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Experiences and Lessons Learned from the End-of-Substructure card production of the ATLAS ITk Strip Upgrade

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The ATLAS Strip Tracker for HL-LHC consists of individual modules of silicon sensors and front-end electronics. The modules are mounted on carbon-fiber substructures with 14 modules per side. An End-of-Substructure (EoS) card connects up to 28 data lines to lpGBT and VL+ ASICs that provide data serialization and 10 GBit/s optical data transmission to off-detector systems, respectively. The EoS is powered by a dedicated DC-DC converters. As the production of ˜2000 EoS cards and DC-DC converters is close to completion, we report on production experience including detailed QC statistics. We conclude with a few lessons learned during the project duration.

Summary (500 words)

The silicon tracker of the ATLAS experiment will be upgraded for the upcoming High-Luminosity Upgrade of the LHC (HL-LHC). The main building blocks of the new strip tracker are modules that consist of silicon sensors and hybrid PCBs hosting the read-out ASICs. The modules are mounted on rigid carbon-fiber substructures, known as staves in the central barrel region and petals in the end-cap regions, that provide common services to all the modules. At the end of each stave or petal side, a so-called End-of-Substructure (EoS) card facilitates the transfer of data, power, and control signals between the modules and the off-detector systems. The module front-end electronics transfer data to the EoS card on 640 MBit/s differential lines. The EoS connects up to 28 data lines to one or two lpGBT chips that provide data serialization and uses a 10 GBit/s versatile optical link (VL+) to transmit signals to the off-detector systems. The lpGBT also recovers the LHC clock on the downlink and generates clock and control signals for the modules. To meet the tight integration requirements in the detector, several different EoS card designs are needed. Custom-made holders and clamps are produced to guide cables and optical fibers as well as to shield the sensors from the opto-electric system. The power to the EoS is provided by a dedicated dual-stage DC-DC package providing 2.5 and 1.2 V to the EoS cards. As the EoS production of almost 2000 EoS cards and accompanying DC-DC converters is getting close to completion, we report on the production experience including detailed QC statistics and design validation (QA) results. We will conclude with some “lessons learned”during the duration of this project.

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