Eleventh Edition | Global Edition

Digital Fundamentals

Thomas L. Floyd

PEARSON

Boston Columbus Indianapolis New York San Francisco Hoboken
Amsterdam Cape Town Dubai London Madrid Milan Munich Paris Montreal Toronto
Delhi Mexico City São Paulo Sydney Hong Kong Seoul Singapore Taipei Tokyo

CONTENTS

CHAPTER 1 Introductory Concepts 15

1-1 Digital and Analog Quantities 16
1-2 Binary Digits, Logic Levels, and Digital Waveforms 19
1-3 Basic Logic Functions 25
1-4 Combinational and Sequential Logic Functions 27
1-5 Introduction to Programmable Logic 34
1-6 Fixed-Function Logic Devices 40
1-7 Test and Measurement Instruments 43
1-8 Introduction to Troubleshooting 54

CHAPTER 2 Number Systems, Operations, and Codes 65

2-1 Decimal Numbers 66
2-2 Binary Numbers 67
2-3 Decimal-to-Binary Conversion 71
2-4 Binary Arithmetic 74
2-5 Complements of Binary Numbers 77
2-6 Signed Numbers 79
2-7 Arithmetic Operations with Signed Numbers 85
2-8 Hexadecimal Numbers 92
2-9 Octal Numbers 98
2-10 Binary Coded Decimal (BCD) 100
2-11 Digital Codes 104
2-12 Error Codes 109

CHAPTER 3 Logic Gates 125

3-1 The Inverter 126
3-2 The AND Gate 129
3-3 The OR Gate 136
3-4 The NAND Gate 140
3-5 The NOR Gate 145
3-6 The Exclusive-OR and Exclusive-NOR Gates 149
3-7 Programmable Logic 153
3-8 Fixed-Function Logic Gates 160
3-9 Troubleshooting 170

CHAPTER 4 Boolean Algebra and Logic Simplification 191

4-1 Boolean Operations and Expressions 192
4-2 Laws and Rules of Boolean Algebra 193
4-3 DeMorgan's Theorems 199

4-4 Boolean Analysis of Logic Circuits 203
4-5 Logic Simplification Using Boolean Algebra 205
4-6 Standard Forms of Boolean Expressions 209
4-7 Boolean Expressions and Truth Tables 216
4-8 The Karnaugh Map 219
4-9 Karnaugh Map SOP Minimization 222
4-10 Karnaugh Map POS Minimization 233
4-11 The Quine-McCluskey Method 237
4-12 Boolean Expressions with VHDL 240
Applied Logic 244

CHAPTER 5 Combinational Logic Analysis 261
5-1 Basic Combinational Logic Circuits 262
5-2 Implementing Combinational Logic 267
5-3 The Universal Property of NAND and NOR gates 272
5-4 Combinational Logic Using NAND and NOR Gates 274
5-5 Pulse Waveform Operation 279
5-6 Combinational Logic with VHDL 283
5-7 Troubleshooting 288
Applied Logic 294

CHAPTER 6 Functions of Combinational Logic 313
6-1 Half and Full Adders 314
6-2 Parallel Binary Adders 317
6-3 Ripple Carry and Look-Ahead Carry Adders 324
6-4 Comparators 327
6-5 Decoders 331
6-6 Encoders 341
6-7 Code Converters 345
6-8 Multiplexers (Data Selectors) 347
6-9 Demultiplexers 356
6-10 Parity Generators/Checkers 358
6-11 Troubleshooting 362
Applied Logic 365

CHAPTER 7 Latches, Flip-Flops, and Timers 387
7-1 Latches 388
7-2 Flip-Flops 395
7-3 Flip-Flop Operating Characteristics 406
7-4 Flip-Flop Applications 409
7-5 One-Shots 414
7-6 The Astable Multivibrator 423
7-7 Troubleshooting 427
Applied Logic 429

CHAPTER 8 Shift Registers 449

8-1 Shift Register Operations 450
8-2 Types of Shift Register Data I/Os 451
8-3 Bidirectional Shift Registers 462
8-4 Shift Register Counters 465
8-5 Shift Register Applications 469
8-6 Logic Symbols with Dependency Notation 476
8-7 Troubleshooting 478
Applied Logic 480

CHAPTER 9 Counters 497

9-1 Finite State Machines 498
9-2 Asynchronous Counters 500
9-3 Synchronous Counters 507
9-4 Up/Down Synchronous Counters 515
9-5 Design of Synchronous Counters 519
9-6 Cascaded Counters 527
9-7 Counter Decoding 531
9-8 Counter Applications 534
9-9 Logic Symbols with Dependency Notation 539
9-10 Troubleshooting 541
Applied Logic 545

CHAPTER 10 Programmable Logic 561

10-1 Simple Programmable Logic Devices (SPLDs) 562
10-2 Complex Programmable Logic Devices (CPLDs) 567
10-3 Macrocell Modes 574
10-4 Field-Programmable Gate Arrays (FPGAs) 577
10-5 Programmable Logic software 585
10-6 Boundary Scan Logic 595
10-7 Troubleshooting 602
Applied Logic 608

CHAPTER 11 Data Storage 627

11-1 Semiconductor Memory Basics 628
11-2 The Random-Access Memory (RAM) 633
11-3 The Read-Only Memory (ROM) 646
11-4 Programmable ROMs 652
11-5 The Flash Memory 655
11-6 Memory Expansion 660
11-7 Special Types of Memories 666
11-8 Magnetic and Optical Storage 670
11-9 Memory Hierarchy 676
11-10 Cloud Storage 680
11-11 Troubleshooting 683

CHAPTER 12 Signal Conversion and Processing 697
12-1 Analog-to-Digital Conversion 698
12-2 Methods of Analog-to-Digital Conversion 704
12-3 Methods of Digital-to-Analog Conversion 715
12-4 Digital Signal Processing 723
12-5 The Digital Signal Processor (DSP) 724

CHAPTER 13 Data Transmission 739
13-1 Data Transmission Media 740
13-2 Methods and Modes of Data Transmission 745
13-3 Modulation of Analog Signals with Digital Data 750
13-4 Modulation of Digital Signals with Analog Data 753
13-5 Multiplexing and Demultiplexing 759
13-6 Bus Basics 764
13-7 Parallel Buses 769
13-8 The Universal Serial Bus (USB) 775
13-9 Other Serial Buses 778
13-10 Bus Interfacing 784

CHAPTER 14 Data Processing and Control 801
14-1 The Computer System 802
14-2 Practical Computer System Considerations 806
14-3 The Processor: Basic Operation 812
14-4 The Processor: Addressing Modes 817
14-5 The Processor: Special Operations 823
14-6 Operating Systems and Hardware 828
14-7 Programming 831
14-8 Microcontrollers and Embedded Systems 838
14-9 System on Chip (SoC) 844

ON WEBSITE: http://www.pearsonglobaleditions.com/floyd
CHAPTER 15 Integrated Circuit Technologies 855
15-1 Basic Operational Characteristics and Parameters 856
15-2 CMOS Circuits 863
15-3 TTL (Bipolar) Circuits 868
15-4 Practical Considerations in the Use of TTL 873
15-5 Comparison of CMOS and TTL Performance 880
15-6 Emitter-Coupled Logic (ECL) Circuits 881
15-7 PMOS, NMOS, and E^2CMOS 883

ANSWERS TO ODD-NUMBERED PROBLEMS A-1
GLOSSARY A-31
INDEX A-42