** efficiency

Efficiency of the RPC switching cell



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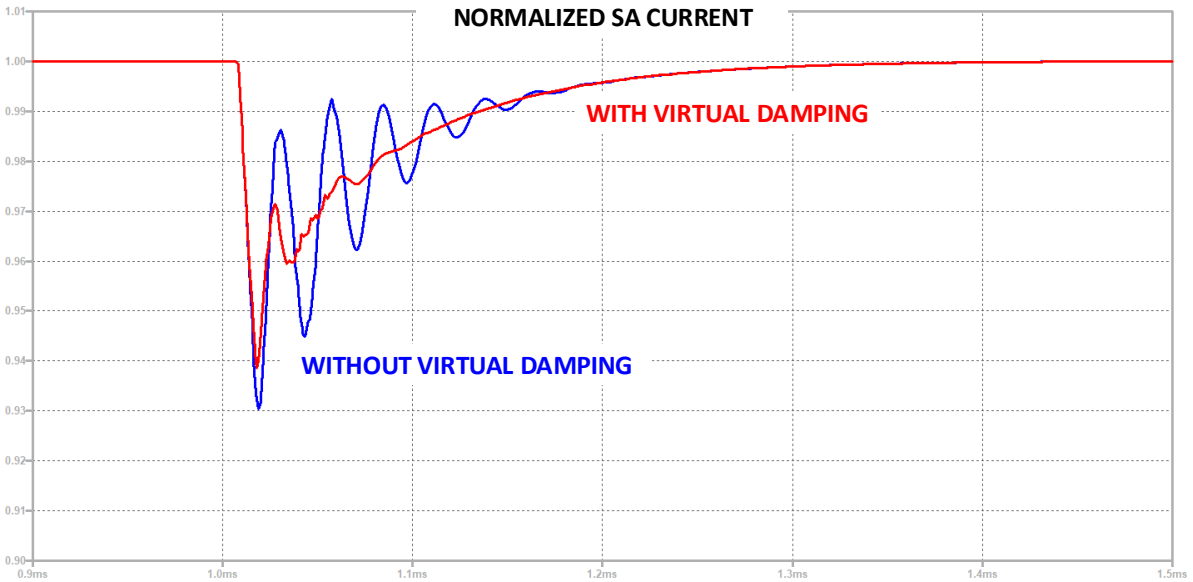
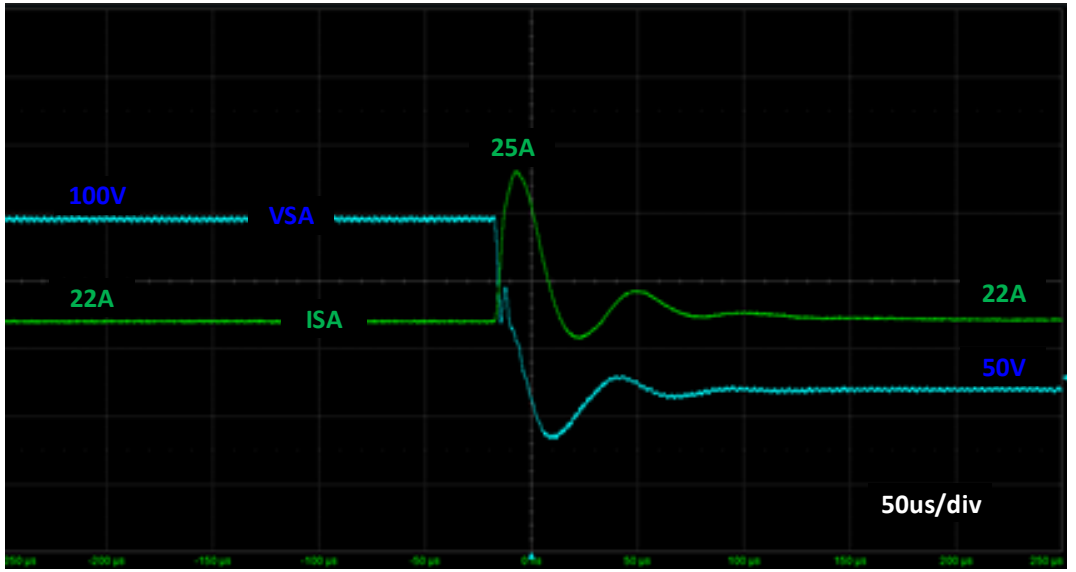
EMC and efficiency performances

- **Digitally controlled virtual damping** to mitigate the oscillations related to resonance between the SA capacitance and the harness inductance in S3R DET systems.



Virtual damping simulation.



Real damping response as a transient from 100V to 50V at SA interface.

