Status of the DCS for the $\overline{\text{P}}$ANDA EMC

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EMC DCS Overview

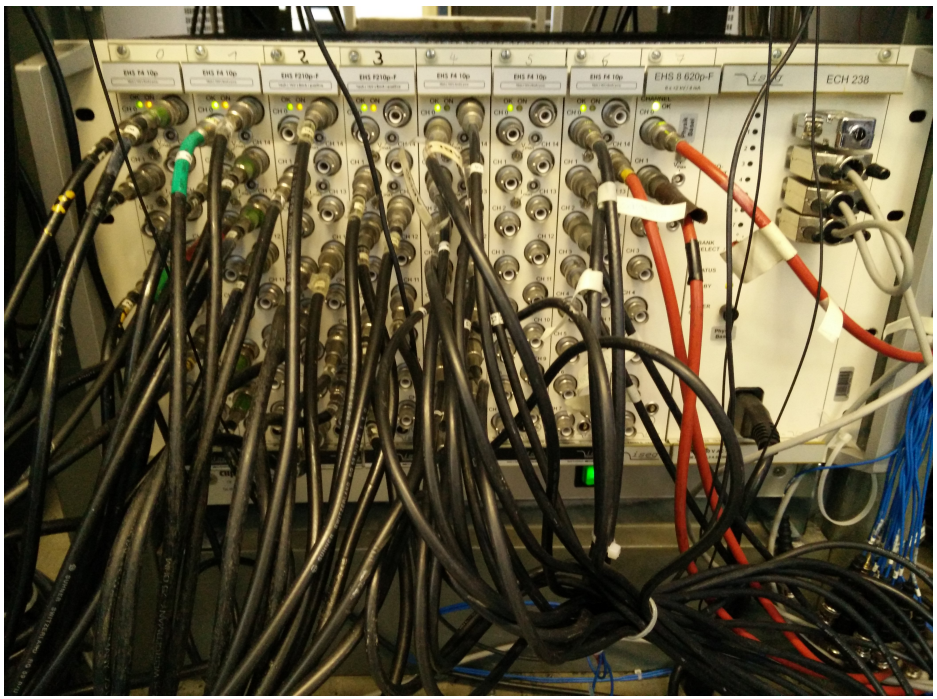
- High Voltage: iseg EHS
- Low Voltage: Wiener PL512
- Custom Hardware:
  - **T**emperature and **H**umidity **M**onitoring Board for $\overline{\text{P}}$ANDA (THM$\overline{\text{P}}$)
  - LED Pulser
  - Sampling Analog-Digital Converter (ADC)
  - ADC Crates
  - Photosensor Voltage Regulation System
- Cooling System: prototype currently tested, final system not yet decided

DCS Software Status

- No (final) hardware, software development not possible:
  - Cooling System
  - SADC and Crates
  - Photosensor Voltage Regulation System
- EPICS Device Support available:
  - iseg EHS
  - Wiener PL512
  - THM$\overline{\text{P}}$
  - LED Pulser
- CS-Studio OPI for lab use:
  - iseg EHS
  - Wiener PL512
  - THM$\overline{\text{P}}$
  - LED Pulser

High Voltage: iseg EHS

- Modular system
- Polarity, maximum voltage/current, and measurement precision determined by module type
- Communication: CAN bus
- Newer crates have integrated PC

