Elektrische Energieverteilung eines Megawatt-Brennstoffzellen-Hybridantriebs am Projektbeispiel NEWBORN

Fraunhofer Institute for Integrated Systems and Device Technology (IISB), Erlangen, Germany

Deutscher Luft- und Raumfahrtkongress 2026, Aachen, 09.09.2026

Dr.-Ing. Markus Meindl

Fraunhofer IISB – The Power Electronics Institute of the Fraunhofer Gesellschaft

Fraunhofer is one of Europe's leading organization for applied research, with 32,000 employees across 75 institutes.

Fraunhofer Institute for Integrated Systems and Device Technology (IISB)

- Main Location: Erlangen, Germany
- 500+ Employees
- Contact persons: Dr.-Ing. Markus Meindl, Florian Hilpert

Relevant expertise:

- High-Voltage solutions for aviation applications
- Power modules for SiC and GaN power semiconductors
- Reliability and lifetime testing of power electronics
- Isolated DC/DC converters (e.g., 800V → 28V)
- Non-isolated DC/DC converters for fuel cell/battery systems
- Drive inverters (> 100 kW …. 1.5 MW)
- E-motor development and prototypes / 1 MW test bench
- Control of electric drives
- On-board chargers
- Battery systems and battery management systems
- System integration and load management of fuel cell systems/ fuel cell compressors/fuel cell laboratory
- Design and control of DC HV supply networks
- Cryogenic power electronics for superconducting applications

Energy materials and UWBG semiconductor technology; Institute for Applied Physics, TU Freiberg
Prof. Johannes Heitmann

Semiconductor production technology, Institute of Electron Device; FAU-Erlangen-Nürnberg
Prof. Jörg Schulze

Power Electronics Systems, Chair of Power Electronics FAU-Erlangen-Nürnberg
Prof. Martin März

Intelligent Energy Systems; Institute of Electronics for Electrical Storage University of Bayreuth
Prof. Vincent Lorentz

Production Technology Institute of Manufacturing Automation and Production FAU-Erlangen Nürnberg
Prof. Jörg Franke

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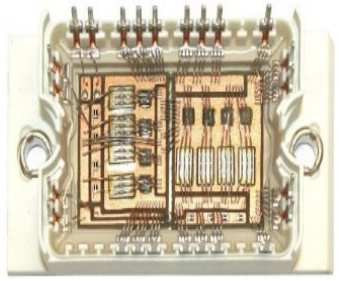
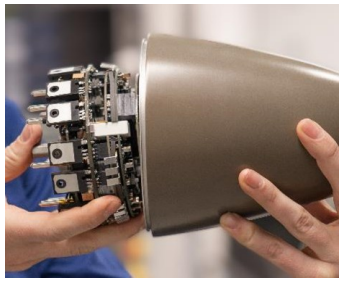
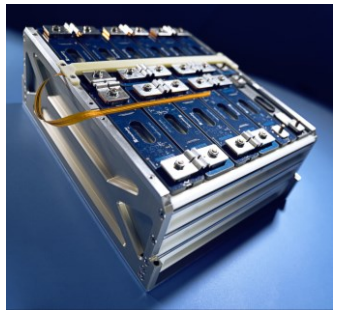
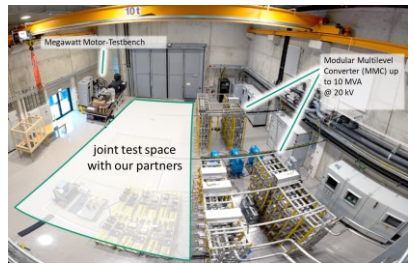
Fraunhofer IISB – Aviation and Space competences

Overview

- PACKAGING & RELIABILITY
  - packaging of power electronics [metal sintering, wire bonding, additive manufacturing, and coating]
  - power cycling and thermal characterization of power modules & systems
  - Lifetime prediction and failure analysis
- POWER ELECTRONICS from some kW to several MW of the highest gravimetric power density
  - Custom-made power electronics for special applications and requirements
  - Multiphase traction drive inverters
  - Isolating and non-isolating DC/DC converters
  - Bidirectional DC/AC inverters for multigrid coupling
- FUEL CELL & HYBRID SYSTEMS
  - Fuel cell system integration
  - Custom fuel cell management system and cell voltage monitoring
  - High-speed air compressors
  - MW-class traction drives [motor-inverter co-simulation environment]
- ENERGY STORAGE AND DC GRID
  - Custom battery systems & battery management
  - DC grid management & control functionalities [junction box, solid state DC breaker, pyro fuses]
- CRYOGENIC POWER ELECTRONICS & DRIVES
  - Cryogenic cooled power electronics for superconducting power distribution & drives
  - Cryo-cooled motor development





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EU-Aviation Projects with Fraunhofer IISB involvement

