Computer Automated Measurement and Control Crate's Monitoring Card

Michael Ferguson, Brian Eng, Mary Ann Antonioli, Peter Bonneau, Tanest Chinwanawich,
Tony Madany, Marc McMullen, Armenak Stepanyan, Werth Teachey and Amrit Yegneswaran

Physics Division, Thomas Jefferson National Accelerator Facility, Newport News, Va 23606
February 18, 2004

The HMS Monitoring System (HMS) checks a variety of electronic instrumentation of the Continuous Electron Beam Accelerator Facility's Large Acceptance Spectrometer at the Thomas Jefferson National Accelerator Facility in Newport News , Virginia, USA.

This paper describes the design of the Computer Automated Measurement and Control (CAMAC) crate's monitoring card (CCMC).

CCMC is the first of the three types of monitoring cards – FASTBUS, CAMAC and NIM, each of which reads out the status of the crate parameter signals, developed for HMS [1]. CCMC reads the six CAMAC backplane voltages: ±6V, ±12V, and ±24V, and determines whether these voltages are within operational limits. CCMC also monitors the crate temperature.

Figure 1 shows the dataflow in the CCMC. Before voltages are sent to the analog to digital converter (ADC) a resistor divider reduces the positive voltages; the negative voltages are inverted first with operational amplifiers and then their levels are reduced by adjusting the gain on the amplifiers so that the ±6V, ±12V, and ±24V levels are read as 1V, 2V, and 4V respectively – below the ADC reference voltage of 5V.

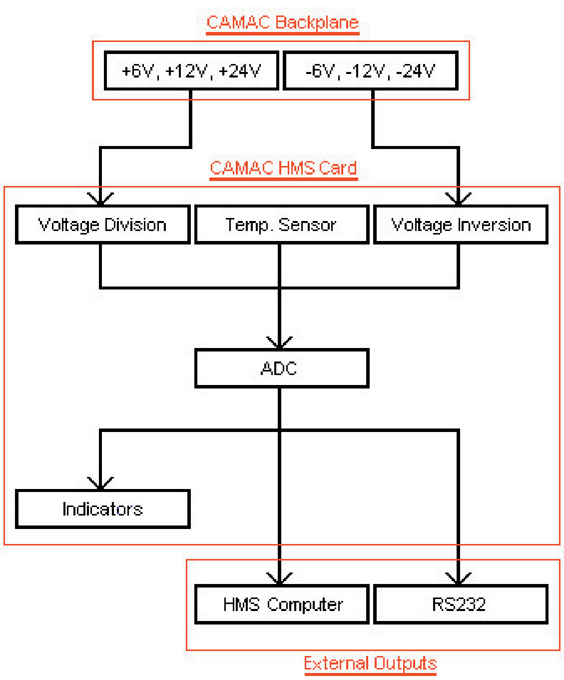

FIG. 1. CCMC dataflow.

To read the voltages from the CAMAC backplane CCMC uses a peripheral interface controller (PIC) from Microchip Technology, Inc. (model 16F877) which has an 8-channel ADC. Figure 2 shows the pin-out for the PIC. In addition to the main inputs and outputs, there is also a RS232 formatted input/output (I/O), which is used during testing and calibrating to read out voltage values to a computer terminal via the serial port.

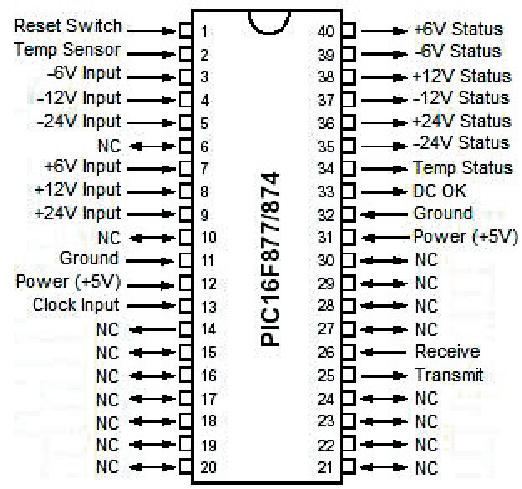

FIG. 2. PIC pin-out for CCMC.

To measure the temperature[2], the precision integrated-circuit Fahrenheit sensor, LM34, is used. The output voltage of the sensor, read by one of the ADC channels of the PIC, fig. 2, represents air temperature in the immediate vicinity of the sensor.

The prototype CCMC is shown in fig. 3. This card fits into a single CAMAC slot and plugs into the backplane via the double-sided slot connector.

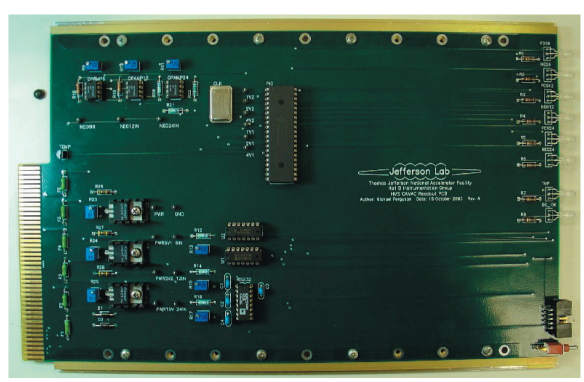

FIG. 3. CCMC.

Tests on this card were conducted in a CAMAC mini-crate from the Sparrow Corporation, fig. 4.

FIG. 4. CCMC test stand.

It was determined that the sampling rate for the PIC ADC was too low – voltage fluctuations were more than 100 mV. Therefore, a program was written to ensure that the PIC reads each voltage level a 1000 times and uses that average to determine whether the voltage level meets specifications. This technique did not increase read time significantly and proved to be accurate.

For the accuracy and precision test of the ADC readings, the serial readout was connected to a computer so that the ADC's read-back values could be compared to the values measured with a digital multi-meter (DMM).

Table I presents the results of the measurement. The difference between the average readback value and the measured value is zero for all voltages except ±24 where it is about 50mV. This indicates that taking the average of 1000 readings does help.

	+6V	**-6 V**	**+12V**	**-12 V**	**+24 V**	**-24 V**
Meas. (DMM)	5.99	5.99	12.02	12.02	24.22	-24.24
Avg. Readback	5.99	5.97	12.02	12.02	24.27	-24.29
Std. Dev. Rdback.	0.00	0.00	0.00	0.00	0.00	0.01
Rdback. - Meas.	0.00	0.00	0.00	0.00	0.05	0.05

TABLE I. Results of voltage accuracy and precision test.

After the PIC determines whether the voltages from the ADC meet specifications, it outputs a digital logic signal (1 = good, 0 = bad) that is used to power status LEDs on the card's front panel.

Thermal tests of the regulators, for which the card was left running in the crate for ten hours continuously, indicated that the regulators did not overheat.

In conclusion, the designed and fabricated CCMC prototype works well. The next step is to initiate the production run and install these cards in the CAMAC crates in the end-station. This addition to the crates should enhance the safety of the overall system.

---

[1] An overview of the HMS in given in the CLAS-Note 2003-018 by M. A. Antonioli et. al. For software overview see CLAS-Note 2004-001 by B. Eng et. al.

[2] CAMAC crates do not have a temperature sensor.