



Airbus DS

PPUs for High Voltage Thrusters:  
new developments and  
technologies status

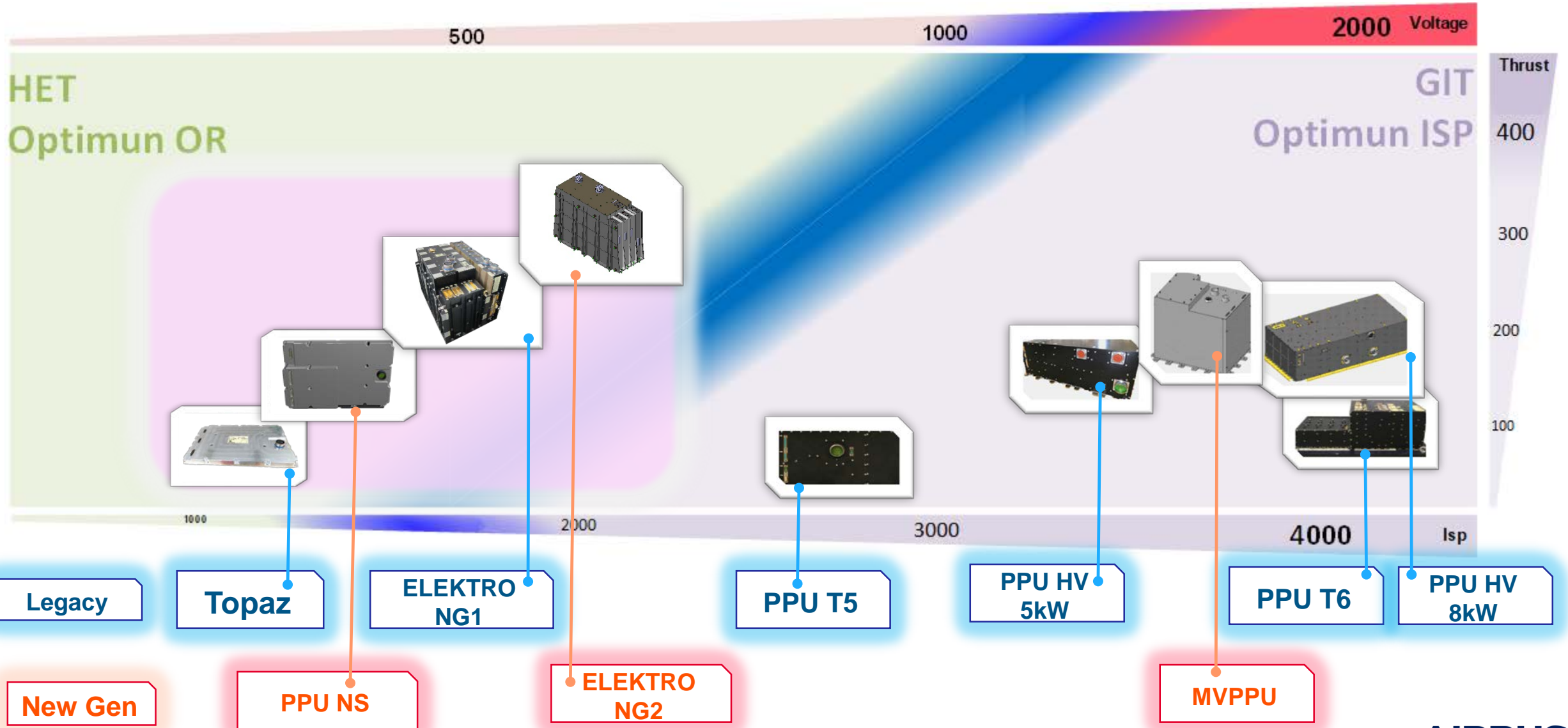
*EPIC Workshop*

DEFENCE AND SPACE

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*Space products – Technical Manager*

