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MOSAIC board: a modular system for readout and testing of particle physics detectors and their related electronics.

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In this work the MOSAIC (“MODular System for Acquisition, Interface and Control”) board, designed for the readout and testing of the new pixel tracker modules of the ALICE experiment, is described. It is based on a large Artix7 Field Programmable Gate Array device by Xilinx and is compliant with the six unit “Versa Modular Eurocard” standard (6U-VME) for easy housing in a standard VMEbus crate from which it takes only power supplies and cooling.

The board can read data through 10 high-speed serial receivers at rate up to 6.6 Gbps or using up to 132 slow LVDS lines and it is equipped with 1GB-DDR3 memory for temporary data storage. Two FMC-LPC mezzanine slots are provided for connectivity expansion to many other devices, such as ancillary modules, additional interfaces or devices to be tested. Furthermore, four programmable LEMO Input/Outputs, complying with Nuclear Instrument Module standard, are provided for addition flexibility in different test setups.

The FPGA houses an 8-bit microprocessor for system supervision, network management, data sending and diagnostics. Communications with external PC are done through Gigabit-Ethernet interface using TCP/IP and UDP/IP protocols. Thanks to Direct Memory Access technology, hardware IP fragmentation and TCP offload, the interface is able to send data at full Gigabit speed.

Moreover, the system is provided with an internal data generator for network testing and a pulser to automate the injection of test patterns into the device under test.

The board is currently used to perform the functional test of the modules of the new pixel tracker for the upgrade of the ALICE experiment and will be also part of the first readout and control system prototype.

The firmware architecture provides the possibility to easily add new custom interfaces to other front-end modules. Thanks to its flexibility and configurability, MOSAIC board is suitable for many applications in the readout and testing of particle physics detectors and their related electronics.

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