

Detector Control System for the ALICE Time Projection Chamber

U. Frankenfeld¹, P. Braun-Munzinger¹, C. Garabatos¹, R. Renfordt², H. Sann¹, H.R. Schmidt¹,
H. Stelzer¹, D. Vranic¹, J. Wiechula²

¹GSI Darmstadt, ²University of Frankfurt

The Time Projection Chamber (TPC) is the main tracking detector of the ALICE Experiment at the CERN Large Hadron Collider (LHC). The Detector Control System (DCS) of the TPC controls the following subsystems: high voltage (108 channels), low voltage (72 channels), gas system, cooling system (40 circuits), laser system, front-end electronic (216 read-out control units) and the drift voltage of the field cage. Its functionality includes: switching the sub-systems on/off, monitoring and logging of relevant detector parameters, stabilizing of the temperature in the sensitive volume of the detector and reporting and logging of alarm conditions.

The TPC Control is part of the hierarchical Control System of Alice. During normal operation the shift crew controls the detector at the highest level (Experiment Control System). No specialized knowledge about the sub-detectors is required. This implies that the DCS has to have the appropriate functionality built in, for example setting the voltages in the right order.

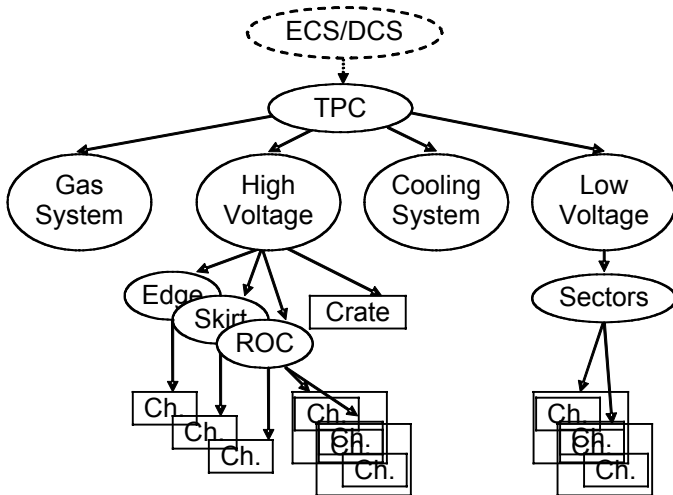


Figure 1: The hierarchical control system prototype.

A prototype of the hierarchical control system containing the high voltage for the readout chambers and the low voltage for the front-end electronic has been developed (Fig 1). It is implemented in the PVSS2 SCADA system from ETM [1]. The Finite State functionality is realized with the PVSS2 implementation of the SMI++ tool package [2].

The HV and LV channels are grouped according to operational needs, e.g., switching on/off two voltages for a sector simultaneously.

The Control system is connected to ISEG HV modules via an OPC server (OLE for Process Control) [3]. It is operated with 48 channels; the remaining 60 channels were simulated within the PVSS system. One Wiener PL 500 power supply with three channels was connected to the system; the remaining 69 channels were simulated.

The different tasks like grouping the different channels or connecting the logical units to the hardware are realized in

several PVSS2 scripts. Those scripts can be interpreted at different PVSS control managers to allow a load balancing and avoid an interference of the sub-systems. The managers can be distributed on different CPUs.

The prototype control system will be used with a reduced number of channels (2 LV + 3 HV) for the operation of an inner readout module in a beam test.

Measurements have been carried out to study the behavior of a DCS controlled temperature regulation system. An inner readout chamber without a wire planes is mounted into a temperature stabilized box. Inside the box temperature sensors (PT 1000) are glued to the pad plane. The sensors are readout with an ELMB ADC [4]. Four front-end cards (FEC) are mounted onto the chamber outside the box. The FEC are connected to a low voltage power supply and to a cooling system. In this set-up the measured heat transfer to the pad plane while switching on the FECs is 0.18 °C with a relaxation time of approximately 30 minutes. In the Alice TPC the temperature of the FEC cooling can be set for each sector individually to adjust to the power consumption: Figure 2 shows the temperature of the pads under the electronic (a) and in a distance of 10 cm (b) while switching off the FECs and increase the cooling temperature (c) simultaneously. The temperature under the FECs only changes by 0.05 °C whereas at the distant pad the temperature remains stable. The temperature change is well within the required range of 0.1 °C [5]. The set-points for the cooling circuits of the ALICE TPC have to be fine tuned during commissioning.

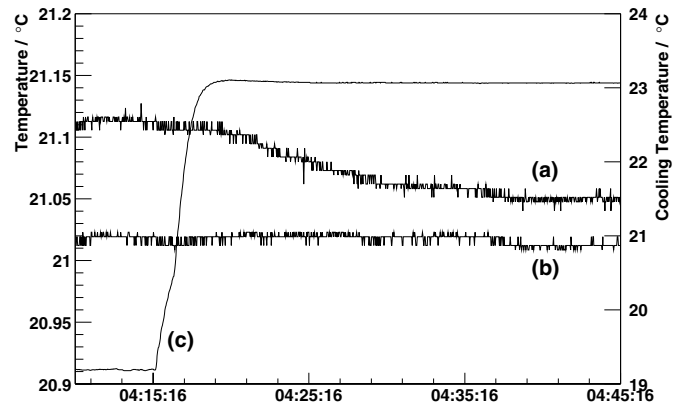


Figure 2: Switching off the FECs and increasing the cooling temperature simultaneously.

References

- [1] <http://www.etm.at>
- [2] <http://itcobe.web.cern.ch/itcobe/Projects/Framework/>
- [3] <http://www.opcfoundation.org/>
- [4] <http://atlas.web.cern.ch/Atlas/GROUPS/DAQTRIG/DCS/ELMB/>
- [5] ALICE TPC Technical Design Report