**AIRBUS**

# PPU Airbus DS Portfolio



## Main Features – HV PPU GIT 5kW

**Compatible with main GIT thrusters:** RIT 2X and easily upgraded to other GIT thrusters

**Dual mode operation:** wide voltage range from low (800V) to high voltage (up to 1.5 kV)

- ❑ High voltage flight proven technology

Delivered power up to: **6 kW**

- ❑ 4.5 kW in the grids
- ❑ 1 kW for plasma ionization through the thruster
- ❑ 500 W for the neutralizer

**Thruster parameters** flexible to change

**Full autonomy**, including recovery from beam events

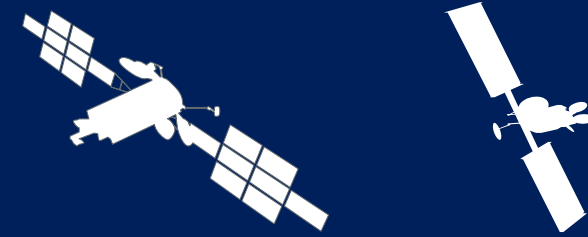
Regulated **100V** bus with primary bus protection integrated

**Flow Control Unit** integrated in the PPU (**optional**)

TM/TC based on MIL-STD-1553B

- ❖ Co-developed with **GIESEPP EPIC** project

## HV PPU GIT 5kW



Major customers in **Europe** and **USA**

**8** flight models already **delivered**



# HV PPU GIT 5kW - Architecture

## Positive High Voltage (PVH)

- ❑ Screen grid supply
- ❑ 2.2kW per module

## Interface Control Unit (ICM)

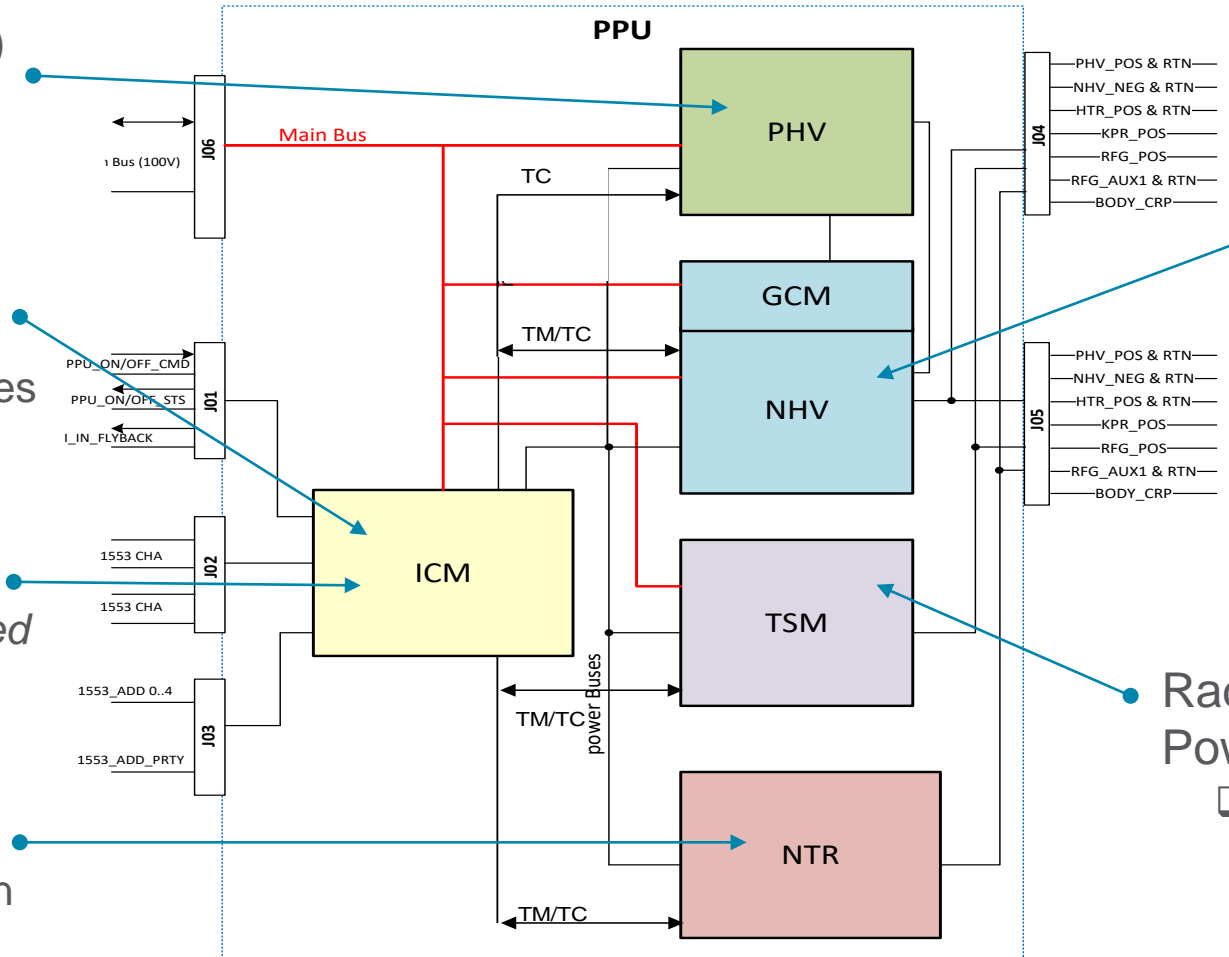
- ❑ MIL-STD-1553B I/F
- ❑ Auxiliary Power Supplies
- ❑ Thruster controller

