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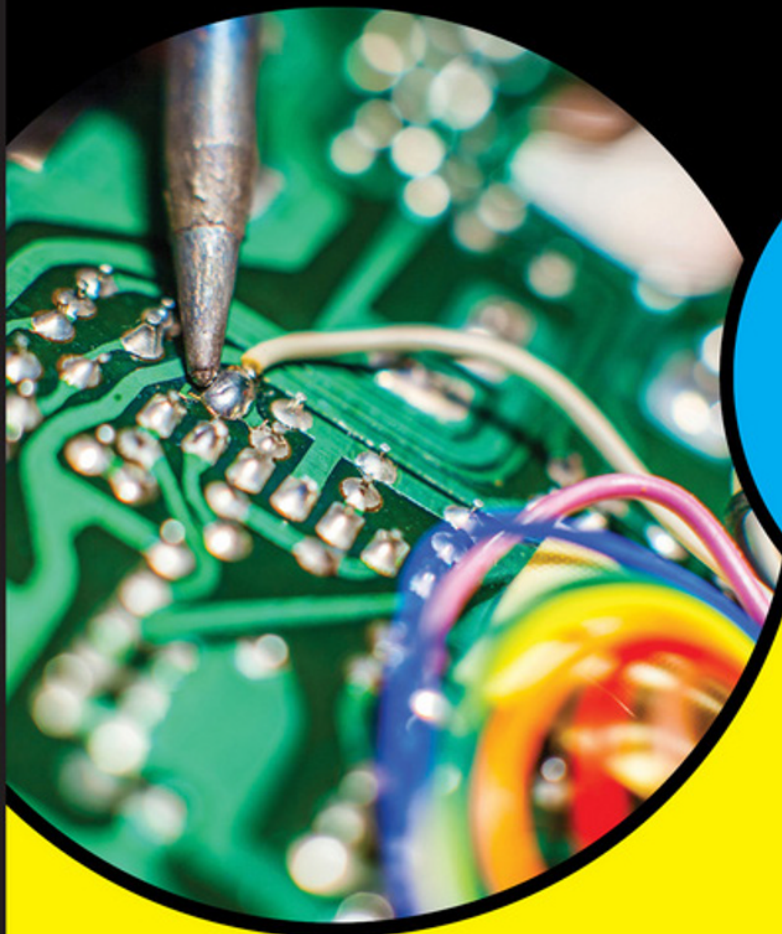


2nd Edition

# Electronics

ALL-IN-ONE

for  
**dummies**<sup>®</sup>  
A Wiley Brand



**9**  
**Books**  
in one!

Doug Lowe





# Electronics

All-in-One

2nd Edition

**by Doug Lowe**

for  
**dummies**<sup>®</sup>  
A Wiley Brand

## Electronics All-in-One For Dummies®, 2nd Edition

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# Introduction

Welcome to the amazing world of electronics!

Ever since I was a kid, I've been fascinated with electronics. When I was about 10 years old, my dad bought me an electronic experimenter's kit from the local RadioShack store. I still have it; it's pictured here.



I have incredible memories of evenings spent with my dad, wiring the sample circuits to make squawking police sirens, flashing lights, a radio receiver, and even a telegraph machine.

The best part was dreaming that when I grew up, I'd have a job in the field of electronics, that someday I'd understand exactly how those resistors, capacitors, inductors, transistors, and integrated circuits actually worked, and I'd use that knowledge to design televisions or computers or communication satellites.

Well, that dream didn't come true. Instead, I went into a closely related field: computer programming. But my love of electronics never died, and I've spent the last 40 years or so experimenting with electronics as a hobbyist.

This book is an introduction to electronics for people who have always been fascinated by electronics but didn't make a career out of it. In these pages, you'll find clear and concise explanations of the most important concepts that form the basis of all electronic devices, concepts such as the nature of electricity (if you think you really know what it is, you're kidding yourself); the difference between voltage, amperage, and wattage; and how basic components such as resistors, capacitors, diodes, and transistors work.

Not only will you gain an appreciation for the electronic devices that are a part of everyday life, but you'll also learn how to build simple circuits that will not only impress your friends but may actually be useful!

## About This Book

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*Electronics All-in-One For Dummies*, 2nd Edition, is intended to be a reference for the most important topics you need to know when you dabble in building your own electronic circuits. It's a big book made up of nine smaller books, which we at the home office like to call *minibooks*. Each of these minibooks covers the basics of one key topic for working with electronics, such as circuit building techniques, how electronic components like diodes and transistors work, or using integrated circuits.

This book doesn't pretend to be a comprehensive reference for every detail on every possible topic related to electronics. Instead, it shows you how to get up and running fast so that you have more time to do the things you really want to do. Designed using the easy-to-follow For Dummies format, this book helps you get the information you need without laboring to find it.

Whenever one big thing is made up of several smaller things, confusion is always a possibility. That's why this book is designed with multiple access points to help you find what you want. At the beginning of the book is a detailed table of contents that covers the entire book. Then each minibook begins with a minitable of contents that shows you at a minigance what chapters are included in that minibook. Useful running heads appear at the top of each page to point out the topic discussed on that page, and handy thumbtabs run down the side of the pages to help you find each minibook quickly. Finally, a comprehensive index lets you find information anywhere in the entire book.



