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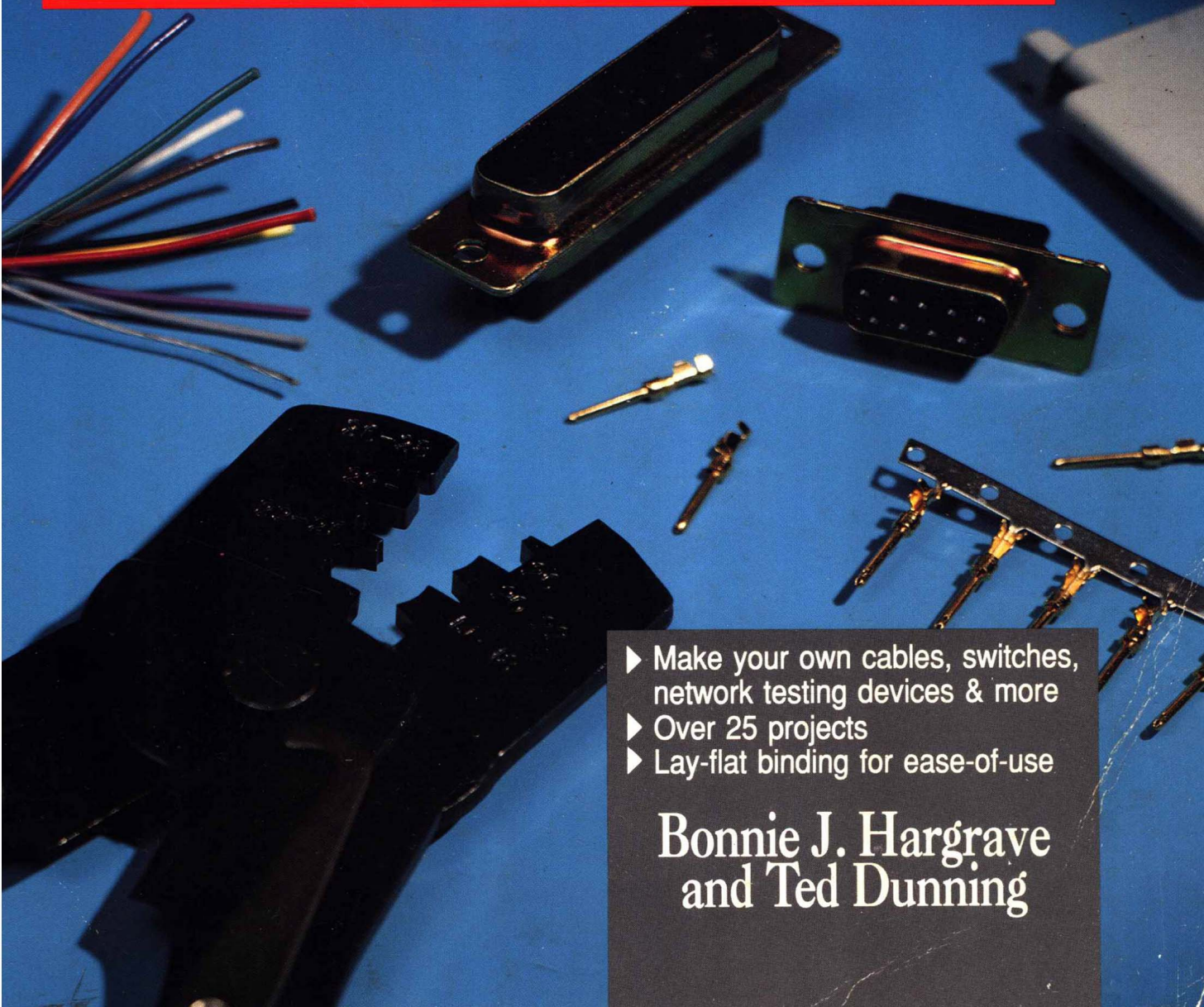

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Bonnie J. Hargrave
and Ted Dunning

Build Your Own Computer Accessories and Save a Bundle

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Ted Dunning

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We especially wish to thank our long-suffering spouses, without whom this book would never have been written.

Thanks, Ted. Thanks, Bonnie.

Introduction

This book is an attempt to distill years of experience in installing, connecting, and using computers into a collection of practical information for other computer users. We have presented these 27 projects in a way that, we hope, will both encourage the novice and challenge the experienced among you. Where there was a risk of presenting too much versus too little detail, we opted for the former. When the decision was between helping our readers understand more about computers versus impressing them, we again chose the former. We know you will save money, and we think you'll even have fun making and using these projects.

For the beginner

Our overriding purpose in writing this book was to help those who are inexperienced with computers and computer accessories feel more comfortable, confident, and inquisitive about them. Cables are easy, simple, and fun to make. And the first time you make one of your own, plug it in, and find that it works can be a thrill.

