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TABLE OF CONTENTS

Paragraph	Page	Paragraph	Page
SECTION 1 — GENERAL			
1-1	Introduction	1-1	
1-2	Importance of Testing	1-1	
1-3	Functional Divisions of Testing	1-1	
1-4	Safety Precautions	1-1	
1-5	Safety Practices	1-3	
SECTION 2 — BASIC MEASUREMENTS			
2-1	General	2-1	
2-2	Voltage Measurement	2-1	
2-2.1	DC Voltage Measurement	2-1	
2-2.1.1	Oscilloscope Method	2-1	
2-2.1.2	Electronic Voltmeter Method - DC	2-1	
2-2.1.3	Digital Voltmeter Method	2-1	
2-2.2	AC Voltage Measurement	2-2	
2-2.2.1	Oscilloscope Method	2-2	
2-2.2.2	Electronic Voltmeter Method - AC	2-2	
2-2.2.3	Digital Voltmeter - AC	2-2	
2-3	Current Measurements	2-2	
2-3.1	AC Current Measurement	2-3	
2-3.2	Current Probes	2-3	
2-4	Resistance Measurements	2-3	
2-4.1	Digital Multimeters	2-4	
2-5	Capacitor Measurements	2-4	
2-5.1	Types of Capacitors	2-5	
2-5.1.1	Paper Capacitors	2-5	
2-5.1.2	Plastic Film Capacitors	2-5	
2-5.1.3	MICA Capacitors	2-6	
2-5.1.4	Glass Capacitors	2-6	
2-5.1.5	Ceramic Capacitors	2-6	
2-5.1.6	Electrolytic Capacitors	2-6	
2-5.1.7	Air Capacitors	2-7	
2-5.2	Capacitance-Measuring Equipment	2-7	
2-5.2.1	Bridge Type	2-7	
2-5.2.2	Reactance Type	2-9	
2-5.2.3	The Octopus	2-9	
2-6	Inductance Measurement	2-9	
2-6.1	Inductors	2-9	
2-6.2	Shielding	2-10	
2-6.3	Storage Factor (Q)	2-11	
2-6.4	Metallic Cores	2-11	
2-6.5	Filter Chokes	2-11	
2-6.6	Inductance Measurements	2-11	
2-6.6.1	Hay Bridge	2-11	
2-6.6.2	Maxwell Bridge	2-11	
2-6.7	Measurement Procedure	2-12	
2-6.8	Reactance Measuring Equipment	2-13	
2-6.9	Measurement of Inductance Using the VTVM	2-13	
2-7	Impedance Measurements	2-14	
2-7.1	Bridge Methods	2-14	
2-7.1.1	Wheatstone Bridge	2-17	
2-7.1.2	Kelvin Bridge	2-17	
2-7.1.3	Resistance-Ratio Bridge	2-18	
2-7.1.4	Schering Bridge	2-18	
2-7.1.5	Hay Bridge	2-18	
2-7.1.6	Maxwell Bridge	2-18	
2-7.2	Substitution Techniques in Bridge Measurement	2-18	
2-7.3	Twin-T Bridged-T Bridges	2-19	
2-7.4	Vector Bridges	2-20	
2-7.5	Constant Current Impedance Measuring Technique	2-22	
2-7.6	Impedance Angle Meter	2-22	
2-7.7	Impedance Measurements by Square Wave Testing	2-22	
2-7.8	One-Voltmeter Method of Impedance Measurement	2-24	
2-7.9	Q-Meter Method	2-25	
2-7.9.1	Q Measurements	2-25	
2-7.9.2	Inductance Measurements	2-26	
2-7.9.3	Distributed Capacitance Measurements	2-26	
2-7.9.4	Small Capacitor Measurements	2-26	
2-7.9.5	Large Capacitor Measurements	2-27	
2-7.10	Impedance Testing of Antenna and Transmission Lines	2-27	
2-7.10.1	RF Impedance Bridge	2-28	

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
2-8	Power Measurements	2-29	
2-8.1	AF Power	2-29	
2-8.2	Decibel Meters	2-29	
2-8.3	Volume Level Meters	2-29	
2-8.4	Electrodynamic Meters	2-30	
2-8.5	Torsion-Head, Iron-Cored, and Composite-Coil Watt Meters	2-31	
2-8.6	Vacuum Tube Voltmeter	2-32	
2-8.7	Absorption Power Meters	2-32	
2-8.7.1	Output Power Meters	2-32	
2-8.7.2	In-Line Watt Meters	2-32	
2-8.7.3	Bolometer	2-34	
2-8.7.4	Balanced Bridges	2-34	
2-8.7.4.1	Potentiometer Bridge	2-35	
2-8.7.4.2	Product Bridge	2-35	
2-8.7.4.3	Summation Bridge	2-35	
2-8.7.5	Unbalanced Bridges	2-35	
2-8.7.5.1	All-DC Compensated Bridge	2-35	
2-8.7.5.2	DC and Audio Power Compensated Bridge	2-36	
2-8.7.6	Self-Balancing Bridge	2-36	
2-8.7.7	Bolometer Power Meter	2-37	
2-8.8	Calorimeters	2-39	
2-8.8.1	Static Calorimeters	2-39	
2-8.8.1.1	Adiabatic Calorimeter	2-39	
2-8.8.1.2	Nonadiabatic Calorimeter	2-39	
2-8.8.1.3	Twin Calorimeter	2-40	
2-8.8.2	Flow Calorimeters	2-40	
2-8.8.2.1	Substitution Flow Calorimeters	2-41	
2-9	Frequency Measurements	2-41	
2-9.1	Frequency Measurement Methods	2-42	
2-9.2	Frequency Standards	2-42	
2-9.2.1	U. S. National Bureau of Standards	2-42	
2-9.2.2	Radio Frequencies	2-43	
2-9.2.3	Silent Periods	2-43	
2-9.2.4	Audio Frequencies and Musical Pitch	2-43	
2-9.2.5	Time Intervals and Signals	2-43	
2-9.2.6	Radio Propagation Forecasts	2-45	
2-9.2.7	Accuracy	2-45	
2-9.2.8	Time Coded Subcarrier	2-45	
2-9.2.9	Secondary Standards	2-46	
2-9.3	Mechanical Rotation/Vibration Measurements	2-46	
2-9.3.1	Tuning Fork Methods	2-47	
2-9.3.2	Stroboscope Methods	2-47	
2-9.3.3	Frequency Counter Methods	2-48	
2-9.4	Audio Frequency Measurements	2-48	
2-9.4.1	Oscilloscope Methods	2-48	
2-9.4.2	Frequency Counter Method	2-48	
2-9.4.3	Additional Methods	2-48	
2-9.5	Radio Frequency Measurements	2-49	
2-9.5.1	Frequency Counter Methods	2-49	
2-9.5.2	Frequency Counter Accuracy	2-49	
2-10	Waveform Measurements	2-50	
2-10.1	Procedures for Waveform Observations	2-50	
2-10.2	Oscilloscope	2-50	
2-10.3	Oscilloscope Probes	2-50	
2-10.3.1	High-Voltage Probes	2-51	
2-10.3.2	Low-Capacitance Probes	2-51	
2-10.3.3	Detector Probes	2-51	
2-10.3.4	Direct Probes	2-51	
2-10.4	Lissajous Measurements	2-51	
2-10.5	Phase Relationships Effect on Lissajous Patterns	2-51	
2-10.6	Single-Sideband Measurements	2-52	
2-10.7	Octopus Measurements	2-52	
2-10.7.1	Basic Octopus Construction	2-53	
2-10.7.2	Octopus Use	2-53	
2-10.7.3	Additional Octopus Construction Techniques	2-55	
2-10.7.4	Variable Frequency Tests	2-56	
2-11	Modulation Measurements	2-57	
2-11.1	Amplitude-Modulation Measurements	2-58	
2-11.1.1	Oscilloscope Measurement Methods	2-59	
2-11.1.2	Types of Modulation Display	2-59	
2-11.2	VHF-UHF Measurement Method	2-59	
2-11.3	Single-Sideband Measurements	2-59	
2-11.4	Frequency Modulation	2-61	
2-11.4.1	Frequency Deviation	2-61	
2-11.4.2	Frequency Deviation Measurement	2-61	
2-11.4.3	Alternate Method	2-61	
2-12	Testing Electron Tubes	2-62	
2-12.1	Substitution Test	2-63	
2-12.2	Transconductance Testers	2-63	
2-12.2.1	Static Method	2-64	
2-12.2.2	Dynamic Method	2-64	
2-12.3	Additional Test Circuits	2-64	
2-12.3.1	Short-Circuit and Noise Test	2-64	

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
2-12.3.2 Gas Test	2-64	2-13.11.2 MOSFET (Enhancement Type) Test	2-78
2-12.3.3 Cathode Leakage Test	2-64		
2-12.3.4 Filament Activity Test	2-65		
2-12.4 Tube Characteristic Graphic Display	2-65	2-14 Integrated Circuits	2-78
2-12.4.1 Diode Tube Measurement	2-65	2-14.1 Static Electricity Hazards to Integrated Circuits	2-78
2-12.4.2 Grid-Controlled Tube Measurements	2-65	2-14.2 Static Sensitive Devices	2-78
2-12.5 High-Power HF Amplifier Tube Tests	2-66	2-14.2.1 Very Sensitive Devices	2-78
2-12.5.1 Klystron Tube Tests	2-66	2-14.2.2 Sensitive Devices	2-78
2-12.5.2 Traveling-Wave Tube	2-66	2-14.2.3 Moderately Sensitive Devices	2-78
2-12.5.3 Magnetron Tube Tests	2-67	2-14.3 Electrical Equipment, Tools, Soldering Irons	2-79
2-12.5.4 Crossed-Field Amplifier	2-67	2-14.3.1 Test Equipment	2-79
2-13 Testing of Semiconductors	2-67	2-14.4 Personal Apparel	2-79
2-13.1 Transistor Testing	2-68	2-14.5 Wrist-Bracelets	2-79
2-13.1.1 Resistance Test	2-68	2-14.6 Static Sensitive Components	2-79
2-13.2 Transistor Testers	2-68	2-14.7 Intergrated Circuit (IC) Testing Devices	2-79
2-13.2.1 Collector Leakage Current Test	2-68	2-14.7.1 Logic Probes	2-79
2-13.2.2 Direct-Current Gain Test	2-69	2-14.7.2 Logic Pulse Generator	2-79
2-13.2.3 Punch-Through Voltage Test	2-69	2-14.8 Testing ICs	2-79
2-13.2.4 Alternating-Current Gain Test	2-70		
2-13.3 Transistor Characteristic Graphical Display	2-70	2-15 Standing Wave Measurement	2-80
2-13.4 Handling of Transistors	2-71	2-15.1 Reflection Coefficient (K)	2-82
2-13.4.1 Crystal Diode Testing	2-71		
2-13.4.2 Substitution Test	2-71	2-16 Field Intensity and Noise (Interference) Measurements	2-83
2-13.5 Crystal Diode Testers	2-72	2-16.1 Noise Generating Sources	2-83
2-13.5.1 RF Crystal Diode Test	2-72	2-16.1.1 Atmospheric Noise	2-83
2-13.5.2 Switching Diode Test	2-72	2-16.1.2 Galactic Noise	2-83
2-13.6 Diode Characteristic Graphical Display	2-72	2-16.1.3 Man Made Noise	2-84
2-13.6.1 Reverse Voltage-Current Analysis	2-72	2-16.2 Electromagnetic Interference (EMI)	2-84
2-13.6.2 Regulator Diode Test	2-72	2-16.2.1 EMI Measurements	2-84
2-13.7 Static Resistance Measurements	2-73	2-16.3 Field Strength Measurements	2-85
2-13.8 Silicon-Controlled Rectifier	2-73	2-16.3.1 Antenna Gain	2-85
2-13.8.1 SCR Test	2-74	2-16.3.2 Field Strength	2-85
2-13.8.2 TRIAC	2-74	2-16.3.2.1 Standard Antenna Method	2-86
2-13.8.3 TRIAC Test	2-74	2-16.3.2.2 Substitution Method	2-88
2-13.9 Unijunction Transistors	2-75	2-16.3.2.3 Standard Field Generator Method	2-88
2-13.9.1 UJT Testing	2-75	2-16.3.3 Relative Field Strength Measurements	2-88
2-13.10 Field Effect Transistor	2-75	2-16.3.3.1 Grid-Dip Meter Method	2-88
2-13.10.1 N Channel Test	2-76	2-16.3.3.2 Simple Meter Application	2-89
2-13.10.2 P Channel Test	2-76	2-16.3.3.3 Advanced Meter Application	2-89
2-13.11 MOSFET	2-77	2-16.4 Antenna Radiation Pattern	2-89
2-13.11.1 MOSFET (Depletion/ Enhancement Type) Test	2-78		
		2-17 Battery Measurements	2-89

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
2-17.1 Storage Batteries	2-89	2-26 Receiver Gain Measurements	2-99
2-17.2 Dry Batteries	2-90	2-26.1 Voltage Gain Measurement Procedure	2-100
2-17.3 Carbon Zinc and Alkaline Batteries	2-90	2-27 Minimum Discernible Signal Measurements	2-100
2-17.4 Mercury Cells	2-90	2-28 Frequency Spectrum Measurements	2-101
2-17.5 Nickel Cadmium Batteries (NICAD)	2-90	SECTION 3 — TEST TECHNIQUES AND PRACTICES	
2-18 RF Attenuator Measurements	2-91	3-1 Communications Receiver Testing	3-1
2-19 Magnetic Measurements	2-91	3-1.1 Receiver Sensitivity	3-1
2-19.1 TS-15C/AP Fluxmeter	2-91	3-1.1.1 Impedance Matching Considerations	3-1
2-19.1.1 Magnetic Flux Density Adapters	2-91	3-1.1.2 AM Receiver Sensitivity	3-2
2-19.2 Sensitive Research Model FM Fluxmeter Operation	2-92	3-1.1.3 Single Sideband Sensitivity Measurement Considerations	3-2
2-19.3 Hall-Effect Method	2-93	3-1.1.3.1 SSB Receiver Test Equipment	3-3
2-20 Vibration	2-93	3-1.1.4 CW(A-1) and Facsimile (A-4) Sensitivity Determination	3-3
2-21 Intermodulation Distortion Measurements	2-94	3-1.1.5 Voice Modulated (A-3) Sensitivity Determination	3-4
2-21.1 Cross-Modulation and Parasitic Generation	2-95	3-1.1.6 SSB (A-3J) Sensitivity Measurements	3-4
2-21.2 Intermodulation Distortion Detection	2-95	3-1.1.7 Tone Modulation (A-2) Sensitivity Measurements	3-4
2-22 Tuned Circuit Alignment	2-95	3-1.1.8 FSK (F-1) Sensitivity Determination	3-4
2-22.1 Types of Circuits Requiring Adjustment	2-96	3-1.1.9 FM (F-3) Sensitivity Measurement	3-4
2-23 Systems Testing and Monitoring	2-96	3-1.1.10 Pulse-Modulation Sensitivity Measurement	3-4
2-23.1 System Testing and Monitoring Methods	2-96	3-1.2 Determining I-F Bandwidth Response	3-5
2-24 Attenuation and Insertion Loss Measurements of Transmission Lines	2-96	3-1.3 Selectivity and Bandwidth Measurements	3-6
2-24.1 Loss Measurement	2-96	3-1.3.1 Overall Selectivity	3-6
2-24.2 Output Measurement	2-97	3-1.3.2 Bandwidth	3-6
2-24.3 Transmission Line Formulas	2-97	3-1.4 AGC Measurements	3-7
2-24.3.1 Attenuation Measurements	2-98	3-1.4.1 Delayed AGC Considerations	3-7
2-24.4 Attenuation in Waveguide	2-98	3-1.5 Receiver Standard Measurement	3-7
2-25 Receiver Noise Measurements	2-98	3-1.6 Squelch (Silencer) Circuit Measurements	3-8
2-25.1 Noise Figure	2-98	3-1.7 Modulation Distortion Measurements	3-9
2-25.2 Noise Source Measurement Method	2-99	3-1.8 AFC Characteristic Measurements	3-9
2-25.3 FM Receiver Consideration	2-99		
2-25.4 Radar Receiver Considerations	2-99		

