LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

LMU – Cluster Universe
Stefan Rummel

Update on Power Supply development

7th International meeting on DEPFET detectors

6.02.11-9.02.11 Bonn

Overview

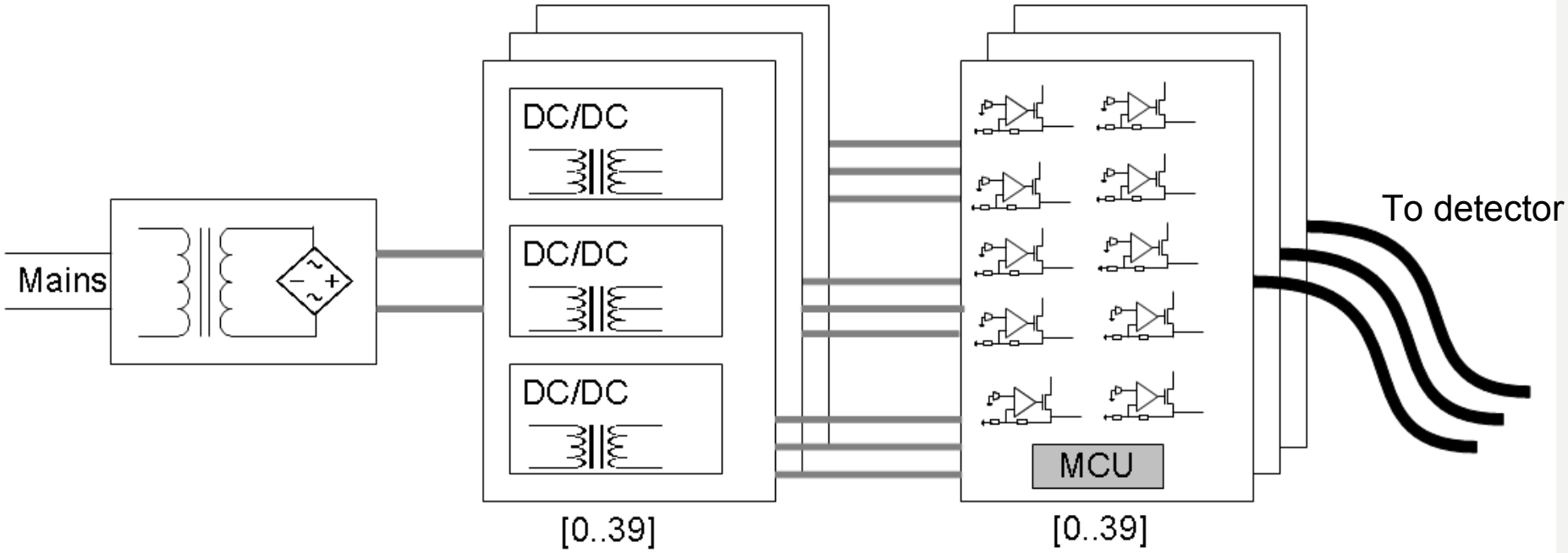
- PS project schedule – way towards the PXD PS
- PS architecture – from mains to LV
- PS architecture – System & Digital steering
- Update on firmware development
- Multichannel prototype – MIMA PS

Project schedule

- Important milestones:
  - Requirements analysis **DONE**
  - Demonstration regulation under realistic conditions (cable, distance, noise, transients...) **DONE**
  - Development of steering, read back, PS slow control **ONGOING**
  - Demonstration of multi module operation, safety features
  - Reliable prototype for testing of ladders in 06/2012
  - Commissioning beginning of 2013

System architecture

System architecture – mains to detector



- AC/DC conversion
- 230V → LV

Commercial component

- Secondary voltage generation
- Electrical isolation
  - Analog
  - Analog low current
  - Digital

- Primary voltage generation
- Linear post regulation
- Steering
- Readback current voltage
- Current- voltage limiting

