

Wiring Your Digital Home

FOR

DUMMIES®

by Dennis C. Brewer and Paul A. Brewer



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Digital Home***
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About the Authors

Dennis C. Brewer is also the author of *Security Controls for Sarbanes-Oxley Section 404 IT Compliance: Authorization, Authentication, and Access* (Wiley). He earned a BSBA degree from Michigan Technological University and a Novell Network Engineer Certification, and he spent over a dozen years as an information technology specialist with the state of Michigan. Over the last ten years, Dennis has worked on networking and computer technology projects from the level of hands-on integration, maintenance, and operations to developing policy and charting future direction. He retired from his position as an information technology security solutions specialist in January 2006 from the state of Michigan, Department of Information Technology, Office of Enterprise Security. He currently operates his own IT consulting practice and works on additional book projects.

Dennis's on-the-ground and on-the-sea experience with electricity, wiring, building design, and construction, repairing, and maintenance includes 12 years in the U.S. Navy Reserve (where he attained the rank and rating of Chief Petty Officer, Interior Communications Electrician) and 12 years in the Michigan National Guard as a Combat Engineer Officer (which he retired from as a Captain in 1993).

Dennis currently resides in the quiet little town of Laurium, in the Upper Peninsula of Michigan, with his wife, Penny. Their shared hobbies and pastimes include reading, camping in the "little house," biking, walking when weather permits, and auto rides in sun, rain, sleet, or snow through the highways and byways of the Keweenaw peninsula (which almost always includes sightings of white-tailed deer, an occasional black bear or wolf, or a bald eagle busying itself "fishing" the mouth of the Eagle River, where it empties into Lake Superior). Dennis says, "There is nothing more rewarding than watching the sun set over the big lake after an engaging afternoon of writing, except for maybe helping someone install a home network!"

Paul A. Brewer has earned a state of Michigan Masters Electrician License and Michigan Residential Builders License. He studied electrical engineering at Michigan Technological University, in Houghton, Michigan. He is currently the vice president of the electrical contracting firm of All Systems Electric (run by his sons) located in Ishpeming, Michigan, and he also works on writing projects.

While in the U.S. Navy, Paul worked on electro-mechanical systems of the submarines of the Sunshine Squadron out of Key West Florida and later out of Charleston, South Carolina, as an Interior Communications Electrician Petty Officer Second Class. He also worked as an expeditor for a general contractor and as an electrician in several states. For the final three years that Callahan Mining Company operated the Ropes Gold Mine near Ishpeming, he ran the

electrical department for a developing underground mine; he also ran his own electrical contracting firm from 1976 to 2005. While at the Ropes Gold Mine, he designed and built an automatic control system that was CCTV monitored and could load skips by remote control. In addition, he maintained the high- and low-voltage distribution systems and the dewatering pumps as they advanced deeper with the mine's descent. In his contracting business, he has completed wiring projects that included department stores, offices, restaurants, homes, saw mills, and roller mills. On off-the-grid sites, he has installed generators, solar panels, and battery-powered inverter systems, which includes volunteering his time to the U.S. National Park of Isle Royal to install a solar-inverter-powered system on the beautiful island national park in Lake Superior.

Paul currently resides in the city of Ishpeming, Michigan, in the Upper Peninsula. He takes advantage of the area's seasonal amenities: skiing, skating, and — when the freeze precedes the snow — clears off the lake in front of his house to share the rink, where everyone is welcome to skate. Presque Isle Park in Marquette is a favorite place to ski in the winter. In the summer, he hits the rollerblade trails and concerts in the park. Paul says, "The park deer population in past years included two albino deer, which once cooperated by showing themselves when I took my only sister, Peggy, and her husband, Joe, to see them."

Dedication

Paul A. Brewer: I dedicate this book to our late brother, Edward Leslie Brewer. Ed, the oldest of us five children, was the spark that ignited our interest in the subject of electricity. As an extensive reader of all matters, Ed's knowledge of the electrical code book is best described as "a walking code book." When I first started in the business, he steered me to the right track by freely and enthusiastically giving me the code-compliant way to do a job. In later years, I still found good advice upon request and sometimes it came unsolicited. I do miss him.

Dennis C. Brewer: This book is dedicated to all those (too many to count or mention by name) who showed me how to actually do or make something with hand tools, power tools, and motorized equipment — particularly to my older brothers, Edward, Alfred, and Paul for their early encouragement toward learning to use tools and the trades. I also dedicate this book to those who want to learn how to do new things and pass that fresh knowledge, skill, or ability on to someone else who could benefit from the doing.

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Dennis C. Brewer: Thanks to my wife, Penny, for her relentless patience and support; my friend Joe, for always asking the tough technical questions; my oldest son, Jason, for the inspiration to always do quality work; my youngest son, Justin, for pointing out that sometimes designs need to go a little bit outside of the lines; and my mother, Verna, for reminding me recently that finding the right answer to a problem is worth some degree of celebration.