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
3-1.9 Receiver Alignment	3-9	3-3 Facsimile Systems Testing	3-36
3-1.9.1 Alignment of Crystal Filter Circuits	3-10	3-3.1 Fundamentals of Facsimile	3-38
3-1.9.2 Alignment of Wave Traps	3-10	3-3.1.1 Facsimile Transmitter	3-38
3-1.9.3 Alignment of Beat-Frequency Oscillators	3-12	3-3.1.2 Facsimile Recorder Set	3-39
3-1.9.4 AM Receiver Alignment	3-13	3-3.1.3 Signal Requirements	3-40
3-1.9.4.1 Disabling Automatic Gain Controls	3-13	3-3.1.3.1 Land Lines	3-40
3-1.9.4.2 Disabling Local Oscillators	3-13	3-3.1.3.2 Radio	3-40
3-1.9.4.3 BFO Considerations	3-14	3-3.1.4 Control Signals	3-40
3-1.9.4.4 I-F Amplifier Alignment	3-14	3-3.2 Overall Functional Description	3-40
3-1.9.4.5 RF Stage Alignment	3-14	3-3.2.1 Standby Condition	3-42
3-1.9.5 FM Receiver Alignment	3-15	3-3.2.2 Start Cycle	3-42
3-1.9.5.1 Limiter-Type Discriminator Alignment	3-16	3-3.2.3 Phase Cycle	3-42
3-1.9.5.2 Ratio Detector Alignment	3-17	3-3.2.4 Start-Record Cycle	3-42
3-1.9.5.3 I-F Amplifier Alignment	3-18	3-3.2.5 Copy Cycle	3-42
3-1.9.5.4 RF And Oscillator Stages Alignment	3-19	3-3.2.6 Stop Cycle	3-42
3-2 Communications Transmitters and Transceiver Testing	3-19	3-3.2.7 Test Circuits	3-42
3-2.1 Frequency Generation	3-20	3-3.2.8 Power Supply Circuits	3-42
3-2.2 Frequency Measurement	3-20	3-3.2.9 Automatic Operation	3-42
3-2.3 Amplitude Modulation Measurement	3-21	3-3.2.10 Manual Operation	3-43
3-2.4 Frequency Modulation Measurements	3-24	3-3.2.11 Normal Operation	3-43
3-2.5 Frequency Derivation Measurements	3-26	3-3.2.12 Additional Checks	3-43
3-2.6 Single Sideband (SSB) Measurements	3-27	3-4 Teletypewriter Testing	3-43
3-2.6.1 Balanced Modulators	3-27	3-4.1 Teletypewriter Equipment	3-44
3-2.6.2 Sideband Filters	3-29	3-4.2 Range Orientation	3-44
3-2.6.3 Sideband Suppression Testing	3-29	3-4.2.1 Page Printer Malfunction	3-44
3-2.6.4 Distortion in SSB System	3-29	3-4.2.2 Range Finding	3-44
3-2.6.5 Two-Tone Testing Procedure	3-30	3-4.3 Maintenance and Adjustments	3-44
3-2.6.6 Signal-To-Distortion Ratio Measurement	3-31	3-4.4 Factors Affecting Quality of Communications	3-47
3-2.7 I-F and RF Amplifiers	3-31	3-4.4.1 Start Stop Mode	3-47
3-2.7.1 I-F Gain Measurement	3-32	3-4.4.2 Character Transmission	3-48
3-2.7.2 FM and SSB Requirements	3-32	3-4.4.3 Character Combinations	3-48
3-2.7.3 Variable Tuned Filters	3-32	3-4.4.4 Signal Quality	3-48
3-2.7.4 RF Power	3-33	3-4.4.5 Unit Lengths	3-48
3-2.7.5 Peak-Envelope-Power (PEP) Output Measurement	3-33	3-4.4.6 Transmitter Contacts	3-48
3-2.7.6 AM/FM Considerations	3-34	3-4.4.7 Lever Positioning	3-49
3-2.8 Transmitter Power Measurement	3-34	3-4.4.8 Transmission Speed Factors	3-49
3-2.9 Neutralization Procedures	3-34	3-4.5 Synchronous Mode	3-49
		3-4.6 Bias Distortion	3-50
		3-4.6.1 Relays	3-50
		3-4.6.2 FSK-Caused Distortion	3-50
		3-4.6.3 Receiver Tuning	3-50
		3-4.6.4 Monitor Distortion	3-50
		3-4.6.5 Speed Distortion	3-50
		3-4.7 Fortuitous Distortion	3-50
		3-4.8 End Distortion	3-50
		3-4.9 Characteristic Distortion	3-50
		3-4.10 Distortion Measurements	3-51
		3-4.11 DC Measurements	3-52

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
3-4.11.1 Loop Current Measurements . . .	3-52	3-5.19 Measurements	3-66
3-4.11.1.1 Connections	3-52	3-5.20 Optical Test Equipment	3-66
3-4.11.1.2 Connections	3-52	3-5.21 Basic Lens Characteristics	3-66
3-4.11.1.3 Control Settings	3-52	3-5.22 Collimation	3-66
3-4.11.1.4 Test Procedures	3-52	3-5.23 The Dioptrimeter	3-66
3-4.11.1.5 Test Results	3-52	3-5.24 Threshold	3-67
3-4.11.2 Low Level Voltage		3-5.25 Resolution	3-67
Measurements	3-52	3-5.26 The Infrared Optical Tester	3-67
3-4.11.2.1 Equipment Required	3-52	3-5.27 Electronic Test Equipment	3-68
3-4.11.2.2 Connections	3-52	3-5.28 Standard Infrared Detector Test	
3-4.11.2.3 Control Settings	3-52	Equipment and Procedures	3-69
3-4.11.2.4 Test Procedure (General)	3-52	3-5.29 AN/SAR-7 Infrared Viewing Set	3-69
3-4.11.2.5 Test Results	3-52	3-5.29.1 Operating Conditions	3-69
3-4.11.3 DC Distortion Measurements	3-52	3-5.29.2 Operator's Vision	3-69
3-4.11.3.1 Equipment Requirements	3-52	3-5.29.3 Precautions	3-70
3-4.11.3.2 Connections	3-52	3-5.29.4 Preparation Procedure	3-70
3-4.11.3.3 Control Settings	3-53	3-5.30 Infrared Systems in General	3-70
3-4.11.3.4 Test Procedures	3-53		
3-4.11.3.5 Test Results	3-53	3-6 Radar Testing	3-70
3-4.11.4 DC Distortion Measurements		3-6.1 General	3-70
Methods	3-53	3-6.2 Radar System Operational	
3-4.11.4.1 Equipment Requirements	3-53	Requirements	3-71
3-4.11.4.2 Connections	3-53	3-6.3 Synchronizer	3-71
3-4.11.4.3 Control Settings	3-53	3-6.4 Transmitter	3-71
3-4.11.4.4 Test Procedures	3-54	3-6.5 Antenna	3-71
3-4.11.4.5 Test Results	3-54	3-6.5.1 Duplexer	3-72
3-5 Infrared Equipment and Tests	3-54	3-6.5.2 ATR Switch	3-73
3-5.1 Infrared Radiation Theory	3-55	3-6.5.3 Pre-Set Antennas	3-73
3-5.2 Infrared Sources and Atmospheric		3-6.5.4 Test Points	3-73
Effects	3-55	3-6.6 Receiver	3-73
3-5.3 Sources for Active Systems	3-57	3-6.6.1 Bandwidth	3-73
3-5.4 Optics for Infrared System	3-58	3-6.7 Indicator	3-74
3-5.5 Processing Incoming Radiation	3-58	3-6.7.1 Frequency Measurement and	
3-5.6 Infrared Bands	3-58	Standards	3-74
3-5.7 Nancy Gear	3-60	3-6.8 Frequency Testing Standards	3-74
3-5.8 Infrared Receiver	3-60	3-6.9 Method of Coupling Frequency	
3-5.8.1 Detectors	3-61	Standards	3-74
3-5.8.2 Limitations	3-61	3-6.10 Frequency Testing Equipments	3-74
3-5.9 Thermal Detectors	3-61	3-6.11 Spectrum Analyzers and Frequency	
3-5.10 Pneumatic Detectors	3-61	Counters	3-74
3-5.11 Photo Detector	3-62	3-6.11.1 Spectrum Analyzer	3-74
3-5.12 Photovoltaic Detectors	3-64	3-6.11.2 Frequency Counter	3-74
3-5.13 Luminescent Detectors	3-64	3-6.12 Resonant-Coaxial-Line Frequency	
3-5.14 Image-Forming Detectors	3-64	Meter	3-74
3-5.15 Targets and Background	3-64	3-6.13 Resonant-Cavity Frequency	
3-5.16 Infrared Transmitters	3-64	Meter	3-74
3-5.17 Radiation Source	3-64	3-6.14 Factors Affecting Measurements	
3-5.18 Modulation	3-66	Accuracy	3-76
		3-6.14.1 Accuracy	3-76

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
3-6.14.2 Meter Tuning	3-76	3-6.40 Noise Figure Determination	3-93
3-6.14.3 Atmospheric Effects	3-76	3-6.40.1 Crystal Characteristics	3-93
3-6.15 Frequency Measurement	3-76	3-6.41 Test Method Using Noise Generator	3-93
3-6.15.1 Transmitter Frequency	3-76	3-6.42 Test Method Using CW Signal Generator	3-95
3-6.15.2 Receiver Frequency	3-76	3-6.43 Minimum Discernible Signal Measurement	3-95
3-6.16 Reaction-Type Indication Method	3-76	3-6.44 RF Leakage Determination	3-95
3-6.17 Transmission-Type Indication Method	3-77	3-6.45 Leakage Detection Method	3-95
3-6.18 Combination Power and Frequency Testing	3-77	3-6.46 MDS Measurement Using Pulsed- Signal Generator	3-95
3-6.19 Local-Oscillator Frequency Measurement	3-77	3-6.46.1 MDS Measurement	3-96
3-6.20 Power Measurements	3-78	3-6.47 MDS Measurement Using FM Signal Generator	3-96
3-6.20.1 Units	3-78	3-6.47.1 Range Control	3-98
3-6.21 Power Testing Data	3-78	3-6.47.2 MDS Measurements	3-98
3-6.22 Peak Power and Average Power	3-78	3-6.48 CW (Doppler) - Type Receiver Consideration	3-98
3-6.23 The Decibel and Its Use	3-79	3-6.48.1 RCVR Gain	3-98
3-6.23.1 Power Ratios	3-79	3-6.48.2 CW Radar	3-98
3-6.23.2 Decibel	3-80	3-6.49 Testing Receiver Bandwidth	3-99
3-6.24 Reference Level (dBm)	3-80	3-6.50 Integrated Receiver Method	3-99
3-6.24.1 Voltage/Current Ratios	3-80	3-6.51 Preferred Receiver Method	3-99
3-6.24.2 Peak Power	3-80	3-6.51.1 Marker Pips	3-100
3-6.24.3 Average Power	3-80	3-6.52 Testing TR Recovery Time	3-100
3-6.25 Power Sampling Techniques	3-83	3-6.52.1 TR Function	3-100
3-6.26 Test Antenna	3-83	3-6.53 Pulse or FM Signal Generator Test Method	3-101
3-6.26.1 Disadvantages	3-84	3-6.54 CW Signal Generator Method	3-101
3-6.27 RF Probe	3-84	3-6.55 Current and Voltage Checks	3-101
3-6.28 Directional Couplers	3-84	3-6.56 Testing Receiver Recovery Time	3-102
3-6.28.1 Waveguide Action	3-84	3-6.57 Transmitter Performance Testing	3-102
3-6.29 Broad-Band Coupler	3-86	3-6.58 Magnetron Magnetic Field	3-102
3-6.30 Single-Hole Coupler	3-86	3-6.59 Precautions	3-102
3-6.30.1 Directional Coupler	3-86	3-6.59.1 Nonmagnetic Tools	3-102
3-6.31 Bidirectional Couplers	3-86	3-6.60 Magnetron Material Storage	3-103
3-6.31.1 Reflected Energy	3-87	3-6.61 Pulse Repetition Rate Measurements	3-103
3-6.32 Attenuators	3-87	3-6.61.1 Frequency Counter	3-103
3-6.32.1 Pads	3-87	3-6.61.2 Oscilloscope	3-103
3-6.32.2 Strips	3-88	3-6.62 Pulse Width Measurements	3-103
3-6.32.3 Cascades	3-88	3-6.63 Modulator Pulse Measurement	3-103
3-6.32.4 Power Overloads	3-89	3-6.64 Resistive Load	3-104
3-6.32.5 Power/dBm Conversion	3-89	3-6.64.1 Dummy Load	3-104
3-6.33 Attenuation Checks	3-89	3-6.65 Voltage Divider	3-104
3-6.34 Calibration Standards	3-89	3-6.66 Power Measurement	3-104
3-6.35 Calibration Accuracy	3-90	3-6.67 Overall System Techniques	3-104
3-6.36 Cable-Attenuation Calibration	3-90	3-6.68 Timing Circuit Testing	3-104
3-6.37 Attenuator Calibration	3-90	3-6.69 Radar Triggering	3-105
3-6.38 Receiver Performance Testing	3-91		
3-6.38.1 Testing Receiver Sensitivity	3-91		
3-6.39 Noise Analysis	3-92		
3-6.39.1 Thermal Agitation	3-93		

TABLE OF CONTENTS

Paragraph	Page	Paragraph	Page
3-6.69.1 Trigger Loop	3-105	3-6.96 Antenna And Target Altitudes. . .	3-118
3-6.69.2 Pulse "A"	3-105	3-6.97 Propagation Factors.	3-120
3-6.69.3 Pulse "B"	3-105	3-6.98 Duct Formation	3-120
3-6.69.4 Pulse "C"	3-105	3-6.99 Atmospheric Refraction	3-121
3-6.69.5 Gate C-D.	3-105	3-6.100 Rain Echoes and Scattering . . .	3-121
3-6.69.6 Pulse "D"	3-105	3-6.101 Atmospheric Absorption.	3-121
3-6.69.7 Pulse "E"	3-105	3-6.102 Resonance Chamber (Echo Box)	3-121
3-6.69.8 Pulse "F"	3-105	3-6.102.1 Echo Box Operation	3-122
3-6.70 Range Data Accuracy.	3-105	3-6.103 Corollary Data	3-122
3-6.70.1 Time Delays	3-105	3-6.103.1 Echo Box Installation	3-122
3-6.71 Zero Range Error	3-106	3-6.103.2 Multiresonant Boxes	3-122
3-6.72 Fixed Target Method	3-106	3-6.104 Calibration.	3-122
3-6.73 Double-Echo Method.	3-106	3-6.105 TR Recovery Time Check.	3-123
3-6.74 Standing-Wave-Ratio Measurement	3-107	3-6.106 Spectrum Analysis.	3-123
3-6.75 Slotted-Line Method	3-107	3-6.106.1 Precautions	3-123
3-6.76 Directional Coupler Method	3-107	3-6.107 System Trouble Shooting	3-123
3-6.77 Bidirectional Coupler Method . . .	3-108	3-6.108 Low Receiver Sensitivity.	3-125
3-6.78 Causes of Standing Waves	3-108	3-6.109 AFC Operational Difficulties. . .	3-125
3-6.79 Locating Discontinuities.	3-108	3-6.110 Poor Minimum-Range Performance.	3-125
3-6.80 Dummy RF Load Method.	3-110	3-6.111 Incorrect Operating Frequency	3-125
3-6.80.1 Dummy RF Load.	3-110	3-6.112 Poor Spectrum	3-125
3-6.80.2 Time-Domain Relfectometer. . .	3-110	3-6.113 Magnetron Pulling	3-125
3-6.81 Spectrum Analysis.	3-110	3-6.114 Magnetron Pushing	3-125
3-6.82 Transmitter Spectral Display	3-110	3-6.115 Defective Magnetron	3-126
3-6.83 Transmitter Output Versus Receiver Response.	3-111	3-6.116 Beam Width Determination.	3-126
3-6.83.1 Side Lobes	3-111	3-6.117 Radar MTI Testing.	3-126
3-6.84 Modulation Distortion	3-112	3-6.118 Cancellation Ratio.	3-126
3-6.84.1 Display Troubles	3-112	3-6.118.1 Measurement	3-126
3-6.85 Frequency Meter Method	3-112	3-6.119 Sub-Clutter Visibility.	3-127
3-6.86 Spectrum Analyzer Method.	3-113	3-6.119.1 Measurement	3-127
3-6.87 Spectrum Analyzer Circuit Analysis	3-113	3-6.120 MTI Troubles	3-127
3-6.87.1 Modes	3-113	3-6.121 Excessive Delay Line Attenuation	3-127
3-6.87.2 Klystron Testing.	3-114	3-6.122 Total Failure of Delay Line.	3-127
3-6.88 Transmitter Spectral Display Analysis	3-114	3-6.123 Coherent Oscillator Tuning	3-127
3-6.89 Frequency Measurement.	3-115	3-6.124 Power Grid Tubes	3-128
3-6.90 Installation Testing	3-115	3-6.125 Cooling	3-128
3-6.90.1 AFC Checks	3-116	3-6.126 Modulator Pulse	3-128
3-6.91 Overall Radar Performance	3-117	3-6.128 Klystron Amplifiers.	3-128
3-6.92 Minimum-Range Performance	3-117		
3-6.93 Maximum-Range Performance	3-117	3-7 IFF SYSTEMS	3-130
3-6.93.1 Target Reflection	3-117	3-7.1 "Aims" System Components.	3-133
3-6.94 Radar System Performance Factors	3-118	3-7.2 Interrogator System	3-133
3-6.95 Radar System Sensitivity	3-118	3-7.2.1 Interfacing	3-133
		3-7.3 AN/UPA-59A(V) System Components	3-133

