

CONTENTS

Acknowledgments	xix
Introduction	xx

Part I

The Basics

▼ 1 The Personal Computer	3
A Brief Look at the Evolution of Computers	4
The Evolution of Personal Computers	9
The PC over the Years	10
Intel versus Apple	13
An Overview of Systems and Components	15
Input Devices	18
Output Devices	20
Inside the System Case	21
It All Works Together	21
In This Book	22

▼ 2	Basic PC Concepts and Terminology	25
	An Introduction to Digital Logic	26
	Digital versus Analog	26
	Computing in Binary Numbers	27
	The Hexadecimal Number System	30
	Working with Number Systems on the PC	31
	Electricity and the PC	32
	AC Power and DC Power	33
	External Power Issues	34
	Protecting Against ESD	34
	A Quick Overview of the Electronics of the PC	35
	Conductors, Insulators, and Semiconductors	36
	The Electronic Building Blocks of the PC	36

Part II

Internal Components

▼ 3	Microprocessors	39
	An Introduction to Digital Logic	40
	Two-State Logic	40
	Binary Data	41
	Storing Data in a Byte	42
	Converting Decimal to Binary	43
	Binary Logic Operations	44
	The Hexadecimal System	45
	Semiconductors	45
	Conductors and Insulators	46
	How an IC Is Made	46
	The Transistor	47
	Storing Electricity	48
	Integrated Circuit	48
	The Microprocessor	48
	CPU's Bus System	50
	Packaging	51
	Cooling the Processor	51
	Sockets and Slots	54
	The Evolution of the PC Microprocessor	57
	The Pentium	61
	Intel Pentium Pro	62
	The Pentium II	62
	Intel Pentium III	66
	Intel Pentium 4	68
▼ 4	Motherboards	71
	Motherboard Designs	72
	Motherboards	72
	Backplanes	72

Motherboard Form Factors	73
The IBM PC XT	74
The IBM PC AT	75
The Baby AT Form Factor	75
Micro-AT Form Factor	76
LPX and Mini-LPX Specifications	76
ATX Form Factor	76
Mini-ATX	79
NLX Form Factor	79
The Components of the Motherboard	80
Upgrading a Motherboard	82
▼ 5 Chipsets and Controllers	85
Introduction to Chipsets	86
Socket Type	87
North Bridge and South Bridge	87
Processor Generations	88
Controller Chips	88
Bus Architectures	89
Keyboard Controller	91
Super I/O Controller	91
Other Device Controllers	92
Chipsets	92
Chipset Functions	94
Intel Chipsets	96
Non-Intel Chipsets	101
New Developments	104
▼ 6 The BIOS and the Boot Process	107
An Introduction to the BIOS	109
The BIOS Utilities and Programs	109
BIOS Manufacturers	109
Bootting the Computer	109
System Boot Sequence	110
Cold Boots versus Warm Boots	112
The POST Process	112
BIOS Startup Screen	115
System Configuration Summary	116
ROMs, PROMs, and EPROMs: BIOS Chips	118
Read-Only Memory (ROM)	118
Programmable Read-Only Memory (PROM)	118
Erasable Programmable Read-Only Memory (EPROM)	118
Electrically Erasable Programmable Read-Only Memory (EEPROM)	119
Complementary Metal-Oxide Semiconductor (CMOS)	120
ROM BIOS	120
The BIOS Configuration	121
System Configuration Data	121

