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The HEPD-02 Data Processing and Control Unit for the CSES-02 mission

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The High Energy Particle Detector (HEPD) is designed to detect electrons in the energy range from 3 to 100MeV and Protons in the range from 30 to 200MeV with good energy (at least 10% at E > 5 MeV) and angular resolutions (at least 10° at E > 3 MeV).

Data Processing and Control Unit (DPCU)

The DPCU board is part of the electronic subsystem of HEPD-02 and implement the functionalities of :

- Scientific data collection: from the front end board(TRIGGER &T-DAQ),
- HEPD-02 Data Handling(scientific and housekeeping data),
- Satellite interface management: RS-422 and CAN 2.0,
- HEPD-02 System control & housekeeping management,

The DPCU board is designed with:

- HOT/COLD architecture: The board work in COLD redundancy.
- Use of Commercial off the shelf **Automotive components,**

The HOT and COLD sections are based on:

- **Xilinx Zynq XC7Z045** SoC for Control and HK management;
- **MICROSEMI A3P FPGA** for Zynq boot management and Zynq Health status management(watchdog, memories check, etc.)

On the Zynq run a fault tolerant OS that execute a continuous health check control on HEPD-02.

The most important interfaces on board are:

- 4x SpaceWire link for HEPD-02 internal protocol,
- 2x CANBUS redunded interface to/from Satellite,
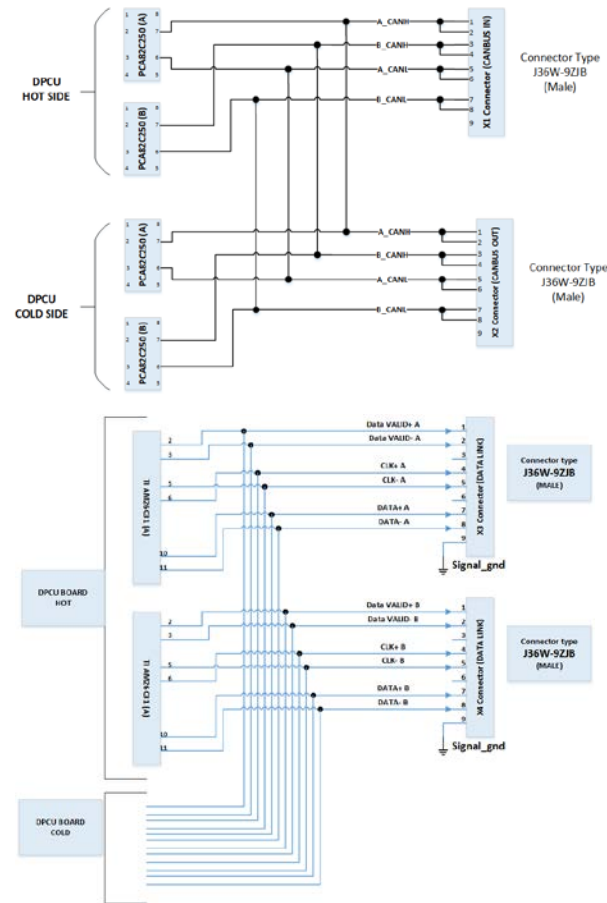- 2x RS422 interface to/from satellite.
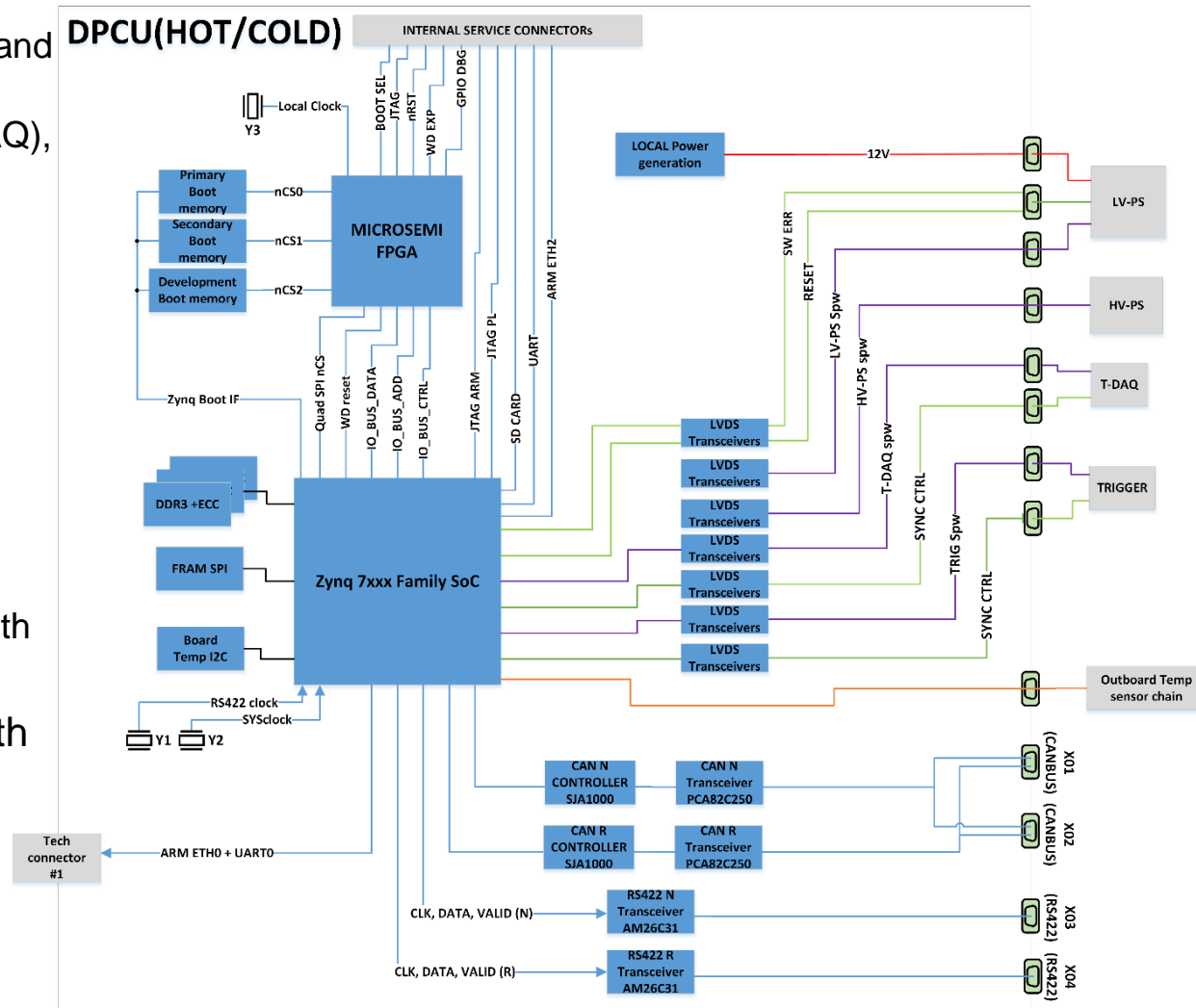
Spacewire INTERFACE

