

The Prototype Design of PEB - a Component of the HGTD In-detector Electronics for the ATLAS Phase-II Upgrade

The High Granularity Timing Detector (HGTD) is proposed as a part of the ATLAS Phase-II upgrade to mitigate the impact of pileup on object reconstruction by precisely measuring the time of tracks. In addition, HGTD also provides an instantaneous measurement of the luminosity. HGTD is composed of 8032 front-end modules. Each module consists of two Low Gain Avalanche Detectors (LGADs) of approximately $2 \times 2 \text{ cm}^2$ bump-bonded to two ATLAS LGAD Timing Integrated Read-Out Chips (ALTIROC) and held together by a module flex (flexible PCB). Each module will be connected to the Peripheral Electronics Boards (PEB) through a flex tail (another flexible PCB). The connections between on-detector and off-detector electronics are performed via optical fibers, high/low voltage cables, interlock cables and monitoring signal cables. The PEB acts as a bridge between the front-end modules and the off-detector systems. The optical fibers provide shared data streams for Timing, Trigger and Control (TTC), Detector Control System (DCS) and Data Acquisition System (DAQ), and dedicated data streams for the luminosity system. The PEB uses the low-power GigaBit Transmission chip (lpGBT) and the Versatile Link + Transceiver (VTRx+). The PEB also includes the 12 V to 1.2 V DC-DC converters (bPOL12v) for the digital and analogue voltages supplied to the front-end modules. The supply voltages are monitored using the internal multiplexed ADC on the lpGBTs. Since the input channel number of this ADC is limited to 8, a multiplexing chip is required to handle all the signals connected to PEB. A full custom 64-to-1 multiplexing ASIC (MUX64) has been developed with a radiation tolerance suitable for its implementation on the PEB. According to the optimization of mirror structure for the layout of the modules, 6 types of PEBs need to be designed for HGTD. Based on previous development experience, the PEB 1F was chosen to be designed first as a prototype since it is the most complicated PEB type, which supports up to 55 front-end modules with 12 lpGBT, 9 VTRx+ and 52 bPOL12v in a very limited space. The requirements and overall specifications of the electronics of HGTD will be presented as well as the technical design and the project status.

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