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FEC-CCS: A common Front-End Controller card for the CMS detector electronics.

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The FEC-CCS is a custom made 9U VME64x card for the Off-Detector electronics of the CMS detectors. Special effort has been invested in the design of the card in order to make it compatible with the operational requirements of multiple CMS sub-detectors namely the Tracker, the ECAL Crystals and ECAL Preshower, the PIXELs, the RPCs and the TOTEM. This paper describes the design architecture of the FEC-CCS card focusing on the special design features that enables the common usage by the CMS subsystems. Results from the integration period in the sub-systems and performance measurements will also be reported. The design of a custom made testbench for the production testing of the 150 cards produced will be presented and the attained yield will be reported.

Summary

The CMS Tracker control system, initially developed for the needs of the CMS Tracker sub-detector, has now been adopted by the majority of the CMS sub-detectors as a common control system for their front-end electronics. The CMS sub-detectors using this "common"control system are the ECAL Crystals and ECAL Preshower, the PIXELs, the RPCs and the TOTEM. This fact made apparent the need of a having common Front-End Controller card for the off-detector electronics part for those sub-detectors thus minimizing the effort and the associated cost for the development of the card and facilitate the maintenance during the operation period of the CMS experiment.
The FEC-CCS card is a 9U VME64x compliant card following design rules for custom VME hardware in CMS. The main functions of the FEC-CCS card are to distribute both the fast timing signals (40MHz clock and Trigger Commands) and the slow control data through the optical control links to the front-end electronics ASICs. The FEC-CCS card functions as a VME carrier for the mezzanine Front End Controller modules (mFECs) that host the functionality of the master node controller for the front-end control links. The FEC-CCS can be populated with up to 8 mFEC modules.
The VME FEC-CCS card features a Local Bus that interconnects the mFECS. An FPGA circuit implements the interface logic between the VME bus and the on-board Local Bus. Slow control information passes though the VME bus and the Local Bus. Instead the fast timing signals are distributed to the mFECs though a different FPGA circuit that implements the sub-detector specific Trigger Command handling. To enable the seamless utilization of the FEC-CCS modules across the different CMS subsystems a high level of programmability has been introduced in the firmware design so that not only an identical module but also a unique firmware version could be deployed to all the modules for all the sub-systems thus minimizing the effort for system maintenance and support for the years to come. For the ECAL Crystals, Preshower and TOTEM subsystems the FEC-CCS card delivers some extended functionalities like the fanout of the TTC signal and the merging of the TTS (Trigger Throttling Signals) signals via a private special backplane connector.
Nearly 40 prototype FEC-CCS cards have been produced up until now and delivered to all the involved CMS sub-systems to participate in various detector testbenches and test beam data taking systems. Test results from selected test setups will be reported along with some preliminary performance measurements. The power dissipation of a fully loaded card has been measured and found to be 30 W.
The current status of the FEC-CCS production is at the phase of the production testing. A custom made hardware and software has been developed for this purpose at

CERN. The paper will conclude by briefly discussing the production test bench and the production yield attained.

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