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Performance of a New Generation Controller for the Power Systems of HEP experiments

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The performance of the new CAEN controller R6060 was measured on a real slice of the ATLAS RPC detector, using 15 Easy3000 modules of various types, and compared with the present controller A1676A. An average improvement of a factor 30 was found for the response time of the single command execution, and of about 5 for the parameter refresh. Considering the test setup, an additional factor of at least 4 to apply to the above-mentioned factors is expected in real experimental conditions.

Summary (500 words)

In HEP experiments the power system supplying detectors and electronic boards should have high granularity and a wide range of set and monitored parameters, and must be able to efficiently manage and monitor the detector working points and the Front-End and Service electronics. Controllers are the instruments that perform this task: here the performance of a new generation controller designed by the company CAEN S.p.A., named R6060, is presented and compared to the controller A1676A, currently in use in the power systems based on the CAEN Easy standard.

The results of a test campaign that has been done using a power system rack supplying an RPC slice of the ATLAS Muon Spectrometer will be presented. The rack is equipped with four crates, hosting 15 Easy3000 LV, HV, ADC and DAC modules for a total of 708 channels.

This test allowed for a thorough comparison between the two different controllers, and also to test whether the current communication bus, a CANbus type, represents a bottleneck. It focused on the response time of the system, measuring with the precision of a millisecond the execution time of single and global commands, the refresh times of the monitored 708 channels, and the communication time over the CANbus.

There are two key differences between the two controllers: the A1676 is usually placed inside a mainframe SY4527 together with other controllers, and all of them are read in series, while the R6060 is a completely standalone unit, granting great scalability to the experiments; secondly, after each query to the system the A1676A needs to wait for the answer from modules before doing another query, while the R6060 doesn't have this constraint. Clearly, this grants better overall performance when there are several controllers in the system, like in the LHC experiments.

The R6060 is on average 30 times faster than the A1676A for the single command execution while it is 10 times faster for a global command on the whole system. Concerning the refresh time of the parameters the R6060 is 5 times faster. These figures partially depend on the test conditions and on the module types. Moreover, the R6060 showed much more stable behavior: the fluctuations on the time measurements of different modules are below 1%, while for the A1676A are above 30%.

Concerning the communication time, measurements show that the time loss due to the CANbus is 2 orders of magnitude lower compared to the time needed to send and update a command.

It is also important to underline that these tests make up for the best-case scenario for the A1676A, since it was the only controller placed in the mainframe SY4527. In real cases, such as in the Muon spectrometer of ATLAS, in each SY4527 there are from 4 to 8 A1676A, meaning that after the Phase2 upgrade the expected total performance uplift is around 100 times. Moreover, the performance will be further increased when the Easy3000 modules are replaced by the new Easy5000 series.

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