Contribution ID: **163**

Type: **Poster**

The 120Gbps VCSEL array based optical transmitter (ATx) development for the High-Luminosity LHC (HL-LHC) experiments

Wednesday 25 September 2013 17:11 (1 minute)

The integration of VCSEL array and driving ASICs in a custom optical transmitter module (ATx) for operation in the detector front-end is demonstrated. The ATx provides 12 parallel channels with each channel operating at 10 Gbps. The assembly comprises a ceramic substrate with high-density wiring for electrical interface, OE components, and a micro-lens array with guiding structure for optical interface. Commercial driver is currently used on the demonstrator and will be replaced by a radiation tolerant driver. The complete module with ASIC shielded is to be irradiated under x-ray with total dose over 10Mrad.

Summary

The development of high-speed, low power, radiation-tolerant optical data links is critical for the LHC upgrade as well as other collider detector developments. A general trend is to leverage the rapid advancement in commercial optical transceivers, qualify a suitable form factor, maintain the optical/electrical interfaces and fabrication/assembly platform, and customize the components and materials to ensure radiation tolerance. VCSEL-based technology has been widely adopted by short-range data transmission links and parallel modules utilizing an array of VCSELs have also been commercialized. In this paper, we report the development of integrating a VCSEL array with a driving ASIC in a custom optical transmitter module (ATx).

The VCSEL array and driving ASIC in the custom transmitter module (ATx) is based on ceramic packaging technologies with high-density circuitries, single layer thick film with plated through holes and solder bumps. The ceramic substrate serves as a good heat spreader for stable laser operation. Low thermal coefficients of linear expansion of ceramic and optical connector resin are also beneficial to the reliability of the modules.

The light output of the VCSEL is collimated and deflected by 90 degree using array optics. The VCSEL and micro-lens is visually aligned and tacked down with epoxy. The distance from the VCSEL aperture to the optical plane of the lens is optimized with spacers. The fiber ribbon cable which clips onto the module, the Prizm cable, is also a commercially available standard component.

A commercial array driver has been electrically characterized using multi-channel data transmission with each channel operating at 10 Gbps, both in standard alone and I2C mode. This driver is currently used on the demonstrator and will be replaced by a radiation-tolerant driver. The micro-lens block and the connection elements are made from optically clear Polyetherimide (PEI) compound, and the structural resin is similar to the conventional MT ferrule. The complete module with driver ASICs shielded is to be irradiation under x-ray with total dose above 10 Mrad.

The 12-channel ATx module is designed to operate at 10 Gbps/ch with a 10E-12 bit error rate, indicating a potential of 120-Gbps aggregate throughputs. The ceramic carrier is to be submitted for fabrication in early May and the module will be assembled in July. Transmitter testing is designed to optimize the optical eye-diagram at 10 Gbps. Electrical transmission signal integrity and optical insertion loss will be evaluated, and the assembly challenges will be discussed.

The ATx front-end transmitter is intended to work with commercial parallel receivers such as micropod and lightable engines. System integration issues, especially power budget will be explored. We describe the devices evaluated, the experimental set-up for multi-channel testing based on a transceiver enabled FPGA evaluation kit, and the analysis of performance compliant test.

Primary author: GUO, Di (University of Science and Technology of China)

Co-authors: Mr PROSSER, Alan (Fermilab); DENG, Binwei (Hubei Polytechnic University, P.R. China); LIU, Chonghan (Southern Methodist University); SU, Da-Shung (Academia Sinica (TW)); GONG, Datao (Southern Methodist Univeristy); LIANG, Futian (University of Science and Technology of China); LIU, Gang (Institute of High Energy Physics, Beijing, P.R. China); LIANG, Hao (University of Science and Technology of China); YE, Jingbo (Southern Methodist University (US)); Prof. CHEN, Jinghong (Southern Methodist University); CHRAMOWICZ, John (Fermi Lab); TENG, Ping-Kun (Academia Sinica-Unknown-Unknown); KWAN, Simon (Fermilab); HOU, Suen (Academia Sinica (TW)); LIU, Tiankuan (Southern Methodist University); Ms LI, Xiaoting (Central China Normal University, Southern Methodist University); XIANG, annie (Southern Methodist University)

Presenter: YE, Jingbo (Southern Methodist University (US))

Session Classification: Poster