The Unauthorized Guide to iPhone®, iPad®, and iPod® Repair

TECHNICAL ACCURACY GUARANTEED by iFixit

A DIY Guide to Extending the Life of Your iDevices!

Timothy L. Warner

que

FREE SAMPLE CHAPTER

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Timothy L. Warner

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800 East 96th Street,
Indianapolis, Indiana 46240 USA

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ISBN-10: 0-7897-5073-2
ISBN-13: 978-0-7897-5073-0

Library of Congress Cataloging-in-Publication Data is on file

Printed in the United States of America
First Printing: May 2013

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While Que, iFixit, and I have made every effort to ensure that the directions provided in this book are complete and accurate, any attempt on the reader's part to perform an iDevice do-it-yourself upgrade or repair is solely at the reader's risk. Even when our instructions are carefully followed, the slightest misstep in disassembly or reassembly could result in further damage or destruction of the iDevice. Also, any attempt to repair or upgrade your iDevice immediately voids any warranty you have through Apple. You've been warned!

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About the Author

Timothy L. Warner is an IT professional and technical trainer based in Nashville, TN. As Director of Technology for a progressive high school, he created and managed a self-servicing warranty repair shop for all Apple hardware used at the institution. Warner has been an Apple enthusiast and power user since the original Macintosh was released in 1984. He has worked in nearly every facet of IT, from systems administration and software architecture to technical writing and training. Warner can be reached at tim.warner@cbtnuggets.com.

Dedication

To the most important women in my life: Susan Warner, Zoey Warner, Sherry Warner, and Trish Warner.

Acknowledgments

Publishing a book requires collaboration between many different people. Thanks to my wonderful editor, Rick Kughen, for conceiving the idea for this work. Thanks to the entire Pearson team, especially Lori Lyons, who worked valiantly to get this book out before Apple released another set of products (not an easy feat, I assure you).

Special thanks to Walter Galan and Kyle Wiens from iFixit for their enthusiastic partnership in this endeavor. Thanks to Charlotte Kughen of Wordsmithery LLC for her great suggestions and for making my words flow so nicely.

Thanks to Tom Chick of Intelligent Designs (idez.com) for the technical guidance on the iDevice take-aparts—you have been a great mentor to me over the years.

Thanks to all my family and friends for your continued love and support. Special shout-out to my parents, Larry and Sherry Warner, in whose basement I produced most of this manuscript during an extended family vacation.

We Want to Hear from You!

As the reader of this book, *you* are our most important critic and commentator. We value your opinion and want to know what we're doing right, what we could do better, what areas you'd like to see us publish in, and any other words of wisdom you're willing to pass our way.

We welcome your comments. You can email or write to let us know what you did or didn't like about this book—as well as what we can do to make our books better.

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Introduction

Have you ever broken an electronic device? In particular, has your iPod, iPhone, or iPad ever taken a tumble, resulting in a cracked screen? Is your iDevice's battery life not what it once was?

How do you ordinarily handle these situations when they occur? Please take comfort in the fact that *you are not obligated to pay Apple's sometimes exorbitant fees for out-of-warranty iDevice replacements*. Instead, you can learn to perform your own repairs!

If you study this book and invest in the proper time, tools, and materials to attain enough practical experience then you can save yourself a lot of money (and even make quite a bit of extra money to boot) performing iDevice repairs for your family, friends, and even the general public.

Do you want to know more? Read on, friend!

What's in This Book

To present all the various ways you can take full control of your iDevices, this book contains 19 chapters. Each chapter walks you through a different aspect of Do-It-Yourself (DIY) iDevice repair, from character traits of the ideal iDevice tech to where to get the best deals on iDevice hardware:

- **Chapter 1, "Why Do It Yourself?"** presents all the reasons why you might want to consider taking screwdriver in hand and performing DIY work on your iDevices.
- **Chapter 2, "The Tools of the Trade,"** is all about understanding what is required of you, from character traits to specific hardware tools, to become an effective iDevice technician.
- **Chapter 3, "Protecting Your iDevice User Data and Settings,"** is where you learn how to ensure that you don't lose any of your precious documents or settings when you perform work on iDevice hardware.
- **Chapter 4, "iDevice Repair Best Practices,"** connects you to the larger computer technician community and makes you fully aware of the tips and tricks professionals use to guarantee a safe work environment.
- **Chapter 5, "iPhone 3GS Disassembly and Reassembly,"** is a great place to begin your iDevice disassembly practice because 3GS hardware is inexpensive and the phones are relatively easy to take apart.