Clean Sky

Gauging the **EN**vironm**E**ntal **S**ustainability of electr**I**c aircraft **S**ystems

CLEAN AVIATION PHASE 2

2 MW Multi Power train **I**nnov**A**tive for hy**B**rid-**E**lectric **R**egional **A**pplication

Construction of **N**ovel **CER**tification meth**O**ds and means of compliance for disruptive technologies

Hybrid **E**lectric Regional **A**ircraft **D**istribution **T**echnologies

Hybrid-**E**lectric **R**egional **A**rchitecture

Hydrogen Fuel Cell Electric **Po**wer **T**rain **De**monstration

NExt generation high po**W**er fuel cells for air**BORN**e applications

THErmal **MA**nagement **for** the **H**ybrid **E**lectric **R**egional **A**ircraft

Modular, Scalable, and Technology-**O**pen **D**esign for Future **A**viation **BAT**teries

Arc Fault Detection, low EMI and Reliability for **POWER** Electronics in Electric **AIR**crafts

On-board **SY**stems **R**elevant for h**Y**bridization of Regional aircraft**S**

CLEAN AVIATION PHASE 3

CLEAN AVIATION PHASE 4

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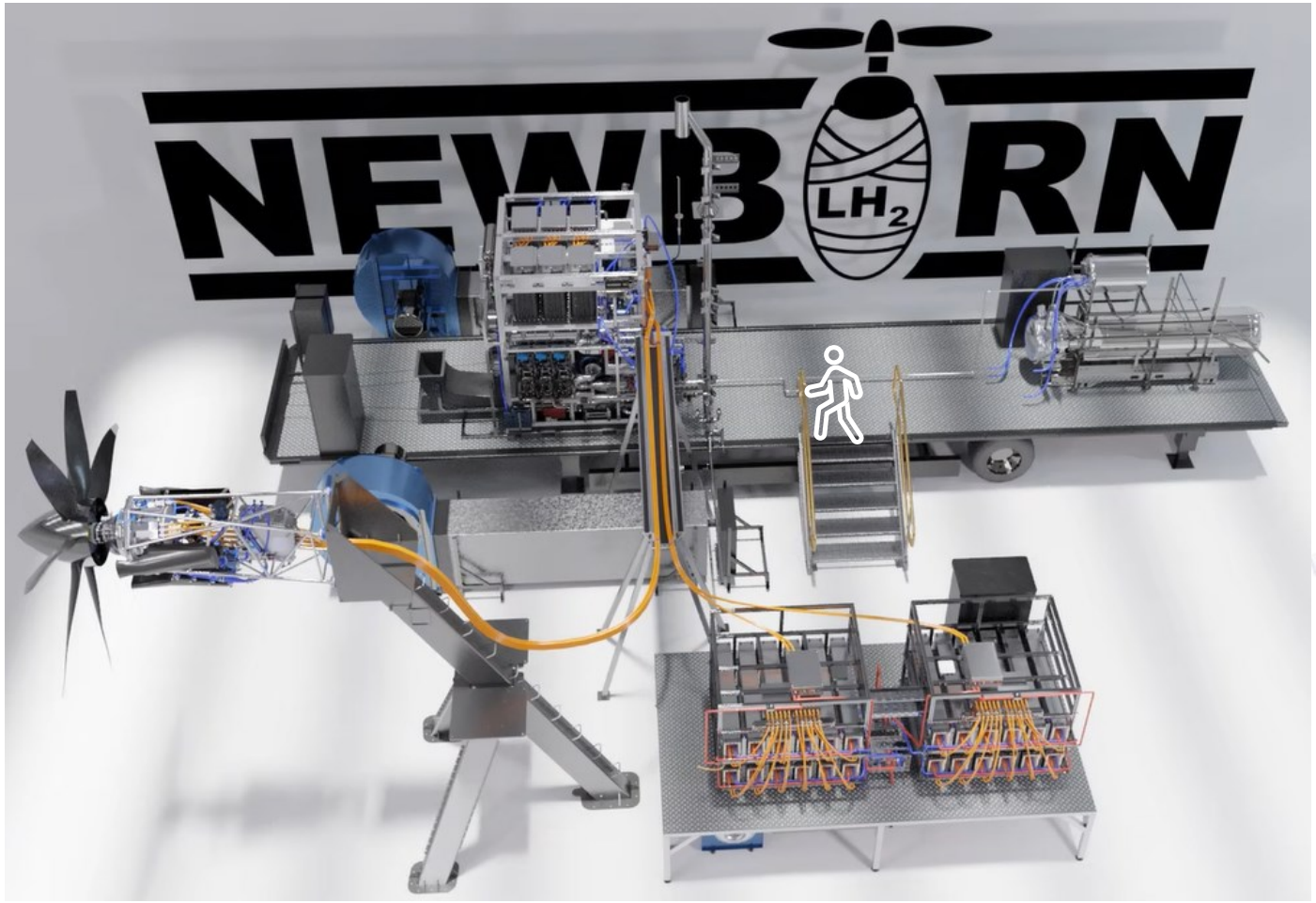
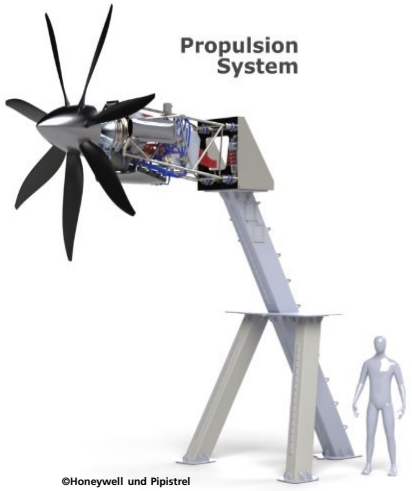
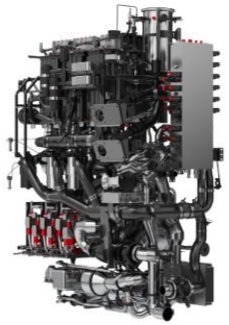
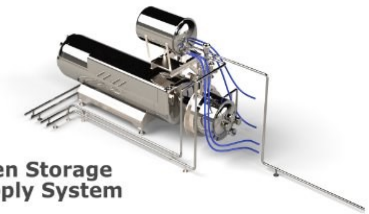
An example: NEWBORN Project

