VME based readout module for Analog multiplexed ASICs

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Introduction

New generation of experimental facilities comprises detector arrays with several hundreds to thousands of independent detector segments. To process the signals from segmented detectors, specific ASICs (Application Specific integrated Chip) are now being commonly developed and deployed in large detector arrays. In many experiments, the number of signals (multiplicity) for a given event is small compared to the total number of detector segments, and consequently analog multiplexing is preferred for signal readout. Analog multiplexing has the advantage of reduced space, easier readout and it is cost effective. One such commonly used front end ASIC is the GASSIPLEX[1] developed at CERN and recently, a new variant of this called MANAS[2] has become available to high energy physics experiments. In this proceeding we report the development of readout electronics for processing and digitizing the MANAS signals for nuclear physics applications using silicon strip detectors.

Technical Description

We have designed a custom VME [3] 3U card to readout all the 16 strips of the silicon detector, which are the inputs to the MANAS chip. The design includes a VMEbus slave interface, Interrupter module and dedicated MANAS chip controller. The core design of VMEbus slave interface operates like a bridge between VMEbus and the MANAS controller (designed on the same chip). As we know VMEbus interface is asynchronous, meaning that any central clock does not coordinate the VME backplane signals. This can be a very difficult problem when interfacing to programmable chips like FPGA, which generally use synchronous design practices. It is necessary to synchronizes all the signals, with system clock, from VMEbus backplane before passing them to the MANAS controller. Our VME core design is an A24:D32:D16 interface, meaning that it participates in 24-bit addressing cycles and 32-bit (or smaller) data cycles. The core design of VME responds to VMEbus single read and single write cycles. It also responds to the block transfer BLT16 and BLT32. The FPGA code is written as industry standard Hardware Description Language (VHDL). We have implemented our design on Xilinx's Spartan IIE FPGA. A process called synthesis converts the VHDL source code into machine instructions that the FPGA device understand. An overview of the readout boards is given in Fig1.

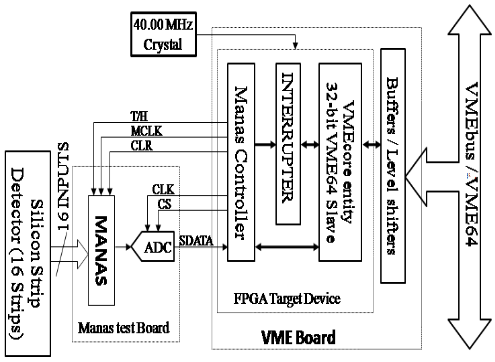

Fig.1 MANAS readout schematic for Silicon strip detector.

One MANAS chip has 16 input channels, each comprising of a charge sensitive pre-amplifier, shaper, track and hold followed by a multiplexing unit. The multiplexed output (SWAN_OUT) from MANAS is fed to a peak sensing ADC chip, which digitizes each channel within 1µs, the serial data is readout using MANAS controller implemented in FPGA on a VME card. The MANAS controller provides the control signals to the MANAS chip as well as

ADC chip. The setup was tested using a 16 channel silicon strip detector connected to the MANAS inputs and collecting the signals induced by alpha particles from radioactive source. The detector is a 50mmx50mm double sided strip detector having 16 strips on either side. The strips on front surface are connected to MANAS inputs where as the trigger is generated from the back side. The detector was irradiated with an Am-Pu source on its front side.

Results

Alpha particles are stopped in the detector strips depositing its full energy. Fig 2 shows the one dimensional histogram showing energy spectrum from one of the strips. For the strip(#2), the two peaks correspond to two alpha energy from the source. By scanning the signals across all the 16 strips we have obtained the intensity distribution of particles as shown in Fig 3. The flat distribution shows uniform illumination of the front surface of the detector. The channel wise gain variation is shown in Fig 4. The gains are normalized w.r.t one of the channel whose gain is fixed at 1.

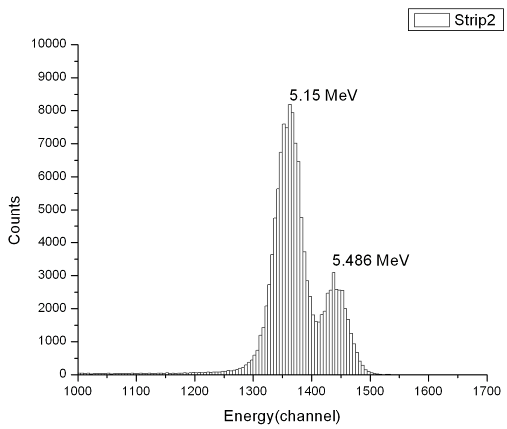

Fig. 2 Energy spectrum for AmPu alpha source from one of the strips.

Conclusions

From these test results we conclude that, MANAS along with this new readout card can be used for low energy nuclear physics applications using silicon strip detectors and gas detectors.

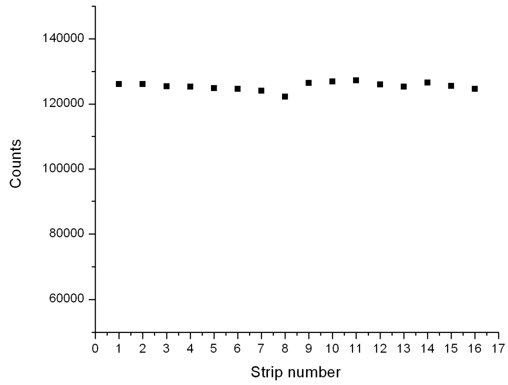

Fig. 3 The intensity distribution along the length of the detector

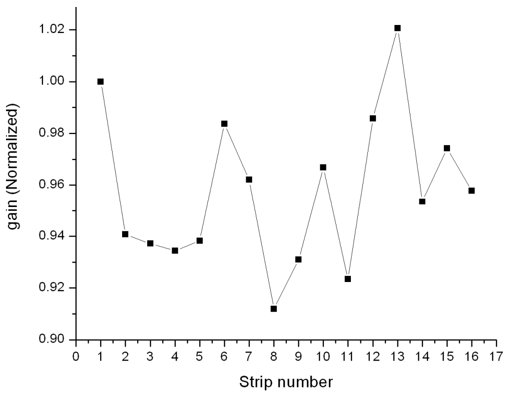

Fig. 4 The gain variation across input channels of the MANAS

Acknowledgment

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References

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[3] IEEE Standard for versatile backplane bus : VMEbus