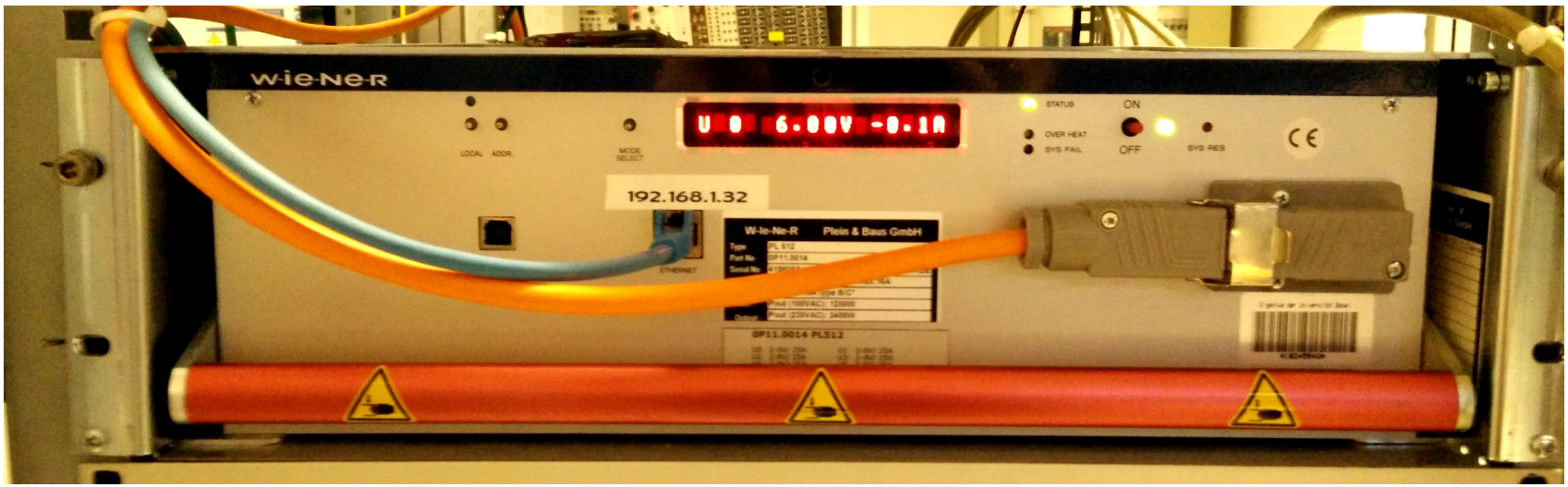


Device Support for iseg EHS

- iseg Hardware Abstraction Layer (isegHAL)
  - Daemon communicates with iseg devices via CAN bus
  - Uses SocketCAN framework to access CAN
  - Client library to access data from daemon
  - Daemon and client communicate via Unix domain socket
- EPICS device support by F. Feldbauer implements client
  - Supports all parameters of all iseg devices
  - EPICS clients informed about every change without the need to poll regularly
  - New iseg crates with internal PC contain EPICS and this device support by default
  - Available to all $\overline{\text{P}}$ANDA groups

Low Voltage: Wiener PL512

- Modular system
- Voltage range, maximum current, measurement precision determined by module type
- Communication: Ethernet – UDP/IP
- Protocol: Simple Network Management Protocol (SNMP)



Device Support for Wiener PL512

- devSNMP[1] provides EPICS device support for SNMP-controllable devices
- No programming work necessary
- SNMP parameters can directly be used in EPICS database
- EPICS database file for PL512 available from us for all $\overline{\text{P}}$ANDA groups
- Parameters regularly polled via fanout records

[1] `https://groups.nscl.msu.edu/controls/files/devSnmp.html`

Temperature and Humidity Monitoring Board for $\overline{\text{P}}$ANDA

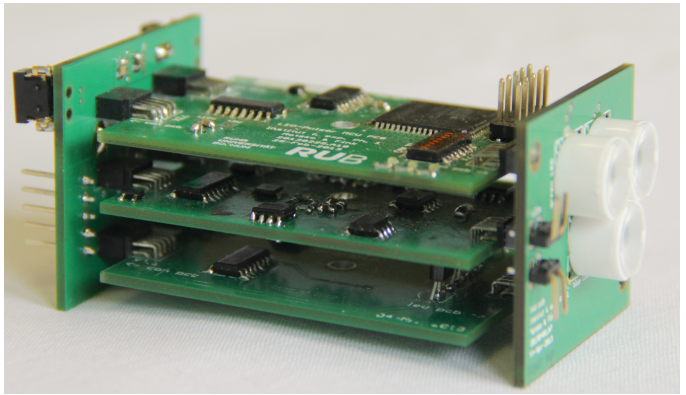
- Mainboard with eight slots for measurement piggy-back boards (PBBs)
- Different PBBs for different measurement tasks
  - Temperature via Pt100
  - Temperature via NTC thermistor
  - Humidity
  - Pressure
- PBB converts measured parameter into voltage signal
- 14-bit ADC on the mainboard
- CAN bus

Device Support for the THM$\overline{\text{P}}$

- Custom hardware $\Rightarrow$ custom device support
- CAN access based on SocketCAN
- THM$\overline{\text{P}}$ asked to send all data at a regular interval
- THM$\overline{\text{P}}$ sends raw ADC conversion via CAN bus
- Conversion to °C, mbar, %RH done via EPICS calc record
- Calibration parameters in EPICS database
- In addition, THM$\overline{\text{P}}$ test software without EPICS dependency available
- THM$\overline{\text{P}}$ hardware and software available to all $\overline{\text{P}}$ANDA groups