## Flow Control Unit (FCU)

- ❑ can optionally be added

## Neutralizer-Supply (NTR)

- ❑ Neutralizer supplies
- ❑ Very high configuration capability.



## Negative High Voltage (NHV)

- ❑ Accelerator grid supply
- ❑ Grid clearing function (GCM)

## Radio-Frequency Generator Power supply (RFG-PS)

- ❑ Power supply for external RFG

## Main Features – HV PPU GIT 8kW

PPU for **MSR-ERO** mission for **RIT 2X** thruster

- ❑ Delivered power: **8.3 kW**
  - ❑ 6.8 kW in the grids
  - ❑ 1 kW for plasma ionization through the thruster
  - ❑ 500 W for the neutralizer
- ❑ Screen Grid voltage: **1600V**
  - ➔ **Higher Isp** and fuel efficiency

High Voltage Technology able to reach up to 2200V

Thruster **parameters flexible** to change

**Full autonomy**, recovery from beam events

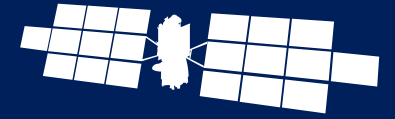
**FCU** electronics included

Unregulated power bus (100V-135V & 80V-100V)

TM/TC based on **MIL-SDT-1553B**

## HV PPU GIT 8kW

### Deep Space Missions



**EM1 delivered**

**CDR** being held during **CW19**

EM2 under test

**5 FMs** to be delivered by **Q3 2024**





# GIESEPP MP & DEEP PPU main goals

## GIESEPP MP

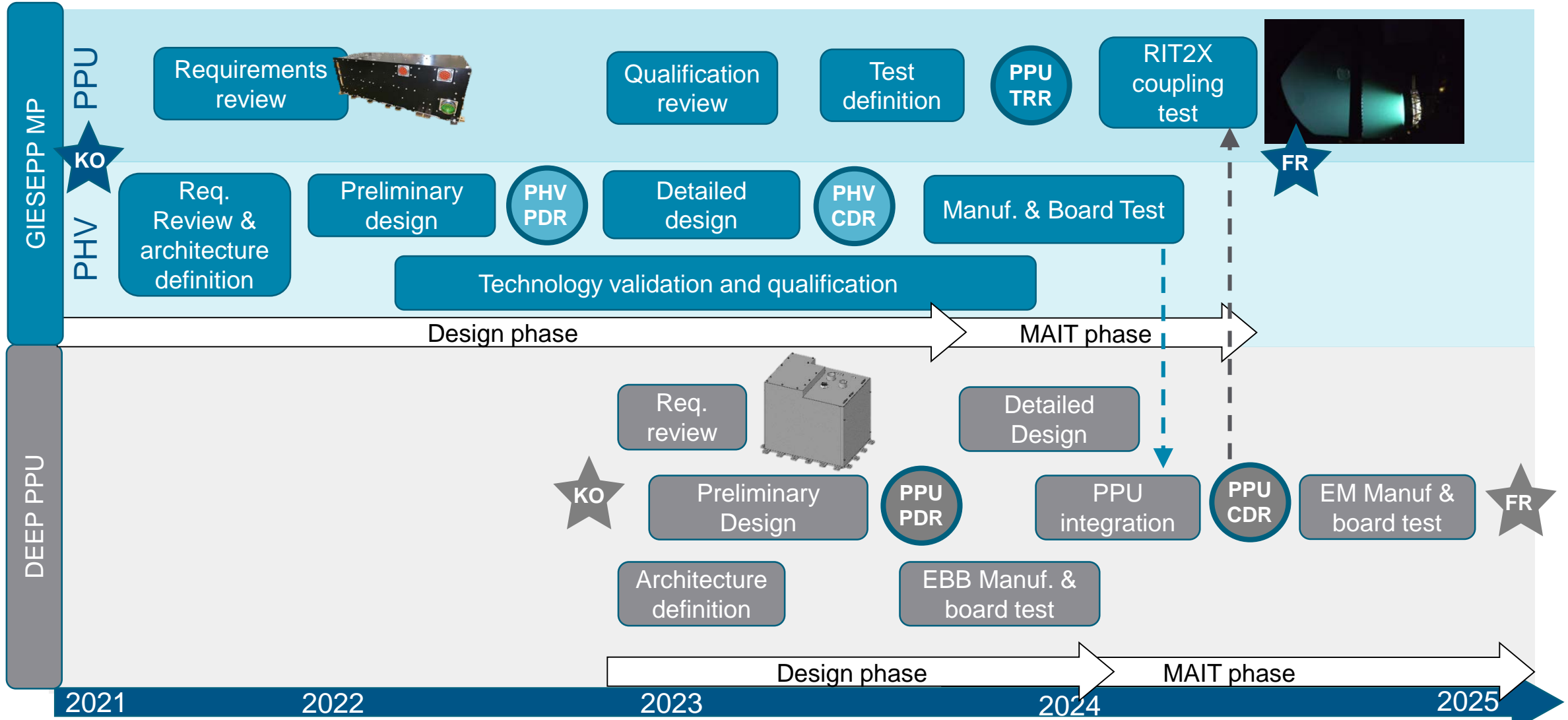
- Increase the maturity of GIESEPP phase 1 **RIT 2X EPS up to TRL 6/7**
  - GIESEPP is the first European Plug and Play **Gridded Ion Engine Standardized Electric Propulsion Platform**
  - EPS was conceived to:
    - be able to exchange critical elements with reduced impact in the rest of the EPS
    - minimized recurring costs
    - secure European non-dependence
- Take first steps to answer future market needs
  - Development of **new PHV module**

## DEEP PPU

- To design, build and test a **disruptive PPU for GIT** that has far better performances than its predecessors
  - Targets all supplies except for the PHV supply



