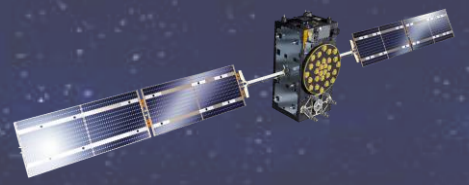
TRANSFORMING POWER INTO SUCCESS



Excellence in
Space Power Electronics

Electric Propulsion Innovation & Competitiveness Workshop 2023

Multifunctional PPU (thrusters up to 900W)

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SPICA PPU Modularity

Generally, the application of Electric Propulsion can be categorized into the needs for:

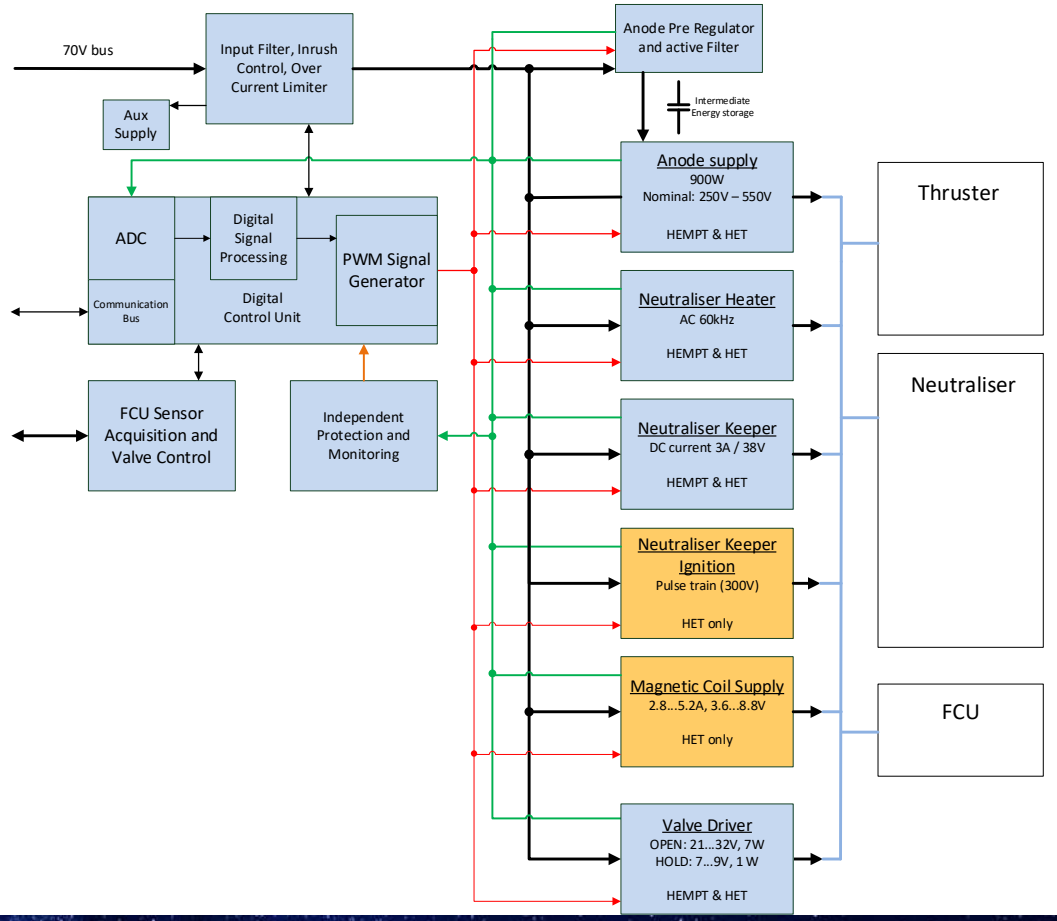
- Orbit Raising -> max. thrust → Mode 1: HET BHT600
- Station Keeping -> max. impulse → Mode 2: HEMPT EV0

Based on the internal Digital Control Unit, the M-PPU will be capable to be set into two different operation modes:

PPU Modularity

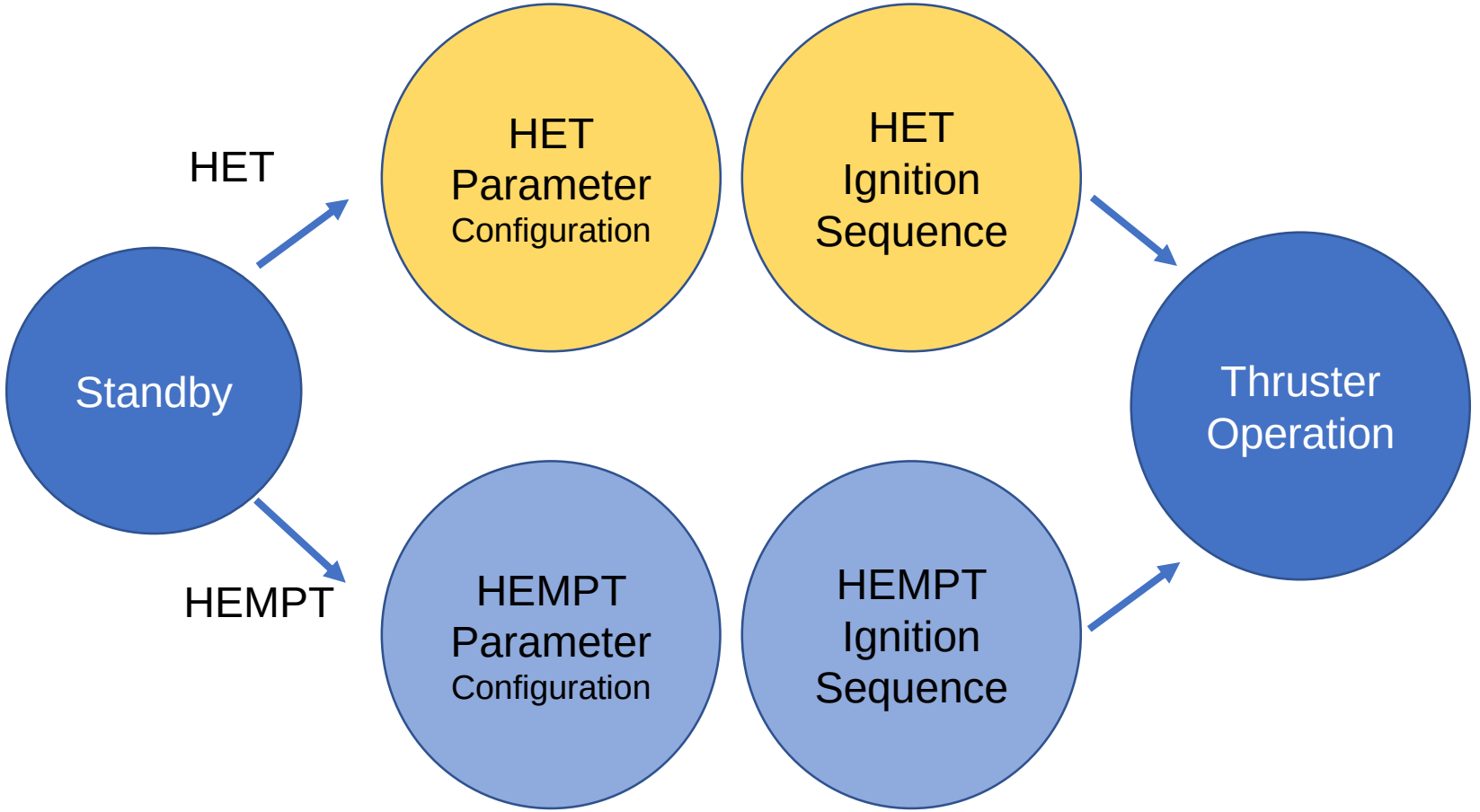
The modular approach is based on the experience, that several functional blocks of a HEMPT and a HET PPU are quite similar.

- HEMPT and HET
- additional for HET



PPU Control Modes

- Individual control parameters.
- Individual ignition sequence.
- Common operation (thrust control).