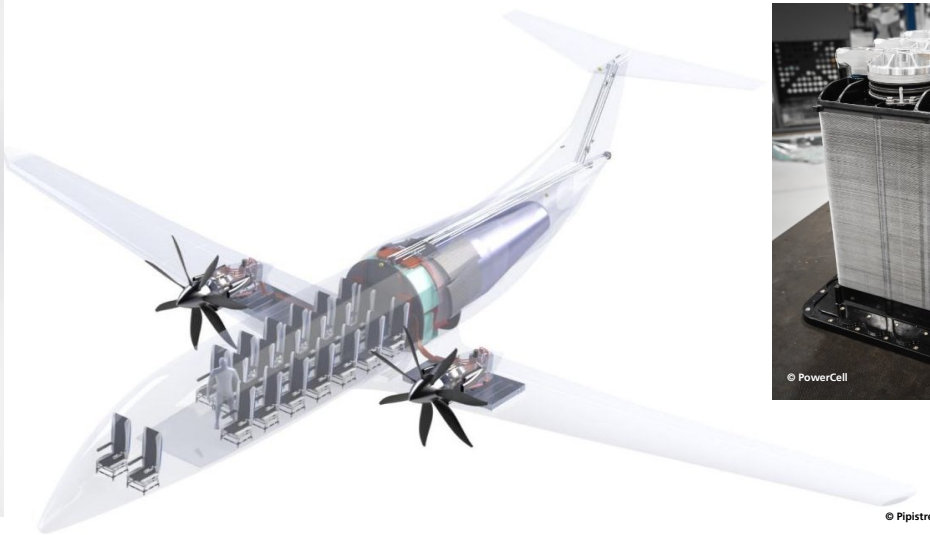
NExt generation high poWer fuel cells for airBORNe applications. Jan 2023 – Dec 2026