# GIESEPP MP & DEEP PPU activities

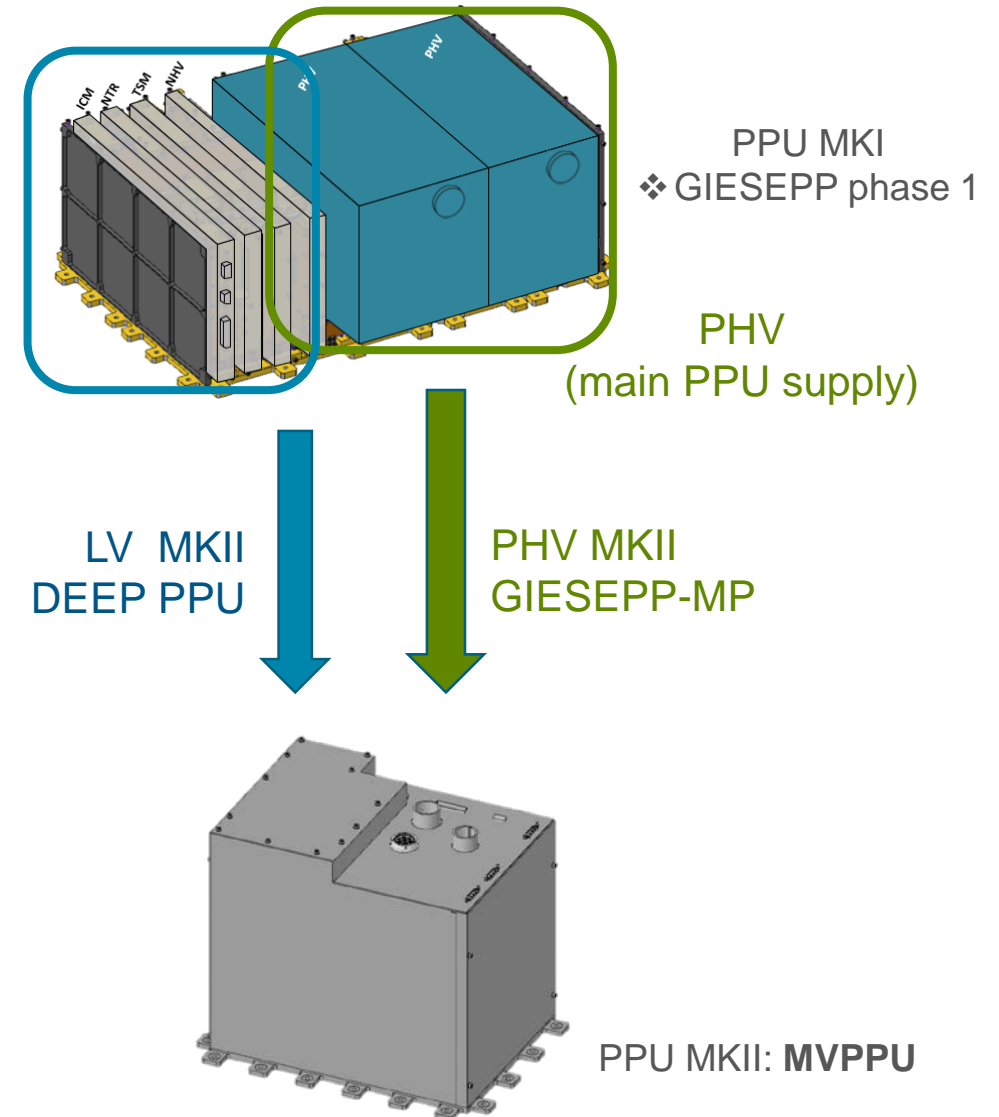


# MVPPU: Technology evolution

- Development of new technologies for next PPU generation:
  - **GaN transistors** and high switching-frequency converters
  - New **HV insulation** techniques
  - **Digital Control** and advance control techniques
  - Use of **COTS** → **Next Space** approach
  - **Optimization of magnetics** design
- Evolution started with the PHV module: the bigger impact in the PPU
  - Higher volume, mass and delivered power
  - More complexity: high-voltage and beam-out events management
- Design for Test and Design for Manufacturing approach prioritizing SMT technology and automatized processes

## ❖ Design targets

1. 30% mass and volume reduction ✓ **Up to 50%**
2. 50% cost reduction ✓
3. Efficiency > 92% ✓ **Up to 95.5%**
4. Respond to high production rates ✓





