Stress Test of digital DAQ system for PANDORA

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Programable digitizers are employed in the data acquisition (DAQ) system of the PANDORA project.[1] The aim of the PANDORA project is to build a neutron detection system with real-time neutron-gamma discrimination capability for the study of (p,n) reactions. We use a very low energy threshold to avoid loss of neutron events. This increases the background counting rate. For a high beam intensity, this can be a problem. In this work, stress tests were performed to confirm the system works with high trigger rates for future (p,n) experiments.

CAEN 730-series is a family of 14-bit, 500 M Samples/s Flash ADC Waveform Digitizers.[2] According to the manual,[3] the speed of data transfer through an optical fiber from the digitizers to a computer is up to 80 MB/s. The DPP-PSD (digital pulse processing for the pulse shape discrimination) firmware[4] is capable for our purpose. A parameter corresponding to the particle type can be calculated in the firmware and a threshold can be set to filter events.[5] The digitizer can be configured to dump the waveform (waveform mode) or to dump only the time and charge information (list mode). Stress tests were conducted for both modes.

The hardware configuration for the tests is shown in Fig. 1. To suit the experimental situation of acquiring data from at least 15 PANDORA scintilator bars (each has signal on both side) and some auxilliary detectors, we combined two 16-channel modules (V1730B) and one 8-channel module (V1730D) using a daisy chain. Each digitizer was configured to "paired mode," in which one digitizer is triggered only if both channels of a pair, *e.g.* ch0 and ch1, are triggered. A LUPO(Logic Unit for Programmable Operation) module[6] was used to generate a 62.5 MHz signal to synchronize the three boards. Test input signals were generated from a pulser. We used a software called digiTES developed by CAEN[7] to control the digitizers and to acquire data. Originally, with digiTES, only boards that were of exactly the same model could be used together. We modified the program for using different boards. Other conditions for the stress test is shown in Table 1 along with the results.

For the waveform mode test, we configured the digitizer to acquire waveforms with 300 sampling points for each pulse. In this configuration, the digitizer can work with a low inefficiency up to 10 kHz input pulse frequency. This corresponds to a data transfer rate of 24 MB/s. As some events have already been lost in 10 Hz test, we can assume that the maximium data transfer speed is under 24 MB/s. This is only 30% of the 80 MB/s marked in the manual. We will work around this issue as the waveform can help us improve the charge and time resolution in future applications.

For the list mode test, the digitizers can work fine under a trigger rate of 10 kHz. However, higher rates such as 100 kHz are too much for digitizers. Based on the result of the 100 kHz test, we can expect the maximium inefficiency-free trigger rate for digitizers to be around 36 kHz.

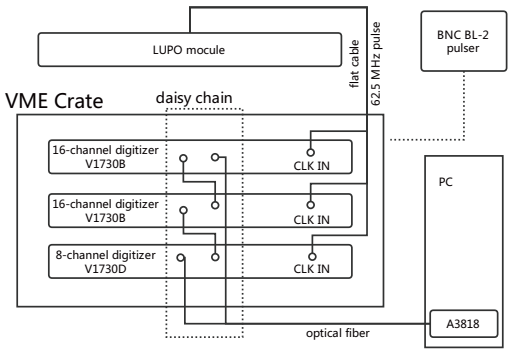

Fig. 1. Hardware diagram for the digitizers stress test.

Table 1. Result of stress testing.

acquiring mode	number of channels	Pulser frequency(kHz)	live time(%)
waveform	4	~ 10	92.3
	4	~ 200	<5
list	40	~ 2	99.9
	40	~ 10	100.0
	40	~ 100	36.0

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References

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