- **Chapter 6, "iPhone 4S Disassembly and Reassembly,"** shows you how easy and (dare I say it) enjoyable it is to work on iPhones; they represent the best Apple iDevices to repair, bar none.
- **Chapter 7, "iPhone 5 Disassembly and Reassembly,"** continues the iPhone DIY love; you'll be pleased to note that with respect to the iPhone, Apple actually made this model of the device easier for us repair techs to disassemble and perform parts replacements.
- **Chapter 8, "iPad 2nd Generation Disassembly and Reassembly,"** presents a full walkthrough on the iPad 2. You'll be unpleasantly surprised to learn how difficult it is to gain entry to these beasts.
- **Chapter 9, "iPad 3rd and 4th Generation Disassembly and Reassembly,"** doesn't have a lot more good news in the screen removal department (iPads are notorious for DIYers in this regard). However, after you have the display off, performing repairs and parts replacements on iPads is largely a breeze.
- **Chapter 10, "iPad mini Disassembly and Reassembly,"** presents how to disassemble and reassemble Apple's smallest iPad model. The good news is that the iPad interior is intelligently designed. The bad news is that the display is difficult to remove and parts are permanently soldered to the logic board.
- **Chapter 11, "iPod touch 4th Generation Disassembly and Reassembly,"** provides proof that Apple doesn't want anybody (including its Apple Store employees) opening any iPod touch device.
- **Chapter 12, "iPod nano 5th and 7th Generation Disassembly and Reassembly,"** takes on the nearly insurmountable task of disassembling an iPod nano without doing more damage in the process. Again, Apple considers all iPods to be disposable devices; I do my best to teach you how to prove Apple wrong.
- **Chapter 13, "Sourcing iDevice Replacement Parts,"** submits strategies for separating the wheat from the chaff, as it were, in terms of finding iDevice replacement parts that actually work. You would be surprised (or not) at the quality variance that exists in the marketplace.
- **Chapter 14, "Addressing Water Damage,"** gives practical tips and tricks for resurrecting an iDevice that has taken a bath against your will. The information in this chapter can save you quite a bit of money at the Apple Store!
- **Chapter 15, "Replacing the Front Display and/or Rear Case,"** shows you how to perform what is by far the most common iDevice repair—replacing the display assembly and/or the rear case.
- **Chapter 16, "Replacing the Battery,"** demonstrates that batteries do indeed have a limited lifetime and it is relatively straightforward, depending upon the model, to replace the battery in your iDevice.

- **Chapter 17, "Replacing the Logic Board and/or Dock Connector,"** teaches you about the logic board, which constitutes the "brains" of any iDevice, and gives you techniques for performing this most fundamental of parts swap-outs.
- **Chapter 18, "Recovering Data from Your Broken iDevice,"** presents clear instructions for retrieving otherwise lost data from crashed, crushed, or otherwise hopelessly damaged iDevices.
- **Chapter 19, "Before You Sell, Donate, or Recycle Your iDevice,"** outlines lots of ways to protect your privacy when you decide to pass your iDevice along to another person.

That's a lot of stuff! Then again, there's a lot you can do with your iDevices. It is my goal as your instructor to make you fully aware of what's possible with your new, secondhand, or seemingly "broken" iPods, iPhones, and iPads.

Who Can Use This Book

You don't have to be a technical expert to use this book; many of the procedures discussed here require nothing more than basic computer skills. It helps if you know your way around electronics or computer hardware, and you'll find out soon enough that this book contains some procedures that require those skills to greater or lesser degrees. But in general, just about anybody can perform most of the hardware and software exercises presented.

As you must know, iDevices are made by Apple. However, you can use iTunes and many other iDevice management tools either on OS X (Mac) or Windows. This book is written for both platforms. In most cases, the procedure is the same; I point out where operating system-specific differences exist.

