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Test and commissioning of the CARLOS control boards for the ALICE Silicon Drift Detectors

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The paper presents the test strategy and its results during the installation of the CARLOS end ladder board. This board is able to compress data coming from one Silicon Drift Detector (SDD) front-end electronics and to send them towards the data concentrator card CARLOSrx in counting room via a 800 MBit/s optical link.
The paper describes the integration of the CARLOS end ladder boards, including its cooling system, mechanical supports, the low voltage distribution, various signal cables and optical fiber patch panels. The complexity and installation sequence require tests at each step of the installation.

Summary

The Inner Tracking System (ITS) of the ALICE experiment contains six coaxial cylindrical layers. Layers 3 contains 14 ladders each one hosting 6 SDDs (Silicon Drift Detectors), while layer 4 contains 22 ladders each one hosting 8 SDDs. The CARLOS end ladder board is placed on both sides of each ladder with the purpose of acquiring and compressing data coming from each SDD before sending them towards the data concentrator card CARLOSrx in counting room through optical fibers. The board contains the compression chip CARLOS that performs a bi-dimensional compression of the data coming from the SDD front-end electronics (called SDD module). CARLOS 16-bit output bus is encoded with 8B/10B Ethernet protocol and sent to a 800 MBit/s single mode optical fiber using a 1310 nm optical laser.
The CARLOS end ladder board receives the trigger signals and the configuration parameters through a 40 MBit/s serial signal coming from CARLOSrx through an optical fiber and converted using a photodiode.
An other photodiode is used for receiving the 40.08 MHz clock coming from the TTC system. The QPLL ASIC on the end ladder board allows to obtain a clock with a peak-to-peak jitter lower than 50 ps that is used both for the serializer (ASIC GOL) of the board and for the front-end electronics.
A special control unit has been developed with the purpose of monitoring parameters such as voltage, current and temperature related to the whole readout chain. The control unit is remotely controlled from the DCS (Detector Control System) board through the I2C bus. The CARLOS end ladder board also provides power for the analog and digital voltages of the front-end boards under the control of the DCS system.
Each ladder has been tested with the use of the complete readout electronics system, developed for ALICE SDD experiment, including its cooling system. The same test was repeated when the ladder was assembled in cylindrical layers (layer 3 and 4) and, in particular, the noise level due to different ladders working at the same time was observed. The system was successfully tested, especially for what concerns data transmission and reception of information via optical links (780 Optical Links are used to process signals from the SDD-detectors and to send the results to the off-detector electronics). Moreover the low voltage distribution and the DCS feature were fully tested and the results confirm the efficiency of the readout electronics, chosen for ALICE SDD experiments, which is integrated in the CARLOS end ladder board.

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