

UNIVERSITI TEKNOLOGI MARA

**DESIGN OF MONOPOLE AND
ARRAY PLASMA ANTENNAS FOR
INDOOR WI-FI APPLICATION**

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PhD

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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.

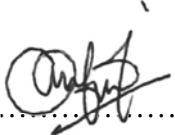
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ABSTRACT

Recently, plasma has been widely used in microwave technology. Therefore the concepts of implementing plasma and antenna technology to form plasma antenna have become practical in recent years. Plasma antenna is an antenna in which radiate electromagnetic wave (EM) energy based on ionized gas instead of metallic conductor. There are many types of plasma antenna that have been demonstrated in previous researches. They can provide dual functionality as an antenna as well as a light source. Nevertheless, the design process of a plasma antenna with dual functionality has not been established in literature. In addition, a basic monopole plasma antenna has a relatively low gain and therefore is unsuitable for high performance indoor wireless communication systems. This research presents the development of a plasma antenna array based on numerical simulation and experimental measurements, discussing the design process for both single and array configuration, and validation of its applicability in indoor wireless communication systems such as Wi-Fi. The research starts with the design and analysis on the fundamentals of a monopole plasma antenna to determine the relationship between plasma frequency and plasma antenna radiating parameters. There are three types of preliminary plasma antenna presented; namely circular, butterfly-shaped and cylindrical fluorescent tube lamps. Each antenna gives different antenna performance in terms of reflection coefficient and antenna gain due to plasma frequency for each type of lamp. The monopole plasma antenna using fluorescent tube was found to provide the best performance, hence was used as the base antenna for investigation of plasma antenna array performance. Here, this thesis also provides analysis on the design of copper cylinder as the coupling technique. The use of copper cylinder in this research was compared with that of copper coil. The use of copper cylinder showed better performance in antenna reflection coefficient and antenna gain. Next, an investigation on the design of plasma antenna array using multiple monopole fluorescent tube plasma antennas was conducted and its performance was analyzed. Based from numerical simulations and experimental measurements, it was observed that by arranging the antennas in 1x4 and 1x8 arrays produced better antenna gains, and subsequently provides the capability transmitting signal stronger than single plasma antenna. For example, 1x8 showed improvements of approximately 5 dBm over 1x4 array, and around 10 dBm over single monopole plasma antennas.

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