

# DUAL BAND ANTENNA FOR RADIO FREQUENCY IDENTIFICATION APPLICATIONS

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To my beloved mother, **HAJJAH SABIAH AB RAHMAN**  
and father, **HAJI SABRAN REMALI**

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## ABSTRACT

Radio Frequency Identification (RFID) has the highest growth of applications system and is the most interesting field of research in communication technology. RFID systems have been implemented in various applications such as Electronic Toll Collection (ETC) and monitoring systems for railway stations. One of the ETC applications is the *Touch & GO* system that uses the Short Range RFID (SRRFID) technology. This technology benefits users as they are able to pay their toll automatically by passing through the toll gate without queuing for a long time. On the other hand, the monitoring system for railway stations uses the Long Range RFID (LRRFID) technology. Railway employees use this technology to monitor locations and automatically control the speed of trains from the railway station. Applications of LRRFID technology are meant for high-end users thus this technology has a higher marketability value as compared to SRRFID. Generally, LRRFID uses: (i) Ultra High Frequency (UHF) band and (ii) Industrial, Scientific and Medical (ISM) band. Both these bands can be applied using a single RFID multipurpose application reader. For this application, a multiband antenna is needed to fulfill the dual application. The aim of this research project is to develop a dual band antenna design operating the UHF and ISM bands having linear and circular polarization capabilities. A square patch antenna is selected as the basic design and modifications on the radiating patch were conducted using Computer System Technology (CST). The simulation from the CST resulted in development of dual band diamond shaped linear polarized antenna. The newly developed antenna has good return loss for frequencies in both bands. To enhance the quality of propagation of this antenna, a pair of slots was introduced to the radiating patch which transformed the proposed antenna to become a circular polarization antenna. Both antennas had air gap introduced between dielectric substrate layer and ground plane to boost the gain and efficiency of the antennas. The developed antennas have good gains, approximately 7~9 dBi and antenna efficiency is about 85~95%.

## ABSTRAK

Pengenalan Frekuensi Radio (RFID) mempunyai pertumbuhan yang paling pesat dalam pelbagai sistem aplikasi dan merupakan bidang penyelidikan dalam teknologi komunikasi yang menarik. Sistem RFID boleh dilaksanakan dalam pelbagai aplikasi seperti sistem Kutipan Tol Elektronik (ETC) dan sistem pemantauan di stesen keretapi. Salah satu daripada sistem ETC adalah sistem *Touch & GO* yang menggunakan teknologi komunikasi jarak dekat RFID (SRRFID). Teknologi ini memberi faedah kepada pengguna jalan raya untuk menjelaskan bayaran tol secara automatik tanpa perlu beratur untuk tempoh masa yang lama. Selain itu, contoh lain untuk teknologi RFID ialah sistem pemantauan di stesen keretapi menggunakan komunikasi jarak jauh RFID (LRRFID). Pekerja keretapi menggunakan teknologi ini untuk memantau lokasi dan mengawal kelajuan secara automatik dari stesen keretapi. Sistem LRRFID merupakan teknologi kompleks untuk pengguna sasaran dan mempunyai nilai komersial yang lebih baik jika dibandingkan dengan sistem SRRFID. Secara umumnya, teknologi LRRFID menggunakan; (i) jalur Frekuensi Ultra Tinggi (UHF) dan (ii) jalur Perindustrian, Sains dan Perubatan (ISM). Kedua-dua jalur ini boleh digunapakai dalam satu pembias RFID pelbagai aplikasi. Antena pelbagai jalur diperlukan bagi memenuhi kehendak kedua-dua aplikasi. Matlamat utama kajian penyelidikan ini adalah membangunkan reka bentuk antena dua jalur dengan keupayaan polarisasi linear dan bulat yang beroperasi pada jalur UHF dan ISM. Antena tampalan segi empat sama dipilih sebagai reka bentuk asas dan pengubahsuaian pada unsur tampalan telah dijalankan menggunakan perisian "*Computer System Technology*" (CST). Simulasi daripada CST menghasilkan antena dua jalur linear polarisasi berbentuk berlian. Antena yang dibangunkan mempunyai refleksi rugi yang baik bagi kedua-dua jalur. Untuk meningkatkan kualiti perambatan antena, sepasang slot diperkenalkan pada unsur tampalan untuk mengubah antena yang dibangunkan itu menjadi antena polarisasi bulat. Kedua-dua antena mempunyai sela udara antara lapisan substrat dan sata bumi bagi meningkatkan gandaan dan kecekapan antena. Ia juga mempunyai gandaan yang baik, kira-kira 7~9dBi dan kecekapan antena kira-kira 85~95%.