

**PROJECT : “Preparation of enabling space technologies and building blocks”
BBK for Low Power PPU**

EXECUTIVE SUMMARY REPORT (ESR)

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1. SUBJECT

This document provides an overview of the activities performed in the frame of the BBK for Low Power PPU, "Preparation of enabling space technologies and building blocks".

2. OBJECTIVES OF THE ACTIVITY

The Power Processing Unit Low Power is intended for low power constellation applications. It targets two types of thrusters:

- Hall Effect Thruster (HET)
- High Efficiency Multistage Plasma Thruster (HEMPT)

The two thrusters have similar output power with 700W for HET and HEMPT. The anode voltage for these two applications are different with 300V to 400V for HET and 600V to 800V for HEMPT.

Two main bus voltage are targeted : 70V and 28V, thus we could have 4 configurations of PPU:

- PPU for HET 28V
- PPU for HET 70V
- PPU for HEMPT 28V
- PPU for HEMPT 70V

For current BBK, we have chosen the configuration that seems to be the worst case: the PPU for HEMPT 28V. It seems to be the worst case because it induces the highest current at primary side and the transformer ratio is the worst because the highest output voltage is targeted.

3. TECHNICAL BASELINE

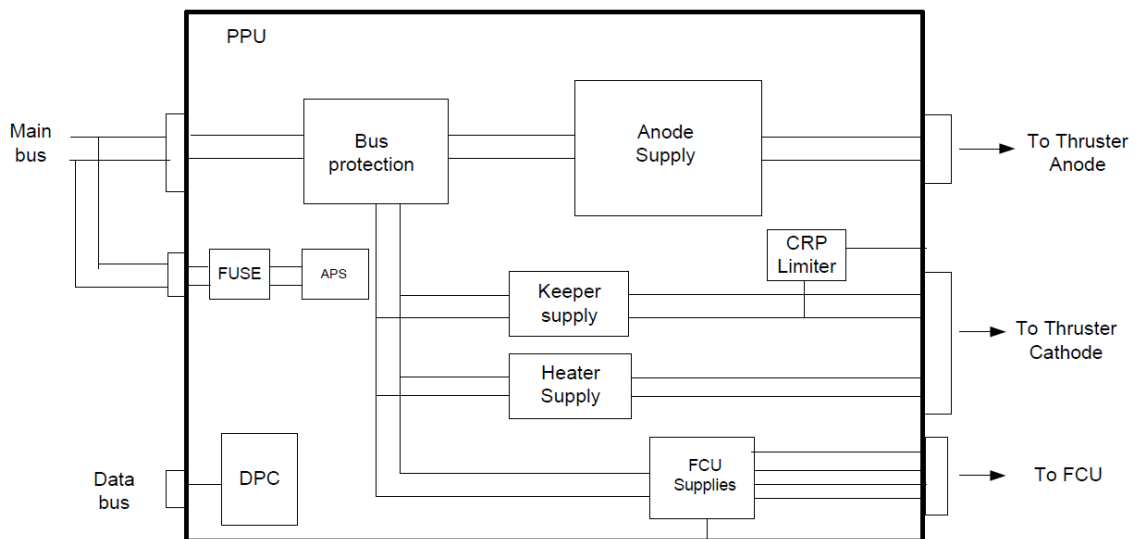
3.1. PPU block diagram

As shown in Figure 1 & Figure 2, the Low Power PPU features the main functions listed below. Some are common to both type of thrusters [COMMON], some are specific to HEMPT Thruster [HEMPT], and some to HET Thruster [HET]. The FCU power supply is considered common.

- ▼ The interface and electrical supplies necessary to drive a thruster:
 - A thruster interface filtering / ESD protection circuitry and thruster electrode bleeding resistors [COMMON]
 - An anode supply [COMMON]
 - A cathode keeper supply [COMMON]
 - A cathode heater supply [COMMON]
 - The CRP limiter (to limit the voltage of the floating ground of the thruster) [HEMPT]
 - An ignitor supply (only for HET thruster) [HET]
 - A magnet supply (only for HET thruster) [HET]
- ▼ The electrical supplies necessary to drive the Flow Control Unit (FCU): [COMMON]

