HARDWARE HACKING

Have Fun While Voiding Your Warranty

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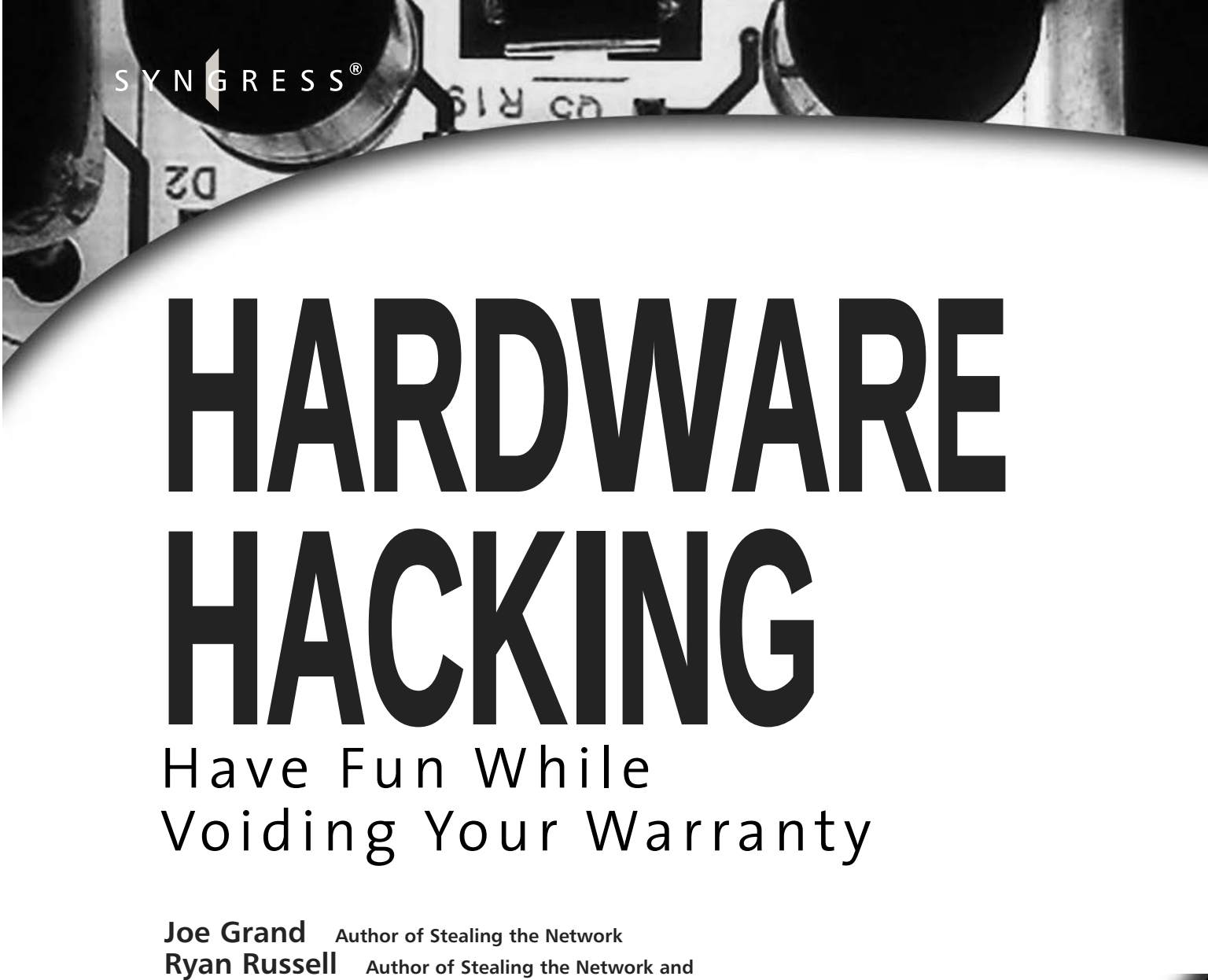

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Have Fun While Voiding Your Warranty

Joe Grand Author of Stealing the Network
Ryan Russell Author of Stealing the Network and Hack Proofing Your Network, Second Edition

And featuring Kevin D. Mitnick Technical Reviewer

Foreword by Andrew "bunnie" Huang

Lee Barken **Marcus R. Brown** **Job de Haas** **Deborah Kaplan**
Bobby Kinstle **Tom Owad** **Albert Yarusso**

