

# RADIOTRON DESIGNER'S HANDBOOK

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Wireless Valve Company Pty., Ltd., 47 York Street, Sydney, Australia.*

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THE RADIO CORPORATION OF AMERICA.

# RADIOTRON DESIGNER'S HANDBOOK

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## PREFACE

This book has been written as a comprehensive, self-explanatory reference handbook for the benefit of all who have an interest in the design and application of radio receivers or audio amplifiers. Everything outside this field—television, radio transmission, radar, industrial electronics, test equipment and so on—has been excluded to limit the book to a reasonable size.

An effort has been made to produce a handbook which, in its own sphere, is as self-contained as possible. Extensive references to other sources of information have been included for the reader who might require additional detail.

The success of the previous edition, of which over 280,000 copies have been sold throughout the world, encouraged Amalgamated Wireless Valve Company Pty. Ltd., to undertake the compilation of the present up-to-date edition which is more complete, great pains having been taken to fill in many of the gaps in the data published hitherto. This has involved a considerable amount of both experimental and analytical work by the editor and by engineers assisting in the project. Some original work, previously unpublished, has been included.

Although the various chapters have been written by individual authors, all are truly the result of team work, each having been carefully and critically examined by several other engineers specializing in that particular field. In this way the accuracy of mathematical calculations and of individual statements was checked and re-checked to ensure that the reader would not be misinformed.

I wish to express my grateful thanks to Mr. R. Lambie, Manager, Mr. D. M. Sutherland, Works Manager, and to the following collaborating engineers—

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F. LANGFORD-SMITH

Amalgamated Wireless Valve Company Pty. Ltd.

## NOTES

*References to valve types are to the prototype (e.g. 6J7) and include all equivalent types (e.g. 6J7-G, 6J7-GT etc.) unless otherwise indicated.*

*If any errors are noted, please write to the Editor, Radiotron Designer's Handbook, Amalgamated Wireless Valve Co. Pty. Ltd., 47 York Street, Sydney, Australia.*

## ACKNOWLEDGEMENTS

The editor wishes to acknowledge his indebtedness to the publishers of the following periodicals for permission to reproduce the diagrams listed below. In some cases the diagrams are based largely on the originals, although modified.

### PERIODICALS

- Audio Engineering 13. 50D, 50E. 14. 1A, B, C, D, E, F, G, H. 15. 15, 16, 57A, 57B, 60. 16. 15. 17. 7, 8, 15A, 15B, 15C, 18, 19A, 19B, 19C, 20, 22, 24B, 24C, 27A, 27B, 27C, 31, 37A. 19. 6A. 20. 10, 13, 14.
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Reference numbers are given either in the titles or in the text. Lists of references giving authors' names and details of articles are given at the end of each chapter.

## ACKNOWLEDGEMENTS (Continued)

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Other acknowledgements are given in the titles.

### OTHER PUBLICATIONS

Aerovox Research Worker, Vol. 11, Nos. 1 and 2, January-February 1939, Figs. 5 and 6. Published by permission of Aerovox Corporation. Tables 38, 43, 44. Charts 38, 1, 2.

Allegheny Ludlum Steel Corporation—curves 3.6% silicon steel. Fig. 5. 20. American Standards Association "American Standard for Noise Measurement" Z24.22-1942. Figs. 19, 7, 8.

Australian Radio Technical Services and Patents Co. Pty. Ltd.—Technical Bulletins. Figs. 15, 22, 23, 24, 25, 26, 27, 43. 31, 3, 4, 5.

Amalgamated Wireless Australasia Ltd. Figs. 18, 7. 28, 2.

Electrical and Musical Industries. Fig. 17, 25.

Jensen Manufacturing Company—Jensen Technical Monograph No. 3. Figs. 14, 2, 3, 4, 5.

P. R. Mallory & Co. Inc. "Fundamental Principles of Vibrator Power Supply" Figs. 32, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13.

National Bureau of Standards Circular C74, Fig. 208 redrawn and published by permission of National Bureau of Standards. Fig. 10, 3.

Standard Transformer Corporation "Engineering a transformer." Figs. 5, 18C, 18D. Table 38, 70.

General Electric Company Ltd. "Radio receiver for use with high fidelity amplifiers." Fig. 15, 62A.

Radio and Television Manufacturers Association (U.S.A.)—Extracts from, or summaries of, the following Standards:

ET-107, ET-109, ET-110, REC-11, REC-101, REC-103, REC-104, REC-105, REC-106-A, REC-107, REC-108, REC-113, REC-114, REC-115-A, REC-116, REC-117, REC-118, REC-119, REC-121, REC-128, S-410, S-416, S-417, S-418, S-504, SE-101-A, SE-103, SE-105, TR-105-A, TR-113-A.

Note:—References in the text to R.M.A. Standards should be taken as having been issued by RTMA.

I.R.E. Standards, Figs. 3, 11B, 15. 37, 1, 2, 3, 4.

Radio Industry Council—Information from standards on resistors and capacitors. Chapter 38 Sections 2 and 3.

Radio Corporation of America. 1, 6. 2, 32A, 33, 34, 35, 47. 3, 16, 17. 10, 6, 13, 26, 30, 48. 17, 5A. 23, 9, 10, 11, 12, 13, 14, 15, 16. 30, 2A, 2B, 2C, 11, 33, 14. 35, 17.