

# Contents

<b>INTRODUCTION</b>	13
Why an IBM Repair Guide?	13
How To Use This Guide.	14
<b>CHAPTER 1 — THE IBM PC DESCRIBED</b>	17
The Structure of the PC System	18
Inside the System Unit	19
Video and Sound	22
Mass Storage	22
System Configuration	23
<b>CHAPTER 2 — IBM PC OPERATIONS</b>	25
The Basic Parts of the IBM PC	25
Chip Location Scheme	27
Central Processing Unit	27
Memory Design	32
The IBM PC Bus Structure	36
Input and Output	39
The Power Supply	52
How the System Works	54
Software Structure	55
Summary	56

<b>CHAPTER 3—BASIC TROUBLESHOOTING</b>	57
Introduction to Troubleshooting	57
Component Recognition	58
Component Failures	63
How Disk Drives Fail	63
How Displays Fail	64
Repair-Generated Failures	64
How To Localize Failures and Make Repairs	65
If You Must Use a Service Center	72
Safety Precautions During Troubleshooting and Repair	72
Summary	73
 <b>CHAPTER 4—SPECIFIC TROUBLESHOOTING &amp; REPAIR FOR THE IBM PC</b>	75
Troubleshooting Index	76
Start-up Problems	76
Run Problems	81
Display Problems	95
Monochrome Monitor and Adapter Card	95
Color/Graphics Monitor and Adapter Card	106
Keyboard Problems	121
Other I/O Problems	125
Summary	134
 <b>CHAPTER 5—ROUTINE PREVENTIVE MAINTENANCE</b>	135
Contributors to System Failure	136
Heat	136
Cold	127
Dust and Other Particles	137
Noise Interference	139
Power-Line Problems	145
Corrosion	148
Magnetism	149
Disk Maintenance	150
Disk Drive Maintenance	152
Using Heat To Spot Potential Troubles	158
Display Screens and Health Problems	159
Summary	160

## **CHAPTER 6—ADVANCED TROUBLESHOOTING**

<b>TECHNIQUES</b> .....	161
Tools of the Trade .....	161
Components and How They Fail .....	168
Using Tools To Find Failed Components .....	170
Other Troubleshooting Techniques .....	172
Soldering and Unsoldering .....	175
Circuit Board Repair .....	178
Recommended Troubleshooting and Repair Equipment ....	178
Spare Parts .....	178
Summary .....	179
 <b>APPENDIX</b> .....	181
IBM PC Data Sheet .....	181
IBM PC Chip Information Chart .....	182
IBM PC System Unit Disassembly Instructions .....	184
IBM PC System Unit Reassembly Instructions .....	185
Keyboard Disassembly and Reassembly Instructions .....	185
Disk Drive Disassembly and Reassembly Instructions .....	186
Replacing Surface-Mounted Components on the System Board .....	186
Useful Recordkeeping Forms .....	186
Routine Preventive Maintenance .....	188
Summary of Cautions and Notes .....	189
ASCII Code Chart .....	190
Hexadecimal-to-Decimal Conversion Chart .....	190
<b>GLOSSARY</b> .....	193
<b>BIBLIOGRAPHY</b> .....	197
<b>INDEX</b> .....	201



# Introduction

---

## WHY AN IBM REPAIR GUIDE?

This book is written and dedicated to all the others who have experienced long, anxious hours waiting for a computer or peripheral device to be fixed and then almost had a coronary when the repair bill was presented.

I am, like yourself, one of the 100 million computer users in this country. When I purchased my first real computer, I was so elated I hardly slept a wink the first night. It wasn't long before my machine was dancing and twirling (figuratively, of course) as it produced tons of code and useful hard-copy reports, articles, and analysis documents.

And then, one day, the dreaded event happened—the computer broke down. I could scarcely contain my frustration. The key, the doggone “A” key stopped working!

My machine was out of warranty. With tenderness, I lifted it and carried it down to my “friendly” computer store.

“My computer is sick.”

“Too bad. What seems to be the problem?”

“Key won’t work.”

“Oh? Well, we can take care of that for you.”

“Great! When can I get it back all better?”

“How about a week from Wednesday . . . late afternoon?”

My heart sank. A week from Wednesday? Eight days just to fix a sick “A” key? Reluctantly, I handed over my cherished computer to the service technician. Sadly, I turned and left.

The next eight days were rough—for me *and* my family. From the third day on, one of us called the store’s computer service center every day to determine the status of the repair and to try to get the work expedited.

On the appointed day my whole family escorted me to the store. I was like a kid at Christmas. There on the counter was my machine, all neat, clean looking, and fixed. I was back in computer heaven. My friend was coming home.

