UNIVERSITI TEKNOLOGI MARA

MULTIPLE-ELEMENT PIFA MIMO ANTENNA DESIGN AT 15GHZ FOR FUTURE 5G WIRELESS TECHNOLOGY

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MSc

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AUTHOR'S DECLARATION

I declare that the work in this thesis 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.

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ABSTRACT

Nowadays, 5G technology has rapidly gained demand for wireless communication systems due to its higher data rates, zero latency and ubiquitous connection within the devices. The frequency above 10 GHz has been allocated by the Federal Communications Commission (FCC) for 5G applications. To meet the demand, Planar Inverted F-Antenna (PIFA) Multiple-Input-Multiple-Output (MIMO) is presented in this thesis. In MIMO antenna design, more than one antenna elements are placed normally very close to each other in a single ground plane. Thus, mutual coupling appears significantly and becomes one of the critical parameters in designing MIMO antennas. The mutual coupling will affect the antenna efficiency and gain as some of the radiated power is absorbed by the adjacent antenna element. Therefore, this research focused on improving isolation between multiple antenna elements and gain. The research began with designing a single element PIFA at 15 GHz that acted as a reference antenna for the two and three-element PIFA MIMO. Then, the normal two-element and three-element PIFA MIMO were developed. Methods such as additional slot structure, parasitic wall and integration slot with parasitic wall were introduced to the multiple PIFA MIMO to mitigate the mutual coupling issue and enhance antenna gain. The selected designs reported in this thesis were fabricated and measured, with the simulated and measured results agreeing well in most cases. The single-element PIFA produced reflection coefficient with -12.88 dB and gain of 7.464 dB with 95% efficiency. As for the two and three-element PIFA MIMO designs, the Design 1 (Normal) of three-element PIFA MIMO produced slightly higher measured gain than the two-element PIFA MIMO from 6.64 dB to 7.16 dB with an accepted isolation range due to the increase in dimension of antenna size. Design 2 (Additional parasitic wall) in two and three-element PIFA MIMO improved gain up to ≈ 8 % compare to conventional Design 1 (Normal). Introducing slots named as Design 3 (Slot) PIFA MIMO proved to increase the isolation. The highest isolation of -54.70 dB was achieved in the simulation of the two-element PIFA MIMO that embedded a rectangular slot structure and a 27% improvement of isolation was found in the three-element PIFA MIMO with a U-slot structure compared to the Design 1-Normal three-element PIFA MIMO. Incorporation of parasitic wall and slot structure named as Design 4 (Parasitic wall and slot) in both designs also successfully produced improved high isolation and gain results with 43.4 dB and 8.76 dB for two-element and 35.22 dB and 8.40 dB for three-element respectively. Hence, these proposed designs offer potential solutions for 5G wireless communication systems especially for hand-held devices.

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TABLE OF CONTENTS