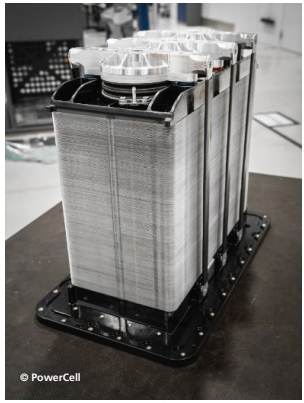






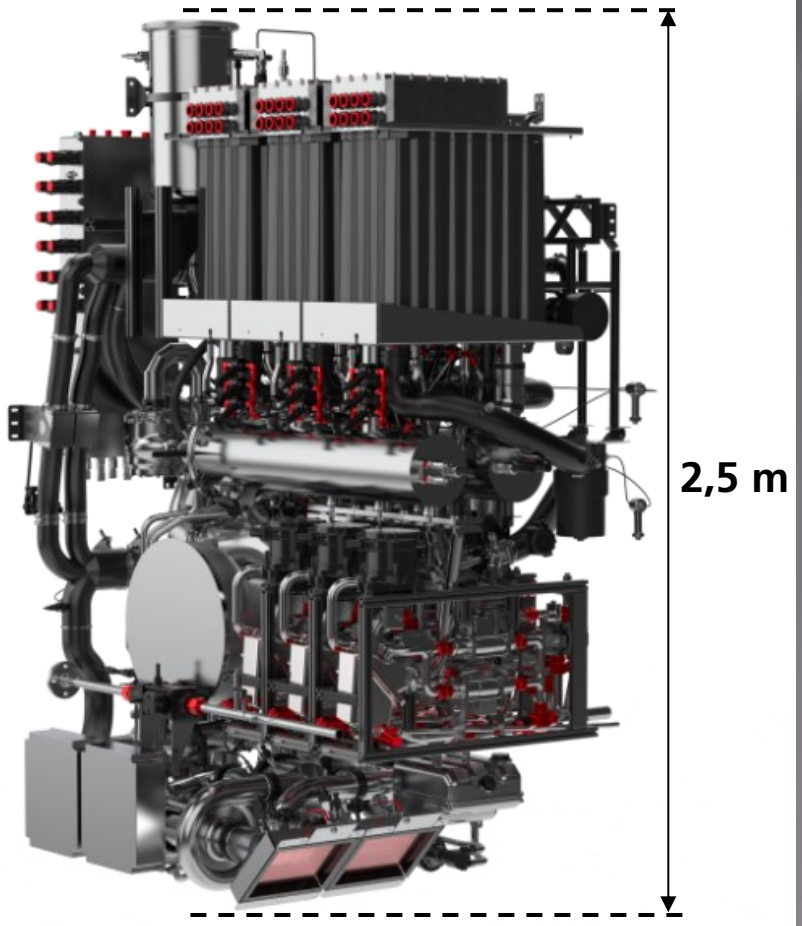


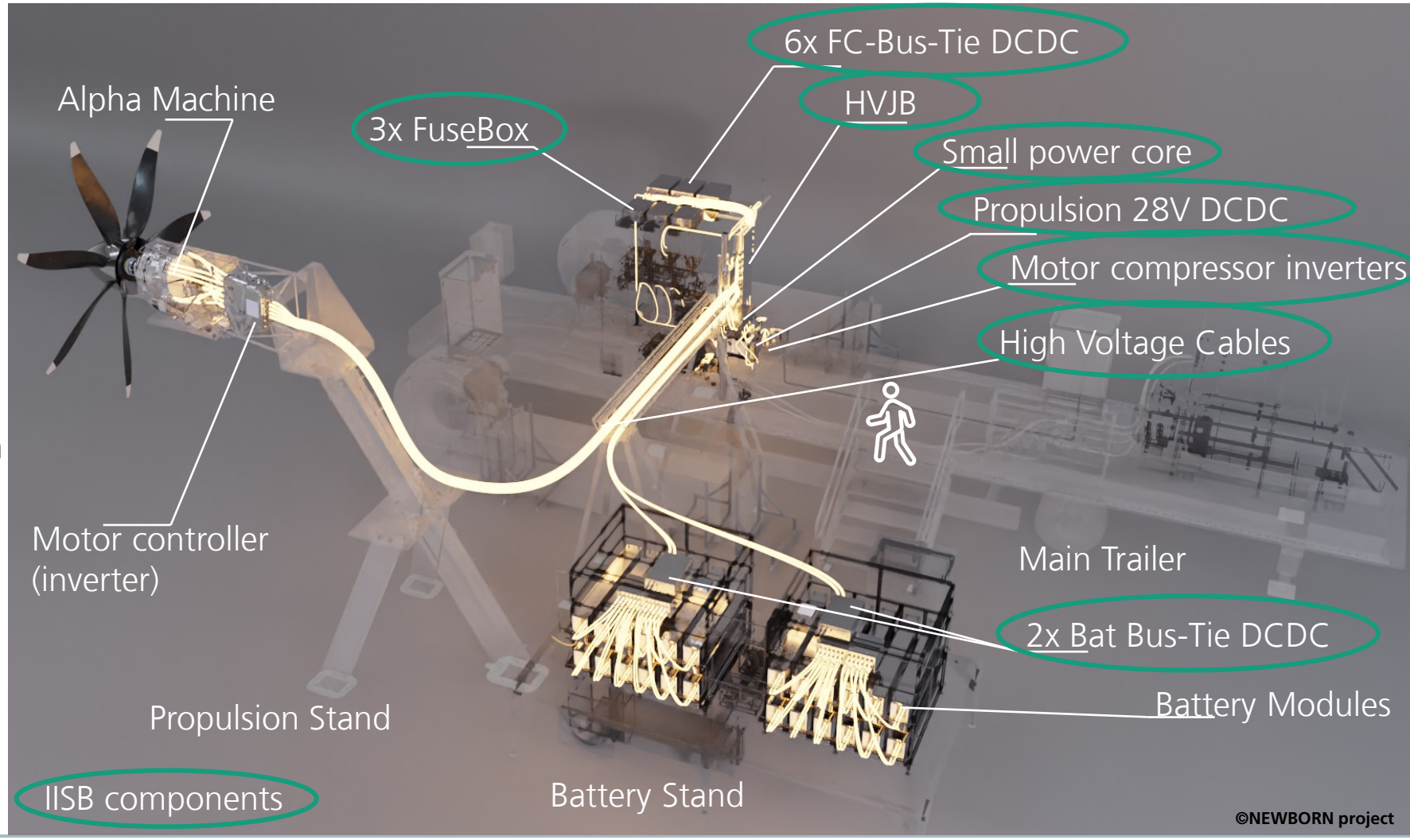




NEWBORN Project – Ground Demonstrator Test 2026

HV-Bus NEWBORN-Demonstrator (1 MW Shaftpower)





