2011 International Nuclear Atlantic Conference - INAC 2011
Rio de Janeiro,RJ, Brazil, October 24 - 28, 2011
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN
ISBN: 978-85-99141-03-8

DEVELOPMENT OF A DIGITAL LOG RATEMETER

Cláudio Domienikan, Andréia Brito, Fábio de Toledo and Guilherme S. Zahn

Instituto de Pesquisas Energéticas e Nucleares, IPEN - CNEN/SP
Av. Professor Lineu Prestes 2242
05508-000 São Paulo, SP
clanikan@ipen.br

ABSTRACT

A compact log ratemeter that measures and displays an average count rate through a microcomputer is presented. This ratemeter was developed to be used to monitor a laboratory of production of radioactive samples and also for teaching purposes. The main features are log measurement range from .1 to 1.000 counts/sec and adjustable level alarm. The electronic circuit uses a Geiger tube LND7224, and the processed signal is applied to a National Instruments Multifunction I/O USB-6008 connected to a PC through USB input. A program developed in LabView allows storage of data and real-time observation of the rate of radiation evolution. This ratemeter was designed and constructed in the IPEN-CNEN/SP.

1. INTRODUCTION

The ratemeter, or Geiger counter, is an instrument that measures and displays an average count rate of nuclear radiation events. Generally it uses a Geiger-Müller tube to detect alpha particles, beta particles or gamma rays [1]. Each particle detected produces an electric pulse but the ratemeter cannot distinguish the energy or type of the detected particles. Geiger-Müller is an inert gas-filled tube (usually helium, neon or argon with halogens added) that briefly conducts electricity when a particle or photon of radiation makes the gas conductive. The tube amplifies this conduction by a cascade effect and outputs a current pulse, which is then often displayed by a led display and/or audible clicks. Ratemeters are popular instruments used for measurements in health physics, industry, geology and other fields, because they can be made with simple electronic circuits.

2. GENERAL DESCRIPTION OF THE DIGITAL LOG RATEMETER

A block diagram of the digital log ratemeter is illustrated in Fig. 1. A high voltage circuit provides 650 V to bias the LND7224 Geiger tube [2]. This Geiger tube is an end window-alpha-beta-gamma detector, and the sensitivity curve can be seen in Fig. 2. The pulse from the Geiger tube is amplified and extended by a monostable multivibrator. The extended signal is converted to D.C. voltage by a log frequency-to-voltage-converter and then amplified. The output signal goes to a voltage meter that shows the radiation level by means of a log scale ranging from 0.1 counts/second to 1000 counts/second.

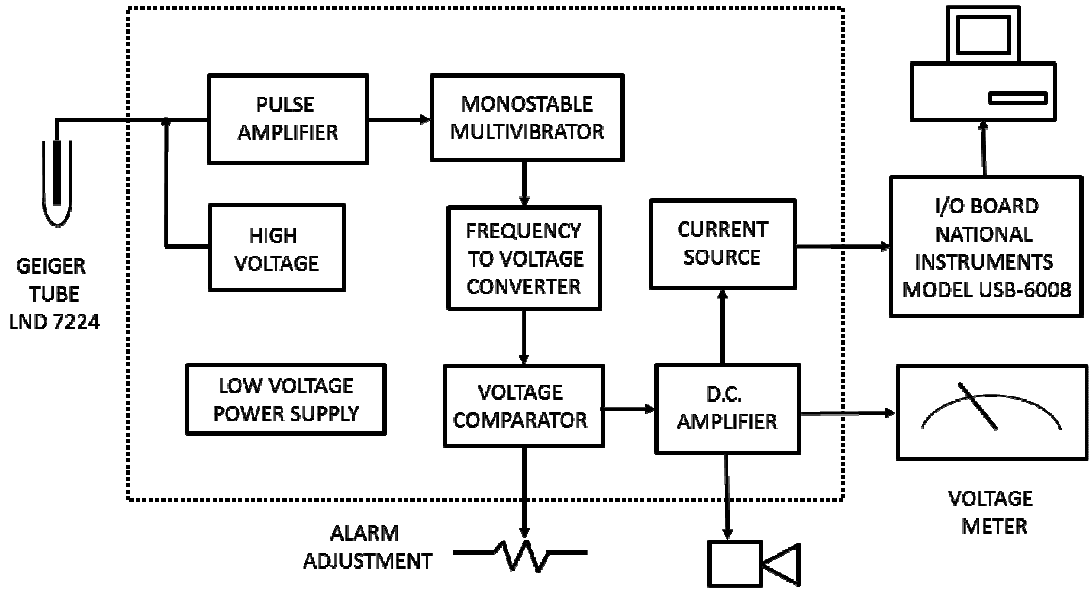

Figure 1. Block diagram of the digital log ratemeter.

