

Content

1	LIST OF PICTURES	19
2	LIST OF TABLES	29
3	GENERAL	33
4	DESCRIPTION OF WAVEFORMS	35
4.1	Analogue Waveforms	35
	Amplitude Modulation (AM)	35
	Double Sideband reduced Carrier (DSB-RC)	36
	Double Sideband suppressed Carrier (DSB-SC)	36
	Single Sideband full Carrier	37
	Single Sideband reduced Carrier (SSB-RC)	38
	Single Sideband suppressed Carrier (SSB-SC)	38
	Single Sideband Modulation (SSB)	38
	Independent Sideband Modulation (ISB)	39
	Vestigial Sideband Modulation (VSB)	40
	Frequency Modulation (FM)	40
	Wide Frequency Modulation (WFM)	41
	Pre-emphasis and de-emphasis	42
4.2	Digital Waveforms	43
	Amplitude Shift Keying (ASK)	43
	Frequency Shift Keying (FSK)	44
	Continuous Phase Frequency Shift Keying (CPFSK)	45
	Double Frequency Shift Keying (DFS K)	45
	Constant Envelope 4-Level Frequency Modulation (C4FM)	46
	Minimum Shift Keying (MSK)	47
	Tamed Frequency modulation (TFM)	48
	Gaussian Minimum Shift Keying (GMSK)	48
	Multi Frequency Shift Keying (MFSK)	48
	Phase Shift Keying (PSK)	50
	Binary Phase Shift Keying (BPSK)	50
	Quadrature Phase Shift Keying (QPSK)	52
	Offset Quadrature Phase Shift Keying (OQPSK)	54
	Staggered Quadrature Phase Shift Keying (SQPSK)	54
	Compatible Differential Offset Quadrature Phase Shift Keying (CQPSK)	54
	Coherent Phase Shift Keying (CPSK)	55
	Differential Coherent Phase Shift Keying (DCPSK)	55
	8PSK Modulation	55
	Differential Phase Shift Keying (DPSK)	56
	Differential Binary Phase Shift Keying (DBPSK)	56
	Differential Quadrature Phase Shift Keying (DQPSK)	56
	Differential 8 Phase Shift Keying (D8PSK)	56

Quadrature Amplitude Modulation (QAM)	57
Orthogonal Frequency Division Multiplexing (OFDM)	59
Spread Spectrum (SS)	60
Direct Sequence Spread Spectrum (DSSS)	60
Frequency Hopping Spread Spectrum (FHSS)	61
Incremental Frequency Keying (IFK)	61
Analogue Pulse Modulation	62
Pulse Amplitude Modulation (PAM)	62
Pulse Width Modulation (PWM)	62
Pulse Position Modulation (PPM)	62
Digital Pulse Modulation	63
Pulse Code Modulation (PCM)	63
Delta Modulation	63
4.3 Description of modulation states	65
Asynchronous Data Transmission	65
Synchronous Data Transmission	65
Simplex	66
Duplex	66
Half duplex	66
Semi duplex	66
4.4 Baud Rate, Bit Rate, Symbol Rate	67
Bit rate	67
Symbol rate	67
Baud rate	67
4.5 Data formats	68
NRZ (Non Return to Zero)	69
NRZ (S) (Non Return to Zero - Space)	69
NRZ (M) (Non Return to Zero - Mark)	69
Bi- Φ -L (Biphase Level)	69
Bi- Φ -S (Biphase Space)	69
Bi- Φ -M (Biphase Mark)	69
4.6 Coding	70
Code	70
Codes in communication used for brevity	70
An example: the ASCII code	70
Codes to detect or correct errors	71
Error-correcting code (ECC)	71
Forward Error Correction (FEC)	71
Convolutional code	72
Viterbi algorithm	72
Reed-Solomon error correction	73
Overview of the method	73
Properties of Reed-Solomon codes	73
Use of Reed-Solomon codes in optical and magnetic storage	74
Timeline of Reed-Solomon development	74
Satellite technique: Reed-Solomon + Viterbi coding	74
Turbo code	75

