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Versatile Link+ Transceiver Production Readiness

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The Versatile Link+ project is about to enter its production phase, ready for the Phase 2 HL-LHC detector upgrades. We present the status of the front-end part of the Versatile Link+ project: the Versatile Link+ Transceiver (VTRx+), which provides a low-mass, radiation tolerant, optical transmit- and receive module for tight integration in the upgrading HL-LHC detectors. We describe the development and thorough testing carried out with the transceiver prototypes and their sub-components and the design decisions that have led to the final production-ready prototype. The planned production timeline, aligned with the assembly timescales of the HL-LHC experiments, is also presented.

Summary

During the phase 2 upgrades of the ATLAS and CMS experiments at the Large Hadron Collider (LHC) several detectors will be replaced to improve their physics performance. In particular, these upgrades aim to replace the innermost detectors that are exposed to the harshest radiation environments. To cope with the increasing data volume and the higher trigger rate, high-speed optical links will be deployed in large quantities as part of the upgrade programme. The tight space constraints and the high channel count of the on-detector electronics will require to develop a low-profile (20mm x 10mm x 2.5mm), multi-channel front-end component. During their expected lifetime these components will have to withstand high radiation levels (1MGy total dose, 1x10^15 n/cm2 and 1x10^15 hadrons/cm2 total fluence) and they have to operate over a wide temperature range (-35 ℃ to +60 ℃).
The Versatile Link+ (VL+) project has developed a custom front-end module that fulfils these requirements. The front-end module (VTRx+) will be based on radiation-tolerant Laser Diode Driver (LDD) and TransImpedance Amplifier (TIA) ASICs, and commercial VCSEL and PIN photodiode (PD) components. Components have been evaluated and shown to meet the required performance targets during both functional and environmental testing. We will show an overview of the performance of VCSELs and PDs operating over the full required temperature range. Radiation testing has also been carried out for candidate VCSELs and PDs and the results will be shown, along with the impact of the observed degradation on system performance and margins. The design decisions that aim to guarantee the best performance in the special environment of the final applications are explained.
Several VTRx+ prototype generations have been developed and tested in order to optimize the design. The final VTRx+ utilizes a thin optical coupling lens that covers the qualified optical components and the latest versions of the radiation-hard ASICs. Electrical connectivity is accomplished using a low-profile 40-pin connector and optical connection is provided by a fibre pigtail with a MT connector interface. The test results of the final prototypes will be presented.
Finally, we will present the planned production timeline, which starts with a pre-series production at the end of 2019 followed by a thorough pre-series qualification programme. The launch of the series production is planned for mid-2020. The series production is foreseen to last for around two years providing VTRx+ transceiver modules in time for the planned experiment upgrades.

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