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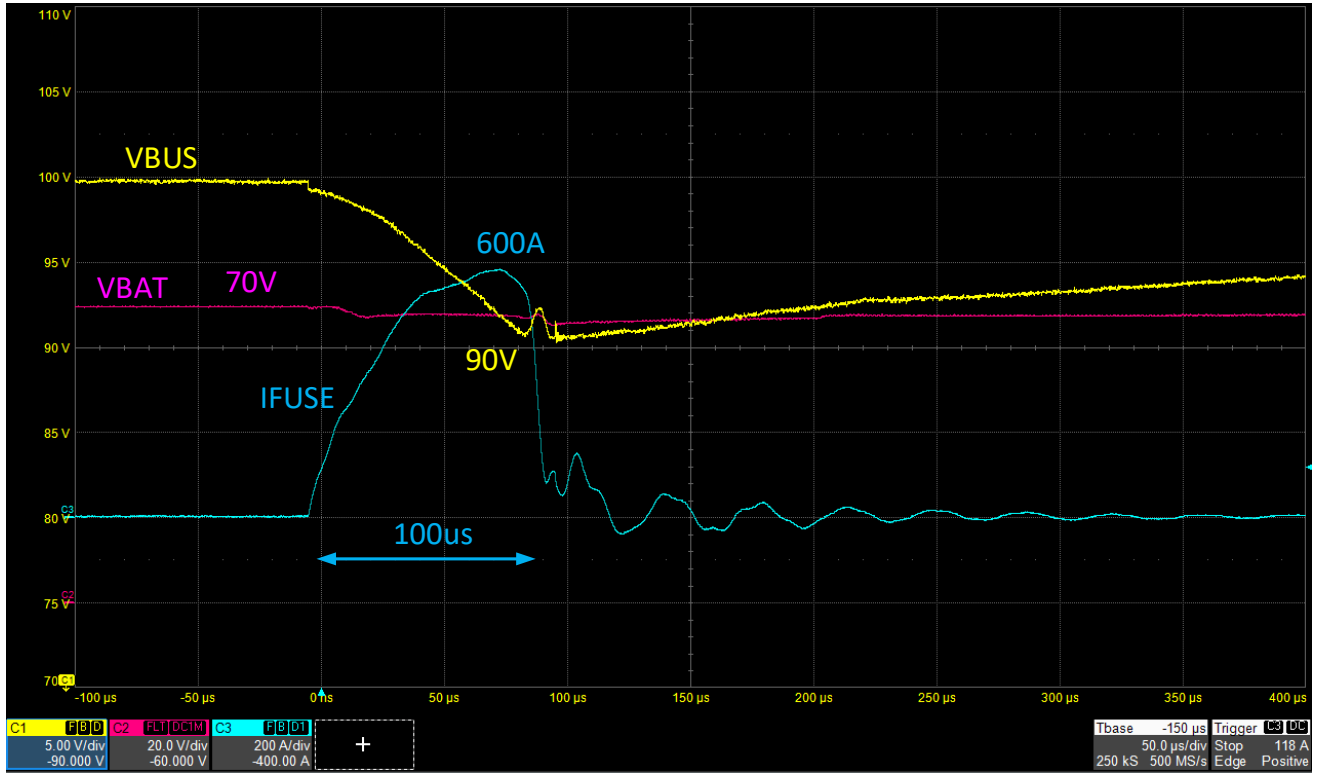
Fuse blowing event digital management

- MVPCU provides enough current to guarantee fuse blowing, this is called **Boost Mode**.
- **Boost Mode increases**, during a limited period of time, the maximum **current** at the output of the RPC converters in case the bus collapses during a fuse blowing event.
- **Anti-windup** feature ensures **over-voltage** of less than *5 % (ECSS-E-ST-20C)*



100 V bus fuse blowing transient event.
Only 10 V voltage drop with a 600 A peak current.

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Conclusion

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MultiVoltage Power Conditioning Unit (MVPCU)

- ❑ **MVPCU** allows to provide **up to 3 regulated power buses**
- ❑ Any voltage between **100 V** and **28 V**
- ❑ **x2** increase of **power density**
- ❑ **High flexibility**

- ✓ **1 kW @ 100V**
- ✓ **3 kW @ 70 V**
- ✓ **2 kW @ 28 V**
- ✓ **21 kg**
- ✓ **308 mm x 380 mm x 209 mm**

- ✓ **17 kW @ 100V**
- ✓ **4 kW @ 28 V**
- ✓ **36 kg**
- ✓ **528 mm x 380 mm x 209 mm**

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MVPCU

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The Power Roadmap

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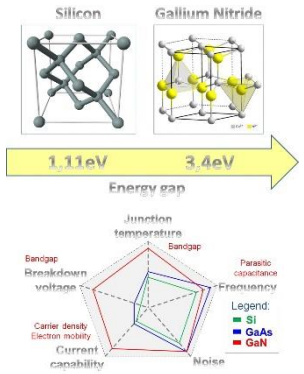
The Power Roadmap

