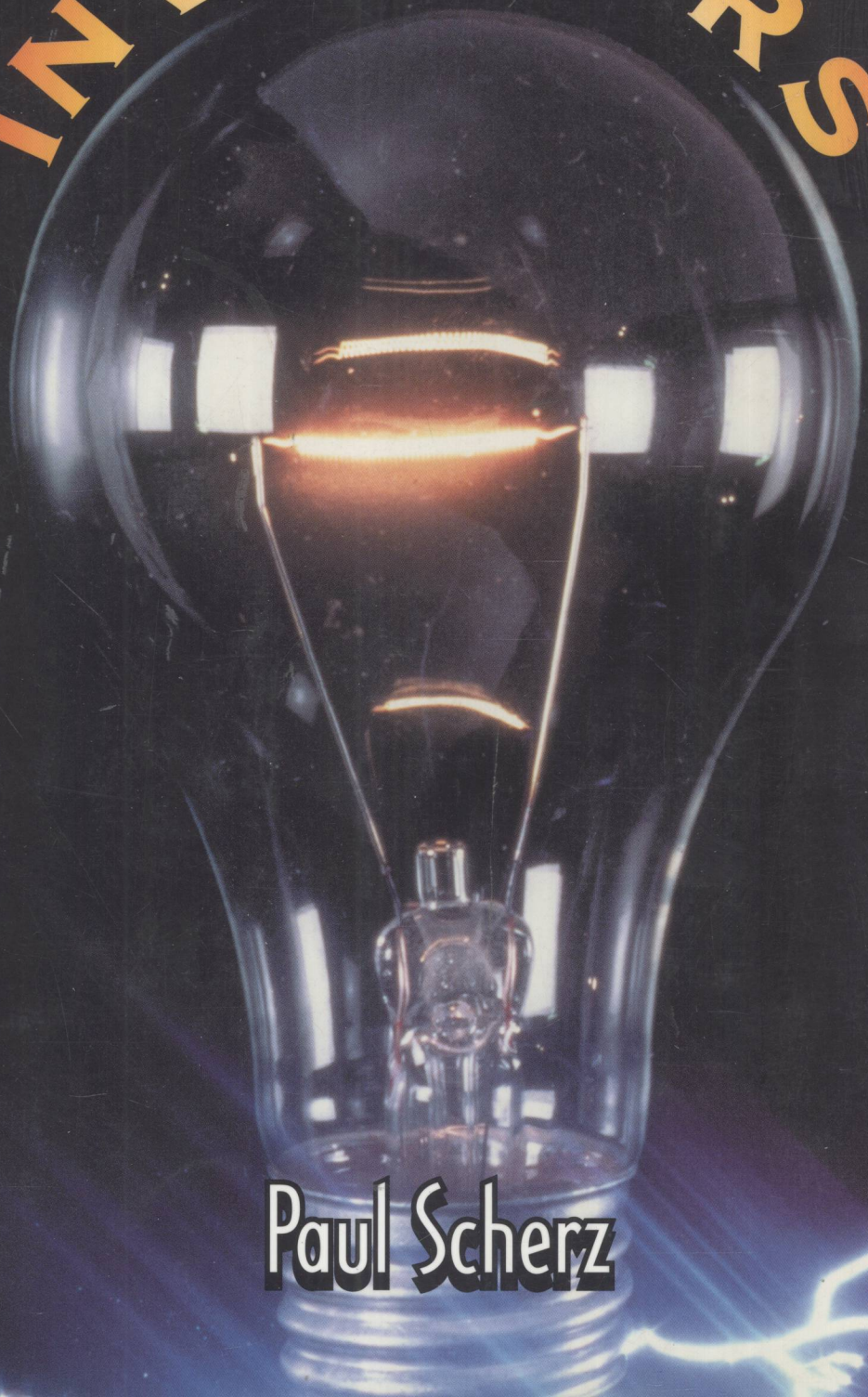
Practical Electronics for Inventors



Paul Scherz

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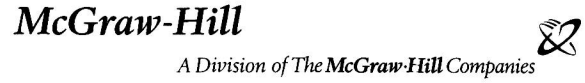

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Practical Electronics for Inventors

PREFACE

Inventors in the field of electronics are individuals who possess the knowledge, intuition, creativity, and technical know-how to turn their ideas into real-life electrical gadgets. It is my hope that this book will provide you with an intuitive understanding of the theoretical and practical aspects of electronics in a way that fuels your creativity.

What Makes This Book Unique

Balancing the Theory with the Practical (Chapter Format)

A number of electronics books seem to throw a lot of technical formulas and theory at the reader from the start before ever giving the reader an idea of what a particular electrical device does, what the device actually looks like, how it compares with other devices similar to it, and how it is used in applications. If practical information is present, it is often toward the end of the chapter, and by this time, the reader may have totally lost interest in the subject or may have missed the "big picture," confused by details and formulas. *Practical Electronics for Inventors* does not have this effect on the reader. Each chapter is broken up into sections with the essential practical information listed first. A typical chapterone on junction field-effect transistors (JFETs)is outlined below.

