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A Novel Readout System for a High Efficiency Cosmic Ray Veto for the Mu2e Experiment

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The Mu2e Cosmic Ray Veto system must veto cosmic-ray muons over an area of about 300m2 with an overall efficiency of 99.99% in the presence of high background rates from beam-induced neutrons and gammas. It consists of 5,504 long extruded scintillator extrusions with embedded 1.4 mm wavelength shifting fibers read out by 2×2 mm2 sil- icon photomultiplier (SiPM) diodes. A high-rate, robust, custom de- signed electronics readout system has been designed and tested to power and read out the signals from the SiPMs. It consists of: (1) small cir- cuit board, the Counter Mother Board, situated on the ends of the scintillator counters, and which provides a bias distribution network, a temperature sensor, flasher LEDs, and passive SiPM pulse shaping; (2) a Front End Board which digitizes in time and amplitude, and stores in on-board memory signals from up to 64 Counter Mother Boards, as well as providing bias to the SiPMs, pulses to the LEDs, and measur- ing SiPM currents; and (3) a Readout Controller which collects zero- suppressed data from the Front End Boards via Category 6 Ethernet cables which also deliver 48V power to the Front End Boards using the power over Ethernet standard. The data collected in the controllers is formatted appropriately and transmitted over 3.125 Gb/s optical fibers to custom circuit boards that interface with a computer farm used for triggering and data acquisition. The vetoing of background events is done in the offline analysis. The use of commercial hardware has kept costs and development time down. Test results of the performance of a prototype system will be reported.

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