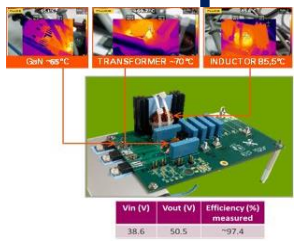
GaN devices continuous improvement

2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024

Learning the physics

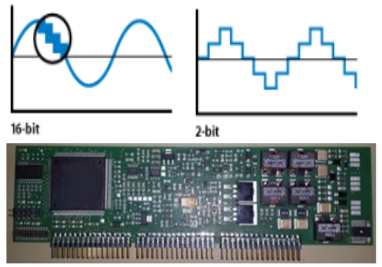


Concept Bread Boarding

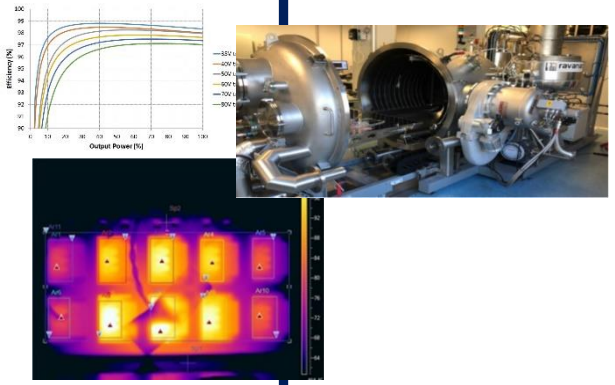


JUICE: Flight Model with Digital Control

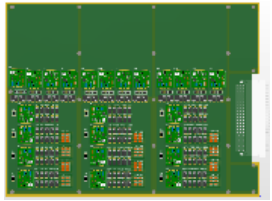
Digital Control Bread boarding



GaN Validation



First GaN flight qualified power conversion module



MVPCU
EVO PCDU
EVO HP PDDU
MVPPU
MVPSU

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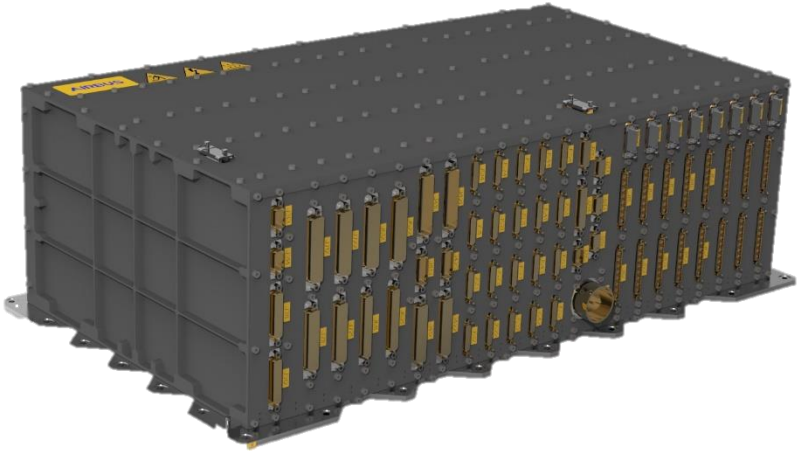
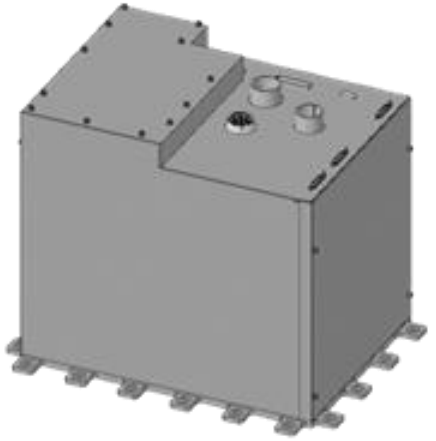
To be presented in SPW2025

EVO HP PCDU



- Power **Conditioning** and **Distribution** Unit for **deep space** and **science missions (MSR-ERO baseline)**
- **Upgraded parts** to classical space requirements
- **Engineering Model** under test

MVPPU



- **M**ulti-**V**oltage **P**ower **P**rocessing **U**nit
- Power electronics for **Electric Propulsion** thrusters
- **High voltage** (2 kV) management
- **High flexibility** for multiple thruster technologies
- **Engineering Model** under test

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Thank You!!!

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the power for Space

MVPPU – Multi-technology PPU for medium and High Power Electric Propulsion

GHPS – generic high power system. The Power Standard for Human Exploration

Launcher electronics

MVPCU – Multivoltage PCDU. COTS & GaN Power revolution for New Generation GEO

MVPPU – Multi-technology PPU for medium and High Power Electric Propulsion

EVO PCDU – Power for Earth Observation & Science

MEGA – main electronics for global access. The Power for the New Space Economy

Solutions for energy conditioning, distribution and electrical propulsion.

A wide range of voltage and power levels.

State of the art technologies: Silicon and GaN, full digital control.

> 2000 years cumulated in orbit.

MVPCU – Multivoltage PCDU. COTS & GaN Power revolution for New Generation GEO

MVPPU – Multi-technology PPU for medium and High Power Electric Propulsion

GHPS – generic high power system. The Power Standard for Human Exploration

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