TABLE OF CONTENTS

Paragraph	Page	Paragraph	Page
3-7.4 AN/UPX-23 Interrogator Set.	3-133	3-8.5.3 Obtaining a Fix	3-157
3-7.4.1 AN/UPX-23 Subsystems.	3-133	3-8.5.4 System Testing	3-159
3-7.5 Antennas.	3-133	3-8.6 Initial Navigation	3-159
3-7.6 Transponder Components.	3-133	3-8.6.1 Development Criterion	3-160
3-7.7 Test Equipment	3-133	3-8.6.2 Earth Characteristics.	3-160
3-7.7.1 Test Conditions	3-133	3-8.6.3 Co-ordinate System	3-160
3-7.8 System Overview	3-136	3-8.6.4 Vehicular Navigation on Earth . .	3-160
3-7.8.1 Operational Checks	3-136	3-8.6.5 Basic Requirements	3-160
3-7.8.2 Back-to-Back Testing	3-136	3-8.6.5.1 Accelerometers	3-162
3-7.8.3 Antenna Testing.	3-136	3-8.6.5.2 Misaligned Platform	3-162
3-8 Navigational Aids	3-138	3-8.6.6 Basic SINS	3-163
3-8.1 General.	3-138	3-8.6.6.1 Essential Components.	3-163
3-8.1.1 Atmospheric Effects.	3-138	3-8.6.6.2 Platform Alignment	3-163
3-8.1.2 Interference	3-139	3-8.6.6.3 Ships Movement	3-163
3-8.1.3 Ionization.	3-139	3-8.6.6.4 Heading.	3-165
3-8.1.4 Ducting	3-140	3-8.6.6.5 Errors Developed in Sins.	3-165
3-8.1.5 Hyperbolic Navigational Systems	3-140	3-8.6.6.6 Characteristic Errors.	3-165
3-8.1.6 Rho-Theta Navigation	3-141	3-8.6.6.7 Gyro Biasing.	3-167
3-8.2 Loran "A".	3-141	3-8.6.7 Resetting SINS	3-169
3-8.3 Loran "C".	3-142	3-8.6.7.1 Latitude Misalignment	3-169
3-8.3.1 Characteristics	3-142	3-8.6.7.2 Gyro Bias Error.	3-169
3-8.3.2 Station Network	3-142	3-8.6.7.3 Heading.	3-170
3-8.3.3 Reception Ranges.	3-144	3-8.6.7.4 Longitude	3-170
3-8.3.4 Receivers	3-144	3-8.6.8 General Scheme of Operation . .	3-171
3-8.3.4.1 Receiver Operation	3-144	3-8.6.9 SINS-Detailed Theory	3-171
3-8.3.5 Time Measurement	3-145	3-8.6.9.1 Gyros	3-171
3-8.3.6 Position Accuracy	3-145	3-8.6.9.2 Platform Followup.	3-175
3-8.4 Omega System	3-145	3-8.6.9.3 Compensating for Spherical Earth.	3-175
3-8.4.1 Theory	3-145	3-8.6.9.4 Oscillations.	3-176
3-8.4.2 Operating Characteristics.	3-150	3-8.6.9.5 Damping Signal Error.	3-179
3-8.4.2.1 Signal Format	3-150	3-8.6.9.6 Rotating Earth and the 24 Hour Oscillation	3-179
3-8.4.2.2 Synchronization Control.	3-151	3-8.6.9.7 Error Prediction	3-185
3-8.4.2.3 Lane Identification	3-151	3-8.6.9.8 Platform Dynamics	3-186
3-8.4.2.4 Propagation Characteristics . . .	3-153	3-8.6.10 Gyro Drift.	3-187
3-8.4.3 System Usability	3-153	3-8.6.11 3rd Order Damping.	3-190
3-8.4.4 Omega Notices and Navigational Warnings.	3-154	3-8.6.12 Monitor Gyro	3-190
3-8.4.5 Ancillary Uses and the Future of Omega	3-154	3-8.6.13 System Testing.	3-191
3-8.4.5.1 Time and Frequency	3-154	3-8.7 TACAN Equipment.	3-191
3-8.4.5.2 Differential Omega.	3-154	3-8.8 Hydrography	3-196
3-8.4.6 Charts and Publications.	3-154	3-8.8.1 Accuracy	3-196
3-8.4.7 System Testing	3-155	3-8.8.2 Controls.	3-196
3-8.5 Satellite Navigation	3-155	3-8.8.3 Raydist	3-197
3-8.5.1 Effects on Satellite Orbit.	3-156	3-8.8.4 Shoran	3-198
3-8.5.2 NAVSAT Equipment Configurations.	3-157	3-8.8.5 Decca HI-FIX	3-199
		3-9 Sonar Systems-Overall Performance Checks.	3-199

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
3-9.1 External Factors Affecting Performance	3-199	3-10.15.4.4 Blocking-Oscillator Frequency Divider	3-235
3-9.1.1 Water Conditions	3-199	3-10.15.4.5 Binary Divider	3-235
3-9.1.2 Turbulence	3-199	3-10.15.4.6 Monostable Multivibrator	3-236
3-9.1.2.1 Background Noise	3-199	3-10.15.4.7 Astable Multivibrator	3-237
3-9.1.2.2 Reverberation	3-200	3-10.16 Television Cameras	3-239
3-9.2 Internal Factors Affecting Performance	3-200	3-10.16.1 Vertical Deflection	3-240
3-9.2.1 Driver Power Output	3-200	3-10.16.2 Horizontal Deflection	3-242
3-9.2.2 Receiving Sensitivity	3-200	3-10.16.3 Video Amplifiers	3-243
3-9.2.3 Key Circuits	3-200	3-10.16.3.1 RC-Coupled Circuits	3-244
3-10 Television Systems and Equipment	3-200	3-10.16.3.2 Shunt-Compensated Circuits	3-244
3-10.1 Basic Television Systems	3-200	3-10.16.3.3 Series-Compensated Circuits	3-244
3-10.2 Television Systems	3-204	3-10.16.3.4 Shunt-Series Compensated Circuits	3-245
3-10.3 System Integration	3-206	3-10.16.3.5 Cathode Compensation	3-246
3-10.4 Complex Systems	3-207	3-10.16.3.6 Low-Frequency Compensation	3-246
3-10.5 Special Systems	3-207	3-10.16.3.7 Transistor Video Amplifiers	3-247
3-10.6 High-Resolution Systems	3-210	3-10.16.4 Video Preamplifiers	3-249
3-10.7 Slow-Scan Synchronization	3-211	3-10.16.4.1 Vacuum-Tube Cathode Follower	3-249
3-10.8 Video Patch Cords and Jacks	3-211	3-10.16.4.2 Two-Stage Vacuum-Tube Amplifier	3-250
3-10.9 Grounding	3-211	3-10.16.4.3 Transistor Emitter Follower	3-250
3-10.10 Types of Television Cable	3-212	3-10.16.4.4 Transistor Current-Feedback Pair	3-251
3-10.11 Coaxial Cable Connectors	3-213	3-10.16.4.5 Nuistor Cascode Amplifier	3-252
3-10.12 Coaxial Adapters	3-213	3-10.16.4.6 Hybrid Cascode Preamplifier	3-252
3-10.13 Camera Cables	3-213	3-10.16.5 Video-Output Circuits	3-253
3-10.14 Cathode-Ray Tubes	3-215	3-10.16.6 High-Peaker Circuits	3-254
3-10.14.1 Construction	3-215	3-10.16.7 Aperture-Correction Circuits	3-255
3-10.14.2 The Electron Gun	3-215	3-10.16.8 Blanking-Insertion Circuits	3-257
3-10.14.3 Electrostatic Focus	3-215	3-10.16.9 Gamma Correction	3-262
3-10.14.4 Electromagnetic Focus	3-217	3-10.16.10 White-Peak Clippers	3-264
3-10.14.5 Electrostatic Deflection	3-218	3-10.16.11 Sync Addition	3-265
3-10.14.6 Electromagnetic Deflection	3-219	3-10.16.12 Automatic Sensitivity	3-266
3-10.14.7 The Ion Trap	3-219	3-10.16.13 Camera Blanking	3-267
3-10.14.8 Picture Tubes	3-220	3-10.16.14 Deflection Protection	3-268
3-10.14.9 The Vidicon	3-221	3-10.16.15 Cable-Delay Compensation	3-270
3-10.14.10 The Image Orthicon	3-224	3-10.16.16 Vidicon Filament Compensation	3-272
3-10.14.11 The SEC Tube	3-226	3-10.16.17 Dynamic Focus	3-273
3-10.15 Sync Generators	3-227	3-10.17 Lighting	3-273
3-10.15.1 Sync Signals	3-227	3-10.17.1 Principles of Light	3-274
3-10.15.2 Types of Sync Generators	3-228	3-10.17.2 Light Sources	3-275
3-10.15.2.1 Pulse-Counter Sync Generators	3-228	3-10.17.2.1 Incandescent Lamps	3-275
3-10.15.3 Binary Sync Generators	3-229		
3-10.15.4 Circuit Analysis	3-233		
3-10.15.4.1 Master Oscillator	3-233		
3-10.15.4.2 Astable Blocking Oscillator	3-234		
3-10.15.4.3 AFC Phase Detector	3-234		

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
3-10.17.2.2 Tungsten-Halogen Lamps . . .	3-276	3-10.22.1 Test Equipment	3-337
3-10.17.2.3 Other Light Sources	3-277	3-10.22.2 Camera Measurements	3-343
3-10.17.3 Invisible Light	3-278	3-10.22.2.1 Vertical Resolution	3-343
3-10.17.4 Lighting Requirements	3-279	3-10.22.2.2 Horizontal Resolution	3-344
3-10.18 Television Monitors	3-279	3-10.22.2.3 Geometric Distortion	3-344
3-10.18.1 Monitor Circuits	3-280	3-10.22.2.4 Gamma and Video Linearity	3-345
3-10.18.2 Video-Output Stages	3-281	3-10.22.2.5 Noise	3-345
3-10.18.3 DC Restorers	3-282	3-10.22.2.6 Shading	3-345
3-10.18.4 Differential Amplifiers	3-283	3-10.22.2.7 Moire	3-346
3-10.18.5 Sync Separators	3-284	3-10.22.3 Monitor Testing	3-346
3-10.18.6 Vertical-Deflection Generators	3-286	3-10.22.3.1 Resolution	3-346
3-10.18.7 Horizontal Deflection	3-289	3-10.22.3.2 Geometric Distortion	3-347
3-10.18.8 Horizontal Output Circuits . . .	3-291	3-10.22.3.3 Gamma	3-348
3-10.18.9 Transistor Horizontal-Output Circuits	3-293	3-10.22.4 Sync Generators	3-348
3-10.18.10 Dynamic Focus	3-295	3-10.22.4.1 Pulse Widths and Amplitudes	3-348
3-10.18.11 High-Voltage Supplies	3-295	3-10.22.4.2 Pulse-Cross Display	3-348
3-10.19 Supporting Equipment	3-297	3-10.22.5 Measurements In Video- Distribution Equipment	3-349
3-10.19.1 Video Distribution Amplifiers	3-297	3-10.22.5.1 The Multiburst Signal	3-350
3-10.19.2 Pulse Distribution Amplifiers	3-297	3-10.22.5.2 The Stairstep Signal	3-350
3-10.19.2.1 Schmitt Trigger	3-298	3-10.22.6 Noise Measurements	3-353
3-10.19.2.2 Output Stages	3-298	3-11 Radiac Equipment Testing	3-354
3-10.19.3 Video-Insert Amplifiers	3-299	3-11.1 General	3-354
3-10.19.4 Equalizing Amplifiers	3-303	3-11.2 Radiac Fundamentals	3-354
3-10.19.5 Stabilizing Amplifiers	3-303	3-11.2.1 Alpha Particles	3-354
3-10.19.5.1 Circuits	3-305	3-11.2.2 Beta Particles	3-355
3-10.19.5.2 Equalization Circuits	3-308	3-11.2.3 Gamma Waves	3-355
3-10.19.6 Video Switches	3-308	3-11.2.4 Neutron Particles	3-355
3-10.19.6.1 Single-Output Mechanical Switches	3-308	3-11.3 Radiactive Materials	3-355
3-10.19.6.2 Complex Mechanical Switches	3-308	3-11.4 Unit of Radiation Measurement . .	3-355
3-10.19.6.3 Electronic Switchers	3-309	3-11.5 Quality Factors	3-355
3-10.20 Optics	3-310	3-11.6 Radiation Detectors	3-355
3-10.20.1 Optical Terms	3-310	3-11.6.1 Ionization Chamber	3-355
3-10.20.2 Fixed Lenses	3-317	3-11.6.2 Geiger-Mueller Tube	3-356
3-10.20.3 Zoom Lenses	3-318	3-11.6.3 Scintillation Counters	3-357
3-10.20.4 Lens Care	3-320	3-11.6.4 Dosimeter	3-358
3-10.21 Television Recording	3-320	3-12 Synchro and Servo Equipment	3-358
3-10.21.1 Magnetic-Tape Recording	3-321	3-12.1 General	3-358
3-10.21.2 Vertical Scan	3-323	3-12.1.1 Transmitter (Generator) Synchro	3-358
3-10.21.3 Helical Scan	3-323	3-12.1.2 Receiver (Motor) Synchro	3-359
3-10.21.4 Electronics Assembly	3-324	3-12.1.3 Differential Synchros	3-359
3-10.21.5 Tape-Transport System	3-327	3-12.1.4 Control Transformer (CT) Synchros	3-359
3-10.21.6 Circuit Descriptions	3-328	3-12.1.5 Synchro Capacitors	3-359
3-10.22 Television Testing and Maintenance	3-337	3-12.1.6 Servo Circuits	3-359

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
3-12.2 Synchro Equipment Testing	3-360	3-15 Magnetic Amplifiers	3-381
3-12.2.1 Overload Indicators	3-360	3-15.1 Basic Principles	3-382
3-12.2.2 Blown-Fuse Indicators	3-360	3-15.2 Amplifier Circuits Without Feedback	3-382
3-12.2.3 Voltage and Resistance Measurements	3-360	3-15.3 Amplifier Circuits With Feedback	3-385
3-12.2.4 Symptoms of Incorrect Wiring . .	3-360	3-15.4 Construction	3-385
3-12.2.5 Symptoms of Open-Circuited and Short-Circuited Wiring	3-360	3-15.5 Amplifiers Using Twin Toroidal Cores	3-386
3-12.3 Synchro Zeroing Methods	3-360	3-16 Power Supplies	3-386
3-12.3.1 Zeroing Receiver Synchros	3-363	3-16.1 Half-Wave Power Supplies	3-387
3-12.3.2 Zeroing Transmitter Synchros . .	3-363	3-16.2 Full-Wave Power Supplies	3-387
3-12.3.3 Zeroing Differential Transmitter Synchros	3-364	3-16.3 Bridge-Type Power Supplies	3-387
3-12.3.4 Zeroing Differential Receiver Synchros	3-364	3-16.4 Voltage Multiplier Circuits	3-387
3-12.3.5 Zeroing Control Transformer Synchros	3-364	3-16.4.1 Full-Wave Voltage Doubler	3-389
3-12.4 Synchro Testing	3-364	3-16.4.2 Cascade Voltage Doubler	3-389
3-12.4.1 Angle Position Indicator	3-365	3-16.4.3 Voltage Tripler	3-389
3-12.4.2 Standard Test Synchros	3-365	3-16.4.4 Voltage Quadrupler	3-389
3-13 Automatic Control Systems	3-365	3-16.5 Multiphase Power Supplies	3-389
3-13.1 Electronic Servomechanism Controls	3-365	3-16.5.1 Three-Phase Half-Wave Power Supply	3-389
3-13.1.1 DC Servomotor Method	3-365	3-16.5.2 Six-Phase Half-Wave Power Supply	3-389
3-13.1.2 AC Servomotor Method	3-365	3-16.6 RF High-Voltage Supply	3-390
3-13.1.2.1 Input Error Signal	3-365	3-16.7 Voltage Regulators	3-392
3-13.1.2.2 Diode Limiter Circuit	3-365	3-16.7.1 Gas-Tube Regulator	3-392
3-13.1.2.3 Differential Amplifier Circuit	3-366	3-16.7.2 Electronic Regulator	3-393
3-13.1.2.4 Class B Push Pull Circuit	3-366	3-16.8 Time Delay Circuits	3-393
3-13.1.2.5 Motor Driver Circuit	3-366	3-16.9 Generators and Motors	3-395
3-13.1.2.6 Gear Train	3-366	3-16.9.1 Generators	3-395
3-13.2 Amplidyne Servomechanism Control Method	3-367	3-16.9.2 Motors	3-395
3-13.3 Hydraulic Servomechanism Controls	3-371	3-16.9.3 Dynamotors	3-395
3-13.3.1 Variable-Flow Pump	3-371	3-16.9.4 Maintenance Considerations . . .	3-396
3-13.3.2 Hydraulic Motor	3-372	3-16.9.5 Lubrication	3-396
3-13.3.3 Oil Pressure	3-372	3-16.9.6 Temperature Checks	3-397
3-13.3.4 Error Measurements	3-373	3-16.9.7 Noise	3-397
3-14 Gyro Stabilization Systems	3-373	3-16.9.7.1 Electrical Noise	3-397
3-14.1 Gyro Fundamentals	3-373	3-16.9.8 Test Instruments	3-398
3-14.1.1 Electrically Suspended Gyro . . .	3-375	3-16.9.8.1 Motoring Test	3-398
3-14.1.2 System of Coordinates	3-375	3-16.9.8.2 Testing for Insulation Breakdown	3-398
3-14.2 Stable Elements	3-377	3-16.9.8.3 Checking Commutator	3-399
3-14.2.1 Pitch and Roll Stabilization . . .	3-379	3-16.9.8.4 Checking Generator Under Load	3-399
3-14.3 Maintenance Considerations	3-381	3-16.9.8.5 Testing and Servicing Brushes	3-399
		3-16.9.8.6 Fire and Flashing	3-400
		3-16.9.8.7 Replacing Brushes	3-400

