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## The AMC13XG: A New Generation Clock/Timing/DAQ Module for CMS MicroTCA

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The AMC13 provides clock, timing and DAQ service for many subdetectors and central systems in the upgraded CMS detector. This year we have developed an upgraded module, the AMC13XG, which supports 10 gigabit optical fiber and backplane interfaces. Many of these modules are now being installed in the CMS experiment during the current LHC shutdown. We describe the implementation using Xilinx Kintex-7 FPGAs, commissioning, production testing and integration in the CMS HCAL and other subsystems.

### Summary

The AMC13XG is constructed of a 3-board assembly. The tongue 1 board houses the front-panel optics in a quad SFP+ cage, provides a 1 GbE interface for configuration and control, and acquires DAQ data from AMC cards over the MicroTCA backplane. Most functions are implemented in a Xilinx Kintex XC7K325T FPGA in a 900 pin BGA package. This device was chosen because it supports 16 high-speed (up to 12.5 Gb/s) serial links and about 325,000 logic cells and is relatively inexpensive. By comparison, the XC6VLX130T used in the first generation AMC13 had about 130,000 logic cells and up to 6.6 Gb/s serial links. The use of 10 Gb/s links required a complete PCB redesign, including the selection of a particular high speed PCB base material rather than the typical FR-4. Other changes to the tongue 1 board include the upgrade of the on-board memory to DD3 with 512 MB capacity and 6.4 GB/s throughput. In principle the AMC13XG can support a DAQ throughput approaching 3 GB/s with all 3 front-panel links operating at 10 Gb/s.

The tongue 2 board houses a Xilinx Spartan XC6SLX25T FPGA, an Atmel AVR32 microcontroller and most of the low-jitter clock fanout circuitry. The Spartan FPGA provides housekeeping functions including a flexible interface for download and programming of firmware into an SPI flash memory and management of IP and MAC address setting. In addition the Spartan FPGA distributes timing and trigger signals to AMC modules via the MicroTCA backplane. The AVR32 microcontroller implements a MicroTCA Module Management Controller (MMC) using firmware produced by our Wisconsin colleagues. It provides for configuration management, control and monitoring of module operation. This MMC extends the MicroTCA standard to provide many additional features valuable for CMS, including readout of up to 16 analog sensors, power supply status inputs, multi-stage power enable and others.

The tongue 3 board shipped with the AMC13XG is a simple two-layer board which provides access to JTAG and console signals for initial programming and debug. The AMC13XG is customized for various

applications by installing a new tongue 3 board with can accommodate for example discrete I/O for clock/control or a crosspoint switch for trigger applications. Power and GPIO signals are provided on a connector to tongue 3 for this purpose.

We present the new AMC13XG design, production testing, customization and commissioning in the ongoing CMS upgrade project.

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