MASSACHUSETTS INSTITUTE OF TECHNOLOGY

RADIATION LABORATORY SERIES

LOUIS N. RIDENOUR, *Editor-in-Chief*

CATHODE RAY TUBE DISPLAYS

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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Foreword

THE tremendous research and development effort that went into the development of radar and related techniques during World War II resulted not only in hundreds of radar sets for military (and some for possible peacetime) use but also in a great body of information and new techniques in the electronics and high-frequency fields. Because this basic material may be of great value to science and engineering, it seemed most important to publish it as soon as security permitted.

The Radiation Laboratory of MIT, which operated under the supervision of the National Defense Research Committee, undertook the great task of preparing these volumes. The work described herein, however, is the collective result of work done at many laboratories, Army, Navy, university, and industrial, both in this country and in England, Canada, and other Dominions.

The Radiation Laboratory, once its proposals were approved and finances provided by the Office of Scientific Research and Development, chose Louis N. Ridenour as Editor-in-Chief to lead and direct the entire project. An editorial staff was then selected of those best qualified for this type of task. Finally the authors for the various volumes or chapters or sections were chosen from among those experts who were intimately familiar with the various fields, and who were able and willing to write the summaries of them. This entire staff agreed to remain at work at MIT for six months or more after the work of the Radiation Laboratory was complete. These volumes stand as a monument to this group.

These volumes serve as a memorial to the unnamed hundreds and thousands of other scientists, engineers, and others who actually carried on the research, development, and engineering work the results of which are herein described. There were so many involved in this work and they worked so closely together even though often in widely separated laboratories that it is impossible to name or even to know those who contributed to a particular idea or development. Only certain ones who wrote reports or articles have even been mentioned. But to all those who contributed in any way to this great cooperative development enterprise, both in this country and in England, these volumes are dedicated.

L. A. DUBRIDGE.

Preface

THE use of cathode-ray tubes as a means of displaying information in radar and other equipments demanded a huge expansion of production facilities during the war. In the 3½ year period from January 1942, nearly 3 million of these tubes were manufactured. Although some of the production was in specialized types that are not likely to find popular usage, there are now available from surplus stocks and from present manufacture many cathode-ray tubes of various types. Along with development of the tubes and their screens, there has been a corresponding development of the art of beam deflection, reported here only in part, but in such detail as to suggest numerous variations. It is hoped that the application of these tubes to peacetime uses will be aided by the publication of this volume.

Cathode Ray Tube Displays is one of seven related volumes of the Radiation Laboratory Series that deal with lumped-parameter circuits. It describes solutions to problems involved in the application of cathode-ray tubes to radar displays and to test equipment. Although the design of the tubes themselves is not considered in any detail, operating characteristics of the tubes and of their auxiliary equipment and the characteristics and construction of their screens are discussed in detail. A number of means of producing sweeps is given both for electrostatic- and magnetic-deflection tubes. Great emphasis is placed on sweeps that progress linearly with time.

Because of the close relation between the function of a radar set and the design of its display system, it was particularly difficult to avoid frequent reference to specific radar applications of cathode-ray tubes. It is one of the purposes of the introductory chapter, therefore, to present a general description of the problems peculiar to radar so that the motivation of some of the circuit design can be understood. Several following chapters elaborate on the parts and functional circuits used in building up a display system. Later chapters show how these parts can be synthesized into complete systems.

Nonstandard values of resistors indicated in some of the circuit drawings signify the use of standard RMA values in series or parallel to obtain the desired power rating. For example, a 6-watt resistor is

actually made up of three 2-watt resistors of the appropriate resistance value. The connection of multiple-element vacuum tubes as triodes or diodes is shown in some cases. This practice is usually employed to avoid the need of other types of tubes as spare parts in field equipment. Other types may function as well in the circuits.

The editors wish to acknowledge the ever-helpful inspiration and guidance of the editor-in-chief, Louis N. Ridenour, and of his editorial board. The preparation of the art and manuscript of this book was greatly aided by the efforts of Charles Newton and his assistants, V. Josephson, M. Dolbeare, and M. Phillips. Whatever uniformity of style and format the book may possess is due to the Technical Coordination Group operating under the supervision of L. B. Linford and A. M. Stone.

The editors extend to the authors their appreciation of an onerous task conscientiously performed, and their congratulations upon its completion. The assistance of W. O. Reed and W. E. Henry in furnishing important background material for several sections was important and necessary for the completion of these sections.

The editorial staff wishes to thank Martha Murrell for so effectively and ably supervising the preparation of the illustrations. Much of the special typing was done by Doris Williams, to whom the editors are much indebted.

THE EDITORS.

CAMBRIDGE, MASS.,
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