A MTCA.4 Based System for the Control of Accelerator Magnets

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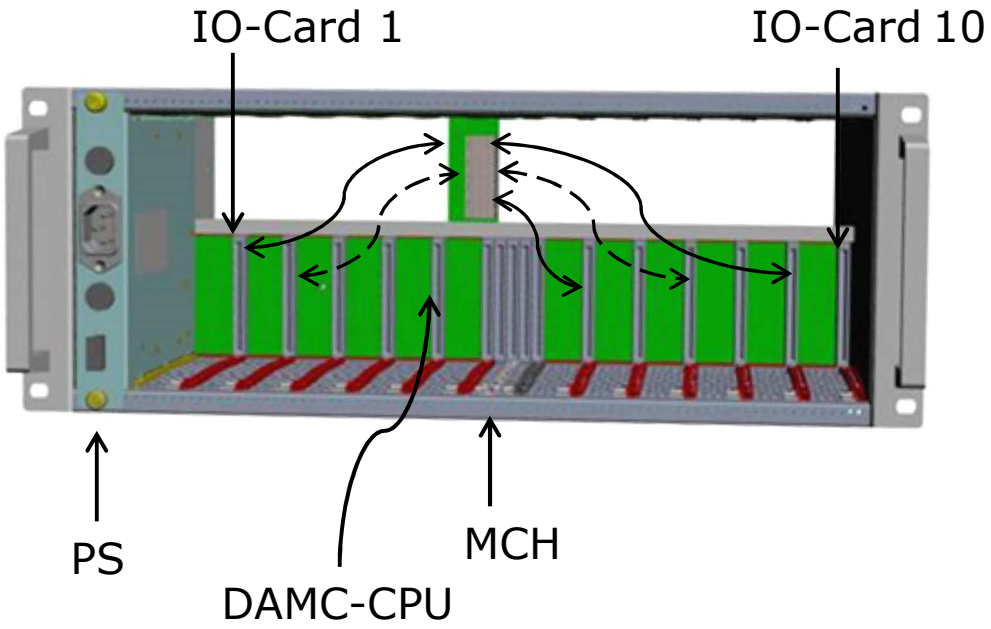
PROBLEM DOMAIN

- The existing control system based on the SEDAC– it is fieldbus developed by DESY in 1976!
- SEDAC COPSC have many different types of controllers, which are not compatible each to other
- Old system can not be supported now and should be replaced to modern solution
- Boundary conditions: as cheap as possible, standard, high precision and versatile solution
- MTCA.4 as prototype was selected for new control system

