

Contents

FOREWORD	vii
PREFACE.	xi
CHAP. 1. INTRODUCTION	1
CHAP. 2. RADIO DISTANCE AND SPEED MEASUREMENTS	4
DISTANCE MEASUREMENTS.	4
2-1. Introduction.	4
2-2. Definitions of Methods of Distance Measurement	4
2-3. Time Modulation and Demodulation.	5
2-4. Phase Modulation and Demodulation.	7
2-5. Frequency Modulation and Demodulation.	13
2-6. Summary.	15
SPEED MEASUREMENTS.	16
2-7. Continuous-wave Systems.	16
2-8. Pulse Systems—Internally Coherent	18
2-9. Pulse Systems—Externally Coherent.	20
SPEED AND DISTANCE MEASUREMENTS.	24
2-10. Phase and Rate of Change of Phase	25
2-11. Time Demodulation and Differentiation.	26
2-12. Phase and Frequency Demodulation	26
2-13. Time, Phase, and Frequency Demodulation.	28
2-14. Considerations Applying to Intermittent Data.	28
POSITION-FINDING.	29
2-15. Introduction.	29
2-16. Pulse-echo Systems.	31
2-17. Radar Beacons	33
2-18. Hyperbolic Systems	34
2-19. An Omnidirectional Beacon Using Time Modulation	36
CHAP. 3. TECHNIQUES OF PULSE TIME MEASUREMENTS.	37
TRANSMISSION AND RECEPTION	37
3-1. Transmission of Pulses	37
3-2. The Reception of Pulses	39

SYNCHRONIZATION	42
3-3. Synchronization of the R-f Pulse Generator	43
3-4. Control of the PRF by the Timing Waveform	44
3-5. Synchronization by a PRF Generator	45
3-6. Zero Calibration	45
3-7. Remote Control of Synchronization	46
TIME MODULATION	47
3-8. Single-scale Time Modulation	47
3-9. Multiple-scale Time Modulation	48
<i>The Characteristics of Components</i>	50
3-10. Timing Standards	50
3-11. Vacuum Tubes	51
3-12. Calibrated Subassemblies	52
<i>Fixed and Modulated Timing Pulses</i>	53
3-13. Fixed Pulses	54
3-14. Single-scale Time-modulation Circuits	55
3-15. Double-scale Time-modulation Circuits	58
3-16. Multiple-scale Systems	61
TIME DEMODULATION	62
3-17. Time Selection and Discrimination	62
SOME PROPERTIES OF CATHODE-RAY-TUBE DISPLAYS	64
3-18. Time Selection and Discrimination	64
3-19. Time Demodulation	64
3-20. Time Modulation	65
CHAP. 4. GENERATION OF FIXED INDICES	69
SINGLE-FREQUENCY MARKER GENERATORS	69
4-1. Sinusoidal Oscillators and Amplitude Comparators	69
4-2. Regenerative Amplitude-comparison Circuits	73
4-3. Class C Crystal Oscillator and Blocking Oscillator	75
4-4. Gas-tetrode 300-cps Relaxation Oscillator	76
4-5. Blocking Oscillators	78
4-6. Multivibrators	80
MULTIPLE-FREQUENCY MARKER AND TRIGGER GENERATORS	81
4-7. Frequency Division	81
4-8. Frequency Division and Pulse Selection	87
4-9. Separate Oscillators and Pulse Selector	89
4-10. Synchronization by Automatic Frequency Tracking	95
4-11. Lightweight Direct-reading Loran PRF Generator	100
4-12. Injection Feedback Divider for Oboe PRF	103

