contents

Preface vii

1 the ideal diode 1

1-1 The ideal diode 1

2 the solid-state junction diode 7

2-1 The junction diode 7
2-2 Intrinsic conduction 7
2-3 Doped semiconductors 8
2-4 The *PN* junction 10
2-5 Forward bias 12
2-6 Reverse bias 13
2-7 Barrier capacitance 14
2-8 Diffusion capacitance 15

3 diode equivalent circuits 27

3-1 Diode piecewise models 27

4 diode circuit analysis 35

4-1 Single-diode circuits 35
4-2 Assumed-state analysis 36
4-3 Breakpoint analysis 37

5 the junction transistor (transistor action) 53

5-1 The controlled current source 53
5-2 The junction transistor 54
5-3 Transistor current components 55

6 the common-base model 63

6-1 The common-base dc model 63
6-2 The common-base piecewise model 64

7 the common-emitter model 77

7-1 The common-emitter model 77
7-1 Piecewise development 78

8 biasing and stabilization 89

8-1 Constant base-current bias 89

8-2 Constant emitter-current bias 90
8-3 Combination bias 91
8-4 Constant collector-voltage biasing 92

9 transistor incremental models 109

9-1 The common-base T parameter model 110
9-2 The common-emitter T parameter model 110
9-3 The h parameters 111
9-4 The common-base h parameters 113
9-5 The common-emitter h parameters 113

10 transistor high-frequency models 121

10-1 The hybrid-π model 121
10-2 The Miller effect 122

11 basic transistor amplifiers 129

11-1 The common-base amplifier 130
11-2 The common-emitter amplifier 131
11-3 The emitter-follower amplifier 132
11-4 Summary of basic amplifier characteristics 134

12 the field-effect transistor (FET) 147

12-1 FET types 147
12-2 JFET operation 149
12-3 IGFET operation 153

13 FET models 161

13-1 FET large-signal models 161
13-2 FET small-signal models 166

FET biasing 179

14-1 JFET biasing 179
14-2 Fixed bias 180
14-3 Current-derived self-bias 181
14-4 Constant-current bias 184
14-5 Zero-temperature-coefficient biasing 185
14-6 Miscellaneous biasing methods 186
14-7 IGFET biasing 188
14-8 The Ohmic region (voltage-controlled resistor) 191

15 basic FET amplifiers 209

15-1 Incremental model review 209
15-2 The common-source amplifier 210

15-3 The common-drain amplifier (source follower) 212
15-4 The common-gate amplifier 213
15-5 High-frequency considerations 214

appendixes

A current notation 227

B voltage notation 229

index 231