How to Use This Book

I think you will find this book easy to use and helpful. To that end, I have included some items that help organize and call attention to specific pieces of information.

As you've probably already noticed, this book contains Notes, Tips, and Cautions—all of which are explained here:

NOTE

Notes point out ancillary bits of information that are helpful, but not crucial.

TIP

Tips point out a useful bit of information to help you solve a problem.

CAUTION

Cautions alert you to potential disasters and pitfalls. Don't ignore these!

I've offered many solutions to your iDevice repair problems, but some of these solutions involve software, websites, and services owned by third parties outside my direct control. I've included web addresses (URLs) for those sites when appropriate. To keep long and cryptic URLs under control, I used the is.gd URL shortening service for your convenience. I've tried to ensure that the web addresses in this book are accurate, but given how quickly the Web changes, you might find an address or two that no longer works. I am sorry about that, but with a little Google searching, you can probably find the resource at its new location.

Warning and Disclaimer

While Que, iFixit, and I have made every effort to ensure that the directions provided in this book are complete and accurate, any attempt on the reader's part to perform an iDevice do-it-yourself upgrade or repair is solely at the reader's risk. Even when our instructions are carefully followed, the slightest misstep in disassembly or reassembly could result in further damage or destruction of the iDevice. Also, any attempt to repair or upgrade your iDevice immediately voids any warranty you have through Apple. You've been warned!

There's More Online...

When you need a break from reading, feel free to go online and check out my personal website at www.timwarnertech.com. Here you'll find more information about this book as well as other work I do. And if you have any questions or comments, feel free to email me directly at tim@timwarnertech.com. I do my utmost to answer every email message I receive from my readers and students.

Do It *Your Way*

With all these preliminaries out of the way, it's now time to get started. Put on your reading glasses, fire up your iDevice, and get ready to take complete control of your Apple hardware!

4

iDevice Repair Best Practices

This chapter takes care of some literal and figurative housecleaning that any self-respecting iDevice technician should undertake before performing any DIY work on iDevices.

I'm talking about answers to questions such as the following:

- How can I determine whether an iDevice is in or out of warranty?
- What do those strange acronyms like IMEI and ICCID mean?
- What's the difference between an iDevice Model Number and an Order Number?
- What do the strange hieroglyphics on the back of my iDevice represent?
- How can I maximize the safety effectiveness of my repair workshop?

Those are some juicy questions, don't you agree? What are you waiting for? Let's get to work!

Checking iDevice Warranty Coverage

Whenever you are presented with an iDevice and are asked to perform an out-of-warranty repair, the first thing you should do is definitively verify the actual warranty status of the device. Fortunately, you can easily find an answer to this question in ways that we will discuss now.

If you can't start the iDevice, then you can obtain the serial number, from the original product packaging or in iTunes. (You can find instructions for locating the serial number in iTunes in the sidebar later in this section.)

NOTE

Check the Back of the Device

Some older iDevice models have their serial numbers printed on the back case.

FIGURE 4.1 We can determine an iDevice serial number from within iOS.

You can check your iDevice serial number in iOS 6 by navigating to Settings, tapping General, and then tapping About. This interface is shown in Figure 4.1.

You can also submit the device's serial number to Apple's Check Your Service and Support Coverage page (https://is.gd/C8pEzh). The resulting web page, shown in Figure 4.2, provides you with the following information about the given device:

- Device purchase date
- Telephone technical support status, along with expiration date
- Repair and service coverage status, along with expiration date

