



# TABLE OF CONTENTS

## Volume III

	Page No.
CHAPTER XVI: CRYSTAL CHARACTERISTICS .....	805
16.01 Theory of Operation .....	805
16.02 Measurement of RF Impedance of Crystals .....	808
16.03 Measurement of Intrinsic Admittance .....	812
16.04 Measurement of Mixer Parameters .....	812
16.05 Low Level Detectors .....	836
16.06 Large Signal Detection Characteristics .....	844
16.07 Modulation .....	845
16.08 Microwave Switching .....	846
16.09 Harmonic Generation .....	848
16.10 DC Measurement of Conversion Loss and Noise Ratio .....	850
16.11 Burnout and Handling Precautions .....	851
Appendix A: Impedance Loss Method .....	854
Appendix B: Derivation of Incremental Loss Equation (Broadband Mixing) .....	855
Appendix C: Derivation of Conversion Loss Expression for the Modulation Method .....	856
Appendix D: Relationship between Current Sensitivity, $\beta$ , and Crystal Properties .....	857
Appendix E: Microwave Diode Chart .....	859
Appendix F: Summary of Special Crystal Measurement Techniques .....	860
Appendix G: Mixer Design Information .....	862
CHAPTER XVII: NOISE FACTOR .....	865
17.01 Definitions .....	866
17.02 Noise Factor Equations .....	868
17.03 Noise Sources and Their Operation .....	870
17.04 Measurement of Noise Factor .....	874
17.05 Accuracy Considerations .....	882
CHAPTER XVIII: RECEIVER CHARACTERISTICS .....	889
Radio Frequency Section	
18.01 Noise Figure Definition .....	889
18.02 Measurement of Noise Figure with Various Generators .....	890
18.03 Measurement of Noise Figure with Various Detectors .....	893
18.04 Measurement of Single-Stage Noise Figure .....	897
18.05 Measurement of RF Gain vs Frequency .....	898
18.06 RF Gain or Transmission Loss: Image and I-F Rejection .....	901
18.07 Measurement of RF Gain: High Impedance Mixer .....	902
18.08 Measurement of RF Gain: Low Impedance Mixer .....	904
18.09 General Precautions in Making RF Measurements .....	905
Local Oscillator Section	
18.10 Measurement of Tracking .....	906
18.11 Measurement of Warm-Up Drift .....	907

## CONTENTS

## Chapter XVIII, continued

18.12 Measurement of Spurious Frequency Modulation . . . . .	907
18.13 Measurement of AFC Tuning Coefficient . . . . .	908
18.14 Measurement of Local Oscillator Radiation . . . . .	908
Frequency Converter Section	
18.15 Measurement of Conversion Gain . . . . .	909
18.16 Measurement of Oscillator Injection . . . . .	910
Intermediate Frequency Section	
18.17 I-F Amplifier Response Curves . . . . .	911
18.18 Vacuum Tubes vs Transistors . . . . .	914
18.19 Measurement of I-F Gain . . . . .	916
18.20 Measurement of I-F Gain vs Frequency . . . . .	917
18.21 Measurement of I-F Phase Shift or Time Delay . . . . .	919
18.22 I-F Response to Pulse Modulation . . . . .	920
18.23 Measurement of I-F Pulse Response . . . . .	922
18.24 Measurement of AGC Characteristics (I-F) . . . . .	923
18.25 Measurement of Cascode Amplifier Neutralization . . . . .	923
Second Detector and Discriminator Section	
18.26 Measurement of Detector Efficiency and Linearity . . . . .	924
18.27 Measurement of Equivalent Loading . . . . .	925
18.28 Measurement of Discriminator Response Curve . . . . .	925
18.29 Measurement of AGC Characteristics . . . . .	926
18.30 Measurement of AFC Characteristics . . . . .	930
Video Section	
18.31 Video Amplifier Response Curves . . . . .	933
18.32 Measurement of Video Gain . . . . .	934
18.33 Measurement of Video Gain vs Frequency . . . . .	936
18.34 Measurement of Video Phase Shift or Time Delay . . . . .	937
18.35 Measurement of Video Pulse Response . . . . .	939
18.36 DC Restorer Characteristics . . . . .	939
Miscellaneous Receivers	
18.37 Super-Regenerative Receiver Measurements . . . . .	940
18.38 Crystal-Video Receiver Measurements . . . . .	942
CHAPTER XIX: CHARACTERISTICS OF MICROWAVE SIGNALS . . . . .	
19.01 Survey of Basic Characteristics . . . . .	945
I. Description of Microwave Signals . . . . .	945
II. Modulated Microwave Signals . . . . .	946
III. Applications of Modulated Microwave Signals . . . . .	951
IV. Network Responses to Microwave Signals . . . . .	953
V. Measurements of Microwave Signal Characteristics . . . . .	956
19.02 Theory . . . . .	960
I. Modulated Microwave Signals . . . . .	960
II. Network Effects on Modulated Microwave Signals . . . . .	971