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Contents at a Glance

| | |
|--|-------------------|
| <i>Introduction</i> | <i>1</i> |
| <i>Part I: Installing Power Distribution and Basic Wiring</i> | <i>9</i> |
| Chapter 1: Designing Your Digital Dream Home | 11 |
| Chapter 2: Bringing In the Services | 21 |
| Chapter 3: Roughing In the Wiring | 43 |
| Chapter 4: Trimming Your Home's Electrical System | 69 |
| Chapter 5: Controlling Your Life Remotely | 89 |
| <i>Part II: Adding Communication, Audio, and Video Systems</i> | <i>99</i> |
| Chapter 6: Wiring Your Home Phone System | 101 |
| Chapter 7: Installing a Public Address System | 119 |
| Chapter 8: Installing Cable TV and Advanced Digital Services | 131 |
| Chapter 9: Adding Stereo and Surround Sound | 143 |
| Chapter 10: Wiring Family Rooms and Home Theaters | 159 |
| Chapter 11: Installing Video Systems and Cameras | 175 |
| <i>Part III: Installing Home Networks and Advanced Technology</i> | <i>183</i> |
| Chapter 12: Home Networks and Internet Connections | 185 |
| Chapter 13: Integrating Computer Controls and Voice Technology | 205 |
| <i>Part IV: Security and Safety Systems</i> | <i>219</i> |
| Chapter 14: Working with Security Zones and Alarm Systems | 221 |
| Chapter 15: Backup and Alternative Power | 239 |
| <i>Part V: Extending Technology to Outdoor Living Spaces</i> | <i>253</i> |
| Chapter 16: Wiring Outside the House | 255 |
| Chapter 17: Outdoor Electronics | 279 |
| <i>Part VI: The Part of Tens</i> | <i>289</i> |
| Chapter 18: The Ten Best Wiring Web Sites | 291 |
| Chapter 19: The Ten Biggest Wiring Mistakes | 295 |
| Chapter 20: Ten Troubleshooting Tips | 305 |

| | |
|---|------------|
| <i>Part VII: Appendixes</i> | 313 |
| Appendix A: Product Sources | 315 |
| Appendix B: What Mr. Ohm Wanted You to Know | 319 |
| Appendix C: About the CD | 335 |
| <i>Index</i> | 339 |

Table of Contents

Introduction 1

| | |
|--|---|
| About This Book..... | 1 |
| Conventions Used in This Book | 2 |
| What You Don't Have to Read | 2 |
| Foolish Assumptions | 2 |
| How This Book Is Organized..... | 3 |
| Part I: Installing Power Distribution and Basic Wiring | 3 |
| Part II: Adding Communication, Audio, and Video Systems | 4 |
| Part III: Installing Home Networks and Advanced Technology | 5 |
| Part IV: Security and Safety Systems | 5 |
| Part V: Extending Technology to Outdoor Living Spaces | 5 |
| Part VI: The Part of Tens | 6 |
| Part VII: Appendixes..... | 6 |
| Icons Used in This Book..... | 7 |
| Where to Go from Here..... | 7 |

Part 1: Installing Power Distribution and Basic Wiring 9

Chapter 1: Designing Your Digital Dream Home 11

| | |
|---|----|
| Living on Digital Easy Street | 12 |
| Planning Your Digital Dream Home..... | 13 |
| Designing for new construction | 13 |
| Remodeling an existing residence..... | 14 |
| Completing single-focus projects..... | 14 |
| Choosing the Contractor — or Being Your Own | 15 |
| Selecting a contractor..... | 15 |
| Being your own contractor | 18 |
| Gathering Tools and Equipment | 18 |
| Hand tools | 18 |
| Power tools | 19 |
| Test equipment | 20 |

Chapter 2: Bringing In the Services 21

| | |
|---|----|
| Understanding the Power You Need..... | 21 |
| Alternating stuff..... | 22 |
| Transforming current with transformers | 22 |
| Amps and volts and other terms | 23 |
| Meeting Power Company and Code Requirements | 26 |
| Getting permitted | 26 |
| Installing in light of code requirements..... | 27 |

| | |
|--|-----------|
| Choosing a circuit panel | 29 |
| Choosing a distribution-panel location | 30 |
| Installing Electrical Services | 31 |
| Setting up temporary service | 32 |
| Looking up to overhead electrical service | 33 |
| Going underground | 36 |
| Connecting the electrical distribution panel | 37 |
| Grounding your service | 39 |
| Chapter 3: Roughing In the Wiring | 43 |
| Laying Out Receptacles (Legally) | 43 |
| Spacing receptacles | 44 |
| When to use GFI receptacles | 45 |
| Setting box heights | 49 |
| Making sure the box is flush | 51 |
| Mounting boxes during rewiring projects | 51 |
| Calculating box fill | 53 |
| Drilling Holes for Wiring | 54 |
| Drilling the framing | 54 |
| Drilling joists | 56 |
| Pulling Wires | 58 |
| Wiring to Code | 59 |
| Diagramming | 61 |
| Wiring the rest of the house | 65 |
| Wiring dryers and ranges | 65 |
| Wiring closets | 66 |
| Chapter 4: Trimming Your Home's Electrical System | 69 |
| Selecting Device Styles and Colors | 69 |
| Working with Receptacles and Switches | 71 |
| Installing receptacles and GFIs | 71 |
| Installing switches | 75 |
| Flushing and Leveling Electrical Devices | 85 |
| Testing Your Installations | 87 |
| Chapter 5: Controlling Your Life Remotely | 89 |
| Controlling Your Gadgets Remotely | 89 |
| Infrared and radio frequency remotes | 90 |
| Motion sensors | 90 |
| X10 remotes and devices | 91 |
| Using Timers for Around-the-Clock Control | 96 |

***Part 11: Adding Communication, Audio,
and Video Systems 99***

Chapter 6: Wiring Your Home Phone System101

| | |
|---|-----|
| Wiring Your Phone Service | 102 |
| Planning service entrances | 102 |
| Planning internal house wiring | 106 |
| Wiring for Conventional Phones | 108 |
| Installing a Home PBX System | 111 |
| Integrating VoIP | 112 |
| Understanding how VoIP works | 112 |
| Choosing a VoIP phone adapter | 113 |
| Choosing a VoIP service provider | 116 |
| Videoconferencing from Home | 116 |
| Equipping for videoconferencing | 117 |
| Using gateways for multi-point conferencing | 118 |

Chapter 7: Installing a Public Address System119

| | |
|--|-----|
| Planning a Home Communications System | 120 |
| Selecting locations | 120 |
| Choosing wire | 122 |
| Selecting amplifiers and speakers | 123 |
| Choosing intercom components | 124 |
| Installing the Hardware | 125 |
| Installing LV rings | 125 |
| Installing a central control unit | 126 |
| Connecting radio antennas | 127 |
| Installing and wiring remote locations | 128 |