BIOS Updates and Flash BIOS	127
Flashing Dangers	127
Dealing with a Corrupt BIOS	127
Flashing Security	128
The Boot Block	128
▼ 7 Computer Memory	129
A Brief Overview of ROM	130
CMOS	132
RAM	132
Random Access	132
Volatile versus Nonvolatile	133
Bits, Bytes, and Words	133
Memory Speeds	133
RAM Types	136
Static RAM	137
DRAM	138
Matching Memory to the Motherboard	140
Parity Memory	144
DRAM Technologies	145
Video RAM	146
Parameter RAM	147
Logical Memory Configuration	147
Conventional Memory	147
The Upper Memory Area	148
Extended Memory and the High Memory Area	148
Dealing with Memory Errors	149
Common Memory Errors	149
Software Diagnostic Tools	150
Memory Testing Tools	150
Installing Memory Modules in a PC	151
Installing a SIMM in a PC	152
Installing a DIMM on a PC	154
Configuring the PC for Memory	155
Removing a Memory Module	155
▼ 8 Cache Memory	157
Cache on the PC	158
SRAM and Cache Memory	158
Caching in Operation	159
Internal, External, and Levels of Cache	160
Sizing Your Cache	161
Cache Memory Types	163
Caching Write Policies	164
Nonblocking Cache	164
Cache Mapping	165
Cache Mounts	165

Installing a Cache Module	166
General Tips for Working on a Motherboard	166
Installing a COAST Module	166
Installation Problems	167
Enabling the Internal Cache	167
Enabling the External Cache	167
▼ 9 Hard Disks and Floppy Disks	169
Hard Disk Drives	170
Hard Disk Construction	170
The Spindle Motor	173
Storage Media	174
Read/Write Heads	175
Head Actuators	179
Air Filters	181
Logic Boards	182
Connectors and Jumpers	182
Bezel	184
Interfaces	184
ST506/412 Interface	184
ESDI	184
IDE	185
SCSI Interface	185
FC-AL Interface	185
System Bus Interface	186
Transfer Protocols	186
Data Addressing	186
Data Organization	187
Disk Capacities	189
Hard Disk Performance	189
Performance Indicators	190
Interleaving	191
Formatting the Disk	191
Partitioning the Hard Disk	192
File Systems	193
Disk Space Requirements	193
Disk Compression	195
RAID	195
Floppy Disk Drives	196
Floppy Disk Construction	197
Formatting	200
▼ 10 CD-ROMs and DVDs	201
The Technology of the CD and CD-ROM	202
CD-ROM Formats	202
Compact Disc Media	207
CD-ROM Drive Operation	208

Audio Output and Controls	212
Single and Multiple Drives	214
Digital Versatile/Video Disc (DVD)	215
DVD Technology	215
Installing a DVD Drive in Your PC	217
▼ 11 Expansion Cards	219
Using Expansion Cards	221
Expansion Buses	222
Bus Mastering	226
Local Bus Architectures	226
Portable PC Interface	226
SCSI Interfaces	229
Serial and Parallel Ports	229
USB and IEEE 1394 Interfaces	229
Expansion Cards	230
Controller Cards	231
Input/Output (I/O) Cards	231
Interface Cards	231
Memory Cards	233
Memory Expansion Card (MEC)	233
PC Card Memory	234
Modem Cards	234
Sound Cards	235
Video Cards	237
Expansion Card Operation	239
Interrupt Requests (IRQs)	240
I/O Addresses	241
Direct Memory Access	241
Setting System Resources	243
Plug and Play	243
Working with Expansion Cards	243
Installing an Expansion Card	243
Troubleshooting Expansion Cards	244
Dealing with Choke Points	249
Resolving Resource Conflicts on Windows PCs	249
Resolving Resource Conflicts with Plug-and-Play Devices	250
▼ 12 Video Cards	253
How a Video Card Works	254
Transform and Lighting Phase	254
Setup Phase	255
Dividing Up the Work	255
2D and 3D Graphic Data	256
Converting Digital to Analog	256
Pathways and Converters	256
Video Card Standards	256
Connector	259

