

CONTENTS

<i>Preface</i>	vii
1. REVIEW OF AMPLIFIER CIRCUITS	1
1-1. Equivalent Circuit of a Vacuum Tube	1
1-2. Voltage Feedback in Amplifiers	4
1-3. Current Feedback in Amplifiers	5
1-4. Illustrations of Current and Voltage Feedback	6
1-5. Some Characteristics of Feedback Amplifiers	8
1-6. The Cathode Follower	11
1-7. Graphical Analysis of the Cathode Follower	13
1-8. Practical Cathode-follower Circuits	15
1-9. Characteristics and Applications of the Cathode Follower	17
1-10. Cathode-follower-type Circuits	17
1-11. The Operational Amplifier	22
1-12. The Principle of the Virtual Ground in Operational Amplifiers	24
1-13. Basic Uses of Operational Amplifiers	25
2. LINEAR WAVE SHAPING: RC, RL, AND RLC CIRCUITS	28
2-1. The High-pass RC Circuit	28
2-2. The High-pass RC Circuit as a Differentiator	36
2-3. Double Differentiation	39
2-4. The Low-pass RC Circuit	40
2-5. The Low-pass RC Circuit as an Integrator	46
2-6. RL Circuits	47
2-7. RLC Circuits	48
2-8. Ringing Circuit	52
3. LINEAR PULSE AMPLIFIERS	58
3-1. The RC Coupled Amplifier Stage	58
3-2. Steady-state Analysis of an Amplifier	59
3-3. Amplitude and Time-delay Response of an RC Coupled Amplifier Stage	60
3-4. Unit Step Response of an Amplifier	63
3-5. Transient Response of an RC Coupled Amplifier Stage	65
3-6. Shunt Compensation to Improve Rise-time Response	67
3-7. Additional Methods of Rise-time Compensation	72
3-8. Rise-time Response of Cascaded RC Coupled Amplifiers	74
3-9. Rise-time Response of Cascaded Amplifiers with Overshoot	76
3-10. Attenuators	77
3-11. Rise-time Compensation in the Cathode Circuit	81
3-12. The Cathode Follower at High Frequencies	85

3-13. Low-frequency Compensation	89
3-14. Effect of a Cathode Bypass Capacitor on Low-frequency Response	93
3-15. Effect of Screen Bypass on Low-frequency Response	95
3-16. Flat-top Response of Cascaded Stages	96
3-17. The Totem-pole Amplifier	99
3-18. Cathode Interface Resistance	101
4. NONLINEAR WAVE SHAPING	104
4-1. Diode Characteristics	104
4-2. Triode Characteristics	106
4-3. Clipping or Limiting Circuits	111
4-4. Compensation for Cathode-temperature Changes in Selectors	117
4-5. Clamping Circuits	119
4-6. Synchronized Clamping	126
4-7. Tubes Used as Switches	129
4-8. An Overdriven Two-stage <i>RC</i> -coupled Amplifier	135
4-9. Cathode Follower with Capacitive Load	138
5. THE BISTABLE MULTIVIBRATOR	140
5-1. The Stable States of a Binary	140
5-2. The Self-biased Binary	144
5-3. Commutating Capacitors	146
5-4. Regeneration in a Binary	147
5-5. Resolving Time in a Binary	150
5-6. Methods of Improving Resolution	152
5-7. Triggering of the Binary	156
5-8. Unsymmetrical Triggering through a Triggering Tube	159
5-9. Symmetrical Triggering	161
5-10. The Cathode-coupled Binary	164
5-11. Hysteresis in the Cathode-coupled Binary	168
5-12. Cathode Interface Resistance in the Binary	172
6. MONOSTABLE AND ASTABLE MULTIVIBRATORS	174
6-1. The Plate-coupled Monostable Multi—The Stable State	174
6-2. The Quasi-stable State	175
6-3. Waveforms of Plate-coupled Multi	178
6-4. The Influence of Tube Current I_1 on Waveforms	183
6-5. Recovery Time in a Monostable Multi	184
6-6. The Cathode-coupled Monostable Multi Waveforms	187
6-7. Overshoots in Cathode-coupled Multi	190
6-8. Linearity of Delay of Cathode-coupled Multi	193
6-9. The Influence of E on Waveforms	195
6-10. Triggering of the Monostable Multi	195
6-11. The Monostable Circuit Adjusted for Free-running Operation	197
6-12. The Astable Plate-coupled Multi	199
7. VOLTAGE TIME-BASE GENERATORS	202
7-1. General Features of a Time-base Signal	202
7-2. The Thyatron Sweep Circuits	204
7-3. Vacuum-tube Sweep Circuit	208
7-4. Circuits to Improve Sweep Linearity	213
7-5. The Miller Sweep	217

