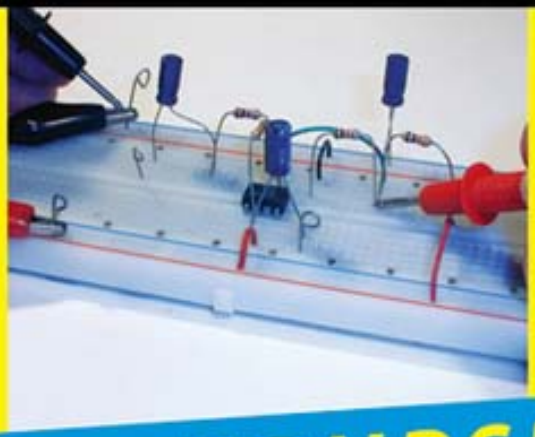

DO-IT-YOURSELF

Circuitbuilding FOR DUMMIES®

Discover how to:

- Build electronic circuits from start to finish
- Prepare a project from schematics, then solder and test it
- Work from detailed do-it-yourself instructions with step-by-step illustrations

H. Ward Silver
Author of Ham Radio For Dummies

Do-It-Yourself Circuitbuilding For Dummies®

Table of Contents

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by H. Ward Silver

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About the Author

H. Ward Silver has the experience of a 20-year career as an electrical engineer developing instrumentation and medical electronics. He also spent 8 years in broadcasting, both programming and engineering. In 2000 he turned to teaching and writing as a second career. He is a contributing editor to the American Radio Relay League (ARRL) and author of the popular “Hands-On Radio” column in QST magazine every month. He is the author of the ARRL’s Amateur Radio license study guides and numerous other articles. He developed the ARRL’s online courses, “Antenna Design and Construction,” “Analog Electronics,” and “Digital Electronics.” Along with his comedic alter-ego, Dr Beldar, Ward is a sought-after speaker and lecturer among “hams.” When not in front of a computer screen, you will find Ward working on his mandolin technique and compositions.

Dedication

Circuitbuilding Do-It-Yourself For Dummies is dedicated to the many technical writers whose articles in *QST*, *Popular Electronics, 73, CQ, Scientific American*, among others, inspired me to cut and solder and tinker my way through high school. Getting an amateur radio license on the way, that practical experience led directly to my first career as an electrical engineer. Another dedication is due my students and readers that make my second career as a writer equally enjoyable. If I can do for you what they did for me, I'll be very satisfied, indeed.

Author’s Acknowledgments

In the early days of electrical experimentation, before “electronics” was even a word, there was no choice but to build one’s own circuits. Back then, circuits were all about motors, lighting, and simple control systems. They were built with hammers, wrenches, screwdrivers, and, yes, soldering irons. Circuitbuilding was a full-body experience!

For a time not so long ago, it seemed that actually building one’s own circuits was an activity that would go the way of AC-DC motor and knife switch. Electronic gadgets had become so inexpensive and easy to use, why should anyone bother to build anything more complicated than plugging cables together? The Internet and personal computer took building out of the physical world and into the realms of the network and cyberspace.

That trend has reversed in recent years. People of all ages are rediscovering the thrill and satisfaction of learning-by-doing. They’ve found that “lifting the hood” is just as much fun for electronics and circuits as developing a Web site or hooking up the latest gadget from the store. Not only just building, but modifying or “hacking” equipment, is providing hours of enjoyment, too!

If you’re a budding circuitbuilder, welcome to the party! Join the thousands of ham radio operators, robotics enthusiasts, engineers, inventors, tinkerers, and hobbyists—people just like you. Heat up that soldering iron, turn on the voltmeter, and start building!

—H. Ward Silver

Publisher's Acknowledgments

We're proud of this book; please send us your comments through our online registration form located at www.dummies.com/register/.

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Introduction

Perhaps you've never built anything electronic, and now you want to. Perhaps you have built something before, but now you want to do something different. Look no further. *Circuitbuilding Do-It-Yourself For Dummies* is the book for both kinds of readers. Primarily, this book is intended to act as an introduction and guide to someone just getting started with electronics and circuits. It covers basic tools and techniques. If you are somewhat experienced with electronics, you'll find the book most useful as a workshop reference for specific kinds of tasks. The latter half of the book focuses on specific how-tos: cables, connectors, measurements, and maintenance.

There are so many circuits and applications of electronics that it is impossible to provide a detailed how-to guide for even a tiny fraction of the different types! The goal of this book is to show you the tools and techniques that circuitbuilders use, common to a wide variety of electronic construction needs.

This book presents basic techniques most useful to beginners. As such, you won't find detailed discussions of advanced topics such as fabricating your own circuit boards or performing reflow soldering at home. Nevertheless, if you become familiar with the techniques in this book, it will be easier for you to move on to more sophisticated techniques. I'll also give you pointers about where to find information on them.

This book is *not* a circuit design course or cookbook. I'll be assuming that you already have a schematic from a book or magazine or maybe you've purchased a kit. This

book shows you how to build it, not design it. The list of resources in Appendix A include quite a number of how-to-design books about electronics and even some online courses and tutorials.

What You're Not to Read

As you make your way through *Circuitbuilding Do-It-Yourself For Dummies,* feel free to skip around to where your interests and needs take you. You don't have to read each chapter in order. Use the Table of Contents or the Index to find help on a specific topic, such as wiring up a particular cable. The extensive Glossary in the back of the book will help with unfamiliar terms. Sidebars contain material that's interesting but not required reading.