COPSC CRATE ARCHITECTURE

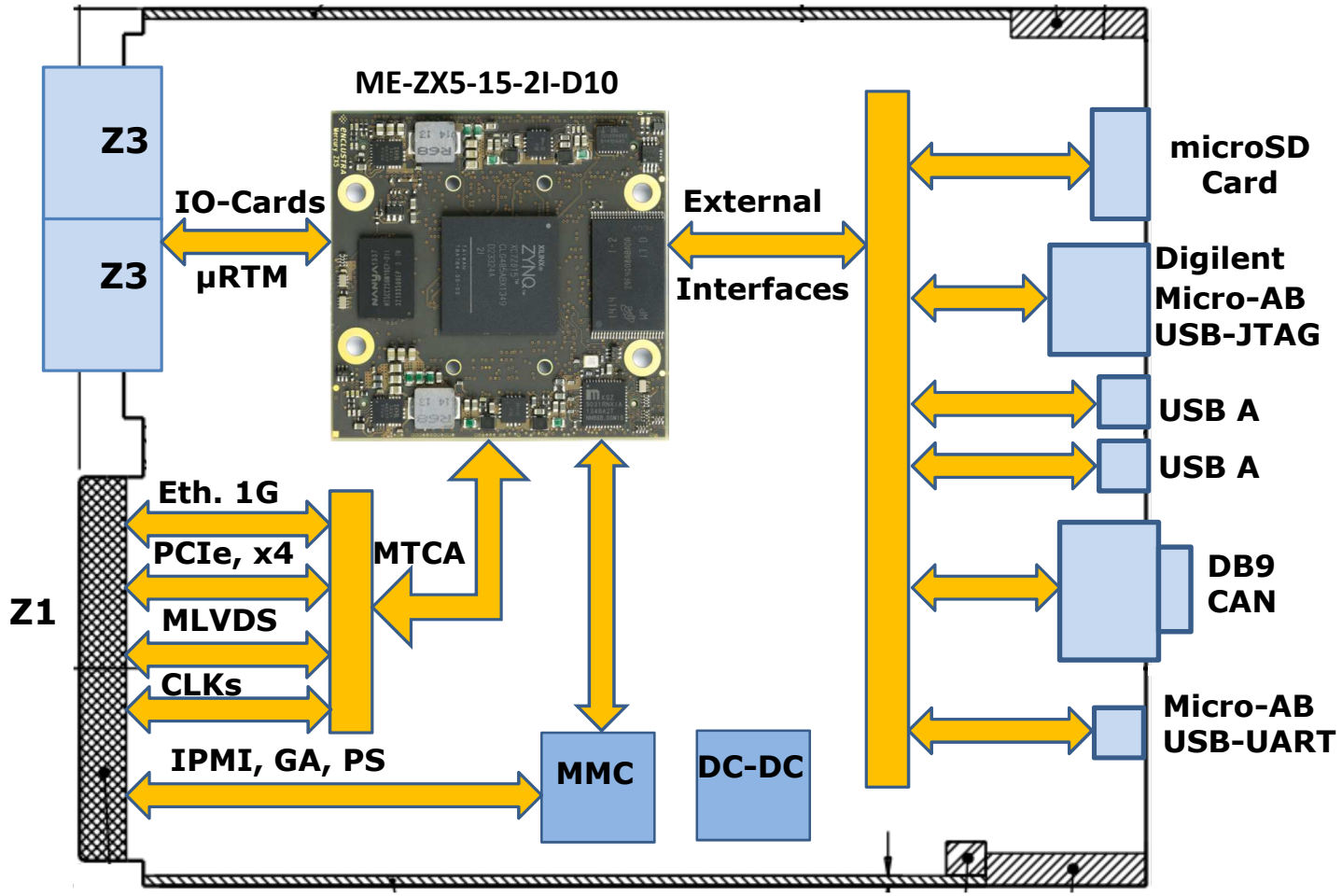
- Concept MTCA.4 based crate was presented already at last year
- Standard set of MTCA.4 features are supported by Backplane: IPMI, PCIe, Ethernet, MLVDS bus, CLOCKs etc.
- DAMC-CPU Z3 connectors to port 12-14 of IO-Card Z1connector
- Other application can be implemented in this crate
- NO cooling unit



DAMC-CPU Card Features

- The main part of DAMC-CPU board is Enclustra Mercury system-on-chip module ME-ZX5-15-2I-D10, which is based on the Zynq FPGA
- The DAMC-CPU board was designed by FEA and can be used as controller of IO-Cards, as simple MTCA.4 CPU or as AMC with µRTM interface
- The ZX5 boot options are defined by MMC
- The DAMC-CPU is Full Size, Double AMC
- Power consumption < 15 Watt
- Cost < 1000€