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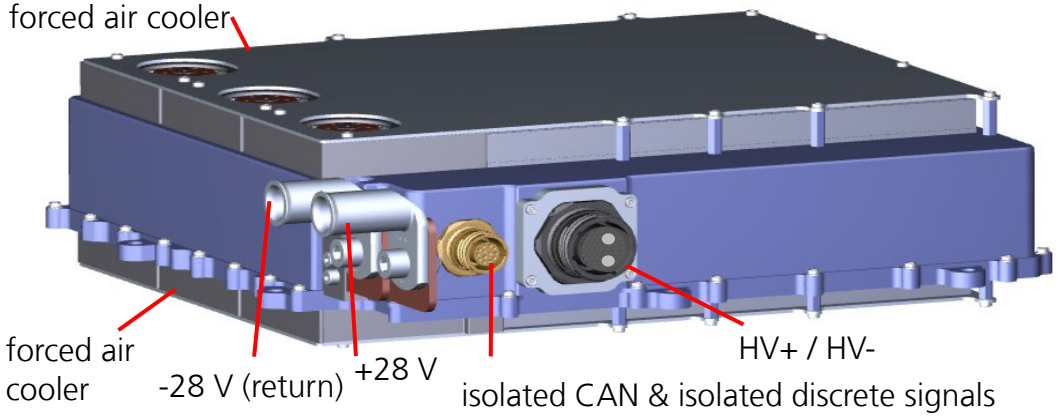
Exemplary prototypes for power electronics in electric aircraft

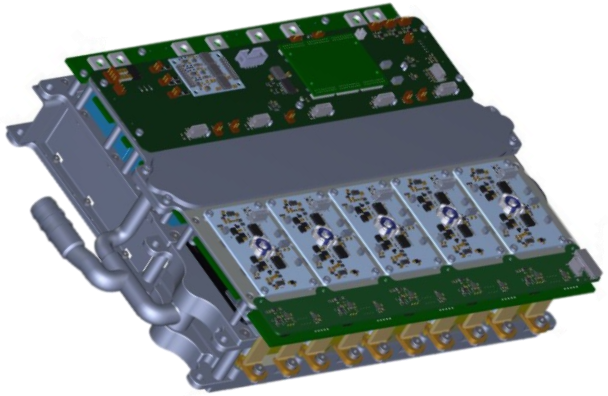
Developed in Project NEWBORN

CAD isolated 28 V DC/DC triple (3-1) fail safety concept

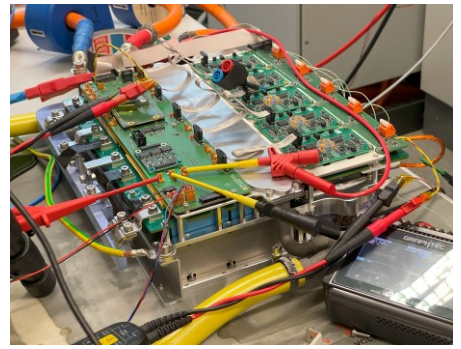


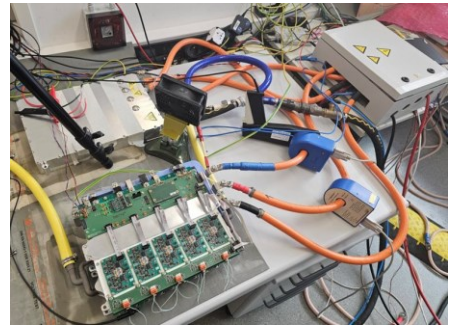
HV:	500 V…850 V
LV-current:	400 A_{PEAK}
LV-power:	11 kW
Galvanic isolated:	2500 Vrms
Modi:	Precharge HV-Bus Charge 28V Batterie
Cooling:	Forced Aircooled
Safety:	(3-1) safety concept, 1700V SiC MOSFETS
Units:	3 x 130 A
Weight:	~ 8 kg (without aircooler)
Power density:	1,4 kW/kg
If a unit fails:	7,3–7,84 kW available