TABLE OF CONTENTS

Paragraph	Page	Paragraph	Page
3-17	Swept Frequency Testing Techniques	3-400	
3-17.1	Tracking Generator	3-401	
3-17.2	Impedance Matching	3-401	
3-17.3	Other Sweep Frequency Techniques	3-401	
3-17.3.1	Impedance	3-401	
3-17.3.2	Noise Figure	3-402	
3-17.3.3	Additional Tests	3-402	
3-18	Computer Equipment Testing	3-402	
3-18.1	Computer Types	3-402	
3-18.1.1	Analog Computers	3-403	
3-18.1.2	Digital Computers	3-403	
3-18.1.2.1	Input	3-404	
3-18.1.2.2	Output	3-404	
3-18.1.2.3	Memory	3-404	
3-18.1.2.4	Arithmetic	3-405	
3-18.1.2.5	Control	3-405	
3-18.2	Maintenance Techniques	3-405	
3-18.2.1	Maintenance Programs	3-405	
3-18.2.2	Basic Programs	3-405	
3-18.2.3	Reliability Programs	3-406	
3-18.2.3.1	Types	3-406	
3-18.2.3.2	Interpretation	3-406	
3-18.2.4	Diagnostic Programs	3-406	
3-18.2.4.1	Increasing-Area Check	3-406	
3-18.2.4.2	Decreasing-Area Check	3-406	
3-18.2.4.3	Overlapping-Area Check	3-406	
3-18.2.4.4	Large-Area Check	3-406	
3-18.2.5	Utility Programs	3-406	
3-18.2.6	Marginal Checking	3-407	
3-18.2.6.1	DC Supply Voltage Variation	3-407	
3-18.2.6.2	Circuit-Part Value Variation	3-407	
3-18.2.7	BITE Testing	3-407	
3-18.3	Computer Diagrams	3-409	
3-18.3.1	Logic Symbols	3-409	
3-18.4	Logic Gates	3-410	
3-18.4.1	The Inverter Circuit	3-411	
3-18.4.2	The AND Gate	3-411	
3-18.4.3	The OR Gate	3-412	
3-18.4.4	The NOR Gate	3-413	
3-18.4.5	The NAND Gate	3-415	
3-18.4.6	The Emitter Follower	3-416	
3-18.5	Digital Binary Registers	3-416	
3-18.5.1	UP Counter Design	3-418	
3-18.5.2	DOWN Counter	3-420	
3-18.5.3	Double Rank Counter	3-421	
3-18.6	Timing	3-422	
3-18.6.1	Timing Pulse Generation	3-422	
3-18.6.2	Word Time Generation	3-423	
3-18.7	Shift Registers	3-428	
3-18.7.1	"Shift to Zero" Registers	3-429	
3-18.7.2	The Force Transfer Shift Register	3-430	
3-18.7.3	Magnetic Core Shift Registers	3-431	
3-18.7.4	The Parallel Binary Register	3-433	
3-18.7.5	Military Standard Symbols	3-433	
3-18.7.6	Multiplication and Division, Using Shift Registers	3-434	
3-18.8	Adders	3-434	
3-18.8.1	Fundamentals of Addition	3-434	
3-18.8.2	Additions Using Bi-stable Devices	3-436	
3-18.8.2.1	Serial Quarter-Adders	3-436	
3-18.8.2.2	Serial Half-Adders	3-437	
3-18.8.2.3	Serial Adders	3-437	
3-18.9	Subtractors	3-438	
3-18.9.1	Fundamentals of Subtraction	3-438	
3-18.9.2	Subtractions Using Bi-stable Devices	3-439	
3-18.9.2.1	Quarter-Subtractors	3-439	
3-18.9.2.2	Half-Subtractors	3-439	
3-18.9.3	Symbolic Quarter-Adder	3-440	
3-18.9.4	Full Serial Add-Subtract Units	3-440	
3-18.9.5	Parallel Additions and Subtractions in Binary Digital Computers	3-441	
3-18.9.5.1	Parallel Adders-Subtractors	3-441	
3-18.9.6	Incremental Adders in Special Purpose Circuits	3-442	
3-18.10	Storage Devices	3-442	
3-18.10.1	Types of Storage Devices	3-443	
3-18.10.2	Definition of Terms	3-443	
3-18.10.3	Delay Line Storage	3-444	
3-18.10.4	Electrostatic Storage	3-444	
3-18.10.5	Magnetic Spot Storage	3-444	
3-18.10.5.1	Basic Principles	3-445	
3-18.10.5.2	RZ Recording	3-446	
3-18.10.5.3	NRZ Recording	3-446	
3-18.10.5.4	NRZ Read-Write Circuits	3-447	
3-18.10.5.5	Types of Magnetic Spot Storage Devices	3-447	
3-18.10.5.5.1	Magnetic Drum	3-448	
3-18.10.5.5.2	Magnetic Tapes	3-448	
3-18.10.5.5.3	Magnetic Disks	3-448	
3-18.10.6	Magnetic Core Storage	3-448	
3-18.10.6.1	Reading	3-449	
3-18.10.6.2	Writing	3-450	

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
3-18.11 Compensators	3-450	4-8.3 Resistor-Inductor Differentiation .	4-13
3-18.11.1 Exclusive "OR"	3-450	4-9 Integrated Voltage Waveforms.	4-14
3-18.11.2 Algebraic Comparator	3-451	4-10 Modulated Waveforms	4-14
3-18.12 Alignment	3-452	4-10.1 Amplitude Modulation.	4-15
3-18.12.1 Core Memories	3-452	4-10.2 Frequency Modulation.	4-17
3-18.12.2 Magnetic Drums	3-453	4-10.3 Phase Modulation	4-19
3-18.12.3 Timing Adjustment	3-453	4-10.4 Pulse Modulation	4-19
3-18.12.4 Signal Amplitude Adjustment	3-454	4-11 Response and Discriminator Waveforms	4-19
3-18.12.5 Timing and Amplitude Relationship	3-454	4-11.1 Response Curves	4-19
3-18.13 Preventive Maintenance	3-454	4-11.2 Discriminator Curves	4-21
3-18.13.1 Magnetic Drum Units.	3-455	4-12 Intensity Modulated Presentations.	4-23
3-18.13.2 Tape Drive Units.	3-455	4-12.1 Comparing Two Frequencies.	4-23
3-18.13.3 Magnetic Tape	3-455	4-13 Circular Sweep Presentations.	4-24
3-18.14 Troubleshooting	3-456	4-14 Waveform Distortion	4-24
3-18.14.1 Memory Units	3-456	4-14.1 Amplitude	4-26
3-18.14.2 Magnetic Drum Units.	3-457	4-14.2 Frequency Distortion.	4-26
3-18.14.3 Maintenance Programs	3-457	4-14.3 Interference Distortion.	4-26
3-18.14.4 Write-Read Check	3-457	4-15 Use of Lissajous Figures	4-28
3-18.14.5 Runout Test	3-457	4-15.1 Phase Relationship	4-28
3-18.14.6 Noise Test	3-458	4-15.2 2:1 Lissajous Patterns	4-30
3-18.14.7 Crosstalk Test	3-458	4-15.3 3:1 Lissajous Patterns	4-33
3-18.14.8 Magnetic Tape Units	3-459	4-15.4 Other Lissajous Patterns.	4-34
3-18.15 Repair Procedures	3-459	4-16 Transient Response Measurement.	4-35
SECTION 4 - WAVEFORM INTERPRETATION		4-16.1 Background	4-35
4-1 Waveform and Phase Development	4-1	4-16.2 Measurement Technique.	4-36
4-2 Sinusoidal Waveforms.	4-1	4-16.3 Transients	4-37
4-3 Non-Sinusoidal Waveforms	4-2	4-16.4 Reactive Elements.	4-37
4-3.1 Phase Distortion	4-4	4-16.5 Resistive Elements.	4-38
4-3.2 Harmonic Distortion	4-4	4-16.5.1 High Frequency Elements	4-38
4-3.3 Complex Waveforms	4-4	4-16.6 Measuring Equipment	4-38
4-3.4 Mirror Symmetry	4-4	4-16.7 Test Equipment Connection	4-39
4-4 Square Waveforms.	4-5	4-16.8 Transistor Considerations	4-39
4-5 Rectangular Waveforms	4-8	4-16.9 Transistor Delay Time	4-40
4-6 Sawtooth Waveforms	4-9	4-16.10 Transistor Storage Time	4-40
4-7 Trapezoidal Waveforms.	4-9	4-16.11 Transistor Response.	4-41
4-8 Differentiated Voltage Waveform	4-11	4-17 Spectrum Waveform Analysis and Measurements.	4-42
4-8.1 Rectangular Voltage Waveforms.	4-12	4-17.1 Electromagnetic Frequency Spectrum.	4-42
4-8.2 Sawtooth Voltages	4-13		

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
4-17.2 Wavelength-Frequency Conversion	4-42	5-3 Directional Couplers	5-7
4-17.3 Acoustic Spectrum	4-42	5-4 Peak Power Measurement	5-9
4-17.4 Spectrum Analysis	4-42	5-4.1 Notch Wattmeter Method	5-9
4-17.5 Frequency Domain-Display Capabilities	4-42	5-4.1.1 Alternate Method	5-10
4-17.6 Spectrum Analysis Usages	4-42	5-4.2 Heterodyne Method	5-10
4-17.7 Complex Waveform	4-47	5-4.3 Integration-Differentiation Method	5-10
4-17.8 Modulation Measurements	4-47	5-4.3.1 Accuracy	5-11
4-17.8.1 Amplitude Modulation	4-47	5-4.4 Average to Peak Power Conversion	5-11
4-17.8.2 Frequency Modulation	4-48	5-4.5 Low Peak Power Measurement	5-12
4-17.8.3 Phase Modulation	4-50	5-5 Standing Wave Measurements	5-12
4-17.8.3.1 Sidebands	4-50	5-5.1 General	5-12
4-17.9 Carrier Frequency	4-52	5-5.2 Standing Waves	5-12
4-17.10 Pulsed Waves	4-52	5-5.2.1 Standing Wave Characteristics	5-12
4-17.11 Rectangular Pulse	4-52	5-5.2.2 Ratios	5-13
4-17.12 Pulsed Wave Analysis	4-52	5-5.2.3 Measurement	5-13
4-17.13 Analyzing the Spectrum Pattern	4-53	5-5.3 Lecher-Line Methods	5-13
4-17.13.1 Typical Spectrum Patterns	4-55	5-5.4 Probes	5-14
4-17.13.2 Spectrum Analyzer Interpretation	4-55	5-5.5 Neon Lamp Method	5-14
4-17.13.2.1 Line Spectrum	4-55	5-5.6 Shorting Bar Method	5-14
4-17.13.2.2 Pulse Spectrum	4-55	5-5.7 Bridge Methods	5-15
4-17.14 Spectrum Analyzer Operation	4-55	5-5.8 Resistance-Capacitance Bridge	5-15
4-17.14.1 Resolution	4-55	5-5.8.1 Calibration	5-15
4-17.14.2 Other Spectrum Analyzer Considerations	4-55	5-5.9 Accuracy of Bridge Measurements	5-16
SECTION 5 — ANTENNA AND TRANSMISSION LINE MEASUREMENTS		5-5.10 Power Out vs Impedance Matching	5-16
5-1 Direct RF Power Measurement	5-1	5-5.10.1 Tuning Procedure	5-16
5-1.1 Basic Variation Method	5-1	5-5.11 Wavemeter Methods	5-17
5-1.2 Two Register Variation Method	5-2	5-5.12 Reaction-Type Wavemeter	5-17
5-1.3 Substitution Method	5-2	5-5.13 Absorption-Type Wavemeter	5-17
5-1.4 RF Bridge Method	5-8	5-5.14 Coaxial-Line Wavemeters	5-18
5-1.4.1 RF Balanced Bridge	5-4	5-5.14.1 Procedure	5-18
5-1.5 RF Power Output Meter Method	5-4	5-5.15 Coaxial Cavities	5-18
5-1.5.1 Energy Source	5-4	5-5.16 Coupling	5-18
5-1.5.2 Dummy Loads	5-4	5-5.17 Accuracy of Cavity Wavemeters	5-20
5-1.5.3 Dummy Load Limitations	5-5	5-5.18 Grid Dip Meter Method	5-20
5-2 Indirect RF Power Measurement	5-6	5-5.19 Crystal Voltmeter Method	5-21
5-2.1 General	5-6	5-5.20 Thermal Methods	5-21
5-2.2 Lamp Load Method	5-6	5-5.21 Photoammeter Method	5-21
5-2.2.1 Alternate Method	5-6	5-6 Field Strength Measurements	5-21
5-2.3 Bolometer Methods	5-7	5-6.1 General	5-21
5-2.3.1 Thermistors	5-7	5-6.2 Variables	5-22
		5-6.3 Test Equipment	5-22
		5-6.4 Relative Field Strength Measurement	5-22

TABLE OF CONTENTS (Continued)

Paragraph	Page	Paragraph	Page
5-6.5 Absolute Field Strength Measurement	5-22	5-6.13.2 Minimizing Errors of Field Strength Measurements	5-32
5-6.6 Alternate Signal Generator Methods	5-23	5-6.13.3 Expected Values of Accuracy	5-33
5-6.7 Standard Antenna Method	5-23	5-6.13.4 Final Error Measurement Data.	5-33
5-6.8 Standard Field Method	5-24	5-6.14 Atmospheric Effects	5-33
5-6.9 Induction Field Technique	5-24	5-6.14.1 Ionospheric Measurement.	5-33
5-6.10 Radiation Field Technique	5-24	5-6.14.2 Ionosphere Measurement Using Oscilloscope	5-33
5-6.11 Field Strength Measuring Devices	5-25	5-6.14.3 Atmospheric Noise Measurements	5-33
5-6.11.1 Antenna	5-25	5-6.15 Mobile and Automatic Recording	5-34
5-6.11.2 Effective Antenna Length	5-25	5-7 Time Domain Reflectometry	5-34
5-6.11.3 Antenna Radiation Resistance.	5-25	5-7.1 General.	5-34
5-6.12 Test Techniques	5-25	5-7.2 Test Setup.	5-35
5-6.12.1 Antenna Directivity Patterns	5-25	5-8 Insertion Loss Considerations	5-36
5-6.12.2 Gain and Effective Area.	5-26	5-8.1 General.	5-36
5-6.12.3 Receivers	5-26	SECTION 6 — SYSTEM TESTING	
5-6.12.4 Vacuum-tube Voltmeters.	5-26	6-1 System Make-up	6-1
5-6.12.5 Thermocouples	5-26	6-2 System Testing Procedure	6-1
5-6.12.6 Bolometers	5-27	6-3 Types of Systems Tests.	6-1
5-6.12.7 Crystal Rectifiers	5-27	6-3.1 Transmitter System Testing	6-1
5-6.12.8 Standard Oscillators	5-27	6-3.2 Receiver System Testing.	6-1
5-6.12.9 Frequency Considerations	5-27	6-3.3 Display System Testing	6-2
5-6.12.9.1 LF and MF Radiation Measurement Methods	5-27	6-3.4 Interface and Control System Testing	6-2
5-6.12.9.2 Errors	5-27	6-4 Intersystem Test	6-2
5-6.12.9.3 Radiation Efficiency.	5-28	6-4.1 Back-to-Back Test.	6-3
5-6.12.10 HF Radiation Measurement Methods	5-28	6-4.2 End Around Test	6-4
5-6.12.11 Microwave Radiation Measurement Methods	5-28	6-4.3 Off-Ship System Testing.	6-4
5-6.12.12 Standard Antenna Method	5-29	6-4.4 Interconnecting Cable Testing.	6-5
5-6.12.13 Standard Field Method	5-29	6-4.4.1 Cable Short Testing	6-5
5-6.12.13.1 Test Site.	5-29	6-4.4.2 Cable Open Testing.	6-5
5-6.12.14 Test Equipment Calibration	5-30	6-4.4.3 Fault Location in Long Cable Runs	6-5
5-6.12.15 Loop Antenna Standardization	5-30	6-4.4.3.1 Ground Testing via Varley Loop.	6-5
5-6.12.15.1 Limitations.	5-30	6-4.4.3.2 Short (Cross) Testing via Varley Loop.	6-6
5-6.12.16 Dipole Antenna Calibration	5-30	6-4.4.3.3 Alternative Loop Methods.	6-6
5-6.12.17 Silicon Crystal Rectifier Calibration	5-31	6-4.4.3.4 Opens Location via Bridge Method	6-8
5-6.12.18 Antenna Horn Calibration	5-31		
5-6.12.19 Voltage Transfer Ratio.	5-32		
5-6.12.20 Receiver Indicator Calibration	5-32		
5-6.13 Accuracy of Field Strength Measurements.	5-32		
5-6.13.1 Sources of Error.	5-32		

LIST OF ILLUSTRATIONS

Figure	Page	Figure	Page
SECTION 1 — GENERAL			
1-1	Electronic Maintenance, Functional Diagram.	1-2	
SECTION 2 — BASIC MEASUREMENTS			
2-1	Basic Ohmmeter Circuits.	2-4	
2-2	Capacitor Bridge Measuring Circuit . . .	2-8	
2-3	Capacitance-Measuring Section Taken from a Typical Reactance Type Electronic Volt-OHM-Capacitance Milliammeter.	2-10	
2-4	Basic Bridge Circuits Used for Inductance Measurements.	2-12	
2-5	Determining Inductance with a VTVM and Decade Resistance Box.	2-13	
2-6	Basic Bridge Circuits	2-15	
2-7	General Bridge Circuit Configuration. .	2-16	
2-8	Resistance-Ratio Bridge Residual Elements	2-16	
2-9	Wagner Ground.	2-16	
2-10	Substitution Bridge Schematic.	2-18	
2-11	Generalized Four Terminal Network. .	2-19	
2-12	Twin-T Circuit	2-19	
2-13	Bridged-T Bridge	2-20	
2-14	A Null Instrument Utilizing a Bridged-T.	2-20	
2-15	Input and Output Impedances of Twin-T at Balance	2-20	
2-16	Vector Bridge	2-21	
2-17	Vector Bridge Phase Angle Determination	2-21	
2-18	Vector Bridge Phasor Diagram	2-22	
2-19	Constant-Current Impedance Measuring Method.	2-22	
2-20	Impedance-Angle Meter	2-23	
2-21	Square Wave Impedance Measurement Test Arrangement.	2-23	
2-22	Square Wave Technique for R or C Measurement	2-24	
2-23	Waveform of Voltage E_R	2-24	
2-24	Square Wave Technique for L Measurement	2-24	
2-25	One-Voltmeter Method of Impedance Measurement.	2-24	
2-26	Simplified Q-Meter Circuit, Series. . . .	2-25	
2-27	Simplified Q-Meter Circuit, Parallel. . .	2-25	
2-28	Simplified Q-Meter Connection for Measuring Small Capacitances	2-26	
2-29	Simplified Q-Meter Connection for Measuring Large Capacitances	2-27	
2-30	Typical RF Bridge.	2-28	
2-31	Schematic Circuit of a Volume-Level Indicator for Measuring Audio-Frequency Power in the Transmission of Speech and Music Showing Connections to a Calibrating Circuit.	2-30	
2-32	Electrical Equivalent of the Electrodynamic Wattmeter	2-30	
2-33	Electrical Equivalent of Compensated Electrodynamic Wattmeter	2-31	
2-34	Mechanical Equivalent of the Electrodynamic Wattmeter	2-31	
2-35	Simple Electronic Wattmeter Circuit. .	2-32	
2-36	VHF-UHF Wattmeter.	2-33	
2-37	Typical In-Line Wattmeter	2-33	
2-38	Basic Bolometer Bridge Circuit.	2-34	
2-39	Typical Thermistor Characteristics . . .	2-34	
2-40	Potentiometer Bridge.	2-35	
2-41	Product Bridge	2-35	
2-42	Summation Bridge.	2-36	
2-43	Simplified Diagram of a Two-Disk Thermistor Bridge	2-36	
2-44	Simplified Diagram of V Bridge	2-37	
2-45	Self-Balancing Bridge Circuit	2-37	
2-46	Relation Between Bolometer Wire Dimensions and Wavelength for Small Substitution Error	2-37	
2-47	Power Meter Block Diagram	2-38	
2-48	Generalized Adiabatic Calorimeter Using Low-Frequency Power Substitution.	2-39	
2-49	NBS Adiabatic Calorimeter	2-39	
2-50	Twin Calorimetric System.	2-40	
2-51	Differential Air Thermometer-Type Calorimeter	2-40	
2-52	Generalized Flow Calorimetric System Using Substitution at Low-Frequency Power.	2-41	
2-53	Generalized Balanced Flow Calorimeter	2-41	
2-54	National Bureau of Standards Frequency and Time Facilities.	2-42	
2-55	Schedules for WWV and WWVH.	2-44	

