Monitorig system for radiation hardness tests of electronic components for future FAIR experiments.

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Electronic components installed in the field of reaction products in future experiments at FAIR have to be radiation hard. At present, selected parts undergo exhaustive tests with use of intense minimum ionising particles' beams, mostly 3 GeV protons at Jülich sychrotron facility. A control system based on ARDUINO processor has been developed to monitor the components status in situ .

Monitoring system requirements

For components like DC/DC converters or LDO voltage stabilisers the output voltage level as well as expected transient voltage spikes rate has to be monitored during irradiation. Voltage level monitoring (input and output) requires relatively low readout frequency below 1 Hz and can be implemented on inexpensive ARDUINO-Nano system. It is programmed to control an optocoupler based set of relays to govern applied input voltages (for each of 12 channels separately) and reading an ADC values of output voltages for each channel. System supervises the output voltage level and - if needed - switches off the malfunctioning channels to avoid its influence on other DUTs. Measurement status is logged on a local memory and displayed via implemented web server on connected clients. The control electronics has to be placed far away from the device under test in order to avoid spurious effects due to the irradiation.

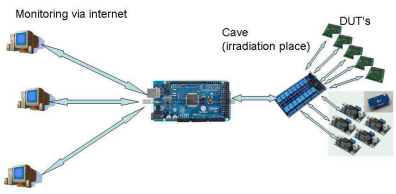

Figure 1: Block diagram of the system testing a set of DC/DC converters controlled by ARDUINO processor.

Hardware realisation

A base plate equipped with two sets of clamps and a PCB-holder has been prepared to accomodate different devices under test (DUTs). They have to be placed in a row such that the irradiating beam punches through all of them. A small scintillator placed on the beam axis behind tested chips and read out by a photomultiplier monitors the beam intensity. Its signals are also registered by ARDUINO system on separate counter and stored with time stamps spill

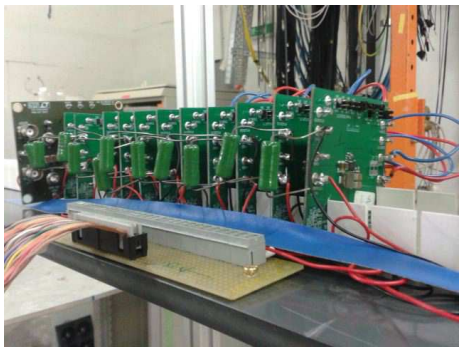

Figure 2: Base plate with PCB card holder and wiring.

by spill. This information helps to estimate precisely beam intensity integral. One raw of electrical clamps is supplied with input voltage (controlled by ARDUINO via set of relays) for the DUTs. Their outputs are wired via second clamps raw to the multiplexer and ADC on controller board to supervise output voltage levels.

ARDUINO control system

The processor itself can be programmed in a C-like programing language with use of different libraries to serve standard functionality (time server, SD-card I/O, internet I/O). Main loop of the program consists of output voltage

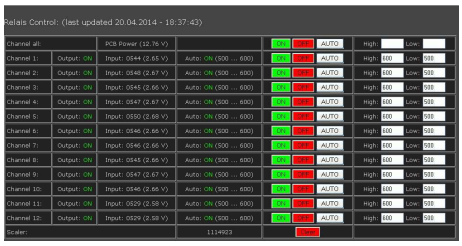

Figure 3: Control output of the monitoring system.

check channel by channel, input voltage check, counter readout, internet service, timer service. The voltage read out values are compared to the upper and lower threshold values which can be defined for each channel. In case of over- or under voltage in three consecutive readout steps the affected channel is switched off.

References

[1] http://www.arduino.cc/

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