Chapter 8: Installing Cable TV and Advanced Digital Services ...131

| | |
|--|-----|
| Readying Your Home for Prime Time | 131 |
| Bringing TV service into your home | 132 |
| Installing TV cable jacks | 132 |
| Installing TV cable | 134 |
| Connecting the common distribution point | 136 |
| Installing for a Fiber Optic Future | 138 |
| Understanding fiber optic cable | 138 |
| Consider your fiber optic strategy | 139 |
| Choosing home fiber optic service | 140 |
| Connecting to fiber optic devices | 141 |
| Hooking up to the ONT | 141 |
| Checking availability | 142 |

Chapter 9: Adding Stereo and Surround Sound143

| | |
|--|-----|
| Considering Whole-House Sound Systems | 143 |
| Using monophonic sound | 145 |
| Enhancing audio with stereo sound | 145 |
| Selecting stereo speaker locations..... | 145 |
| Encompassing your listeners with surround sound..... | 146 |
| Choosing and Installing Speakers | 153 |
| Wiring multi-room systems | 154 |
| Choosing speakers | 155 |
| Wiring in the speakers | 155 |

Chapter 10: Wiring Family Rooms and Home Theaters159

| | |
|---|-----|
| Designing for Adaptable Family Rooms | 159 |
| Lighting Your Family Room..... | 161 |
| Measuring light levels | 162 |
| Selecting fluorescent fixtures..... | 163 |
| Using recessed fixtures..... | 164 |
| Using track fixtures | 166 |
| Supplementing with lamps and task lighting..... | 167 |
| Controlling your family room lights | 168 |
| Planning Family Room Outlets | 169 |
| Designing Your Dedicated Home Theater | 170 |
| Maintaining access to the equipment..... | 171 |
| Including a control center | 172 |
| Maintaining clear sound zones | 173 |

Chapter 11: Installing Video Systems and Cameras175

| | |
|--|-----|
| Selecting Video Components..... | 175 |
| Reviewing camera features | 176 |
| Choosing a video surveillance system | 178 |
| Installing Your Video System | 179 |
| Positioning cameras..... | 179 |
| Supplying power to your cameras | 180 |
| Connecting cameras to the network..... | 181 |

Part III: Installing Home Networks and Advanced Technology183

Chapter 12: Home Networks and Internet Connections185

| | |
|---|-----|
| Understanding Internet Terminology: Stirring the Alphabet Soup..... | 186 |
| POTS (Plain Old Telephone System)..... | 186 |
| IP (Internet Protocol) addresses | 187 |
| DNS (Domain Name Services)..... | 187 |
| DHCP (Dynamic Host Configuration Protocol)..... | 188 |

| | |
|---|-----|
| Reviewing Your Internet Connection Options | 188 |
| Dial-up service | 190 |
| ISDN (Integrated Services Digital Network) | 190 |
| T-1 lines | 190 |
| Fractional T-1 | 191 |
| Broadband cable | 191 |
| DSL (Digital Subscriber Line) or ADSL (Asymmetric Digital Subscriber Line) | 191 |
| Fiber optic service | 191 |
| BPL (Broadband Over Power Lines) | 192 |
| Area wireless services | 192 |
| Connecting Your Home Network to the Internet | 192 |
| Installing a DSL or cable modem | 193 |
| Installing and configuring a router | 194 |
| Using firewalls | 196 |
| Understanding hubs and switches | 196 |
| Preparing to Wire Your Digital Home for Networking | 197 |
| Understanding Wireless “Wiring” | 199 |
| Setting Up Your Home Network | 200 |

Chapter 13: Integrating Computer Controls and Voice Technology205

| | |
|---|-----|
| Selecting Home Automation Components | 205 |
| Choosing automation software | 206 |
| Selecting a computer to run HAL | 207 |
| Wiring Your Home Automation Computer | 209 |
| Connecting HAL to the telephone | 209 |
| Installing voice-command stations | 209 |
| Interfacing with the home’s electrical system | 212 |
| Providing backup power to the automation system | 214 |
| Networking your automation system | 215 |
| Programming the automation interfaces | 215 |

Part IV: Security and Safety Systems.....219

Chapter 14: Working with Security Zones and Alarm Systems221

| | |
|--|-----|
| Protecting Your Home with Alarms | 221 |
| Comparing intrusion alarms | 222 |
| Understanding sensors | 223 |
| Wiring and installing sensors | 224 |
| Increasing safety with supplemental alarms | 225 |
| Surveilling Your Surroundings | 231 |
| Digital cameras | 231 |
| Closed-circuit television (CCTV) | 231 |
| Webcams | 232 |

| | |
|--|-----|
| Integrating Alarm and Communication Systems..... | 233 |
| Improving Your Home's Safety | 234 |
| Get the facts for your area | 234 |
| Screen visitors | 235 |
| Make some security elements visible..... | 236 |
| Secure your home | 236 |

Chapter 15: Backup and Alternative Power239

| | |
|---|-----|
| Identifying Your Home's Critical Systems | 239 |
| Comparing Types of Backup Power | 241 |
| Uninterruptible power supplies | 241 |
| Inverter systems | 242 |
| Green power systems | 243 |
| External combustion steam systems | 245 |
| Internal combustion systems | 246 |
| Interfacing Backup Systems to Your Electrical System..... | 246 |
| Alternative Energy Systems | 248 |
| Choosing an inverter..... | 249 |
| Caring for batteries | 249 |

