

The Gigabit Optical Transmitters for the LHCb Calorimeters

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This report presents the boards developed for the optical data transmission of the calorimeter system of the LHCb experiment and test results. We developed two types of transmission boards: the single-channel and the multi-channel ones. Multi-channel boards can be equipped with a variable number of transmitters, depending on the need, with a maximum allowed of 12 channels. Each optical channel allows transmitting 32 bit data at 40.08 MHz. The boards have been designed and built using radiation hard devices produced at CERN. The optical links have been qualified using the eye diagram and the BERT at 1.6Gbps.

Summary

The report describes the optical links developed for the data transmission of the LHCb calorimeter system. They are used to establish high speed (1.6Gbps) connections over long distances of about 100 m among the front-end electronics cards of the calorimeter system, the L0 trigger system and the DAQ boards. The optical transmitters are built as mezzanines boards, i.e. as cards to be plugged to carrier-boards (to the CROC calorimeter boards, to the SPD control boards and to the validation cards). They get power, control signals and reference clock from the underlying carrier-boards. To plug the mezzanines boards to the carrier-boards we plan to use the high-speed connectors by Samtec. To transmit 32 bits patterns at 40.08MHz through the optical fibers we use the GOL chip (Gigabit Optical Link), radiation hard, produced by the CERN Microelectronic Group. The data transfer rate, running the transmitter at 40.08MHz, including header and parity bits, using the 8B/10B encoding mode, is of about 1.6 GHz per link.

The reference clock will be generated by the carrier-board and distributed to the GOL chips from a clock distributor. The jitter introduced by these devices is guaranteed to be less than 2ps RMS.

As optical transducer in the single-channel transmitter boards we use the VCSEL (Vertical Cavity Surface Emitting Laser) laser diode (1mW at 6mA) by ULM Photonics. It operates on multimode optical fibers at a wavelength of 850nm and is equipped with SMA type fibre connector.

In the multi-channel boards we use a parallel transmitter made by Agilent. The optical transducer is the SNAP12 standard compliant, equipped with the MPO/MTP ribbon fibre connector interface. It operates on multimode optical fibre at a wavelength of 850 nm.

The start up of the GOL is managed by means of the CRT4T power switches. Special care has been spent in the projecting the PCBs and in placing the bypass capacitors, in order to minimize the noise level and the bit error rate.

The report will describe the test performed on the prototypes to fully qualify the optical link. The link has been qualified using the eye diagram and the BERT. The results show that the BER is better than 10^{-13} as expected.

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