

<b>1</b>	<b>Fundamental Solid-State Principles</b>	<b>1</b>
1.1	Atomic Theory	2
1.2	Doping	6
1.3	The <i>PN</i> Junction	9
1.4	Bias	12
	Chapter Summary/Key Terms	
<b>2</b>	<b>Diodes</b>	<b>19</b>
2.1	Introduction to the <i>PN</i> -Junction Diode	20
2.2	The Ideal Diode	22
2.3	The Practical Diode Model	25
2.4	Other Practical Considerations	29
2.5	The Complete Diode Model	34
2.6	Diode Specification Sheets	40
2.7	Zener Diodes	45
2.8	Zener Diode Specification Sheets	49
2.9	Light-Emitting Diodes (LEDs)	54
2.10	Diode Testing	56
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	
<b>3</b>	<b>Common Diode Applications: Basic Power Supply Circuits</b>	<b>73</b>
3.1	Transformers	75
3.2	Half-Wave Rectifiers	78
3.3	Full-Wave Rectifiers	87
3.4	Bridge Rectifiers	92
3.5	Working with Rectifiers	97
3.6	Filters	100
3.7	Zener Voltage Regulators	110
3.8	Putting It All Together	116
3.9	Power Supply Troubleshooting	118
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	

<b>4</b>	<b>Common Diode Applications: Clippers, Clampers, Voltage Multipliers, and Displays</b>	<b>135</b>
4.1	Clippers (Limiters) 136	
4.2	Clipper Applications 143	
4.3	Clampers (DC Restorers) 145	
4.4	Voltage Multipliers 150	
4.5	LED Applications 155	
4.6	Diode Circuit Troubleshooting 157	
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	
<b>5</b>	<b>Special Applications Diodes</b>	<b>173</b>
5.1	Varactor Diodes 174	
5.2	Transient Suppressors and Constant-Current Diodes 180	
5.3	Tunnel Diodes 188	
5.4	Other Diodes 191	
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/Pushing the Envelope/Answers to the Example Practice Problems	
<b>6</b>	<b>Bipolar Junction Transistors</b>	<b>201</b>
6.1	Introduction to Bipolar Junction Transistors (BJTs) 202	
6.2	Transistor Construction and Operation 205	
6.3	Transistor Current and Voltage Ratings 209	
6.4	Transistor Characteristic Curves 217	
6.5	Transistor Specification Sheets 221	
6.6	Transistor Testing 225	
6.7	Related Topics 226	
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	
<b>7</b>	<b>DC Biasing Circuits</b>	<b>239</b>
7.1	Introduction to DC Biasing: The DC Load Line 240	
7.2	Base Bias 245	
7.3	Voltage-Divider Bias 250	
7.4	Other Transistor Biasing Circuits 262	
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	
<b>8</b>	<b>Introduction to Amplifiers</b>	<b>283</b>
8.1	Amplifier Properties 284	
8.2	BJT Amplifier Configurations 293	
8.3	Amplifier Classifications 297	
8.4	Decibels 303	
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/Pushing the Envelope/Answers to the Example Practice Problems	
<b>9</b>	<b>Common-Emitter Amplifiers</b>	<b>317</b>
9.1	AC Concepts 318	
9.2	The Roles of Capacitors in Amplifiers 322	

9.3	The Common-Emitter AC Equivalent Circuit	327
9.4	Amplifier Gain	329
9.5	Gain and Impedance Calculations	334
9.6	Swamped Amplifiers	340
9.7	$h$ -Parameters	345
9.8	Amplifier Troubleshooting	351
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	
<b>10</b>	<b>Other BJT Amplifiers</b>	<b>365</b>
10.1	The Emitter Follower (Common-Collector Amplifier)	366
10.2	Emitter Follower AC Analysis	370
10.3	Emitter Followers: Practical Considerations, Applications, and Troubleshooting	375
10.4	The Darlington Emitter-Follower	381
10.5	The Common-Base Amplifier	386
10.6	Common-Base Applications and Troubleshooting	389
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	
<b>11</b>	<b>Power Amplifiers</b>	<b>403</b>
11.1	The AC Load Line	404
11.2	RC-Coupled Class A Amplifiers	410
11.3	Transformer-Coupled Class A Amplifiers	414
11.4	Class B Amplifiers	421
11.5	Class AB Amplifiers (Diode Bias)	433
11.6	Class AB Amplifiers: Troubleshooting and Circuit Configuration	440
11.7	Related Topics	446
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	
<b>12</b>	<b>Field-Effect Transistors</b>	<b>459</b>
12.1	Introduction to JFETs	460
12.2	JFET Biasing Circuits	470
12.3	AC Operating Characteristics: The Common-Source Amplifier	482
12.4	AC Operating Characteristics: Common-Drain and Common-Gate Amplifiers	493
12.5	Troubleshooting JFET Circuits	500
12.6	JFET Specification Sheets and Applications	503
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Answers to the Example Practice Problems	
<b>13</b>	<b>MOSFETs</b>	<b>519</b>
13.1	MOSFET Construction and Handling	520
13.2	D-MOSFETs	522
13.3	E-MOSFETs	527
13.4	Dual-Gate MOSFETs	532
13.5	Power MOSFETs	534