Part V: Extending Technology to Outdoor Living Spaces.....253

Chapter 16: Wiring Outside the House255

| | |
|---|-----|
| Powering Sunrooms | 255 |
| Installing power and lighting | 256 |
| Bringing entertainment to the sunroom..... | 257 |
| Electrifying Patios and Decks | 257 |
| Lighting Your Garden | 259 |
| Delivering Electricity to Outbuildings | 260 |
| Retrofitting power to existing outbuildings..... | 262 |
| Wiring in workshops | 264 |
| Lighting outbuildings | 267 |
| Installing network, phone, TV, and intercom service | 268 |
| Wiring for sheds | 268 |
| Installing Saunas..... | 269 |
| Selecting a sauna stove..... | 269 |
| Supplying power | 271 |
| Installing the sauna stove control | 272 |
| Wiring near Pools and Hot Tubs | 273 |
| Pumping Water on Your Property | 274 |
| Powering well pumps..... | 274 |
| Installing garden and waterfall pumps | 277 |
| Using waste system pumps..... | 277 |

Chapter 17: Outdoor Electronics279

| | |
|---|-----|
| Designing around the Weather | 279 |
| Running wires in bulkheads | 280 |
| Wiring directly to the point of use | 280 |
| Using Electronic Devices in Outdoor Kitchens | 282 |
| Wiring Outdoor Theaters or Sound Systems..... | 283 |
| Controlling outdoor theaters or sound systems | 283 |
| Planning the theater space | 284 |
| Installing a Home Weather Station..... | 284 |

Part VI: The Part of Tens289**Chapter 18: The Ten Best Wiring Web Sites291**

| | |
|---|-----|
| Wiring Devices | 291 |
| Wire and Cable | 291 |
| Home Electronics | 292 |
| Home Security | 292 |
| Networking and Electronics Technology | 292 |
| Networked Video Surveillance | 293 |
| Solar and Alternative Energy | 293 |
| Digital Home Media..... | 293 |
| Outdoor Living | 293 |
| Remodeling and Repair Projects | 294 |

Chapter 19: The Ten Biggest Wiring Mistakes295

| | |
|---|-----|
| Not Leaving Enough Slack..... | 295 |
| Not Paying Attention to Details | 296 |
| Including Lighting Loads on Receptacle Circuits..... | 297 |
| Ignoring Physics | 297 |
| Gravity | 297 |
| Wind | 298 |
| Water | 298 |
| Fire..... | 299 |
| Installations Not Designed for Use and Abuse | 299 |
| Improperly Interpreting the National Electrical Code..... | 299 |
| When Grounding Is Not Grounding..... | 300 |
| Ignoring the BOCA or IRC Codes..... | 301 |
| Not Following Your Own Consistency Rules..... | 302 |
| Minimizing Wiring Runs and Circuit Counts..... | 302 |

Chapter 20: Ten Troubleshooting Tips305

| | |
|---|-----|
| Collect the History | 305 |
| Who witnessed the point of failure? | 306 |
| What was happening at the time? | 306 |

| | |
|---|-----|
| Where was the device when it failed?..... | 307 |
| How did it fail? | 307 |
| When did the failure occur? | 307 |
| Why did it fail? | 307 |
| Understand the Process | 308 |
| Plan the Approach | 308 |
| Follow Safety Procedures | 309 |
| Eliminate the Obvious | 309 |
| Begin at the Beginning | 310 |
| Avoid the Replacement Trap | 310 |
| Check the Vital Signs | 311 |
| Eliminate the Cause | 311 |
| Verify the Repair..... | 311 |

Part VII: Appendixes.....313

Appendix A: Product Sources315

| | |
|---|-----|
| Big-Box Stores..... | 315 |
| Best Buy..... | 315 |
| Circuit City | 315 |
| The Home Depot..... | 316 |
| Lowe's | 316 |
| Small-Box Stores..... | 316 |
| Micro Center | 316 |
| RadioShack..... | 316 |
| Wholesale Electric and Contractor Suppliers | 316 |
| Crescent Electric Supply Company..... | 317 |
| GE Supply | 317 |
| Graybar Electric Company..... | 317 |
| Home Automated Living..... | 317 |
| WESCO International..... | 318 |

Appendix B: What Mr. Ohm Wanted You to Know319

| | |
|---|-----|
| Using the Basic Ohm's Law Formula | 319 |
| Measuring current in amps | 320 |
| Measuring electromotive force in volts..... | 321 |
| Calculating Electrical Values..... | 321 |
| Calculating power in watts..... | 322 |
| Calculating energy use in watt-hours..... | 322 |
| Measuring power in AC circuits | 322 |
| Using the NFPA Wire Properties Table | 324 |
| Selecting Conductors..... | 327 |
| Limitations for using small conductors..... | 329 |
| Bundling conductors together..... | 329 |

| | |
|---|-------------------|
| Using non-metallic cable (NMC)..... | 331 |
| Converting between Celsius and Fahrenheit | 331 |
| Ethernet Length Limits | 332 |
| Appendix C: About the CD | 335 |
| System Requirements | 335 |
| Using the CD with Microsoft Windows | 336 |
| What You'll Find | 337 |
| If You've Got Problems (Of the CD Kind) | 337 |
| <i>Index</i> | <i>339</i> |



Introduction

Thousands of years ago, a home was little more than a sheltered place in which to sleep. Later, indoor fireplaces and ovens allowed people to cook inside their homes. In recent centuries, homes sprouted washrooms and sinks, thanks to indoor plumbing, and in the last 100 years, electrical and telephone systems have become standard features.

Homes have come a long way since their humble beginnings as crude shelters. In the 21st century, digital lifestyles will influence home design as never before. The modern home is a place for high-fidelity entertainment, advanced communications, and automated convenience. This book shows you how to bring your home into the new millennium. We show you how to install whole-home remote controls, cable TV systems, computer networks, public address systems, multi-room sound, backup power, and the latest phone systems.