CAD halfbridge multiphase Buck/Boost converter



HV- nominal:	810 V…850 V
HV- min/max:	800 V / 900 V
Max-current:	625 A
Efficiency:	> 98 %
Weight Power Core:	12 kg
Power density:	far beyond 20 kW/kg
Modules:	XM 1700 V SiC-HB-Modul





Back-2-Back-Test in laboratory

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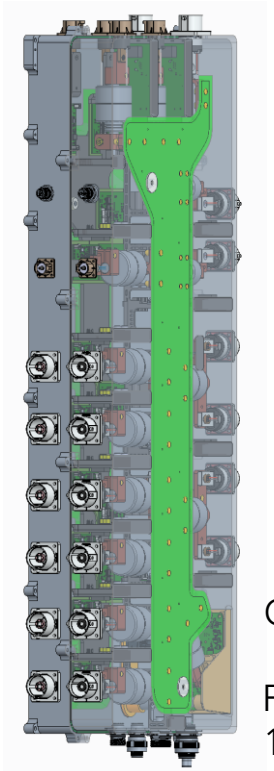
Exemplary prototypes for power electronics in electric aircraft

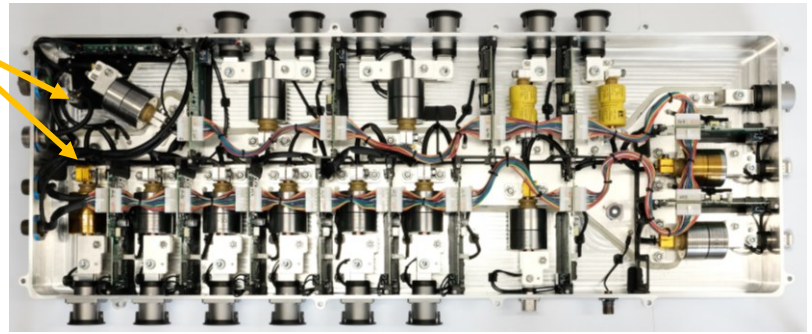
HV-Junction Box