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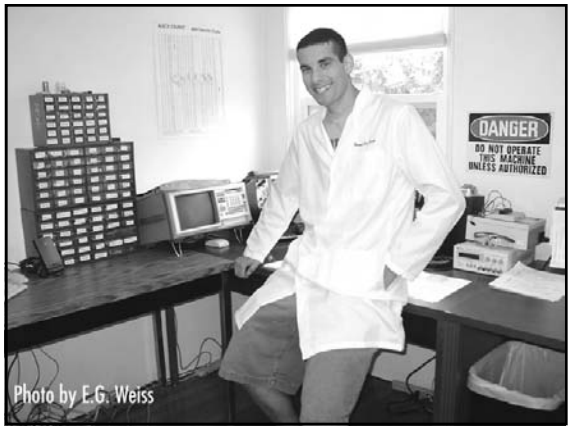

Joe Grand; Grand Idea Studio, Inc. Joe Grand is the President and CEO of Grand Idea Studio, a product design and development firm that brings unique inventions to market through intellectual property licensing. Many of his creations, including consumer electronics, medical products, video games and toys, are sold worldwide.

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"Let's be grateful for those who give us happiness; they are the charming gardeners who make our soul bloom." —Marcel Proust

With deepest appreciation for my charming gardeners, a special thank you to my love Stephanie, my mom and dad, Frieda and Israel, my brothers, Derren and Martin, my sister Randi and her husband Scott, my Uncle Harry and my Grandmother Sophie. Thank you for your support and love.

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Albert co-founded AtariAge (www.atariage.com) in 2001, a comprehensive website devoted to preserving the history of Atari's rich legacy of video game consoles and computers, which has become one of the busiest destinations on the web for classic gaming fans. In 2003, Albert helped bring the first annual Austin Gaming Expo (www.austingamingexpo.com) to Austin, an extremely successful event that drew over 2,000 visitors in its first year.

Albert is the author of Chapter 7 "Hack Your Atari 2600 and 7800," Chapter 8 "Hack Your Atari 5200 and 8-Bit Computer," and Chapter 11 "Hacking the iPod."

Foreword Contributor

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Contents

Foreword

Hacking—and in particular, hardware hacking—has experienced a bit of a renaissance recently. I am personally quite pleased about the increased interest in hacking. Your interest in this book, *Hardware Hacking: Have Fun While Voiding Your Warranty*, is a testament to the increased demand for knowledge about hardware hacking. I'd like to take a few pages and a few minutes of your time to share with you why your interest in the topic makes me happy as a fellow hardware hacker.

First allow me to pontificate on the meaning of the word *hack*. The term has evolved quite dramatically over the years. Hacking has shaped technology perhaps as much as technology has shaped our perception of the hacker. According to *The New Hacker's Dictionary* (a public-domain lexicon of jargon created by hackers, www.jargon.8hz.com):

> hack: 1. /n./ Originally, a quick job that produces what is needed, but not well. 2. /n./ An incredibly good, and perhaps very time-consuming, piece of work that produces exactly what is needed. [1]

The second sense of the word is perhaps the closest to the definition I associate with the word *hack*. Thus, it follows that a hacker is one who labors to create good, typically innovative solutions to targeted problems. This book you are about to read was editted by a true hacker, Joe Grand, and it speaks mostly to the class of hacks that address the need to adapt and improve on existing consumer solutions.

As you can see, my view of hacking is a rather romantic and idealized one. I eschew the Hollywood stereotype of a hacker as a slovenly, socially maladept person with a bent for vengeance, data theft, or per-

haps a penchant to blithely play a game of deploy-the-nuke inside NORAD's computers. Although there are certainly such elements in today's hacker culture, I prefer to focus on promoting the more socially redeeming aspects of hacking. I believe that hacking is rooted in a desire to play with and understand technology, a modern manifestation of the values of exploration, passion, and hard work that date back to the first explorers and settlers of this country. Furthermore, hacking is a kind of grass-roots technology movement, in contrast to the kinds of technology movements that are forwarded by corporations and governments. As a result, hackers tend to play the part of proxy for the masses when it comes to sorting out the interplay of technology, society, and business. As technology continues to infuse our daily lives, it is becoming more important for society to bring its representatives to the technology direction table.

It is interesting and perhaps informative to see how hardware hacking has evolved over the years. In the early days of electronics, common hobbyists—hackers of sorts, but the term wasn't coined back then—could cobble together unique, useful, and sometimes outright impressive pieces of hardware that could match commercially available products in both performance and quality. In fact, some of the projects that hackers labored over in their garages went on to form the roots of today's technology.

