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5G COPLANAR ANTENNA WITH METAMATERIAL GROUND PLANE

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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.

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

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ABSTRACT

This project focuses on study of a patch antenna for 5G application. The antenna also will be integrated with coplanar waveguide and metamaterial structure as the ground plane for gain augmentation. For the past decades, 4G has been the main band for mobile communication. A new 5G band offers a seamless communication thus expanding the possibilities that can be achieved by 5G. Significant improvement on communication speed enables a major advancement in real time interaction that cannot be achieved in 4G band. The study aims for designing a coplanar 5G coplanar antenna with metamaterial as ground plane that resonate at 5G band which is 3.5GHz. From the result obtained, the antenna parameters such as bandwidth, return loss, gain, and radiation, pattern will be tabulated for study. Parametric studies and analysis also will be done on the designed antenna structure will be designed to match the frequency of the antenna according to formulas. Substrate that will be used for the antenna design is FR-4 with 4.3 of dielectric permittivity and 1.6mm height. The actual substrate dimension is 30mm width x 50mm length x 1.6mm height and copper patch antenna and ground plane is printed onto the substrate. The antenna ground plane will be integrated with metamaterial structure. The metamaterial structure that will be used is Complementary Split Ring Resonator (CSRR). Dimension of the CSRR is calculated to imitate an equivalent L (inductor) and C (capacitor) resonator to match the operating frequency of the antenna which is 3.5 GHz. The particular CSRR dimensions are 6mm radius with 1.3mm width, and the second split ring come with 2.83mm radius with the same width. The etched CSRR produced an L C equivalent circuit with 2.61462 nH and 791.189 fF values of lump element, designed specifically to improve the antenna gain. Result obtained shows a remarkable antenna gain by 134.18% gain increment compared with the antenna that does not integrated with metamaterial ground plane. The gain increased from 1.58 dB to 2.12 dB at 3.5 GHz when metamaterial structure is etched to the ground plane. Impedance of the antenna is very well matched at 3.5 GHz with return loss only at -36.48 dB. The return loss reached less than -10 dB from 3.38 GHz to 3.68 GHz giving a 300 GHz bandwidth which is acceptable range for a 5G antenna. The antenna directivity is considerably high which is 6.35dBi making is acts a lot closer to directional antenna. A directional antenna is valuable for communication that requires a specific direction of signal.

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