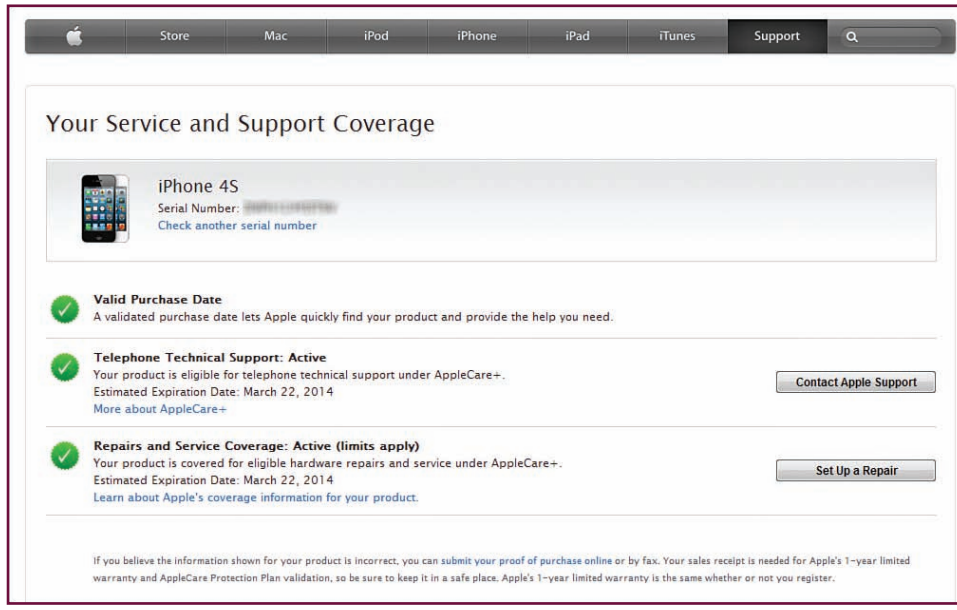

FIGURE 4.2 You can determine iDevice warranty coverage by visiting Apple's website.

FINDING THE SERIAL NUMBER IN ITUNES

Locating your iDevice serial number in iTunes 11 is easy. Plug in your iDevice and navigate to the device's **Summary** page in iTunes. The serial number is plainly displayed next to the small icon image of your device. Protip: Click the serial number value to toggle between the serial number and the unique identifier (UDID).

The format of the iDevice serial number is a combination of non-unique and unique information. It really does not behoove you to attempt deciphering Apple's serial number format because (surprise, surprise) Apple changes the format on a semiregular basis.

Instead, if you would like a breakdown of a given iDevice's serial number then I suggest that you visit the Dutch website Chipmunk International BV (http://is.gd/8BnvUi) or EveryMac.com (http://is.gd/wNrlgV). You can submit your device's serial number and obtain a list of detailed metadata concerning the origins of the device. This metadata includes the following:

- Year the model was introduced
- Production year
- Production week
- iDevice model name
- Order Number
- CPU speed
- Screen size
- Screen resolution
- Case color
- Capacity
- Factory of origin

To quote Miguel de Cervantes from his wonderful novel *Don Quixote*, "Forewarned, forearmed; to be prepared is half the victory." With that in mind, let's continue on the journey to iDevice metadata enlightenment.

Verifying iDevice Version Info

As you know, Apple has historically not been precise, much less consistent, in its product naming. For instance, consider the iPad. These are the official product names for the three generations of iPad:

- iPad
- iPad 2
- New iPad

Give me a break! What makes matters worse is that all three generations have simply **iPad** etched on the back panel.

The same goes for iPhones; remember our previous discussion of iPhone 3G, 3GS, and iPhone 4S? What relationship do those product names have with 3G or 4G carrier network connectivity? You have to consult a reference table to answer that question.

The most reliable method for identifying a particular iDevice model is to ascertain its model number. This alphanumeric string is printed on the rear case of the device (see Figure 4.3).

FIGURE 4.3 You can determine the iDevice model number and other metadata by viewing the rear case.

Use Table 4.1 as a reference to determine a model number.

TABLE 4.1 iDevice Model ID Reference Table

iDevice	Model ID
iPhone 3GS	A1303
iPhone 4 (GSM)	A1332
iPhone 4 (CDMA)	A1349
iPhone 4S	A1387
iPhone 5 (GSM)	A1428
iPhone 5 (GSM and CDMA)	A1429
iPad 1st generation Wi-Fi	A1219
iPad 1st generation Wi-Fi/3G	A1337
iPad 2nd generation Wi-Fi	A1395
iPad 2nd generation Wi-Fi/3G (AT&T)	A1396
iPad 2nd generation Wi-Fi/3G (Verizon)	A1397
iPad 3rd generation Wi-Fi	A1416
iPad 3rd generation Wi-Fi/4G (AT&T)	A1430
iPad 3rd generation Wi-Fi/4G (Verizon)	A1403

iPad 4th generation Wi-Fi	A1458
iPad 4th generation Wi-Fi/LTE (AT&T)	A1459
iPad 4th generation Wi-Fi/LTE (Verizon)	A1460
iPad mini Wi-Fi	A1432
iPad mini Wi-Fi/LTE (AT&T)	A1454
iPad mini Wi-Fi/LTE (Verizon)	A1455

What Are Order Numbers?

