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# The Array Structure of 2x2 Coplanar Monopole Antenna with Wilkinson Power Combiner for RF Energy Harvesting Application

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**Abstract-** This paper presents the new structure of coplanar monopole receiving antenna with array arrangement of 2x2 coplanar monopole antenna for the RF energy harvesting purposes. The novelty in this structure is that it is designed to work on almost all useful multi frequency bands i.e. Radio, GSM, ISM, and UWB. Also it has large capturing area due to its coplanar and array structure so it is capable of receiving maximum power from the atmosphere. The structure of 2x2 array shows 9.2 dB peak gain and 98% efficiency. One more advantage of this structure is that there is enough space for implementing the RF-DC converter circuit on the same surface of substrate. So that the module is compact in size and able to minimize connector losses due to avoid the port connectors and impedance matching circuit between them. Wilkinson power combiner is used to combine the powers of individual design.

**Keywords:** Coplanar monopole antenna, RF-DC Converter, Impedance matching, Wilkinson power combiner

## I. INTRODUCTION

The RF energy harvesting system is the emerging field of wireless communication system. The wireless communication system uses low power devices. These devices are generally battery operated. For continues and efficient working of the system these devices are needed continues charging of its batteries. The RF energy harvesting is one of the solutions of this need. This RF energy harvesting system is composed of receiving antenna of the microwave frequency and radio frequency (RF) signals present in the atmosphere, a converter circuit to converting this received RF signal in to DC signal and a matching circuit in between antenna and converter circuit for maximum conversion. This DC output voltage may be stored in Capacitor and can be used to charges a battery continuously.

The main part of the harvester circuit is receiving antenna. It is the heart of it. The receiving antenna is desired to be compact in size and may be designed for the ranges as the need of circuit. The designers design its own receiving antenna for its

harvesting module and its need. To design a new harvesting module authors design its own coplanar antenna [1]. which is capable to resonant on multi bands e.g. Radio, GSM, ISM and UWB band (900 MHz-3.1 GHz and 5.6 GHz-9.6GHz) with band rejection for WLAN (3.1GHz-5.6GHz) band. And then make the arrangements for enhancement of its characteristics. Some literatures regarding this were studied. For UWB planar antenna structure M. Yazdi et al. presented their structure of microstrip antenna with band rejection characteristics [2]. Ji-yong park et al presented a patch antenna with circularly polarization. It is designed for 5.8 GHz range. It provides the 4-5 dBi gain [3]. For the band rejection due to particular need the variations in patch were investigated [4]-[6]. Parasitic patch is also one of the best solution for providing the band rejection [7]-[8].

This paper presents the extension of the work [1] by 2x2 array arrangement of that coplanar monopole antenna structure to enhance the characteristics of single structure.

## II. ANTENNA DESIGN

The array arrangement of the proposed 2x2 array of coplanar monopole antenna has been optimized on the licensed simulator software HFSS @16. Fig.1 shows its geometrical view. The Wilkinson power combiner has been used to combine the received power of this array. This combiner has been used here because it provides the impedance matching easily simply by adding the resistor at its connecting leg. In this work the value of resistor at the connecting leg of Wilkinson is finding 100  $\Omega$  to match the impedances of line feed and combiner.

The array structure of coplanar antenna was designed on the substrate of FR4 epoxy with a relative permittivity of 4.4 and a thickness of 1.6 mm. This single structure of monopole antenna [1] was designed to cover some usable bands e.g. radio, GSM, ISM and UWB bands (900MHz-1GHz, 2.1-4 GHz, and 5.6