

Contents

Certificate I	iii
Certificate II	v
Abstract	v
Acknowledgements	vii
Dedication	ix
Contents	xi
List of Figures	xiii
Nomenclature	xv
1 Introduction	1
1.1 History	1
1.2 Literature Review	2
1.3 Objective	4
1.4 Thesis outline	5
2 Antenna Theory	7
2.1 Transmission Lines	7
2.1.1 Lumped element	8
2.1.2 Distributed element	8
2.2 Radiation Pattern	8
2.2.1 3D Radiation Pattern	9
2.2.2 2D Radiation Pattern	10
2.2.3 Radiation Pattern Lobes	10
2.3 Gain	11

2.4	Bandwidth	12
2.5	VSWR	13
2.6	Return Loss	13
2.7	Antenna Measurement process and setup	14
2.7.1	Measurement process	14
2.7.2	Design Setup	15
2.7.3	Apparatus Setup	16
2.7.4	Vector Network Analyzer,MS46322B	17
3	Types of Antenna	19
3.1	Microstrip Antenna	19
3.1.1	Structure	19
3.1.2	Feeding methods	20
3.2	Inverted-F Antenna	21
3.3	Singleband Inverted-F antenna for mobile applications	21
3.4	Dualband Inverted-F antenna design for mobile applications	24
3.4.1	Effect of S11 on change of length of upper arm(La1)	25
3.4.2	Effect of S11 on change of length of lower arm(La5)	25
3.4.3	Effect of S11 on change of position of feedarm(La3)	25
3.4.4	Effect of S11 on change of position of lower arm (La4 + La5)	26
4	Design Process and Fabrication	29
4.1	Design of Inverted F antenna for laptop applications	29
4.2	Singleband configuration of IFA	29
4.2.1	Antenna Geometry	29
4.2.2	Simulation and Optimization	31
4.2.3	Measured Results	34
4.3	Dualband configuration of IFA antenna with lumped element	37
4.3.1	Antenna Geometry	37
4.3.2	Simulation and Optimization	37
4.3.3	Radiation Pattern	38
4.3.4	S11 measurement setup	40
5	Conclusions and future research scope	41
5.1	Results and Discussion	41
5.2	Future Work	43
	Bibliography	45

List of Figures

2.1	Coordinate system for antenna analysis.	9
2.2	Radiation Pattern in 3D	9
2.3	Radiation Pattern in 2D	10
2.4	Lobe Formation	11
2.5	Return loss curve of a patch antenna.	14
2.6	Design and Fabrication process of a prototype antenna	15
2.7	Interface of CST MICROWAVE STUDIO	16
2.8	Radiation pattern measurement setup	16
2.9	VNA,MS46322B	17
3.1	(a)Rectangular and (b)Circular microstrip antennas	19
3.2	(a)Top view and (b)Side view of microstrip antenna	20
3.3	(a)microstrip feed and (b)coaxial probe feed	20
3.4	Inverted-F Antenna (IFA) design.	21
3.5	Structure of Inverted-F Antenna.	22
3.6	close view of the IFA Structure.	22
3.7	S11 parameter w.r.t change in position of the feed.	23
3.8	E-field radiation pattern of an inverted-f antenna.	23
3.9	H-field radiation pattern of an inverted-f antenna.	23
3.10	Structure of Dualband Inverted-F Antenna.	24
3.11	close view of the IFA structure.	24
3.12	S11 parameter w.r.t change in La1.	25
3.13	S11 parameter w.r.t change in La5.	26
3.14	S11 parameter w.r.t change in La3.	26
3.15	S11 parameter w.r.t change in position of (La4 + La5).	27
4.1	Structure of the proposed design	30
4.2	Front view of the antenna	30
4.3	Cropped view of the dimension parameters of the antenna	31

4.4	S11 variation with "W1"	32
4.5	S11 variation with "W2"	32
4.6	S11 variation with "W3"	33
4.7	S11 variation with "W4"	34
4.8	Front view of the fabricated prototype	34
4.9	Measured and simulated S11 parameter	35
4.10	(a)elevation plane pattern	35
4.11	(b)azimuthal plane pattern	35
4.12	Polar far-field pattern at	35
4.13	(a)elevation plane pattern	36
4.14	(b)azimuthal plane pattern	36
4.15	Polar far-field pattern at	36
4.16	3D radiation pattern at 2.45 GHz	36
4.17	Front view of the antenna	37
4.18	Variation of S11 w.r.t change in position of lumped port	37
4.19	Simulated S11 parameter	38
4.20	E-field and H-field radiation pattern at 2.48 GHz	38
4.21	E-field and H-field radiation pattern at 4.98 GHz	38
4.22	3D Radiation pattern at 2.45 GHz	39
4.23	3D Radiation pattern at 4.9 GHz	39
4.24	S11 measurement setup	40

Nomenclature

Abbreviations

ISM	Industrial, Scientific and Medical
GHz	GigaHertz
VNA	Vector Network Analyzer
mm	milimeter

