A VME-base Data-Acquisition System for Scattering Experiments At a Pulsed Neutron Source.

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Abstract

We developed a VME-base data-acquisition system for scattering experiments at a pulsed-neutron source. Single-ended and linear-position sensitive ^{3}He neutron detectors are used in various neutron-scattering experiments. The data are acquired by multi-channel time analyzer (TA) and position-sensitive detector (PSD) modules on a VME system.

We use a PC in place of a VME CPU module, which is usually necessary to use the VME system. For this purpose, we developed an interface-module (SCSI-VME) which performs read/write data from/to VME modules via a standard SCSI connection. By employing the SCSI standard, we can use any PCs or workstations. A VME-base data-acquisition system with a PC is shown in Fig. 1. The PC controls three daisy-chained VME crates by SCSI cables.

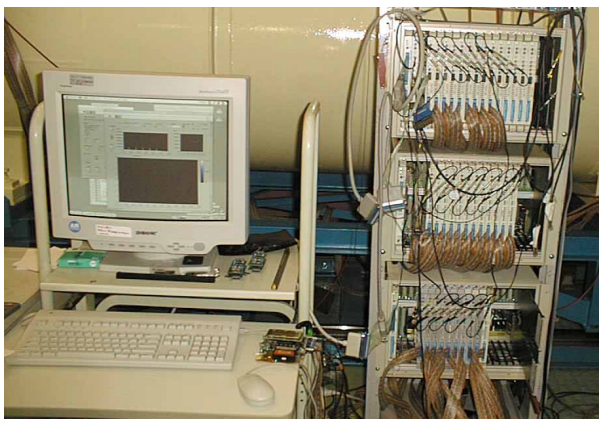

Figure1: VME-base data-acquisition system

1 CHARACTERISTICS OF THE SCSI-VME MODULE

The SCSI-VME module is shown in Fig. 2. The module consists of 2 FPGAs (Field Programmable Gate Array) and some TTLs. Although usually one such module is used as a controller in a VME crate, more than one module can be used in the same crate.

The specifications of the SCSI-VME module are summarized below.

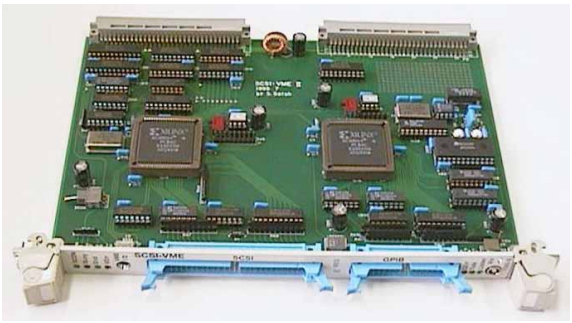

Figure2: The SCSI-VME module

- **Compact size:** It is housed in a VME double-height 1-span module.
- **Transfer speed:** The net speed is about 0.5 µsec/byte.
- **PC:** Any PCs or workstations which have a SCSI port.
- **A GPIB port:** It has a GPIB port. (Always acts as a controller)
- **A VIDEO input port:** 640dot(H) * 512dot(V) * 8bit, it accepts NTSC signal.
- **Low power:** The power-consumption rate is only 5W (+5V 1A).
- **Low cost:** About 50,000 yen/module.

2 THE STRUCTURE OF THE SCSI-VME MODULE

Figure 3 shows a block diagram of the SCSI-VME module. The SCSI-VME module mainly consists of three independent parts: namely, a SCSI-VME part which transfers data between SCSI and VME, a SCSI-GPIB port, and a video capture port.

The module supports a subset of SCSI-command: namely, Inquiry (12h), Write-VME (2Ah), Read-VME (28h), Write-GPIB or Write-VIDEO (22h), Read-GPIB or Read-VIDEO (20h), and Read-GPIB status (21h). If it receives other commands, it always replies a check-condition status code.