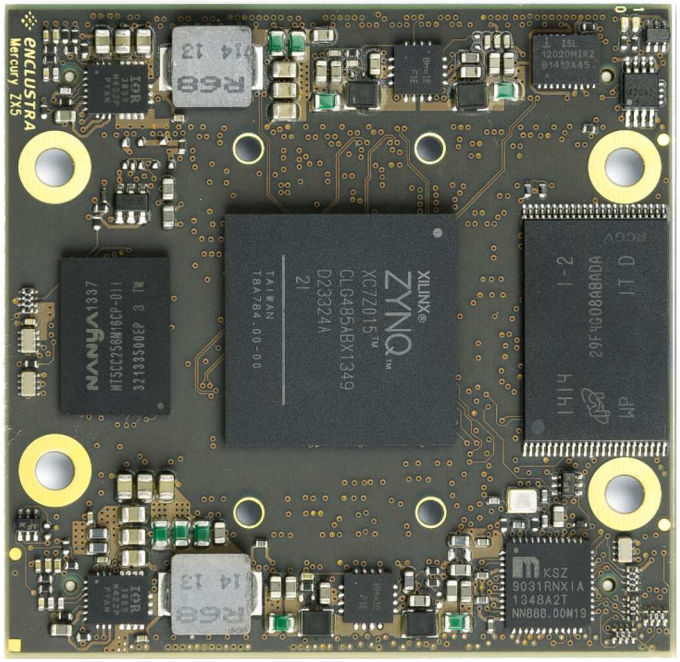
Block Diagram of DAMC-CPU



ZX5 Features

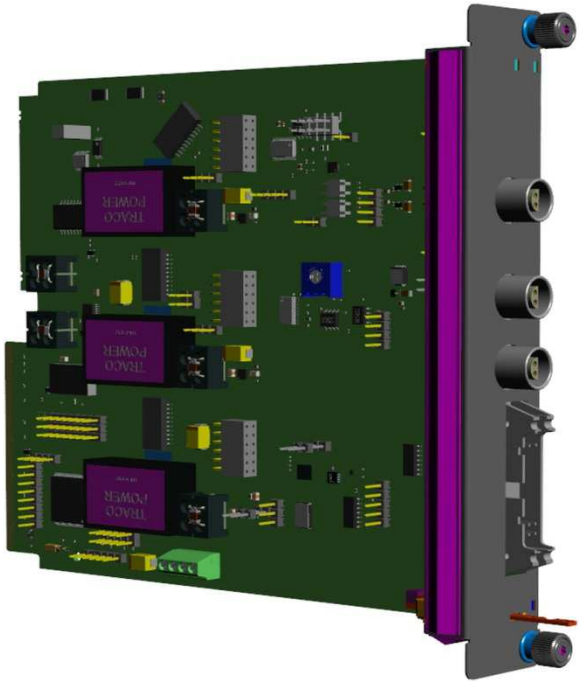
The Enclustra Mercury ME-ZX5-15-2I-D10 (ZX5) module includes:

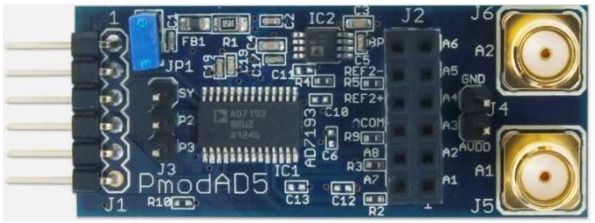
- Xilinx Zynq®-7015 SoC, with:
  - Dual ARM® Cortex™-A9 MPCore™ based processing system (PS)
  - Xilinx Artix-7 28 nm FPGA fabric based programmable logic (PL)
- PCIe Gen2 ×4, USB 2.0, Gigabit Ethernet PHY etc.
- 4 MGTs @ 6.25 Gbit/sec
- 1 GB DDR3L SDRAM, 512 MB NAND flash, 64 MB quad SPI flash
- 158 user I/Os:
  - 12 ARM peripheral I/Os (SPI, SDIO, CAN, I2C, UART)
  - 146 FPGA I/Os (single-ended, differential or analog)
- Small form factor (56 × 54 mm)
- 5 to 15 V supply voltage



Features Prototype IO-Card

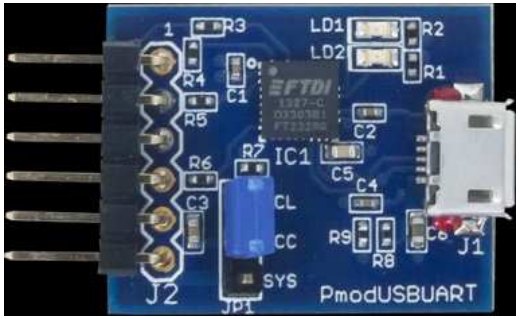
- Prototype IO-Cards has two implementations of ADC and DAC and Digital controller for management of external PS:
  - PMOD (Peripheral Module interface) devices
  - ON board placing components
- Different types of Magnet PS can be controlled by one type of IO-Card
- Every PMOD slot has SPI interface
- The IO-Card is made on a multi-layer PCB – 14 Layers
- Power consumption of IO-Card smaller than 10 W

