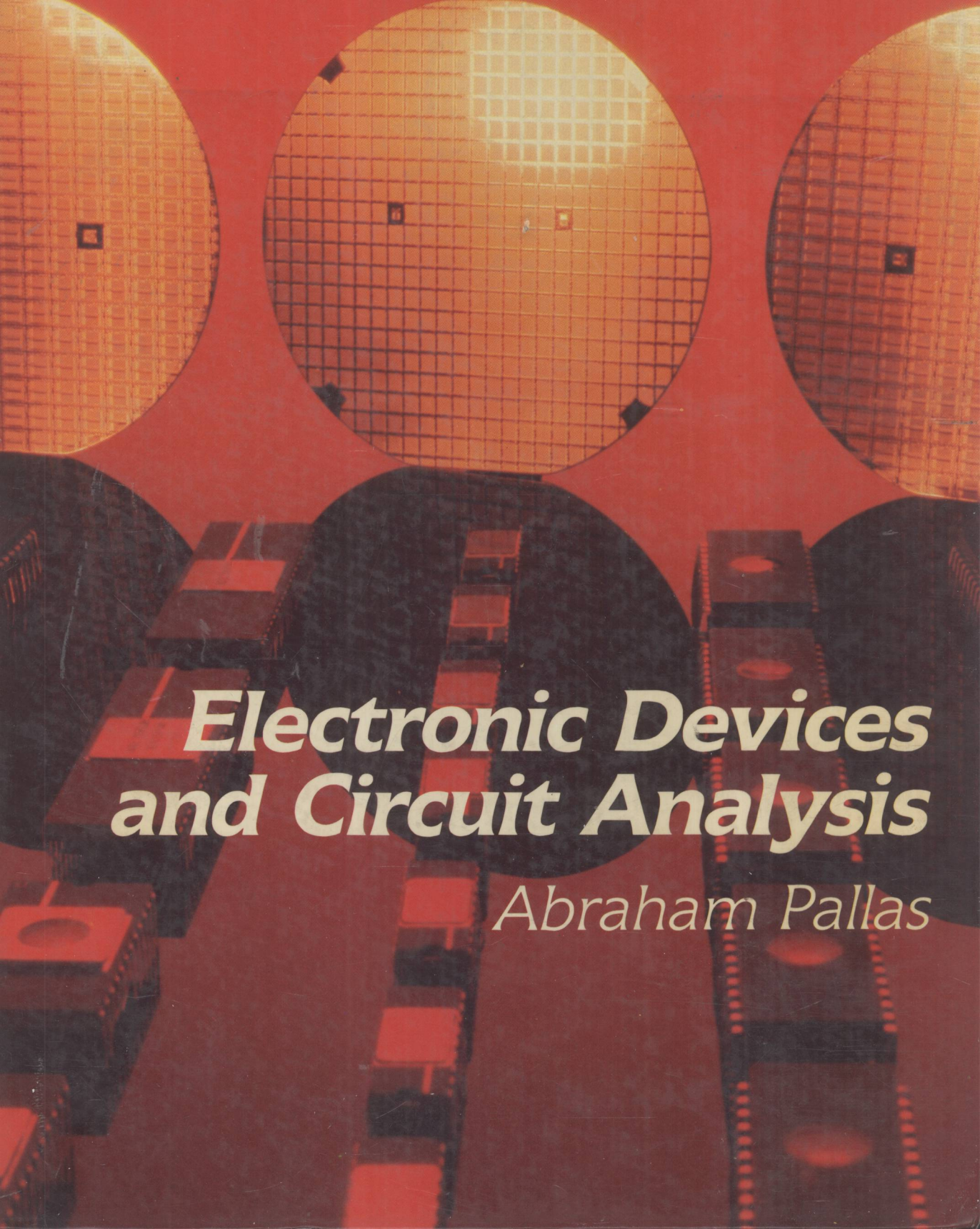

Electronic Devices and Circuit Analysis

Abraham Pallas

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Preface

Most introductory textbooks in electronics fall into one of two categories: those primarily concerned with devices, what they are and how they work, and those primarily concerned with circuit design. This is fine if the end goal is training for design work. However, many of the students studying electronics will get their first field experience not in designing circuits, but rather in analyzing them. *Electronic Devices and Circuit Analysis* takes this point of view.