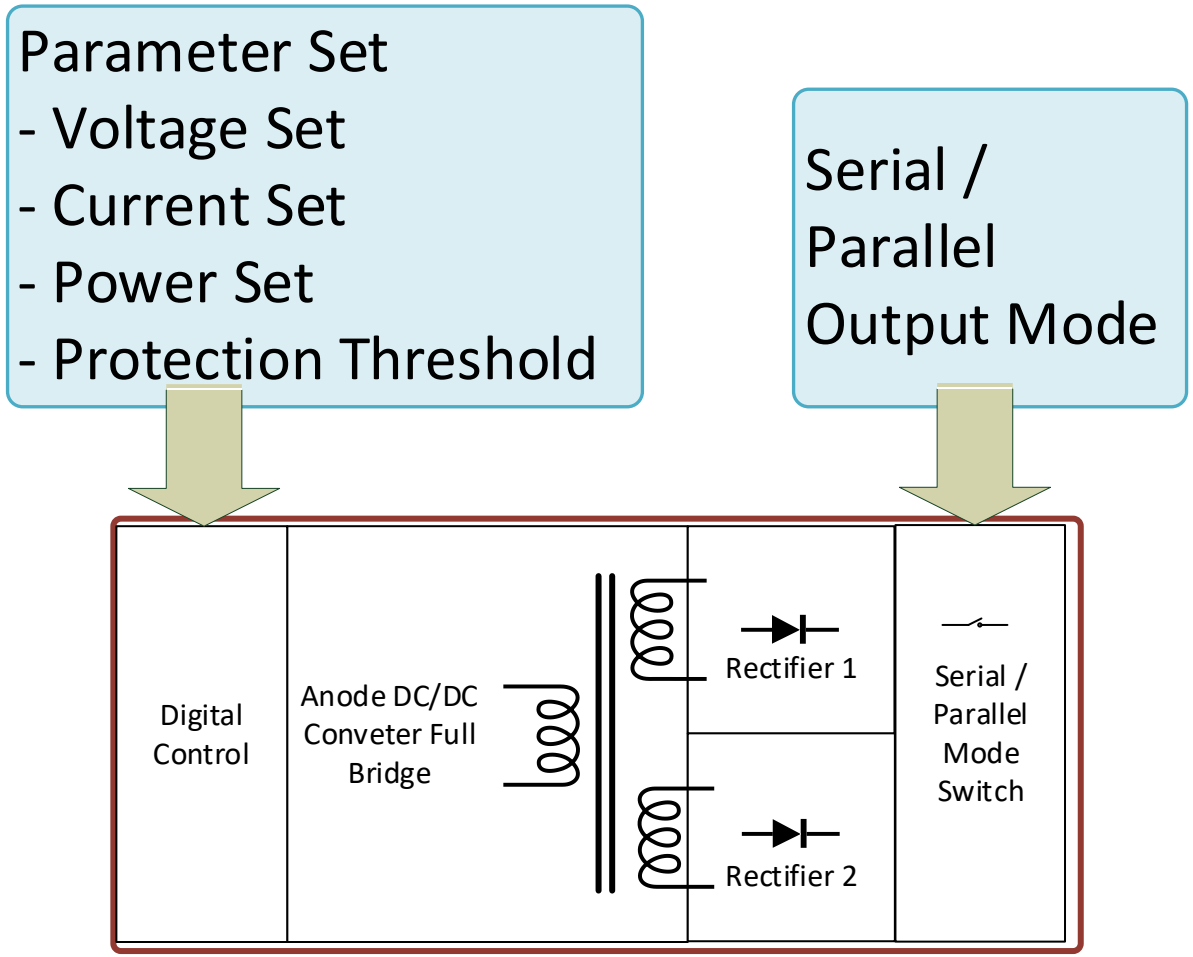


Parameter / Configuration

	HET		HEMPT	
Anode Supply	active	parallel output mode; 100…380V / 2,4A	active	serial output mode; 320…640V / 1,2A
Neutralizer Heater Supply	active	8V / 7A (DC)	active	14V / 3,5A (AC 60kHz)
Neutralizer Ignitor Supply	active	350V pulse	mute	-
Neutralizer Keeper Supply	active	30V / 1A	active	40V / 2,5A
Magnetic Coil Supply	active	16V / 5A	mute	-