Wiring Your Digital Home For Dummies offers illustrations, diagrams, and job-site photographs to help you better understand the sometimes complex wiring topics. We've packed this book with practical advice on what to include in new-home designs and techniques that work whether you're building a new home or updating an existing one. Even if you're not a do-it-yourselfer, this book helps you better understand digital systems, allowing you to make more informed decisions as you work with your architect or builder.

About This Book

If you've ever started a sentence with, "I wish my home were wired for (insert fantasy here)," then *Wiring Your Digital Home For Dummies* is for you! This book is organized into parts and chapters, creating the framework that builds and binds the book together. You needn't approach the book in one single way — we expect that you will jump from section to section based upon your needs and plans.

We wrote this book both with the construction trade professional and the novice in mind. For the do-it-yourselfer, we've packed in lessons learned from a combined 80-plus years of working as electricians, technicians, and computer and networking geeks. We hope you can relate to these lessons as you complete your projects.

If you're a professional, *Wiring Your Digital Home For Dummies* provides a heads-up on features you may want to include in the next home you wire, and it gives some insights about what your residential customers will ask you to do in the days and years to come. For builders, architects, engineers, designers, and electricians, this book is not only a reference but also a marketing checklist. As a builder, use it to work with the buyer the next time you're asked to quote a price for a new home. Electrical contractors will want to use this book when working with the builder to offer options in the wiring contract.

Conventions Used in This Book

When we refer to or paraphrase some section of *the code*, we mean the National Electrical Code (NEC) sponsored by the National Fire Protection Association (NFPA). Often we use the word *must* without referring specifically to the code. This usually means either the code requires it or the circuit won't work correctly any other way. *Wiring to code* means meeting a minimum standard. Most of the time this minimum standard is sufficient.

In some cases, we refer you to helpful resources on the Internet. Web addresses are printed this way: www.wiley.com.

What You Don't Have to Read

It's perfectly okay to skip items you already know or don't care about. For example, if you already know the code inside and out, then you can probably skip stuff that is marked with the Code Stuff icon (although we think that a quick refresher is always a good idea).

In some cases we include sidebars, which provide nice-to-know information. Sidebars don't contain critical information, so you can safely skip them if they don't meet your current need.

And finally, it's a good idea to read all paragraphs marked with Warning icons. The information in those paragraphs is critical and will prevent mistakes that could cost you — or hurt you.

Foolish Assumptions

Whether you know nothing about wiring, everything about wiring, or you're somewhere in between, all we assume about you is that you want to better

understand modern home wiring and how best to make it work with digital-age conveniences. You might be looking to build a new home or planning to upgrade your existing home. You might be an architect or engineer responsible for designing and selecting parts for someone else's home. You may be a builder or electrician looking to market digital-home features in your future jobs.

Whatever your reason for picking up this book, we think that when you're done reading you'll be in a better position to articulate and act on your own ideas and specific needs as you work to create your ideal digital home.

How This Book Is Organized

As electricians and technicians, we're very interested in the parts that make up the whole of the house wiring job. A home works well only when all its systems and subsystems work in harmony with one another. Every technical job eventually comes down to nuts and bolts, pieces and parts, step one followed by step two, and tab A going onto slot B. Our entire wired world is based on bringing the right parts together at the right time in the right way. Like wiring systems, this book is an assembly of parts that work together to make the whole. The parts, chapters, and topics break subjects down into bite-size pieces that you can easily use.

Although each part and chapter covers a unique topic, you may notice some overlapping subject material. We did this so you catch the complementary relationships between such things as (for example) security alarms and surveillance cameras.

Use the table of contents or index to skim for topics of immediate concern or to refresh yourself on information of interest after your first read. This book can be a valuable reference as you work through projects for many years to come. The table of contents, chapter titles, section headings, and icons help you quickly find the information you're seeking.

Part I: Installing Power Distribution and Basic Wiring

Regardless of where your electrical power is coming from — a potato, a coin battery, or the power company — you need to get the power to the place that most needs it, and you must keep it under control at all times. The same goes for phone service and other systems. The chapters in Part I provide the groundwork for bringing the wires into your home and then distributing them to your various living spaces.

- ✓ **Chapter 1:** Use this chapter to reach out for your digital future and find inspiration for planning your new digital home or next remodeling project. This chapter also provides tips on selecting a contractor, and we show you which tools you'll need.
- ✓ **Chapter 2:** From the red tape of building permits to dealing with the power company, this chapter is all about getting services to your home, be it power, phone, cable, or Internet. We show you how to set up temporary services at a construction site, and how to install permanent service entrances and distribution panels for power, phone, and cable TV.
- ✓ **Chapter 3:** This chapter tells you how to get the right kind of wires to the lights, phones, TVs, and computers in every nook and cranny of your home.
- ✓ **Chapter 4:** Bare electrical wiring isn't pretty or safe. This chapter shows you how to make the final connections, install attractive trim, and make sure everything works perfectly.
- ✓ **Chapter 5:** Written for the control *enthusiast* in all of us, this chapter explains why you will need a 100-pocket vest to carry all of the remote controls for your home. No, not really. But Chapter 5 does help you get complete control of anything electrical, including lights and appliances.

Part II: Adding Communication, Audio, and Video Systems

Part II covers the convenience and luxury items that help you get the most enjoyment out of your investment.

- ✓ **Chapter 6:** In this chapter we chat with you about phone stuff, including traditional analog systems as well as digital, Internet-based phone systems. We show you how to install a home telephone exchange system that lets you make calls from the kitchen to the garage, and we show how to use your Internet service to affordably call distant relatives and friends. This is the quintessential chit-chat cheaply chapter.
- ✓ **Chapter 7:** This chapter discusses intercom systems that let you ask who's at the door while you're in the kitchen and push a button to let Mr. McMahon in with the million-dollar check, if it's really him.
- ✓ **Chapter 8:** This chapter is all about the wiring that brings entertainment to a video screen near you. We show how to run TV cable throughout the home while maintaining great video-signal strength. We also introduce home fiber optic services, which are becoming increasingly available.

