

## Contents

<b>1</b>	<b>History of Wireless Communication</b>	<b>1</b>
1.1	Basics of Electromagnetics	1
1.2	Towards Application	7
1.3	Development of Technology	9
1.4	Conclusions	13
1.5	References	13
<b>2</b>	<b>Propagation of Radio Waves</b>	<b>14</b>
2.1	The Radio Spectrum	14
2.2	Earth's Atmosphere	14
2.3	Radio Wave Propagation for Terrestrial Radio Links and Propagation Modes	15
2.3.1	The Surface Wave	15
2.3.2	The Sky Wave	16
2.3.3	Tropospheric Wave	17
2.3.4	Direct Wave (Line of Sight)	18
2.3.5	The Space Wave	18
2.3.6	Link Budget	18
2.3.7	Mobile Propagation in Built-up Areas	19
2.3.8	Propagation Mechanisms	20
2.3.9	Modeling of Wave Propagation in Built-up Areas	22
2.4	References	23
<b>3</b>	<b>Antennas: Typical Components of Radio Communication Systems</b>	<b>24</b>
3.1	History of Antennas and Wireless Communication	24
3.2	Antenna Parameters	25
3.2.1	Resonant Frequency	25
3.2.2	Gain	26
3.2.3	Radiation Pattern	26
3.2.4	Efficiency	26
3.2.5	Bandwidth	26
3.2.6	Polarization	26
3.3	Wire Antennas	27
3.3.1	Half-Wave Dipole	27
3.3.2	Quarter-Wave Dipole (Groundplane Antenna)	28
3.3.3	Yagi Antenna	29
3.3.4	Helix Antenna	30
3.3.5	Planar Antennas	31
3.3.6	Patch (Microstrip) Antenna	31
3.3.7	Horn Antenna	33
3.3.8	Parabolic Antenna	33
3.4	References	35
<b>4</b>	<b>Microwave Circuits: Between Antenna and System Circuitry</b>	<b>36</b>
4.1	Filter in the Transceiver	36
4.2	Switch	36
4.3	Low Noise Amplifier	37
4.4	Mixer	38
4.5	Power Amplifier	38
4.6	Local Oscillator	38
4.7	Intermediate Frequency	39
4.8	Practical Problems	39
4.9	Practical Equations	40
4.9.1	Power	40
4.9.2	Amplitude, Voltage and Current	40

4.10	References . . . . .	41
<b>5</b>	<b>Spread Spectrum and Multicarrier Systems</b>	<b>42</b>
5.1	Introduction to Spread Spectrum . . . . .	42
5.2	Introduction to Multicarrier Communications . . . . .	44
5.3	References . . . . .	46
<b>6</b>	<b>Mobile Communication Systems and Wireless Broadband Networks</b>	<b>48</b>
6.1	Mobile Systems . . . . .	48
6.1.1	Basic Principles of Mobile Systems . . . . .	48
6.1.2	Global System for Mobile Communications - GSM . . . . .	49
6.1.3	Data Transfer in Mobile Networks - GPRS and EDGE . . . . .	50
6.1.4	Universal Mobile Telecommunication System - UMTS . . . . .	51
6.2	Wireless Broadband Networks . . . . .	53
6.3	Wireless LAN - WiFi . . . . .	53
6.4	WiMAX . . . . .	54
6.5	Mobile WiMAX . . . . .	56
6.6	References . . . . .	57
<b>7</b>	<b>Terrestrial and Space Microwave Radio Communication</b>	<b>58</b>
7.1	Microwave Radio Relay . . . . .	58
7.2	Satellite Radio Relay . . . . .	59
7.3	Link Analysis . . . . .	60
7.3.1	System Noise Temperature . . . . .	62
7.4	Conclusion . . . . .	64
7.5	References . . . . .	64
<b>8</b>	<b>Atmospheric Optical Communication Links</b>	<b>65</b>
8.1	History of Optical Wireless Communication . . . . .	65
8.2	Terrestrial FSO Architecture . . . . .	66
8.2.1	FSO Optical Receiver . . . . .	67
8.2.2	FSO Optical Transmitter . . . . .	68
8.3	Power Level Diagram of Terrestrial FSO . . . . .	70
8.4	Some of Limitations of Through-the-Air Communications . . . . .	70
8.5	References . . . . .	72
<b>9</b>	<b>Radar Systems</b>	<b>73</b>
9.1	Basic Principle of Radar . . . . .	73
9.2	History of Radar . . . . .	74
9.3	Radar Cross Section of Targets . . . . .	76
9.4	Radar Equation . . . . .	77
9.5	Pulse Radar . . . . .	79
9.6	References . . . . .	81
<b>10</b>	<b>Digital Video and Audio Broadcasting</b>	<b>82</b>
10.1	The Satellite Television Broadcasting and the Standard DVB-S . . . . .	82
10.2	The Cable Television Broadcasting and the Standard DVB-C . . . . .	83
10.3	The Terrestrial Television Broadcasting and the Standard DVB-T . . . . .	85
10.4	Second Generation of the Classical DVB Standards . . . . .	87
10.5	Mobile Digital Television and its DVB Standards . . . . .	89
10.6	References . . . . .	90

<b>11</b>	<b>Microprocessors</b>	<b>91</b>
11.1	Microprocessors, Microcontrollers	91
11.2	Hardware Architecture	91
11.2.1	Central Processing Unit (CPU)	92
11.2.2	Internal CPU Buses	92
11.2.3	Arithmetic Logic Unit (ALU)	92
11.2.4	Registers	93
11.2.5	Control Unit (CU)	93
11.3	Software Architecture	94
11.3.1	Operations	94
11.3.2	Complex Instruction Set Computing (CISC) Model	94
11.3.3	Reduced Instruction Set Computing (RISC) Model	94
11.4	Programming Languages	94
11.4.1	High-level Programming Languages	94
11.4.2	Assembly Language	95
11.5	Cores Differences	95
11.6	References	96
<b>12</b>	<b>Introduction to Digital Signal Processors (DSP)</b>	<b>97</b>
12.1	VLIW Architecture	97
12.1.1	Introduction to Parallel Systems	97
12.1.2	The TMS320C6000 DSP's	98
12.2	Integer and Floating-Point Word Format	99
12.3	Development of DSP Applications	100
12.3.1	Implementation of FIR filter	101
12.4	References	103
<b>13</b>	<b>Programmable logical devices (PLD)</b>	<b>104</b>
13.1	History of PLDs	104
13.2	Architecture of FPGA	105
13.3	FPGA applications	107
13.4	Configuring the FPGA	108
13.5	References	110
<b>14</b>	<b>Computer and Communication Networks</b>	<b>111</b>
14.1	Basic Network Concepts	111
14.1.1	Transmission Technology	111
14.1.2	Switching Methods	112
14.2	The Internet: Structure and Services	112
14.3	Local-Area Networks: Ethernet	115
14.4	Conclusions	116
14.5	References	116
<b>15</b>	<b>Coexistence of Radio Communication Systems:</b>	
	<b>EM Compatibility</b>	<b>117</b>
15.1	Sources of Electromagnetic Interference	117
15.2	Measuring of Electromagnetic Interference	117
15.3	Open Area Test Site	118
15.3.1	Anechoic Chamber	119
15.3.2	Test Antennas	119
15.3.3	Receivers	120
15.3.4	Measuring of Conducted EMI	120
15.4	EMC Technology	121
15.4.1	Shielding	122
15.4.2	Filters	122
15.5	Electromagnetic Immunity Testing	123
15.6	References	123