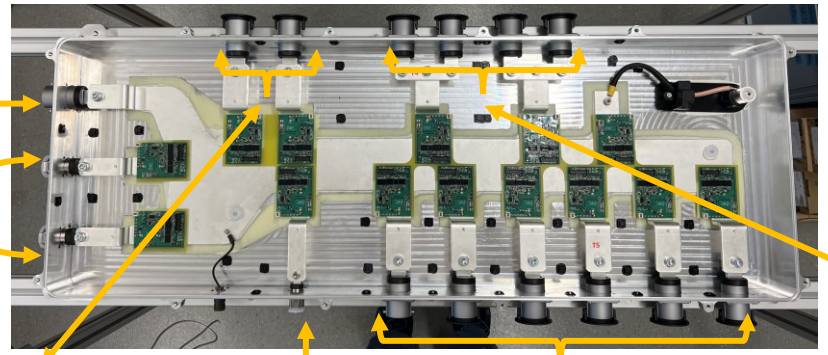
Weight ~45 kg



- Insulation requirements
  - Air gaps > 5 mm
  - Creepage distances > 7 mm

28V BoP DCDC and back up





Ground Charge

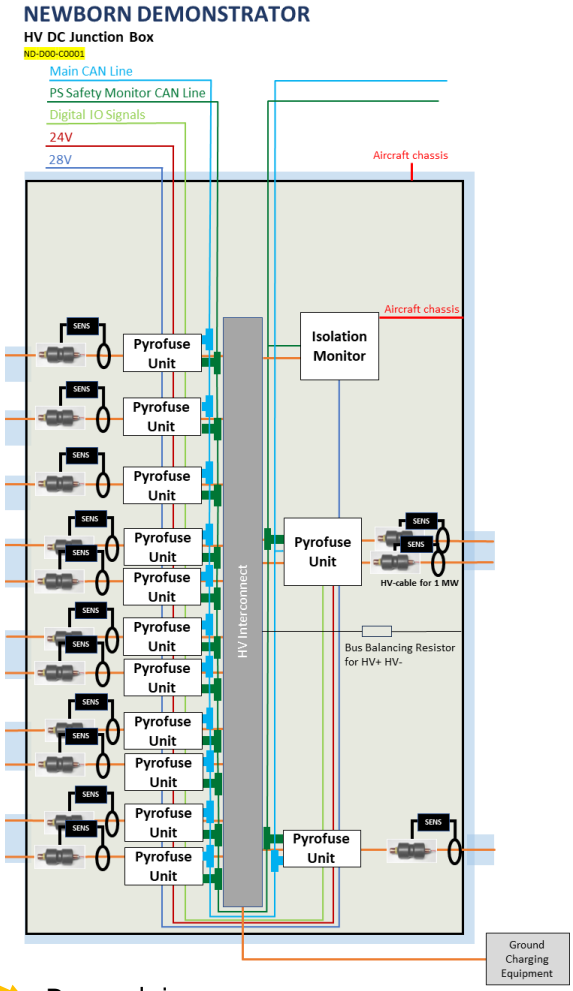
FC Compressor 1,2

Battery DCDC

HV Auxillary

Fuel Cell 1, 2, 3

Propulsion



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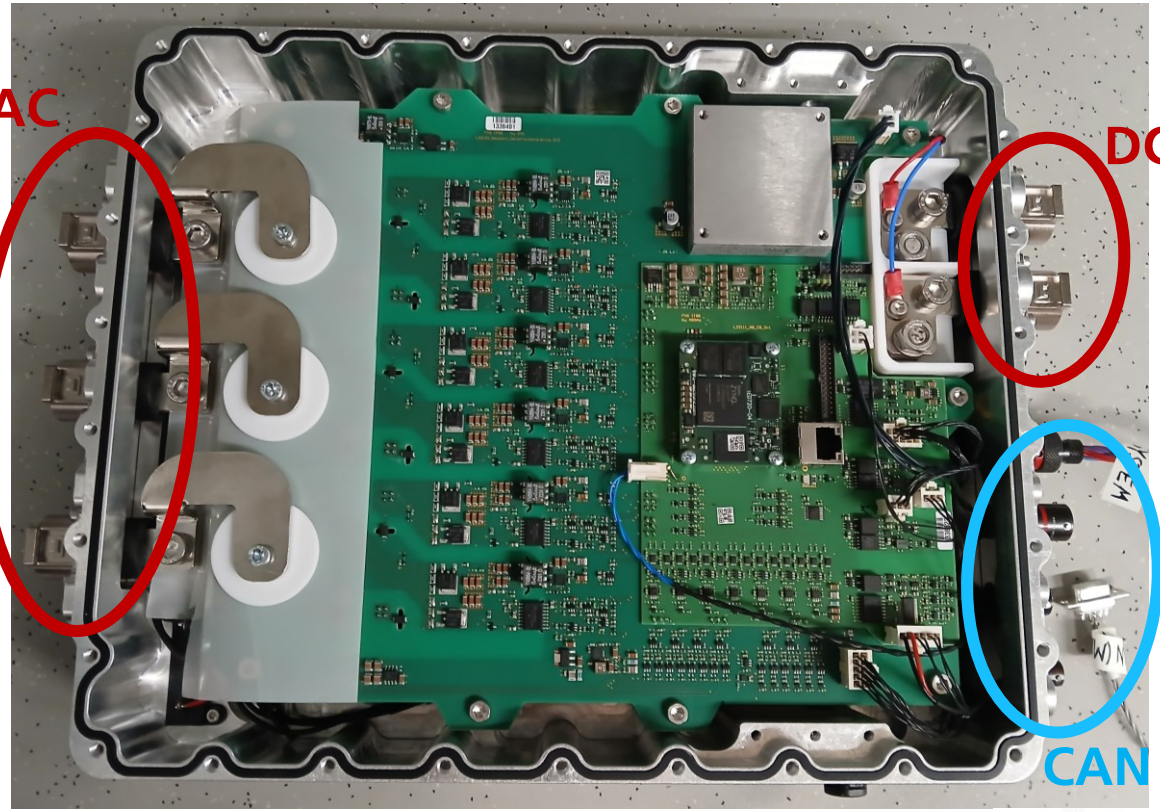
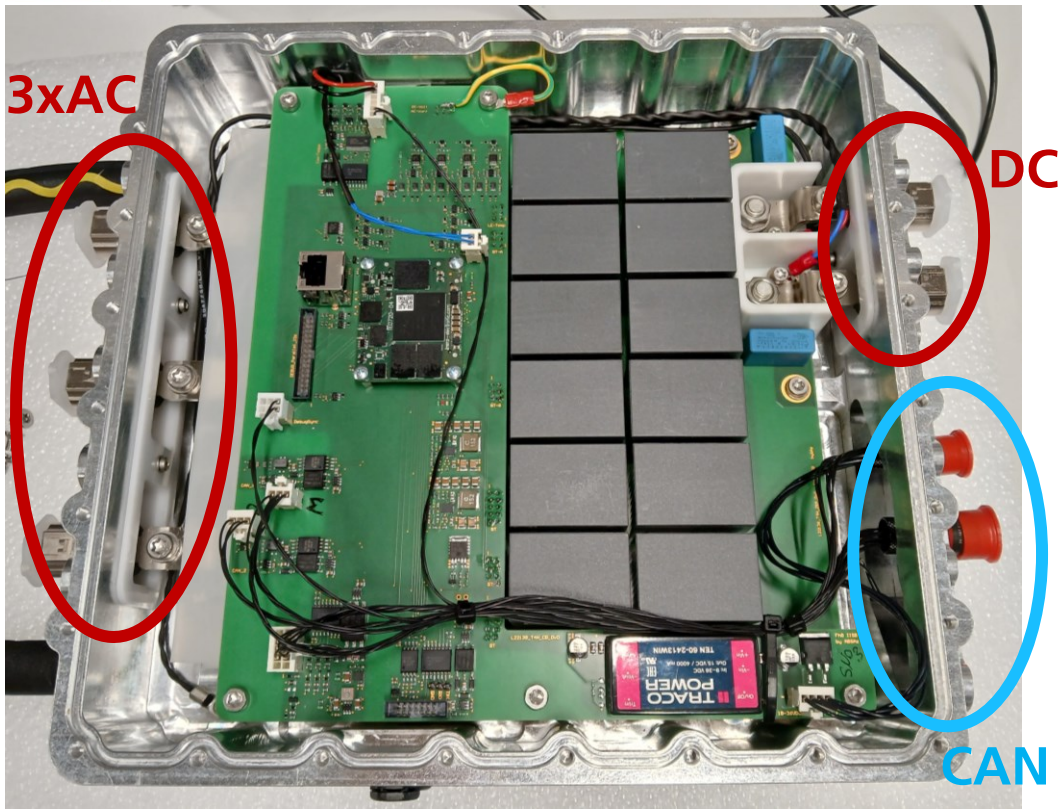
IISB Compressor Motor Inverter