- ✓ **Chapter 9:** Here we show you how to leverage the stereo players and receivers you own to bring wonderful stereo sound — including the controls for that sound — into every room.
- ✓ **Chapter 10:** This chapter details how to wire for and get the most enjoyment out of your theater and surround sound systems. In addition to dedicated home theaters, this chapter also helps you wire a multi-use family room
- ✓ **Chapter 11:** This chapter helps you select, wire, and place video cameras, which add to your home's convenience and security.

Part III: Installing Home Networks and Advanced Technology

This section covers the physical backbone and digital logic foundation for hooking up a modern automated home.

- ✓ **Chapter 12:** This chapter covers the installation of network wiring, routers, firewalls, and network hubs and switches to connect to the Internet.
- ✓ **Chapter 13:** Here we discuss the basics of integrating advanced controls and computer software to facilitate voice command and true automatic control of devices in your home.

Part IV: Security and Safety Systems

Part IV explains some ways to enhance the safety and security of your domicile by including alarm features and backup power.

- ✓ **Chapter 14:** Here we show you how to install security alarms and other safety features.
- ✓ **Chapter 15:** This chapter covers the installation of mechanical and solid-state backup systems to provide nonstop electrical power to critical systems, even in the event of a power outage. Earth-friendly sun- and wind-power backup systems are also covered briefly.

Part V: Extending Technology to Outdoor Living Spaces

Many people feel torn when they're inside watching a good movie and the weather outside is so inviting. Part V shows you how to move some of your

entertainment technologies outside so you can enjoy the outdoors in new ways.

- ✔ **Chapter 16:** This information is all about bringing power and communications services beyond the confines of your home's wall to outbuildings and outdoor living spaces.
- ✔ **Chapter 17:** This chapter briefly covers some additional ways to bring network and other services to the outdoor landscape. We also show you how to build your own driveway traffic light as a just-for-fun project.

Part VI: The Part of Tens

Following the standard *For Dummies* roadmap, we included a Part of Tens. In fact, we liked the idea so much that we included three full chapters of Tens, making this really a Part of 30. These chapters are a ready reference long after you've read the rest of the book ten times.

- ✔ **Chapter 18:** This chapter takes you away on a World Wide Web search to ten of our favorite wiring and digital technology Web sites. Expect to find lots of great online information and links to even more helpful sites.
- ✔ **Chapter 19:** In this chapter we talk about the ten biggest wiring no-nos, so be sure to read this chapter before you pull your first foot of wire.
- ✔ **Chapter 20:** At some time in your life (if it hasn't happened already), you'll be inundated with requests for assistance. Someone is bound to ask you for help; you might even have a problem of your very own to solve. When that happens, bring Chapter 20 to the rescue with its ten universal troubleshooting tips.

Part VII: Appendixes

This part of the book contains the appendixes, which is where we stuck information that was important but didn't fit in the rest of the book.

- ✔ **Appendix A:** This appendix provides a list of product sources, showing you where to go to find the supplies you need for any wiring project.
- ✔ **Appendix B:** This appendix delves into electrical theory, wire properties, and provides ampacity tables from the National Electrical Code.
- ✔ **Appendix C:** This appendix gives you an overview of what's on the CD that's included with this book. It also provides installation instructions.

Icons Used in This Book

We use various icons in the margins to help organize some of the material and identify our intentions.



Whenever you see the Tip icon, it's our way of keeping your forehead somewhat rounded. If you don't read these tips, you may flatten your forehead with repeated smacking as you keep saying, "Now, why didn't I think of that?" Tips are our way of putting you and your project on the fast track to completion, with less effort and (hopefully) fewer mistakes.



If this book included quiz questions, paragraphs next to the Remember icon are the answers. We repeat these important things because they're worth remembering.



If you watch racing events, you're likely familiar with the caution flag. When this flag comes out, it's time to slow down and look for speed bumps, oil slicks, or debris ahead. The Warning icon is our caution flag. Think of these as must-read items. Once you read and understand these warnings, the green flag will be out for you on the next turn.



Sometimes you feel like you're in the know, and sometimes you don't. When you want to know more about the whys, hows, and wherefores of the technical side of home wiring, read these technical background and detail exposé items with wild-hearted expectation. Or feel free to skip them altogether.



Whenever you see this icon, pay particular attention to ensure that you follow the rules laid down by the building authority. In most cases the code we refer to is the NEC sponsored by the NFPA, which is adopted as the law of the land by code-enforcement authorities all over the United States (and even some other countries). We believe the code authors meant for you to do things the way they're explained in Code Stuff paragraphs. Whenever in doubt about a code question, check the latest code book or handbook, a licensed electrical professional, or consult with the governing code-enforcement authority.

Where to Go from Here

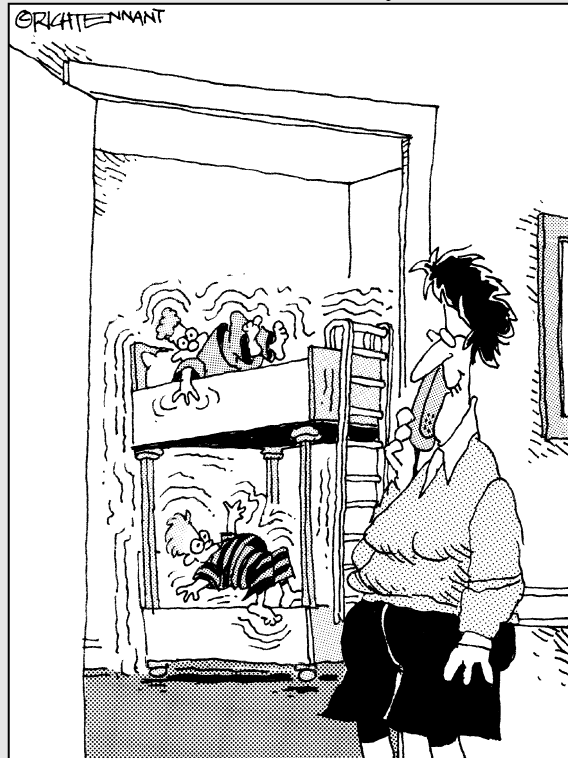
Although we don't recommend pulling out sections of the book to reorder the chapters, you can read them in any order you like. If you're a total wiring novice, you probably want to start with the first four chapters. They provide a foundation of knowledge, skills, and abilities that support the rest of the book (and the rest of your work). After that, follow your muse (or your immediate construction plans) to the topics that interest you most.