Shannon-Hartley theorem	75
Theorem	75
Examples	76
4.7 Used code tables	77
ITA2, ITA2P and ITA3(CCIR342-2)	77
Russian MTK2	78
CCIR476-4, HNG-FEC, PICCOLO MK VI	79
ITA 2	80
ITA 2 P	80
ITA 3	80
CCIR 476	80
ASCII / CCITT 5	80
4.8 Channel access methods	85
Frequency-division multiple access (FDMA)	85
Time division multiple access (TDMA)	85
Code division multiple access (CDMA)	86
Orthogonal Frequency multiple access (OFDMA)	86
4.9 The OSI Reference Model	87
The Physical Layer	87
The Data Link Layer	88
The Network Layer	88
The Transport Layer	89
The Session Layer	90
The Presentation Layer	90
The Application Layer	90
4.10 Protocols	91
ACP127	91
STANAG 4406 Messaging	91
STANAG 5066	92
X.25	93
RSX.25	99
Automatic Link Establishment (ALE)	100
Codan Automated Link Management (CALM)	102
4.11 Designation of Emissions	103
Determination of Necessary Bandwidths	107
4.12 Table of system and user sorted by Baud rate	116
HF MODES	129
General Information	129
Spectrum	129
Sonagram	129
Oscilloscope	129

Phase Spectrum	129
Phase Plane	130
Speed Bit Analyses	130
Bit Correlation, Autocorrelation Function (ACF)	130
1. AFS Navy FSK	131
2. ALE 3G	131
3. ALE400	134
4. ALIS	135
5. ALIS 2	136
6. ARD9800 OFDM 36ch Modem	137
7. ARQ-E	138
8. ARQ-E3	138
9. ARQ-M2	140
10. ARQ-M4	140
11. ARQ-S	141
12. ARQ-SWE	142
13. ARQ 6-70S	143
14. ARQ 6-90/98	143
15. ASCII	144
16. AUM-13	144
17. AUS MIL ISB Modem	145
18. AUTOSPEC	146
19. Baudot ITA No.2	147
Baudot Code	149
Murray Code	149
Western Union Code	149
ITA2 Code	149
20. Baudot-ARQ System	150
21. Baudot F7B	150
22. Baudot Sync	151
23. BEE	152
24. BR 6028	152
25. BR 6029C Time Diversity Modem	153
26. BUL 107.53 Bd	154
27. BULG ASCII	154
28. CHN MIL 4FSK	155
29. CHN MIL 8FSK	157
30. CHN MIL Hybrid Modem	158
31. CHN 4+4 Modem	159
32. CHIP 64/128	160
33. CIS 11	161
34. CIS 12	162
35. CIS 12 ARQ	163
36. CIS 14	163
37. CIS 150 Bd SELCAL	164
38. CIS 16x75 Bd	165
39. CIS 36-50	166
40. CIS 405-3915	167
41. CIS 50-17 Baudot	168
42. CIS 50-50	169
43. CIS 81-29	169
44. CIS 81-81	170

45.	CIS 500 Bd FSK Burst Modem	171
46.	CIS 1280 Bd Modem	172
47.	CIS 3000 Bd Modem	173
48.	CIS 4FSK 96 Bd	174
49.	CIS 4FSK 100 Bd	175
50.	CIS 4FSK 150 Bd	175
51.	CIS-ARQ	176
52.	CIS AT-3004 Modem	178
53.	CIS MFSK-20	178
54.	CIS 45/60/93 Channel OFDM	180
	45 tone OFDM	180
	60 tone OFDM	180
	93 tone OFDM	181
55.	Clansman FSK Modem	182
56.	Clover	182
57.	Clover II	184
58.	Clover 2000	185
	Error-Correction Coding	186
	Selective ARQ Repeat	187
	Signal Format	187
	Modulation Formats	187
	Data Modes	187
	Data Throughput (Bps)	187
59.	CODAN	188
	CODAN 4 Channel mode	189
	CODAN 8 Channel Mode	189
	CODAN 12 Channel Mode	190
60.	CODAN Chirp mode	190
61.	CODAN Selcall	191
62.	Contestia	192
63.	Coquelet 8	194
64.	Coquelet 8 FEC	195
65.	Coquelet 100	196
66.	Coquelet 13	196
67.	CROWD 36	197
68.	CROWD 36 Selective Calling	199
69.	CW	199
70.	CW-F1B	200
71.	D AF VFT	200
72.	DGPS	201
	TX numbers	202
	Message types	202
	Type 3 Message	202
	Type 5 Message	202
	Type 7 Message	202
	Type 9 Message	203
	Type 9-3 Message	203
	Type 9-1 Message	203
	Type 16 Message	204
	DGPS Message Scheduling	204
	Type 3 Message	205
	Type 5 Message	205