- Basic Introduction and Typical Applications (three-lead device; voltage applied to one lead controls current flow through the other two leads. Control lead draws practically no current. Used in switching and amplifier applications.)
- Favors (*n*-channel and *p*-channel; *n*-channel JFET's resistance between its conducting lead increases with a negative voltage applied to control lead; *p*-channel uses a positive voltage instead.)
- How the JFETs Work (describes the semiconductor physics with simple drawings and captions)
- JFET Water Analogies (uses pipe/plunger/according contraption that responds to water pressure)

- Technical Stuff (graphs and formulas showing how the three leads of a JFET respond to applied voltages and currents. Important terms are defined.)
- Example Problems (a few example problems that show how to use the theory)
- Basic Circuits (current driver and amplifier circuits used to demonstrate how the two flavors of JFETs are used.)
- Practical Consideration (types of JFETs: small-signal, high-frequency, dual JFETs; voltage, current, and other important ratings and specifications, along with a sample specification table)
- Applications (complete circuits: relay driver, audio mixer, and electric field-strength meter)

By receiving the practical information at the beginning of a chapter, readers can quickly discover whether the device they are reading about is what the doctor ordered. If not, no great amount of time will have been spent and no brain cells will have been burned in the process.

Clearing up Misconceptions

Practical Electronics for Inventors aims at answering many of the often misconceived or rarely mentioned concepts in electronics such as displacement currents through capacitors, how to approach op amps, how photons are created, what impedance matching is all about, and so on. Much of the current electronics literature tends to miss many of these subtle points that are essential for a better understanding of electrical phenomena.

Worked-out Example Problems

Many electronics books list a number of circuit problems that tend to be overly simplistic or impractical. Some books provide interesting problems, but often they do not explain how to solve them. Such problems tend to be like exam problems or homework problems, and unfortunately, you have to learn the hard waysolving them yourself. Even when you finish solving such problems, you may not be able to check to see if you are correct because no answers are provided. Frustration! *Practical Electronics for Inventors* will not leave you guessing. It provides the answers, along with a detailed description showing how the problem was solved.

Water Analogies

Analogies can provide insight into unfamiliar territory. When good analogies are used to get a point across, learning can be fun, and an individual can build a unique form of intuition. *Practical Electronics for Inventors* provides the reader with numerous mechanical water analogies for electrical devices. These analogies incorporate springs, trapdoors, balloons, et cetera, all of which are fun to look at and easy to understand. Some of the notable water analogies in this book include a capacitor water analogy, various transistor water analogies, and an operational amplifier water analogy.

Practical Information

Practical Electronics for Inventors attempts to show the reader the subtle tricks not taught in many conventional electronics books. For example, you will learn the difference between the various kinds of batteries, capacitors, transistors, and logic families. You will also learn how to use test equipment such as an oscilloscope and multimeter and logic probes. Other practical things covered in this book include deciphering transistor and integrated circuit (IC) labels, figuring out where to buy electrical components, how to avoid getting shocked, and places to go for more in-depth information about each subject.

Built Circuits

A reader's enthusiasm for electronics often dies out when he or she reads a book that lacks practical real-life circuits. To keep your motivation going, *Practical Electronics for Inventors* provides a number of built circuits, along with detailed explanations of how they work. A few of the circuits that are presented in this book include power supplies, radio transmitter and receiver circuits, audio amplifiers, microphone preamp circuits, infrared sensing circuits, dc motors/RC servo/stepper motor driver circuits, and light-emitting diode (LED) display driver circuits. By supplying already-built circuits, this book allows readers to build, experiment, and begin thinking up new ways to improve these circuits and ways to use them in their inventions.

How to Build Circuits

Practical Electronics for Inventors provides hands-on instruction for designing and construction circuits. There are tips on drawing schematics, using circuit simulator programs, soldering, rules on safety, using breadboards, making printed circuit boards, heat sinking, enclosure design, and what useful tools to keep handy. This book also discusses in detail how to use oscilloscopes, multimeters, and logic probes to test your circuits. Troubleshooting tips are also provided.

Notes on Safety

Practical Electronics for Inventors provides insight into how and why electricity can cause bodily harm. The book shows readers what to avoid and how to avoid it. The book also discusses sensitive components that are subject to destruction form electrostatic discharge and suggests ways to avoid harming these devices.

Interesting Side Topics

In this book I have included a few side topics within the text and within the Appendix. These side topics were created to give you a more in-depth understanding of the physics, history, or some practical aspect of electronics that rarely is presented in a conventional electronics book. For example, you will find a section on power distribution and home wiring, a section on the physics of semiconductors, and a section on the physics of photons. Other side topics include computer simulation programs,

where to order electronics components, patents, injection molding, and a historical timeline of inventions and discoveries in electronics.

Who Would Find This Book Useful

This book is designed to help beginning inventors invent. It assumes little or no prior knowledge of electronics. Therefore, educators, students, and aspiring hobbyists will find this book a good initial text. At the same time, technicians and more advanced hobbyists may find this book a useful reference source.

ABOUT THE AUTHOR

Paul Scherz is a physicist/mechanical engineer who received his B.S. in physics from the University of Wisconsin. His area of interest in physics currently focuses on elementary particle interactions, or high-energy physics, and he is working on a new theory on the photon problems with Nikolus Kauer (Ph.D. in high-energy physics, Munich, Germany). Paul is an inventor/hobbyist in electronics, an area he grew to appreciate through his experience at the University's Department of Nuclear Engineering and Engineering Physics and the Department of Plasma Physics.

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