7-6. Pentode Miller Sweep with Suppressor Gating	219
7-7. Phantastron Circuits	221
7-8. The Bootstrap Sweep	228
7-9. Additional Methods of Linearity Improvement	232
8. CURRENT TIME-BASE GENERATORS	236
8-1. The Generator Waveform	236
8-2. Effect of the Omission of the Impulsive Component of Current	238
8-3. Current Drivers	240
8-4. Methods of Linearity Improvement	244
8-5. Illustrative Current-sweep Circuits	247
8-6. Television Sweep Circuit	248
9. PULSE TRANSFORMERS AND BLOCKING OSCILLATORS	253
9-1. Equivalent Circuit	253
9-2. Transformer Inductance Parameters	256
9-3. Transformer Capacitances	259
9-4. Ferrite Cup-core Transformers	261
9-5. Rise-time Response of a Transformer	263
9-6. The Flat Top of the Pulse	265
9-7. Decay-time Response of a Transformer	267
9-8. Pulse-transformer Design Considerations	271
9-9. The Blocking Oscillator	272
9-10. The Blocking-oscillator Rise Time	275
9-11. The Blocking-oscillator Pulse Amplitude	276
9-12. The Blocking-oscillator Pulse Width	278
9-13. The Blocking-oscillator Backswing	280
9-14. The Blocking-oscillator Period	281
9-15. The Blocking-oscillator Output Impedance	282
9-16. The Blocking-oscillator Output Terminals	282
9-17. The Monostable Blocking Oscillator	283
9-18. Applications of Blocking Oscillators	284
10. ELECTROMAGNETIC DELAY LINES	286
10-1. Distributed-parameter Lines	286
10-2. Lumped-parameter Delay Lines	291
10-3. Reflections on Transmission Lines	299
10-4. Delay-line Control of a Blocking Oscillator	305
10-5. Pulse Coders	307
10-6. Pulse Decoders	309
10-7. Distributed Amplifiers	315
10-8. Distributed Amplifiers in Cascade	318
10-9. Practical Considerations in Distributed Amplifiers	319
11. COUNTING	323
11-1. The Binary Chain as a Divider	323
11-2. The Binary Chain as a Counter	325
11-3. Counting to a Base Other than 2	327
11-4. Improvement of Resolution in a Binary Chain with Feedback	329
11-5. Additional Types of Decade Counters	330
11-6. Reversible Binary Counter	335
11-7. A Special Gas-filled Counter Tube	335

11-8. A Vacuum-type Counter Tube	339
11-9. Ring Counters	343
11-10. Application of Counters	344
11-11. Storage Counters	346
11-12. Linearization of Storage Counters	350
11-13. Applications of Storage Counters	352
12. SYNCHRONIZATION AND FREQUENCY DIVISION	355
12-1. Pulse Synchronization of Relaxation Devices	355
12-2. Frequency Division in the Thyatron Sweep	358
12-3. Other Astable Relaxation Circuits	360
12-4. Monostable Relaxation Circuits as Dividers	363
12-5. Stability of Relaxation Dividers	364
12-6. Stabilization of Frequency Dividers by Resonant Circuits	368
12-7. Synchronization of a Thyatron Sweep with Sinusoidal Signals	372
12-8. Sine-wave Frequency Division with a Thyatron Sweep	377
12-9. Sine-wave Synchronization of Other Relaxation Devices	378
12-10. A Sinusoidal Divider Using Regeneration and Modulation	382
12-11. The Locked Oscillator as a Divider	384
12-12. Synchronization of a Sinusoidal Oscillator with Pulses	386
13. DIGITAL COMPUTER CIRCUITS	392
13-1. Some Features of a Digital Computer	392
13-2. The <i>OR</i> Circuit.	394
13-3. The <i>AND</i> Circuit	397
13-4. The <i>NOT</i> Circuit	400
13-5. The <i>INHIBITOR</i> Circuit.	401
13-6. An Example of a Switching Circuit	404
13-7. The <i>AND</i> Circuit Used for Pulse Reshaping	407
13-8. Regenerative Broadening	409
13-9. The <i>EXCLUSIVELY-OR</i> Circuit	411
13-10. Registers	411
13-11. Dynamic Registers.	413
13-12. The Dynamic Binary	415
13-13. The Havens Delay Circuit	416
13-14. Binary Addition	419
13-15. Code-operated Multiposition Switch.	422
13-16. Magnetic-core Binary Elements	425
13-17. Applications of Magnetic Binary Cores	425
14. TRANSMISSION GATES	429
14-1. Basic Operating Principle of Gates	429
14-2. Unidirectional Diode Gate	430
14-3. An Application of the Unidirectional Diode Gate	432
14-4. Other Forms of the Unidirectional Diode Gate.	433
14-5. Bidirectional Gates Using Multielement Tubes	435
14-6. Reduction of Pedestal in a Gate Circuit	436
14-7. A Bidirectional Diode Gate	438
14-8. Balance Conditions in a Bidirectional Diode Gate.	440
14-9. Signal Input Impedance and Connections	442
14-10. Effect of Circuit Capacitances. Example	442
14-11. Four-diode Gate	443

