

Contents

Preface vii

1 Introduction 1

- 1-1 Overview of Microcomputer Systems 2
 - 1-1-1 *Hardware* 2
 - 1-1-2 *Software* 4
- 1-2 Data Representation 6
 - 1-2-1 *Binary Format* 6
 - 1-2-2 *BCD Format* 11
 - 1-2-3 *Alphanumeric Codes* 11
- 1-3 Addresses 14
- 1-4 General Operation of a Computer 16
- 1-5 Microprocessors in Digital System Design 20

2

8086 Architecture 25

- 2-1 CPU Architecture 26
- 2-2 Internal Operation 33
- 2-3 Machine Language Instructions 35
 - 2-3-1 *Addressing Modes* 35
 - 2-3-2 *Instruction Formats* 39
- 2-4 Instruction Execution Timing 47
- 2-5 The 8088 50

3	Assembler Language Programming 53
	3-1 Assembler Instruction Format 55
	3-2 Data Transfer Instructions 59
	3-3 Arithmetic Instructions 63
	3-3-1 Binary Arithmetic 65
	3-3-2 Packed BCD Arithmetic 73
	3-3-3 Unpacked BCD Arithmetic 75
	3-4 Branch Instructions 78
	3-4-1 Conditional Branch Instructions 79
	3-4-2 Unconditional Branch Instructions 82
	3-5 Loop Instructions 86
	3-6 NOP and HLT Instructions 90
	3-7 Flag Manipulation Instructions 92
	3-8 Logical Instructions 93
	3-9 Shift and Rotate Instructions 97
	3-10 Directives and Operators 100
	3-10-1 Data Definition and Storage Allocation 101
	3-10-2 Structures 107
	3-10-3 Records 111
	3-10-4 Assigning Names to Expressions 112
	3-10-5 Segment Definition 113
	3-10-6 Program Termination 116
	3-10-7 Alignment Directives 117
	3-10-8 Value-Returning Attribute Operators 118
	3-11 Assembly Process 120
	3-12 Translation of Assembler Instructions 128
4	Modular Programming 141
	4-1 Linking and Relocation 143
	4-1-1 Segment Combination 145
	4-1-2 Access to External Identifiers 147
	4-2 Stacks 151
	4-3 Procedures 155
	4-3-1 Calls, Returns, and Procedure Definitions 157
	4-3-2 Saving and Restoring Registers 161
	4-3-3 Procedure Communication 162
	4-3-4 Recursive Procedures 165
	4-4 Interrupts and Interrupt Routines 169
	4-5 Macros 174
	4-5-1 ASM-86 Macro Facilities 174
	4-5-2 Local Labels 176
	4-5-3 Nested Macros 177
	4-5-4 Controlled Expansion and Other Functions 179
	4-6 Program Design 183
	4-7 Program Design Example 191
5	Byte and String Manipulation 207
	5-1 String Instructions 208
	5-2 REP Prefix 212

5-3	Text Editor Example 215
5-4	Table Translation 220
5-5	Number Format Conversions 223

6 I/O Programming 229

6-1	Fundamental I/O Considerations 231
6-2	Programmed I/O 236
6-3	Interrupt I/O 240
6-4	Block Transfers and DMA 251
6-5	I/O Design Example 258

7 Introduction to Multiprogramming 272

7-1	Process Management and iRMX 86 274
7-2	Semaphore Operations 282
7-3	Common Procedure Sharing 287
7-4	Memory Management 291
7-5	Virtual Memory and the 80286 297

8 System Bus Structure 308

8-1	Basic 8086/8088 Configurations 310
8-1-1	Minimum Mode 314
8-1-2	Maximum Mode 319
8-2	System Bus Timing 324
8-3	Interrupt Priority Management 329
8-3-1	Interrupt System Based on a Single 8259A 329
8-3-2	Interrupt System Based on Multiple 8259As 337
8-4	Bus Standards 339

9 I/O Interfaces 346

9-1	Serial Communication Interfaces 349
9-1-1	Asynchronous Communication 352
9-1-2	Synchronous Communication 354
9-1-3	Physical Communication Standards 354
9-1-4	8251A Programmable Communication Interface 361
9-2	Parallel Communication 369
9-2-1	8255A Programmable Peripheral Interface 371
9-2-2	A/D and D/A Example 374
9-3	Programmable Timers and Event Counters 378
9-3-1	Intel's 8254 Programmable Interval Timer 380
9-3-2	Interval Timer Application to A/D 383
9-4	Keyboard and Display 383
9-4-1	Keyboard Design 385
9-4-2	Display Design 385
9-4-3	Keyboard/Display Controller 387
9-5	DMA Controllers 395
9-6	Diskette Controllers 402
9-7	Maximum Mode and 16-Bit Bus Interface Designs 413

10	Semiconductor Memory 423
10-1	General Memory Organization 424
10-2	Static RAM Devices 427
10-3	Dynamic RAM Devices 434
10-4	Backup Power for Semiconductor Memories 442
10-5	ROM Devices 444
11	Multiprocessor Configurations 450
11-1	Queue Status and the LOCK Facility 453
11-2	8086/8088-Based Multiprocessing Systems 456
11-2-1	<i>Coprocessor Configurations</i> 456
11-2-2	<i>Closely Coupled Configurations</i> 460
11-2-3	<i>Loosely Coupled Configurations</i> 463
11-2-4	<i>Microcomputer Networks</i> 477
11-3	The 8087 Numeric Data Processor 477
11-3-1	<i>NDP's Data Types</i> 478
11-3-2	<i>Processor Architecture</i> 482
11-3-3	<i>Instruction Set</i> 485
11-3-4	<i>An Example</i> 493
11-4	The 8089 I/O Processor 496
11-4-1	<i>IOP Architecture</i> 499
11-4-2	<i>Communication between CPU and IOP</i> 502
11-4-3	<i>Instruction Set</i> 510
11-4-4	<i>Examples</i> 515
12	VLSI Processing and Supporting Devices 519
12-1	The 80130 520
12-2	The 80186 524
12-2-1	<i>Instruction Set</i> 525
12-2-2	<i>Internal Architecture</i> 531
12-2-3	<i>Bus Structure</i> 544
13	The 80286/80287 551
13-1	Single-level Tasks 555
13-2	Multilevel Tasks 564
13-3	Multiple Tasks 572
13-4	Interrupt System 583
13-5	System and Task Initialization 590
13-6	Interfacing to the 80286 595
13-7	The 80287 602
	Appendix: 8086/8088 Instruction Set Summary 605
	Index 613