And then I got the bill. “Wait a minute! This bill says fifty-four dollars and twenty-three cents!”

“Yes, it does.”

“To fix one key?”

“Well, the key actually cost less than five dollars. The rest is labor.”

“But, but . . .” I was stuttering and stammering as I paid the bill, and they escorted me and my computer out to the car.

Although I was indeed happy to have my machine

back, I never forgot that day and that bill. I knew there had to be a less expensive way. Most computers don't often have major failures. Most problems come from the breakdown of simple chips (those little black plastic centipede-looking things) or other easy-to-spot components. And with a little training, just about anyone could make most repairs.

A plan began to develop. Why not repair my own equipment and keep the labor costs for myself? I began to read, study, research, and test various troubleshooting techniques, I spent the next year preparing myself.

And then it happened again. Right in the middle of typing out a college report using my word processor program, the machine suddenly stopped. It quit printing and refused to access the disk where the report was stored.

The report was due the next morning. Here was my first real opportunity to test my knowledge of repairing my computer. To my delight, I was able to troubleshoot and repair the computer in less than an hour. And most of that time was spent running down to the electronics parts store to buy a chip. The total cost for the repair—82 cents plus tax. Probable savings—forty-five dollars. I was convinced. We were all delighted. My research was paying off.

It wasn't long before our friends who also owned computers heard about my success and began calling on me to help fix their machines too. Another idea began to develop. Rather than spend my life running from one friend's repair to another friend's repair (you'll never know how many friends you have until you can fix a computer), I decided to write a book and let everyone save on their own repairs.

This is the result. In the two years it took to complete this guide, each step, each troubleshooting idea was tested and verified.

## HOW TO USE THIS GUIDE

This guide is structured to make it quick and easy for either the novice or the experienced technician to locate and correct most computer failures.

Chapter 1 describes just what constitutes an IBM PC system. The chapter begins with a definition and specification overview, followed by a discussion of system structure.

In Chapter 2, the operation of the IBM PC is explored from both internal and external perspectives.

This chapter describes what happens inside the machine and explains what events you should observe as the system powers up. Each of the major subsystems of an IBM PC is discussed, and numerous drawings are included to help you understand.

The third chapter introduces troubleshooting and repair. In easy-to-understand terms, it leads you step by step through the diagnostic techniques—called troubleshooting—for microcomputer hardware. Chapter 3 covers repair methods and numerous useful hints taught to the best service technicians.

Chapter 4 describes specific hardware malfunctions (failures) that can happen to the IBM PC. The main focus of the book, IBM-specific failure diagnosis and repair, begins in this chapter. The chapter starts with a trouble-symptom index table that guides you quickly to the page that treats a specific problem. Malfunctions are organized by computer subsystem. Each type of failure is analyzed to the chip level with ample drawings, including a picture layout of the board on which the failure is most probably located, with chips highlighted for easy identification.

A good repair guide should not just help locate and correct computer failures; it should also provide guidance in preventing further failures. Chapter 5 provides valuable periodic preventive maintenance suggestions to help maintain a healthy system. This chapter covers such subjects as maintenance of disks and disk drives, electrical and magnetic interference, and recommended cleaning techniques. The chapter also includes a list of preventive maintenance actions you can use to keep the system in peak operating condition and to extend its "on-line" life.

By the time you've mastered Chapters 1 through 5, you should be able to troubleshoot and repair 95 percent of all IBM PC computer failures. Chapter 6 was written for those who wish to go after the remaining 5 percent of malfunctions. This chapter describes the tools of the repair technician's trade—logic probes, logic pulsers, current tracers, oscilloscopes, logic analyzers, and signature analyzers. The chapter even provides guidance in developing some of your own diagnostic tools, both hardware and software.

The Appendix provides a wealth of backup information. It includes step-by-step disassembly and reassembly instructions, conversion tables, specification data sheets, and component-marking conventions. In the Appendix, you will also find forms useful for recording original system configuration, maintenance, and configuration changes, as well as a preventive-maintenance schedule.

A reference section, a glossary, and a thorough index complete the guide.

This book is a detailed troubleshooting and repair document. It is not a treatise on basic computer theory or a highly technical discussion of chip operation, registers, busses, and logic gates. It is an all "meat and potatoes" manual to enable the computer user to

repair his or her own machine in those 95 percent of circumstances where knowledge and a good reference are enough to find and repair a failure.

Using this guide, you should be able to isolate and correct most IBM failures. It has brought me much success in my own troubleshooting, and I trust it will do the same for you.

Robert Brenner