Part I

Installing Power Distribution and Basic Wiring

The 5th Wave

By Rich Tennant



"The kids are getting up right now.
When we wired the house we added
vibrating pager technology to
their bunkbeds."

In this part . . .

This part discusses what you need to keep the electrons contained and under your control so you can do useful — and innovative and entertaining — things. The skilled wiring work basics covered in these chapters apply to the rest of the book. The information contained in these chapters proves to be useful for any home wiring project.

Chapter 1

Designing Your Digital Dream Home

In This Chapter

- ▶ Living in a digital dream home
 - ▶ Designing or remodeling your home for the digital age
 - ▶ Selecting contractors or wiring it yourself
 - ▶ Collecting the necessary tools and test equipment
-

Aesthetically, a digital home is a warm, welcoming abode — a place where you love to spend time and enjoy life with your family and close friends. The digital home has just the right lighting in every space, whether that space is used for reading, computing, or a favorite hobby. A digital home is a place where technology enhances and eases your lifestyle and maximizes the enjoyment of your surroundings. A modern digital home is a habitat where elements of shape, infrastructure, and control combine to meet your needs with a maximum of convenience.

Functionally, a digital home is one that takes full advantage of the latest technologies for electronics, networking, communications, and electromechanical devices. The well-wired contemporary digital home also anticipates coming advances and adapts easily to future changes. Each digital home is unique, tailored to the needs and desires of the individual homeowner; yet a well thought-out digital home contains wiring and electronic equipment that meets accepted standards of construction and design.

Are you ready to start planning your digital home? This chapter shows you some of the benefits of a digital home and gets you started with the designing and planning process. We go over some of the features you may want to incorporate and help you decide whether you want to be your own contractor.

Living on Digital Easy Street

Close your eyes and imagine yourself in the ultimate digital home. It's Saturday and no one has to go to work or school. You are awakened to a sun-drenched morning by the quietly rising sound of a string quartet playing a classic movement by Tchaikovsky. As you enter the bathroom, the lights come up to a warm glow automatically. The sink water is instantly warm with the first twist of the 24-carat gold-plated faucet as you wash your face and take care of dental hygiene. After you emerge from your shower, the rack-warmed towels are an arm's reach away.

The kitchen welcomes you with the fresh wafting aroma of Tanzanian peaberry coffee, and your favorite morning news show tunes in on the flip-down television screen the instant you enter the breakfast nook. After the news, you walk out to the patio and read the newspaper editorials. As you leave the kitchen space, the TV turns off automatically. It is a sunny morning but still a little chilly outside, so you press a remote control button to light the gas fireplace and kick on its built-in circulation fan. As the rising sun warms the morning air, you press another button to turn off the fireplace.

It's a nice morning, so you pull out your hand-held computer and type a few e-mails, which you send via your wireless network. Later, you use the PC workstation in your kitchen to copy some digital photos from your camera and send them to grandma in Arizona. While online, you check the local Doppler weather radar image to see if any clouds are in the area. There are none, so you decide to take a walk in the park.

When you return home in the evening, you find that the microwave has just cooked a light dinner moments before your return. Later, you watch a newly released DVD in your home theater. After the movie the auto-vac-bot begins its quest for stray popcorn fragments, gliding almost silently across the floor. Lights in rooms and hallways sense your presence and automatically turn on and off as you pass through, ready to turn in for the night.

The scenario presented here illustrates just some of the possibilities of the modern digital home. Your dream home may look a little different, but with proper planning the possibilities are virtually limitless. The next few sections help you start your plan for your own digital home.

Planning Your Digital Dream Home

It may seem easier to design and build your digital dream home from the ground up, but any home can be adapted to include modern wiring, controls, appliances, computers, and other technology. As you start planning your digital home, you need to consider several factors:

- ✓ **Budget:** What can you afford? Does your home have enough space for the features you want?
- ✓ **Features:** Make a list of the features you want.
- ✓ **Appliance locations and sizes:** Choose where you want certain appliances, and determine what size each appliance should be.
- ✓ **Outlets:** Determine the type, location, and number of outlets you need before construction begins.



Define your requirements in writing to help focus you and your contractor on meeting the design objectives. Page through this book chapter by chapter, taking note of the items you want to include in your own digital home. Also, go through each room in your home (or your home plan) and make a list of features you want in each of those rooms. Be specific in your plan, because it influences the wiring installed in each room.

Designing for new construction

When building new homes, contractors often tend to do things the way they have done them in previous homes. As the homeowner of a new house — or a do-it-yourselfer building your own home — it is absolutely critical that you

- ✓ Include your digital home plans in the design specifications.
- ✓ Communicate to everyone involved the need for neatness and attention to detail.

For example, wiring runs should be made so that they minimize *crosstalk* (interference between power supply wires and communication wires). Different wiring types should have adequate separation, particularly on long parallel runs.

