

SLOW CONTROL FOR MICROMEGAS AND DRIFT CHAMBERS

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Abstract

A new spectrometer is being built for the COMPASS particle physics experiment at CERN. Saclay is in charge of the construction and the operation of two types of gaseous detectors: Micromegas microstrip detectors and Drift chambers [1], [2]. The operation of the detectors requires the slow control of high voltages and currents, and of the thresholds for the Front-End. This control system has been implemented using the Experimental Physics and Industrial Control System (EPICS) Software tool kit. For the high voltages, the system CAEN SY127 was chosen and has been controlled since March 2000. For the thresholds of the Micromegas chambers, a specific VME hardware and a JAVA graphical interface were developed to configure and monitor the thresholds.

1 INTRODUCTION

As part of the COMPASS collaboration at CERN, Saclay is in charge of the building of 2 types of gaseous detectors: 12 Micromegas microstrip chambers and 2 Drift chambers. The slow control for these detectors consists of the control of high voltages and of the discrimination thresholds and is based on EPICS with vxWorks on the VME side and Solaris 8 on the SUN workstation side. At present, this control system is carried out for six Micromegas and one Drift chambers and run during three months last summer. We have used one VME for the Micromegas chambers and one VME for the Drift with a PPC MVME2431-1 CPU on each VME.

2 HIGH VOLTAGES

For the high voltages, it was decided to use the CAEN system, model SY127 because this system has been known to the physicists for a long time and consequently we had several CAEN crates at hand. This system is specifically designed to power detectors such as PM and chambers. Each CAEN crate can house 10 modules and each module has four channels. For each high voltage channel, the user has to give a "Ramp-up" and a "Ramp-down" value and a current limit value. The high voltage will linearly increase or decrease with time, the rate being determined by « Ramp-up » or « Ramp-down » parameters. If a channel draws a current larger than the programmed limit, the channel is signaled to be in overcurrent. Thereupon, a number of actions can be optionally taken. In our case, the channel is switched off.

The high voltage will drop to zero at a rate determined by the value of ramp-down for that channel.

In our experiment, two CAEN crates are used. One for the Micromegas chambers and PM, and one for the Drift chambers. For the Micromegas chambers, CAEN modules have a voltage range of 2kV with a current limit of 40 μ A and have a current resolution of 10 nA. For the photomultipliers, 2 modules A333 (4kV, 2mA) are used. Another CAEN crate controls the high voltages for the Drift chambers with modules A234 (2KV, 200 μ A). All these CAEN modules have a maximal voltage protection.

In the past, the physicists controlled locally on the CAEN crate or remotely from a terminal with a RS232 link. Now, the high voltages are controlled from a VME via a CAEN communication module in the VME, model V288, and a CAENET link.

We obtained the EPICS software for CAEN SY127 from SLAC. This software was first written at Jefferson Laboratory. There are MEDM displays for the control of the values of « Ramp-up », « Ramp-down », trip, current limit, voltage limit, and others displays for the real readback of the current and the voltage. For safety reasons, we have separated the displays dedicated to the controls of the high voltages and the displays for the monitoring. In total, at present there are 36 high voltage channels. Next Spring, 6 new Micromegas chambers and a second Drift chamber will be installed. Hence, the number of channels will double. There will be 2 CAEN crates serially. At present, we are limited by the rate of scanning of the channels to one per second. Practically, we get the current for all the channels only once per second.

The EPICS tools Channel Archiver, xarr and Striptool allow to control effectively the high voltage system. Striptool is a real time tool and the Channel Archiver permits to diagnose the behavior of the high voltages in retrospect.

3 MICROMEGAS THRESHOLDS

3.1 Hardware

Each Micromegas chamber has up to 1024 strips by plane. These strips are linked by 16 to a small card that houses each a full custom ASIC called SFE16 designed in our department to answer to specific need for Micromegas chambers. This chip SFE16 contains 16

channels with a low noise preamplifier. Each channel allows to operate one strip. This chip provides also a setting of the thresholds common for 16 channels and a logical OR for the same 16 channels. The slow control is in charge of the command control of the thresholds and of the read-out of the OR to keep the thresholds system independent from the acquisition in any circumstance. The threshold's setting depends on the position of the channel in the detector. Hence, this writing has to be done chip by chip.

A dedicated bus was developed to supply the power to the cards SFE16 and to carry the signals. Around each Micromegas chamber there are 2 busses of 32 SFE16 cards. Consequently, for 12 chambers there are 24 busses. At the head of each bus, a buffer board was designed to do an electric adaptation of the signals. A VME interface board was also built to adapt the signals from the VME to the buffer card and a binary input output VME board ADAS ICV196 is used to write and read bit patterns.

The chip SFE16 is composed of 4 registers with 6 bits for the address, 4 bits for the subaddress and 8 bits of data. One of the registers is the value of the threshold. The other registers are electronic parameters.

The busses are written in parallel and the bit patterns serially. Hence, the purpose of the software is to write 24 bit patterns for the 24 busses of the 12 chambers and these 24 bit patterns are constructed with the same bit of the same register of the same chip of the different busses. To build these specific patterns, a convenient method was to use a file in which all the values of the 32 chips of the 24 busses are written.

The bit patterns are written through a VME binary input output board ADAS ICV196 that has 96 channels. One port of 32 channels is used to write the pattern, another port to read the pattern of bit. There is only one channel for the CLOCK signal and one channel for the LOAD signal.

