

**Investigation of Low Profile Antenna Designs
for Use in Hand-Held Radios**

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(ABSTRACT)

Antennas in hand-held radios must be compact and unobtrusive. Electrically small and low-profile antennas experience high input reactance, low input resistance, and low radiation efficiency. Further degradation of radiation efficiency occurs in hand-held radios due to size-reduced ground planes, losses within the plastic device casing, and losses due to coupling with the tissue of the user. These factors may also affect the radiation pattern of the antenna.

This discussion reports on antenna designs that are well suited for hand-held radios. The design issues are covered for electrically small antennas and the hand-held environment. A review of Microstrip Antenna (MSA) theory, and the theory of the Inverted-L Antenna (ILA), and variations on the ILA including the Inverted-F Antenna (IFA), Planar Inverted-F Antenna (PIFA), and Dual Inverted-F Antenna (DIFA) is included. Two specific antenna designs are presented: the DIFA and the Proximity-Coupled Rectangular Patch MSA. The radiation patterns and input impedance of the DIFA are calculated numerically and measured empirically. The Proximity-Coupled Rectangular Patch Microstrip Antenna is treated numerically.

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TABLE OF CONTENTS

ABSTRACT.....	ii
ACKNOWLEDGMENTS.....	iii
TABLE OF CONTENTS.....	iv
Chapter 1: Introduction.....	1
1.1 Overview.....	1
1.2 Antenna History.....	2
1.3 Current Work.....	5
1.4 Statement of Problem and Summary of Issues.....	6
Chapter 2: Fundamentals of Electrically Small Antennas.....	9
2.1 Fundamental Limitations.....	9
2.1.1 Section Overview.....	9
2.1.2 Limit on Radiation Q.....	11
2.1.3 Limit on Radiation Efficiency.....	16
2.2 Design Issues for Electrically Small Antennas.....	21
2.2.1 Currents on Dipole Antennas.....	21
2.2.2 Antennas over Conducting Ground Planes.....	24
2.3 Design Issues in the Hand-Held Environment.....	27

2.3.1 Section Overview.....	27
2.3.2 Design Issues for a Truncated Ground Plane.....	28
2.3.3 Casing Effects.....	33
2.3.4 Antennas Operated Near the Human Body.....	35
2.4 Conclusion.....	39
Chapter 3: The Inverted-L Antenna and Variations.....	42
3.1 Introduction.....	42
3.2 The Far Field Radiation Pattern of the Inverted-L Antenna.....	43
3.3 The Input Impedance of the Inverted-L Antenna.....	49
3.4 Variations on the Inverted-L Antenna.....	59
3.4.1 The Inverted-F Antenna.....	59
3.4.2 The Planar Inverted-F Antenna.....	61
3.4.3 The Proximity Coupled Planar Inverted-F Antenna.....	66
3.4.4 The Dual Inverted-F Antenna.....	69
Chapter 4: Analysis and Design of the Dual Inverted-F Antenna.....	76
4.1 Introduction.....	76
4.2 Numerical Techniques.....	77
4.2.1 The Method of Moments Applied to Wire Antennas.....	77
4.2.2 The Numerical Electromagnetics Code (NEC)	81
4.2.2.1 <i>Current Basis and Weighting Functions</i>	81
4.2.2.2 <i>Feed Technique</i>	82
4.2.2.3 <i>Derivation of Antenna Fields</i>	83

4.2.2.4 <i>Modeling Guidelines</i>	85
4.2.3 Validation of Modeling Techniques.....	86
4.2.3.1 <i>Comparison to Published Data</i>	86
4.2.3.2 <i>Application to the Dual Inverted-F Antenna</i>	91
4.3 Numerical Analysis.....	97
4.3.1. The Inverted-F Antenna.....	97
4.3.2 The Dual Inverted-F Antenna.....	104
4.3.3 The Effects of a Size-Limited Ground Plane.....	111
4.3.3.1 <i>The Inverted-F Antenna over a Conducting Box</i>	111
4.3.3.2 <i>The DIFA Over Conducting Boxes of Various Size</i>	117
4.4 Experimental Results and Analysis.....	128
4.4.1 Measurement of the IFA Against a Large Ground Plane.....	128
4.4.2 Measurement of the DIFA Against a Large Ground Plane.....	133
4.4.3 Measurement of the DIFA Over Conducting Boxes of Various Size.	138
4.5 Conclusion.....	151
Chapter 5: The Microstrip Antenna	153
5.1. Introduction.....	153
5.2. The Rectangular and Circular Patch Microstrip Antennas.....	155
5.2.1. The Magnetic Cavity Model.....	155
5.2.2. Application of the Magnetic Cavity Model.....	161
5.2.2.1. <i>The Rectangular Patch Microstrip Antenna</i>	161
5.2.2.2. <i>The Circular Patch Microstrip Antenna</i>	164
5.2.3. Summary of the Magnetic Cavity Model Results.....	166

5.3. Broadband Microstrip Antennas.....	172
5.3.1. Section Overview.....	172
5.3.2. Optimizing the Substrate Properties for Increased Bandwidth.....	172
5.3.3. Stacked Microstrip Patch Antennas.....	173
5.3.4. Non-Contacting Feed Configurations.....	177
5.4. Size-Reduced Microstrip Antennas.....	183
5.4.1. Size-Reduced Rectangular Patch Microstrip Antennas.....	183
5.4.2. Size-Reduced Circular Patch Microstrip Antennas.....	194
5.5. Summary of Broadband and Size-Reduced Microstrip Antenna Designs.....	198
5.6. Conclusion.....	200
Chapter 6: The Proximity Coupled Rectangular Patch Microstrip Antenna.....	203
6.1. Introduction.....	203
6.2. Method of Analysis.....	204
6.2.1. Application of the Method of Moments to Planar Antennas using SONNET.....	204
6.2.2. Feed and Field Modeling in SONNET.....	206
6.2.3. Application of SONNET to Free Space Radiation Problems.....	207
6.2.4. Verification of the SONNET Algorithm.....	209
6.2.4.1. <i>Convergence Tests</i>	209
6.2.4.2. <i>Application of SONNET to the Rectangular Patch MSA</i>	214
6.3. Numerical Analysis of the Proximity-Coupled Rectangular Patch Microstrip Antenna.....	218
6.3.1. The Proximity Coupled Rectangular Patch Microstrip Antenna.....	218

6.3.2. Affect of Patch Size on Input Impedance.....	221
6.3.3. Affect of Feedline Location on Input Impedance.....	224
6.3.4. Open-Circuit Single Shunt Stub Tuning.....	229
6.4. Conclusion.....	233
Chapter 7: Conclusions and Recommendations.....	235
7.1 Conclusions.....	235
7.2 Recommendations.....	236