

Performance Comparison Test of Conventional and Metamaterial Antenna

**This thesis represented in partial fulfilment for the award of the
Master of Engineering (Hons) Electrical Engineering
Universiti Teknologi MARA**



**FARAWAHIDA BT AHMAD RAMLI
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM**

ACKNOWLEDGEMENT

In the name of ALLAH, the Most Gracious and Merciful, I am very grateful I have been given the opportunity to complete my Final Year Project entitled “Performance Comparison Test of Conventional and Metamaterial antenna”.

For this golden opportunity, I would like to express my special thanks to my Project Supervisor, Assoc. Prof. Dr. Ahmad Asari Sulaiman for the willingness to supervise me. Their understanding, persistence, constructive and professional ways in assisting and giving invaluable advices, openness to provide the useful references and guidance really helped me in completing this project from the beginning to final stage.

I’d also like to thank my colleagues at Faculty of Electrical Engineering UiTM Shah Alam for those involved in supporting me directly or indirectly to cooperate with me in finishing this project.

Lastly, I deliver my thankfulness to my family for all their support. They are my most inspirational source to complete this project in the time that was given to me. Thank you.

ABSTRACT

In this paper, the performance of conventional and metamaterial antennas (microstrip rectangular patch antenna with V-shape using Circular Ring defected ground structure (DGS) and rectangular microstrip patch antenna with nine squares of Electromagnetic Band Gap (EBG) structure on the ground plane) in Wi-Fi application which having the frequency of 2.45GHz is tested. The performance and distance coverage is determined by using Transceiver (AirMax Bullet M2 Hp) and AirMax AirOS by Ubiquiti Networks. The scope of project includes recording time duration to transfer small-size of video (16.6Mb) and medium-sized movie (369Mb) files from a local to remote host by varying output power of the transceiver, distance and type of antennas at both transmitting and receiving ends. The performance of the conventional antenna is better than metamaterial antenna. At 20 meter, both antenna is still working with the same signal strength -58 dBm but conventional antenna have higher transfer rate and shorter time taken to transfer files compare to metamaterial antenna. As for two metamaterial antenna tested, it is conclude that EBG antenna is better than DGS antenna because of it higher signal strength and time taken to transfer file is shorter compare to DGS antenna which is 7.83 second (16.6Mb) and 143 second (369Mb) for DGS antenna and 5.7 second (16.6Mb) and 143 second (369Mb) for EBG antenna. This result will help to add market value to antenna tested.

TABLE OF CONTENTS

CONTENTS	PAGE
TITLE	i
APPROVAL	ii
DECLARATION	iii
ACKNOWLEDGEMENT	iv
ABSTRACT	v
TABLE OF CONTENTS	vi
LIST OF FIGURES	ix
LIST OF TABLES	xi
LIST OF ABBREVIATIONS	xii
CHAPTER 1 INTRODUCTION	
1.0 Introduction	1
1.1 Problem Statement	2
1.2 Objectives of Research	2
1.3 Scope of Research	2
1.4 Thesis Organization	3
CHAPTER 2 LITERATURE REVIEW	
2.0 Introduction	5
2.1 Antenna Theory	5
2.2 Microstrip Antenna	6
2.3 Antenna Parameters	7
2.3.1 Radiation Pattern	7
2.3.2 Bandwidth	10
2.3.3 S-Parameter	10
2.3.4 Return Loss	11
2.3.5 Gain	11

2.4	Metamaterial	
2.4.1	Defected Ground Structure (DGS)	11
2.4.2	Electromagnetic Band Gap (EBG)	13
2.5	Past Works Review	14

CHAPTER 3 METHODOLOGY

3.0	Introduction	15
3.1	Project Flow	16
3.2	Literature review	17
3.3	Performance Test Procedure	
3.3.1	Antenna Under Test	18
3.3.2	Test Equipment	
3.3.2.1	Transceiver (Ubiquiti Bullet M2 Hp)	19
3.3.2.2	Ubiquiti AirOS	20
3.3.3	Test Equipment Configuration	22
3.3.4	Test Equipment Setup	28
3.3.5	Measurement Equipment	
3.3.5.1	Vector network Analyzer (VNA)	30
3.3.5.2	Antenna Training Measurement System (ATMS)	31

CHAPTER 4 RESULTS AND DISCUSSION

4.0	Introduction	32
4.1	Testing result	
4.1.1	Defected Ground Structure (DGS) antenna	32
4.1.1.1	Conventional Antenna as Transmitter	33
4.1.1.2	Metamaterial Antenna as Transmitter	36
4.1.2	Electromagnetic Band Gap (EBG) antenna	39
4.1.2.1	Conventional Antenna as Transmitter	39
4.1.2.2	Metamaterial Antenna as Transmitter	42
4.1.3	Comparison between Conventional and Metamaterial Antenna	45