Type 7 Message	205
Type 9 Message	205
Type 16 Message	205
73. DominoF	206
74. DominoEX	206
75. DPRK ARQ 600 Bd	208
76. DPRK ARQ 1200 Bd	209
77. DPRK FSK 600 FEC	210
78. DPRK BPSK Modem	211
DPRK 150 Bd BPSK	211
DPRK 300 Bd BPSK	211
DPRK 600 Bd BPSK	212
DPRK 1200 Bd BPSK	212
79. DRM	212
Stream Multiplexer	214
Fast Access Channel (FAC)	214
Service Description Channel (SDC)	214
Main Service Channel (MSC)	214
Transmission Frame	214
MPEG-4	215
Advanced Audio Encoding (AAC)	215
MPEG CELP	215
Harmonic Vector Excitation Coding	215
Multilevel Coding	215
80. DRM – WinDRM	216
81. DUP-ARQ	217
82. DUP-ARQ II	219
83. DUP-FEC II	219
84. ECHOTEL 1810 HF Modem	219
85. ECHOTEL 1820 HF Modem	220
86. F7B-195.3 Bd 4-Tone	222
87. Fax	223
88. FEC-A	226
89. G-TOR	227
90. Globe Wireless Pactor	229
91. Globe Wireless Single Tone Modem	230
92. Globe Wireless Multi Tone Modem	231
Globe Wireless OFDM with 12 carriers	231
Globe Wireless OFDM with 24 carriers	232
Globe Wireless OFDM with 32 carriers	232
93. GRC MIL FSK	233
94. GMDSS-DSC HF	233
95. HC-ARQ	234
96. HDSSTV	235
97. HELL	236
F-Hell, Press-Hell	236
Feld-Hell	236
GL-Hell	237
Hell-80	237
PC-Hell	237
PSK-Hell and FM-Hell	237
FSK-Hell	239

Duplo-Hell	239
Sequential Multi-Tone Hell	240
Concurrent Multi-Tone Hell	240
Slow-Feld	240
98. HFDL	241
99. HNG-FEC	245
100. ICAO Selcal	245
101. IRA-ARQ	247
102. IRN QPSK 207 Bd	248
103. Italian MIL 1200 Bd FSK	250
104. Italian MIL 1200 Bd PSK	251
105. Japan 8-Tone ASK	251
106. Japan 16-tone PSK	252
107. Japan 1500 Bd QPSK	253
108. Japan 32-tone OFDM	254
109. JT2	255
110. JT44	256
111. JT6M	257
112. JT65A/JT65B/JT65C	258
113. LINCOMPEX	260
114. LINEA Sitor	260
115. LINK 1	261
116. LINK 10	262
117. LINK 11 CLEW	262
118. LINK 11 SLEW	265
119. LINK 14	266
120. LINK 22	267
121. LINK Y	268
122. LINK Z	268
123. Mazielka	269
124. MD 522 NB	269
125. MD 522 WB	270
126. MD 522 DIV	270
127. MD 1061	271
128. MD 1142	272
129. MD 1280	273
130. MFSK-8	273
131. MFSK-16	274
132. MFSK AFS Navy Modem	275
133. MFSK BUL 8-Tone	275
134. MFSK Modem ALCATEL 801	276
MFSK 4-TONE ARQ SYSTEM 150 to 1200 Bd	276
MFSK 8-TONE ARQ SYSTEM 16.7 & 100 Bd	277
135. MFSK TADIRAN HF Modem	277
136. MFSK TE-204/USC-11 Modem	277
137. MFSK Thrane & Thrane TT2300-ARQ Modem	279
138. MFSK YUG 20-Tone Modem	279
139. MIL STD 188-110A ser	280
140. MIL STD 188-110A Appendix A 16-Tone	281
141. MIL STD 188-110A Appendix B 39-Tone	282
142. MIL STD 188-110B	282
143. MIL STD 188-110B Appendix C	283

144.	MIL STD 188-110BA Appendix F	284
145.	MIL STD 188-141A	284
	Linking Protection	285
	AL-0	286
	AL-1	286
	AL-2	286
	AL-3	286
	AL-4 (classified application level)	286
	Alternate Quick Call (AQC) ALE	286
146.	MIL STD 188-203-1A	287
147.	MIL STD 188-203-3	287
148.	MIL STD 188-212	287
149.	MIL STD 188-342	287
150.	MLA Navy Baudot	288
151.	MT 63	289
152.	Nokia Adaptive Burst System	290
153.	NUM 13	291
154.	Olivia	292
	Olivia MFSK layer	293
	Olivia Walsh functions FEC layer	294
155.	PACTOR I	295
156.	PACTOR II	296
157.	PACTOR II-FEC	297
158.	PACTOR III	297
159.	Packet Radio	300
160.	Panther-H FH Modem	301
161.	PAX/PAX2	303
162.	PICCOLO Mark VI	304
163.	PICCOLO 12	307
164.	POL-ARQ	310
165.	PSK 10	310
166.	PSK 31	312
167.	PSK 63 FEC	313
168.	PSK 125 FEC	313
169.	PSK 220 FEC	314
170.	PSKAM 10/31/50	314
171.	Q15x25	317
172.	RAC-ARQ	317
173.	RFSM 2400/8000	318
	RFSM-2400 Modem	318
	RFSM-8000 Modem	319
174.	Robust Packet Radio RPR	319
175.	ROS	320
176.	ROU-FEC	321
177.	RS-ARQ	322
178.	RS-ARQ II	323
179.	RS GM2xxx Modem	323
180.	RS GN2130 Modem	325
181.	RTTYM	326
182.	RUS Mil Voice Scrambler	327
183.	Selenia Parallel Tone Modem	327
184.	Siemens CHX-200 FSK Modem	328