# MVPPU: optimized architecture

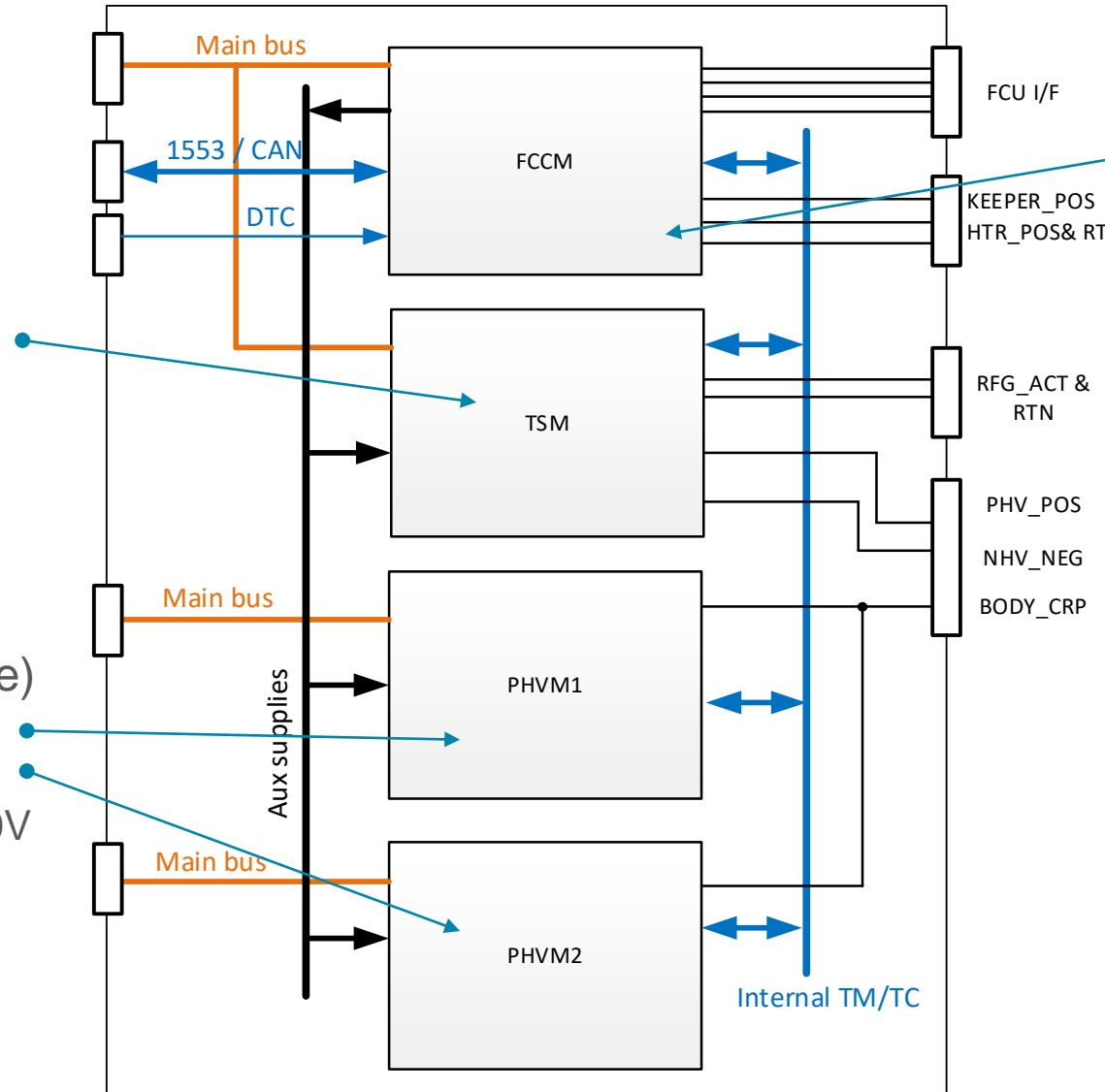
❖ Only 3 types of modules

## TSM (Thruster Specific)

- ❑ Accelerator grid supply
- ❑ -100V to -800V
- ❑ Radio-Frequency Supply
- ❑ Up to 1kW