Video Card Components	259
Video Processor	260
Video Memory	260
Resolution	261
Color Depth	262
Aspect Ratio	264
How Much Video Memory Is Needed?	264
3D Video Memory	265
Video RAM Technologies	266
Bus Mastering	267
Video Chipsets	267
The Video BIOS	268
The RAMDAC	270
3D Graphics	270
3D Graphics Accelerators	270
Transform and Lighting	271
Setup	271
Rendering	272
Installing a Video Card	274
Troubleshooting the Video Card	275
Determining the Type of Video Card in a PC	276
Troubleshooting Video Problems	277
Nothing Is Displayed on the Monitor	277
The Display Is Scrambled	278
The Display Appears Fuzzy or Blurry	278
The Settings for the Video Card Are Not Listed in the Windows Display Settings	279
Higher Resolutions Cannot Be Selected	280
Upgrading the RAM on a Video Card	280
▼ 13 System Resources	281
Getting the CPU's Attention	282
Communicating to Devices	282
Taking Control	283
The PC's System Resources	283
Interrupt Request (IRQ)	283
Checking Out IRQ Settings	284
IRQ Connections	286
IRQ Assignments	287
Configuring IRQ Settings	288
Programmable Interrupt Controllers	296
I/O Addresses	298
Common I/O Address Assignments	298
I/O Addresses in Windows	300
Logical Devices	301
Memory Addresses	302
Direct Memory Access (DMA)	302
DMA Operation	303

DMA Channels	304
DMA Modes	304
DMA Parties	306
Resolving Resource Conflicts	307
Plug and Pray	308
One Step at a Time	308
Read the Fantastic Manual (RTFM)	308
Troubleshooting IRQs	308
Troubleshooting DMA Channels	309
Running Windows Troubleshooting	309
▼ 14 Power Supply and Electrical Issues	311
Understanding Electricity	312
Counting Electrons	312
Measuring Current	313
Switching AC to DC	315
Elementary Electronics	316
Digital Circuit	316
Semiconductors, Conductors, and Insulators	316
Electronic Building Blocks	316
Static Electricity and ESD	317
ESD	318
Dealing with Static Electricity	319
The Power Supply	319
Good Power Signal	320
Soft Switches	321
Voltages	322
Power Supply Form Factors	323
Operational Ratings	328
Electrical Power Issues	329
Protecting the Power Supply	330
Watts and Volt-amps Ratings	333

Part III

External Components

▼ 15 The System Case	339
The Case for the Case	341
Case Components	342
The Chassis	342
The Cover	344
The Front Panel	346
Front-Panel Switches	348
Drive Bays	350
System Case Styles	352
Tower versus Desktop	352
System Case Form Factors	357

System Case Features	358
I/O Templates	359
Power Supply	363
Auxiliary Fans	363
LEDs, the Speaker, and Some Connecting Wires	364
Cooling Vents	365
Mounting Hardware	365
▼ 16 Monitors and Displays	367
CRTs versus Flat-Panels	368
The PC Monitor	369
CRT Displays	370
Flat-Panel Displays	370
Flat-Screen versus Flat-Panel	370
Viewable Size	371
Dots and Pixels	372
Resolution	373
Aspect Ratio	374
Monitor Size and Resolution	374
Color Depth	375
Refresh Rate	376
Signals and Connectors	378
Monitor Controls	378
Video Display Standards	378
Video Cards	380
The Cathode Ray Tube (CRT)	380
Painting the Screen	380
Refreshing the Display	382
Masking the Display	383
Dot Pitch and Stripe Pitch	384
Scan Rates	386
Raster versus Vector Graphics	386
Analog versus Digital CRTs	389
Flat-Panel Displays	389
Liquid Crystal Display (LCD)	389
LCD Types	392
Viewing Angles	394
Integrated PC and Monitors	394
Pen-Based Systems	396
Monitor Power	396
Power Management	396
Degaussing	396
Screen Savers	397
Monitor Maintenance	397
Caring for the Monitor	398
Monitor Safety	399
Personal Safety	399
Environmental Issues	400

