DISTRIBUTED MONITORING SYSTEM FOR EPICS IOC HEALTH

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Abstract

A microprocessor-based IOC VME crate monitoring system has been developed for the TRIUMF/ISAC Radioactive Beam Facility control system. Distributed monitoring modules reside in the IOC VME crates and broadcast their address and status on a single CANBus loop. Each module builds a map of all the monitor statuses that can be read via the VME backplane by the local IOC. The module is capable of monitoring crate parameters including voltages, temperature, fan speed, airflow etc. EPICS writeable watchdog registers allow detection of software problems. When requested by a CANBus command the module will generate a VMEbus sysreset and can cycle the power to the crate.

1 INTRODUCTION

The TRIUMF/ISAC Radioactive Beam Facility control system utilizes EPICS implemented in VME [1]. Due to the distances from the control room and the several locations, where access is restricted, an IOC health monitoring system has been implemented.

2 DESIGN GOALS

For a VME crate monitoring system, several parameters must be measured and compared to acceptable values. These parameters include:

- Temperature
- Voltage
- Fan speed
- VME SYSFAIL

In addition, for IOC health, monitoring EPICS scan tasks is essential. Although monitoring will detect problems the system should provide a means for correcting the problem if possible. Processor hang-ups may be corrected by resetting the processor. This can be accomplished by driving the VME SYSRESET. However some processor or other module latch-ups can only be remedied by cycling the power to the VME crate.

In the TRIUMF/ISAC facility several of the IOC VME crates reside in areas that are biased at high voltage. Communicating with these crates requires galvanic isolation.

As previously described [2] CANBus is being used for control of all beam steering elements. Due to its success and support by the EPICS collaboration slow control communication should be implemented using CANBus. Each crate-monitoring module should broadcast its status over the CANBus so that all modules can build a status map of the other crate monitors. The local IOC, via the VME bus, should read this map. The module should broadcast a single summary status word, thus minimizing CANBus activity. The existing IOC and Ethernet communications should be utilized to provide display and alarming to the operators.

The monitoring system must be retrofitted into the previously chosen Elma VME crates [www.elma.com].

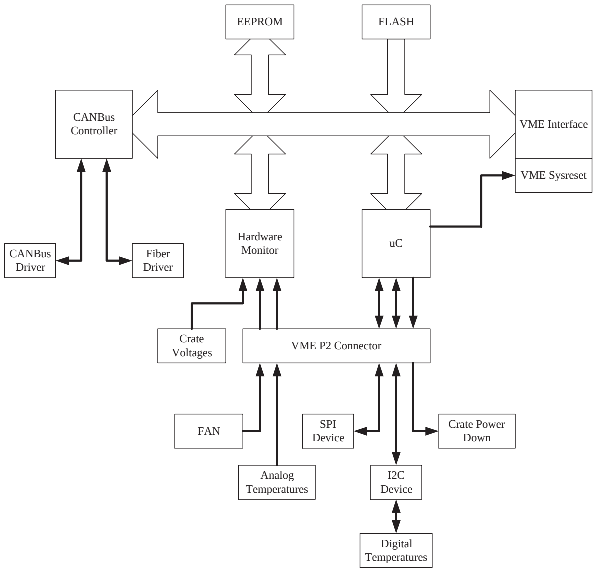

Figure 1: Block Diagram of VME Module

3 SYSTEM DESIGN

The crate monitoring system consists of three parts:

- a standard width 6U VME module,
- an interface PCB,
- and a hub

3.1 VME Module

A block diagram of the VME module is shown in Figure 1. The module can measure the 5, +12, -12, and 5 standby power supply voltages. It has an onboard temperature sensor, and supports the Dallas Semiconductor 1-Wire ™ temperature sensors [www.dalsemi.com]. In addition, two analogue inputs are available for use with temperature sensors such as the National Semiconductor LM34/35 [www.national.com]. Fan speed measurement requires fans with a tachometer output. The module is capable of monitoring up to five fans. Other features include a serial RS-232 port as well as both SPI and I^2C interfaces for sensor expansion. The module resides in VME A24 memory space. All parameters can be read through VME registers and trip levels are written into VME registers and saved in EEPROM. The system supports up to 256 modules. Visual and audible indications of problems are provided. The module's front panel displays include:

- VME Access
- CANBus Tx/Rx
- RS-232 Tx/Rx
- Fan Trip
- Temperature Trip
- Watchdog Timeout
- +5V out of tolerance
- +12V out of tolerance
- -12V out of tolerance
- +5V standby out of tolerance
- Crate power inhibit

In addition to the CANBus interface, a fibre optic interface can be used when galvanic isolation is required.

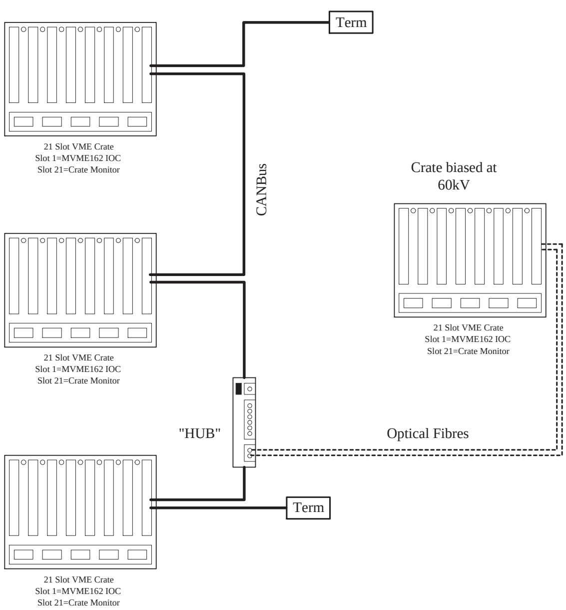

Figure 2: Crate topology

3.2 Hub

The fibres connect to a "HUB" much like an Ethernet 10BaseT system as illustrated in Figure 2. The CANBus transceivers reside on the hub and all CANBus activity is relayed to the module over the fibres. The fibres are kept short enough so that the added delay does not effect proper CANBus communication.

3.3 PCB Interface

The interface PCB allows connecting external devices such as fans, temperature sensors, and the power supply inhibit via the VME P2 connector.

4 OPERATION

A crate (A) reset or power cycle occurs when the module in crate (A) receives a CANBus reset or power command from crate (B). Writing the destination crate ID followed by the appropriate command to the crate-monitoring module in crate (B) via VME generates these commands.

There are 16 possible watchdog registers for monitoring EPIC scan tasks. Currently for the TRIUMF/ISAC control system scan tasks of 0.01 to 10 seconds are being used. Each of the 16 watchdogs can be set from 1 to 15 seconds in one-second increments. Each EPICS scan task must be modified to include a write to a VME memory location each time the task executes. If the task fails to write to the location within the specified period a flag is set in the global status register for that crate monitor. The register contains a one-bit summary for each of fan, watchdog, temperature, and voltage. This global status register is transmitted at a 1Hz rate as a CANBus broadcast. Each crate monitor receives this data and stores it in the VME register, which corresponds with the address of the transmitting module. If the data contains fault information a flag is set in the VME fault register. The IOC needs only to check this register to determine if other crates are operating properly. If the flag has been set the IOC must then check all the mapped global status registers for the 256 possible crates.

5 STATUS

A prototype module is currently undergoing initial testing.

REFERENCES

[1] Keitel R. et al, "Design and Commissioning of the ISAC Control System at TRIUMF", these proceedings

[2] Bishop D. et al, "Distributed Power Supply Control using CANBus", ICALEPCS 97, Beijing, November 1997.