<b>13.6</b>	Complementary MOSFETs (CMOS): A MOSFET Application	535
<b>13.7</b>	Other MOSFET Applications	538
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	
<b>14</b>	<b>Amplifier Frequency Response</b>	<b>549</b>
<b>14.1</b>	Basic Concepts	550
<b>14.2</b>	BJT Amplifier Frequency Response	558
<b>14.3</b>	FET Amplifier Frequency Response	576
<b>14.4</b>	Multistage Amplifiers	584
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	
<b>15</b>	<b>Operational Amplifiers</b>	<b>597</b>
<b>15.1</b>	Op-Amps: An Overview	598
<b>15.2</b>	Operation Overview	601
<b>15.3</b>	Differential Amplifiers and Op-Amp Specifications	609
<b>15.4</b>	Inverting Amplifiers	621
<b>15.5</b>	Noninverting Amplifiers	625
<b>15.6</b>	Troubleshooting Basic Op-Amp Circuits	630
<b>15.7</b>	Op-Amp Frequency Response	632
<b>15.8</b>	Negative Feedback	636
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	
<b>16</b>	<b>Additional Op-Amp Applications</b>	<b>657</b>
<b>16.1</b>	Comparators	658
<b>16.2</b>	Integrators and Differentiators	665
<b>16.3</b>	Summing Amplifiers	672
<b>16.4</b>	Instrumentation Amplifiers	681
<b>16.5</b>	Other Op-Amp Circuits	682
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Answers to the Example Practice Problems	
<b>17</b>	<b>Tuned Amplifiers</b>	<b>693</b>
<b>17.1</b>	Tuned Amplifier Characteristics	694
<b>17.2</b>	Active Filters: An Overview	698
<b>17.3</b>	Low-Pass and High-Pass Filters	702
<b>17.4</b>	Band-Pass and Notch Filters	709
<b>17.5</b>	Active Filter Applications and Troubleshooting	722
<b>17.6</b>	Discrete Tuned Amplifiers	726
<b>17.7</b>	Discrete Tuned Amplifiers: Practical Considerations and Troubleshooting	733
<b>17.8</b>	Class C Amplifiers	735
	Chapter Summary/Equation Summary/Key Terms/Practice Problems/ Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer Applications Problems/Answers to the Example Practice Problems	

## **18 Oscillators** **751**

- 18.1** Introduction 752
- 18.2** Phase-Shift Oscillators 756
- 18.3** The Wien-Bridge Oscillator 758
- 18.4** The Colpitts Oscillator 762
- 18.5** Other *LC* Oscillators 766
- 18.6** Crystal-Controlled Oscillators 770
- 18.7** Oscillator Troubleshooting 773

Chapter Summary/Equation Summary/Key Terms/Practice Problems/  
Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer  
Applications Problems/Answers to the Example Practice Problems

## **19 Solid-State Switching Circuits** **783**

- 19.1** Introductory Concepts 784
- 19.2** Basic Switching Circuits: Practical Considerations 792
- 19.3** Schmitt Triggers 804
- 19.4** Multivibrators: The 555 Timer 812

Chapter Summary/Equation Summary/Key Terms/Practice Problems/  
Troubleshooting Practice Problems/Pushing the Envelope/Suggested Computer  
Applications Problems/Answer to the Example Practice Problems

## **20 Thyristors and Optoelectronic Devices** **839**

- 20.1** Introduction to Thyristors: The Silicon Unilateral Switch (SUS) 840
- 20.2** Silicon-Controlled Rectifiers (SCRs) 845
- 20.3** Diacs and Triacs 856
- 20.4** Unijunction Transistors (UJT) 865
- 20.5** Discrete Photodetectors 871
- 20.6** Optoisolators and Optointerrupters 878

Chapter Summary/Equation Summary/Key Terms/Practice Problems/Pushing  
the Envelope/Suggested Computer Applications Problems/Answers to the  
Example Practice Problems

## **21 Discrete and Integrated Voltage Regulators** **889**

- 21.1** Voltage Regulation: An Overview 890
- 21.2** Series Voltage Regulators 895
- 21.3** Shunt Voltage Regulators 899
- 21.4** Linear IC Voltage Regulators 901
- 21.5** Switching Regulators 907

Chapter Summary/Equation Summary/Key Terms/Practice Problems/  
Troubleshooting Practice Problems/Suggested Computer Applications Problems/  
Answers to the Example Practice Problems

## **Appendices**

- A** Additional Specification Sheets and Resistor Tables 922
- B** Approximating Circuit Values 929
- C** *h*-Parameter Equations and Derivations 932
- D** Selected Equation Derivations 943
- E** Glossary 961
- F** Transistor Amplifier Design 972
- G** Answers to Selected Odd-Numbered Problems 977

## **Index** 979