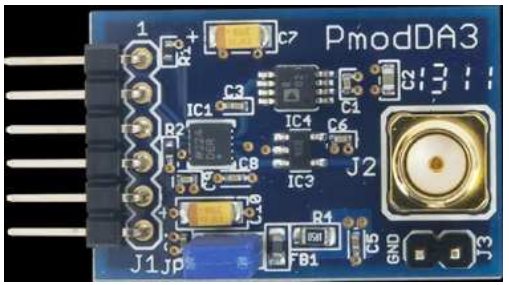


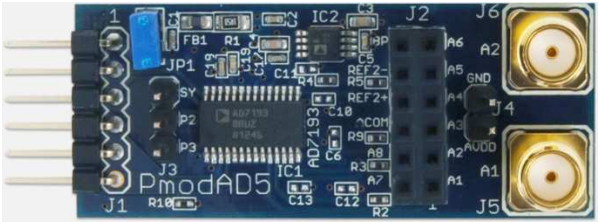


Features PMOD

- Pmod™ devices are Digilent's line of small I/O interface boards
- The PMOD cards usage are very attractive, because it allows to install different ADC/DAC with different parameters and with the same interface, for example - SPI
- IT is way to extend the capabilities of programmable logic and embedded control boards.

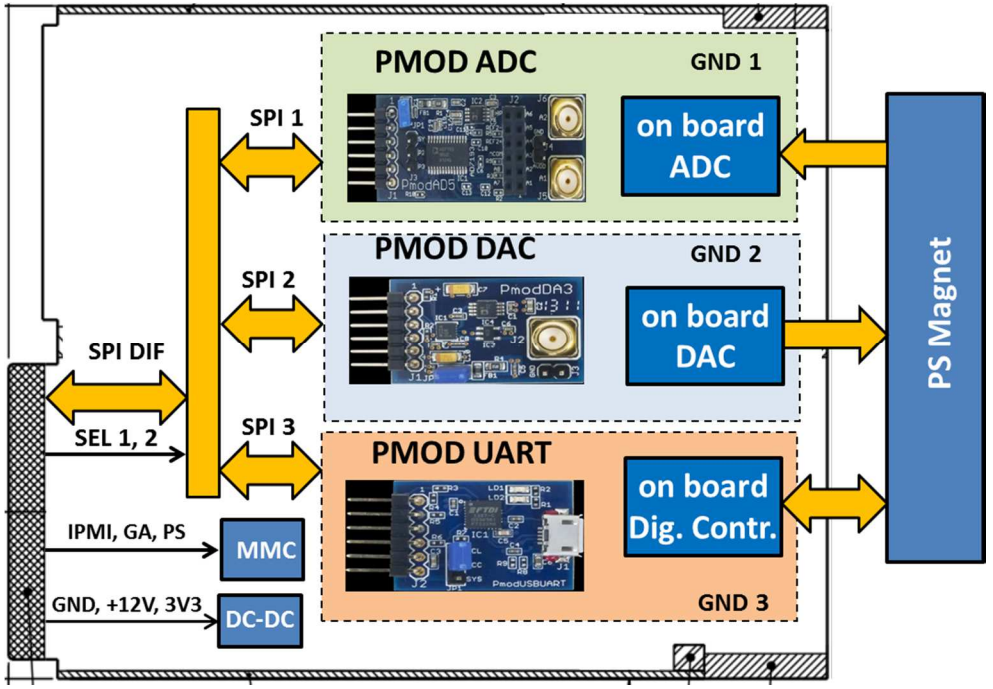






Block Diagram Prototype IO-Card

1. Backplane Z1 connector:
    1. card power – GND, 12V and 3,3V
    2. SPI – 4 diff signals and 2 single ended
    3. MMC interface – IPMI, GA[0:2], PS0, PS1, Enable
2. Power – DC/DC convertors and isolation components
3. MMC – micro controller, EPROM ID, temperature sensor
4. SPI interface – control, isolation, splitting and multiplexing
5. ADC – last version 24 bit ADC
6. DAC – last version 16 bit DAC
7. Digital interface – UART interface/ control and status signals