185.	SITOR A/B	329
186.	ARQ mode A	329
187.	FEC mode B	329
188.	SKYFAX	330
189.	SSTV	333
190.	STANAG 4197	335
191.	STANAG 4198	337
192.	STANAG 4202	337
193.	STANAG 4285	339
194.	STANAG 4415	340
195.	STANAG 4444	341
196.	STANAG 4479	342
197.	STANAG 4481 FSK	343
198.	STANAG 4481 PSK	343
199.	STANAG 4529	344
200.	STANAG 4538	345
201.	STANAG 4539	346
202.	STANAG 4591	346
203.	STANAG 5031	347
204.	STANAG 5035	347
205.	STANAG 5065	347
206.	Systeme 3000 HF Modem	348
207.	Tadiran AutoCall	348
208.	Tadiran Data Mode	349
209.	TFM3/5	350
210.	Throb	351
211.	TMS-430 Modem	352
212.	TWINPLEX	352
213.	VFT	354
214.	VISEL	355
215.	WINMOR	356

5 OTHER SYSTEMS ON HF

5	OTHER SYSTEMS ON HF	359
216.	Advanced Narrowband Digital Voice Terminal (ANDVT) Family	359
	TACTERM	359
	MINTERM	359
	AIRTERM	360
217.	ALF	361
218.	Beacons	361
	Maritime Mobile Service (MMS) Beacon	361
	Aeronautical Mobile Service (AMS) Beacon	361
	Amateur Radio Beacon	362
	Single Letter Beacons (SLB)	363
219.	Analogue Voice Scrambler Sailor CRY-2001	365
220.	Buoys	366
	Drifting buoys	366
	Fishing Buoys	366
	Sel-Call Buoys	366
221.	Chirpsounder	367
	Chirpcomm	368
222.	CODAR	369

223.	D-OMEGA	369
224.	Datatrak	370
225.	DECCA	371
226.	EFR	371
227.	Eurofix	372
228.	Long Range Ocean Radar	374
229.	LORAN-C	375
	LORAN data channel communication (LDC)	376
	Ninth-Pulse Modulation	376
	Messages	376
230.	NAVTEX	377
231.	NDS200 DGPS	378
232.	OMEGA	380
233.	Over The Horizon Radar	381
234.	Russian ALPHA and LORAN-C System	383
235.	Russian BRAS-3 and RS-10 System	383
236.	Super Dual Auroral Radar Network	387
237.	Time Signal Stations	390
238.	WERA	391
6	HINTS FOR RADIO MONITORING	393
6.1	Recognizing of PSK-, MSK- and TFM - Signals	393
6.2	Different PSK modulation	394
6.3	Fingerprinting	396
	General	396
	Pre-Carrier and Post-Carrier	396
	Fingerprinting with MFSK signals	398
7	TABLES FOR RADIO MONITORING	401
7.1	Allocation of International Call Signs	401
7.2	Alphabetical List of Country Codes	405
7.3	Selective Calling	409
7.4	Allocation of Maritime Identification Digits	413
7.5	NATO Routing Indicators	418
7.6	Aeronautical Fixed Telecommunication Network	423
7.7	AFTN Messages	425
	Standard Messages	425

7.8	Notice to Airmen (NOTAM)	427
7.9	Weather Forecast (TAF and METAR)	434
	TAF	434
	METAR	434
7.10	Teleprinter Alphabets	437
7.11	ATU 80 Words Identification	438
7.12	Arabic words identification	441
7.13	Q , X and Z - Code	444
	Q-Codes	444
	X-Codes	454
	Z-Codes	455
7.14	Abbreviations	464
8	INDEX	473