The first three commands are for the VME part. In response to the inquiry command, it replies "SAT" as vender-identification, "VME" as product-identification, and "removable disk" as type. The Write- and Read-VME command takes two operands: namely, 16-bit transfer-count and 32-bit VME address, and performs a data transfer of the given number of bytes to/from the VME memory from/to the VME address. If the transfer is successful, it returns a STATUS code of 00h (successful), and if not, 02h (CHECK CONDITION).

For the GPIB case, the Read-GPIB and Write-GPIB command takes two operands: namely, 9-bit GPIB address and bus status, and 4-bit transfer-count data. In order to adjust the speed difference between the faster SCSI and the slower GPIB port, it provides a 16-byte buffer memory on the board. The Read-GPIB status command should be used before actually reading the buffer data by the Read-GPIB command.

By the Write-VIDEO command, the video signal at the time is captured to the frame memory. By the Read-VIDEO command with one operand, 16-bit transfer-byte count, the frame-memory data of the given number of bytes are transferred to the PC.

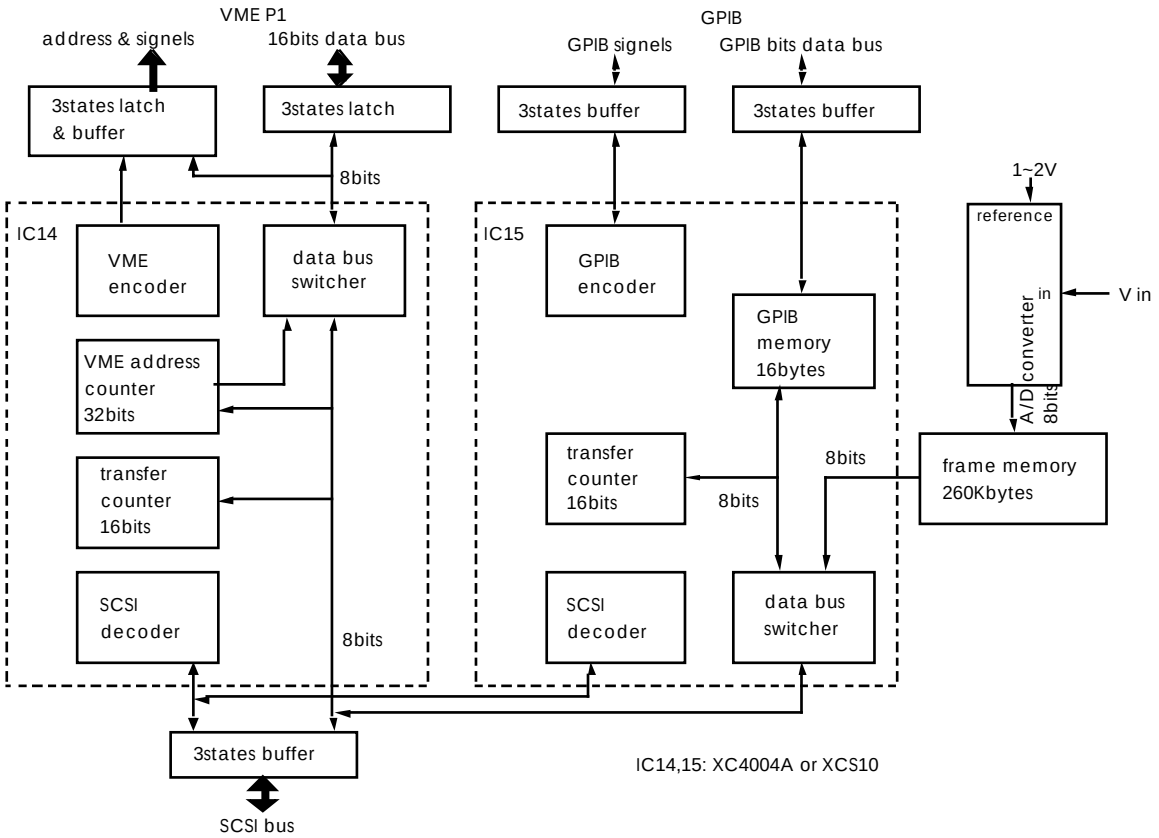

Figure3: Block diagram of the SCSI-VME module

3 DATA-ACQUISITION SYSTEM CONFIGURATION

Fig. 4 shows a general view of the data-acquisition system. We use ^{3}He -gas filled neutron detectors of 1/2 or 1 inch diameter at 10 atmospheres. The amplifier module consists of eight charge-sensitive amplifiers and pulse-shaping modules which have a shaping constant of 0.5 μ sec.

3.1 TA system