The method of this book is to first introduce a device by explaining its operation, ratings, and specifications. Sample circuits using the device are then discussed. Then, rather than going to a design problem, additional circuits are presented, with the text leading the student through an analysis of the circuit, discussing inputs, intermediate signals, and outputs, including why these signals are present. Troubleshooting of the device is discussed, followed by troubleshooting of circuits including the device. This approach leads to a strong foundation in circuit analysis.

Another difference between *Electronic Devices and Circuit Analysis* and traditional texts is the emphasis on helping the student learn, rather than merely the presenting of material. Some of the features of the text are discussions aimed at helping the student understand; graphs expanded to enable the student to verify problem solutions; a list of key equations; and a glossary of key terms. Numerous problems and circuits, with analysis, are included. The text is written in the first person, another departure from traditional texts.

There are two additional features worthy of note. There are BASIC programs throughout the text, to enable the student to use the computer as a problem-solving tool. Another place this is done is in Appendix 1, where the general equation-solving software, TK!SOLVER, is discussed. There is also a heavy emphasis on operational amplifiers and integrated circuits. There are three chapters on op amps, including amplifier and filtering circuits, and a discussion of some of the most popular linear ICs, including the 555 timer.

The student is expected to have completed courses involving DC and AC fundamentals. The mathematics required is algebra and trigonometry. *Electronic Devices and Circuit Analysis* is designed as a text for a two-semester course in electronics. It is suitable for the student who will be going into the field immediately on a technician level, as well as for the student who will be continuing on to further study in electronics.

Abraham Pallas

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chapter 1

a review of fundamentals

1–1 Introduction

Most of the material in electronic circuits is based on electrical fundamentals: Ohm's law, Kirchhoff's voltage and current laws, and the action of inductors and capacitors in series and parallel with resistors and each other. This chapter will review some of these fundamentals, as well as introduce one method of circuit analysis.

1–2 Objectives

After completing this chapter, you will be able to:

- Solve a series circuit for current, voltage drops, and power dissipation
- Solve a parallel circuit for current, voltage drops, and power dissipation
- Solve a series–parallel network for voltages, currents, and power dissipation
- Do voltage and current source conversions on DC circuits
- Apply Thevenin's theorem for DC circuits
- Apply Norton's theorem for DC circuits
- Solve a series AC circuit containing a capacitor
- Solve a series AC circuit containing an inductor

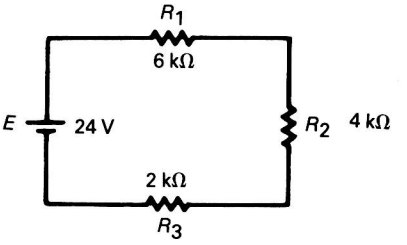

Figure 1–1. Series circuit

1–3 SERIES CIRCUITS

A *series circuit* is defined as a circuit where all the current in the circuit flows through each component. These components may be resistors, capacitors, inductors, or any other electronic device. The key to recognizing components in series is that at any connection there are only two leads involved. An example of this is shown in Figure 1–1.

EXAMPLE 1–1

In Figure 1–1, R_1, R_2, R_3, and E are all in series with each other. In a series circuit, the current is the same throughout. Ohm's law states that the voltage drop across a resistor is given by

$$V = IR \tag{1.1}$$

Kirchhoff's voltage law states that the algebraic sum of the voltages around a loop must be zero. Redrawing the circuit and indicating the polarities, we get the circuit shown in Figure 1–2. Applying Kirchhoff's voltage law around the clockwise loop, and selecting the second sign throughout, we get

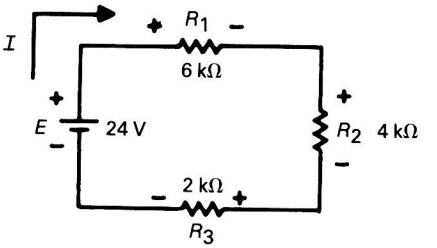

Figure 1–2. Series circuit showing polarities