The Spacewire interfaces have been developed as evolution of those present in HEPD-01. Now the link work as slow control and scientific data transfer link. The interfaces are implemented on the SoC logic part and the LVDS physical layers are created through the use of LVDS transceivers mounted on the board.
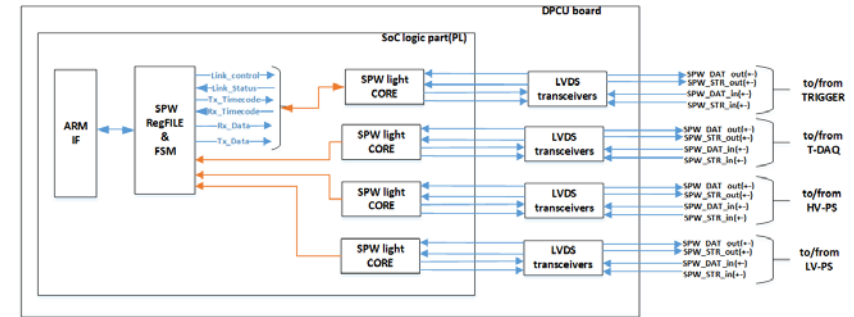
CANBUS INTERFACE

The DPCU board is designed for the management of two CAN bus channels (CAN A and CAN B) with the CAN2.0 standard and shall be able to manage communication on both channels. The two CAN channels are one nominal and one redundant but always active. Communication from DPCU to satellite on the CAN channel occurs only after a query made by the satellite's OBDH computer.

RS-422 INTERFACE

The two RS-422 interface on the DPCU board is dedicated to scientific data transfer to the satellite.
This interfaces are developed as a unidirectional (write only) serial peripheral interface (SPI) protocol on a physical layer using an RS-422 transceiver (texas instruments AM26C31).
The RS422 interfaces have:
- a nominal clock of 6 (± 0.5%) MHz,
- a data frame transmission interval of T1 = 5.5 ms (MAX) and of inactivity equal to a time T2 = 10us (min).

WATCHDOG MANAGEMENT

In order to monitor and manage the correct status of the DPCU, the board work with two distinct watchdogs with different timings. A local watchdog is implemented directly on the DPCU board, while an external one is implemented on the CTRL-LV board.

Thanks for your attention