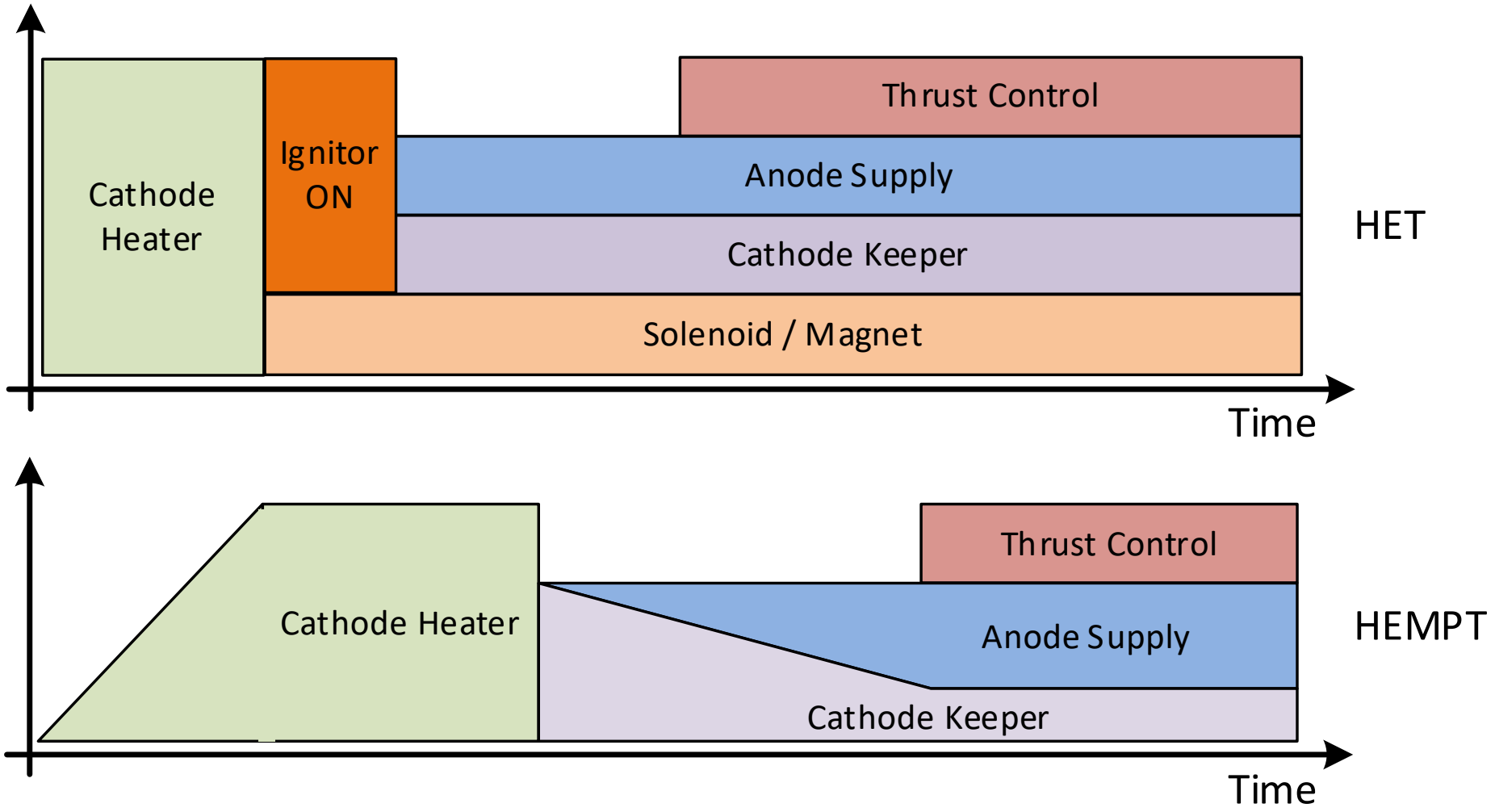
Anode Supply Modes

- Control parameters configurable.
- Converter outputs can be configured as:
  - Serial – high voltage
  - Parallel – high current

