267
11/12
LA-3975-MS

3/3
MASTER

LOS ALAMOS SCIENTIFIC LABORATORY
of the
University of California
LOS ALAMOS • NEW MEXICO

Light Meter for P-16 Phosphor Cathode-Ray Tubes

UNITED STATES
ATOMIC ENERGY COMMISSION
CONTRACT W-7405-ENG. 36

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or 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 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. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

LEGAL NOTICE

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.

This report expresses the opinions of the author or authors and does not necessarily reflect the opinions or views of the Los Alamos Scientific Laboratory.

Printed in the United States of America. Available from
Clearinghouse for Federal Scientific and Technical Information
National Bureau of Standards, U. S. Department of Commerce
Springfield, Virginia 22151

Price: Printed Copy \$3.00; Microfiche \$0.65

LOS ALAMOS SCIENTIFIC LABORATORY
of the
University of California
LOS ALAMOS • NEW MEXICO

Report written: August 12, 1968

Report distributed: October 18, 1968

Light Meter for P-16 Phosphor Cathode-Ray Tubes

by

Wilbur K. Brown

LEGAL NOTICE

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.

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

LIGHT METER FOR P-16 PHOSPHOR CATHODE-RAY TUBES

by

Wilbur K. Brown

ABSTRACT

A light meter is described that has been developed for setting the intensity of P-16 phosphor cathode-ray tubes. The light meter is used in the recording of time-of-flight neutron cross-section data in measurements using an underground nuclear explosion source.

In the course of developing the data recording equipment for the Los Alamos Scientific Laboratory time-of-flight neutron cross-section measurements using an underground nuclear explosion source, a light meter was devised for accurately and reproducibly setting the intensity of P-16 phosphor cathode-ray oscilloscopes.^{1, 2} This particular phosphor had to be used because it was the only phosphor available with a decay time short enough for our application, i.e., streak recording with rapidly moving photographic film. In achieving maximum recording quality, it was necessary to assay the results when using cathode-ray tubes from several manufacturers and several different lenses, film types, and development processes. Keeping the scope intensity constant from run to run during the many trials was essential. During the cross-section measurements at the Nevada Test Site, scope intensities must be accurately set before the experimenters leave the recording equipment a few hours before "shot" time.

The P-16 phosphor has a relatively narrow emission spectrum, peaked in the near ultraviolet at $\sim 3800 \text{ \AA}$. (It is difficult to set the intensity by eye because the eye can only see a fraction of the light emitted.) A CdS photoconductive cell was chosen as detector, and was covered by a Wratten 39 filter to match the response to the phosphor. This filter reduces sensitivity to room light while transmitting $\sim 75\%$ of the P-16 light. The detector is mounted inside a small box, and the open side of the box is held against the cathode-ray tube during

intensity measurement (see Figs. 1 and 2). The

Fig. 1. Schematic of the light meter in position against the face of a cathode-ray tube (side view).

Fig. 2. Two models of the light meter. The model at left is held against the tube face. The model in the center (also shown disassembled at right) has a bayonet mount which fits a bezel mounted on the oscilloscope.

cell and filter are mounted at a distance from the tube face approximately equal to the tube diameter, to reduce geometrical dependence on the sweep pattern used in the measurement. Figure 3 shows an adaptation of the light meter mounted on a Fairchild plate camera. The photoconductive cell is mounted permanently on the inside of the camera in the rear near the lens.

The electrical circuit is shown in Fig. 4.

Fig. 3. An adaptation of the light meter mounted on a Fairchild plate camera.

Fig. 4. Electrical schematic of the light meter.

The meter shunt resistor is selected to join the low sensitivity (LO) scale to the high sensitivity scale (HI) so that a LO reading of 5 is equivalent to a HI reading of 50 on the 50 μ A meter. The battery is chosen such that the voltage is sufficient to give a reading near full scale when the scope intensity is turned fully on. The battery life is long even when small batteries are used since power consumption is of the order of a milliwatt. The series resistor used in the battery check (BATT) is chosen to give a convenient reading, e.g., 25 or 50. The internal resistance of the meter must be small enough not to affect the circuit at lowest cell resistances, i.e., at maximum illumination. The photoconductive cells used in this particular application were Delco Radio LDR-25 and National Semiconductors 532 HP. Cell resistance varies inversely with the illumination of the CdS element (a log-log plot of resistance vs illumination yields a straight line with a slope of -0.7). With the two scales incorporated in this design the light meter covers a three-decade range in cathode-ray tube intensity.

The cathode-ray tube spot must be swept in a pattern during the intensity measurement for two reasons: (1) The light output from a spot tends to saturate with increased accelerating voltage and thus is not a good indication of writing intensity; (2) if the spot is allowed to remain at any particular position at high intensity for even a short time, the phosphor will "burn," i.e., the phosphor is ablated from the surface. The choice of patterns is arbitrary; as a standard (or reference) we use a one-dimensional sweep with a 20- μ sec total sweep time and 50 kc/sec repetition rate. The sweep amplitude is adjusted so that the line length is a little less than the tube-face dimension. The oscilloscope must be focused at the time the intensity is set.

REFERENCES

1. A. Hemmendinger et al., "Time-of-Flight Neutron Cross-Section Measurements Made with Neutrons from Nuclear Explosions," Los Alamos Scientific Laboratory report LA-3478, Part I (1967).
2. W. K. Brown and A. P. Furnish, "A High-Resolution Recording System for Neutron Cross-Section Measurements Using an Underground Nuclear Explosive Source," to be presented at the 15th Nuclear Science Symposium, Montreal, Canada, October 23 to 25, 1968, and published in the Symposium issue of the IEEE Trans. on Nucl. Science.