

Contents

Foreword	v
Acknowledgements	vii
Authors	ix
1. Introduction to Ultrawideband Systems	1
<i>Cong Ling</i>	
1.1 Overview	1
1.2 UWB Schemes	3
1.2.1 Impulse radio/time hopping	3
1.2.2 Direct sequence	5
1.2.3 Frequency hopping	6
1.2.4 OFDM	9
1.3 Industry Standards	11
1.3.1 Single band versus multiband	11
1.3.2 Standards	11
1.4 Applications	12
1.5 Challenges	13
2. Figures of Merit for UWB Antennas	15
<i>David Puente and Daniel Valderas</i>	
2.1 Requirements for a UWB Antenna	16
2.1.1 Efficiency and matching	16
2.1.2 Signal distortion and dispersion (ringing)	17
2.1.3 Stability over frequency of the transmission-reception transfer function	17
2.2 UWB Antenna Parameters	19
2.2.1 Variability in the frequency domain	19
2.2.2 Variability in the time domain: Pulse distortion parameters	23
2.2.3 Variability in the space domain	24
2.3 Simulation in the Time Domain	27

3. Classification of UWB Antennas	29
<i>David Puente and Daniel Valderas</i>	
3.1 Helical Antennas	29
3.2 Frequency-independent Antennas	31
3.2.1 Spiral antennas	31
3.2.2 Biconical antennas	32
3.3 Log-periodic Antennas	34
3.4 Horn Antennas	36
3.4.1 3D horn antennas	36
3.4.2 2D horn antennas	38
3.5 UWB Antennas Derived from Resonant Antennas	39
3.5.1 3D monopoles	39
3.5.2 2D resonant antennas	46
3.6 Conclusions	47
4. UWB Monopole Antenna Analysis	51
<i>Daniel Valderas and Juan I. Sancho</i>	
4.1 Introduction	51
4.2 Current-conductive Parts on Planar Monopole Antennas	51
4.2.1 Currents parallel and perpendicular to the ground plane: A working hypothesis	51
4.2.2 Non-radiating currents in a PMA	54
4.3 Transmission Line Model for UWB Monopole Antennas	56
4.3.1 General description	56
4.3.2 Description of the model	58
4.3.3 Purpose of the analogy	58
4.3.4 Graphical approach: The Smith Chart	59
4.4 Design Based on TLM	61
4.4.1 Design of an UWB-PMA antenna with a given bandwidth	61
4.4.2 Design of an UWB-PMA antenna having a maximised bandwidth	61
4.4.3 Design of omnidirectional UWB antennas	62
4.4.4 Design of directional UWB antennas	62
4.4.5 Design of 2D PCB antennas for UWB	62
4.4.6 Case study 1: Semi-rectangular planar monopole case .	62
4.4.7 Case study 2: Broadband matching of a full-rectangular planar monopole case	65

5. UWB Monopole Antenna Bandwidth Synthesis	69
<i>Daniel Valderas and Juan I. Sancho</i>	
5.1 Introduction	69
5.2 Defining the Lower Limit of the Frequency Band	70
5.3 Obtaining the Upper Frequency with Staircase Profile in TLM	71
5.3.1 One step in a PMA's profile according to TLM	71
5.3.2 Two steps in a PMA's profile according to TLM	74
5.3.3 Analytical estimate of the upper limit of the band for a rectangular staircase monopole	75
5.4 Obtaining the Upper Frequency through Slot Etching	78
5.5 Case Study 1	82
5.5.1 Design	82
5.5.2 Simulation and measurements	83
5.6 Case Study 2	86
5.6.1 Design	86
5.6.2 Simulation and measurements	87
5.7 Case Study 3	88
5.7.1 Design	89
5.7.2 Simulation and measurements	90
5.7.3 Discussion: Impedance matching and transfer function	92
6. UWB Monopole Antenna Bandwidth Maximisation	95
<i>Daniel Valderas and Juan I. Sancho</i>	
6.1 Introduction	95
6.1.1 Modifying the profile of the edge of the PMA closest to the ground plane	97
6.1.2 Applying TLM: Changing the characteristic impedance	97
6.2 Case Study: Maximising AMP Impedance Bandwidth	101
6.2.1 Lower frequency limit of the band: Initial L , W and p parameters	101
6.2.2 Adjusting the width	102
6.2.3 Changing the height p over the ground plane	102
6.2.4 Implementing a bevelled cut	102
6.2.5 Changing the profile close to the feed	105
6.2.6 Simulation and measurements	106
6.3 Discussion of Spectral Efficiency in Broadband Antennas	108

7. UWB Folded Monopole Antennas	115
<i>Daniel Valderas and Juan I. Sancho</i>	
7.1 Introduction	115
7.2 Current Distribution in an Antenna Folded along Vertical Axes	117
7.3 TLM Applied to an FMA	117
7.4 Case Study: Maximising FMA Impedance Bandwidth	120
7.4.1 Design	120
7.4.2 Simulation and measurements	123
7.4.3 Design options	133
8. Revolution Monopole Antennas	139
<i>Daniel Valderas and Juan I. Sancho</i>	
8.1 Introduction	139
8.1.1 Current distribution in an RMA	140
8.1.2 TLM applied to an RMA	143
8.1.3 Case study: Maximising RMA impedance bandwidth	143
9. Printed Circuit Monopoles	157
<i>Daniel Valderas and Juan I. Sancho</i>	
9.1 Introduction	157
9.2 Current Distribution in a PCM	158
9.3 TLM Applied to a PCM	158
9.4 Case Study: Tailored Bandwidth for UWB PCM	160
9.4.1 Design	160
9.4.2 Simulations and measurements	161
10. Applications of UWB Antennas	167
<i>Xiaodong Chen</i>	
10.1 UWB Communications	167
10.1.1 Antennas required in impulse radio system	168
10.1.2 Antennas required in MB-OFDM system	171
10.2 EM Measurement	173
10.2.1 EM spectrum monitoring	173
10.2.2 EMC testing	173
10.3 Medical Imaging — Breast Cancer Detection	174

10.3.1	Horn and tapered slot antennas	175
10.3.2	Stacked patch antennas	176
10.4	Radars	177
10.4.1	Antenna array in impulse radars	178
10.4.2	Broadband phase array	180
	Bibliography	183
	Index	191