In house development

System architecture – mains to detector

- "out of the shelf" power LV PS, O(kW)
  - Available
  - Compliant with safety regulations

- Issues related to this approach
  - Need good filtering both input and output of DC/DC converter
  - Stability
  - Assure that faults on DC/DC level have no impact on primary supply

→ DC/DC converter card for multichannel PS prototype incorporates measures to deal with this

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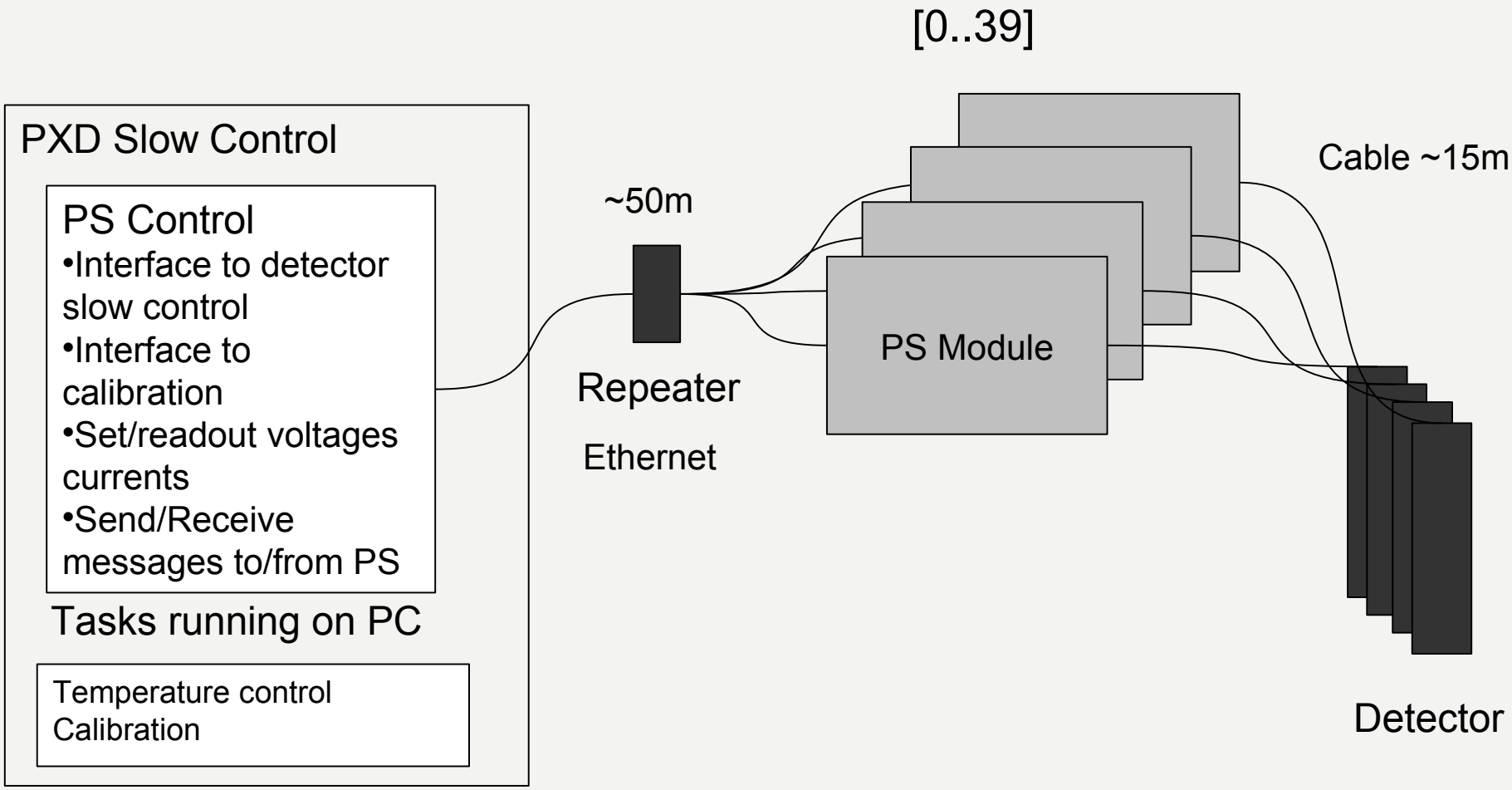
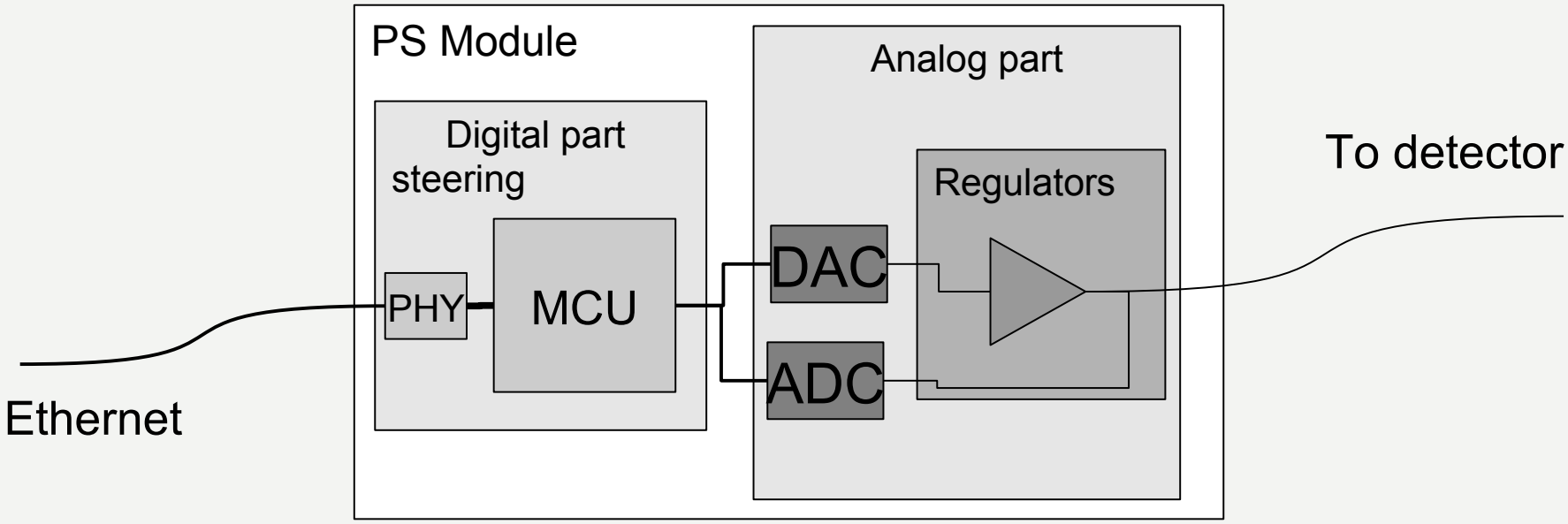
System architecture / Slow control

