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IBM® PC Advanced Troubleshooting & Repair

Robert C. Brenner



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WARNING: Opening or otherwise modifying the IBM PC may void any manufacturer's warranty on the product.

WARNING: Dangerous voltages and currents are found in the IBM PC power supply. Only trained technicians should troubleshoot in or around power supplies.

WARNING: Dangerous voltages and currents are found in the display monitor used with the IBM PC. Only trained technicians should troubleshoot in or around video display terminals.

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*This book is dedicated to my seventh-grade teacher, Lillian Siefert,
for the encouragement and support that motivated me to seek a writing career.
Her smiles from heaven continue to inspire me through long,
arduous hours of technical research and writing.*

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Introduction

Why a book on a machine that was originally introduced in 1981?

When IBM unveiled the IBM Personal Computer (PC) during the summer of 1981, it was a dream come true for many aspiring microcomputer manufacturers. The decision by “Big Blue” to enter the microcomputer market made these machines credible and acceptable by businesses everywhere. The legitimizing of microcomputers in the office environment by the introduction of the IBM PC produced an impact on business that has been felt around the globe. Almost overnight, Fortune 500 companies sat up and took a serious look at uses of the microcomputer in their environment. And applications were discovered that seemed impossible (at least for a desktop computer).

Suddenly the “in thing” was to own a PC. Sales of IBM PCs skyrocketed. So did sales of non-IBM microcomputers. And the personal computer revolution was on.

IBM’s professional approach to design, manufacturing, marketing, sales, and support ensured that the PC would have a long and useful life. Six years after the first PC was sold, over 3 million PCs are still in use.

Documentation is an important area of support for the success of any new product, and over a dozen books have been published on the IBM PC. Most books cover the use of the machine from a software operation perspective. To meet the needs of understanding the hardware of the PC, IBM developed the *Technical Reference* manual and the *Hardware Maintenance and Service* manual.

While these were (and still are) useful reference documents, more information was requested by the consumer. Howard W. Sams & Company published the *IBM PC Troubleshooting & Repair Guide* in early

1986. This book was closely followed by the IBM Model 5150 **COMPUTERFACTS™**. The former book served as the bridge between the owner's manual that came with the machine and the service center schematics found in the **COMPUTERFACTS**. Yet, this still did not completely answer the needs of the user. What was needed was an intermediate to advanced book that described the detail found in the IBM PC **COMPUTERFACTS** for computer service technicians, service center technicians, advanced hobbyists, and educational institutions.

Meanwhile, schools and universities teaching microcomputer repair needed a text that would guide the student through troubleshooting and repair based on a well-known and widely accepted machine—the IBM PC.

This book was developed to meet these needs. It is intended to complement both the Sams **COMPUTERFACT** and the *IBM PC Troubleshooting & Repair Guide*. This advanced technical book complements the **COMPUTERFACT** service data with descriptive text and expanded troubleshooting and repair circuit explanations. It is written to complete the documentation requirements of the using public and all the service centers and repair shops that troubleshoot and repair this marvelous machine. It can be used as a text for a course in microcomputer troubleshooting and repair. Its intent is to make better repair technicians out of us all.

Three types of service center technicians can be found in the industry today:

- Mechanics
- Bulldozers
- Professionals

The “mechanic” examines the circuit boards looking for a visual cause for the problem. This person performs only the preliminary steps in troubleshooting and then seeks a simple way to fix the failure. This is the type of individual who will bang the side of a chassis to see if this corrects the problem, or who does a 3-foot drop to see if that will produce a failure. It often does, although it typically causes a new failure without changing the original problem. This is the same person who persistently sprays the circuit board components with cool spray, then applies the heat gun which heats chips until the failure changes or goes away. This person is totally unaware that the operating life of most of the components that have been frozen and then overheated has been significantly reduced.

The “bulldozer” observes the symptoms, isolates the problem to a failing subsystem, and then replaces every related part in that subsystem. This is certainly not a professional approach to troubleshooting and repair.

The “professional” follows a careful, methodical process to identify and isolate a problem. Much like a detective, this person reads all the available technical documentation, has the necessary information in view, and uses all the right equipment and tools to recognize the clues and follow the indications that lead to a failure that can be “surgically” corrected.

This book was written to help you become known by your actions—to help you become a professional technician.

The book begins with a systems overview of the IBM PC. Each major part of the machine is described in general terms.

Chapter 2 is a detailed description of the operation of the PC system. Many schematic subsets of the IBM PC COMPUTERFACTS are included to give you an in-depth understanding of the signals and circuitry associated with each major signal, address, clock, and data. The book is intended to supplement the Sams COMPUTERFACTS so you will get both the broad macro view and close-up microscopic view of the circuitry.

In Chapter 3, you are guided through the techniques and tricks used by service technicians to troubleshoot and repair this machine. This includes cold troubleshooting, when the technician has no idea of the problem, which instructs you in ways to isolate the problem to a specific area. Use of the tools of the trade is also covered in this chapter.

Preliminary service checks are addressed in Chapter 4. It's here that the troubleshooter confirms that the problem is not operator error or a software malfunction and isolates a symptom to a particular area of circuitry.

Once the area of the problem has been isolated, Chapter 5 guides the technician through the detailed circuit troubleshooting analysis that leads to identification of the failed part. This chapter covers problems in the power supply, the system board, the monochrome monitor/printer adapter board, the color graphics monitor adapter board, the keyboard, and the disk drives and disk drive adapter board.

Comprehensive appendices cover disassembly and reassembly, adjustments to the system and power boards, notes regarding the schematics, switch and jumper settings, and a list of the safety precautions and warnings found in the text.

Troubleshooting can be very frustrating if you are left to struggle through the process by yourself without a good guide. This book provides the techniques for quick and easy troubleshooting and repair. It is the first in a series of advanced troubleshooting and repair manuals that Howard W. Sams & Company is producing. Its existence makes all our jobs easier and much, much clearer.

