GAIN-ENHANCEMENT AND SIDE LOBE LEVEL REDUCTION OF ARRAY LTCC ANTENNA FOR RADAR APPLICATION

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ABSTRACT

A 2×2 Array Low Temperature Co-fired Ceramic (LTCC) Antenna with Metal Ring operating at 9.41GHz for Radar Application is presents in this paper. Metal ring has been used integrated with aperture coupled feeding method and rectangular patch radiating element to enhance the antenna performance. LTCC of 8 layers substrate offers high dielectric constant, $\varepsilon_r = 5.9$ and 96μm thickness by using Ferro A6S, while silver metal thickness is 10μm. Simulations of the LTCC antennas were done by using CST Microwave Studio Software. The results of return loss (S_{11}), voltage standing wave ratio (VSWR), bandwidth (BW), half power beam width (HPBW), Side Lobe Level (SLL) and gain are compared and analysed between the Single Patch, 1×2 and 2×2 Array LTCC antennas. All the results show good performances of the designed LTCC antennas and well matched at the input. The 2×2 array LTCC antenna with metal ring was able to reduce the side lobe level to -22.10dB (39% reduction) and enhanced gain to 9.68dB (42% increment) as compared to the single LTCC antenna with metal ring.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

An antenna is a device that carries a unique behaviour which essential in radar communication systems by transmits and receives Radio Frequency (RF) signals. Along with the development of radar technique, miniaturization and wide bandwidth has become a widespread development trend of this low profile antenna [1]. However, another characteristic of paramount importance for radar application is low side lobe level (SLL) and high gain [2]-[5].

Low Temperature Co-fired Ceramic (LTCC) has many advantages, such as its high temperature resistance, high thermal conductivity, low dielectric loss, excellent characteristics for high-frequency and high-Q, so it is ideally suited to the material of a compact antenna [6]. Low dielectric constant of the substrate results in large bandwidth while high dielectric constant, ε_r promises for compact antenna [7]. LTCC multilayer substrate offers high dielectric constants which are 5.9 and 7.8 or even 14 [37]. They are ideally for compact antenna, but have penalty on narrowing bandwidth. Thin substrate thickness offers minimize radiation of feeding line, and a use of thick substrate for the patch elements to achieve good antenna radiation and bandwidth [9]. Therefore, the volume structure of LTCC multilayer substrate with high dielectric constant and thick substrate will promise a compact and wide bandwidth of LTCC antenna. Besides that, stacked patch antennas [10]-[12] are well-known method to have a large antenna bandwidth with high gain. Furthermore, high quality factor, Q of the LTCC multilayer substrate itself can give high gain LTCC antenna performance.