Power supply - System architecture



Power supply - System architecture



- Steering via MCU – ARM
- Interface to ADC/DAC's via SPI
- Integration into slowcontrol via ethernet

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Update on firmware development

Firmware development

- Firmware – TUM/Fortiss; Chair for Robotics and Embedded Systems
- Project work: Simon Barner
- Schedule:
  - First year (requirement analysis, fault tree analysis, implementation)
  - Second year (debugging phase, fine tuning)

→ See talk by Mr. Barner later on

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Multichannel prototype

Multichannel prototype

- Motivation
  - Multichannel prototype to study
    - System effects
    - Operation
    - Voltage and current readback
  - PS for MIMA setup
  - PS for TB's

- Features
  - Using our prototype regulator
    - Variable hardware current limit
    - Remote sensing
    - Status outputs – current limit, over temperature
    - Voltage settable down to 0V
  - 16 Channel inc. settable - 250V HV channel
  - Readback of voltages and currents
  - Steering done via multichannel DAC PCI and ADC card

As needed in final PS

MItch. Prototype - architecture

- DC/DC converter card
  - 3 isolated domains – analog, steering, digital
  - Hot swap controller with over current protection
- Linear regulator card with 16 Channel
- Steering / voltage- and current read back
  - 32 Ch. DAC card for voltage and current limits
  - Combined 4 Ch. diff. input ADC / 32bit digital IO card

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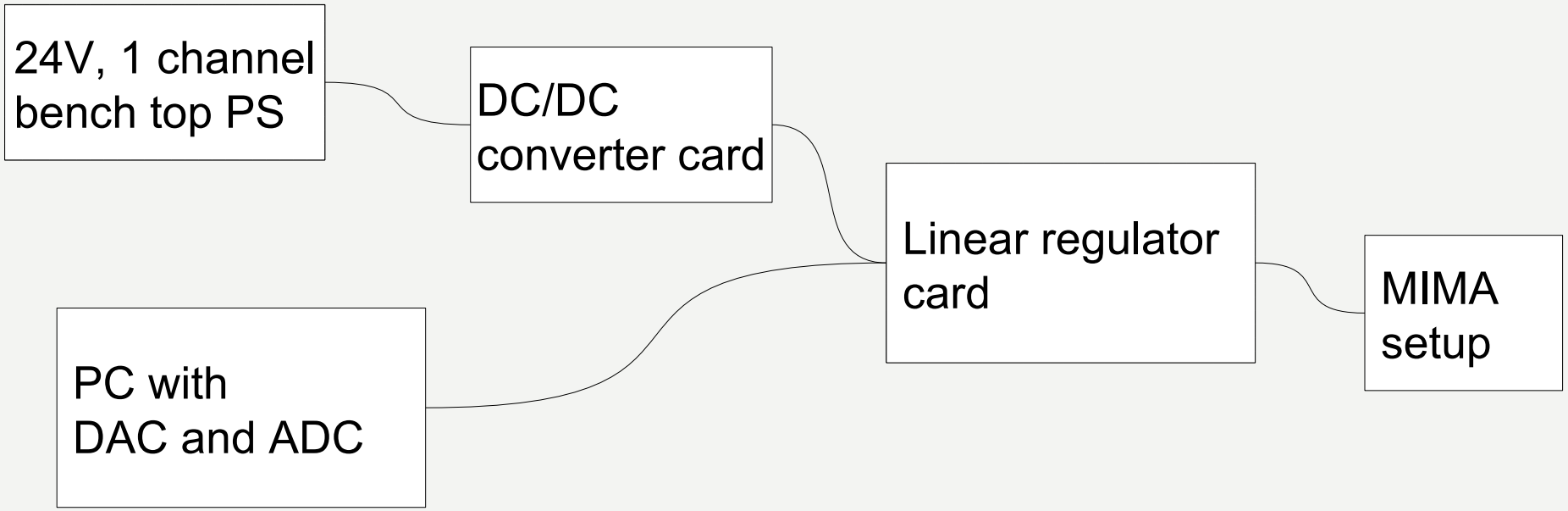
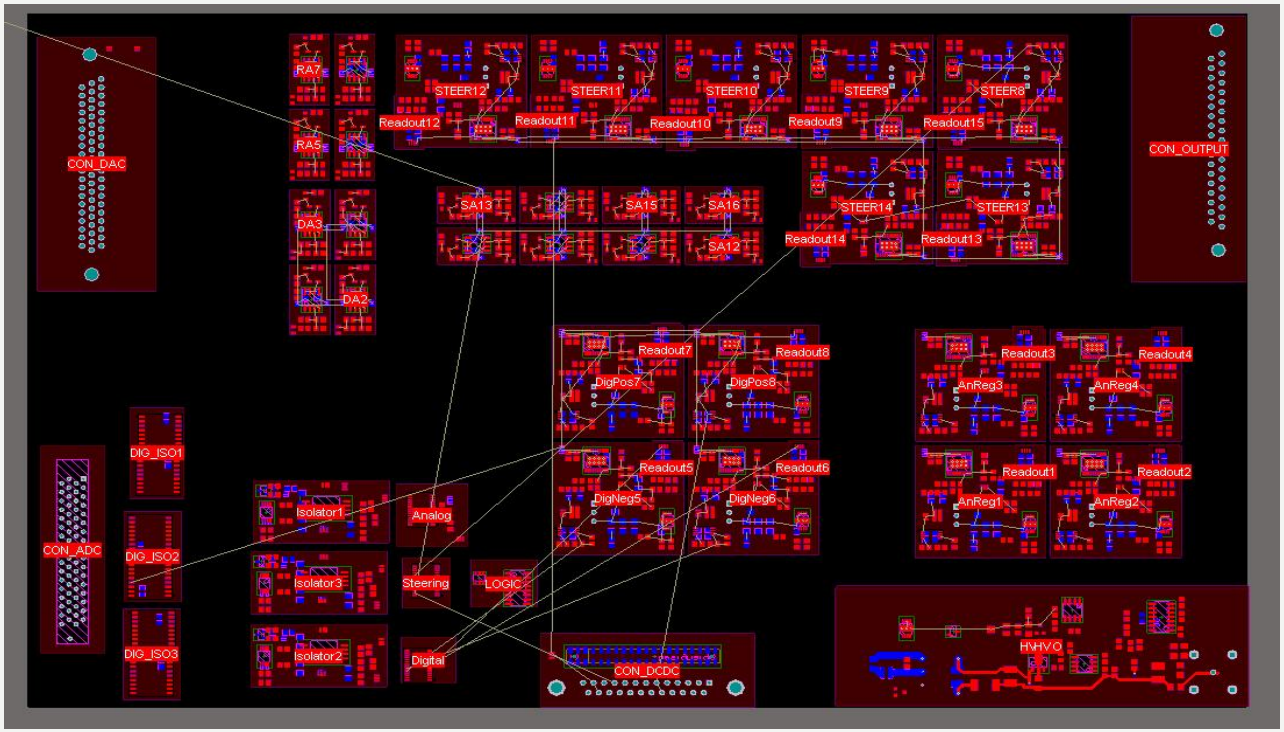


