Title
PORTABLE ALPHA-SURVEY INSTRUMENT

Permalink
https://escholarship.org/uc/item/35b8j2n6

Authors
Roach, William J.
Walker, Robert J.

Publication Date
1961-04-17
DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.
PORTABLE ALPHA-SURVEY INSTRUMENT

William J. Roach and Robert J. Walker

April 17, 1961
PORTABLE ALPHA-SURVEY INSTRUMENT

William J. Roach and Robert J. Walker

Lawrence Radiation Laboratory
University of California
Berkeley, California

April 17, 1961

Abstract

A transistorized, portable alpha-survey instrument has been developed. Features included are: time-proved air proportional probe (18 in.² area); D-cell powered, built-in speaker and audio amplifier; circuit board modules; and sufficient sensitivity and high-voltage power to operate almost any similar type of detector without modification.
PORTABLE ALPHA-SURVEY INSTRUMENT

William J. Roach and Robert J. Walker

Lawrence Radiation Laboratory
University of California
Berkeley, California

April 17, 1961

Introduction

Control of radiation and protection of workers from radiation exposure requires the use of portable survey instruments by experienced personnel. When dealing with alpha emitters one must be especially wary and have trustworthy instruments. This report tells of the development of a portable alpha-survey instrument which, we feel, meets the needs of alpha surveying.

Discussion

The instrument basically consists of three circuit boards, a meter readout, a speaker, and a probe. Figure 1 shows: (a) preamplified, (b) count-rate and audio amplifier, (c) high-voltage supply. Figure 2 shows: (a) instrument top with microammeter and speaker installed, (b) instrument bottom half with battery holders and probe holder installed. Figure 3 shows the complete instrument.

Separate circuit boards were chosen for two reasons: (a) on a common circuit board high-voltage leakage is always troublesome, and (b) in the event of irrevocable damage to one circuit an entire common circuit board must be discarded, but in module design only the faulty unit is lost.

Present placement of the boards offers the maximum natural shielding provided by the instrument case, and no further shielding is necessary. The high-voltage oscillator is placed at a point as far from the preamplifier as possible, in order to eliminate radiation coupling.

The preamplifier is a three-stage stabilized unit (Fig. 4). It features heavy current feedback and high attenuation of lower frequencies, which eliminates harmonic ripple introduced by the high-voltage power supply.

Preamplifier output is fed to a discriminator circuit which determines the firing level of the count-rate monostable. The audio section is coupled to the first half of the monostable and produces an audible click when a pulse is counted. The audio unit is designed to attenuate circuit noise yet give maximum volume for a pulse; it is biased in such a manner that current is used only when a pulse is produced. Range and discriminator potentiometers are full-size for reliability and ease of adjustment.

*This work was performed under the auspices of the U.S. Atomic Energy Commission.
Fig. 4. Circuit diagram.
The high-voltage circuit features a relaxation oscillator and eight stages of doubling; output is regulated and adjustable. Diodes are a low-cost type selected for low leakage. The oscillator frequency is made as low as possible to enable the attenuation circuit in the preamplifier to be effective. The supply voltage to the high-voltage section and to the audio sections features decoupling and filtering to eliminate noise. Current drain is 5 to 6 ma, allowing 200 to 350 hours of use—depending on the duty cycle.

Choice of the detector was very simple. The air proportional probe designed and built at Lawrence Radiation Laboratory is outstanding in performance (Fig. 5); it operates at 1740 to 1760 v with a point source efficiency of 25 % to 30 %. The Mylar cover may need to be replaced if sufficiently damaged, or the collector wire may become broken and need to be replaced, but otherwise the probe has an infinite life. The area of this probe may be greatly expanded without affecting its operation. William J. Roach and Robert J. Walker, An Alpha Hand and Foot Counter Using Air Proportional Detectors, to be published as a UCRL report. An average survey probe has a background counting rate of 1 to 2 counts per minute. These probes must operate from sea level to 1000 ft above sea level and from 20 % to 100 % relative humidity. No effects are noticed from these ambient changes. We currently have 40 probes in service. About five probes per month need servicing, and this is generally for a new Mylar cover.

Results

This instrument has been used successfully with moderated BF3 tubes for fast-neutron dosimetry; Geiger tubes; scintillation detectors for fast-neutron, thermal-neutron, or gamma-ray detection; and also solid-state alpha detectors. Sufficient gain and high-voltage power have been built into this instrument to eliminate the need for development of an instrument for each type of emission to be measured.
Fig. 5
This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.