Open Hardware MTCA development at Warsaw University of Technology and Creotech Instruments SA

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R&D director at Creotech Instruments SA
Agenda

- A few words about Warsaw University of Technology
- A few words about Creotech Instruments SA
- What is Open Hardware
- OH MTCA.4 development at CTI and WUT
- WR-MCH
Warsaw University of Technology
Faculty of Electronic Systems

75 Professors
198 Assistant Professors
162 PhD students
15323 publications
3800 students

Institutes:

• The Institute of Control and Computation Engineering
• The Institute of Computer Science
• The Institute of Microelectronics and Optoelectronics
• The Institute of Radioelectronics
• The Institute of Electronic Systems
• The Institute of Telecommunications
Company history

Creotech Instruments S.A.:

- Creotech Ltd. was founded in 2008 by three scientists of Warsaw University and Warsaw University of Technology, who also worked at CERN, Switzerland.
- 2011 – joint-stock company Creotech Instruments S.A. was created, employment: 5 full time job equivalents (FTJE)
- 2013 – first cleanroom facility built 30m2, start of space projects
Company history cont.

Creotech Instruments S.A.:

- August 2014 – state owned Industrial Development Agency invested in Creotech – (the first investment of the Polish state in a private company after II WW), 14 FTJE
- November 2014 – second cleanroom built 120m2, 5 space projects in realisation (4 for ESA), 5 in logbook (4 for ESA), 4 projects for scientific facilities in realisation, 16 R&D projects, 35 FTJE (3 PhD, 28 engineers)
- December 2014 – 2 proposals on small satellite development and integration, automatic electronics assembly line
- February 2015 – certification of assembly line, 40FTJE
Who we are?

Our proprietary solutions were tested in international research projects.
Newly built 8 and 6 class clean-room with assembly line
Creotech technological base

- Imaging systems based on high-end, high resolution digital cameras
- Electronic signal processing systems
- Instruments and satellite subsystems
- Electronics assembly technologies according to IPC, MIL, ECSS standards
- Mechatronics manufacturing
We do it not only for science..

But interaction with scientific projects improves our skills and know-how
How the OHWR gives us business opportunity

- It's great place to advertise company capabilities, skills, expertise and collect more orders
- It's place to exchange ideas, collect feedback and product improvements
- Here the company may show realized projects and get recommendations
- Sharing hardware and firmware files encourages other companies to do the same and lets us gain part of their know-how
- Next products can be created much faster thanks to modification or re-use of existing ones, developed and tested by someone else
- Thanks to opening design files in early stage of product, other engineers may find bugs or suggest modifications which leads to better product – the peer review
- By sharing own product HW and FW files, company gets vantage over competition – some clients will choose such solution which they can control, modify or repair in the future (after warranty period)
How we started with OHWR: SPEC, SVEC, TDC/DTC

- SPEC, SVEC, FMC DEL, FMC DDS, were outsourced by CERN to CTI
- Several hundreds pieces produced by 3 companies
- Used worldwide
VME ADC board

- 36 ADC channels, simultaneously sampling
- 16 bits
- 250kHz
- 64MB of RAM
- MPV901 compatible
- Main application: SEM grids
- OHWR design

Product developed in close collaboration with CERN,
180 pieces produced
Application: Linac 4 SEM grid readout, DC transformer DAQ
CERN requested OH licensing in call for tender
Examples of successful OH projects

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Country</th>
<th>HW development</th>
<th>HW commercialisation</th>
<th>HDL development</th>
<th>SW development</th>
<th>Projects</th>
<th>Members</th>
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<td>Your trusted control system partner</td>
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Glossary

- HW development: Hardware development
- HW commercialisation: Hardware commercialisation
- HDL development: Firmware development (e.g. VHDL)
MTCA.4 development at CTI and WUT (OHWR)

- AMC FMC v2 (Artix 7)
- AMC FMC v3 (Artix 7) with RTM
- AMC FMC with Kintex 7 FPGA
- AMC QSFP (UltraScale) *
- MTCA micro-chassis
- AMC CPU
- RTM SFP
- AMC DSP *
- WR MCH
  * during development
AMC FMC board

- 7-series FPGA, Artix 200T
- Dual HPC FMC
- Flexible clock crossbar
- 2Gbit SDRAM@400MHz
- 2x 256Mbit FLASH
- Custom NXP MMC (open!)
- SCANSTA JTAG switch
- WR timing receiver

- Version 3.1 with RTM
- Used for GSI TMS, CBM, LNLS, CCFE and others
AMC FMC board – Kintex version

- 7-series FPGA, Kintex 350T
- Dual HPC FMC
- Clock crossbar
- 2Gbit SDRAM @ 800MHz
- 2x 256Mbit FLASH
- Custom NXP MMC (open!)
- SCANSTA JTAG switch
- WR timing receiver

- Version 1.0 with RTM
- Used for GSI CBM and passive radars
AMC FPGA QSFP board (CBM)

- Kintex Ultra Scale FPGA
- 6 QSFP, 24 x10Gbit/s optical links per board
- RTM for additional QSFP and SFP+ optical transceivers
- clock distribution circuit with crosspoint switch, VCXO, WR clock recovery
- DDR3 SRAM, 800MHz, 3 individual controllers
- Dual configuration FLASH.
- Stand-alone operation possible
- Coming soon
AMC-CPU-COM EXPRESS 6

- Troubles with Concurrent i7 CPU and Vadatech crate interoperability
- Own AMC-CPU designed.
- No more troubles with IPMI
- Recent i5 & i7 cores
- Supports SSC, FP1, FP2
- Gen 3 PCIe switch
- FPGA extension slot
- Plenty of IO, USB, eSATA, VGA
- mPCIe (WiFi, 3G modem)/ mSATA
- 2 gigabit ports with P0, P1 support
- Low cost, i5 CPU < 2k EUR
RTM-SFP+8

- Compatible with:
  - AMC-FMC v3
  - AMC-FMC-K (AFCK)
  - WR-MCH*

- 8 SFP+ cages
- Clock input and output
Two slot micro chassis

- 2 AMC slots
- Ports 0, 1 as SFSP+
- FP as QSFP
- Configurations:
  - CPU+AMC
  - AMC+AMC+2xPCle over fibre
  - AMC+AMC +2x 10Gb Eth over fibre
- RTM version in development
- Stainless steel, industrial temp range
- Applications: passive radars, remote sensing and protection in Tokamaks
AMC DSP accelerator – 16 cores with flexible crosspoint switch

- 16 TI DSP cores
- Artix FPGA
- Crossbar switch
- 2x 20Gbit quad lane mSAS connectors
- 2x Gigabit Ethernet
- Designed for GEM detector signal processing
- Prototype stage
FMC development – boards compatible with AFC/AFCK

- FMC ADC 100M 14b 4CHA
- FMC ADC 125M 14b 16cha
- FMC DAC 100M 12b 16cha
- FMC ADC 130M 16B 4cha
- FMC ADC 250M 16B 4cha
- FMC TDC/DTC
- FMC DEL 4cha 1ns
- FMC fast DIO 5
- FMC DIO32
- FMC LVDS32*
- FMC HV +/- 8kV *
- FMC SENS 12cha *
- FMC DDS (WR-RF)
- FMC ADC 125M 14b DAC 600M 16b
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