MItch. Prototype - Regulator card

- Main ingredients:
  - 16 channel regulator
  - Level adjustment - derive voltage- and current limit- set value from DAC
  - Readback
    - Current sense amplifier
    - Voltage sense
    - Level adjustment and single ended to diff. conversion to drive ADC
    - Analog multiplexer - 8 regulator ch one ADC channel
    - Optional analog isolation
  - Digital steering
    - Shutdown
    - Multiplexer channel selection
    - Power OK (OVC v (DC/DC power ok))

MItch. Prototype - Regulator card

- Footprint - 320mm * 200mm – double “Eurocard”
- Heat sink with 13K/W foreseen for each regulator
- Layout highly repetitive
  - One regulator layout
  - Interfaces similar, adjustment DAC – set voltages



Next steps

- PCI ADC / DAC replacement - “Digital Steering Board”
  - ADC / DAC board with SPI interface

  → Hardware to test firmware developments

- Adapt DC/DC converter boards to final requirements

- Together with the “Digital Steering Board” we have a prototype close to the final PS – from both the analog and digital point of view

Summary

- Concept for PXD power supply system is there
  - Power conversion architecture
  - Digital steering
  - Analog part

- Started an effort on a first multichannel prototype for the MIMA setup (~ March)

- Firmware effort has started

- Next steps incorporating ADC and DAC's

→ Full scale prototype by end of this year

Backup