14-12. Six-diode Gate	445
14-13. Synchronous Clamp	447
14-14. Operation of Synchronous Clamp.	449
14-15. Balance Conditions in Synchronous Clamp.	452
14-16. Other Forms of Gating and Clamping Circuits.	453
15. VOLTAGE COMPARATORS	458
15-1. Applications of Voltage Comparators	458
15-2. Classification of Comparator Circuits	459
15-3. A Diode in Cascade with a Nonregenerative Amplifier	460
15-4. Factors Affecting Comparator Operation	463
15-5. A Tube Operating at Cutoff	465
15-6. Regenerative Comparators	468
15-7. The Multiar.	468
15-8. Blocking-oscillator Comparator	473
15-9. The A-C Coupled Multivibrator Comparator	474
15-10. The D-C Cathode-coupled Multivibrator Comparator	475
15-11. A Gas-tube Comparator Used as a Switch	476
15-12. Comparators for Sinusoidal Voltages	477
15-13. Amplifiers for Comparators	481
16. TIME MODULATION AND MEASUREMENT	485
16-1. Time-base Modulation Systems	485
16-2. Comparison of Bootstrap and Miller Time-base Generators	487
16-3. An Analogue-to-Digital Converter	491
16-4. Phase-modulation System.	494
16-5. Phase-shifting Devices and Circuits	495
16-6. Multiple-scale Modulation	499
16-7. Delay-line Modulation.	501
16-8. Pulsed Oscillators	504
16-9. Double-scale Time-modulation Systems, Externally Synchronized	506
16-10. Time Measurements	508
17. PULSE AND DIGITAL SYSTEMS	515
17-1. Fundamental Principles of Television Transmission	515
17-2. Interlaced Scanning	516
17-3. Composite Television Signal	519
17-4. The Synchronizing Signal.	520
17-5. Signal Separation at the Receiver	526
17-6. The Synchronizing Signal Generator.	527
17-7. Synthesis of Composite Television Signal	532
17-8. Bandwidth Requirements of a Television Channel.	533
17-9. Basic Elements of a Radar System	535
17-10. Type <i>A</i> and <i>R</i> Indicators	536
17-11. Plan-position Indicator, PPI	537
17-12. Resolved Sweeps	538
17-13. Other Types of Displays	541
17-14. Electronic Marking on a Display	543
18. TRANSISTORS IN PULSE AND DIGITAL CIRCUITS	548
18-1. Semiconductors.	548
18-2. Donor and Acceptor Impurities	550

18-3. Drift and Diffusion	551
18-4. The p - n Junction	552
18-5. The Junction Transistor	556
18-6. Characteristics of Transistors—The Grounded-base Configuration	559
18-7. The Grounded-emitter Configuration	562
18-8. The Grounded-collector Configuration	564
18-9. A Vacuum Tube—Transistor Analogy	564
18-10. Voltage and Current Limits in Transistor Switching Circuits	567
18-11. A Linear Equivalent Circuit for a Transistor	568
18-12. Transistors as Small-signal Amplifiers	573
18-13. Comparison of Transistor Amplifier Configurations	575
18-14. Equivalent Circuit of a Transistor at High Frequencies	578
18-15. Transient Response of Transistors	581
18-16. Effect of Collector Capacitance	584
18-17. Delay Time in a Transistor	585
18-18. Storage Time in a Transistor	586
18-19. Over-all Transistor Response	587
18-20. Analytic Expressions for Transistor Characteristics	589
18-21. DC Conditions in Cutoff and Saturation Regions	593
18-22. A Transistor Binary Circuit	595
18-23. A Direct-connected Binary Circuit	598
18-24. Monostable and Astable Transistor Multivibrators	599
18-25. The Blocking Oscillator	602
18-26. Logical Circuits	604
<i>Problems</i>	609
<i>Appendix: Tube Characteristics</i>	665
<i>Index</i>	675