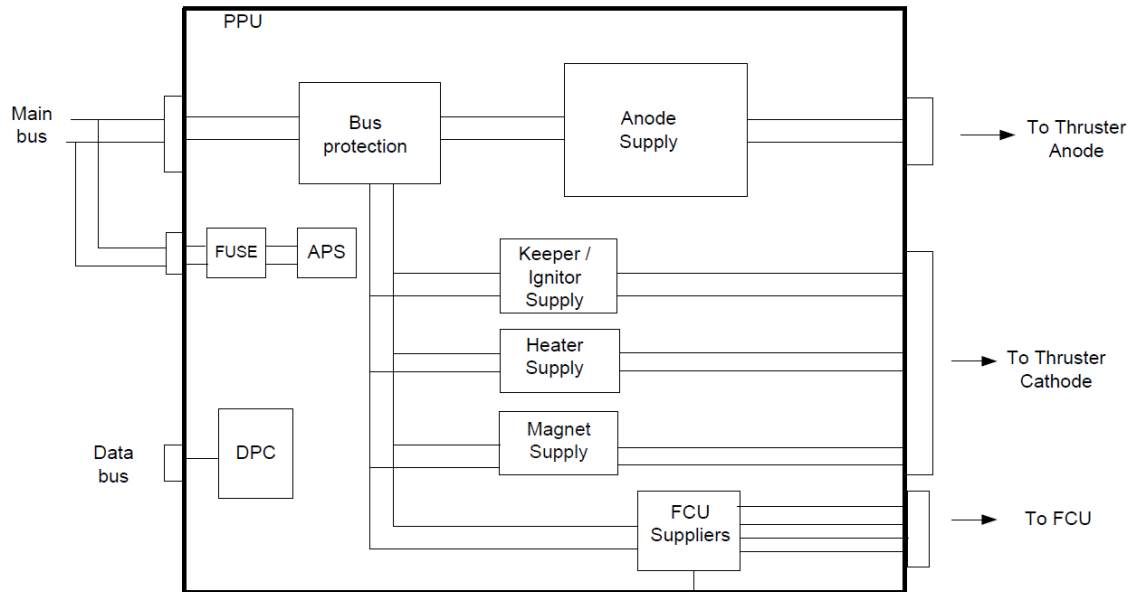
- A FCU interface (and ESD protection circuits)
- Up to 3 digital valve drivers (high pressure valve, low pressure valve, isolation valve)
- A proportional valve supply (compatible with maximum 2 digital valves)
- ▼ The regulation loop controller necessary to control the anode discharge current [COMMON]
- ▼ The TM/TC, data interface (CAN bus, 1553 bus as option) and sequence controller [COMMON]
- ▼ The primary bus interface (input filters and input switch protection) [COMMON]

An Auxiliary Power Supply (APS) to supply the low-level circuits. [COMMON]



HEMPT-PPU-TASB-PN-0017_03

Figure 1 : PPU HEMPT concept



HEMPT-PPU-TASB-PN-0017_03

Figure 2: PPU for HET concept

4. TRADE-OFF AND PACKAGING

4.1. Electrical topology for anode supply trade-off

The objective of the PPU Low Power is to propose a new PPU that is capable of providing 700W to the thruster HET or HEMPT and to identify the optimum Anode Supply electrical topology, common to both thrusters, with parts and technologies easy to manufacture in order to propose a competitive equipment. After a trade-off phase, the selected topology for the Anode Supply was analysed and validated by an electrical breadboard.

4.2. Packaging trade-off

In order to reduce the recurring cost of the PPU LP, many iterations on the PPU packaging and mechanical architecture were considered. After analysis, the main conclusion drawn are:

- The number of interconnections need to be limited
- The number of PCB need to be the lowest
- The number of trough hole components shall be minimized

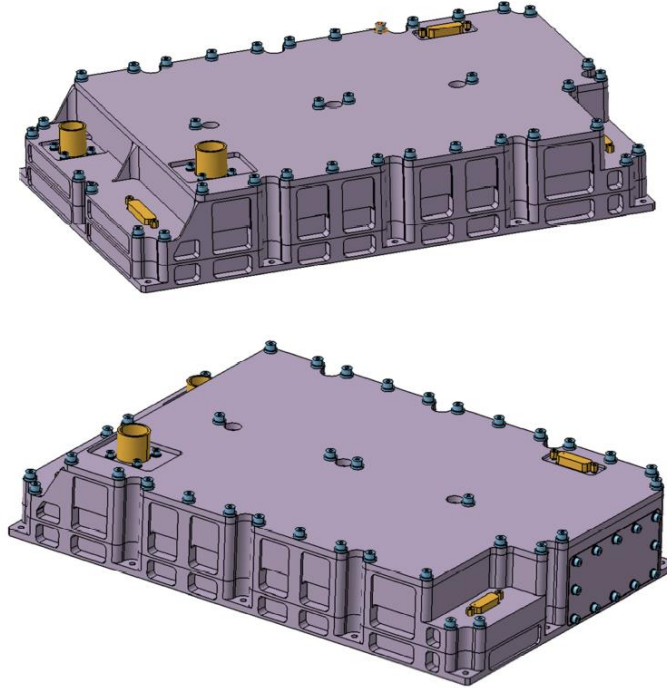
These constraints lead to the use of a flat packaging with two PBAs one above the other. The two PCBs have very limited interconnections and only one “power” connection from main bus to the input of cathode supplies. The other connections are low level to give TC and TM between them.

4.3. Selected packaging

The PPU LP packaging is a “pizza box” assembly reducing the assembly costs.

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The following figures show preliminary views of the PPU Low Power:



5. PERSPECTIVES AND CONCLUSION

The outputs of the activities performed confirmed that the topology chosen is the proper one with respect to our design objectives. Based on the different tests performed and analyses, we have identified improvement actions that are under implementation for the final flight hardware design.

END OF DOCUMENT

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