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FACULTY OF ENGINEERING
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Microwave Metamaterial

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Submitted by
Eng. Marwah Ahmed Mohamed Shafee
B.Sc. of Electrical Engineering
Electronics and Communication Engineering
Ain Shams University, 2004

Supervised by
Prof. Diaa Abd El-Magid Khalil
Dr. Ahmed Hisham Morshed
Dr. Amr Mohamed Ezzat Safwat

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AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
CAIRO-EGYPT

Examiners Committee

Name: Marwah Ahmed Mohamed Shafee
Thesis : Microwave Metamaterial
Degree: Master of Science in Electrical Engineering

Name, Title and Affiliation	**Signature**
Prof. Hadia El-Hennawy Electronics and Communication Eng. Dept. Faculty of Engineering-Ain Shams University	....
Prof. Esmat Abdalfatah Abdallah Electronics Research Institute, National Research center	....
Prof. Diaa Abd El-Magid Khalil Electronics and Communication Eng. Dept. Faculty of Engineering-Ain Shams University	....
Dr. Amr Mohamed Ezzat Safwat Electronics and Communication Eng. Dept. Faculty of Engineering-Ain Shams University	....

Date: 6.2.2010

Curriculum Vitae

Name of the Researcher	Marwah Ahmed Mohamed Shafee
Date of Birth	$9^{th}$of July 1982
Place of Birth	Cairo, Egypt
First University Degree	B.Sc in Electrical Engineering, Electronics and Communication Department, Ain- Shams University
Date of Degree	June 2004

STATEMENT

This Thesis is submitted to Ain Shams University in partial fulfillment of the degree of Master of Science in Electrical Engineering.

The work included in this thesis was carried out by the author in the department of electronics and communication engineering, Ain Shams University.

No part of this Thesis has been submitted for a degree or a qualification at any other university or institute.

Name : Marwah Ahmed Mohamed Shafee
Signature :
Date :

To My Parents

I present to you this thesis to express my deep gratitude and love

Thanks

Microwave Metamaterial

Marwah Ahmed Mohamed Shafee

Supervised by
Prof. Diaa Abd El-Magid Khalil, Dr. Ahmed Hisham Morshed, and Dr. Amr Mohamed Ezzat Safwat

ABSTRACT

A new category of microwave metamaterial structures named as *high-impedance wire* (HIW); is studied in this thesis. The characteristics of HIWs allow the engineering of dispersion relation of transmission lines. High impedance wires offer two main benefits; size reduction and multiple operating bands. New implementation for HIWs, Signal-HIW, was proposed and it was used in miniaturizing some microwave devices.

Four applications based on the Signal-HIW are proposed. First application is combining two HIWs in one structure to form a HIW-TL. HIW-TL has interesting dispersion characteristics, it has three independent bands of operation. Second application is compact HIW rat-race coupler. The new coupler is made by replacing the rat-race ring with a Signal-HIW. The proposed coupler size is reduced by 44.7% from the conventional implementation. Third application is a new implementation for compact dual-mode filter. The filter circuit model is also derived. Finally, the design of a patch antenna using Signal-HIW was studied. The design flow for the antenna was developed. The new patch antenna occupies only 45.6% of conventional patch area.

All the proposed devices were fabricated and measured. The measurements results were compared with simulations. Very good agreements were achieved.

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Contents

List of Figures XI

List of Tables XII

List of Abbreviations XIV

List of Symbols XV

1 Introduction 1

1.1 Motivation and Objective of the Thesis 2
1.2 Metamaterial 2
1.3 Left-Handed Materials (LHM) 3
1.3.1 Composite Righ/Left Handed (CRLH) TL. 7
1.3.2 Dual-Composite Right/Left Handed TL. (D-CRLH) 8
1.3.3 Generalized Left Handed Model 10
1.4 Implementation of LHM Structures 11
1.4.1 Dual Transmission Line Approach 11
1.4.2 SRR and CSRR Approach 12
1.5 High Impedance Surface (HIS) 13
1.6 High Impedance Wire (HIW) 14
1.7 Thesis Outline 15