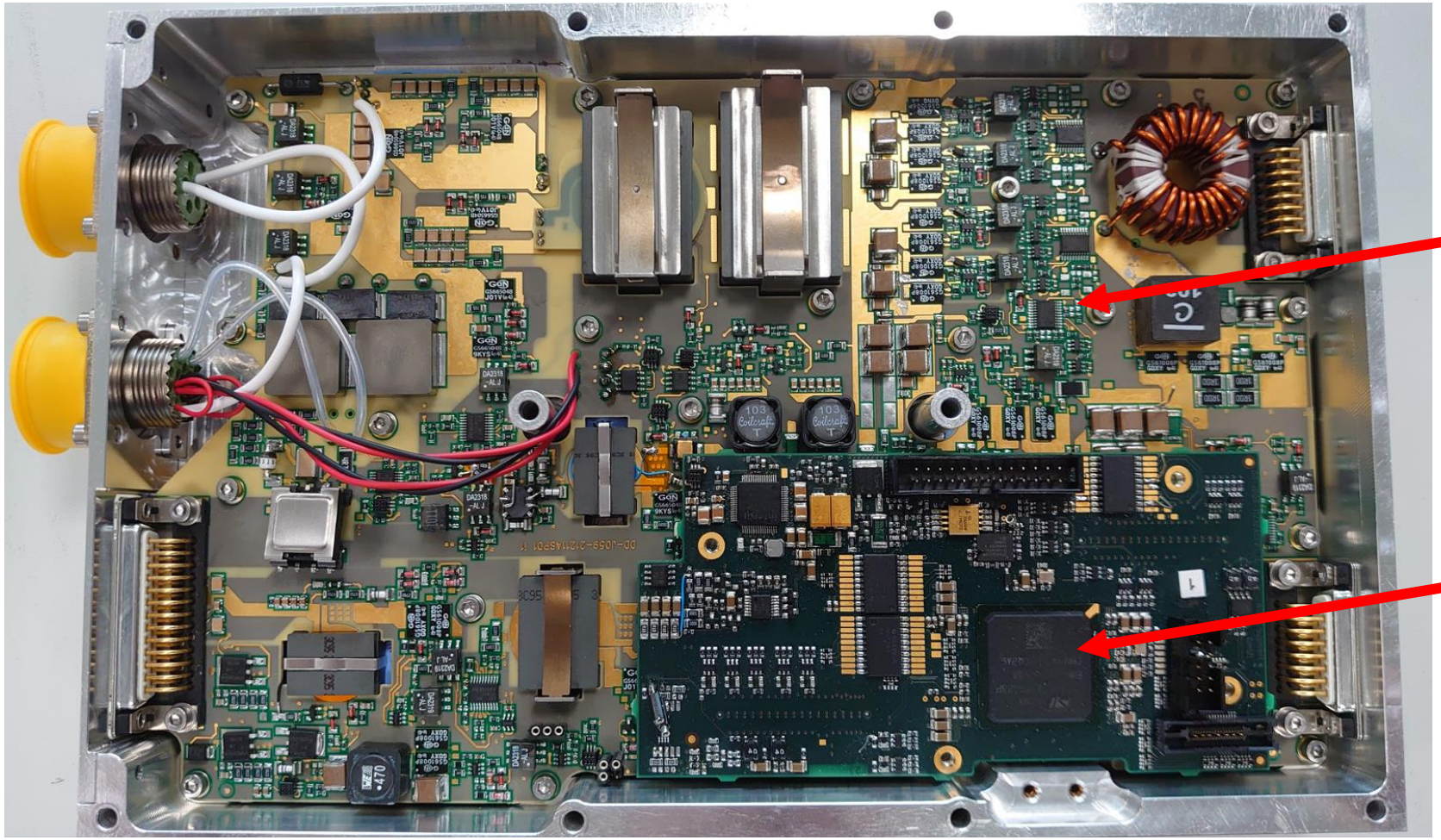


Ignition Sequence

towards commanded operational point

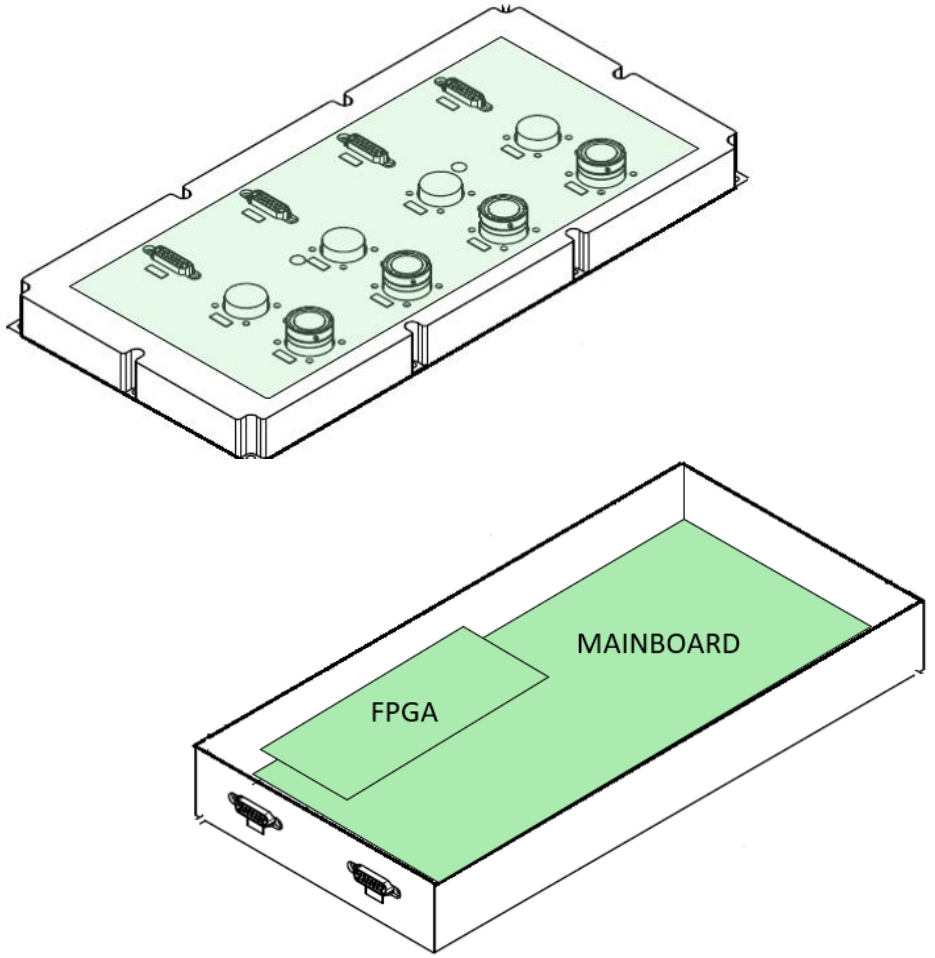


SPICA PPU



Switch Matrix

- By adding a switch matrix, (integrated on the PPU housing) it is possible to:
  - go into a hybrid dual use of the PPU
    - HET for orbit raising and
    - HEMPT for station keeping maneuvers
  - drive up to 6 dedicated thrusters from one SPICA PPU



M-PPU
Conclusion / Main advantages

- **Flexible**
  - the SPICA PPU can either serve HET or HEMPT
  - PPU operation configurable via digital control (no change on H/W)
- **Scalable**
  - Hybrid or Dual operation from one SPICA PPU (HET & HEMPT)
  - Built-in switch matrix: driving up to 6 thrusters from one SPICA PPU
- **Ready for high quantities**
  - mainly SMT technology used leading to optimized manufacturing effort (design to production)
  - full automated testing leading to short testing time (design to test)

- Low mass and dimensions based on
  - Digital Control and GaN technology enabling
  - very high switching frequencies (approx. 600KHz) with the corresponding minimization of filters
  - Active Filtering of Thruster Oscillations leading to an additional significant reduction of the input and output filter size

  ► **Typical mass and dimensions; 900W SPICA PPU** (without switch matrix)
    - **Mass:** **3,5kg**
    - **Dimensions :** **180x370x40mm**

Thank your very much for your attention

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