

Table of Contents

PREFACE	13
INTRODUCTION	18
 CHAPTER 1: RADIO WAVES AND RADIO FREQUENCIES . . .	21
 Big Inventors and Discoveries	21
 Waves in Communication Technology	27
 Origins of Electromagnetic Waves	27
Linear Polarisation	29
Circular Polarisation	32
 Electromagnetic Waves and Their Paths	33
Conducted Waves in Waveguides	34
Coaxial Cables	35
Two Wire Lines	38
Optical Fiber	38
Microstrip Lines	38
Waveguides	41
Electromagnetic Waves at Boundary Layers	44
Radio Waves Detaching from a Linear Antenna	47
Propagation in Free Space	52
Extraordinary Propagation Effects	55
Ground Wave Propagation	62
Superposition of Electromagnetic Waves	67
 Analogue and Digital Transmission	70
Digital Signals and Digital Transmission	72
Digital Voice and Music	72

Table of Contents

Modulation Types	76
AM and FM	78
CW.	84
FSK	86
PSK	88
BPSK	88
QPSK.	89
PAM	89
PCM.	89
ASK and QAM	90
Special Modulation Types	91
Bits and Symbols	92
Multiplexing, Organisation and Access to Signals.	93
FDMA.	94
TDMA	95
CDMA	96
OFDM und OFDMA.	97
Propagation Time	99
 Technology and the People Behind	 101
Users.	101
Radio Amateurs.	102
Digital Modes for Data Transmission	106
Professional and Commercial Users	108
Example: Aviation	110
Example: Authorities with Security Tasks	111
Example: Public Transportation.	113
Developers and Engineers	114
SWL.	117
Radio as a Hobby	120
Do-It-Yourself Projects	125

Table of Contents

Example from Research and Development	129
Maxwell's Equations	131
Structure of a Frequency Selective Surface	132
Incident Transverse Wave	134
Reflected and Transmitted Wave	135
Integral Equation Method in the Space Domain	135
Representation in the Frequency Domain	136
Impact of Substrate	140
Impact of Polarisation	140
Linear Equation System	142
Algorithm and Calculation	142
Some Selected Results	143

CHAPTER 2: TRANSMISSION OF RADIO WAVES 148

Transmitter and Receiver	148
Transmitters with High Power and with Low Power	149
Good Reception Quality and Good Links	152
Noise: Reckon Without One's Host	152
Minimizing Noise	155
Propagation Loss	157
Frequency Ranges	158
Earth Curvature	164
Atmosphere	165
Solar Effects	168
Earth's Magnetic Field	172
Our Weather on Earth	174
Radio Weather and Predictions	175
Time Signals	177

Table of Contents

Antennas, Waveguides and Risks	177
Antennas	178
Basic Types of Antennas	181
Linear Antennas	182
Aperture Antennas	185
Magnetic Antennas	190
Active Antennas	192
Antenna Groups and Arrays	193
Antennas in Mobile Networks	193
Special Antennas	195
Polarisation	198
Bandwidth and Resonance	199
Matching and Return Loss	201
Cables and Waveguides	202
Plugs and Adapters	204
 Practical Example Planar Antenna	 205
Radiators for GHz-Frequencies (X-Band)	205
Feed System and Coupling	207
Linear Polarisation	208
Circular Polarisation	209
Antenna, Converter and Receiver	210
 Simulation Models	 212
 CHAPTER 3: USERS AND SYSTEMS	 214
 Fields of Application	 214
Radio and TV	216
Public Mobile Networks	217
Professional Radio	219
Digital Radio	221

Table of Contents

Transportation	225
Shipping	225
Aviation	229
Railway	230
Road Traffic	232
Signals from Space	233
Galactical Radio Sources.	235
Scientific Missions in Space	238
Transmissions over Communication Satellites	241
Giotto and Halley's Comet	243
Remote Sensing.	246
Worldwide Weather Data	248
Military Applications.	251
Intelligence.	258
 Systems and Components	 262
Methods and Modes	264
Communication Protocols	264
Regulation and Harmonization	266
Duplex Operation -	
Amateur Radio Repeaters as an Example	268
ARQ Semi Duplex in Maritime Radio	269
Other ARQ Modes	272
Error Detection and Error Correction.	273
Encoding	280
Encryption - from ENIGMA to TETRA	280
ALE Operation and Encryption	283
Frequency Hopping	284
Localization	285
GPS.	286
Radar	287
Triangulation	289
Direction-Finding Methods	290

Table of Contents

Localization in Amateur Radio	292
Movements in Space and the Doppler Effect	293
Sensors and Systems in Aviation	293
Antennas on Board	294
Aviation and Safety	296
Repeater for Mobile Radio	297
Antenna Preamplifiers	298
Converters	299
Practical Experience	300
Basic Properties	300
Link Balance and Imbalance	301
Antenna Diversity	303
Frequency Hopping	305
Resilience	306
Circuit and Implementation	306
Modulation and Operation Mode	307
Bad Boys and Destroyers	307
Lightnings and Overvoltage	309
Good Guys	311
Good Match	312
Balancing	323
Standing Wave Barrier	324
Second Antenna to Compensate Interference	325
Good Antenna Placing	326
Voice Quality	328
Coverage and Long Distances	331
Quantification and Helpful Quantities	335
Consumer Products in the Course of Time	337
Radio and Television	337
Mobile Devices	339
Recent and Modern Receiver Technologies	341

Table of Contents

Parameters of Receivers	341
Early Concepts	344
Proven Concepts	347
Digitalising the RF Level	350
Professional Systems	358
Algorithms Meet Electromagnetics.	361
Simulation for Radio Network Planning	361
Numeric Calculations of Electromagnetic Fields	362
Signal Decoding.	363
CHAPTER 4: NETWORKS	366
Terrestrial Networks and Satellite Networks	366
Telephone.	368
Networks for Radio and TV.	368
Transport Networks for Mobile Radio	370
Networks for Amateur Radio	372
Satellite Networks for Navigational Use	378
Satellite Networks for Phone and Internet.	380
VSAT	380
Public Mobile Radio and Landline Infrastructure.	381
Internet.	386
Impact on Society	388
Benefit	389
Visions, Concerns und Fears.	389
Social Networks	391
Health Aspects	394

Table of Contents

LIST OF ILLUSTRATIONS. 403

TABLE DIRECTORY 421

BIBLIOGRAPHY 423

GLOSSARY. 424