ELECTRONIC CIRCUITS

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"Then said a Teacher, Speak to us of Teaching.

And he said:

No man can reveal to you aught but that which already lies half asleep in the dawning of your knowledge.

The teacher who walks in the shadow of the temple, among his followers, gives not of his wisdom but rather of his faith and his lovingness.

If he is indeed wise he does not bid you enter the house of his wisdom, but rather leads you to the threshold of your own mind.

The astronomer may speak to you of his understanding of space, but he cannot give you his understanding.

The musician may sing to you of the rhythm which is in all space, but he cannot give you the ear which arrests the rhythm nor the voice that echoes it.

And he who is versed in the science of numbers can tell of the regions of weight and measure, but he cannot conduct you thither.

For the vision of one man lends not its wings to another man.

And even as each of you stands alone in God's knowledge, so must each one of you be alone in his knowledge of God and in his understanding of the earth."

PREFACE

"Electronics is the science and technology which deals primarily with the supplementing of man's senses and his brain power by devices which collect and process information, transmit it to the point needed, and there either control machines or present the processed information to human beings for their direct use."[1]

This is an extremely broad definition and encompasses an enormous body of knowledge, so enormous that it is frequently subdivided into three superficially distinct areas of inquiry, as follows:

1 *electronic components*
2 *electronic circuits*
3 *electronic systems*

It is unrealistic and probably naive to assume that *electronics* can be separated into three minor areas that can be examined independently of one another. Systems, circuits, and components are very closely tied together. System requirements often lead to the development of new components and circuits. A new component may finally result in the practical realization of a new system, and this could stimulate the development of new circuits. So you can see that the separation of *electronics* into three minor areas of interest is an academic fiction. In spite of the artificiality of the division, it seems to be the only orderly approach to arranging the huge amounts of data facing us.

Electronic components as used here will signify devices such as vacuum and gas tubes, thermistors, varistors, transistors, and magnetic and dielectric amplifiers and storage elements. The term *electronic circuit* will refer to the connection of electronic components together with the ordinary elements of resistance, capacitance, inductance, and power sources into complete circuits.

This book presents the fundamental principles and techniques associated with electronic circuits without emphasizing particular components or system applications. If vacuum tube circuits seem to receive the greatest attention, it is only because the analysis of such circuits is more highly developed at the time of writing.

[1] Reprinted with permission from "Let Us Re-Define Electronics," by W. L. Everitt, *Proc. IRE*, vol. 40, no. 8, August, 1952, p. 899.

If I were asked to summarize this book as briefly as possible, the result would read as follows:

> Electronic components can be represented by simple equivalent circuits. Electronic circuit design is thereby reduced to *ordinary* circuit design and is no longer a problem in electronics.

When the idea is flatly stated like this, I am appalled at the size of the book. However, simple ideas are usually the most difficult to execute and explain. Many illustrations under varying conditions are required before the generality and simplicity are understood.

The book is subdivided into three parts, as follows:

Part I: *Introduction*

Part II: *Class A Circuits*

Part III: *Operation in the Switching Mode*

Part I is a brief introduction to the principles of equivalent circuits and the elements of electric circuit theory based on the complex frequency and Laplace transform approach.

Parts II and III are the main sections of the book. Most of the usual and some unusual circuits using nearly all the various components are presented. All circuits covered in Part II require continuous operation of the electronic component. This is called *Class A operation* in this book. Nearly all the circuits in Part III require discontinuous operation of the electronic component. This is defined in this book as *operation in the switching mode.*

The approach is almost entirely analytical. Although many useful methods from advanced mathematics are avoided, the book is still unashamedly mathematical in nature. I feel no compulsion to apologize for this. In the light of modern developments it would be surprising to handle the subject otherwise.

Many useful and informative results, formulas, and design charts are obtained, but the emphasis is on the techniques used rather than the results themselves. No attempt has been made to write a handbook of formulas or to compile an encyclopedia of illustrative numerical problems. The book presents the methods of formulating circuits to obtain useful design formulas and performance criteria.

The book should appeal to a diversified group of readers. Practicing engineers and physicists will find it to be a usable reference in their everyday work with circuit design and development. It can also be

used as a textbook at the graduate or undergraduate level covering a two- or three-semester sequence of courses.

The reader should have a background that includes elementary calculus, an introductory course in electronics, and a previous or concurrent course in a-c circuit theory will prove immensely helpful.

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Part II: Class A Circuits

Part III: Operation in the Switching Mode