The output voltage from the amplifier is also converted to a current signal, from 4 to 20 mA that corresponds to the log radiation information. The output current is applied to an input of the NI-USB-6008 I/O board [3]. This I/O board is connected to the computer USB port. A log meter on the computer screen, developed by Labview [4] software, permits to observe the radiation rate in real time (Fig. 3).

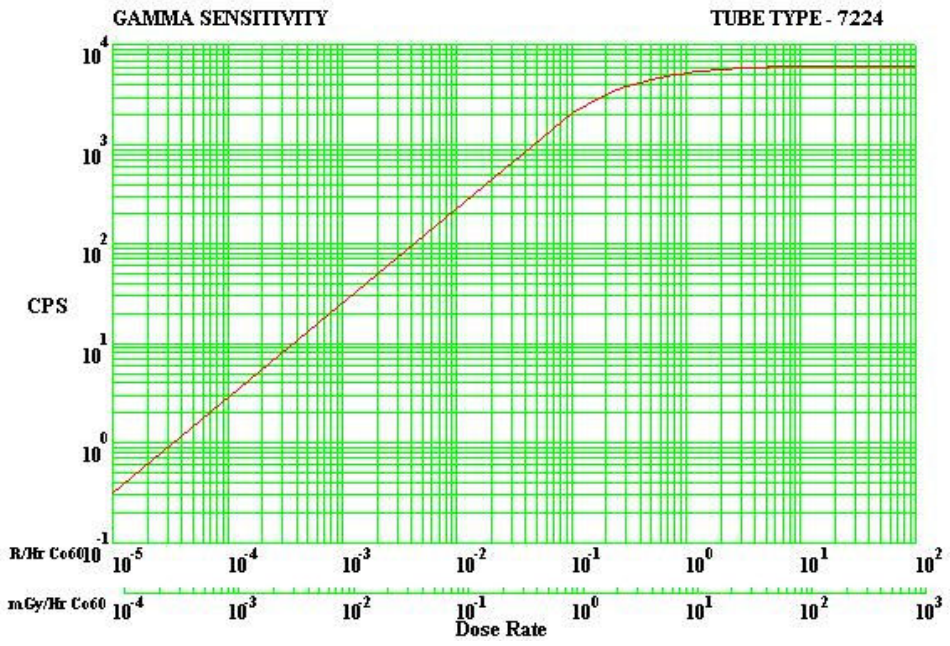

Figure 2. Gamma sensitivity for LND 7224 Geiger tube.

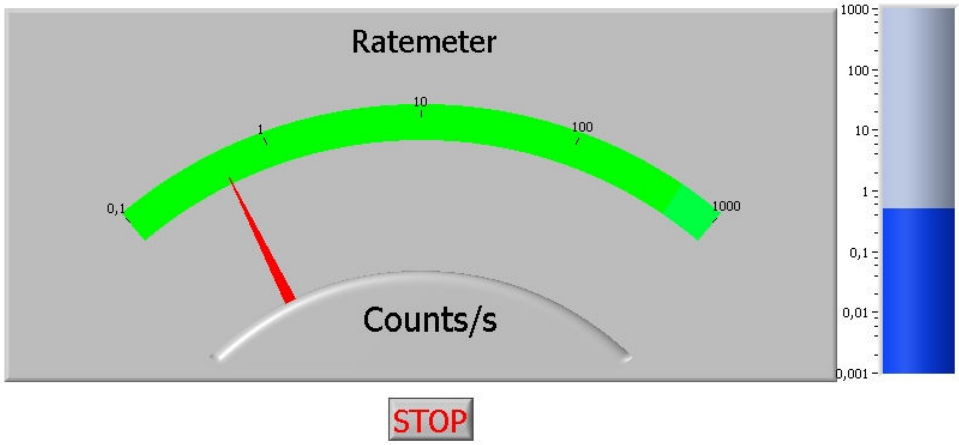

Figure 3. Log meter on the computer screen.

The circuit of the digital log ratemeter was placed in a commercial low cost plastic box. The prototype of the ratemeter can be seen in Fig. 4.

Figure 4. Digital log ratemeter.

3. CONCLUSIONS

An inexpensive digital log ratemeter has been designed and constructed at IPEN. Its main feature is the output in a single, continuous log scale, instead of using keys to select the adequate scale. This equipment was installed in the Laboratory of Hyperfine Interactions (LIH) at IPEN and it is used for environmental monitoring, operating properly.

REFERENCES

1. L. Tauhata, E. S. Almeida, "Radiações Nucleares", CNEN, Rio de Janeiro, Brasil (1984).
2. "Geiger-Mueller tubes – end window-alpha-beta-gamma detector", http://www.lndinc.com/products/368/ (2011).
3. "Low-cost multifunction data acquisition (DAQ)", http://sine.ni.com/nips/cds/view/p/lang/en/nid/201986 (2011).
4. "National Instruments – products and services", http://www.ni.com/pdf/manuals/320998a.pdf (2011).