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
2-56	Time Code Format of WWV and WWVH	2-46	2-85	Traveling-Wave Tube Test Arrangement	2-67
2-57	Direct Phase Comparison	2-49	2-86	Collector Leakage Current Test Circuit	2-68
2-58	Lissajous Patterns, Showing Frequency Ratios	2-51	2-87	Transistor Direct-Current Gain Test.	2-69
2-59	Lissajous Patterns of a 1:1 Ratio, Showing Effect of Phase Relationships	2-52	2-88	Direct Reading Transistor Direct-Current Gain Tester	2-69
2-60	Undistorted Transmitter Output Signal	2-52	2-89	Transistor Punch-Through Voltage (V_{PT}) Test Circuit.	2-70
2-61	Distorted Transmitter Output Signal	2-52	2-90	Transistor Beta-Test Circuit.	2-70
2-62	In-Circuit Tester Schematic Diagram	2-53	2-91	Circuit to Display Collector Current-Voltage Curve	2-70
2-63	Typical Oscilloscope Displays	2-53	2-92	Typical Collector Current-Voltage Curve	2-71
2-64	Transistor Check-Single Junction	2-54	2-93	Display Circuit Used with Oscilloscope OS-8C/U	2-72
2-65	Diode Check.	2-54	2-94	Typical Characteristic Curve of a Silicon Diode	2-72
2-66	Transistor Check-Base to Emitter	2-54	2-95	Diode Reverse Current-Voltage Characteristics	2-73
2-67	Transistor Check-Base to Collector	2-54	2-96	Semiconductor Diode Test Circuit	2-73
2-68	Potentiometer Noise Check.	2-55	2-97	Zener Diode Characteristic Pattern	2-73
2-69	Distinction Between PNP and NPN Transistors	2-55	2-98	SCR Active Elements	2-74
2-70	Tester Using 1.0-Volt Source	2-55	2-99	Testing an SCR with an Ohmmeter.	2-74
2-71	Tester Using 10.0-Volt Source	2-56	2-100	Gate-Controlled Full-Wave AC Silicon Switch.	2-74
2-72	Modified In-Circuit Tester (Schematic Diagram)	2-56	2-101	First Test.	2-75
2-73	Tester Using 1.0-Volt Source	2-57	2-102	Second Test	2-75
2-74	Tester Using 10.0-Volt Source	2-57	2-103	Unijunction Transistor	2-75
2-75	Antenna Current Increase with Amplitude Modulation	2-58	2-104	Unijunction Transistor Equivalent Circuit	2-76
2-76	RF Carrier Amplitude Modulated by a Complex Waveform.	2-58	2-105	Junction FETs	2-76
2-77	RF Amplitude Percentage Modulation	2-59	2-106	N Channel JFET Equivalent Circuit	2-76
2-78	Trapezoidal Modulation Patterns	2-60	2-107	P Channel JFET Equivalent Circuit.	2-76
2-79	Overmodulated RF Carrier	2-60	2-108	MOSFET (Depletion/Enhancement Type)	2-77
2-80	Examples of Ideal Two-Tone Test Waveforms.	2-61	2-109	MOSFET (Depletion/Enhancement Type) Equivalent Circuit.	2-77
2-81	FM Deviation and Harmonic Distortion Test Set Up	2-62	2-110	MOSFET (Enhancement Type)	2-77
2-82	Circuit to Display Plate Current-Voltage Characteristic of a Diode Tube	2-65	2-111	MOSFET (Enhancement Type) Equivalent Circuit	2-77
2-83	Circuit to Display Plate Current-Voltage Characteristic of a Triode Tube	2-65	2-112	Logic Pulse Generator	2-80
2-84	Oscilloscope Presentation of Triode Tube Plate Current-Voltage Characteristic	2-66	2-113	Typical Logic Probe	2-81
			2-114	Dip-Type IC	2-82

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
2-115	Flat Pack IC	2-82	3-14	Limiter-Type Discriminator Circuit. .	3-16
2-116	IC Can.	2-82	3-15	Discriminator Characteristic	
2-117	Median Values of Average Noise			Measurements.	3-17
	Power Expected from Various		3-16	Ratio Detector Circuit	3-18
	Sources (Omni-Directional		3-17	Frequency Standard Distribution	
	Antenna near Surface)	2-84		System	3-20
2-118	Standard Antenna Method for		3-18	Frequency Synthesizer.	3-21
	Measuring Field Strength	2-87	3-19	Harmonic Distortion Displays	3-22
2-119	Substitution Method of Determining		3-20	Amplitude-Modulated Carrier	3-22
	Field Strength.	2-88	3-21	Trapezoidal AM Carrier Pattern	3-22
2-120	Probe Meter	2-92	3-22	Distorted Amplitude-Modulated	
2-121	Magnetic Flux Density Adapter			Waveforms.	3-23
	in Use	2-92	3-23	Trapezoid Method of Determining	
2-122	Search-Coil in Neutral Plane			% of Modulation	3-24
	of Magnet	2-93	3-24	Overmodulated Carrier.	3-24
2-123	Fluxmeter Model FM.	2-93	3-25	Variation of FM Wave Component	
2-124	Hall-Effect Device	2-94		with Degree of Modulation	3-26
2-125	Coaxial Line.	2-97	3-26	FM Spectral Display at Indices of	
2-126	Noise Figure Measurement	2-99		1.603, 3.037, 4.592, and 7.000	
2-127	Superheterodyne Receiver			Respectively (Carrier @ 30%).	3-28
	Stage Gain	2-100	3-27	Typical Single-Tone Output of a	
2-128	Minimum Discernible Signal			Balanced Modulator.	3-29
	Measurement	2-101	3-28	Sideband Filter Outputs	3-30
			3-29	Examples of Ideal Two-Tone	
				Test Waveforms.	3-30
			3-30	Equipment Setup for Measurement	
				of Signal-To-Distortion Ratio,	
				Using the Two-Tone Test	3-31
				I-F Gain and Distortion	
				Measurement, Test Equipment	
				Arrangement	3-32
3-1	Typical Impedance Matching		3-32	VHF Transceiver Main Tuning	
	Network	3-1		Capacitor.	3-33
3-2	Typical Equipment Arrangement		3-33	Transmitter Average Power	
	for Radio Receiver Testing	3-2		Measurement Configurations	3-34
3-3	Equipment Arranged to Obtain		3-34	Directional Coupler with Automatic	
	a Visual IF Bandwidth Response	3-5		Drive Control Signal.	3-35
3-4	Selectivity Curve of Typical AM		3-35	Neutralization Circuits	3-37
	Receiver	3-6	3-36	Facsimile System, AFTS and	
3-5	Receiver Response Curve	3-6		RFCS Modes	3-38
3-6	Effects of Decreased Scan Speed		3-37	Facsimile System, Data Mode	3-39
	with Constant Scan Width.	3-7	3-38	Facsimile Recorder Set AN/UXH-2C.	3-41
3-7	Automatic Gain Control,		3-39	Facsimile Recorder Set, Functional	
	Characteristic Curve.	3-7		Block Diagram	3-41
3-8	Squelch Circuit Employing F.E.T.	3-8	3-40	Location of Test Switches.	3-44
3-9	Equivalent Electrical Circuit and		3-41	Mark and Space Signals in the	
	Reactance Curve of a Quartz			Teletype Character R.	3-47
	Crystal	3-10	3-42	Five-Level Code Chart	3-48
3-10	Crystal Filter Circuit	3-11			
3-11	Wave Trap Circuits.	3-12			
3-12	Beat Frequency Oscillator Circuit.	3-13			
3-13	FM Versus AM Resonance Curves.	3-15			

SECTION 3 — TEST TECHNIQUES
AND PRACTICES

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
3-43	The 7.42-Unit Teletype Signal	3-49	3-74	Reverse Directional Coupler	3-86
3-44	Selecting Intervals for Letter Y	3-49	3-75	Single-Hole Directional Coupler	3-87
3-45	Teletypewriter Distortion	3-51	3-76	Bidirectional Coupler	3-87
3-46	Test Configuration for DC Distortion Tests	3-54	3-77	Waveguide Attenuators, Showing Construction	3-88
3-47	Crossover Pattern Seen on a Bias-Free Signal	3-54	3-78	Radar AFC, Block Diagram	3-91
3-48	Crossover Pattern Seen on Active Traffic Channel with Approximately 25% Distortion	3-54	3-79	Typical Radar Mixer and AFC Circuits	3-92
3-49	Basic Components of an Infrared Facility	3-56	3-80	Gas Discharge Tube Noise Source	3-95
3-50	Infrared Band	3-57	3-81	MDS Measurements Using Pulsed RF Signal Generator	3-96
3-51	The Atmospheric Transmission Spectra	3-57	3-82	MDS Measurement Using FM Signal Generator	3-97
3-52	Transparent Region of Various Materials	3-58	3-83	Signal-Width and Phase-Control Circuit	3-97
3-53	Spectrum Analysis Experiment	3-60	3-84	Effect of Sawtooth Amplitude on Presentation of Artificial Echo	3-97
3-54	Golay Cell Structural Arrangement	3-62	3-85	Receiver Response Curve	3-99
3-55	Photoemissive Cell Diagram	3-63	3-86	Test Setup for Checking Receiver Response	3-100
3-56	Structure of a Semiconductor	3-63	3-87	Response Curve, Showing Marker Pip at Mid-Frequency Point	3-100
3-57	Electron Image Converter	3-64	3-88	Graphic Comparison of TR Recovery Time and Leakage Power	3-101
3-58	Typical Infrared Image Tubes	3-65	3-89	TR Recovery Test Indication Using a CW Signal	3-102
3-59	Radar Facility, Showing Timing Data Supplied by the Synchronizer	3-71	3-90	Receiver Recovery Time	3-102
3-60	Transmitter Section, Schematic Diagram	3-72	3-91	Pulse Width Measurement	3-103
3-61	Typical Radar Receiver	3-73	3-92	Trigger Pulses	3-105
3-62	Frequency Measurement, Reaction-Type	3-77	3-93	Pulse Generator Relationships	3-106
3-63	Change of Waveform Observed During Frequency Measurement	3-77	3-94	Double-Echo Range Scope Presentation	3-107
3-64	Frequency Measurement, Transmission-Type Indication	3-78	3-95	Graph of Relation Between Incident Power, Reflected Power, and SWR	3-109
3-65	Combination Power and Frequency Measurement	3-78	3-96	Time-Domain Measurement of Line Length vs Impedance	3-110
3-66	Transmitting Pulses, Showing Peak and Average Power	3-79	3-97	Ideal Spectral Display of a Modulated RF Carrier	3-111
3-67	Power to dBm Conversion Chart, 1 Milliwatt to 10 Megawatts	3-81	3-98	Transmitter Spectral Display Compared with Receiver Response Curve	3-111
3-68	Power to dBm Conversion Chart, 1 Milliwatt to 0.1 Micromicrowatt	3-82	3-99	Effect of Receiver Bandwidth upon Pulse Shape	3-112
3-69	Average to Peak (Duty Cycle) Power Conversion Chart	3-83	3-100	Transmitter Spectral Displays, Showing Distortion Resulting from Frequency Modulation	3-112
3-70	Placement of Pickup Antenna	3-84			
3-71	Directional Coupler, Cutaway View	3-85			
3-72	Directional Coupler, Direct Power Flow	3-85			
3-73	Directional Coupler, Reversed Power Flow	3-85			

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
3-101	Transmitter Spectral Display, Showing Distortion Resulting from Amplitude Modulation	3-113	3-129	Wave Scattering from Interference	3-140
3-102	Transmitter Spectral Display, Showing Distortion Resulting from Combined Frequency and Amplitude Distortion.	3-113	3-130	Omega Transmission Intercepts	3-141
3-103	Typical Spectrum Analyzer, Block Diagram	3-114	3-131	Rho-Theta Diagram	3-142
3-104	Typical Reflex Klystron Chart	3-114	3-132	Loran-C Network, Triad Arrangement	3-144
3-105	Klystron Modes as Presented on Spectrum Analyzer	3-114	3-133	Loran-C Station Network, Star Arrangement	3-144
3-106	Typical Magnetron Spectral Display	3-115	3-134	Omega Wave Radiation	3-146
3-107	Typical Magnetron Spectral Display, Analyzer Width Control Advanced.	3-115	3-135	Omega Wave Interlacing	3-147
3-108	Effect of Differentiator Upon Mixer Output	3-115	3-136	Lines of Position	3-148
3-109	Typical Spectral Display, Showing Frequency-Meter Pip	3-116	3-137	Phase Relationships	3-148
3-110	Overall Spectral Representation of Transmitter and Local Oscillator Output	3-116	3-138	Uncertainty of Ship's Position	3-149
3-111	Radar Performance Versus Maximum Range	3-119	3-139	Divergence of Lines-of-Position (LOPs).	3-149
3-112	Surface Target Nomograph	3-120	3-140	Transitional Paths of Omega Transmissions	3-150
3-113	Air Target Compensation	3-121	3-141	Omega Signal Transmission Format	3-151
3-114	Typical Echo Box	3-122	3-142	Omega Phase Differences	3-152
3-115	Ringtime Indication on a Scope	3-122	3-143	Differential Omega Concept	3-155
3-116	Echo Box Indication of Radar Trouble	3-124	3-144	Navy Navigational Satellite System	3-156
3-117	Video Section of a Typical MTI Receiver	3-126	3-145	Integrated Doppler Measurement	3-158
3-118	Filament Voltage vs Output Power	3-128	3-146	Doppler Frequency Variation with Time.	3-159
3-119	Typical Block Diagram of a Modulator Incorporating a PFN	3-129	3-147	Latitude and Longitude Grid Principle	3-161
3-120	Squarewave Generation	3-130	3-148	Stable Platform	3-162
3-121	Effects of Harmonics on Waveshape	3-130	3-149	Ship's Acceleration Vector	3-162
3-122	Klystron Electrical Representation	3-131	3-150	Basic Accelerometer.	3-162
3-123	Klystron Power Supply Connections	3-131	3-151	Platform Not Horizontal.	3-163
3-124	Klystron Sectional View	3-132	3-152	Heading Misalignment (Orientation to North)	3-163
3-125	MK XII IFF System, Simplified Block Diagram	3-137	3-153	Stable Platform Principle	3-164
3-126	Antenna System Attenuated Measurement	3-138	3-154	N-S E-W Movement	3-164
3-127	Electromagnetic Wave Propagation	3-139	3-155	Platform Tilt as Ship Moves Around Earth	3-165
3-128	E & H Field Vectors.	3-140	3-156	SINS Block Diagram	3-166
			3-157	24-Hour Latitude Error Curve	3-166
			3-158	Plot of Latitude Error Curve	3-167
			3-159	Heading vs Latitude Error	3-167
			3-160	Predicted Heading Error	3-168
			3-161	Latitude 60°N Predicted Heading Error Curve	3-168
			3-162	Longitude 24-Hour Error Plot	3-168
			3-163	Breaks in 24-Hour Error Plot	3-169
			3-164	Gyro Break Curve	3-169
			3-165	Latitude Corrections	3-169

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
3-166	Bias Corrections	3-169	3-205	Defining the Polar Axis.	3-182
3-167	Latitude Error After Reset	3-170	3-206	Polar Axis in Relation to the Earth	3-183
3-168	Latitude Error With No Bias Correction	3-170	3-207	Polar Axis Torquing.	3-183
3-169	Latitude Error Corrected to Bias Mean Axis	3-170	3-208	Defining the Equatorial Axis	3-183
3-170	Latitude and Heading Error Curve	3-171	3-209	Polar Axis in Relation to Space	3-183
3-171	Latitude and Heading Mean Axis	3-171	3-210	24-Hour Rotation of Polar Axis	3-184
3-172	Longitude Standoff	3-171	3-211	Y and E Axis Plots.	3-184
3-173	Incorrect Bias Ramp Function	3-171	3-212	3 Gyro System	3-185
3-174	Longitude Break	3-172	3-213	Y Axis Misalignment	3-185
3-175	Eliminating Longitude Error	3-172	3-214	Y and E Axis Misalignments	3-185
3-176	Correcting Longitude Error Without Correcting Bias	3-172	3-215	Heading Error.	3-186
3-177	Plotted Errors.	3-172	3-216	Latitude Change	3-186
3-178	Rotational Vectors	3-173	3-217	Latitude Change and the E Gyro	3-187
3-179	SINS 3-Gyro Arrangement	3-173	3-218	Earth Rate and the Y Gyro	3-188
3-180	Gyro Axis	3-173	3-219	Y Gyro and Earth Rate in Opposite Direction	3-188
3-181	Gyro Expanded View.	3-174	3-220	Earth Rate and the Y Gyro Approaching the Earth Plane	3-188
3-182	Gyro Perpendicular Axis.	3-175	3-221	Undamped 24-Hour Oscillation	3-188
3-183	Simplified Gyro Drawing	3-175	3-222	Heading vs Latitude	3-189
3-184	Ship Versus Platform Coordinate	3-176	3-223	Longitude Error	3-189
3-185	Gimbal and Torque Motor Arrangement	3-176	3-224	Longitude Standoff	3-189
3-186	Platform Sensing Rotation	3-177	3-225	Gyroscope	3-190
3-187	East Movement Looking from the South Pole Without X Axis Compensating Torque	3-177	3-226	Gyro Breaks.	3-190
3-188	East Movement Looking from the South Pole With Y Axis Compensating Torque	3-178	3-227	Drift Rate vs Earth Rate	3-191
3-189	North South Movement	3-178	3-228	New Drift Center.	3-191
3-190	Disturbed Platform	3-178	3-229	Drift Center After Reset	3-191
3-191	Disturbed Platform	3-179	3-230	Latitude and Heading Drift Vectors	3-192
3-192	Schuler Oscillating Platform	3-179	3-231	Monitor Platform	3-192
3-193	Result of Schuler Oscillation While Traveling East.	3-179	3-232	Monitor Platform Rotation	3-192
3-194	North-South Schuler Oscillation.	3-180	3-233	Monitor Gyro Axis Alignment	3-193
3-195	Schuler and 24-Hour Oscillations	3-180	3-234	M Gyro Aligned With X Gyro	3-193
3-196	Damping	3-180	3-235	M Gyro Aligned With Y Gyro	3-193
3-197	Second Order Damping.	3-181	3-236	Relative Occurrence of TACAN Radio Beacon Signals.	3-195
3-198	3rd Order Damping	3-181	3-237	Raydist Overview	3-198
3-199	Gyro Gimbals	3-181	3-238	Simple Television System	3-200
3-200	Space Oriented Gyro	3-181	3-239	Interlaced Scanning Sequence	3-201
3-201	Gyro Rotation in a 24-Hour Period	3-182	3-240	Simple Industrial Synchronization	3-203
3-202	Earth Referenced Gyro.	3-182	3-241	Industrial Synchronization with Blanking	3-203
3-203	Misaligned Gyro	3-182	3-242	EIA Standard RS-170 Television Waveform	3-204
3-204	Misaligned Gyro Showing Spin Axis for 24-Hour Period	3-182	3-243	EIA Standard RS-300 Waveform for Closed-Circuit Television	3-205
			3-244	IRE Scale for Monitoring Television Signals	3-205
			3-245	Oscilloscope Frequency-Response Characteristics for Television Signal Monitoring	3-206