LED Pulser for the EMC

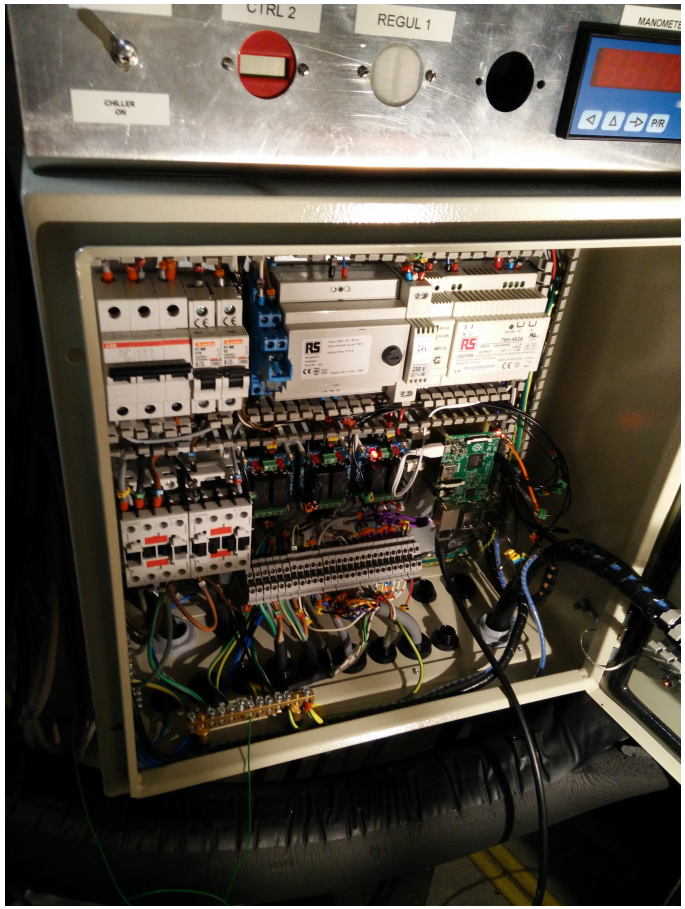
- LED Pulser to monitor complete readout chain
- Keep track of radiation damage in scintillation crystals
- Three colors: red, green, blue
- Blue LED pulse similar to scintillation pulse of $PbWO_4$
- Pulse intensity variable by LCDs
- Internal and external trigger
- CAN bus



- Again: custom hardware $\Rightarrow$ custom device support
- Architecture similar to THM$\overline{\text{P}}$ device support

Cooling System Prototype

- Capable of cooling a part of the EMC (Forward Endcap and a single Barrel slice), $P_{\text{cool}} = 12\,\text{kW}$
- Cooling liquid: 60 % CH_3OH and 40 % H_2O at $-25\,^{\circ}\text{C}$
- To be used for the preassembly at FZ Jülich
- Chiller accessible via Modbus
- In addition, several relais connected to GPIOs of Raspberry Pi
- USB-Modbus converter also connected to Raspberry Pi



DCS for the Cooling System Prototype

- Modbus device support for EPICS: devModbus[2]
- Again no programming work necessary
- Custom device support for the GPIOs of the Raspberry Pi
- Device support for the Raspberry Pi also supports I^2C and SPI via the GPIO pins
- Used for several test setups for flow, pressure, and temperature regulation

[2] `http://cars9.uchicago.edu/software/epics/modbusDoc.html`

EMC Prototype “Proto192” – also DCS Prototype

- Before starting mass production, concepts and components for the EMC were tested in the “Proto192” for several years.
- Five beamtimes at CERN, Mainz, and Bonn
- “Proto192” had full DCS: Power supplies, cooling, temperature/humidity/ pressure/flow readout

