DEVELOPMENT OF DATA ACQUISITION SOFTWARE FOR VME BASED SYSTEM

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Abstract

A Data Acquisition system for VME has been developed for use in accelerator based experiments. The development was motivated by the growing demand for higher throughput in view of the increasing size of experiments. VME based data acquisition system provides a powerful alternative to CAMAC standards on account of higher readout speeds (100 ns/word) resulting in reduced dead time. Further, high density VME modules are capable of providing up to 640 channels in a single VME crate with 21 slots. The software system LAMPS, earlier developed for CAMAC based system and used extensively in our laboratory and elsewhere has been modified for the present VME based system. The system makes use of the VME library to implement Chain Block Transfer Readout (CBLT) and gives the option of both Polling and Interrupt mode to acquire data. Practical throughput of ~250 ns/word in zero suppressed mode has been achieved.

INTRODUCTION

With increase in size of Nuclear physics experiments, a secular trend toward higher throughput bus standards has been observed. VME [1] - an acronym for VERSA Module Euro card – provides a powerful alternative to the CAMAC standard on account of higher readout speed (100ns/word) leading to significant reduction in dead time. High channel density VME modules significantly bring down the expenses involved in acquisition of data per channel. Further, usage of optical fiber link makes sure that the interconnect technology doesn't become a bottleneck during data transfer. LAMPS [2] software, earlier developed for CAMAC based system, has been modified for VME based acquisition system. It currently supports CAEN [3] V785 ADC, V775 TDC and V862 QDC and V830 scalar modules. Practical throughput, using VME data acquisition system and LAMPS, of ~250ns/word in zero-suppressed mode has been achieved.

ARCHITECTURE

System Architecture

The VME data acquisition system (see Figure 1) consists of VME digitizer modules plugged into the VME backplane, controlled by master module. VME master module (V2718) is a VME to PCI (Peripheral Component Interconnect) Optical Link Bridge, housed in a 1-unit wide VME 6U (19" x 10.5" x 19.5") module. Master module is controlled using a computer equipped with PCI optical controller card (A2818), capable of transferring data at 80 Mbytes/second. The connection between the master module and controller card takes place through an optical fiber cable.

CAEN digitizer modules for VME provide features like zero suppressed readout and overflow suppression. Zero suppression, once enabled, prevents conversion of value which is lower than user defined threshold. Overflow suppression, once enabled, aborts the memorisation of data which constitutes an ADC overflow.

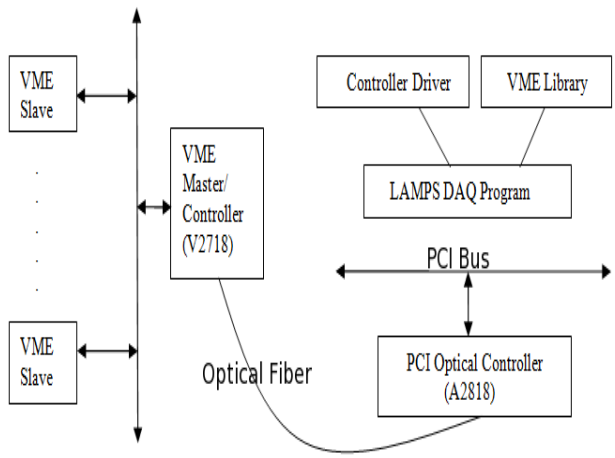

Figure 1: VME Data Acquisition system: System and Software Architecture.

The maximum VME address space is made of 2^{64} bytes for VME64 standard. Each slave occupies a portion of this space. Geographical addressing and address relocation methods for setting base address are absent in VME64. Thus, base address for slaves has been set at hardware level by means of rotary switches. Various registers of VME slave can be accessed, thereafter, by adding relevant offset to the module's base address.

LAMPS program

LAMPS is a data acquisition and analysis package that supports, apart from VME, a number of CAMAC controllers. It has been written in C and user interface has been implemented using GTK.

It allows for online spectra building (see Figure 2) and can also be used for offline data analysis. It provides, inter-alia, tools for performing calibration, peak fit, peak search, quick fit and obtaining the area and centroid of a spectrum region.

It runs under Linux and can also be made to execute on Microsoft Windows through Cygwin [4]. It is designed for large scale experiments and is in use at BARC-TIFR Pelletron laboratory, since August 2002.

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Integration with LAMPS program

The data acquisition program LAMPS was adapted to work with VME hardware. It makes use of the VME library provided by CAEN to transfer data using Chain Block Transfer Mode (CBLT) over an optical fiber link. The vendor supplied library provides function calls to, inter-alia, open and close communication and execute different read/write cycles.

CBLT with interrupts has been used for acquiring data. CBLT mode allows sequential readout of multiple slave modules selected by a single address cycle. It allows for data readouts belonging to same physical event from several contiguous boards in a crate limited to 256 words per CBLT cycle.

Assignment of address to modules in CBLT chain is done at the start of acquisition. The first module in CBLT chain raises an interrupt after output buffer crosses a threshold number of events. Upon receipt of interrupt, CBLT data transfer is initiated which is completely transparent to the master. It makes use of IACKIN-IACKOUT daisy chain line present in VME backplane to propagate the readout token across the CBLT chain.

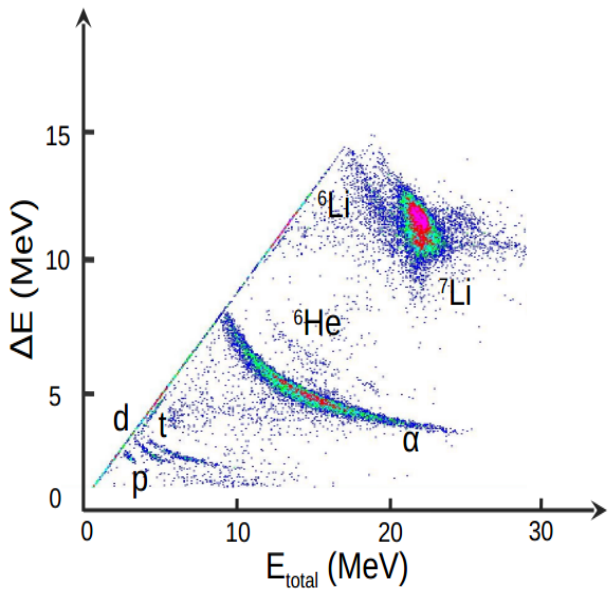

Figure 2: Spectrum acquired using VME DAQ through LAMPS.

Master gate blocking is essential to have any meaningful acquisition with VME, failing which a good number of events could be corrupt depending on data rate. In our setup, BUSY outputs, from digitization modules in the CBLT chain, are ORed together to block the master gate. This prevents event mismatch/corruption by ensuring that the modules which have finished digitizing quickly, as compared to others, cannot accept the next master gate.

To present the same familiar GUI to users and retain the overall structure of the LAMPS program, only minimal changes in GUI were introduced to accommodate VME specific features. The system has been tested successfully and is in use in at BARC-TIFR Pelletron facility.

CONCLUSION

The VME DAQ in the current form provides us with a powerful system because of the large number of parameters which can be acquired simultaneously and its ability to handle high event rates. Broad based support from all leading vendors has given an impetus to the adoption of VME based system and has equipped users with a potent alternative.

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