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
3-246	Simple Closed Circuit Television System	3-206	3-280	Binary Sync Generator	3-230
3-247	Loop-through Input Circuit.	3-207	3-281	Waveforms for Generator	3-230
3-248	Construction of 75-ohm Terminating Plug.	3-207	3-282	Binary Divider Circuit	3-231
3-249	Network Using Video Distribution Amplifiers	3-208	3-283	Waveforms at Inverter (Q705)	3-232
3-250	Television System Showing Sync Distribution	3-208	3-284	Sync Pulse Narrower Circuit	3-233
3-251	Television System with Flexible Video Switching	3-209	3-285	Master Oscillator	3-233
3-252	Complex Television System.	3-209	3-286	Master Oscillator Circuit	3-234
3-253	Video Insert System.	3-210	3-287	AFC Phase Detector.	3-235
3-254	Split-Screen Hookup	3-210	3-288	Phase Relationships in AFC Phase Detector	3-235
3-255	Some Types of Video Jacks.	3-212	3-289	Blocking Oscillator Frequency Divider	3-235
3-256	Coaxial Cable Dimensions.	3-212	3-290	Basic Binary Divider Circuit.	3-236
3-257	Types of Coaxial Adapters	3-213	3-291	Collector Coupled Monostable Multivibrator	3-237
3-258	Simple Cathode-Ray Tube.	3-215	3-292	Emitter Coupled Monostable Multivibrator	3-237
3-259	Cathode of Cathode-Ray Tube.	3-215	3-293	Collector Coupled Astable Multivibrator	3-238
3-260	Action of Control Grid and First Anode.	3-216	3-294	Emitter Coupled Astable Multivibrator	3-238
3-261	Electrostatic Focusing Elements.	3-216	3-295	Typical Television Camera Circuitry	3-239
3-262	Electrostatic Field Between First and Second Anodes	3-216	3-296	Vertical Deflection Circuit	3-241
3-263	Practical Electrostatic Focus System.	3-217	3-297	Vertical Deflection Timing	3-241
3-264	Electromagnetic Focusing.	3-217	3-298	Vertical Deflection Circuitry	3-242
3-265	End View of Electron Paths in Uniform Magnetic Field	3-218	3-299	Horizontal Deflection Circuit.	3-242
3-266	Electrostatic Field Between Two Parallel Plates	3-218	3-300	Horizontal Deflection Circuitry	3-243
3-267	Electrostatic Deflection System	3-219	3-301	RC Coupled Video Amplifier.	3-244
3-268	Electron Beam in a Magnetic Field	3-220	3-302	RC Coupled Transistor Video Amplifier.	3-244
3-269	Arrangement of Deflection Coils	3-220	3-303	Shunt Compensated Vacuum Tube Video Amplifier	3-245
3-270	Bent-Gun Ion Trap	3-220	3-304	Shunt Compensated Transistor Video Amplifier	3-245
3-271	Tilted-Lens Ion Trap (2-Magnet Type)	3-221	3-305	Series Compensated Vacuum Tube Video Amplifier	3-245
3-272	Physical Construction of Vidicon	3-223	3-306	Series Compensated Transistor Video Amplifier	3-246
3-273	Physical Construction of an Electrostatic Focus Vidicon.	3-224	3-307	Series Shunt Compensated Video Amplifier.	3-246
3-274	Internal Construction of an Image Orthicon.	3-225	3-308	Cathode Compensated Video Amplifier.	3-246
3-275	Multiplier Section of an Image Orthicon	3-226	3-309	Low Frequency Compensation.	3-247
3-276	Electrode Arrangement of the SEC Tube	3-227	3-310	Voltage Feedback Pair	3-247
3-277	SEC Target.	3-227	3-311	Current Feedback Pair	3-247
3-278	EIA Standard RS-170 Sync-Generator Waveforms.	3-228	3-312	Direct Coupled Amplifier	3-248
3-279	Sync Generator of a Typical Television Camera	3-229	3-313	Complementary Voltage Feedback Pair.	3-248
			3-314	Video Amplifier Circuit	3-248
			3-315	Video Amplifier Circuits.	3-249

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
3-316	Cathode Follower Video Preamplifier	3-249	3-346	White Clipping of Linear Stairstep Waveform	3-265
3-317	Response of Prepeaking Circuit	3-250	3-347	Sync-Adding Network	3-265
3-318	Two Stage Vacuum Tube Video Preamplifier	3-250	3-348	Automatic Target Voltage Circuit.	3-266
3-319	Emitter Follower Video Preamplifier	3-251	3-349	Automatic Sensitivity Control (Simplified)	3-267
3-320	Transistor Current-Feedback Video Preamplifier.	3-251	3-350	Automatic Sensitivity Circuit.	3-267
3-321	Nuvistor Cascade Video Preamplifier	3-252	3-351	Vidicon Blanking and Deflection Signal	3-267
3-322	Hybrid Cascade Preamplifier	3-253	3-352	Vidicon Blanking Circuit.	3-268
3-323	Simple Video Output Circuit	3-253	3-353	Vidicon Blanking and Sweep Failure Protection Circuits	3-268
3-324	Video Output Circuit	3-253	3-354	Camera Blanking Circuit.	3-269
3-325	Totem Pole Video Output Circuits	3-254	3-355	Vidicon Protection Circuit	3-269
3-326	Effect of Shunt Capacitance in Input Circuit	3-255	3-356	Waveforms Resulting from Transit Delays in Cables	3-270
3-327	High-Peaker Circuit	3-255	3-357	Clamp Pulse Delay Circuit.	3-271
3-328	Output Waveform of Camera Tube	3-256	3-358	Cable Delay Compensation Circuit	3-272
3-329	Vacuum Tube Aperture Correction Circuit.	3-256	3-359	Camera Cable Compensation for Vidicon Filament	3-273
3-330	Transistorized Aperture Correction Circuit.	3-257	3-360	Filament Current Regulator Circuit.	3-273
3-331	Aperture Correction Circuit with Improved Frequency Response	3-257	3-361	Dynamic Focus Circuit.	3-274
3-332	Aperture Correction Circuit with Illustrative Waveforms	3-258	3-362	Visible Portion of Electromagnetic Spectrum.	3-274
3-333	Clamping Waveforms	3-259	3-363	Concept of Light Quantities	3-275
3-334	Vacuum Tube Blanking Insertion Circuit.	3-259	3-364	Spectral Distribution from Black Body Radiator at Different Temperatures	3-276
3-335	Transistorized Blanking Insertion Circuit.	3-260	3-365	Tungsten-Iodine Regenerative Cycle	3-277
3-336	Blanking Insertion Circuit.	3-260	3-366	Spectral Distribution Typical of Most Mercury Lamps	3-278
3-337	Blanking Insertion and Clamp Circuit (Simplified)	3-261	3-367	Spectral Distribution of Xenon Lamps (Three Types)	3-278
3-338	Blanking Insertion Circuit.	3-261	3-368	Nomograph for Calculating Incident Light from Source Intensity	3-279
3-339	Curves Showing Various Values of Gamma	3-262	3-369	Vacuum Tube Television Monitor.	3-280
3-340	Effect of Gamma on a Linear Stairstep Signal	3-263	3-370	Transistorized Television Monitor.	3-281
3-341	Gamma Curves on Logarithmic Plot	3-263	3-371	Vacuum Tube Video Output Circuit	3-281
3-342	Biased Diode Gamma Correction Circuit.	3-264	3-372	Transistorized Video Output Circuit	3-282
3-343	Gamma Correction Circuit	3-264	3-373	Video Signals	3-382
3-344	Gamma Correction Circuit Using Differently Biased Diodes	3-264	3-374	DC Restorer Circuits	3-283
3-345	White Clipper Circuit	3-265	3-375	Differential Amplifier.	3-283
			3-376	Differential Amplifier.	3-284
			3-377	Typical Sync Separation Circuit.	3-285
			3-378	Sync Separation Circuit of a Typical Monitor	3-285
			3-379	Sync Separation Circuit of a Master Monitor.	3-286

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
3-380	Vertical Deflection Circuit for a Vacuum Tube Monitor	3-287	3-414	Refraction by a Lens	3-312
3-381	Vertical Deflection Circuit for a Transistorized Monitor	3-288	3-415	Formation of an Image by a Lens . . .	3-313
3-382	Vertical Scan Generator	3-289	3-416	Lens Shapes	3-313
3-383	Typical Horizontal Oscillator Circuitry	3-290	3-417	Spherical Aberration	3-314
3-384	Horizontal Oscillator Circuitry	3-290	3-418	Coma	3-314
3-385	Horizontal Deflection and High Voltage Power Supply Circuit	3-291	3-419	Astigmatism	3-315
3-386	Waveforms in Typical Horizontal Deflection Circuit	3-292	3-420	Image Distortion	3-315
3-387	Horizontal Output Circuit	3-293	3-421	Chromatism	3-316
3-388	Horizontal Deflection Circuit	3-294	3-422	Correction of Chromatism	3-316
3-389	Dynamic Focus Circuit	3-296	3-423	Calculation of Field of View	3-317
3-390	High Voltage Circuit	3-296	3-424	Field of View Nomograph for 1/2 inch Vidicons	3-318
3-391	Video Distribution Amplifier	3-297	3-425	Field of View Nomograph for 1 inch Vidicons	3-318
3-392	Pulse Distribution Amplifier	3-298	3-426	Field of View Nomograph for 1-1/2 inch Vidicons	3-318
3-393	Schmitt Trigger	3-299	3-427	Optically Compensated Zoom Lens . .	3-319
3-394	Output Circuit of Pulse Distribution Amplifier	3-299	3-428	Mechanically Compensated Zoom Lens	3-320
3-395	Insert Amplifier	3-300	3-429	Optically Compensated Zoom Lens . .	3-320
3-396	Split Screen Effect	3-300	3-430	Magnetic Pattern During Record Mode	3-321
3-397	Insertion of Timing Information into a Picture (Left)	3-300	3-431	Magnetic Pattern During Reproduce Mode	3-322
3-398	Video Insert Amplifier	3-301	3-432	Induced Voltage Versus Signal Frequency	3-323
3-399	Special Effects Generator	3-302	3-433	Four Head Video Tape Recording System	3-323
3-400	Switching Circuitry of Insert Amplifier (Simplified)	3-303	3-434	Magnetic Patterns of Helical Scan Video Tape Recorders	3-324
3-401	Switching Circuitry of Insert Amplifier (Simplified)	3-304	3-435	Recording Mechanism of Single Head System	3-325
3-402	Frequency-Versus-Amplitude Characteristics of Some Coaxial Cables	3-304	3-436	Recording Mechanism of Double Head System	3-325
3-403	Stabilizing Amplifier (Simplified) . . .	3-305	3-437	Typical Head Positions	3-325
3-404	Stabilizing Amplifier	3-306	3-438	Typical Track Positions on Video Tape	3-326
3-405	AGC Circuits of Stabilizing Amplifier	3-307	3-439	Electrical System of Video Tape Recorder (Simplified)	3-326
3-406	Video Equalization Circuit	3-308	3-440	Typical Recorder in Record Mode . .	3-327
3-407	Video Switcher Schematic	3-309	3-441	Typical Recorder in Reproduce Mode	3-328
3-408	A Typical Switching Matrix	3-309	3-442	Modulator - Part 1	3-329
3-409	Switch Control	3-310	3-443	Modulator - Part 2	3-330
3-410	Electronic Video-Switch Module . . .	3-311	3-444	FM Oscillator	3-330
3-411	Schematic of Electronic Switching Junction	3-311	3-445	Demodulator - Part 1	3-331
3-412	Refraction of Wavefront as It Passes Through Glass	3-311	3-446	Three-Stage Limiter	3-331
3-413	Refraction of Light by Glass	3-312	3-447	Demodulator - Part 2	3-332

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
3-448	Schematic of Demodulation Circuits .	3-333	3-479	Electrically Zeroing a Differential Synchro Transmitter Using the Voltmeter Method	3-364
3-449	Signals in Mixer Circuit Shown in Figure 3-448.	3-334	3-480	Electrically Zeroing a Differential Synchro Receiver	3-364
3-450	Record Amplifier	3-334	3-481	Electrically Zeroing a Control Transformer Synchro	3-364
3-451	Reproduce Amplifier	3-335	3-482	DC Servomotor Simplified Schematic	3-366
3-452	Servo System	3-335	3-483	Typical Positioning Servo System . . .	3-367
3-453	Comparator Oscillator	3-336	3-484	Magnetic Field and Current Relationship in Conventional DC Generator	3-368
3-454	Control Oscillator and Related Circuits	3-337	3-485	Magnetic Field and Current Relationship in Short-Circuited DC Generator	3-369
3-455	Motor-Power Amplifier.	3-338	3-486	Short-Circuited DC Generator Supplied with Additional Brushes . . .	3-370
3-456	Audio System.	3-338	3-487	Short-Circuited DC Generator With Additional Brushes and Compensating Windings	3-370
3-457	Erase Oscillator.	3-339	3-488	Amplidyne Generator Equivalent Circuit Showing Effective Magnetic Field Amplification.	3-370
3-458	Detector Probe Suitable for Video Frequencies.	3-340	3-489	Hydraulic Variable Flow Pump	3-371
3-459	Video Sweep Signal Displayed on Oscilloscope	3-340	3-490	Basic Hydraulic Servomechanism . . .	3-372
3-460	EIA Resolution Chart.	3-341	3-491	Hydraulic Motor	3-373
3-461	EIA Linearity Chart.	3-342	3-492	Gyro Precession	3-374
3-462	EIA Linear Reflectance Chart	3-343	3-493	Gyro Stability (Rigidity in Space) as Related to Position Relative to the Earth	3-375
3-463	Signal Injection into Camera Video Preamplifier.	3-345	3-494	Gyro Corrections to Antenna and Indicator	3-376
3-464	Measuring Pulse Width and Rise Time.	3-348	3-495	Pitch and Roll Stabilization of an Antenna	3-376
3-465	Interlaced Pulse-Cross Display	3-349	3-496	Simplified ESG	3-377
3-466	Multiburst Signal.	3-350	3-497	System of Coordinates as Related to the Gyro Stabilization Problem . .	3-378
3-467	Multiburst Signal Showing System Deficiencies	3-351	3-498	Gyro Reference Assembly Showing Roll and Pitch Data Measuring Transmitter Synchros.	3-380
3-468	Normal Stairstep Waveform.	3-351	3-499	Typical B/H Characteristics Curves . .	3-382
3-469	Stairstep Waveform, Showing White Compression	3-351	3-500	Basic Magnetic Amplifier Using Series-Connected Windings	3-383
3-470	Waveforms Encountered in Differential-Gain Measurements	3-352	3-501	Operation of Magnetic Amplifier in the B/H Characteristic Curve	3-383
3-471	Stairstep Signal Simulating Various Scenes.	3-353	3-502	Magnetic Amplifiers Used for Control of AC and DC Loads.	3-383
3-472	Ionization Chamber and Associated Circuit.	3-355			
3-473	Typical Geiger-Mueller Tube	3-356			
3-474	Typical Scintillation Counter.	3-357			
3-475	Radiacmeter-Dosimeter IM-9C/PD . .	3-358			
3-476	Incorrect Synchro Connections Causing Receiver to Operate in Wrong Direction or Give Improper Indication	3-361			
3-477	Electrically Zeroing a Receiver Synchro Using the Jumper Method . .	3-363			
3-478	Electrically Zeroing Transmitter and Receiver Synchros Using the Voltmeter Method.	3-363			