This system consists of an AMP module, TA modules and a PC. Each AMP module receives 8 detectors. The detector is single-ended. A bias voltage of 1000-1500V is applied to the detectors. The output analog signal is transferred to the TA module by a twisted-pair flat cable. The TA module has discriminators at the front-end and the digitized timing signals are stored in histogram memories in the same module.

3.2 PSD system

We use PSD's having a 1/2 inch diameter and a 607 mm effective length, made by Reuter-Stokes. The resistance of the anode wire of the PSD is about 4k •, and bias voltage of 1500-2000V is applied to the detectors. The signals from both ends of a PSD are fed to charge-sensitive preamplifiers and shaping amplifiers. The position is determined by a charge-division method.

This system basically consists of a PSD unit, PSD modules and a PC. Each unit holds 8 PSD's, and many units can be lined up so as to cover a large area with very thin gaps between the detectors. The PSD modules encode the position and time, and histograms are made by the PC.

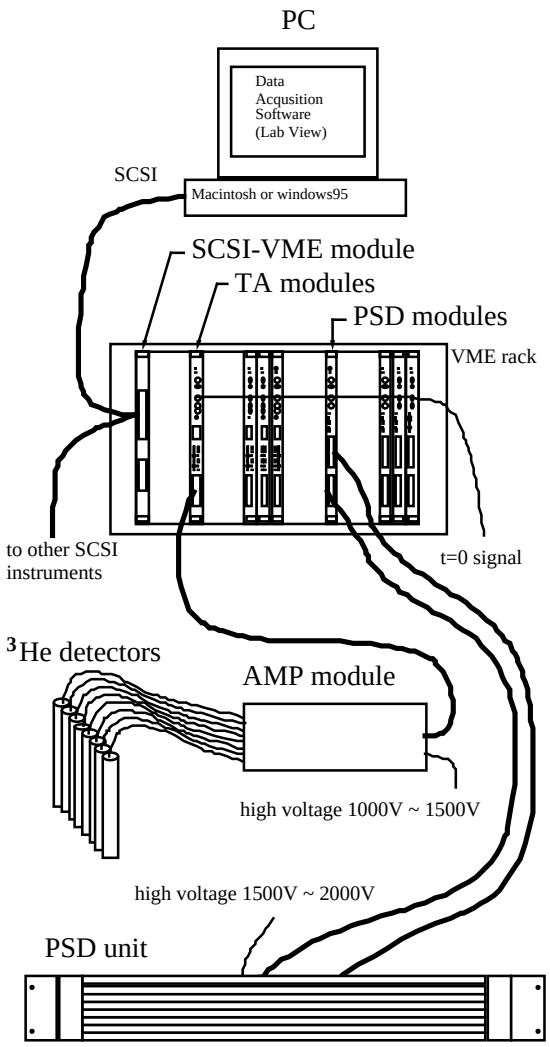

Figure4: General view of the data-acquisition system

3.3 The SCSI-VME module and PC

The acquired data are then collected by the PC through the SCSI-VME module. Although we are mainly using Macintosh computers made by Apple, we are also using PCs running a Windows 98 or 95 operating system. The entire controlling software is based on a commercially available package software, LabVIEW, from National Instruments Inc.

REFERENCES

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