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Temperature Characterization of Versatile Transceivers

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The Versatile Transceiver is a part of the Versatile Link project, which is developing optical link architectures and components for future HL-LHC experiments. While having considerable size and weight constraints Versatile Transceivers must work in severe environmental conditions. One such environmental parameter is the temperature: the operating temperature range is specified to be from -30 to +60℃. In this contribution we present the results of the temperature characterization of the VTRx Transmitter (TOSA). Several TOSA candidates from different manufacturers have been characterized: single and multi-mode Vertical Cavity Surface-Emitting Lasers and a single-mode Edge-Emitter Laser.

Summary

The Versatile Transceiver (VTRx) is a radiation-resistant, low-power, and low-mass optical transceiver operating at rates up to 5 Gbit/s. The versatility is assured with multi-mode and single-mode versions operating at 850 nm and 1310 nm wavelength respectively. The VTRx is a part of the Versatile Link system [1] that consists of front-end and back-end components. Whereas the transceivers located at the Versatile Link back-end sit in a standard crate environment, the front-end VTRx must withstand radiation, operate in a strong magnetic field and be as low mass as possible. In addition, the VTRx must be able to operate without significant degradation in performance across a temperature range of -30 to +60℃ [2].

The main components of the VTRx are a Transmitter Optical Sub-Assembly (TOSA) and GigaBit Laser Driver (GBLD) on the transmitter side, and a Receiver Optical Sub-Assembly (ROSA) including a PIN photodiode and a radiation-tolerant transimpedance and limiting amplifier (TIA/LA) on the receiver side. During these first temperature dependence measurements several VTRx modules with different commercial TOSAs were tested. Results for the transmitter side only are reported here. The functional tests included static and dynamic measurements in both time and frequency domains. The tests were carried out in a temperature test chamber where the VTRx was attached to a test board. Data signals for the VTRx were produced using a pseudo-random bit sequence source and the optical output was measured with an optical power meter, an optical spectrum analyzer, and a high-speed oscilloscope. The light-current characterization shows the temperature dependence of the threshold current and the slope efficiency, whereas the analysis of the optical spectrum shows the change in the central wavelength and the spectral width. Dynamic measurements were carried out using different bias and modulation currents in order to find out optimal driving conditions for each TOSA and thus record the optimal performance of each device at a given temperature. The dynamic parameters, such as jitter, extinction ratio and optical modulation amplitude, as well as the static parameters are shown to meet the specified limits across the whole temperature range.

The measurements showed that both single-mode Edge-Emitter Lasers (EEL) and multi-mode Vertical Cavity Surface-Emitting Lasers (VCSEL) perform well across the temperature range as long as bias and modulation currents are chosen correctly. Single-mode VCSELs fail to meet the specifications at both ends of the temperature range. In general, operation at low temperatures improves timing and jitter parameters, but results in decreased extinction ratio. This temperature characterization has shown that a wide range of TOSA candidates could be used in the final VTRx. The decision about the final experiment-specific TOSA type should be made considering these results together with the results of the full TOSA characterization.

[1] F. Vasey et al., The versatile link, a common project for super-LHC, J. Instrum. 4 (2009) P12003
[2] J. Troska, Versatile link technical specification, (2011)

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