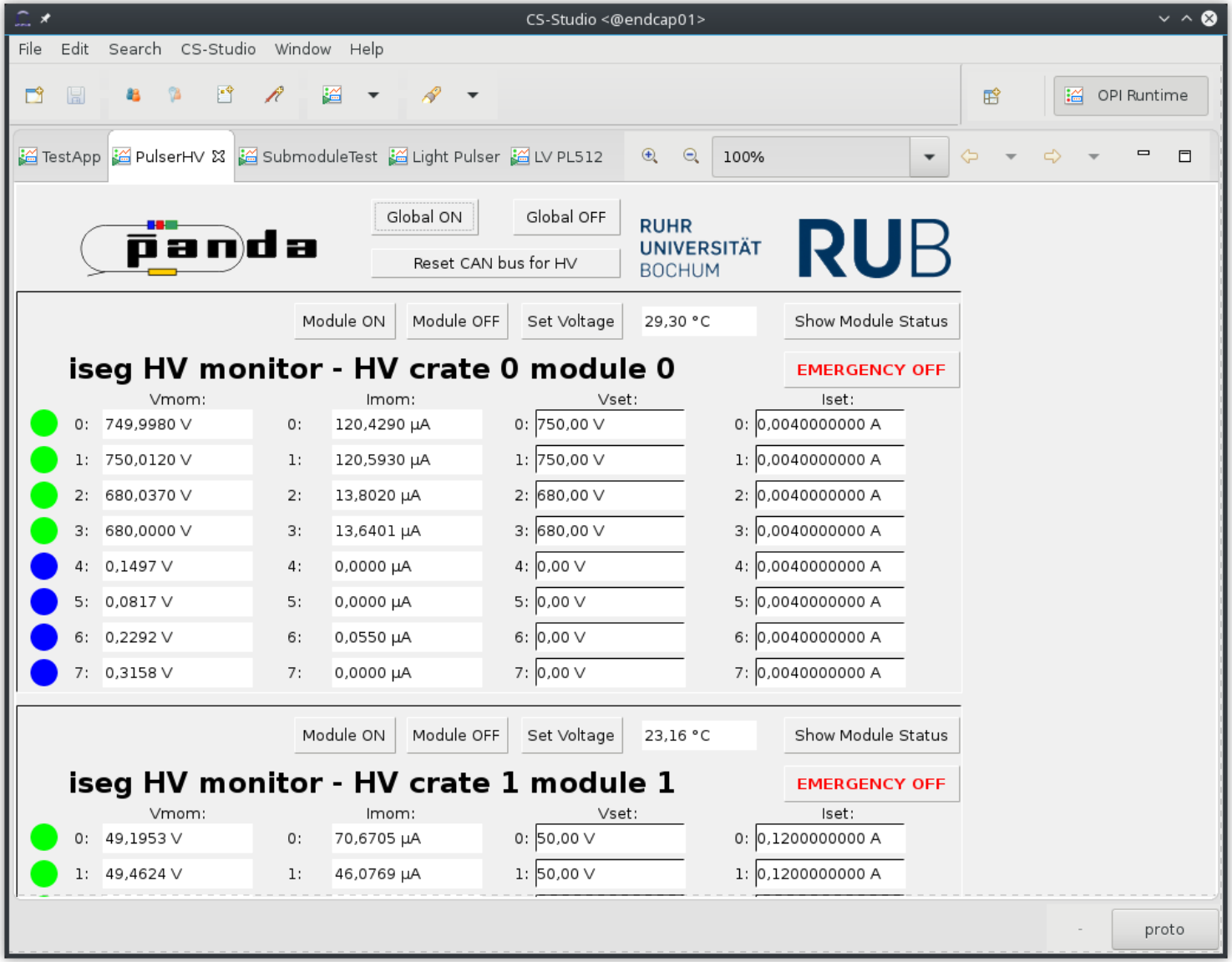
- CS-Studio archiving system with PostgreSQL database
- Alarm server with notification system

$\Rightarrow$ More details: See section 4.3 in the DCS TDR draft

Current EPICS Usage at Bochum EMC Group

- “Proto192” dismantled to re-use $PbWO_4$ crystals
- Mass production for EMC Forward Endcap in progress
- Several teststands for detectors, units, and submodules
- High and low voltage operated via EPICS
- LED Pulser controlled via EPICS
- Temperature readout via THM$\overline{\text{P}}$ and EPICS
- CS-Studio OPIs engineered for use at teststands
- Modular layout, some parts may later be re-used for the expert OPIs at $\overline{\text{P}}$ANDA

Example of CS-Studio OPI



Summary

- DCS for the EMC in advanced state
- Device support for iseg HV, Wiener LV, THM$\overline{\text{P}}$, LED Pulser, test setups, etc.
- Developments from Bochum available to all other $\overline{\text{P}}$ANDA groups/institutes

Thank you for your attention!