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
3-503	Two-Stage Cascaded Magnetic Amplifier	3-384	3-534	Single AND Gate with Multiple Inputs	3-414
3-504	Magnetic Amplifier with Bridge Circuit Incorporated to Cancel Residual Current Flow in the Load.	3-384	3-535	OR Gate Symbol and Truth Table . .	3-414
3-505	Magnetic Amplifiers Using Internal and External Feedback . . .	3-385	3-536	OR Gate Levels.	3-414
3-506	Construction of E-Core Assembly for Use with Magnetic Amplifiers . .	3-386	3-537	Diode OR Gate Pulse Logic.	3-414
3-507	Spirally Wound Toroidal Cores Used in Magnetic Amplifiers	3-386	3-538	Two Versions of Transistorized OR Gates.	3-415
3-508	Basic Power Supply Circuits	3-388	3-539	Five-Input OR Gate in Simplified Form	3-415
3-509	Voltage Multiplier Circuits	3-390	3-540	NOR Gate and Truth Table.	3-416
3-510	Multiphase Power Circuits.	3-391	3-541	Types of NOR Gates	3-417
3-511	RF High Voltage Power Supply	3-392	3-542	NAND Gate and Truth Table.	3-418
3-512	Voltage Regulators	3-394	3-543	Simplified NAND Gate.	3-418
3-513	Proper Oil Level for Various Types of Oil Gages.	3-397	3-544	Positive Logic NAND Gate	3-418
3-514	Insulation Resistance vs Time	3-398	3-545	Emitter Follower Circuit Showing Power Gain	3-419
3-515	Method of Measuring Brush Tension.	3-401	3-546	Emitter Follower Chart Symbol. . . .	3-419
3-516	Swept Measurement Technique	3-402	3-547	Three-Stage Register Truth Table . .	3-419
3-517	Tracking Generator	3-403	3-548	Control Logic Circuitry for an UP Counter	3-420
3-518	Analog Computer for Calculating Altitude of Radar Targets, Block Diagram.	3-404	3-549	UP Counter	3-420
3-519	Basic Digital Computer Sections, Block Diagram	3-404	3-550	DOWN Counter.	3-421
3-520	Circuit Reliability Versus Excursion Voltage Required to Cause Circuit Failure	3-408	3-551	Double Rank Counter	3-422
3-521	Typical Circuit Selected for Marginal Checking, Logic Diagram.	3-408	3-552	Timing Chart	3-423
3-522	BITE Parameters.	3-409	3-553	Clock Relationships.	3-424
3-523	Schmitt Trigger.	3-410	3-554	Word Time Values and Waveforms . .	3-425
3-524	Examples of Pulse Logic.	3-411	3-555	Three-Stage Counter and Timing Diagram.	3-426
3-525	Boolean Inputs and Outputs	3-411	3-556	Four-Stage Counter and Timing Diagram.	3-427
3-526	Basic Single Stage Inverter.	3-412	3-557	Four-Stage Counter with Overflow . .	3-428
3-527	Inverter Symbol	3-412	3-558	Word-Time Generator for a 12 Bit Word.	3-429
3-528	Inverter Cascading.	3-412	3-559	Shift-Right Shift Register	3-430
3-529	Two-Input AND Gate.	3-413	3-560	Force Transfer Shift Register.	3-431
3-530	Two-Input "Inhibited" AND Gate . .	3-413	3-561	Magnetic Core Method	3-431
3-531	Positive Logic Diode AND Gate	3-413	3-562	Four-Stage Register	3-432
3-532	Negative Logic Diode AND Gate	3-413	3-563	Parallel Register	3-433
3-533	Transistor Connection to Produce AND Function, Using Negative Logic	3-413	3-564	Shift to Zeros Register	3-434
			3-565	Forced Transfer Register.	3-434
			3-566	Shift Register	3-434
			3-567	Parallel Register	3-434
			3-568	Series Parallel Register	3-435
			3-569	Shift Register	3-435
			3-570	Shift Register	3-435
			3-571	Shift Register	3-435
			3-572	Shift Register	3-435
			3-573	Shift Register	3-435
			3-574	Right-Shift Register.	3-435

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
3-575	Shift Register	3-436	4-4	Waveform Resulting from Algebraic Addition of a Fundamental Sine Wave with its Second Harmonic Delayed 180 Degrees	4-3
3-576	Addition	3-436	4-5	Waveform Resulting from Algebraic Addition of a Fundamental Sine Wave with its Second Harmonic Delayed 90 Degrees	4-3
3-577	Binary Addition	3-436	4-6	Resultant Waveforms Created by Algebraic Addition of Second Harmonic to Fundamental Sine Wave When Second Harmonic Amplitude is 30 Percent of Fundamental	4-5
3-578	Quarter Adder Truth Table	3-437	4-7	Resultant Waveforms Created by Algebraic Addition of Third Harmonic to Fundamental Sine Wave When Third Harmonic Amplitude is 30 Percent of Fundamental	4-5
3-579	Quarter Adder and Truth Table	3-437	4-8	Resultant Waveforms Created by Algebraic Addition of Third Harmonic to Fundamental Sine Wave When Third Harmonic Amplitude is 15 Percent of Fundamental	4-6
3-580	Half Adder	3-437	4-9	Presence or Absence of Mirror Symmetry Due to Harmonic Addition to Fundamental Sine Wave	4-6
3-581	Full Adder	3-438	4-10	Square Waveforms	4-6
3-582	Quarter Subtractor	3-439	4-11	Formation of a Square Wave	4-7
3-583	Half Subtraction	3-439	4-12	Rectangular Waveforms	4-8
3-584	Full Subtraction	3-440	4-13	Rectangular Waves Used in Television	4-8
3-585	Quarter Adder Using an Exclusive OR Circuit	3-441	4-14	Sawtooth Waveforms	4-9
3-586	Full Serial Add-Subtract Unit	3-441	4-15	Formation of Sawtooth Waveform	4-10
3-587	Full Parallel Add-Subtract Unit	3-442	4-16	Output Current Waveforms for Resistive and Inductive Circuits Resulting from a Sawtooth Voltage Input	4-11
3-588	Special Purpose Incremental Adder	3-443	4-17	Output Current Sawtooth Waveform Resulting from Application of a Trapezoidal Input Voltage Waveform to an Inductor	4-11
3-589	Mercury Delay Line	3-444	4-18	Trapezoidal Voltage Waveform Varieties	4-12
3-590	Magnetic Read/Write Heads	3-445	4-19	Input to and Output from Differentiating Circuits	4-12
3-591	Bar Magnet Effect	3-446			
3-592	Binary Writing of 1 and 0 on Magnetic Material	3-446			
3-593	Reading 1s and 0s	3-446			
3-594	Waveforms	3-447			
3-595	Typical Read/Write Head	3-448			
3-596	Typical Magnetic Drum	3-448			
3-597	Magnetic Disk Channel Layout	3-449			
3-598	Core Memory Matrix	3-449			
3-599	Word Comparison	3-450			
3-600	Word Comparison	3-450			
3-601	Word Comparison	3-451			
3-602	Comparator Circuit	3-451			
3-603	Exclusive OR Gate Comparator	3-451			
3-604	Typical Comparator Circuit	3-452			
3-605	Magnetic Core Read and Write Current Balance Check Waveforms	3-453			
3-606	Typical Drum Read Amplifier Test Waveforms	3-453			
3-607	Magnetic Drum Write-Read Test, Block Diagram	3-458			
3-608	Magnetic Drum Runout Test, Block Diagram	3-458			
3-609	Runout Test Waveform	3-458			
3-610	Noise Test Waveform	3-459			
SECTION 4 - WAVEFORM INTERPRETATION					
4-1	Sine and Cosine Waveforms	4-2			
4-2	Half-Sine Waveforms	4-2			
4-3	Waveform Resulting from Algebraic Addition of a Fundamental Sine Wave with its Second Harmonic in Phase	4-3			

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
4-20	Rectangular Input and Resultant Differentiated Output Waveform	4-13	4-45	Spot-Wheel Patterns	4-24
4-21	Differentiated Wave Amplitude Changes Resulting from Sawtooth Input Rate-of-Change	4-13	4-46	Circular Sweep Comparison Circuit. Using Deflection Systems Only	4-24
4-22	Differentiated Output Waveforms for Sawtooth Input Waveform Progressively Illustrating an Increasing RC or RL Circuit Time Constant	4-14	4-47	Integral Frequency Ratios in Circular Sweeps.	4-24
4-23	Typical Integrator Circuits	4-14	4-48	Fractional Frequency Ratios in Circular Sweeps.	4-25
4-24	Integrated Output Waveforms Progressively Illustrating an RC or RL Circuit Time Constant	4-15	4-49	Output Waveforms Resulting from Poor Circuit Frequency Response . . .	4-27
4-25	Cumulative Wide Integrated Pulse Obtained from Narrow Pulse Rectangular Waveform	4-15	4-50	Combination of Two Signals Forming an Amplitude and Phase-Modulated Resultant	4-27
4-26	RF Carrier Amplitude Modulated by a Sine Wave	4-15	4-51	Formation of A Lissajous Figure, Illustrating 90 Degrees Phase Difference	4-28
4-27	Overmodulated RF Carrier	4-16	4-52	1:1 Lissajous Patterns, Showing Effect of Phase Relationships.	4-29
4-28	Undistorted Modulation	4-17	4-53	Computation of Phase Difference . . .	4-29
4-29	Superimposed Modulation.	4-17	4-54	Phase-Shift Network	4-30
4-30	Intermodulation Distortion	4-17	4-55	2:1 Lissajous Pattern	4-31
4-31	FM Patterns Compared to AM Patterns.	4-18	4-56	Calculation of 2:1 Frequency Ratio .	4-31
4-32	Bessel Curve for Frequency Modulation	4-18	4-57	2:1 Lissajous Patterns for Various Phase Relationships	4-32
4-33	Frequency and Phase Modulation Characteristics	4-19	4-58	3:1 Lissajous Patterns and Calculation of Frequency Ratio	4-33
4-34	Primary Types of Response Curves . .	4-20	4-59	Open 3:1 Lissajous Pattern	4-34
4-35	Positive and Negative Single-Peaked Response Curves	4-20	4-60	Closed 3:1 Lissajous Pattern	4-34
4-36	Response Curve Combinations to Produce a Required Resultant Wide Band Response Curve	4-21	4-61	6:1 Lissajous Patterns.	4-34
4-37	Response Curve Coupling	4-21	4-62	8:1 Lissajous Patterns.	4-35
4-38	Response Curve Resulting from Stagger-Tuned Stages	4-21	4-63	10:1 Lissajous Patterns.	4-35
4-39	Discriminator "S" Curve.	4-22	4-64	3:2 Lissajous Patterns.	4-35
4-40	Ideal Audio-Frequency Response Curve	4-22	4-65	5:4 Lissajous Patterns.	4-35
4-41	Resonant Circuit Audio-Frequency Response Curve.	4-22	4-66	5:3 Lissajous Patterns.	4-35
4-42	High Frequency Response Curve . . .	4-22	4-67	7:2 Lissajous Patterns.	4-35
4-43	Non-demodulated High-Frequency Response Curve.	4-23	4-68	Input Step Functions.	4-36
4-44	Phase-Shifting Circuit for Circular Sweep Displays	4-23	4-69	Linear Constant Parameter Amplifier Responses	4-36
			4-70	Comparison of Applied Pulse Width and Transient Response Times	4-36
			4-71	Transient Response Characteristics . .	4-37
			4-72	Typical Transient Response of a Tuned Stage	4-37
			4-73	Series Resistive and Reactive Diode Components Represented as a Function of Frequency and Transit Times	4-38
			4-74	Typical Test Setup for Measurement of Transient Response in Low Pass Equipment.	4-38

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
4-75	Typical Test Setup for Measurement of Transient Response in Bandpass of FM Equipment	4-39	4-97	Modulation Frequency and Amplitude Effects on an FM Carrier	4-51
4-76	Transistor Equivalent Switching Circuit.	4-39	4-98	Spectrum Distribution for an Index of 24	4-52
4-77	Simplified Transistor Equivalent Switching Circuit with Small Output Load	4-39	4-99	Rectangular Pulse	4-53
4-78	RC Circuit, Simulating Frequency Dependence, Used to Calculate I_R . .	4-40	4-100	Pulsed Radar Output	4-54
4-79	Simplified Equivalent Transistor Switch Circuit with Large Output Load.	4-40	4-101	Pulsed Radar Changes Affected by Modulating Signal Changes	4-54
4-80	Transistor Switch Equivalent Delay Time Circuit.	4-40	4-102	Spectrum Patterns	4-56
4-81	Comparative Minority-Carrier Densities in Transistor Base for Cutoff, Active, and Saturation Regions of Operation	4-41	4-103	Line Spectrum $\beta < PRF$	4-57
4-82	Grounded-Emitter Switch Circuit with Input Voltage and Current Waves and Output Current Response Waveform for Small R_L	4-41	4-104	Pulse Spectrum $\beta > PRF$	4-57
4-83	Electromagnetic Frequency Spectrum.	4-43	4-105	Line Spectra of a Pulsed Modulated 50 MHz Carrier	4-58
4-84	Wavelength-Frequency Conversion Chart	4-44	4-106	Pulsed RF Signal in "Pulsed" Spectrum Display	4-59
4-85	Acoustic Spectrum	4-44	4-107	Block Diagram of a Heterodyne Spectrum Analyzer	4-60
4-86	Time vs Frequencies.	4-45	4-108	Effects of Decreased Scan Time	4-60
4-87	Examples of Time Domain (left) and Frequency Domain (right) Low Level Signals	4-45	SECTION 5 — ANTENNA AND TRANSMISSION LINE MEASUREMENTS		
4-88	Spectrum Analyzer Stability Measurements.	4-46	5-1	Circuit for Measurement of Antenna Input Power	5-1
4-89	Swept Distortion and Response Characteristics	4-46	5-2	Variation Method of Measuring Antenna Resistance	5-1
4-90	Frequency Conversion Characteristics	4-46	5-3	Two-Resistor Variation Method of Measuring Antenna Resistance . . .	5-2
4-91	Spectrum Analyzer Display of an AM Signal	4-47	5-4	Substitution Method of Measuring Antenna Resistance	5-3
4-92	AM Display of Spectrum Analyzer . .	4-47	5-5	Circuit of Typical RF Bridge	5-3
4-93	Modulation Percentage M vs Sideband Level (Log Display)	4-48	5-6	Typical RF Balanced Bridge	5-4
4-94	Double Sideband Carrier Suppressed.	4-48	5-7	Circuit of Typical RF Power Meter	5-5
4-95	Two-Tone Test	4-48	5-8	Circuit Diagram of Power-Level Meter Capable of Covering a Wide Power Range, and of Offering a Variety of Local Impedances	5-5
4-96	Spectrum Distribution for a Modulation Index of $\beta = 2$	4-49	5-9	Use of a Variable Dummy Load to Measure Transmitter Power by Dissipation in a Fixed Resistance . . .	5-6
			5-10	Typical Graph of Light Output Versus Power for an Incandescent Lamp	5-6
			5-11	Test Setup for Lamp-Load Method of Indirect Power Measurement	5-6

LIST OF ILLUSTRATIONS (Continued)

Figure		Page	Figure		Page
5-12	Diagrammatic Setup for Photoelectric Type of Lamp-Load Power Test	5-7	5-38	Cavity Wavemeters in Main Transmission Line	5-20
5-13	Schematic of Waveguide Directional Coupler	5-8	5-39	Standard Antenna Method of Measurement	5-23
5-14	Two-Hole Waveguide Directional Coupler	5-9	5-40	Diagram of Field-Strength Measuring Equipment of the I-F Attenuator Type	5-23
5-15	A Simple Type of Directional Coupler Together with Equivalent Circuits Showing the Action of the Electric and Magnetic Induction.	5-9	5-41	Induction Field Technique	5-24
5-16	Notch Measurement Technique	5-9	5-42	Radiation Field Technique	5-24
5-17	Block Diagram of Peak Power Measurement by Mixing CW and Pulsed Signals	5-10	5-43	Calibration of Dipole Antenna with a Crystal	5-27
5-18	Effect of Mixing CW Pulsed RF Signals of the Same Frequency. . . .	5-10	5-44	Standard Antenna Method at Microwave Frequencies.	5-29
5-19	Effect of Heterodyning CW and Pulsed RF Signals	5-11	5-45	Standardization of Loop Antenna	5-30
5-20	Barretter Integration — Differentiation Technique.	5-11	5-46	Calibration of Dipole Antenna	5-30
5-21	Sequence and Appearance of Signals in the Barretter Integration — Differentiation Technique.	5-11	5-47	Calibration of Horn Antenna	5-31
5-22	Detector for Measuring Low Peak RF Power	5-12	5-48	Calibration of Standard Horn Antenna	5-31
5-23	Development of Standing Wave	5-13	5-49	Time Domain Reflectometry Basic Equipment Setup.	5-35
5-24	Transmission Line Considerations. . .	5-13	5-50	Basic Waveforms Representing Resistive, Capacitive, and Inductive Discontinuities	5-36
5-25	Lecher-Wire System of Frequency Measurement	5-14	5-51	Simple Series Circuit of Two Mismatched Impedances.	5-37
5-26	Lecher-Wire System for Ultra-High-Frequency Measurement.	5-14	5-52	Passive Four-Terminal Circuit Inserted Between Two Mismatched Impedances	5-37
5-27	Typical Electromagnetic Probes	5-15	5-53	Open-Circuit Impedance Equivalence of Passive Four-Terminal Circuit of Figure 5-52	5-37
5-28	Frequency Measurement with Lecher Wires, Shorting-Bar Method. .	5-15			
5-29	Resistance-Capacitance Bridge Circuit for Measuring Standing Wave Ratio.	5-16		SECTION 6 — SYSTEM TESTING	
5-30	Transmitter and Load Test Circuit . .	5-17	6-1	A Back-To-Back System Test Configuration	6-3
5-31	Circuit of Reaction Wavemeter.	5-18	6-2	Typical "End Around" Test Configuration	6-4
5-32	Circuit of Absorption Wavemeter . . .	5-18	6-3	Bridge Ground-Location Configuration	6-6
5-33	Typical Measurement Arrangements Using the Coaxial Wavemeter.	5-19	6-4	Bridge Short-Location Configuration	6-6
5-34	SWR Test Setup for Checking Transmission Line Components	5-19	6-5	Three Alternate Bridge Loop Configuration	6-7
5-35	Iris-Coupled Wavemeter	5-19	6-6	Open Location in Four-Conductor Cable	6-8
5-36	Alternative Cavity Wavemeter	5-20	6-7	Opens Location in Two-Conductor Method	6-8
5-37	Cylindrical Reaction Wavemeter Coupled to Main (Coaxial) Line Through a Quarter-Wave Stub	5-20			