GROUPED-MARKER GENERATION.	106
4-13. Single-frequency Grouped-marker Generators	107
4-14. Multiple-frequency Grouped Markers.	109
CHAP. 5. GENERATION OF MOVABLE INDICES—SINGLE-SCALE CIR- CUI TS.	111
INTRODUCTION	111
5-1. Applications of Time-modulated Indices	111
5-2. System Requirements and Definition of Error.	112
VOLTAGE SAWTOOTH CIRCUITS	114
5-3. A Gated Miller Integrator with a Multiar Comparator	114
5-4. A Gated Multistage Miller Integrator with a Cathode-coupled Double-triode Comparator	116
5-5. Self-gating Miller Integrator—The Phantastron	118
5-6. Self-gating Miller Integrator—The Precision Sanatron	124
5-7. Bootstrap Triangle Generator with Diode Comparator	125
5-8. The Delay Multivibrator	131
<i>Variable Delay Line</i>	132
5-9. Supersonic Delay Tank.	132
SINUSOIDAL OSCILLATOR RANGE CIRCUITS	135
5-10. LC-oscillator, Phase Modulator, and Comparator	135
5-11. The Variable-frequency Oscillator.	137
5-12. A Comparator of Some Single-scale Circuits.	140
CHAP. 6. GENERATION OF MOVABLE INDICES—CIRCUITS.	142
PHASE MODULATION AND AMPLITUDE COMPARISON.	142
6-1. Meacham Range Unit	142
6-2. Precision Ranging Indicator.	147
6-3. Scale Coordination by Frequency Division	153
6-4. Sine-wave Tracking	155
6-5. Three-scale Phase-modulation System	157
CIRCULAR-SWEEP DISPLAYS AS A METHOD OF PHASE MODULATION AND AMPLITUDE COMPARISON.	161
6-6. Circular-sweep Time Modulators, SCR-584	161
STEP-INTERPOLATION TIME MODULATION.	164
6-7. AN/APS-15 Range Unit	164
6-8. Lightweight Direct-reading Loran Indicator.	169
6-9. Summary.	174

CHAP. 7. MANUAL MEASUREMENTS.	176
GENERAL CONSIDERATIONS.	176
INTRODUCTION	176
7-1. Uses	177
CHARACTERISTICS OF DISPLAYS AND CURSORS.	178
7-2. General Considerations.	178
7-3. Indices.	180
7-4. Circular Sweeps	184
7-5. Linear Sweep and Synchronized Presentation	185
ACCURACY CONSIDERATIONS	185
7-6. General Considerations.	186
7-7. Deflection-modulated Display and Deflection-modulated Index	187
7-8. Deflection-modulated Signal and Mechanical Index.	190
7-9. Deflection-modulated Signal and Intensity-modulated Index	190
7-10. Juxtaposition of Intensity-modulated Signal and Index	190
7-11. Superposition of Signal and Index in Deflection-modulated Displays	195
7-12. Reset Error with Intermittent Data and with Two-coordinate Controls	198
7-13. Summary and Comparison of Methods	199
TRACKING METHODS.	200
7-14. Continuous Data.	200
7-15. Intermittent Data	206
7-16. Comparison of Methods.	213
FIXED INDICES FOR MANUAL TIME MEASUREMENT.	215
7-17. A-scope.	215
7-18. J-scope.	216
7-19. Plan-position Indicator with Mechanical Scale.	219
7-20. Electronic Time Marks.	219
MOVABLE TRACKING MARKS FOR MANUAL TIME MEASUREMENT.	220
<i>Direct Tracking.</i>	220
7-21. Introduction.	220
7-22. Movable Electronic Marks	222
7-23. Detailed Circuit Description of Falcon	225
7-24. A/R-scope	231
7-25. A-scope Presentation Used in British CMH System	238
7-26. Systems Using a J-scope with a PPI or B-scope	243
<i>Tracking with Intermittent Data.</i>	247
7-27. Aided Tracking with Intermittent Data.	247
7-28. Two-coordinate Tracking.	251

<i>Especially Accurate Time-measuring Systems</i>	261
7-29. Introduction	261
7-30. Timing Sequence	264
7-31. Circuit Details of Loran Indicator	267
CHAP. 8. TECHNIQUES OF AUTOMATIC TIME MEASUREMENT	275
INTRODUCTION	275
8-1. Automatic vs. Manual Measurements	275
8-2. General Technique of Automatic Time Measurement	276
8-3. Nature of Data and Its Effect on Performance	278
AUTOMATIC TIME MEASUREMENT WITH NORMALLY CONTINUOUS DATA	279
<i>Design of Function Unit</i>	279
8-4. General Theoretical Statement of the Problem	279
8-5. Single-integrator Function Unit	280
8-6. Double-integrator System	282
8-7. Effect of Additional Smoothing	286
8-8. Electrical Integrators	291
8-9. Memory and Coast	304
8-10. Mechanical Function Units	305
<i>Time Discriminators</i>	308
8-11. General Considerations	308
8-12. Simple Time Discriminators	309
8-13. Time Discriminators Consisting of Separate Time Selectors and Detectors	314
8-14. Time Discriminators with Time Selectors, Pulse Stretcher, and Narrow-band Pulse Amplification	317
8-15. Time Selection	321
<i>Target Selection</i>	325
8-16. General Considerations	325
8-17. Practical Examples of Automatic Target Selection	330
<i>Summary</i>	337
8-18. System Planning	337
CHAP. 9. SYSTEMS FOR AUTOMATIC TIME AND POSITION MEASUREMENT	341
PRACTICAL SYSTEMS FOR AUTOMATIC TIME MEASUREMENT	341
9-1. ARO Electrical System	342
9-2. British Oboe Electrical System	348
9-3. Electromechanical Systems	357
POSITION ERROR DETECTORS AND INDICATORS	367
9-4. General Considerations	367