- DC-HV-voltage (contiunously): up to 850VDC
- AC-output current (limited by connectors): ~200ARMS
- PWM-frequency: up to 80kHz
- NO ROTOR-POSITION-SENSOR NEEDED!!
- ~ 100kW continuous AC-output power @ 60°C cooling temperature

Wolfspeed „CAB450M12XM3“



- DC-HV-voltage (contiunously): up to 850VDC
- AC-output current: ~80ARMS
- PWM-frequency: up to 80kHz
- NO ROTOR-POSITION-SENSOR NEEDED!!
- ~ 25kW continuous AC-output power @ 60°C cooling temperature

Wolfspeed „CAB016M12FM3 “

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Power Electronics for Aerospace Applications Europe 2026

Nuremberg, 29-30.09.2026 (optional IISB technical visit 01.10.2026, Erlangen)

General Chair
Prof. Martin März

Full Professor of Power Electronics at FAU Erlangen-Nürnberg and Fraunhofer IISB

Co-Chair
Dr.-Ing. Bernd Eckardt

Head of Department Power Electronics at Fraunhofer IISB and Senior Scientist at FAU Erlangen-Nürnberg

Co-Chair
Dr.-Ing. Markus Meindl

Senior Business Development Power Electronics at Fraunhofer IISB and Senior Scientist at FAU Erlangen-Nürnberg

Tobias Gotthardt
Vice Minister in the Bavarian Ministry of Economic Affairs, Regional Development and Energy

Ladies and Gentlemen,
distinguished participants of PEASA Europe 2026,

it is my great pleasure to welcome you to Nuremberg for the IEEE PELS Workshop on Power Electronics for Aerospace Applications (PEASA) Europe 2026.

The workshop will foster international collaboration in the development of key technologies for sustainable and electrified aviation, while highlighting Bavaria's strengths in aerospace, power electronics, and innovation. With its strong research institutions, innovative companies, and world-class aerospace ecosystem, Bavaria provides an excellent environment for such an important event.

I wish you inspiring discussions, valuable insights, and new international partnerships. I hope you enjoy your stay in Nuremberg and Bavaria, and I look forward to welcoming you to PEASA Europe 2026.

Yours sincerely,
Tobias Gotthardt

https://www.peasa-europe2026.com/

Main Topic: Key technologies for aviation hybrid and electric propulsion

IEEE pels
PEASA Europe 2026
Fraunhofer IISB FAU
29-30 September 2026, Nuremberg, Germany
supported by ECPE

Topics of interest:

- Power electronics
- Cryogenics and superconductivity
- Hybrid-Electric aircraft
- Electric machines
- System integration
- Battery systems
- Fuel Cell systems in aviation
- Airport infrastructure development
- Stability assessment of on-board electrical systems
- Thermal management for electric and hydrogen electric systems
- Digital twins and model-based certification
- High voltage architectures and safety for MW-class propulsion

Technical Committee:

- Prof. Leo Lorenz, ECPE
- Prof. Tao Yang, University of Nottingham
- Prof. Pat Wheeler, University of Nottingham
- Prof. Vincent Lorentz, University of Bayreuth
- Prof. Chris Gerada, University of Nottingham
- Dr.-Ing. Maximilian Hofmann, Fraunhofer IISB
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- Ondrej Kotaba, Honeywell
- Dr. Jernej Drofelnik, Pipistrel
- Andreas Bodén, PowerCell

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Vielen Dank für die Aufmerksamkeit

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Fragen?

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