LIST OF TABLES

Table	Page	Table	Page
SECTION 2 — BASIC MEASUREMENTS			
2-1	Tolerances for Paper Tubular Capacitors	2-6	
2-2	Electrolytic Capacitor Leakage Current Chart	2-7	
2-3	NBS Frequency Standards and Time Transmission	2-43	
2-4	NBS Radio Propagation Coding	2-45	
2-5	Radio Frequency Nomenclature	2-49	
2-6	General Voltage Tolerances for Dry Batteries	2-90	
2-7	Effects of Automobile Vibration Intensity on a Seated Subject Wearing a Seat Belt (Frequencies Less than 100 Hz)	2-94	
2-8	Typical Reactions to Vibrations	2-94	
2-9	Typical Vibrations of Vehicles	2-95	
2-10	Dielectric Constants of Materials	2-97	
SECTION 3 — TEST TECHNIQUES AND PRACTICES			
3-1	Bessel Factors for Finding Amplitudes of Center and Sideband Frequency Components	3-25	
3-2	Values of Modulation Index for Which a Carrier Wave Has Zero Amplitude	3-27	
3-3	Automatic Send-Receive Page Printer Sets	3-45	
3-4	Keyboard Send-Receive Page Printer Sets	3-45	
3-5	Receive Only Page Printer Sets	3-46	
3-6	Multiple Page Printer Console Sets	3-46	
3-7	Send-Receive Typing Reperforator	3-46	
3-8	Receive Only Typing Reperforators	3-46	
3-9	Tape Transmitter Distributor Sets	3-47	
3-10	Signal Distortion Test Sets	3-47	
3-11	Infrared Detector Characteristics	3-62	
3-12	Infrared Receiver Resolution Data	3-69	
3-13	Frequency and Letter Designations for Microwave Bands	3-75	
3-14	Radar Target Area of Aircraft	3-117	
3-15	Estimated Range for Different Propagation Conditions	3-120	
3-16	Interrogator System Components	3-133	
3-17	AN/UPX-23 Interrogator Set Subsystems	3-134	
3-18	Antenna Configurations	3-134	
3-19	Transponder Set Components	3-135	
3-20	Interrogator/Transponder Test Equipment	3-136	
3-21	Basic Pulse Recurrence Rates	3-143	
3-22	Omega Transmitting Stations	3-147	
3-23	Characteristics of Camera Cable	3-214	
3-24	Phosphors for Cathode-Ray Tubes	3-223	
3-25	Relative Gains of Video Amplifiers	3-246	
3-26	Brightness of Some Familiar Light Sources	3-276	
3-27	Picture Areas for Camera Tubes and Films	3-317	
3-28	EIA Standard Pulse Widths	3-349	
3-29	Trouble-Shooting Synchro Circuits	3-362	
SECTION 4 — WAVEFORM INTERPRETATIONS			
4-1	Auxiliary Wavelength-Frequency Conversion Table	4-44	
4-2	Abbreviated Bessel Factor Table	4-49	

PREFACE

POLICY AND PURPOSE

The Electronics Installation and Maintenance Book (EIMB) was established as the medium for collecting, publishing, and distributing, in one convenient source document, those subordinate maintenance and repair policies, installation practices, and overall electronic equipment and material-handling procedures required to implement the major policies set forth in Chapter 400 of the Naval Ships' Technical Manual. All data contained within the EIMB derive their authority from Chapter 400 of the Naval Ships' Technical Manual, as established in accordance with Article 1201, U. S. Navy Regulations.

Since its inception the EIMB has been expanded to include selected information of general interest to electronic installation and maintenance personnel. These items are such as would generally be contained in textbooks, periodicals, or technical papers, and form (along with the information cited above) a comprehensive reference document. In application, the EIMB is to be used for information and guidance by all military and civilian personnel involved in the installation, maintenance, and repair of electronic equipment under cognizance, or technical control, of the Naval Sea Systems Command (NAVSEA). The information, instructions, and procedures, in the EIMB supplement instructions and data supplied in equipment technical manuals and other approved maintenance publications.

INFORMATION SOURCES

Periodic revisions are made to provide the best current data in the EIMB and keep abreast of new developments. In doing this, many source documents are researched to obtain pertinent information. Some of these sources include the Electronics Information Bulletin (EIB), the NAVSEA Journal, electronics and other textbooks, industry magazines and periodicals, and various military installation and maintenance-related publications. In certain cases, NAVSEA publications have been incorporated into the EIMB in their entirety and, as a result, have been cancelled. A list of the documents which have been superseded by the EIMB and are no longer available is given in Section 1 of the General Handbook.

ORGANIZATION

The EIMB is organized into a series of handbooks to afford maximum flexibility and ease in

handling. The handbooks are stocked and issued as separate items so that individual handbooks may be obtained as needed.

The handbooks fall within two categories: general information handbooks, and equipment-oriented handbooks. The general information handbooks contain data which are of interest to all personnel involved in installation and maintenance, regardless of their equipment specialty. The titles of the various general information handbooks give an overall idea of their data content; the General Handbook includes more complete descriptions of each handbook.

The equipment handbooks are devoted to information about particular classes of equipment. They include general test procedures, adjustments, general servicing information, and field change identification data.

All handbooks of the series are listed below with their NAVSEA numbers. The NAVSEA numbers serve also as the stock numbers to be used on any requisitions submitted.

HANDBOOK TITLE	NAVSEA NUMBER
EIMB General Information Handbooks	
General	0967-LP-000-0100
Installation Standards	0967-LP-000-0110
Electronic Circuits	0967-LP-000-0120
Test Methods & Practices	0967-LP-000-0130
Reference Data	0967-LP-000-0140
EMI Reduction	0967-LP-000-0150
General Maintenance	0967-LP-000-0160
EIMB Equipment-Oriented Handbooks	
Communications	0967-LP-000-0010
Radar	0967-LP-000-0020
Sonar	0967-LP-000-0030
Test Equipment	0967-LP-000-0040
Radiac	0967-LP-000-0050
Countermeasures	0967-LP-000-0070

DISTRIBUTION

Initial Set: An "AF" Restriction Code has been assigned to NAVSEA 0967-LP-000-0000 to control the over-requisitioning of the EIMB Series. Fleet and shore activities requiring an initial set of the

PREFACE

EIMB Series (13 handbooks with all changes and heavy-duty binders) should submit their requisition (DD Form 1348 with written justification) through their Supply Officer or area, for issue approval to:

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 Washington Navy Yard
 Washington, D.C. 20374

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All other blocks are to be filled in as normally done by the requisitioner when ordering publications.

Changes and Revisions: The EIMB is continuously being updated. For efficiency these changes and revisions are automatically distributed to using activities who are on the Automatic Distribution List for the EIMB.

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Individual Handbooks: To order individual handbooks and changes, use the stock numbers listed in the Box Score on page ii. Using the stock number for the "BASIC" provides the handbook (with vinyl cover) and all applicable changes.

SUGGESTIONS/CORRECTIONS

NAVSEA recognizes that users of the EIMB will have occasion to offer corrections or suggestions. To encourage more active participation, a pre-addressed comment sheet is provided in the back of each handbook change. Complete information should be given when preparing suggestions. Suggestors are encouraged to include their names and addresses so that clarifying correspondence can be initiated when necessary. Such correspondence will be by letter directly to the individual concerned.

If a comment sheet is not available, or if correspondence is lengthy, corrections or suggestions should be directed to the following:

Commander
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 Washington, D.C. 20362

SECTION 1

GENERAL

1-1 INTRODUCTION

This book provides electronic technicians with reference information on the fundamentals of testing electronic equipment. The function of general-type test equipment available to Navy maintenance personnel is described. Testing techniques and practices are outlined, and the maintenance of test equipment is discussed. Detailed instructions contained in publications for specific equipment are not duplicated by this publication. The importance of testing, functional divisions of testing, and safety precautions are discussed in this section. Basic tests, measurements, and test equipment general functions are discussed in section 2. Section 3 describes electronic testing techniques and practices. The interpretation of waveforms is covered in section 4, with antenna and transmission line measurements being described in section 5. Section 6 of this publication discusses electronic system servicing techniques.

1-2 IMPORTANCE OF TESTING

Naval forces have become dependent upon electrical and electronic equipment in performing their missions. The effectiveness of nontactical, as well as tactical forces, is dependent to large extent upon the reliability of communication, detection, control, computing, and many other types of electronic devices. In turn, the reliability of such equipment is determined by many factors, such as the quality of the equipment in use, the amount of standby equipment available, the ability of operating personnel to perform their tasks, and adequate maintenance facilities. Maintenance is definable as work done to correct, reduce and counteract wear and damage to equipment. Maintenance of Navy electronic equipment is divided into two main categories: preventive (routine) maintenance, and corrective maintenance. Preventive maintenance consists of making checks to determine whether equipment is functioning properly, and includes lubrication procedures and visual inspection of cabling and equipment for evidence of damage. Corrective maintenance is performed to isolate equipment troubles (by means of test techniques), to replace defective parts, and to realign and readjust equipment or otherwise bring the equipment up to proper performance. Testing, considered in its broad sense, includes trouble-shooting, and is that portion of maintenance which requires the greatest skill on the part of the technician. Figure 1-1 shows the functional relationship that exists

between testing and other necessary services that enter into the general shipboard (technical) maintenance of electronic equipment. Testing procedures are referred to as measurements, tests, and checks. All three of these terms may overlap in meaning, depending upon their usage and the results obtained. For instance, a power output measurement and a frequency check constitute a typical test of the operation of a radio transmitter.

1-3 FUNCTIONAL DIVISIONS OF TESTING

The functional divisions of testing, as discussed in section 2 of this book, provide a logical approach to testing and to the study of test equipment circuit theory. These constitute the fundamental test methods necessary to facilitate the operation and maintenance of electronic equipment. The functional divisions of testing may be categorized as follows:

1. Basic measurements consisting of
 - a. Voltage
 - b. Current
 - c. Resistance
 - d. Capacitance
 - e. Inductance
2. Power measurements
3. Frequency measurements
4. Waveform measurements
5. Modulation measurements
6. Impedance measurements
7. Standing Wave measurements
8. Field Intensity and Noise measurements
9. Alignment
10. Tube testing
11. Semi-conductor testing
12. Integrated circuit testing
13. System testing and monitoring

1-4 SAFETY PRECAUTIONS

Every person who works with electronic equipment should be constantly alert to the hazards of this equipment to which he may be exposed, and should also be capable of rendering first aid to injured personnel. The hazards which are considered in this paragraph are: electric shock, rf-energy burns, X-rays produced by high-voltage tubes, radioactive material contained in radar switching tubes, cathode-ray-tube implosion, lightning, and fire.

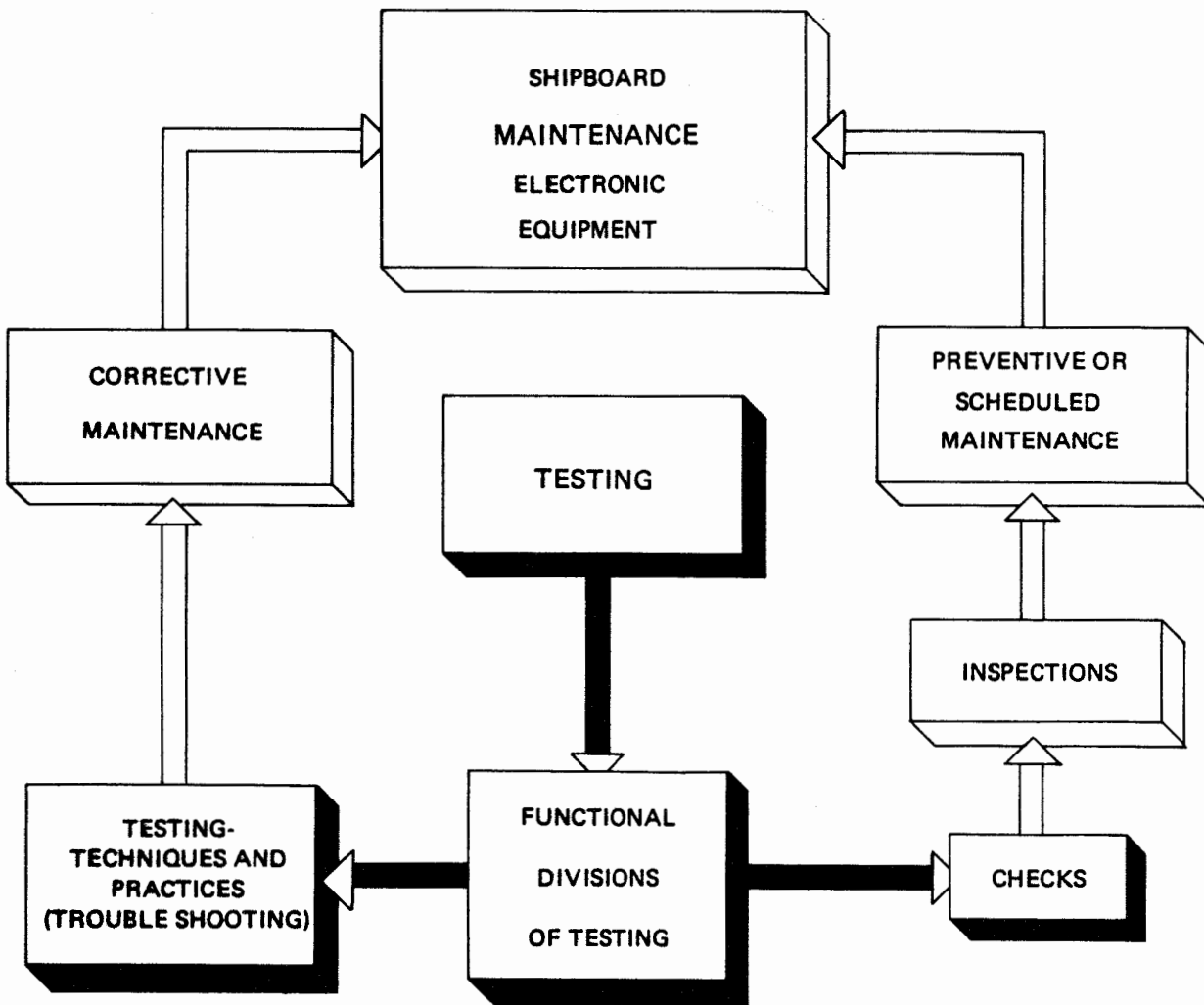


Figure 1-1. Electronic Maintenance, Functional Diagram

Safety must be a major responsibility of all electronics personnel. The installation, maintenance, and operation of electronic equipment enforces a stern safety code. Carelessness on the part of the electronics technician or operator can result in serious injury or death due to electrical shock, falls, burns, flying objects, etc. After an accident has occurred, investigation almost invariably shows that it could have been prevented by the exercise of simple safety precautions and procedures that must be observed at all times. Each person concerned with electronic equipment is responsible to read and become thoroughly familiar with the safety practices and procedures contained in the Electronic Installation and Maintenance Book (General) NAVSEA 0967-LP-000-0100 and in equipment technical manuals, before performing work on electrical or electronic equipment. It is a personal responsibility to identify and eliminate unsafe conditions and unsafe acts which cause accidents. It must be borne in mind that de-energizing main supply circuits by opening supply switches will not necessarily "kill" all circuits in a given piece of equipment. A source of danger that has often been neglected or ignored, sometimes with tragic results, is the input to electronic equipment from other sources, such as synchros, remote control circuits, etc. For example, turning off the antenna safety switches will disable the antenna, but may not turn off the antenna synchro voltages from the ship's compass or stable elements. Moreover, the rescue of a victim shocked by the power input from a remote source is often hampered because of the time required to determine the source of power and turn it off. Therefore, turn off ALL power inputs before working on equipment. Take time to be safe when working on electronic circuits and equipment. Carefully study the schematics and wiring diagrams of the entire system, noting what circuits must be de-energized in addition to the main power supply. Remember--electronics equipments usually have more than one source of power. Be certain that ALL power sources are de-energized before servicing the equipment. Do not service any equipment with the power ON unless absolutely necessary. Remember that the 115-volt power supply voltage is not a low, relatively harmless voltage, but is the voltage that has caused more deaths in the Navy than any other medium.

1-5 SAFETY PRACTICES

The following is a listing of common-sense safety precautions that must be observed at all times:

1. Do NOT work with high-voltage by yourself; have another person (safety observer), qualified in first aid for electrical shock, present at all times. The person stationed nearby should also know which circuits and switches control the equipment, and should be given instructions to pull the switch immediately if anything unforeseen happens.
2. Always be aware of the nearness of high-voltage lines or circuits. Use rubber gloves where applicable, and stand on approved rubber matting (MIL-M-15562). Not all so-called rubber mats are good insulators.
3. Inform remote stations as to the circuit on which work is being performed.
4. Keep clothing, hands, and feet dry if at all possible. When necessary to work in wet or damp locations, use a dry platform or wooden stool to sit or stand on, and place a rubber mat or other non-conductive material on top of the wood. Use insulated tools and insulated flashlights of the molded type when required to work on exposed parts.
5. Do NOT work on energized circuits unless absolutely necessary. Be sure to take time to lock out (or block out) the associated switch and tag it. Locks for this purpose should be readily available; if such a lock cannot be obtained, remove the fuse and tag the holder.
6. Use only one hand when turning power switches ON or OFF. Keep the doors to switch and fuse boxes closed, except when working inside or replacing fuses. Use a fuse puller to remove cartridge fuses, after first making certain that the circuit is dead.
7. All power supply switches or cutout switches from which power could possibly be fed shall be secured in the OPEN (safety) position and tagged. The tag shall read "THIS CIRCUIT WAS ORDERED OPEN FOR REPAIRS AND SHALL NOT BE CLOSED EXCEPT BY DIRECT ORDER OF" (the person either making or directly in charge of the repairs).
8. Never short out, tamper with, or block open an interlock switch.
9. Keep clear of exposed equipment; when it is absolutely necessary to work on it, use only one hand as much as possible.
10. Avoid reaching into enclosures except when absolutely necessary. When reaching into an enclosure, use rubber blankets to prevent accidental contact with the enclosure.
11. Do not use bare hands to remove hot vacuum tubes from their sockets. Wear protective gloves or use a tube puller.
12. Use a shorting stick to discharge all high-voltage capacitors.
13. Make certain that the equipment is properly grounded. Ground all test equipment to the equipment under test.
14. Turn off the power before connecting alligator clips to any circuit.
15. When measuring circuits over 300 volts, do not hold the test prods.