3.2 Software

The thresholds are written at each spill to solve some problems of discharges of the detectors. On the VME side, an EPICS SNL program receives an interrupt and writes the different registers every 14 seconds (Fig. 1).

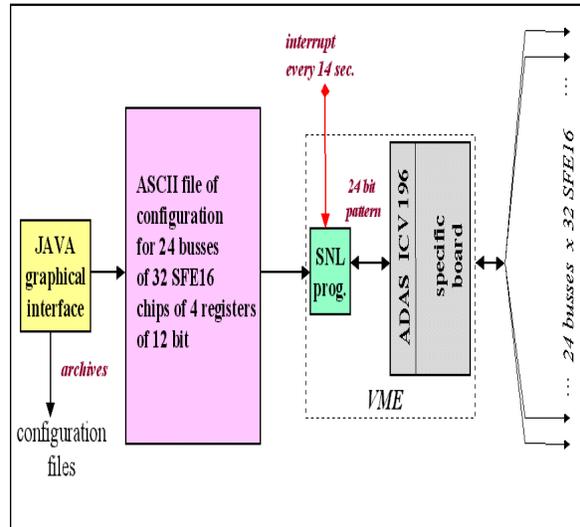


Fig.1 Software for thresholds of Micromegas

A JAVA (JDK 1.2) graphical interface was developed and has two goals. One goal is the “on-line” configuration of the thresholds for all the chambers. Another goal is archiving and restoring configurations. The interface gives the possibility to modify online the threshold of one SFE16 (Fig. 2) or to set the threshold for several SFE16 at the same value or to configure several chambers in the same way (Fig. 3). A specific display is also available for the mapping of all the registers.

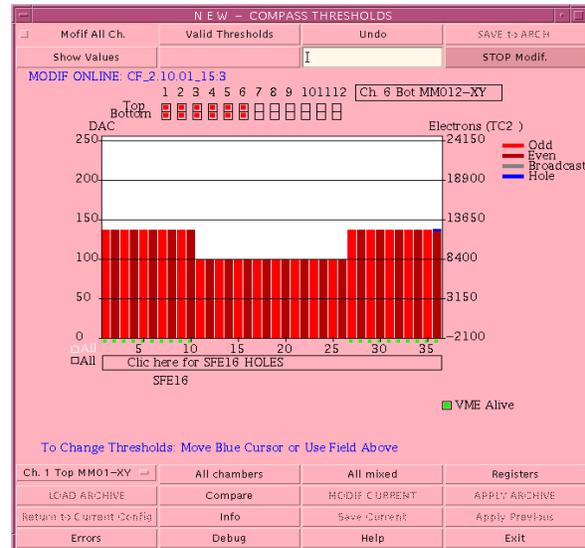


Fig. 2 Display to control 32 thresholds on one bus

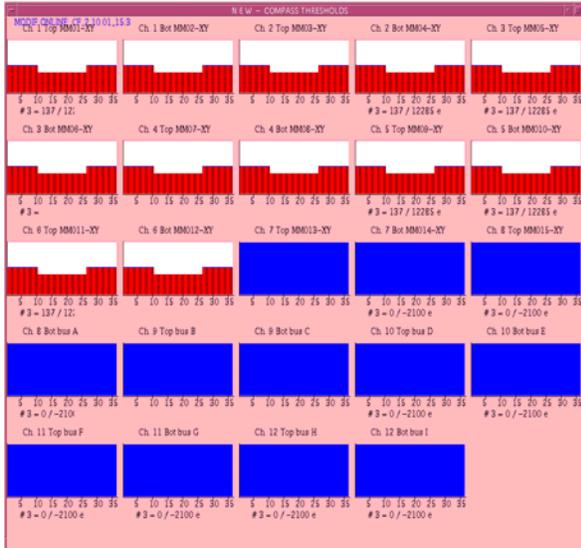


Fig. 3 Display for 12 busses for 6 Micromegas chambers

4 THRESHOLDS FOR DRIFT CHAMBERS

This control consists in sending a negative voltage comprised between 0 and -1600 mV with a step less than 10 mV. The ADAS VME DAC board ICV712 fulfills these needs. For the software, we had only to configure an EPICS database and to create a MEDM display. Therefore, this simple application was rapidly done.

5 LOG MESSAGE QUERY

This program was developed in JAVA and is a real time log message graphical tool. It works from an ascii file gathering all the errors. It provides functions of

search. It is useful to query error log messages by giving name of hardware, time of log message: date or time period. This tool also backs up files of log messages.

6 FUTURE DEVELOPMENTS

One future development is the counting of the OR output by the SFE16 chips. The chosen VME board is the SIS3801 multiscaler from SIS GmbH. Another one is the communication software between EPICS with Channel Access and PVSS2 with DIM that would allow to communicate with the COMPASS general control.

7 CONCLUSION

For all the VME ADAS boards, the EPICS drivers were already written. In our control group, it was the first time we had to control CAEN high voltages and the EPICS software we got, contributed to control our detectors since June 2000. The addition of graphical JAVA tools for thresholds and log error messages has answered all the needs of the physicists.

REFERENCES

- [1] COMPASS Proposal, CERN/SPSLC/P297, March 1,1996
- [2] Micromegas as a large microstrip detector for the COMPASS experiment D. Thers et al. NIM A 469(2001) 133-146

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