Order numbers are unique identifiers for iDevices that describe a unit's configuration, capacity, and color. These identifiers are alphanumeric strings that typically begin with MC or MD. For instance, the order number of one of my iPhone 4S devices is MC918LL. If you submit the order ID to a site such as EveryMac.com's Ultimate Lookup utility (http://is.gd/wNrlgV) you can learn the following about the device that has that ID:

- Specific date of manufacture
- RAM
- Storage capacity
- Model number
- Model ID
- Order number

You can obtain a comprehensive list of iDevice order numbers from various sources on the Web. For instance, try the iPhone Wiki's Models page at http://is.gd/QyN3Ox.

In contrast to the model number that is etched on the back case of your iDevice, you determine the order number from within iOS. Navigate to **S**ettings, General, About and scroll to the Model field. You can see this field in Figure 4.1.

Yes, yes, yes: We have hit a huge point of confusion here. Apple calls the order number by the term *Model* in iOS. No, you aren't crazy. This is one example of Apple's occasional (and frustrating) inconsistency within its iDevice family.

The reason I have spent so much time discussing iDevice identifiers is that most customers seem never to be quite sure that they have the iPad, iPod touch, or iPhone that they wanted. I can't say I blame them. After all, if I laid down $600 for a 3rd generation iPad then I want to ensure that I do indeed have the latest and the greatest model. From arm's length, the 2nd generation and 3rd generation iPads look virtually identical.

Deciphering iOS Speak

If you have spent some additional time nosing around the About screen in your iDevice's iOS or the home page in iTunes then you doubtless noticed some additional acronyms that may tickle your fancy.

- **The International Mobile Equipment Identity (IMEI)** is a globally unique identifier for GSM iPhones or iPads.
- **The Integrated Circuit Card Identifier (ICCID)** is a globally unique identifier for SIM cards.
- **The Electromagnetic Compatibility (EMC)** number is defined in electrical engineering (Reference: http://is.gd/e8JE43) as the "ability of electronic equipment to be a 'good electromagnetic neighbor': It neither causes, nor is susceptible to, electromagnetic interference (within the limits of applicable standards)."
- **The Integrated Circuit Card ID (ICCID)** is a yet another globally unique identifier associated with a GSM iDevice's SIM card. What's interesting is that you can run an ICCID through a mathematical formula in order to yield the subscriber's IMSI (International Mobile Subscriber Identity) number.
- **The Unique Device ID (UDID)** is a globally unique identifier associated with your iDevice that is used by iOS app developers to provision apps prior to their approval and availability at the Apple App Store.

As I mentioned in the earlier sidebar "Finding the Serial Number in iTunes," you can toggle through your iDevice's unique identifiers from within iTunes.

Okay, friends: Time for another experiment. Take your nearest iPhone, iPod touch, or iPad and turn it over. At this point you should feel proud of yourself inasmuch as you understand most of the information that is etched there.

However, the vast majority of iDevice users have no earthly idea what the collection of symbols (I affectionately refer to them as "hieroglyphics") means. Take another look at Figure 4.3 that shows an iDevice rear case and then read the meaning of each symbol, which is explained in the following list (working from left to right).

A: Approval seal of the US Federal Communications Commission (FCC). Note that the iPhone carries the FCC ID (grantee code) on the back case as well.

B: Compliance seal with the Waste Electrical and Electronic Equipment (WEEE) directive. This signifies that the iDevice can be disposed of in an environmentally responsible way.

C: Conformité Européene (CE) approval mark. This signifies that the device may be sold legally in the European Union (EU).