9-5. Design Requirements.	368
9-6. Manual Tracking Systems.	371
9-7. Automatic Tracking Systems	376
TRACKING ON GROUPED OR PERIODICALLY INTERRUPTED DATA	378
9-8. Introduction.	378
9-9. Automatic Time Measurement on Grouped Data.	380
9-10. Example of Automatic Range Tracking on Grouped Data.	386
9-11. Automatic Angle-positioning with Grouped Data.	389
CHAP. 10. SPECIAL DATA-TRANSMISSION SYSTEMS.	391
INTRODUCTION	391
SHORT-DISTANCE WIRE DATA TRANSMISSION	391
10-1. Telemetry	391
10-2. Transmission of Continuous Rotation.	393
10-3. Follow-up Systems.	395
10-4. Characteristics of the Transmission Circuits.	397
RADIO DATA TRANSMISSION	398
10-5. Introduction.	398
10-6. A Pulse Remote-control System	400
10-7. Radiosonde	408
10-8. A British Omnidirectional Beacon	410
CHAP 11. RELAY RADAR SYSTEMS.	417
TIME-MODULATED SINE-COSINE SYSTEM.	417
11-1. Principle of Operation	417
11-2. The Synchronizer	424
11-3. Receiving Equipment.	426
11-4. Synchronizing-pulse Decoding Circuits	426
11-5. Sequencing Circuits and Linear Delays	429
11-6. Step-gate Tracking Circuits.	433
11-7. Modulators and Bidirectional Switch Detectors	435
11-8. Arma Resolver and Servoamplifier.	438
11-9. Performance.	439
11-10. Later Developments in Receiving Equipment	440
PHASE-MODULATED PULSE SYSTEM.	442
11-11. Introduction.	442
11-12. Pulse Representation of Phase-modulated Sinusoids	442
11-13. Discussion of Phase-shifter System.	443
SIMPLIFIED RELAY RADAR SYSTEM FOR CONSTANT-SPEED ROTATION	450
11-14. Introduction.	450
11-15. Details of the System.	451

C-W RELAY RADAR SYSTEM.	458
11-16. General Description of Transmitter Functions.	458
11-17. General Description of Receiving Equipment	459
11-18. Details of the System.	461
11-19. Remarks and Comments on the System.	470
CHAP. 12. DELAY AND CANCELLATION OF RECURRENT WAVE TRAINS	471
12-1. Introduction.	471
THE DELAY LINE.	475
<i>Design of Delay Line for Cancellation.</i>	475
12-2. Introduction.	475
12-3. Echo Elimination	476
12-4. Bandpass Shaping	479
12-5. Equalization of Delay Time with Repetition Interval.	480
<i>Examples of Delay Design</i>	481
12-6. Mercury Lines.	481
12-7. Water Delay Line in System Use.	482
12-8. Possibility of Using Delays in Solids	484
CIRCUIT CONSIDERATIONS IN DRIVING LINE.	487
12-9. Required Nature of Signal	487
12-10. Method of Obtaining Required Type of Signal.	489
<i>Carrier Generator and Modulator Unit</i>	491
12-11. Oscillator.	491
12-12. Modulation.	491
12-13. Amplification	495
12-14. Output Circuit.	495
<i>Dynamic-range Compression.</i>	496
12-15. Definition and Advantages of Compression	496
12-16. Methods	497
CANCELLATION AMPLIFIERS.	498
12-17. Introduction.	498
12-18. Cancellation Methods	498
<i>Carrier-frequency Channels and Cancellation Circuit</i>	499
12-19. Pass Band	499
12-20. Linearity	501
12-21. Gain.	504

12-22. Detection.	506
12-23. Cancellation Circuit	507
12-24. Coupling to Delay Line.	507
<i>Video Section.</i>	508
12-25. Requirements of Video Section.	508
12-26. Amplifier for Bidirectional Video.	508
12-27. Video Rectification.	510
REPETITION-RATE CONTROL.	511
12-28. Repetition-rate Requirements	511
12-29. Manual Control of PRF	514
12-30. Line Synchronized Methods.	515
12-31. Electronic Frequency Tracking	522
12-32. Practical Circuit Details.	523
GLOSSARY	527
INDEX.	529