

A MULTILAYER ULTRA WIDEBAND PATCH ANTENNA WITH LTCC TECHNOLOGY

**This is presented in partial fulfillment for the award of the
Bachelor of Engineering (Hons.) Electronics (Communication)
UNIVERSITI TEKNOLOGI MARA (UiTM)**



**KHAIRUL IZHAM BIN OTHMAN
FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM,
SELANGOR, MALAYSIA**

JULY 2013

ACKNOWLEDGEMENTS

Firstly, I express my highest gratitude and thanks to my supervisor, Madam Noor Hasimah Bt Baba who had helped me at each and every point of the thesis work with her dedication, comments, suggestions and guidance which put me on the right path to fulfil the requirement for this thesis work.

I would also like to thank Madam Suhaila Bt Subahir, for her advice and assistance in completing this project. My grateful thanks are also extended to Mr Mohd Noor for his help and advice about techniques proposed for to my design, and to Master's student, Mr Abdul Hadi who helped me and shared knowledge about LTCC technology from TM research and development (R&D).

I would also like to extend my thanks to the technicians of the communication laboratory of the electrical engineering department for their help in offering me the resources in running the program.

Finally, I wish to thank my parents for their support and encouragement throughout my study.

ABSTRACT

In this work, a simple design of Ultra-wideband antenna has been proposed. The antennas are designed to operate at 7GHz which are in the range of 3.10 GHz to 10.6 GHz for Ultra Wideband. The antenna consists of rectangular and circular patch with a few techniques that been studied in this paper. Ferro A6-S is used as a material for the substrate at each layer. The main purposes of those techniques are used to enhance the operating bandwidth which to support the requirement for Ultra Wideband application in LTCC technology. One of the advantages using low temperature co-fired ceramic (LTCC) technology is the reduction of the antenna size is higher compared to the FR-4 material. The performances of the antenna are being investigated in this paper. The CST Microwave Studio software is being used for all the simulations. Detail of the designed antenna and results is presented and discussed.

Four designs of antennas with direct feeding are presented in this thesis. The antenna achieved the operational bandwidth for UWB application of up to 7 GHz which exceeds the minimum requirement for UWB needs (500 MHz @ 20 % of resonant frequency). Besides that, by using LTCC technology with high dielectric permittivity, ($\epsilon_r = 5.9$) for Ferro A6-S material, a compact size of an antenna has successfully designed.

TABLE OF CONTENT

DECLARATION	I
ACKNOWLEDGEMENT	III
ABSTRACT	IV
TABLE OF CONTENT	V
LIST OF FIGURE	VIII
LIST OF TABLE	XI
LIST OF SYMBOLS & ABBREVIATIONS	XII
CHAPTER 1: INTRODUCTION	1
1.1 BACKGROUND STUDY	1
1.2 ADVANTAGES AND DISADVANTAGES	
MICROSTRIP PATCH ANTENNA	2
1.3 FEEDING TECHNIQUE	3
1.3.1 COAXIAL PROBE FEED	3
1.3.2 MICROSTRIP LINE FEED	4
1.3.3 APERTURE COUPLE FEED	4
1.4 ANTENNA PARAMETER	5
1.4.1 S-PARAMETER	5
1.4.2 BANDWIDTH	5
1.4.3 VOLTAGE STANDING WAVE RATIO (VSWR)	6
1.4.4 RADIATION PATTERN	7
1.4.5 DIRECTIVITY	8
1.4.6 ANTENNA GAIN	9
1.4.7 POLARIZATION	9

1.5	PROBLEM STATEMENT	10
1.6	OBJECTIVES	10
1.7	SCOPE OF WORK	10
1.8	THESIS OUTLINE	11
CHAPTER 2: LITERATURE REVIEW		12
2.1	INRODUCTION OF ULTRA WIDEBAND (UWB)	12
2.1.1	RESEARCH AREA	13
2.1.2	CHALLENGES IN UWB ANTENNA DESIGN	13
2.1.3	RESEARCH PROBLEM AND GOAL OF THE THESIS	15
2.1.4	STATE OF THE ART IN UWB ANTENNAS	16
2.1.5	THESIS CONTRIBUTIONS	17
2.2	LTCC TECHNOLOGY AND ANTENNAS	17
2.2.1	A BASIC INTRODUCTION	17
2.2.2	LTCC FABRICATION PROCESS	18
2.2.3	LTCC MATERIALS	19
CHAPTER 3: METHODOLOGY		20
3.1	APPROACH METHODOLOGY	20
3.2	FLOW CHART OF DESIGN METHODOLOGY	21
3.3	RECTANGULAR MICROSTRIP PATCH ANTENNA	22
3.3.1	DESIGN SPECIFICATIONS	22
3.3.2	DESIGN PROCEDURE	23
3.3.3	SIMULATION SETUP	25
3.4	CIRCULAR MICROSTRIP PATCH ANTENNA	26
3.4.1	DESIGN SPECIFICATIONS	26