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Versatile Transceiver Production and Quality Assurance

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The Versatile Link project has developed a radiation-hard optical link for LHC phase 1 detector upgrades. The project has reached its final stage and we have launched the series production of the Versatile Transceivers (VTRx) and Versatile Twin Transmitters (VTTx). This paper provides an update of the production status and a detailed description and results of the quality assurance programme. The QA programme includes qualification and acceptance testing at CERN and production testing at the manufacturer's premises.

Summary

The LHC detector upgrades planned for LHC long shutdown 2 will increase the bandwidth requirements on the optical links. The Versatile Link common project has developed an optical link architecture operating at 4.8 Gbps that foresees radiation-hard, low-mass and low-power opto-electronic transceiver modules to be deployed in the upcoming upgrades. The modules are available in three versions: single-mode and multi-mode Versatile Transceiver (VTRx) operating at 1310 nm and 850 nm, respectively, and multi-mode Versatile Twin Transmitter (VTTx) operating at 850 nm. The choice among these versions depends on the architecture of the readout system as well as on the fibre plant already present in the experiments.

The front-end components in the LHC experiments, including VTRx and VTTx modules, are situated in an extremely harsh environment where they have to withstand high radiation doses and strong magnetic fields. VTRx prototypes have previously been thoroughly tested during the development phase and the selected parts have been validated for the final assembly. During the series production CERN will deliver qualified known good active components (transmitter sub-assemblies, receiver sub-assemblies, and laser drivers) to the chosen assembly house, which will assemble and test around 30,000 modules.

The VTRx quality assurance programme includes qualification tests, production tests, and lot acceptance tests. First, before the active components are delivered for assembly, component qualification tests are carried out at CERN to ensure that they meet the Versatile Link specifications. Then the components are delivered for assembly and pre-production of a few hundred modules. The pre-production devices go through functional and environmental tests including temperature, magnetic field, and irradiation tests, which will be described in detail in this paper. After a successful pre-production qualification the series production will be launched.

During production the modules are tested at the assembly house using a test setup and procedure developed by CERN. The test setup measures automatically the main parameters, checks that the specifications are met, and saves the results into a database. An operator is required only to change the DUT, start the measurement, and monitor the results. The production testing covers 100% of the modules. At CERN, received modules will be checked once more in lot acceptance tests. This final stage of quality control includes visual inspection and functional tests in lab environment for a randomly selected subset of modules from each received lot. The lot acceptance tests ensure that the modules are received in a perfect condition. It also serves as a cross-check for the production test results.

Traceability is guaranteed by identification (ID) numbers marked on the modules. The results from each stage of the QA programme are saved with the ID information and can be monitored. Details of the stored data and results that are available for the users and QA reports will be provided.

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