Roll the calendar back to 1938: A young Bill Hewlett and Dave Packard get together and invent, in their garage, a high-quality piece of audio test equipment, the HP200A resistance-capacitance audio oscillator. Hewlett and Packard continued on to found the company we know today, and its rich history of engineer-friendly products helped forge the technology base we now enjoy. Most people are familiar with HP as a manufacturer of computers and printers, but HP's richest contributions to technology have been through enabling technologies, such as the tools engineers require to do their jobs. I myself use an HP48GX calculator, and I have an HP1650B logic analyzer on my desk, on top of my old HP8410C network analyzer.

Another well-recognized example of a company and technology with roots in the hacker community is Apple Computer. Roll back to 1976: Steve Wozniak debuts the Apple I at the Homebrew Computer Club in Palo Alto, California. The Apple I was designed over a period of years as a hobby machine, a true product of the hacking culture. Wozniak joined

forces with Steve Jobs, and the two went on to found the Apple Computer that brought us the Apple II and the now ubiquitous Macintosh computer.

The gritty grass-roots hacking culture in the early days of electronics technology served as a kind of incubator for innovation that has resulted in many of the products we enjoy today. Hewlett and Packard, Jobs and Wozniak are just two examples of the influence of the hacker spirit on our society. The basic values of hacking—creating a good thing that is exactly what is needed at a particular time—are a good match with innovation. Furthermore, hackers' independently motivated nature means that thousands of ideas are tested and built by hackers in the absence of venture capital or the risk constraints of investors. Hackers play an important part in the growth of technology, so I am always pleased to see a greater interest and awareness of hacking in the general public.

Recently, hacking has taken on more of a software-oriented bent. This is due in part to the steady pace of hardware improvement guaranteed by Moore's Law. Hardware hacking is a time-consuming labor of love, and it is discouraging to know that almost any hack you can think of to double a computer's performance will be obsolete within 12 months. It is much more rewarding to work in the instant-gratification world of software and let the performance of your programs ride the Moore's Law wave.

Another factor working against hardware hackers is the barrier of entry that was created by the higher levels of integration that naturally followed as a result of Moore's Law. The hackability of the desktop PC met a turning point in the evolution of the IBM PC-XT to the IBM PC-AT. The IBM PC-XT motherboard was chiefly composed of chips that were essentially naked logic gates. This was very hacker-friendly, since most of the core functionality was exposed at a human-friendly scale. The IBM PC-AT, on the other hand, was one of the first desktop computers to use VLSI chips for the processor support logic. I remember my first look at the PC-AT motherboard: I was hoping to be able to read the board like a book, with all the logic gates' part numbers gleaming in their fresh white silkscreen against the matte epoxy bodies of chips. What I saw instead was a closed book; there were perhaps three or four curious, high pin-count chips with part numbers and a manufacturer's logo I had never seen before. These chips were proprietary, and any hope of a deeper level of understanding or hardware exploration seemed to be dashed.

I think perhaps a lot of prospective hardware hackers felt the same way around then, because since then hacking has taken on a distinct software-oriented slant. Some of the most famous hackers today are renowned for their software contributions. Richard Stallman and Linus Torvalds are perhaps household names among the technological elite due to their fantastic contributions to free software through GNU and Linux. The best part about software hacking is its very low barrier of entry. Any willing youth with access to a computer and an Internet connection can plug into any of the various free software efforts and make a contribution to the technology collective. All the tools required to generate high-quality code are virtually free, and aside from the time investment, it costs nothing to use them. On the other hand, hardware hacking has a very real entry cost associated with the activity; there is a bare minimum set of tools that are needed on a daily basis, and an unfortunately large and diverse assortment of expensive, specialized tools is required to accomplish specific jobs. Furthermore, producing a hardware hack typically requires real materials in addition to time and energy, thereby placing creative and/or bold (read: risky) hardware-hacking projects beyond the financial horizon of most young folk. Given that human nature is to follow the path of least resistance, it is no surprise that hacking today is primarily a software affair.

In a twist of fate, recent macro-economic and social trends have worked to reverse the trend and bring more people into hardware hacking. The detritus of the dot-com bubble created fertile soil for sprouting hardware hackers. An overall reduction in demand for components, design, and manufacturing services has resulted from the economic slowdown. High-quality, used test equipment is trickling down into the ranks of hackers, either snatched off the shelf of dead companies or snapped up for pennies on the dollar at auction. Scrap components are also finding their way into distribution, driving down component prices. Combined with an overall soft demand situation, individual hackers are able to command the same level of service and component choice as large corporations. Furthermore, fabrication and assembly services have been forced to drive their prices down, to the point where hardware hackers could purchase high-tech, custom-built multilayer boards for under $50 per board.

Hardware design tool vendors also experienced a corresponding price adjustment due to the economic slowdown. Perhaps the most significant recent technological change for hardware hackers is the introduction of pro-