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Front-end Electronics for BaF2 Detector Array at CSNS-WNS

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The BaF2 (barium fluoride) detector array that is one of the detector systems at CSNS-WNS (White Neutron Source at China Spallation Neutron Source), mainly aiming at measuring the cross section of (n,γ) , consists of the BaF2 crystals and photomultiplier tubes (PMTs) with 92 channels, the front-end electronics, readout electronics, and the data acquisition system (DAQ). The field digitization modules (FDMs), a critical section of the readout electronics, can achieve the full waveform digitization. For the purpose of simplifying the readout structure, all FDMs are located in backend PXIe crates. Analog signals from detectors need to be transmitted from front-end to back-end crates over about 20m distance. Besides, the analog signals should also be transmitted to sub trigger modules (STMs), a part of the trigger system, for trigger consideration. To meet the requirements above, the front-end electronics (FEE) are designed with the capacity of conditioning the fast signal from detectors and fanning out for corresponding processing. The FEE should have good performance of low noise, high band-width, low power consumption and long range driving.

In this paper, FEE for BaF2 detector array at CSNS-WNS is proposed. It is comprised of the front-end fast pre-amplifiers (FPA) and analog fan-out modules (AFM). Each pre-amplifier is implemented with small size and located near detector. It receives signal from detector, amplifies it and further drivers it to fanning out electronics over long distance twisted-pair cable. AFM is implemented as a standard module located in NIM crate. It fans signal from pre-amplifier out to FDM for digitizing and to STM for triggering respectively. Preliminary tests show that the bandwidth can reach up to about 300MHz that is suitable for signal conditioning for BaF2 detector application.

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