Assumptions About You

The subject of electronics is big and broad and deep, but don't panic! You only need tackle the small steps at first — be comfortable and progress at your own speed. This book doesn't expect you to have an engineering degree or a complete shop. In fact, I deliberately performed all of the tasks myself with the simplest equipment and tools, just to be sure my readers could do them, too!

What I *do* assume about you, however, is that you're curious and motivated to build on the basic skills in *Circuitbuilding Do-It-Yourself For Dummies.* Take a few minutes to investigate the online resources I note

throughout the book. You'll also find an extensive list of resources in Appendix A.

Finally, you don't have to run out and buy all of the tools and components shown in the book. I'm sure your local electronics emporium would love it if you did, but take your time! Each task lists the tools and materials needed, and you will be just fine if you acquire them as you need them.

How This Book Is Organized

Circuitbuilding Do-It-Yourself For Dummies is composed of six parts. You'll get started with some electronic construction basics, then move onto specific tasks that show how circuitbuilding is done. From there you can read about techniques that support circuitbuilding like taking measurements and maintenance. A Glossary and the famous Parts of Ten wrap up the book.

Part I: Working Basics for Electronic-ers

This book doesn't neglect the basics — tools and techniques. You may have most of the tools, already! If you don't, this introductory part will help you get the ones you need. Then it's on to simple techniques for working with the materials you'll encounter when building circuits. I'll also help you read and make sense of electronic schematics, the language of circuitbuilders.

Part II: Building Circuits

This part of the book presents several ways of working with electronic components and materials to turn an idea into a living breathing circuit. By learning the basic techniques, you can build even the most complex circuits. Then learn how to install your circuit in a simple enclosure.

Part III: Cables and Connectors

Take a look at the back of any stack of electronic gadgets and what do you find? Cables and connectors! Lots of them! Yet the “how to” of making and repairing cables is rarely presented. That information doesn’t get left out of this book! I cover all kinds of cables and connectors so that when your circuit is finally built, you’ll be able to make the necessary connections to other equipment, too.

Part IV: Measuring and Testing

You can’t see, smell, or touch electricity in your circuits — unless something goes pretty wrong! Testing and evaluating your circuits, then, takes some special electronic eyes and ears. This part of the book shows you how to use basic test instruments as part of the circuitbuilding process and during troubleshooting.

Part V: Maintaining Electronic Equipment

Circuitbuilding isn’t just about soldering components together. Once you’ve built your circuit, what then? This part of the book covers installation and troubleshooting along with information on batteries and dealing with interference and noise. All of these topics are mighty handy out there in the Real World!

Part VI: The Part of Tens

Familiar to all *For Dummies* readers, these are condensed lists of helpful and (hopefully) memorable ideas. In this part, you’ll get the top ten secrets of the art of circuitbuilding, as well as indispensable information on circuit first aid and some supplies you should keep handy.

Glossary

As you go through the book, specific technical terms in *italics* will often be found in the Glossary. Keep a bookmark in the glossary and you won’t have to *gloss over* a term you don’t understand.

Bonus Chapters

The book was so chock-full of critical info, we had to leave a few things out. But have no fear because you can find two bonus chapters on the Web site (www.dummies.com/go/circuitbuildingdiyfd) covering resistor and capacitor types.

Conventions and Icons

To make the reading experience as clear and uncluttered as possible, a consistent presentation style is used:

- *Italics* are used to note a new or important term.
- Web site URLs (addresses) use a monospace font.

Additionally you'll see the following icons used as markers for special types of information.


This icon alerts you to a hint that will help you understand a technical or operating topic. These are often referred to as "hints and kinks" by circuitbuilders.


This icon highlights a new term or concept that you'll need to know about. Be sure to check the book's Glossary, as well.


Whenever I could think of a common problem or "oops," you'll see this icon. Before you become experienced, it's easy to get hung up on some of these little things.


This icon lets you know that there are safety, rules, or performance issues associated with the topic of discussion. Watch for this icon to avoid common gotchas.


These icons remind you of an important idea or fact that you should keep in mind.

Where to Go from Here

If you are just getting started with electronics, I recommend that you read Parts I and II thoroughly and try a few of the tools and techniques. Building a kit (Chapter 4) is a great way to turn your newfound knowledge into a gadget you can really use — a great confidence builder! Then try a couple of the other techniques before striking out on your own. The tasks in Part III can be performed whenever they arise as you build circuits. Study the techniques in Parts IV and V and give them a try.

If you're more experienced with electronics and want to use this book as a reference and how-to guide, be sure to scan through the book first. I'll bet there are a few sections or tips that might be an "Ah, hah!" for you. The Table of Contents can serve as your reference for workbench use.

Appendix A lists many references and provides some bonus material about electronic components, too. Bookmark the sites you find most interesting or useful and you'll have an instant electronic reference library! The print references listed in Appendix A are those that I've found to have a long useful life — many can be found in used bookstores or online at a fraction of their new cost. Even older texts will provide excellent information about how circuits work.

I couldn’t be more pleased to welcome all of you readers to the world of electronics and circuitbuilding. You’ll be able to use these tools and techniques for a long time. Learning them launched me into a lifetime of professional electronics that I’ve found to be both rewarding and enjoyable. I hope it’s the same for you!

Circuitbuilding Do-It-Yourself For Dummies

Introduction

Circuitbuilding Do-It-Yourself For Dummies

Part I

Working Basics for Electronic-ers