***Linear Electronic
Circuits and Systems***

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Linear Electronic Circuits and Systems

SECOND EDITION

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Foreword

Technological progress has nowhere been more rapid than in the fields of electronics, electrical, and control engineering. The *Macmillan Basis Books in Electronics Series* of books have been written by authors who are specialists in these fields, and whose work enables them to bring technological developments sharply into focus.

Each book in the series deals with a single subject so that undergraduates, technicians, and mechanics alike will find information within the scope of their courses. The books have been carefully written and edited to allow each to be used for self-study; this feature makes them particularly attractive not only to readers approaching the subject for the first time, but also to mature readers wishing to update and revise their knowledge.

1974

Noel M. Morris

Preface to the First Edition

The theory and application of the linear electronic circuit have been known and used by electronics and control engineers for many decades; however, recent developments in microtechnology have greatly simplified linear circuit design owing to the introduction of the high-gain integrated circuit operational amplifier. Circuit design can now be considered as systems design with a minimum number of additional discrete components.

This book combines together in one volume all the necessary knowledge required to fully understand and apply linear circuit theory from basic a.c. circuit theory to advanced analog computer circuits. It assumes a basic knowledge of d.c. circuit theory and familiarity with modern circuit components, although many references are made to fundamental principles throughout the book. Transistor construction, operation and circuit design are covered in great depth, one application being the complete design of a discrete-component operational amplifier having similar characteristics to its integrated-circuit counterpart.

Chapter 8 is devoted to a collection of operational amplifier applications collected from research papers, magazines and other publications and my thanks go to the various sources of information, in particular to the Editor of *Wireless World* for permission to publish various circuits. The book will appeal to electronics engineers at all levels from home constructors to technicians and undergraduates, as the linear circuit information serves as a basic grounding in electronic circuitry at all levels. The mathematics incorporated in the proof and derivation of various formulae has been kept to a minimum, since an understanding of the circuit operation is the aim of this book, not the laborious manipulation of complex equations. Simple mathematical expressions are quoted where they have definite applications in linear systems, namely differentiators, integrators, logarithm functions and so on.

Preface to the Second Edition

In the first edition of this book, published in 1974, the reader was introduced to the popular '741' integrated circuit. Chapter 8 included a number of practical circuits using the 741 so that professional engineers and home constructors could demonstrate to themselves the many concepts described in the preceding chapters. After a lapse of eight years, the 741 still forms the basis of linear electronic circuit design, although it has been joined by FET-input, power output, C-MOS and multiple versions to meet the various demands made on the operational amplifier. During this same interval of time, digital integrated circuits have advanced beyond all recognition and the 'computer on a chip' concept has become reality.

Digital signal processing has distinct advantages over linear processing, and many of the tasks previously performed by the 741 or its equivalent are now carried out in a programmed digital integrated circuit, such as filtering, modulating and other processing of analogue signals. The signal processing techniques, however, live on and are still used, although the writing of a computer program is necessary for each required process. There is one problem — that of pin connections. A digital integrated circuit such as the 8-channel analogue to digital converter described in Chapter 9 needs 40 or so connections to the outside world and a rather large integrated circuit package is created. The inconvenience of this is tolerated at the expense of overall size and complexity.

This second edition brings the technology up to date and includes large sections on field-effect transistors and circuits, cascaded bipolar and FET circuits, integrated circuit manufacture and a new chapter on the digitalisation of analogue signals. Despite the digitalisation of signal processes, digital-to-analogue and analogue-to-digital converters are necessary to interface the digital circuits (the computer) with the real outside world. Chapter 9 describes these basic processes and uses a selection of custom-designed integrated circuits created for this purpose. A comprehensive Appendix is included where a selection of the latest electronic components are displayed; my thanks go to RS Components for their permission to print this information.

Practical experimentation is still encouraged, this being the most effective way of investigating the concepts introduced. The circuits of both Chapters 8 and 9 are best understood by practically collecting the components, constructing the circuits

and testing them out. This adds an element of 'fun' to the exercise and was seen to be most welcome by readers of the first edition of this book.

This book is intended for any student of electronics. Whether students are in their first year at the age of 16 or in their final postgraduate year at university, the circuits of this book will illustrate both basic and advanced concepts in a practical manner. Students following TEC certificate, diploma or higher certificate and diploma, City and Guilds electrical or electronic certificates, 'O' and 'A' level electronics, undergraduate or postgraduate courses at polytechnics or universities will all benefit from this book.

Home constructors and practical electronics enthusiasts will find this world of 741 technology fascinating and extend their theoretical knowledge of both the 741 and digitalisation of analogue signals.

1983

Graham Bishop