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Acquisition of two-dimensional pulse height distribution by using CAMAC modules

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1. Introduction

The simple application by using a multichannel analyzer (MCA) is to obtain the pulse height spectrum from a radiation source. This process can record the distribution of input events of the MCA over single-dimensional pulse amplitude. But if additional experimental parameters for each input event are of interest, the distribution over two or more dimension will be required. For example, both the amplitude and the rise time of each pulse from a single detector or coincidental events from two detectors are of interest.

In this study, a system to record the distribution of events over two-dimension by using Computer Automated Measurement and Control (CAMAC) modules [1] was developed and two-dimensional pulse height distribution from two detectors was acquired.

2. Method

The system is shown in Fig. 1. Two separate inputs are provided at a quad input Analog-to-Digital Converter (ADC, ORTEC AD413A). Each of the two input events is digitalized with the ADC and digitalized data are transferred to the Fast Encoding and Readout ADC system driver (FERA driver, Lecroy 4301) via Emitter Coupled Logic (ECL) bus. The FERA driver delivers data to a FERA memory (Lecroy 4302). The FERA memory operates in the list mode to assemble the block of coincidental events. Because the maximum capacity of the FERA memory is 16 kilobyte, stored data should be transferred to the personal computer (PC) before reaching to the maximum capacity of memory and the FERA memory should be cleared to ready for a sequential data acquisition. The crate controller (CAEN C111C) serves as the interface between modules in CAMAC crate and PC via Ethernet.

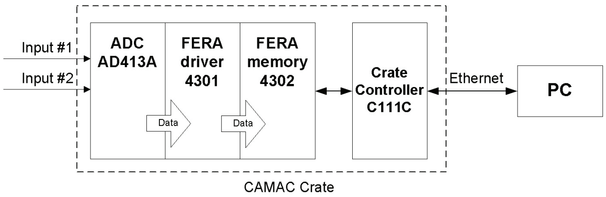

Fig. 1. The schematic arrangement of system to record the distribution of events over two-dimension.

The control program of this system was written in Microsoft Visual C++ 6.0 code. The flow of control program is shown in Fig. 2. After the initialization of modules, registers like lower-level discriminator (LLD) of ADC, readout mode of ADC and others are written. Data acquisition begins after the acquisition time is entered by user and the time of acquisition start is recorded immediately. The overflow signal at the FERA memory is generated when the capacity of memory reaches the preselected value, 12 kilobyte. If the crate controller accepts the overflow signal, data acquisition is stopped for a moment and the time of acquisition end is recorded. After the end of data transfer, data acquisition is restarted immediately if the time of data storage is less than the acquisition time. When the time of data storage is more than the acquisition time, the process of data acquisition is terminated and data is saved as two column dataset (first column is channel number of ADC input 1, second column is channel number of ADC input 2 and the same row means coincidental event) and is displayed as a surface contour plot.

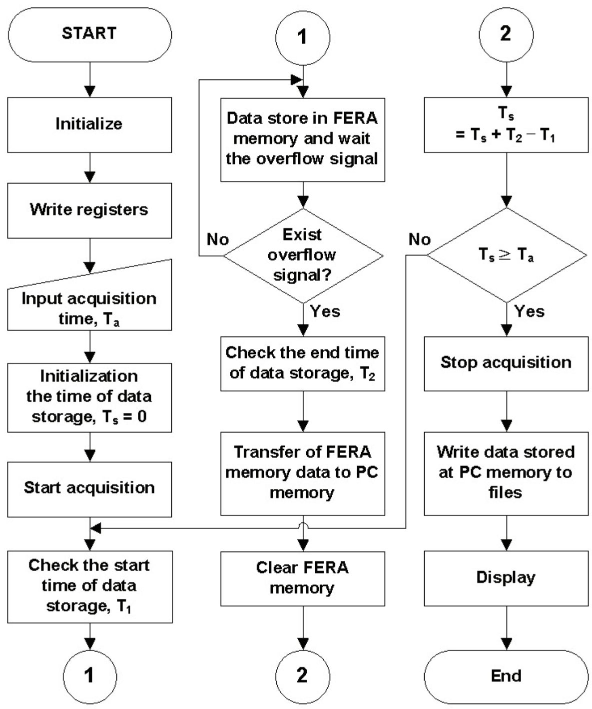

Fig. 2. Flow chart of the control program.

3. Acquisition

^{60}Co γ-rays were measured by using this system and two 3″× 3″ BGO detectors. The set-up of the system is shown schematically in Fig. 3. The angle between the two axes of BGO detectors was 180 degree. When the acquisition time was 3605 sec, the two-dimensional pulse height distribution is shown in Fig. 4. The pulse height from BGO detector 1 is plotted along the X-axis and the pulse height from BGO detector 2 is plotted along the Y-axis and the contour line represents the number of counts corresponding to the particular combination of X and Y coordinate. Two intensive regions near the point (46, 53) and the point (52, 47) represent coincidental events of two γ-rays emitted from ^{60}Co.

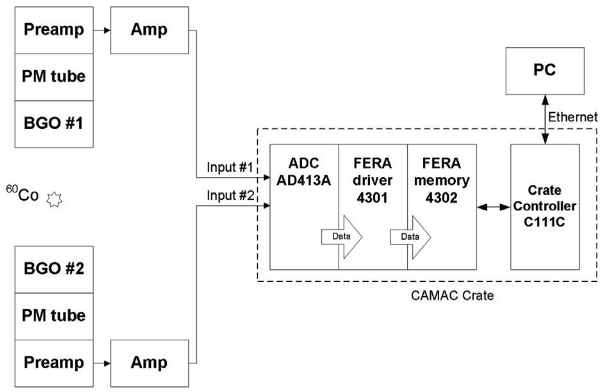

Fig. 3. The schematic arrangement of the system in this test.

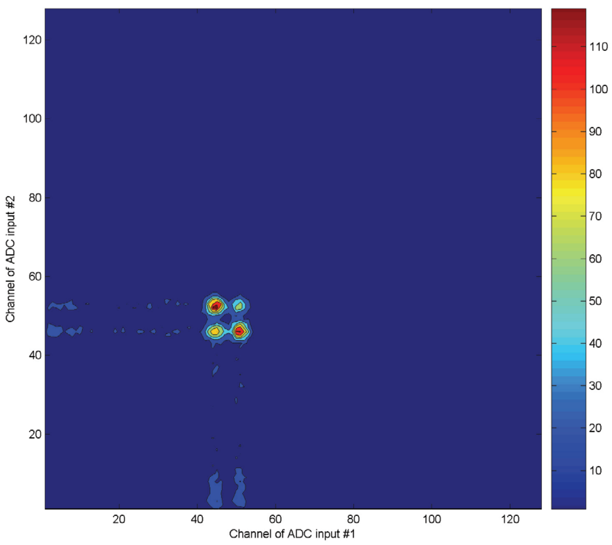

Fig. 4. The two-dimensional pulse height distribution from two 3″× 3″ BGO detectors.

4. Conclusion and further work

The system to record the distribution of events over two-dimension by using CAMAC modules was developed and two-dimensional pulse height distribution is acquired by using two 3″× 3″ BGO detectors. Furthermore, dead-time correction of this system by pulse injection method and the area calculation of coincidental event region with chance coincidence corrections will be performed. This system will be used at the research about pulse shape discrimination by using neutron detector.

Acknowledgement

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REFERENCES

[1] B. Zacharov, "CAMAC Systems: A Pedestrian's Guide", Science Research Council of Daresbury Nuclear Physics Laboratory, 1972.