2 Transmission Line Theory of HIW **17**

2.1 Conventional Transmission Line 18

2.2 Transmission Line with a HIW 20

2.3 HIW-TL 23

2.4 CRLH Transmission Line with HIW 27

2.4.1 Splitting RH region 30

2.4.2 Splitting LH region 31

2.5 CRLH Transmission Line with Two HIWs 32

2.5.1 Splitting RH region 35

2.5.2 Spliting RH and LH Regions 36

2.6 Conclusion 37

3 HIW Planar Implementation **39**

3.1 Ground-HIW 40

3.1.1 Modeling of Ground-HIW 41

3.2 Signal-HIW 44

3.3 HIW Transmission Line 48

3.4 Conclusions 54

4 HIW Rat-Race Coupler **55**

4.1 Introduction 56

4.2 Examples of Size Reduction Techniques 56

4.2.1 Artificial Transmission Line Rat-Race Coupler . . 57

4.2.2 Compact Rat-Race Hybrid Coupler Using Meander Space-Filling Curves 58

4.2.3 Compact Rat-race Hybrid using CRLH sections . . 59

4.2.4 Compact Rat-race Hybrid Based on Complementary Split Rings Resonators 60

4.3 HIW Rat-race coupler 61

4.3.1 Design Procedure 62

4.3.2 Design Results 63

4.4 Conclusions 66

5 HIW Dual-Mode Filter **67**
5.1 Introduction 68
5.2 Example of Size Reduction Techniques 70
5.2.1 DMF loaded with Electromagnetic band-gap (EBG) structure 70
5.2.2 DMF using meander space-filling curves 71
5.2.3 DMF using meander-shaped stepped-impedance ring resonator 72
5.3 Microstrip dual-mode filter equivalent circuit 73
5.4 HIW dual-mode filter 75
5.4.1 Design Procedure 77
5.4.2 Design Results 82
5.5 Conclusions 84

6 HIW Patch Antenna **85**
6.1 Microstrip Patch Antenna 86
6.1.1 Transmission Line Model 88
6.2 Examples of Size Reduction Techniques 89
6.2.1 Fractal Antennas 89
6.2.2 Using a higher permittivity substrate 90
6.2.3 Using Meandering Techniques 90
6.2.4 Inserting Capacitive Elements in the Patch 91
6.2.5 Metamaterial Patch Antennas 92
6.2.6 Ground-HIW Patch Antenna 93
6.3 Signal-HIW patch antenna 97
6.3.1 Design Procedure 98
6.3.1.1 Unit Cell Analysis 98
6.3.1.2 HIW Patch Antenna Study 102
6.3.2 Design Results and Experimental Verification . . . 105
6.4 Conclusions 107

7 Conclusions and Future Work **109**
7.1 Summary 109
7.2 Future Work 111

A Design Equations for Lumped Components **113**

B Dispersion Curves On HFSS **117**

C Published Papers **121**
C.1 Article 1 122
C.2 Article 2 126

References **131**

List of Figures

1.1 Metamaterials Categories 3
1.2 Electric field, magnetic field, wave-vector triad ($\overline{E}$,$\overline{H}$, $\overline{\beta}$) and poynting vector ($\overline{S}$) [3]. (a) Conventional material, and (b) Left-handed material 4
1.3 $\varepsilon - \mu$ diagram [3]. 5
1.4 Experimental verification for LH media [3]. 6
1.5 Composite Right/Left handed TL. (a) CRLH cell. (b) Dispersion curve.Where $\beta\Delta$ is the total phase on the cell. . . . 8
1.6 D-CRLH. (a) Unit cell (b) Dispersion charactersitics.Where $\beta\Delta$ is the total phase on the cell. 9
1.7 Genralized NRI model. (a) Unit cell (b) $\beta - \omega$ Diagram . 10
1.8 Distributed CRLH implmentations. (a) Assymetric cell using interdigital capacitor and stub inductor [2]. (b) Symmetric cell [18]. (c) Using metal-insulator-metal (MIM) capacitor and stub inductor [19]. 12
1.9 SRR and CSRR structures and their equivalent circuits [6]. 13
1.10 High Impedance Surface. (a) Top view. (b) Cross-sectional view. (c) Origin of the capacitance and inductance in the high-impedance surface [7]. 14
1.11 High Impedance Wire behavioral model [8]. 14

2.1 Conventional Transmission Line 18

2.2 Conventional T.L. dispersion characteristics. (a) $\beta - \omega$ curve. (b) Normalized transmission line parameters 20
2.3 Transmission Line loaded with a HIW 21
2.4 HIW dispersion characteristics. (a) $\beta - \omega$ curve. (b) Normalized transmission line parameters 23
2.5 HIW-TL. Equivalent Circuit 24
2.6 HIW-TL dispersion characteristics. (a) $\beta - \omega$ curve. (b) Normalized transmission line parameters 27
2.7 CRLH on a HIW 28
2.8 CRLH-RH-HIW dispersion characteristics. (a) $\beta - \omega$ curve. (b) Normalized transmission line parameters 30
2.9 CRLH-LH-HIW dispersion characteristics. (a) $\beta - \omega$ curve. (b) Normalized transmission line parameters 31
2.10 CRLH transmission line with two HIWs 32
2.11 CRLH-RH-DHIW dispersion characteristics. (a) $\beta - \omega$ curve. (b) Normalized transmission line parameters 35
2.12 CRLH-RH-LH-DHIW performance. (a) $\beta - \omega$ curve. (b) Normalized transmission line parameters 36