Part of our strategy for making these projects easy to understand has been to filter Ted's considerable knowledge of computers and electronics through someone who has less experience (me) and who would substitute plain speaking for the jargon. Computer jargon has its place. Many times words have to be created so people can discuss new technologies. Sometimes, though, this jargon is overused. Overuse of jargon and acronyms, far from aiding communication, closes the door on it. We tried to avoid that.

Of course, I could not write clear instructions unless I actually constructed some of the projects myself. So I did. Despite more than 15 years of working with computer software, I had almost no knowledge about computer hardware and absolutely none about electronics in general. Now I'm comfortable making cables and switch boxes and even some simpler electronic circuits.

We admit we could not explain all of the theory behind the more advanced projects. But we included placement diagrams in every project involving electronic circuitry. Even if you can't read a schematic, and even if you don't fully understand how the circuits work, we believe these placement diagrams will enable you to build some of the advanced projects and enjoy the use of them.

For the experienced electronics hobbyist

We have some great projects for the experienced computer electronics buffs, too. We think you'll find the electronic circuits in projects 21 through 27 to be well-designed, elegant ways to construct testing and communications devices.

Organization of this book

The 27 projects, including instructions for building them, are presented in the first part of the book. All the general explanatory material is located in the appendices.

The projects

With the exception of the four software projects, each project includes a list of components needed and the estimated cost to build the device. We offer suggested uses for each and a comparison with commercially available equivalents, where equivalents exist. All the hardware projects include explanatory photos and diagrams. Projects are organized by level of difficulty from easiest to most challenging, as follows.

Easy (projects 1 through 10) The first ten projects will help you learn how to build your own cables. No soldering is needed in these projects. They include cables, loopback connectors, jumpers, and a gender flipper.

Intermediate (projects 11 through 16) These six projects involve soldering, but the soldering on most of them is quite easy. They include two cable devices—the network terminator and the Macintosh Plus serial cable—and four switch box projects. The switches are an A/B RS-232 switch, an A/B monitor switch, an A/B printer switch, and an A/B/C RS-232 switch.

Software (projects 17 through 20) We found that many of the hardware projects needed some software to go with them. The software took on a life of its own and turned into four separate projects—the software RS-232 loopback, the software RS-232 link tester, the disk torture tester, and the software RS-232 cable tester. All of the software projects were written using Turbo C ver-

sion 2.0, and were tested on an IBM PC-compatible computer, and where appropriate, a Unix-based workstation.

Advanced (projects 21 through 27) All of the electronic circuit projects are in this section. There are seven of them. They are the RS-232 cable tester, the software-controlled RS-232 switch, the continuity tester, the data detector, the RS-232 merger, the coaxial yardstick, and the time domain reflectometer.

The appendices

Much of the explanatory information is given in eight appendices. You'll find definitions of terms, photos of all the components needed to build these projects, and instructions on general techniques such as soldering and crimping. There are also two tutorials: one on using schematics and another on understanding RS-232 port-to-port communications. In these appendices you'll also find the estimated costs of all the projects versus the price of their commercially available equivalents, plus some tips on the best suppliers of the components needed to build them.

Appendix A—schematics The schematics appendix will help you understand our diagrams. We even included a practice session to take you, in a detailed manner, through schematic and placement diagrams for one of the advanced level projects (the data detector).

Appendix B—components The components needed to make all 27 projects are explained and pictured in this appendix. We present the components in the order in which you need them as you progress through the projects.

Appendix C—tools The tools appendix is a brief overview of the tools needed to build these projects, including photos of the ones we used. Of particular interest is a discussion of how to use simulation software to design an electronic circuit.

Appendix D—techniques and tricks of the trade The techniques explained in appendix D should tell you all you need to know to be able to complete the projects. We included a tricks of the trade section which tells you things your mother never taught you about soldering, designing cables, and (mis-) using paper clips.

Appendix E—electrical standards In order to understand what kind of cable connection you need under various circumstances, you have to understand something about the RS-232 standard that underlies much of computer communications. We've explained something about that standard: what it means to you when you're trying to get two devices to talk to each other and what it means in relation to other electrical standards and other computer manufacturers (such as Apple). We delve into the internals of RS-232 port-to-port communication—typical sending and receiving circuitry—and show how one of our projects, the RS-232 merger, works at this internal level.

Appendix F—shopper's guide Because one of our main purposes in writing this book was to present low-cost alternatives to expensive commercial

computer accessories, we included a cost comparison chart. It compares the costs of all our hardware projects with the cost of commercially available equivalents. The shopper's guide also includes a list of the components used in these projects, their typical costs, and the recommended suppliers for each. Also, there is a listing of suppliers we dealt with while writing this book whom we felt could recommend to others as sources for electrical components.

Appendix G—further reading This appendix lists some suggested books you might want to read to learn more about computer communications, electronics, reading schematics, and related areas.

