

**UNIVERSITI TEKNOLOGI MARA**

**COMPACT MULTIBAND ANTENNAS  
ON LOW TEMPERATURE CO-FIRED  
CERAMIC (LTCC) TECHNOLOGY**

**HADI BIN JUMAAT**

Thesis submitted in fulfillment  
of the requirements for the degree of  
**Master of Science**

**Faculty of Electrical Engineering**

April 2015

## **CONFIRMATION BY PANEL OF EXAMINERS**

I certify that a Panel of Examiners has met on 17<sup>th</sup> March 2015 to conduct the final examination of Hadi Bin Jumaat on his Master of Science thesis entitled “Compact multiband antennas on low temperature co-fired ceramic (LTCC) technology” in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

**Hj Zainazlan Md Zain, PhD**

Associate Professor  
Faculty of Electrical Engineering  
Universiti Teknologi MARA  
(Chairman)

**Ahmad Asari Sulaiman, PhD**

Associate Professor  
Faculty of Electrical Engineering  
Universiti Teknologi MARA  
(Internal Examiner)

**Mohammad Tariqul Islam, PhD**

Professor  
Faculty of Engineering and Build Environment  
Universiti Kebangsaan Malaysia  
(External Examiner)

**SITI HALIJJAH SHARIFF, PhD**

Associate Professor  
Dean  
Institute of Graduates Studies  
Universiti Teknologi MARA  
Date: 8<sup>th</sup> April, 2015

## **AUTHOR'S DECLARATION**

I declare that the work in this thesis/dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student : Hadi Bin Jumaat  
Student I.D. No. : 2012276226  
Programme : Master of Science  
Faculty : Electrical Engineering  
Thesis Title : Compact Multiband Antennas On Low Temperature  
Co- Fired Ceramic (LTCC) Technology  
  
Signature of Student :  
Date : April 2015

## ABSTRACT

In recent years, the developments of wireless system that can operate over multiband frequency with compact size have enormous growth. In this project, LTCC technology is benefited for miniaturization of multiband antennas for short range medical sensor application. Three antenna designs on LTCC multilayer substrate have been proposed. They are Aperture Coupled antenna (ACA), Dual Patch Microstrip Antenna (DPMA) and Triple Band Off-Center Fed Microstrip Antenna (TBOCFMA). In aperture coupled antenna structure, observation on the controlling parameters of the aperture coupled antenna on LTCC multilayer substrate package is conducted to investigate the effect of aperture slot at various layers with different height. The proposed concept of this idea is simulated on Ferro A6M microstrip ceramic substrate and compared with the simulated of aperture coupled antenna on Flame Retardant 4 (FR-4) substrate at operating frequency of 5.8 GHz. Thus, the best location of the ground plane that contains the aperture slot has been adopted in DPMA design. In DPMA, dual band frequency spectrum operating at 5.8 GHz and 6.3 GHz frequency band has been proposed. This design develops dual radiating patch at the top and bottom of the overall substrate with the aperture slot at the ground between patches. The second radiating patch is designed to place at the feedline that is innovated from the aperture coupled structure. This design then fabricated and a good agreement was achieved between the simulation and measurement results. Meanwhile, the third design TBOCFMA operating at 5.8 GHz, 6.3 GHz and 10 GHz frequency band is presented. This design adopted the dual radiating patch with the aperture slot at the ground between second radiation patch in DPMA. The feedline then was fed with an off-centred feedline technique to create another resonant frequency. Fabrication also has been done for this design for feasibility of study purpose. The complexity of the LTCC technology fabrication process is covered in this thesis.

## **ACKNOWLEDGEMENT**

**With the name of ALLAH S.W.T Most Gracious Most Merciful**

Alhamdulillah, deepest gratitude to Allah S.W.T for his blessing and finally allow me to complete this research for postgraduate degree of Master Science in Electrical Engineering. First of all, I would like to acknowledge my genuine gratitude to my supervisor, Associate Professor Dr. Mohd. Tarmizi Bin Ali, who has bent every effort to facilitate implementation of this project and has given invaluable support and useful advice throughout the course of the work regarding the project and preparation of this thesis.

I am deeply obliged to the Institute for Universiti Teknologi MARA (UiTM) for the generous financial support I have received for my Master program. I would also like to acknowledge all my great colleagues at Antenna Research Group (ARG). Special thanks to personnel, especially Mr. Khalim Bin Kamisan who's professionally give their cooperation in many aspect and made the whole project possible. Deepest gratitude are also goes to members of Microwave Technology Centre (MTC), Postgraduate Students at Telephony Laboratory for their assist through out this research.

Special thanks to my parents, my family who has supported me throughout the years because they are my motivation and spirit to complete this thesis successfully. Last but not least, Special thanks to all lecturers, researchers, academicians, friends and also to people around me who willing to give a hand during this project. Thank you for the kind helps which really made on each one of you a backbone of this project and this thesis. May Allah bless all of you.