## CONTENTS

ix

### Chapter XIX, continued

III. Theory of Spectrum Analyzer Measurements . . . . .	974
IV. Graphical Methods of Spectrum Analysis . . . . .	979
19.03 Measurements . . . . .	981
I. Frequency Spectrum Measurements . . . . .	981
II. Time and Modulation Measurements . . . . .	991
 CHAPTER XX: MICROWAVE GENERATORS . . . . .	 999
Description, Theory and Measurement of:	
20.01 Reflex Klystron . . . . .	999
20.02 Magnetron . . . . .	1007
20.03 Backward Wave Oscillator . . . . .	1011
 CHAPTER XXI: MICROWAVE AMPLIFIER MEASUREMENTS . . . . .	 1015
Description, Theory and Measurement of:	
21.01 Klystron . . . . .	1015
21.02 Traveling Wave Tube . . . . .	1022
 CHAPTER XXII: ANTENNA MEASUREMENTS . . . . .	 1027
22.01 Antenna Performance . . . . .	1027
22.02 Reciprocity Theorem . . . . .	1028
22.03 Definitions of Antenna Terms . . . . .	1029
22.04 Radiation Patterns - UHF and Microwave . . . . .	1030
22.05 Equipment Requirements . . . . .	1036
22.06 Measurement of the Antenna Radiation Characteristics . . . . .	1039
 CHAPTER XXIII: DUPLEXING TUBE CHARACTERISTICS . . . . .	 1045
23.01 The Duplexing Function . . . . .	1047
23.02 Loaded and Unloaded Q . . . . .	1051
23.03 Insertion Loss . . . . .	1056
23.04 Leakage Power . . . . .	1058
23.05 Arc Loss . . . . .	1066
23.06 Recovery Time . . . . .	1068
23.07 Duplexer Loss . . . . .	1076
23.08 Transmitter Isolation . . . . .	1081
23.09 Position of Effective Short in Duplexer Tubes . . . . .	1082
23.10 The Ignitor . . . . .	1083
 CHAPTER XXIV: TUNNEL DIODE AND PARAMETRIC AMPLIFIERS . . . . .	 1085
24.01 Introduction . . . . .	1085
24.02 Parametric Amplifiers . . . . .	1088
24.03 Tunnel Diode Amplifiers . . . . .	1091
24.04 Measurement of Noise Factor . . . . .	1092
24.05 Gain and Bandwidth . . . . .	1098
24.06 Input Saturation Level (Point) and Dynamic Range . . . . .	1101

## CONTENTS

CHAPTER XXV: TRANSMISSION LINE CHARTS .....	1103
25.01 Relevant Transmission Line Formulas and Data .....	1103
25.02 Rectangular Impedance (Admittance) Chart .....	1105
25.03 Smith Chart .....	1115
25.04 Carter Chart .....	1126
25.05 Clement Chart .....	1127
25.06 Rieke Diagram .....	1129
25.07 Miscellaneous Charts .....	1131
CHAPTER XXVI: IMPEDANCE MATCHING TRANSFORMERS .....	1133
26.01 Matched Systems .....	1133
26.02 Adjustable Matching Transformers (Tuners) .....	1133
26.03 Characteristics of Stubs with Variable Shorts .....	1135
26.04 Coaxial Stub Tuners .....	1138
26.05 Matching Transformers Using Directional Couplers .....	1140
26.06 Example: Power Control by Means of a Variable Impedance and Circulator .....	1144
INDEX .....	1147

