

## Hardware for the Test Stand of the CLAS Drift Chamber High Voltage System

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This paper presents the design and implementation of the hardware for the CAEN test stand (Cats), which is used for rapid testing, calibrating, and debugging of crates and modules of the SY527 CAEN power supply (Sycaps) that provides high voltage (HV) for the CLAS drift chambers.

Sycaps [1] comprises three CAEN mainframes, each holding ten twenty-four-channel cards. Controls to set voltages, current thresholds, and to power all or a specific group of channels are available at the front panel (FP) or in the Hall B counting house at a workstation connected to Sycaps by RS232 or CAENET, CAEN’s native software.

Cats consists of a mainframe (Fig. 1 bottom), which holds the module to be tested and the HV controller module (HVCM, Fig. 1 top) that regulates HV and current levels – facilitating HV readout and current trip tests. It is configured as shown in Fig. 2.

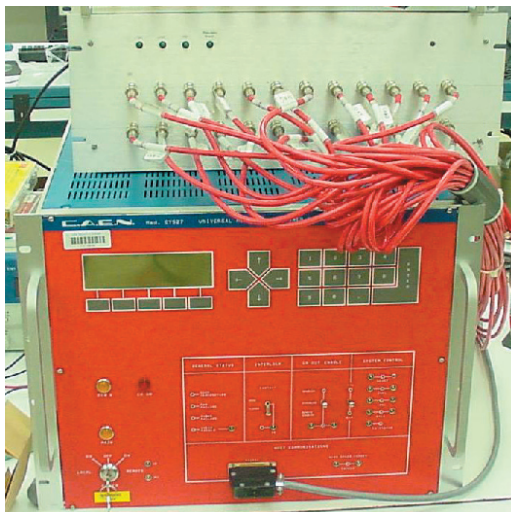


FIG. 1. Cats

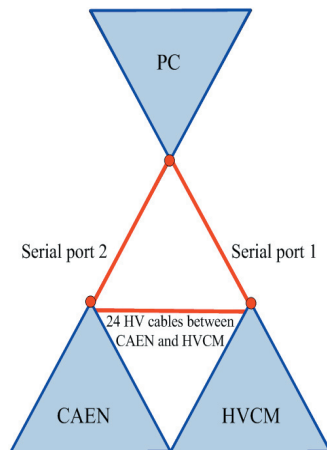


FIG. 2. Cats configuration

HVCM, 19” X 17” X 9” in dimension (Fig. 3), comprises twenty-four Coto HV relays [2], a Thaler 150 ADC [3] and a Microchip 16F877 PIC Microcontroller [4] on a 16” X 12” four-layer (ground, power, and two trace layers) PCB, Fig. 4. The PCB was designed in-house using PCAD 2002.

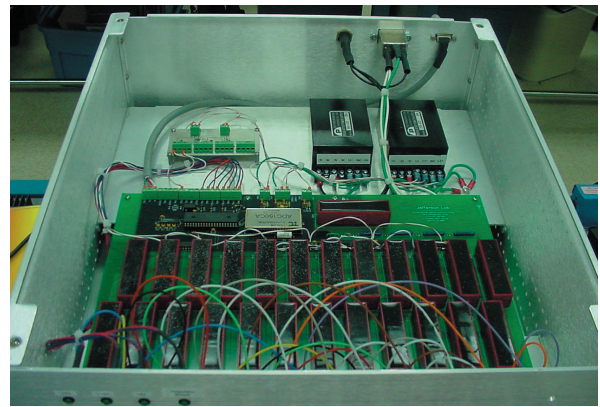


FIG. 3. HVCM

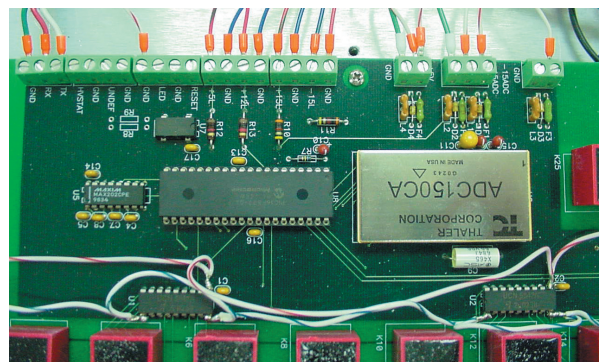


FIG. 4. ADC and PIC inside HVCM

HVCM is powered by two +/- 15 VDC power supplies, Polytron Device P61-15T, and a custom-designed regulator board provides the +/- 5 VDC. The ADC has an independent power supply to reduce noise. SHV connectors on the front panel enable connection to the mainframe.

To read out voltages, mainframe’s HV output is reduced by a voltage divider that consists of five HV resistors in series – four 25MΩ, 1 W, 1% resistors and one 380KΩ, ¼ W, 1% carbon film resistor [5].

At mainframe’s maximum output, 2500 VDC, the voltage drop across each of the first four resistors is 623 VDC and

8 VDC across the fifth resistor. The voltage divider produces, at maximum output voltage,  $\sim 25 \mu\text{A}$  current load on the mainframe.

Since the ADC has one input, to automate Cats, a PIC-resident-control code to switch Sycaps' channels using relays was developed. In this code, relays are represented by certain keys on the keyboards, which when pressed close the corresponding relay in the HVCM. Relay control is initiated when the PIC receives one of twenty-four decimal values; on reception of the decimal value the related relay is powered. Each relay is connected to the ADC that reads sequentially each HV channel of the module.

To read the voltage, C commands are sent to the ADC. Outputted digital data in Bipolar Offset Binary format is sent in three consecutive turns, High Byte, Middle Byte, and Low Byte – covering the entire ADC range. Eight parallel output data pins transfer data from the ADC to the eight related pins on the PIC's PORT B register, from where the data are transmitted to the PC over the RS232 serial port #1 on the mainframe.

Cats' hardware has been tested and at present is able to read out the mainframe's voltage with an accuracy of  $\pm 0.1$  VDC. With Cats, the eighty hours needed to test a module has been reduced to four. Plans for additional hardware – an oscilloscope interface, to allow the ramp rates and voltage ripple tests to be done more precisely are underway.

- [1] CAEN SY527 HV Power Supplies; Users Manual.  
Available at <http://www.caen.it>
- [2] Coto 5500 Series High Voltage Relays; datasheet.  
Available at <http://www.cotorelay.com>
- [3] Thaler ADC 150; applications and datasheet for operation.  
Available at <http://www.thaler.com>
- [4] PIC Microcontroller; applications and datasheet for operation.  
Available at <http://www.microchip.com>
- [5] MOX 750-23 High Voltage Resistors.  
Available at <http://www.ohmite.com>  
Since, these are fixed resistances the  $<1\%$  difference in their values are calibrated out.