
Microwave Digital Radio Systems Criteria

Contents

1. INTRODUCTION	1-1
1.1 Purpose	1-1
1.2 Criteria.....	1-1
1.3 Updating	1-2
1.4 Change History.....	1-2
1.5 General System Description.....	1-3
2. SPECTRUM CONSIDERATIONS	2-1
2.1 General Requirements.....	2-1
3. SYSTEM PERFORMANCE UNDER NORMAL OPERATING CONDITIONS ..	3-1
3.1 Baseband Interface	3-1
3.2 Error Criteria During Normal Operation.....	3-2
3.3 Equipment Caused Burst of Errors	3-3
3.4 Miscellaneous Requirements	3-3
4. SENSITIVITY TO MULTIPATH DISPERSIVE FADING	4-1
4.1 Historical Concept of Fade Margin.....	4-1
4.2 Concept of Dispersive Fade Margin for Digital Radio	4-2
4.3 Dispersive Multipath Fading Model and Fading Signature	4-3
4.4 Formula for Calculating Dispersive Fade Margin	4-7
4.5 Dispersive Fade Margin with Optional Adaptive Equalizers	4-8
4.6 Qualifications to Calculated Dispersive Fade Margin	4-8
4.7 Hysteresis in Resynchronization and Reframe	4-9
4.8 Hysteresis In an Adaptive Equalizer	4-9
4.9 Other Diversity Protection	4-10
4.10 Test Jacks of Propagation Conditions	4-12
5. DIGITAL STREAM TIMING AND JITTER	5-1
5.1 Jitter Accommodation	5-1
5.2 Jitter Generation	5-1
5.3 Jitter Transfer Functions	5-2
5.4 Jitter Enhancement	5-3
6. OUTAGE CONSIDERATIONS.....	6-1
6.1 General	6-1
6.2 Channel Outage.....	6-1
6.3 System Gain	6-1
6.4 Interference	6-2
6.4.1 Co-Channel Interference Sensitivity	6-2
6.4.1.1 Theoretical SNR Versus BER	6-2

6.4.1.2	Co-Channel Carrier-To-Interference Ratio (CIR) Versus BER.....	6-2
6.4.2	RF Filter and Radar Interference	6-3
6.4.2.1	Receiving Filter to Allow Co-Polar Adjacent Channel Operations.....	6-4
6.4.3	Adjacent Channel Interference Sensitivity	6-4
6.5	Equipment Reliability	6-4
6.6	System Reliability Generic Requirements	6-5
7.	SYSTEM GAIN AND RADIO RECEIVER DYNAMIC RANGE	7-1
8.	PROTECTION SWITCHING	8-1
8.1	Introduction	8-1
8.2	Protection Switching Threshold.....	8-2
8.2.1	Protection	8-2
8.2.2	Restoration	8-2
8.3	Detection Time.....	8-2
8.4	Hitless Frequency Diversity Switch.....	8-2
8.5	Other Hitless Switches	8-3
8.6	Switching Times.....	8-4
8.7	Error Performance During Switching	8-4
8.8	Protection Switch Availability and Reliability	8-4
8.8.1	Silent Failures	8-4
8.8.2	Protection Switch Exercising (1XN).....	8-4
8.9	Switch Initiation	8-5
8.10	Supplier-Provided Information	8-5
9.	MONITORING, ALARM, AND CONTROL.....	9-1
9.1	General	9-1
9.2	Local Monitoring	9-2
9.3	Remote Monitoring, Alarm, and Control.....	9-3
9.3.1	Remote Monitored Information	9-3
9.3.2	Remote Alarm and Control Indications	9-3
9.3.3	Telemetry Memory or Stretching.....	9-3
9.3.4	Alarm Interface Aspects.....	9-4
9.3.5	Fail-Safe Alarm and Control System	9-4
9.3.6	Alarm System Capability	9-4
9.4	Operations and Maintenance.....	9-4
9.4.1	Removable Fault Locating	9-4
9.4.2	Performance Monitoring	9-5
9.4.2.1	DS3 Performance Impairment Events	9-5
9.4.2.2	Performance Monitoring Parameters	9-6
9.4.3	Electrical, Technical, and Applications Interfaces.....	9-7
10.	TROUBLE SECTIONALIZATION.....	10-1
10.1	Downstream Alarm Prevention.....	10-1