The *NEC* (*National Electrical Code*) requires a minimum separation of 4" between communication cables and open conductor power wires. (*Open conductor* is a wiring system used prior to the 1950s and is often referred to as *knob and tube*

wiring.) To minimize crosstalk, however, we recommend at least 6" between communication cables and any type of power wires. More separation is better.

Remodeling an existing residence

Homeowners often undertake remodeling projects involving one or two rooms. If you're planning a project, consider rewiring and including additional elements that can take advantage of newer technology.



The demolition and removal of old wiring, fixtures, and equipment is an added cost to consider when undertaking a remodeling project. If you abandon wires because they cannot be fully removed, take extra care to ensure that those abandoned wires cannot be accidentally reenergized later. To do this, cut the wires off flush with the box surface they protrude through, or cut them off in a few places along their route.



When planning your remodeling project, schedule the work so that one trade is not too far ahead of or behind the others. If you're working with a contractor, make sure he takes this into account. For example, the rough-in wiring must be done and the boxes mounted before new drywall is started. Pay close attention to the timeline and to job dependencies.

Completing single-focus projects

You may not have the time or budget to build, remodel, or upgrade your entire home to accommodate a digital lifestyle all at once. Instead, you may want to focus on one living space or one project at a time. Perhaps you have become serious about getting all the value possible from your home computers and want to build a home network to share Internet connections, printers, and fax services. Or maybe you're not satisfied with only two separate smoke alarms in the whole house. Situations like this make for perfect single-focus projects. You can complete many a project without major destruction and reconstruction. We show you some of these projects in Chapters 11 and 17.

Regardless of your project scope, include

- ✓ Starting with the floor plan, then onto the fixture, appliance, and furniture layouts, in that order, to determine where the wiring infrastructure will go.
- ✓ Separating different wiring types.
- ✓ Planning routes for power and communication cabling before drilling.

- ✓ Specifying exact locations for appliances, utilities, services, and outlet boxes.
- ✓ Planning racks, shelves, and mountings.
- ✓ Purchasing or gathering the required tools and equipment.
- ✓ Accounting for any job dependencies and the necessary work sequence.
- ✓ Determining how your plan alternatives affect the overall budget.
- ✓ Visiting the site often to ensure your plans are being implemented properly.

Choosing the Contractor — or Being Your Own

When using a professional contractor, the most important thing (besides writing the check) is knowing what you want included in your home and articulating your needs accurately to a reputable builder or contractor. Defining the work is the same whether you decide to go the do-it-yourself route or hire a contractor. And, of course, you need to choose a competent contractor.

Selecting a contractor

“How,” you wonder, “can I be sure I am choosing the right builder or contractor for my project?” Thanks for asking! Table 1-1 offers some of the things to consider asking or finding out about your prospective contractor.

| Table 1-1 Interviewing a Prospective Contractor | | |
|---|-------------------------|--|
| Question | Answer You Want | Why |
| How long have you been in your business or trade? | Since the earth cooled. | Generally, you want to hire a contractor with some experience in the business. Proceed with caution if the contractor has fewer than four years' experience. |
| Do you have worker's compensation and liability insurance? | Yes. | If he doesn't have insurance and his workers are injured on your premises, you may become liable. |

(continued)

Table 1-1 (continued)

| Question | Answer You Want | Why |
|---|-------------------------------------|--|
| What's your experience with similar projects? | I've done jobs similar to this one. | When a contractor has done a job similar to your project before, his learning from experience should benefit your project. |
| Can you provide industry, trade, and customer references? | You betcha. | If others speak well of the contractor's work and performance, you are more likely to get your project done to your satisfaction. |
| Can I see examples of prior work? | Uh huh. | This one really separates the ho hum contractors from the ones whose attention to detail is unparalleled. If the contracting firm is willing to show you prior work and let you be in the same space as prior customers, you can expect a great finish on your project as well. |
| Are you a member of a professional organization or trade association? | Yep. | You would prefer a contractor who's learning from others in the trade and makes a contribution to the greater good. |
| What's your community involvement? | I'm heavily involved. | Having a contractor willing to giving something back shows that she is concerned with more than making a profit and realizes that all the work she does benefits the community. |
| Can I inspect your vehicle? (Okay, you don't really ask this.) | Huh? | What's the general appearance of the contractor's equipment, vehicles, tools, and employees? If the things you <i>can</i> see aren't up to par, those things you <i>can't</i> see after installation have little chance of being done in a neat, orderly, and workman-like manner. |

| <i>Question</i> | <i>Answer You Want</i> | <i>Why</i> |
|--|---|--|
| Do you have all the required licenses? | Oh yes. | States differ in what type of work requires a license. The license process is designed to provide some level of assurance that the license holder will do work that is safe and up to current building and electrical codes. |
| Has anyone ever complained about your work? | No. (Or “Yes, once, and we solved the problem.”) | You don’t want to be the next in a long string of complaints. Choose a contractor who stands behind his work and satisfies his prior customers. |
| Where are your positive attitude and amiable manner? | You could ask outright, but you’re likelier to see the answer just by watching. | The lack of a can-do attitude can mean a number of things, none of them good. If you want to fight, you hire a boxer; your contractor should be amiable and respect you as a valued customer. |

These questions will help you start evaluating a contractor or builder, but may not include everything that is important to you, so add to it if needed. High-quality builders, remodeling contractors, and electrical contractors are proud of the work they do and are not offended if you check them out. Do your homework so you won’t become the next horror story on the pages of contractor dissatisfaction.



Show me the cost

Get an estimate from more than one contractor if you lack trusted recommendations, especially on expensive projects. An estimate considerably lower than another is usually a red flag; the lowest estimate may not be the best choice. The chosen contractor should give you a written

contract detailing the work to be done. Avoid the contractor who says, “Oh, I didn’t know you wanted x, y, and z done, too. That’s going to cost an arm and a leg.” Know his schedule before you sign — when he will start and when he expects to finish.