

A programmable readout system for $^3\text{He}/\text{BF}_3$ neutron detectors

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Neutron sources are currently becoming a standard to investigate the structures of various materials at mesoscopic scale using elastic scattering techniques, which are applied across a wide spectrum of scientific disciplines such as physics, biology, materials science. Moreover, having the capability of detecting neutrons is a common request of Radioprotection and Security fields, especially in those applications where you need to locate a potentially hazardous neutron emitter, measure its energy and reconstruct its position.

Typical neutron physics experiments carried out at Neutron Spallation Sources and other laboratories (like ESS, SNS, CSNS, ISIS, ILL, ...) make use of large arrays of $^3\text{He}/\text{BF}_3$ position-sensitive tubes to detect neutrons. On the other hand, Nuclear Security main players need more compact systems with standalone electronics to bias and read out neutron detectors.

CAEN SpA has developed a 19" rack-mount solution for the readout of $^3\text{He}/\text{BF}_3$ tubes, which can be tailored for both above mentioned scenario, including neutron physics experiments and environmental/security monitoring system. It is a scalable system allowing to put together few to hundreds neutron detectors. It can be composed starting from three basic building blocks: R803x High Voltage board, R1443 Charge Sensitive Preamplifier specifically designed for $^3\text{He}/\text{BF}_3$ tubes and R5560 14-bit 125MS/s open FPGA Digitizer. Thanks to its firmware programmability, this readout system can perform specific filtering to achieve the best charge, timing and position measurements.

CAEN provides a DAQ software to remotely manage the system and acquire waveforms, energy, ToF spectra and perform position reconstruction. Moreover, the R5560 offers the possibility to use SCI-Compiler, a block-diagram-based software which allows to easily implement custom pulse processing algorithms in the board FPGA.

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