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# Unidirectional H-shaped slot antenna backed by a shallow cylindrical cavity for the 5.8 GHz ISM band

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**Abstract**

A compact slot antenna backed by a shallow cylindrical cavity for high-gain unidirectional radiation in the 5.8 GHz ISM is presented. The antenna has a 96% efficiency, 8 dBi gain, 12 dB front-to-back ratio, and a −10 dB impedance bandwidth of 7.5%. A prototype of the antenna was fabricated and measured and the measurement results were verified against the simulated ones.

**KEYWORDS**

cavity-backed slot antenna, H-shaped slot antenna, unidirectional antenna, 5.8 GHz ISM band

## 1 | INTRODUCTION

Cavity-backed slot (CBS) antennas of different designs have been used extensively over the years to facilitate unidirectional radiation in various applications.[1–10] In the proposed designs, the slot used was linear and the cavity of rectangular shape. Moreover, many of these antennas are either based on substrate-integrated waveguide (SIW) technology or require a suitable superstrate covering for improved performance.

In this paper, we introduce a novel type of cavity backed slot antenna for the 5.8 GHz ISM band that has a simple and most uncomplicated structure comprising only two parts: a metallic cavity and a PCB. In this design, the slot takes the form of an "H" and is center-fed by a microstrip line. The H-shaped slot renders the antenna footprint more compact for a given desired gain,[11] while feeding it in the center increases its operational bandwidth.[12] Other attractive features of the antenna are that the cavity part of the antenna is cylindrical, and hence easy to fabricate, and more importantly that it is extremely shallow rendering the antenna low profile and allowing it to be mounted flush with the skin of a hosting platform and packaged in a limited volume. The proposed antenna has a 96% efficiency and achieves the desired unidirectional radiation with an 8 dBi gain, a 12 dB front-to-back ratio, and a 7.5% impedance bandwidth. The antenna was designed for the 5.8 GHz ISM band but, with due changes, can be readily scaled to other frequency bands.

## 2 | ANTENNA MODEL

The antenna is shown schematically in Figure 1. The antenna comprises two parts: a PCB and a metallic cavity. The PCB used is a TACONIC-TLY-0-0310 with dielectric substrate of relative permittivity $\varepsilon_r = 2.45$, loss tangent of 0.0009, and thickness of 0.8 mm. The PCB has an H-shaped slot, comprising a horizontal slot of length $L_H$ and two vertical slots each of length $L_E$, etched in its ground-plane side. It also have an open-end microstrip feed-line printed on its other side. The cavity is assumed to be made of brass and has a shallow cylindrical form. Clearly, in the final fabrication stage, these two antenna parts are bound