10.2	Switching Section.....	10-1
10.3	Parity Restoration.....	10-1
11.	ORDERWIRE.....	11-1
12.	SERVICE CHANNEL.....	12-1
12.1	Background	12-1
12.2	Service Channel Interface and Requirements	12-1
12.2.1	Service Channel Remoting.....	12-1
12.2.2	Service Channel Provision	12-1
12.3	Service Channel Protection.....	12-2
13.	SAFETY CONSIDERATIONS.....	13-1
13.1	High Voltage	13-1
13.2	High Temperature	13-1
13.3	Radiation Hazards	13-1
14.	POWER SUPPLY INTERFACES AND REQUIREMENTS	14-1
14.1	Introduction	14-1
14.2	Bus Voltages	14-1
14.3	Bus Noise	14-2
14.4	Noise Allocation.....	14-3
14.5	Radio Frequency Interference.....	14-5
14.5.1	Emitted Radiation Requirements	14-5
14.5.2	Conducted Noise Currents	14-6
14.5.3	Field Intensity	14-7
14.6	Electrolytic Capacitors (All Units).....	14-8
14.7	Circuit Breakers	14-8
15.	PHYSICAL DESIGN AND HUMAN FACTORS GENERIC REQUIREMENTS	15-1
15.1	Introduction	15-1
15.2	General Equipment Requirements	15-1
15.3	Additional Environment Factors	15-1
15.3.1	Altitude.....	15-1
15.3.2	Acoustical Noise	15-1
15.3.3	Thermal Shock	15-2
15.4	Human Factors	15-2
15.5	Physical Design	15-2
16.	DOCUMENTATION.....	16-1
16.1	Required Documentation	16-1
16.2	Standards	16-1
17.	THERMAL SHOCK TEST METHODS.....	17-1
17.1	General	17-1
17.2	Tests	17-2

17.2.1	Test 12A: High-Temperature Thermal Shock	17-2
17.2.2	Test 12B: Low-Temperature Thermal Shock	17-3
17.2.3	Test 12C: Cyclic Temperature, High Relative Humidity	17-4
17.2.4	Test 12D: Cyclic Temperature, Low Relative Humidity	17-5
18.	4-GHz DIGITAL RADIO REQUIREMENTS	18-1
18.1	Spectrum Considerations	18-1
18.1.1	Adjacent Channel Generic Requirements	18-1
18.1.2	Frequency Plans	18-1
18.2	RF Interface.....	18-1
18.3	Outage Considerations	18-2
19.	6-GHz DIGITAL RADIO REQUIREMENTS	19-1
19.1	Spectrum Considerations	19-1
19.1.1	Adjacent Channel Generic Requirements	19-1
19.1.2	Frequency Plans	19-1
19.2	RF Interface.....	19-2
19.3	Outage Considerations	19-2
20.	11-GHz DIGITAL RADIO GENERIC REQUIREMENTS.....	20-1
20.1	Spectrum Considerations	20-1
20.1.1	Adjacent Channel Generic Requirements	20-1
20.1.2	Frequency Plans	20-1
20.2	RF Interface.....	20-2
20.3	Outage Considerations	20-2
21.	ACRONYMS	21-1
22.	REFERENCES.....	22-1
	Appendix A: SUMMARY OF REQUIREMENTS AND OBJECTIVES.....	A-1

List of Figures

Figure 1.	General Model of a Digital Radio System	1-4
Figure 2.	The W-Curves in B-fo Space of a 6-GHz 90-Mb/s 16-QAM System With Adaptive Amplitude Equalizer	4-6
Figure 3.	Regenerator Jitter Transfer Function.....	5-3
Figure 4.	Digital Radio Switching Section and Interfaces With Service Channel, Order Wire, Monitors, and Alarm and Control Equipment.	8-1
Figure 5.	Block Diagram on Maintenance System	9-1
Figure 6.	Battery Noise Test Setup.....	14-4
Figure 7.	Radiated Emission Requirements.....	14-5
Figure 8.	Conducted Emission Requirements.....	14-6
Figure 9.	Radiated Susceptibility Requirements.....	14-7
Figure 10.	High-Temperature Thermal Shock Tests	17-2
Figure 11.	Low-Temperature Thermal Shock Tests	17-3
Figure 12.	High Humidity - Cyclic Temperature Test (Perform Three Cycles).....	17-4
Figure 13.	Low Humidity - Cyclic Temperature Test (Perform Three Cycles)	17-5
Figure 14.	4-GHz Frequency Plan	18-3
Figure 15.	6-GHz Frequency Plan	19-3
Figure 16.	11-GHz Frequency Plan	20-3

List of Tables

Table 1. Voltage Requirements for -48V Distribution Subsystems	14-1	
Table 2. Voltage Requirements for -24V Distribution Subsystems	14-2	
Table 3. Electrical Noise ^a	14-2	
Table 4. Noise Allocation Among Converters	14-3	