Appendix H—software listings This appendix is a listing of all the software from the various projects all in one place.

Where we can be reached

We hope you enjoy this book and find it useful. If you have any comments, please send them to us in care of TAB Books or directly via E-mail. Our internet addresses are `bonnie@nmsu.edu` and `ted@nmsu.edu`. We can be reached from most commercial networks, as well.

Contents

1

Easy hardware projects (cables)

1
PROJECT

Jumpers

Level of expertise: Easy Cost to build: $.20

Uses

Jumpers are used when setting up a cable. They can be used to make temporary connections to verify that a cable will work when it is finally built. Several projects in this book use jumpers.

Comparable product

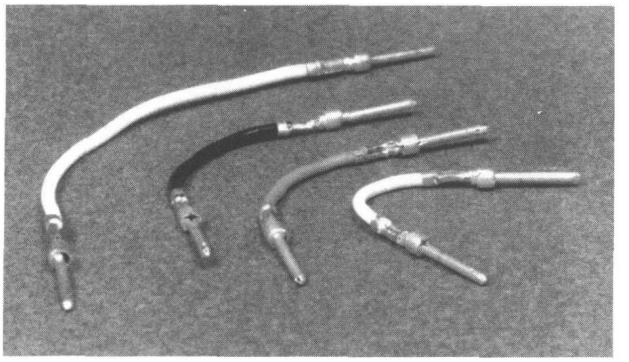
We don't believe you can buy jumpers. You can buy jumper wires which are intended for breadboarding and are not stranded wire. JDR Microdevices sells a plastic box full of them in assorted lengths for around $12. But the point of knowing how to make your own jumpers is so you can make one if the need arises.

Instructions

Jumpers are simple to make, so these instructions deal more with how to use them. To make them, cut a strip of cable about 3" in length and remove the outer sheath. The conductors become the jumpers. Alternatively, you can use scrap conductor wire of approximately 24 gauge. Strip 1/8" of the insulation from each end of the conductor and crimp a male pin on each end. If you've

never stripped wire or crimped a pin, you can read up on how to do this in appendix D.

Male jumpers are the most often used. If you think you'll also need jumpers for female connectors, follow the same procedure using female crimp pins. Figure 1-1 shows some finished jumpers.



1-1 Completed jumpers (male).

How to use jumpers

Many cable connections used in the projects herein require loopbacks; that is, a jumper. Insert one end of the jumper in one hole of the conductor. Insert the other end in another hole and you have an instant connection between the two lines. Of course, because the connection loops back into the same connector, the signal doesn't travel very far. But loopback connections do serve a purpose (see projects 2, 3, and 4 for examples of how they're used). When jumpers are used in our projects they usually are crimped on only one end. The other end of the jumper wire is merged with a second line; that is, it is spliced with other wires, as in projects 6 and 15.

Jumpers can be used in other ways too. In particular, jumpers come in handy when you are figuring out what sort of connections you need in a cable you want to build. You can insert the raw ends of the cable (raw, as in having crimp pins on them, but not yet inserted into a connector) into a port and use jumpers to experiment until the cable works. This is what commercially sold breakout boxes are used for; jumpers are just the low-budget approach. For an even lower-budget approach, look at the "Tricks of the trade" section in appendix D for comments on the role of paper clips in today's computer communications technology.

Components needed and the cost to build

You need eight or so pins, male or female depending upon the connector or port in which you will be using them. You also need about 10" of some scrap cable or another source of 22- to 24-gauge insulated wire. Stranded wire is bet-

ter, but solid wire is acceptable. It helps to have the insulated wires in assorted colors. At most, it should cost you about $.80 to make four jumpers. You might want two sets of them, both male and female.

Recommended suppliers

If you can't find scrap material to do this project, and it is the only one you intend to do, you probably should visit your local Radio Shack to buy the components. Also refer to appendix F.

Tools needed

Crimping tool
Cable stripper

2
PROJECT

RS-232 loopback

Level of expertise: Easy

Cost to build: $1.50

Uses

Use the RS-232 loopback to test a serial port or serial cable. For example, you can plug it into the main serial port on a terminal where you would normally plug in the computer or modem cable. Type on the keyboard. If the characters you type are echoed back on your screen, then the port is working. Similarly, you can connect it to the serial port on a computer and use software to send characters out and verify that they make it back.

A breakout box can stand in for an RS-232 loopback, but if you are debugging serial connections regularly, a loopback should be in your tool kit. You probably will need two of them: one male and one female.

Comparable product

We were unable to find anyone who markets a product similar enough to ours to warrant a price comparison. JDR Microdevices carries an RS-232 loopback tester for $14.95. Its model includes nine LED indicator lights for monitoring the modem signal lines. Our version has no indicators; it just loops back the signal lines. If you combined our loopback with our data detector (project 24), you would have a product comparable to JDR's loopback tester, and you would have a product that would be less likely to load down the data lines.