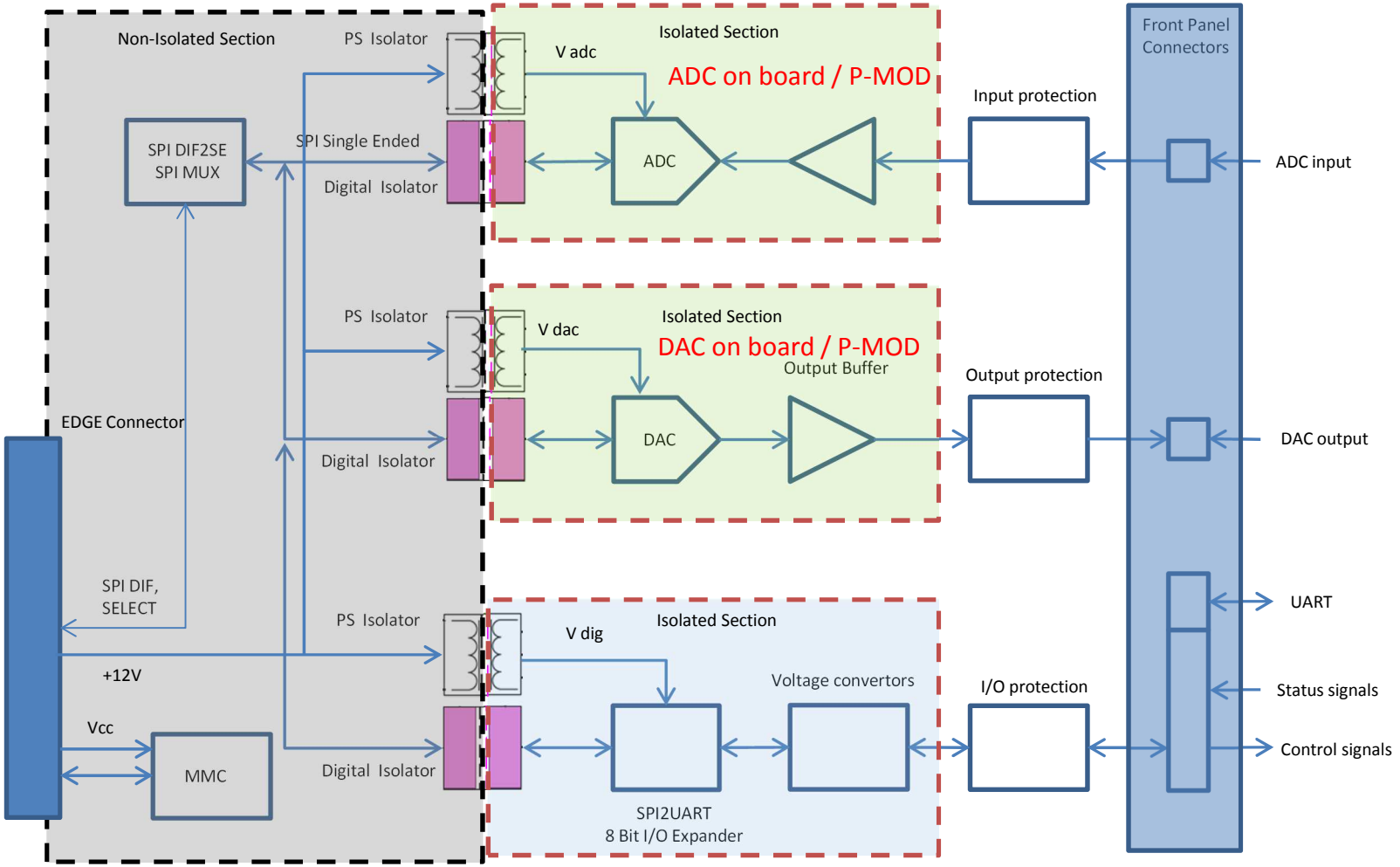
Status&Conclusion

- The prototype of IO-Cards in production now
- A DAMC-CPU board will run in production at the end of 2017
- COPSC crate, Power SUPPLY, MCH will be delivered in beginning, 2018
- Using mezzanine boards for DAMC-CPU and for IO-Card greatly simplifies the design and allows you to modify the system parameters without modifying the basic boards

Thank you for your attention!

Addendum

IO Card Block Diagram



Draft Backplane-Topology Project I/O-Crate Variante 5 Rev. 1.5