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ELECTRONIC MODULES DEVELOPED FOR A GAMMA-RAY BARREL-SCANNING SYSTEM

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L. V. East, M. M. Stephens, and J. E. Swansen

ABSTRACT

Electronic modules consisting of scintillation counter preamplifiers, buffer amplifiers, and a multi-input single-channel pulse-height analyzer are described. These modules were developed for use with an eight-channel NaI(Tl) scanning system for barrels containing plutonium-contaminated waste.

I. INTRODUCTION

This report describes the electronic modules developed for use with an eight-channel NaI(Tl) scintillation spectrometer designed to scan 55-gal barrels for plutonium.¹ A block diagram of the system electronics is shown in Fig. 1. Eight 5-cm by 5-cm NaI(Tl) scintillation detectors are arranged in a vertical array in order to view an entire 55-gal barrel. Pulses from the NaI(Tl) detectors are amplified and fed into a module containing eight independent single-channel pulse-height analyzers with

common threshold and window width controls. The preamplifier, buffer amplifier, and single-channel analyzer circuits are described in the following paragraphs.

II. CIRCUIT DESCRIPTIONS

A. Preamplifier

The NaI(Tl) detector signals are fed to preamplifiers packaged four per 17.8-cm by 10.2-cm by 4.4-cm module. Each preamplifier consists of a charge-sensitive input stage followed by a gain-of-ten line driver, as shown in Fig. 2. The preamplifier design is straightforward and was adapted from a proportional counter preamplifier.² The input is protected from large-voltage transients by the two diodes in the gate circuit of Q_1 . The gate-to-source bias of Q_1 is set to about -0.5 V by means of the 1-k Ω potentiometer in the base circuit of Q_2 . Output pulses are linear to 6 V or better and are RC-CR shaped to have a rise time of 0.5 μ s and a decay time of 0.75 μ s. The pulse decay time is determined by the feedback network in the input stage consisting of a 75-k Ω resistor and 10-pF capacitor. Pulse rise time is determined primarily by an integrating network consisting of a 1-k Ω resistor and 390-pF capacitor in the base circuit of Q_4 .

Fig. 1. Block diagram of barrel-scanner electronics.

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B. Buffer Amplifier Module

C. Pulse-Height Analyzer

The input pulse is differentiated by C_4 and R_{12} and applied to the input of a third differential comparator, IC3A, which is used as a "peak detector".

The output of this comparator will switch to its low state when the input pulse exceeds the reference level set by R_{10} . By the proper choice of the differentiating time constant, the output can be made to return to its high state at the approximate time that the input pulse reaches its peak amplitude. The three logic gates in IC4A comprise a reject flip-flop and anticoincidence gate. An output pulse is generated by the anticoincidence gate only if the input pulse exceeds the lower level but not the upper level, and in coincidence with the positive transition of the peak detector. This pulse is

then shaped by a univibrator and made available as a +5 V logic pulse. A signal that is the logical "OR" of all channels is also available.

REFERENCES

1. L. V. East, J. L. Parker, T. D. Reilly, and R. B. Walton, "Gamma-Ray Scanning System for Barrels Containing Plutonium Waste," IEEE Trans. Nucl. Sci. NS-19, No. 1, 211 (1972).
2. L. V. East and J. E. Swansen, "Charge-Sensitive Preamplifier for Use with Large Proportional Counter Arrays," Los Alamos Scientific Laboratory report LA-4972-MS (1972).