The TOTEM Front End Driver, its Components and Applications in the TOTEM Experiment

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The TOTEM Front End Driver or TOTFED receives and handles trigger building and tracking data from the TOTEM detectors, and interfaces to the global trigger and data acquisition systems. The TOTFED is based on the VME64x standard and has deliberately been kept modular, very flexible and programmable to deal with the different TOTEM sub-detectors and possible evolution of the data treatment and trigger algorithms over the duration of the experiment. The main objectives for each unit are to acquire on-detector data from up to 36 optical links, to perform fast data treatment (data reduction, consistency checking, etc...), to transfer to the next level of the system, and to store data on request for slow spy readout via VME64x or USB2.0. The TOTFED is fully compatible with CMS and permits TOTEM to run both standalone and together with CMS. The TOTEM Front End Driver, its components and applications in the TOTEM experiment are presented in this paper.

Summary

The TOTEM experiment has three sub-detectors: Roman Pots (RP) with silicon strips, T1 detector with Cathode Strip Chambers (CSC) and T2 with Gas Electron Multiplier detectors (GEM). All detectors use the VFAT chip [*] for tracking and trigger generation and use the same data readout system based on the TOTEM Front End Driver or TOTFED. The TOTFED consists of the following physical units: the "VME64x Host Board" , the "OptRX12"(a 12 channels at 800Mbps optical receiver card) and the "S-Link64"transmitter card. The TOTFED hardware was developed in collaboration with the CMS preshower, where TOTEM developed the HOST board, and the CMS preshower the optoRX. Each TOTFED consists of one host board and a maximum of three optical receiver cards and three transmitter cards. These three channels are independent and can send data to the data acquisition system at 200MBps each. The merger unit on the board allows collecting data from all the channels, performing additional data reduction and treatment and sending it via the fourth "S-Link64" to the event builder. This feature enabled its use for the CMS preshower data handling (the Preshower Data Concentrator Card "ESDCC"). Slow readout for spying the stored data from the corresponding memory is implemented via VME64x interface and four independent USB2.0 interface channels. There are additional user defined interfaces on board for future usage. The system makes use of the latest generation of FPGA components. The modularity and the programmability of the FPGAs make the TOTFED extremely flexible for different applications. Within TOTEM a number of TOTFEDs will be used to receive and process the trigger building data from the three sub-detectors. In standalone operation this system will generate the level 1 trigger signal and during operation in conjunction with CMS it will transfer a limited number of trigger building signals to the CMS global trigger system. The TOTFED can also be used to send a programmed data stream for testing purposes. The presentation will give a detailed overview of the design of the components of the TOTFED, and its application in the TOTEM experiment.

[*] VFAT documentation reference

Primary author: Mr ANTCHEV, Gueorgui (CERN PH-TOT / INRNE-BAS)

Co-authors: Mr BARNEY, David (CERN PH-CMA); Mr VICHOUDIS, Paschalis (CERN PH-CME); Mr ASPELL, Paul (CERN PH-MIC); Mr REYNAUD, Serge (CERN PH-CME); Mr SNOEYS, Walter (CERN PH-MIC)

Presenter: Mr ANTCHEV, Gueorgui (CERN PH-TOT / INRNE-BAS)

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