D: Refers to the body that approved the device for CE certification. 0682 refers to Cetecom ICT Services in Germany.

E: Alerts you of the iDevice's status as a Class II wireless device, which means that the iDevice may attempt to operate on wireless frequency bands that some countries disallow.

Whew—that was a heavy slog through acronymville, wasn't it? It's time to lighten things up by covering how warranty repair orders work for iDevices. Next we'll describe some aspects of an electrostatic discharge (ESD)-friendly workspace. After that I share some best practices, won through hard-earned experience, for organizing that workspace.

How Do Warranty Repair Orders Work?

I have to hand it to Apple in how they architected their Apple Retail Stores—it is a pretty slick operation.

Assume that your iPhone is malfunctioning somehow and you make an appointment to visit an Apple Genius at your local Genius bar by visiting the website at https://www.apple.com/retail/geniusbar/. What happens after you hand the Genius your iDevice?

1. The Genius uses Safari to access Apple's online iOS Diagnostics web app at https://iosdiags.apple.com. Apple Stores may alternatively use a hidden app on iOS devices called **iOS Diagnostics** or **Behavior Scan**.
2. The Genius opens a session ticket and sends a link to your iDevice.
3. After you agree to the process, the iOS Diagnostics web app runs a series of scans on your iDevice and generates a report.

The results of an iOS Diagnostics scan are pretty robust; they are generally broken into the following categories:

- Battery Health
- Usage Statistics
- Call Statistics
- Thermal Statistics
- Detailed Analysis

The "Detailed Analysis" also scrubs your iDevice for diagnostic log entries that may reveal the past installation of jailbreak apps. Remember that if the Apple Store technician discovers evidence of jailbreaking, your AppleCare warranty will be voided.

If, by contrast, the problem with your iDevice is definitely hardware-based, the Genius might (at the most) remove the bottom screws and remove the rear panel. You won't find that any Apple Store staffer field-strips your iDevice.

If your warranty claim is approved, you receive a replacement device–period. I sometimes wonder to myself if any Apple Store has an employee who knows how to completely disassemble an iDevice.

Apple Store personnel use a number of proprietary, internal iOS apps. It's far beyond our scope to consider these, but if you want to practice your Google-fu to learn more about them on your own, here is a not-at-all comprehensive list of internal app names:

- Apple Employee Directory
- AppleConnect
- Behavior Scan
- Chatterbox
- Concierge
- Espresso
- Merlin
- MobileGenius
- RFA
- speX
- Switchboard

Creating an ESD-Safe Workspace

Chapter 2, "The Tools of the Trade," covers the dangers of ESD. It also explains how you can protect yourself and your iDevice equipment against ESD by using an antistatic wrist strap and an ESD work mat.

At this time I'd like to share with you some additional tips and tricks to minimize the possibility of ESD causing damage to iDevice components.

Wear Appropriate Clothing and Protect Your Workspace

Please don't even think of wearing polyester clothing (such as a jogging suit) while you work on iDevices. Polyester is an absolute haven for ESD buildup.

Moreover, never introduce vinyl, Styrofoam, or plastic (except for your ESD-safe plastic work tools) into your workspace environment. Surely you've felt a static zap from vinyl, or had Styrofoam packing peanuts stick to your hands? These materials sound a potential death knell to IC components.

Believe it or not, you should strongly consider investing in ESD-safe, antistatic gloves. The reason for this suggestion is that the oils from your fingers can transfer all too easily to the tiny IC components and conductive contacts inside your iDevice. When this happens, you can unintentionally create extra resistance and potential short circuits. This is obviously not a desirable outcome, and it's difficult to troubleshoot these problems to boot.

ESD-safe gloves also carry the advantage of not leaving fingerprints on your pretty iDevice cases.

Handle IC Components Appropriately

Never place iDevice parts on a metal surface. Instead, place the parts on your antistatic work mat. For that matter, be sure that you have a supply of static-shielding storage bags on hand for easy parts transport. When you order an iDevice replacement part, the component should ship in a static-shielding bag. Don't throw them out! You'll be glad to have a stockpile of them on hand in your workspace for future use.

