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A new portable test bench for the ATLAS Tile Calorimeter front-end electronics

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This paper describes a new portable test bench for the TileCal sub-detector of the ATLAS experiment at CERN. The system is used for the certification and quality checks of the front-end electronics drawers. It is designed to be an easily upgradable version of the current 10-year-old system, able to evaluate the new technologies planned for the upgrade as well as provide new functionality to the present system. It will be used during the long shutdown of the LHC in 2013-14 and during future maintenance periods.

Summary

Introduction

MobiDICK is a portable test bench for the ATLAS Tile Calorimeter electronics drawers. The test bench was used during the commissioning period and short shutdowns of 2010 and 2011. This system is composed of a 6U VME crate, which contains different commercial and custom modules. A Single Board Computer (SBC) controls and reads-out the modules connected to the VME bus. A GUI is executed on an external portable computer and communicates with the SBC through an Ethernet connection.

The new version of the system presented in this paper represents a complete redesign of the test bench with state-of-the-art devices. The aim is to guarantee replacement parts during the lifetime of the LHC and the evaluation of new technologies for the future upgrades. The new MobiDICK will provide extra functionality to the system together with a reduced size and weight that improve the portability of the test bench.

System architecture

The core of the new MobiDICK is a commercial Xilinx ML507 development board which controls a custom made ADC module, a High Voltage (HV) controller, an LED driver and two CANbus ports. The main board uses a Small Form-factor Pluggable (SFP) transceiver module for Trigger, Timing and Control (TTC) of the front-end electronics and to receive digital data from them.

The core FPGA device implements an embedded architecture that contains a PowerPC processor running at 400MHz, 256MB memory RAM, commercial Ethernet and serial IP cores and custom IP cores to control the SFP module, the ADC board, the LED driver and the HV controller. All the modules are connected to the PowerPC processor via a PLB bus running at 100MHz.

An Open Source Xilinx Linux distribution runs on the embedded architecture providing an optimized hardware resource management. Glue software provides the interface with the portable computer software.

The ADC module is a custom board to digitize and read out the analog signals coming from the front-end electronics thought dedicated trigger cables. The main component of the board is the ADS5271 chip from Texas Instruments, which digitize a total of 16 differential input channels with 12-bit resolution and a sampling rate of 40MSPS. Two ADS5217 chips are needed to digitize the signals from one complete super-drawer. The digitized data is transmitted to the main board at a bandwidth of 480Mbps per channel.

The High Voltage board generates -830V as needed by the photomultipliers. The LED driver generates electrical signals to trigger the emission of light pulses that illuminate all PMTs of the electronics drawer. The two CANbus drivers provide communication with the slow control devices in the front-end electronics.

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