## PHVM (Positive High Voltage)

- ❑ Screen grid supply
- ❑ Up to 3kW / module
- ❑ Programmable up to 2000V



## FCCM (Fluidic, Control & Cathode)

- ❑ Fluidic control and driving electronics
- ❑ Main PPU Controller
  - ❑ High level functionality
- ❑ Cathode power supplies:
  - ❑ Heater supply
  - ❑ Keeper / Ignitor supply
- ❑ Communication with OBC:
  - ❑ MIL-1553 or CAN bus
- ❑ Auxiliary supplies generation

# MVPPU: Next generation of PPU

## MVPPU for **GEO/MEO** missions:

- Scalable power: **1 kW** to **10 kW**
- Beam Voltage: **600 V** to **2000 V**

## Compatible with main **platforms**:

- 100V regulated** or **un-regulated** main bus
- Both **MIL-SDT-1553B** & **CAN Bus** available
- Flow control** regulation included

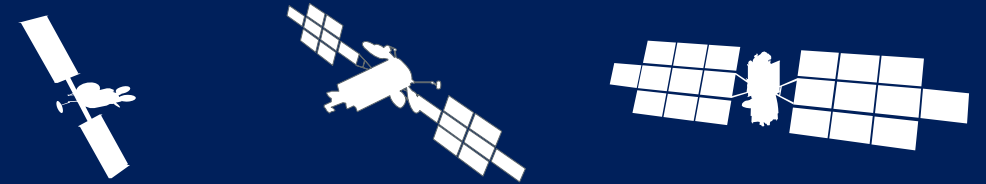
## Next **Space** industrial approach:

- Use of **COTS**
- Automation** of manufacturing and testing
- Designed for **15 years** on station and over **1 MRad**

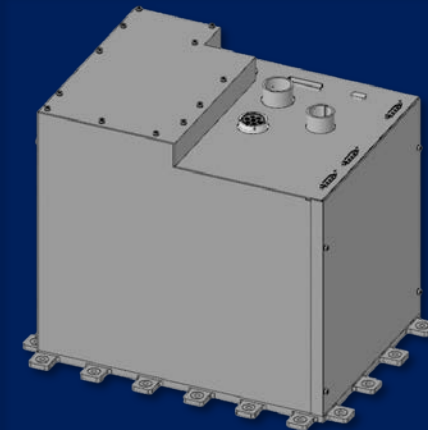
## State of the art technologies for better performances:

- GaN** transistors
- Optimized magnetics**
- Digital control** with configuration flexibility
- In-flight adjustment** of thruster operation