Handle all IC components only at their edges and never by their contact points. As I just mentioned, you need to ward against the transfer of your body oils to the contacts. You also don't want to create an inadvertent circuit bridge between the delicate contacts, which might very well short-circuit and fry them. It should go without saying, but here I go, saying it: Never touch another person who is working on IC components, and vice versa.

Condition the Air in Your Workspace

Industry best practice guidelines suggest that you keep the humidity of your workspace between 70 and 90 percent. You can achieve this level of humidity by measuring the humidity and then using a humidifier or dehumidifier in the room. Why leverage higher humidity? Because ESD charge levels are reduced (but not eliminated) in a higher-humidity environment.

You should also consider installing an ionized air generator in the room to add another layer of defense against the dreaded ESD.

Figure 4.4 shows a bench-top blower. Bench-top ionizers, such as the minIOS2 ionizing air blower (http://www.esdproducts.biz/Ionization/BenchtopIonizers/minION2/minion2.html) cost about $400. However, you must weigh this investment against the peace of mind of insuring against damaging iDevice components and risking dissatisfied customers who face unnecessary delays in parts shipments due to ESD damage.

FIGURE 4.4 A representative bench-top ionizing blower. (Image courtesy of Morn via a Creative Commons License: http://is.gd/tNxYFM)

Documenting and Securing Your iDevice Components

The worst-case scenario for any aspiring iDevice technician is to get well into a disassembly and having to ask, "Wait a minute. Which screws go with which part?" This is a rookie mistake that nearly all of us make in the beginning. However, you are reading this book to benefit from my experience. It is my sincere hope that you can skip merrily over many, if not most, of those beginner's pitfalls.

The very best screw and parts organizer I've ever used comes from our friends at iFixit. As you can see in Figure 4.5, the 8" × 12" magnetic work mat is divided into 20 squares on the magnetic side, and 16 cutout wells on the non-magnetic side.

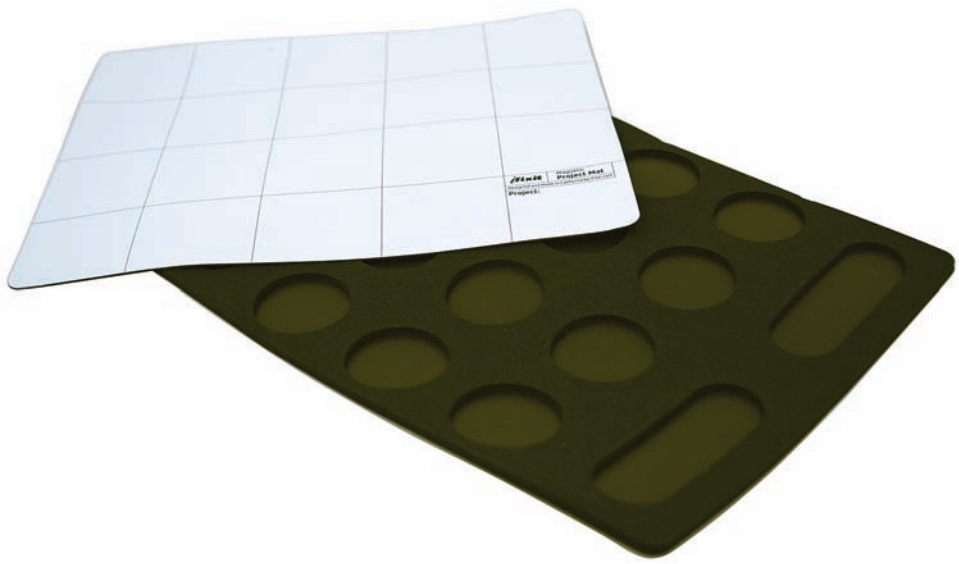

FIGURE 4.5 iFixit magnetic work mats.

The idea is that you can use a dry-erase marker to number the magnetic squares, and for each step of a disassembly procedure you can store the associated screws and parts accordingly. The magnetism of the mat keeps those tiny screws in place.

The non-magnetic side creates an excellent organization space for larger, non-magnetic parts. Honestly, as an iDevice tech you will use the magnetic side of the work mat almost exclusively.

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