▼ 17	Printers	401
	Printer Types and Technologies	402
	The Evolution of the PC Printer	402
	A Quick Look at Printer Characteristics	407
	Dot Matrix Printers	411
	Printing on a Dot Matrix Printer	411
	Print Buffer	412
	Color Dot Matrix Printers	414
	Inkjet Printers	414
	Inkjet Technologies	415
	The Inkjet Printing Process	416
	Inkjet Ink	421
	Inkjet Cartridges	422
	Inkjet Paper	422
	Paper Flow	422
	Printer Drivers	423
	Laser Printers	423
	Laser Printer Technologies	424
	Inside the Laser Printer	428
	Color Laser Printers	430
	Toner	432
	LED Printers	433
	Thermal Printers	433
	Connecting the Printer to the PC	434
	Using a Switchbox	435
	Printer Standards	435
	Connecting to a Network	436
	Printer Safeguards	436
	Laser Printer Care	437
	Setting Up a Printer in Windows	438
▼ 18	Keyboards, Mice, and Pointing Devices	441
	Keyboards	442
	Keyboard Elements	443
	Keyboard Layouts and Styles	454
	Keyboard Technology	458
	Keyboard Controller	462
	Keyboard Cable	462
	Keyboard Connectors	463
	The Mouse	464
	Inside the Mouse	465
	Mouse Connectors	467
	Data Interface	468
	Wheel Mouse	469
	Optical Mouse	470
	Other Pointing Devices	471

▼ 19	Ports and Connectors	475
	Connectors on the Motherboard	476
	Back Panel Connectors	476
	Onboard Connectors	476
	Front Panel Connectors	479
	External Ports and Connectors	480
	Character Data	480
	Serial and Parallel Data	482
	Full, Half, and Single Modes	483
	Serial Ports and Connectors	483
	Pinouts and Cable Connections	484
	Asynchronous Communications	485
	Synchronous Communications	488
	RS-232 Communications	488
	Cabling the Connection	489
	Configuring a Serial Port	489
	Troubleshooting a Serial Port	490
	Parallel Ports	491
	Parallel Port Standards	491
	The USB Interface	493
	Connecting with USB	493
	How USB Works	496
	The FireWire Interface	496
	Defining the 1394 Bus	497
	Wireless Ports	498
	Infrared Ports	498
	Radio Frequency Interfaces	499
	PS/2 and DIN Connectors	499
	Video Interfaces	500
	Video Connectors	502
	SCSI Interface	504
	External SCSI Connectors	504
	SCSI Standards	505
	SCSI Voltage Differentials	506
	Configuring SCSI Devices	507
▼ 20	Networks and Communications	509
	Network Basics	510
	What Is a Network?	510
	Network Structures	511
	Network Components	513
	Servers	513
	Cabling	514
	Cable Types	514
	Cable Characteristics	516
	Ethernet Cable Designations	517
	Broadband versus Baseband	517

Twisted Pair Wire	518
Fiber Optic Cable	518
Backbones and Segments	520
FDDI	520
Segments	520
Networking Devices	521
Repeaters	521
Hubs	521
Bridges	522
Switches	522
Routers	523
Gateways	523
Network Interface Cards (NICs)	523
NIC Connectors	524
Network Topologies	524
Network Addressing	526
MAC Addresses	526
IP Addresses	527
Network Names	528
Configuring a PC for Network Connection	529
Dialing Up a Network	529
Modem Types	529
Internal versus External Modems	530
AT Commands	530
Dial-up Connections	531
Troubleshooting Modem Connections	531
Digital Subscriber Lines (DSL)	532
DSL Modems, Bridges, and Routers	533
Cable Modems	533
ISDN Terminal Adapters	534
Wireless Networking	534
Access Points and Network Adapters	534
Bluetooth	535
▼ 21 Audio/Visual Devices	539
Sound on the PC	540
Sound Card	540
Amplifier	543
Speakers	543
Software	544
Sound Capture and Playback	545
Capture	545
Digital Audio Extraction	548
Playback	548
Sound File Formats	548
Streaming Audio	553
CD-ROM and DVD Interfaces	554