This isn't the kind of book you pick up and read from start to finish, as if it were a cheap novel. If I ever see you reading it at the beach, I'll kick sand in your face. Beaches are for reading romance novels or murder mysteries, not electronics books. Although you could read this book straight through from start to finish, this book is designed like a reference book, the kind of book you can pick up, open to just about any page, and start reading.

You don't have to memorize anything in this book. It's a "need-to-know" book: You pick it up when you need to know something. Need a reminder on how to calculate the correct load resistor for an LED circuit? Pick up the book. Can't remember the pinouts for a 555 timer IC? Pick up the book. After you find what you need, put the book down and get on with your life.

You can find a total of 61 projects strewn throughout this book's chapters. You'll find a plethora of simple projects you can build to demonstrate the operation of typical circuits. For example, in the chapter on transistors, you'll find several simple projects that demonstrate common uses for transistors, such as driving an LED, creating an oscillator, or inverting an input.

I suggest you build each of the projects as you read the chapters. Reading about electronics circuits is one thing, but to understand how a circuit works, you really need to build it and see it in operation. Most of the projects are simple enough that you can build them in 20 to 30 minutes, assuming you have the parts on hand.

If you are lucky enough to have a RadioShack or other store that carries electronic components in your community, you're in luck! If you want to build one of the projects on a Saturday afternoon, you can buzz over to your local electronics store, pick up the parts you'll need, take them home, and build the circuit.

Of course, you can also purchase the components you need at any other store that stocks electronic hobbyist components, and you can find many sources for purchasing the parts online.

Finally, most of the electronic circuits described in this book are perfectly safe: They run from common AA or 9 V batteries and therefore don't work with voltages large enough to hurt you.

However, you'll occasionally come across circuits that work with higher voltages, which can be dangerous. Any project that involves line voltage (that is, that you plug into an electrical outlet) should be considered potentially dangerous and handled with the utmost care. In addition, even battery-powered circuits that use large capacitors can build up charges that can deliver a potentially painful shock.

When you work with electronics, you'll also encounter dangers other than those posed by electricity. Soldering irons are hot and can burn you. Wire cutters are sharp and can cut you. And there are plenty of small parts that can fall on the floor and find themselves in the mouths of kids or pets.

Safety is an important enough topic that I've devoted a chapter to it in Book 1. I strongly urge you to read Book 1, Chapter 4 *before* you build anything.

*Please be careful!* The projects that are presented in Book 9 all work directly with line-level voltage and should be considered dangerous. You must exercise great care if you decide to build any of those projects, as a single mistake could kill you or someone else. Those projects are offered as educational prototypes that are designed to be operated only within the safe confines of your workbench, where you can control the power connections so that no one is exposed to dangerous voltages.

## Foolish Assumptions

Throughout this book, I make very few assumptions about what you may know about the subject of electronics. I certainly don't assume that you've ever taken a class on electronics, have ever assembled a circuit, or are well versed in advanced science or math.

In fact, there are really very few things I do assume:

- » **You're curious about the fascinating world of electronics.** For example, if you've ever wondered how a radio works or what makes a computer possible, this book is for you.
- » **You like to build things.** The best way to learn *about* electronics is to *do* electronics. This book has plenty of simple projects for you to build and back your knowledge up with first-hand experience.
- » **You have a space to work and some basic tools.** You'll need at least a small workspace and basic tools such as a screwdriver and wire cutters.
- » **You can afford to spend a little money to get the parts you need.** Although a few of the projects later in the book require that you purchase items that may cost as much as a hundred dollars or more, most of the components you need can be purchased for just a few dollars.

# Icons Used in This Book

Like any *For Dummies* book, this one is chock-full of helpful icons that draw your attention to items of particular importance. You find the following icons throughout this book:



TIP

Pay special attention to this icon; it lets you know that some particularly useful tidbit is at hand.



TECHNICAL  
STUFF

Hold it — overly technical stuff is just around the corner. Obviously, because this is an electronics book, almost every paragraph of the entire book could get this icon. So I reserve it for those paragraphs that go into greater depth, down into explaining how something works under the covers — probably deeper than you really need to know to use a feature, but often enlightening. You also sometimes find this icon when I want to illustrate a point with an example that uses some electronics gadget that hasn't been covered so far in the book, but that is covered later. In those cases, the icon is just a reminder that you shouldn't get bogged down in the details of the illustration and should instead focus on the larger point.



WARNING

Danger, Will Robinson! This icon highlights information that may help you avert disaster. You should definitely pay attention to the warning icons because they will let you know about potential safety hazards.



REMEMBER

Did I tell you about the memory course I took?

## Beyond the Book

In addition to the material in the print or e-book you're reading right now, this product also comes with some access-anywhere goodies on the web. Check out the free Cheat Sheet for some safety rules to follow, a list of electronic resistor color codes, and more. To get this Cheat Sheet, simply go to [www.dummies.com](http://www.dummies.com) and type **Electronics All-in-One For Dummies Cheat Sheet** in the Search box.

## Where to Go from Here

Yes, you *can* get there from here. With this book in hand, you're ready to plow right into the exciting hobby of electronics. Browse through the table of contents and decide where you want to start. Be bold! Be courageous! Be adventurous! And above all, have fun!



# 1

## **Getting Started in Electronics**

# Contents at a Glance

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