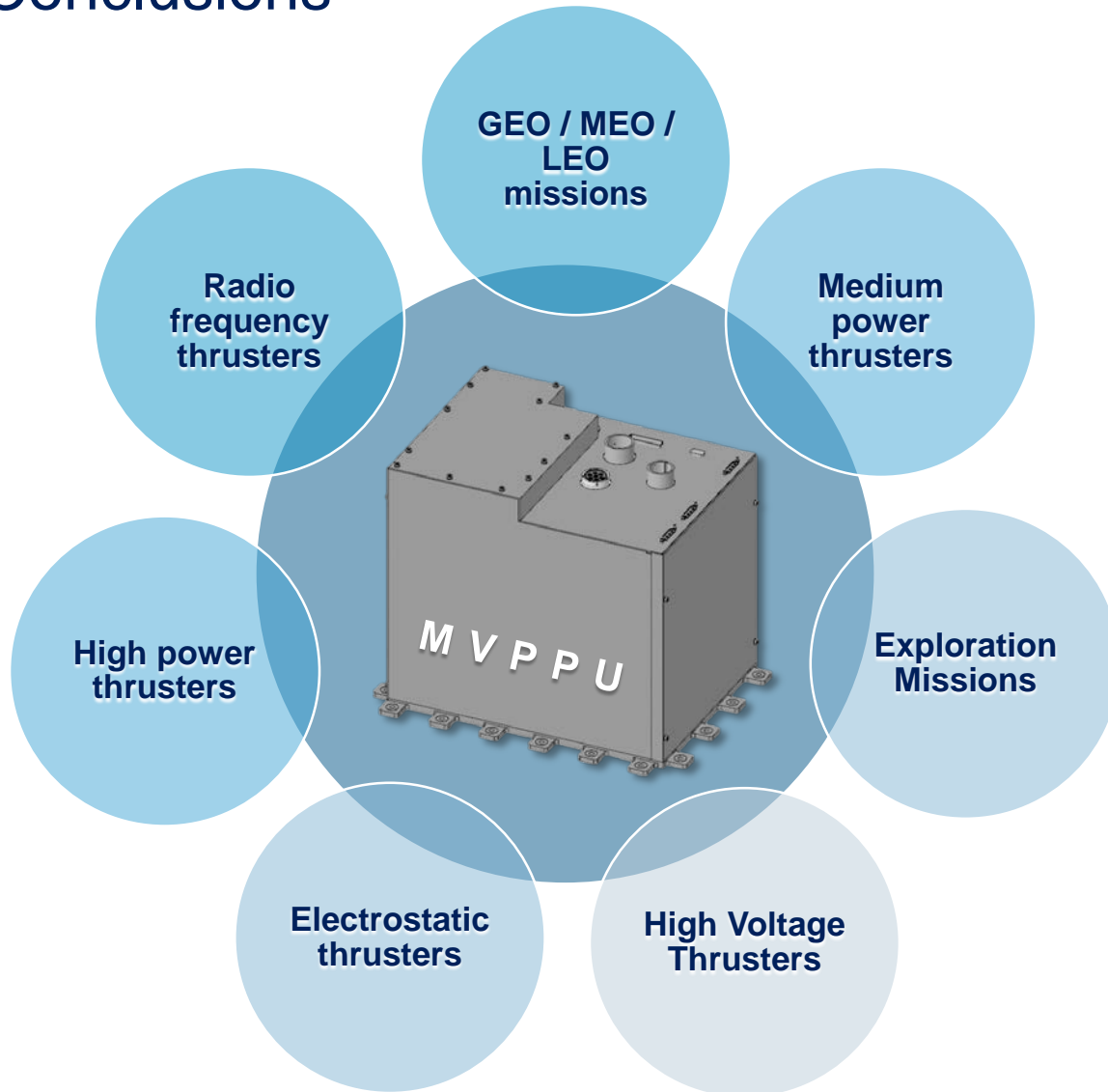
# MVPPU for GIT



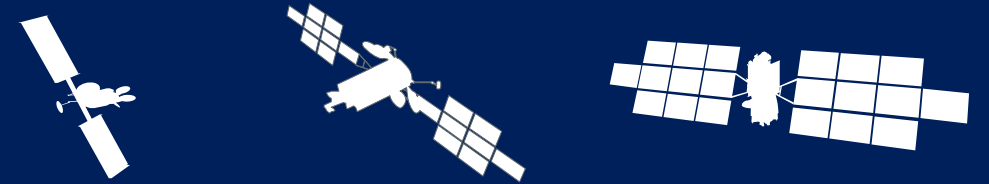
Flight representative **EM under manufacturing**  
**Coupling test** planned for **April 2024**  
**FM** production to start in **Q1 2025**



# Conclusions



# The future PPU for GIT



The **MVPPU** offers a solution ideal for Gridded-Ion systems:

- Very compact unit
- High efficiency
- Wide beam voltage range
- Flexible and scalable
- Next Space industrial approach

**Airbus Crisa PPU portfolio** covers Prime system needs:

- Power to thrust vs Isp
- Extended Power range
- Solutions for short, mid and long-term needs



**TOPAZ**



**PPU NS**



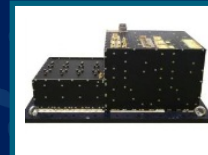
**ELEKTRO  
NG1**



**ELEKTRO  
NG2**



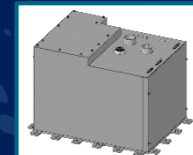
**PPU  
T5**



**PPU  
T6**



**PPU  
GIT**



**MVPPU**

Thank you for your attention