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20-Channel 14MeV Neutron Detector Electronics Readout System

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To measure neutron flux accurately, dozens of neutron detectors are often arranged at different locations of the experimental device. These detectors require steady high voltage power supplies during working, and output the high count rate signal mixed with a large number of X-ray and γ -ray signals. We designed a 20-channel neutron detector readout electronics system to read multi-channel neutron detector signals, and to provide stable high voltage power supplies that the swing is less than 0.5%. The system require four functions, discrimination and selection of neutron signals, anti-saturation of X-ray and γ -ray signals, high voltage driving of multi-channel detector and consistency correction of multi-channel, to meet the special requirements of 1Mc/s counting rate, 0.1% stability high voltage, multi-channel and standard case.

The system, packaged in the 19 inch 3U standard case with low voltage power supplies hardware, consists of signal readout board and high voltage power supply board. The signal readout board contain two parts: the front-end circuit containing protection diode to realize the function of anti-saturation; the digital system based on FPGA to accomplish the function of pile up rejection of signal, counting, measuring time control, high voltage control and monitoring, etc. The high voltage power supply board adopts the design of modular power supplies, high precision DACs and the high voltage feedback circuit, and has the features of security and stability, high integration, etc.

The software developed with the virtual instrument technology can control and monitoring instrument, analyze measurement results, manages the experimental data, and has the function of multi-channel consistency correction.

The result of electrical test shows that the typical value of the neutron count rate of the system is 10Mc/s. High voltage stability is less than $\pm 2.5V$, the error of threshold is 0.145%, and the measured timing error is less than 1ns. So the system achieves the design goal of the 10Mc/s average count rate, anti-saturation, and stable high voltage output of 20 channel.

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