

Dosimetry setup prototype for the Slow Control System of the MPD-TOF

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Abstract

The purpose of the project considered is to create an information tool for effective control of Gamma-Scout Geiger counters. The main goal of the system for nuclear and radiation safety, is to protect health and life of people and to preserve the electronic equipment. Features of proposed software are the next. Real-time dose-rate measuring. Support for previous revisions of Gamma-Scout devices. Data logging and remote display of dose-rate for smartphones. However, it is impossible to record two charged particles in one Geiger tube at the same time [1]. It is important to know, there are limitations in measuring high radiation rates and the energy of incident radiation

I System description



Figure 1: Front panels of Gamma-Scout detectors

The Gamma-Scout (all types, include “Standard”, “Alert”, “Online”, “Rechargeable”) work with the USA made detector “LND 712”.

Pulses come to the anode of the detector. The Gamma-Scout algorithm collects the pulses at the anode parallel to a quartz and builds a rate of pulses each two seconds. Next, the algorithm flatters built with a gauged Cs-137. Third step, the algorithm assigns a dose rate (Sv/h) using the table of dose rate to pulse rate, calibrated with a gauged Cs-137 source (complex, not a polynomial relation). The Gamma-Scout is a Geiger counter that measures alpha, beta, gamma and x-ray radiation.

The detector has a few aspects: [2]

- 1) The tube accepts all inputs: alfa, beta, and gamma (Different to the Russian SBM 20, which does not detect alfa);
- 2) The tube is NOT energy compensated and accepts all rays from isotopes, from a pointed source and its environment;
- 3) The Gamma-Scout displays the Sv/h exactly (and is able to be calibrated, if needed repeatedly) for Cs-137 and similar Co-60, due to a similar energy spectrum – but not identical for all other isotopes;
- 4) If the user works with other isotopes than Cs-137, he gets a reasonable dose rate, but not the precise dose rate; GS has the option to display pulses which the user can convert using his own tables.

2 Software description

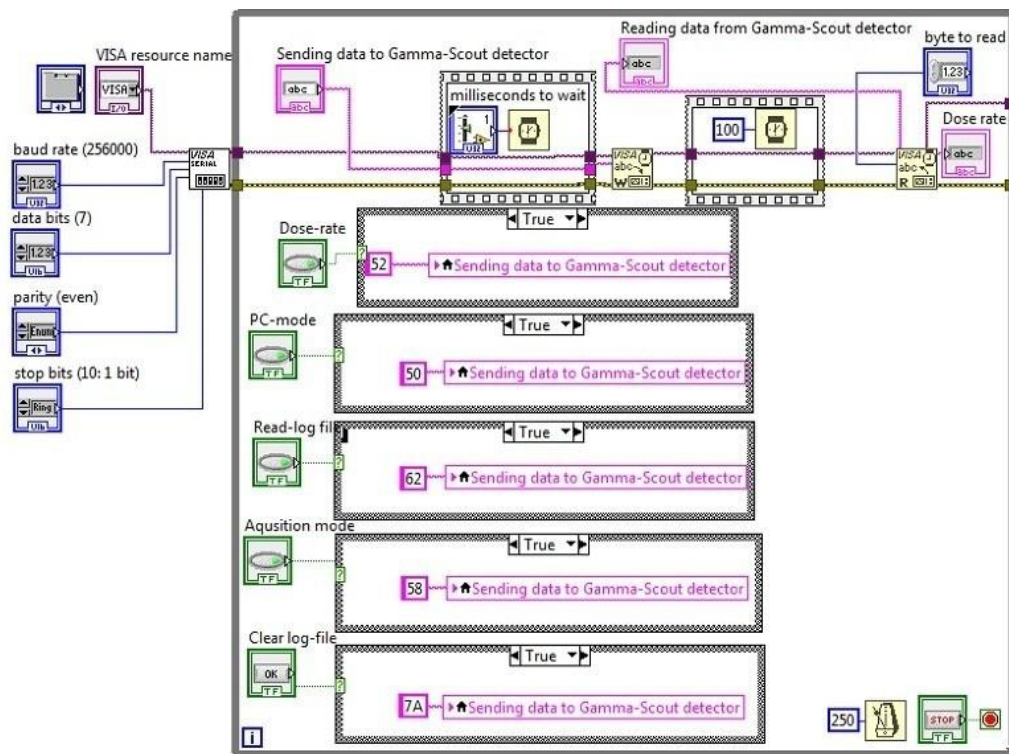


Figure 2: Block diagram of software designed for Gamma-Scout detector

In this project LabVIEW 2016 environment was used with preinstalled drivers for RS-485/232 and VISA library. At first, the VISA functions was initialized with COM-port parameters. Next, the user chooses one of the option: “Read log-file”, “Current dose-rate”, “Switch to “Aquisition mode”, “Switch to PC-mode”, ”Clear log-file” by sending following codes through virtual com-port:

- 'P' (in ASCII) switches to PC mode (same as pressing PC button);
- 'O' (in ASCII) switches to "classic" online mode (only for online devices);
- 'R' (in ASCII) switches to dose-rate online mode (only for online devices);
- 'D' (in ASCII) switches to dose online mode (only for online devices);
- 'X' (in ASCII) exits online mode;
- 'b' (in ASCII) dumps protocol memory;
- 'z' (in ASCII) resets protocol pointer to beginning of memory;
- 'N' (in ASCII) warm start. [3]

At the final step, VISA-read function reads all data in the buffer and software saves all data like current: time, dose, month, day and year.

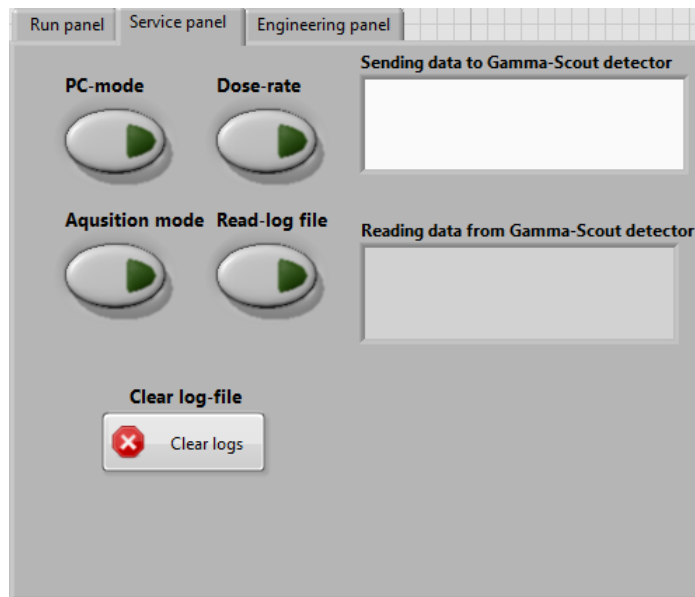


Figure 3: User interface for service panel

3 Summary

Permissible error of Gamma-Scout is +/- 5 percent under environment the input varies between 0.08 and 0.25 Sv/h and partially more. Radiation background should be above 1.0 Sv/h. [2]

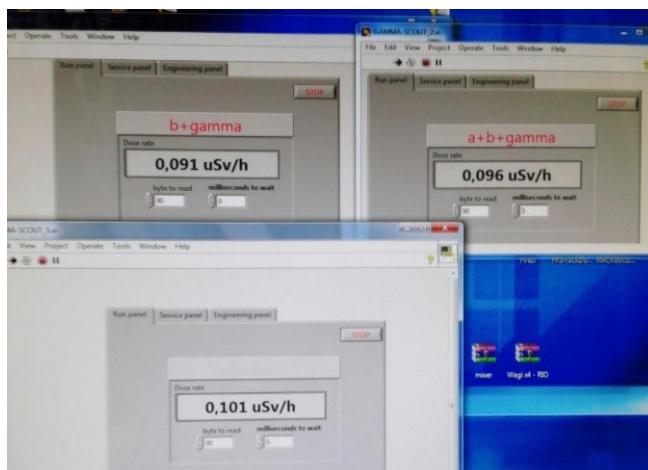


Figure 4: User interface for run panel

As a result, the software of the nuclear and radiation system was designed to read current dose-rate, display it remotely and save it in log-file. To prevent the MPD platform malfunctioning, when the determined level of radiation is reached, a software should be triggered and special procedures should take place to stop electronic equipment, PLC's and physical facilities.

References

- [1] Claus Grupen and Boris Shwartz *"Particle Detectors Second Edition"* Cambridge Monographs on particle physics, Nuclear physics and cosmology (January 2008),
- [2] GAMMA-SCOUT GMBH CO. KG, *Gamma Scout English manual*, (2017)
available at: <https://gamma-scout.com>
- [3] Reverse engineering of Gamma-Scout detector
available at: <https://johannes-bauer.com/linux/gammascout/>