The Multi-crate VME Data Acquisition System

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Introduction

The VME (Versa Module Europe) based data acquisition (DAQ) system is being used for many nuclear physics experiments at VECC [1]. The current version of the software supports both VME and CAMAC system [2]. The DAQ system has been recently upgraded to support the multi-crate VME system.

Hardware Setup

The multi-crate VME system has been implemented using the CAEN V2718 VME crate controllers. The crate controller is interfaced with the host PC through a PCI card and fiber optics link. Eight crate controllers can be daisy chained using one single PCI card. There are options in the PCI driver to accommodate multiple PCI cards, to build even larger system. The current version of the system is restricted only to eight VME crates. The Fig. 1 depicts a typical interconnection of VME crates.

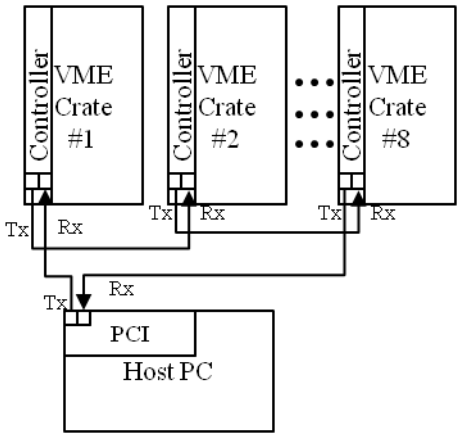

Fig. 1 Hardware connection

The transmitter (Tx) of PCI card is connected to the receiver (Rx) of the first crate controller with a LC-LC type multimode fiber cable. The Tx port of first controller is then connected to the Rx of the second controller. Subsequently, all crates are connected in the same manner. The Tx of the last crate is connected to the Rx of the PCI card. The Crates connected in daisy chain are automatically identifies themselves with unique id number depending on their position in the chain. Maximum sustained data transfer rate is 70MB/sec on the fiber optic interface.

Each VME crate may house multiple VME modules. The typical VME ADC module has 32 channels. A completely populated VME crate may accommodate maximum 20 such modules. So, total 640 channels are accommodated in each crate. The total eight crates may cater maximum 5120 channels. Even if, we choose to operate at half load for each crate; around 2500 channels can be provided, which is sufficiently high for experimental needs with Cyclotron beam.

Software setup

The DAQ Software has to be configured for multiple crates with a text based configuration file, using "system" directive. The software, by default, works in Chained Block Transfer Mode (CBLT). It configures separate CBLT chain for each crate with more than one module. The current version of the software works in common dead time mode with common GATE signal to all the modules. The CBLT chains are executed in sequential order for all the crates. The current driver version does not support the interleaved access to the daisy chained controllers. The software may also work in block transfer mode for each module, in case; the modules are not compatible to each other to form the CBLT chain.

Synchronization

The GATE signal is common to all the modules. The VME modules acquire data within the GATE window. The full event for a GATE

signal is spread over all the modules. The modules tag each event by event number (GATE count) or timestamp. The modules may also store multiple events in the inbuilt FIFO buffer. The read out routine reads the event fragments from all the modules and builds the global event. The GATE signal must be blocked until all the modules are read. The BUSY signals from all the modules are used to block the GATE signal. This mechanism must also ensure that the width of the GATE signal is preserved. The GATE signal which has already arrived before the withdrawal of BUSY signal must not pass. There is no commercial solution available to meet this requirement. One special purpose synchronization module has been designed in-house.

The Synchronization module (see Fig. 2) has been implemented in NIM form factor with a general purpose CPLD board. The module takes BUSY and RGATE (raw GATE) signal as input and outputs QGATE (blocked GATE) signal. The QGATE signal comes out at the rising edge of the next RGATE signal, after the BUSY has been withdrawn. It always ensures that no fragmented GATE is passed. Only the next complete RGATE is passed as QGATE. The module can work with ECL, NIM and TTL signals, selectable by jumper setting.

Fig. 2 Synchronization Module

Performance

The system has been tested for dual crate system with three modules in first crate and two modules in second crate. The CAEN ADC, QDC and TDC modules have been used for testing. These modules are 32channel 12bit resolution and 5.7μsec conversion time for all 32 channels. The actual data rate may be calculated as parameter rate. The ADC data from each channel is defined as one parameter, inclusive of all the associated overhead. The parameter rate signifies the actual channel reading rate of the system. The average event size was 128parameters. At 10 KHz pulsar input 584665 parameters are read in 60sec. The average transfer rate is 1.2Mparameter/sec.

Conclusion

The CBLT transfer call in VME has some fix overhead. The larger transfer size reduces the overhead cost. The VME controllers have limitations in terms of number of consecutive read cycles they could perform in one CBLT call. The number of CBLT calls and the average transfer size in each call are two important parameters to fine tune the CBLT performance for a given controller. Accordingly, the modules can be distributed uniformly in multiple crates.

References

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