3.1 Short-circuited slotlines connected in series [8]; (a) short-circuited slotlines connected in series, and (b) equivalent circuit model using stubs. 40
3.2 Different Ground HIW Planar Transmission Lines [8]. . . 41
3.3 Ground-HIW unit cell equivalent circuit [8]. 42
3.4 Dispersion characteristics of Ground-HIW, (a) $\beta - \omega$ diagram, (b) Bloch Impedance. 43
3.5 Seven-Cells Ground-HIW Scattering Parameters [8]. . . . 44
3.6 Signal-HIW using Interdigital Capacitor and Stub Inductor 45
3.7 Signal and Ground-HIW Dispersion Characteristics Comparison, (a) $\beta - \omega$ Diagram, (b) Bloch Impedance. 46
3.8 Six Cells Signal and Ground-HIW comparison, (a) Radiation Loss, (b) Transmission characteristics. 47

3.9 HIW-TL (D-HIW) Transmission Line 48
3.10 Unit cell of an HIW-TL including host transmission line parameters. (a) Signal and ground wires, (b) Simplified model. 49
3.11 Comparison between Double and Single HIW. (a) $\beta - \omega$ Diagram. (b) Bloch Impedance 50
3.12 HIW-TL Unit Cell, (a) HIW-TL sturcture, (b) Equivalent Circuit. 51
3.13 Gap capcitance 52
3.14 Six cells HIW-TL prototype. (a) Top layer, (b) Bottom layer. 53
3.15 Six cells HIW-TL scattering parameters. 53

4.1 Symbol for rat-race coupler 56
4.2 (a) Artificial transmission line. (b) ATL rat-race coupler. [26] 58
4.3 Compact rat-race couplers using space filling curves used in filling the vacant space [29]. (a) Meander filling curve (b) Triangular meander rat (d) Multimeander curve. 59
4.4 CRLH-RRC [3]. 60
4.5 CSRR unit cells [28]. 60
4.6 Rat-race coupler using CSRR. (a) Conventional coupler, (b) with LH CSRR, and (c) using LH CSRR 61
4.7 Microstrip rat-race coupler with signal HIW prototype . . 62
4.8 HIW-RRC unit cell 63
4.9 HIW rat-race coupler Prototype 64
4.10 HIW rat-race coupler scattering parameters phase difference. 64
4.11 HIW rat-race coupler scattering parameters. 65
4.12 HIW rat-race coupler scattering parameters. 66

5.1 (a) Cavity model of a dual-mode microstrip resonator. (b) Equivalent circuit of the dual-mode resonator. [31] 68

5.2 Some microstrip dual-mode resonators [31]. (a) Circular disk. (b) Square patch. (c) Circular ring. (d) Square loop. (e) Meander loop. 70
5.3 Dual-mode filter based on EBG [32]. 71
5.4 Dual-mode filters using meander space-filling curves [33]. (a) Triangular meander curve. (b) Multi-line-length meander curve. (c) Meander tree curve. 72
5.5 Dual-mode filters using meander stepped impedance TL [34]. 72
5.6 Dual-mode filter as (a) Elliptic band-pass filter. (b) Butterworth band-pass filter. (c) Equivalent circuit of elliptic BPF, (d) Equivalent circuit of butterworth BPF. 74
5.7 Dual-mode filter performance (a) Elliptic band-pass filter. (b) Butterworth band-pass filter 75
5.8 HIW dual-mode filter. (a) HIW-DMF prototype. (b) Equivalent circuit 76
5.9 Effect of square patch size. 78
5.10 HIW unit cells. (a) Single HIW unit cell, (b) Coupled HIW unit cell, ... 79
5.11 Dispersion curve of the single HIW unit cell 80
5.12 Comparison of coupled line circuit and EM model performance. (a) S_{11} and S_{12}, (b) S_{13} and S_{14}, (c) S_{32} and S_{34} . . 82
5.13 HIW dual-mode filter prototype. (a) S_{12}(dB), and (b) S_{11}(dB). 83
5.14 HIW dual-mode filter fabricated prototype. 84

6.1 Various patch configurations used for microstrip patch antenna [37]. 87
6.2 Microsrip Patch 87
6.3 Koch island patch antenna [40]. 90
6.4 Meandered square patch antenna [41]. 91
6.5 Microstrip patch antenna with capacitive elements [42]. . 92