Designing and Analysis of CPW fed planar monopole antenna with broadband circular polarization

ABSTRACT:

The design and implementation of a coplanar waveguide (CPW)-fed planar monopole antenna with circular polarization and broadband operation is presented. The antenna operates in the Industrial, Scientific, and Medical (ISM) and wireless local area network (WLAN) (5 GHz) bands with circular polarization (CP) in both bands. It is demonstrated that a fractional bandwidth for CP larger than 33% can be attained simply by introducing an inverted L-shaped slot in the ground plane and parallel-aligning an inverted-L-shaped strip. The slots are thoughtfully positioned to improve circular polarisation and increase antenna bandwidth. The advantages of the proposed antenna are the simple yet efficient design of the radiator, a wide 3-dB axial-ratio operating band, and a compact size. A review of the literature reveals that multiple designs have been put forth, each with a different slot arrangement and operating frequency. Based on the radiation properties of the antenna, such as its gain, axial ratio, and impedance bandwidth, its performance is assessed. The antenna is appropriate for uses like RFID readers, UWB systems, and wireless communication networks due to its broad circular polarization.

BRIEF THEORY:

A planar antenna puts both the active and parasitic elements on one plane, making them two dimensional. Planar antennas include microstrip antennas and printed circuit board antennas. The antenna "patches" may be square, triangular, or circular. Due to their planar structure and compactness these antennas are better to use for applications like satellite and wireless communications. Popularity of the wireless network has been increased to meet the need of consumer demand in today's advancements in wireless technology.

Despite some disadvantages like- low efficiency, narrow bandwidth, less gain because of their small size and high return loss of microstrip patch antennas these antennas are very popular. By making some modifications like slot cut and different shapes many researchers have try to overcome the demerits of these antennas. The return loss of antenna is controlled by proper impedance matching of feed line and patch.

DESIGN FORMULAS:

$$1.)\ E_{ref} = \frac{E_r + 1}{2}[1 + 0.3u]$$

$$2.)\ Width\ of\ plane:\ W_g = \frac{1.38c}{f_r\sqrt{E_{eff}}}$$

$$3.)\ Length\ of\ monopole:\ l_f = \frac{0.42c}{f_r\sqrt{E_{eff}}}$$

4.) Length of plane:

$$h = \frac{0.36c}{f_r\sqrt{E_{eff}}}$$

5.) Resonant frequency:

$$f_r = 3\frac{+2}{\sqrt{E_{ref}}}\left[\frac{21}{l_f} + \frac{65}{W_g} + \frac{18}{h} - 3\right]$$

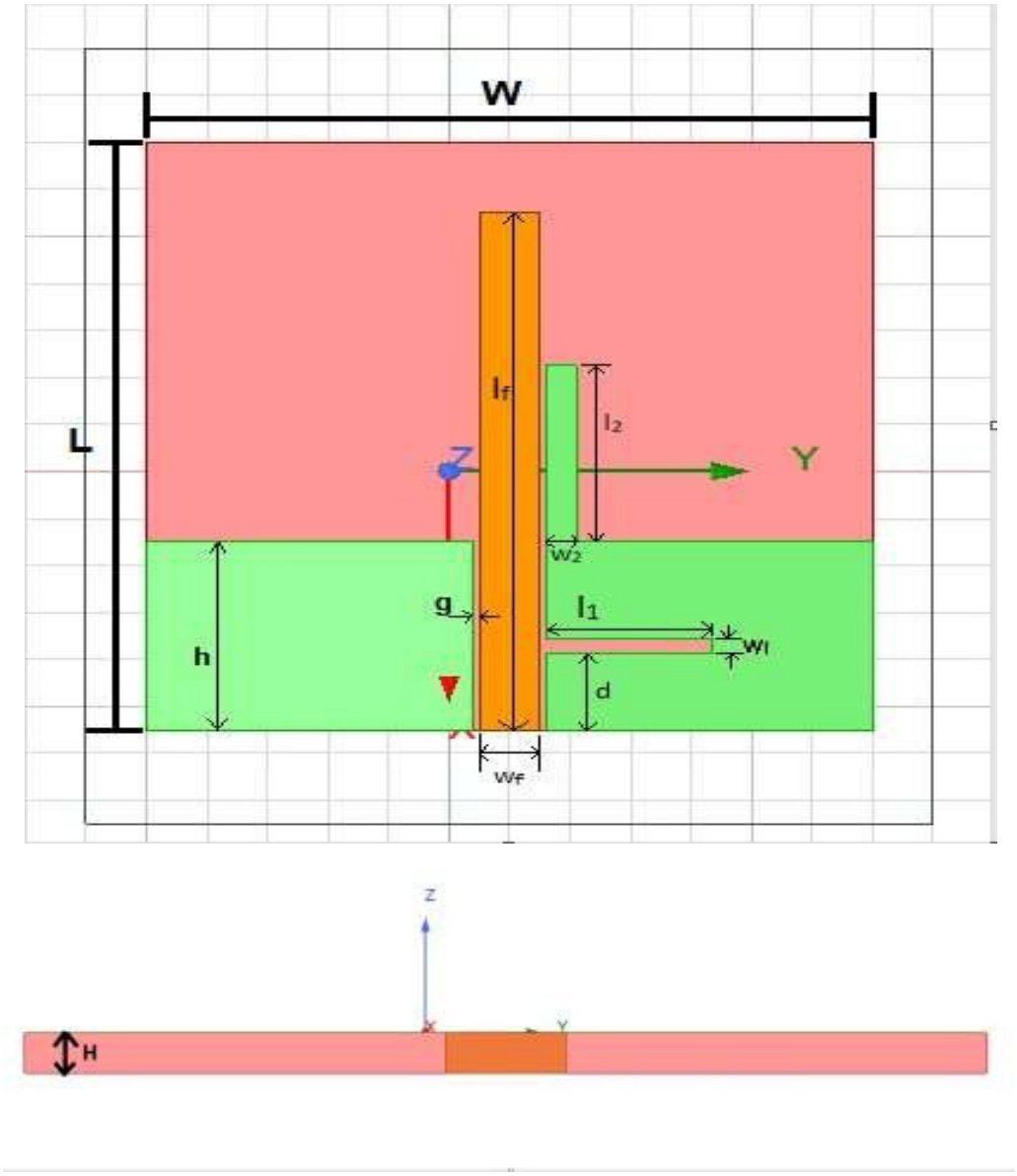

Figure 1: Model of antenna

W	L	H	h	g	w_f
24	25	1	8	0.2	2
l_f	d	l_f	w_1	l_2	w_2
22	3.25	5.5	0.6	7.5	1

Table 1: Parameters of antenna

Explanation of the proposed antenna:

- What is CPW Monopole Antenna?

A CPW monopole antenna is a type of antenna that uses coplanar waveguide (CPW) transmission lines as the feed structure. The CPW monopole antenna consists of a metallic patch or strip, called a radiating element, that is printed on a dielectric substrate. The radiating element is usually in the shape of a rectangular patch or a strip, and it is typically fed by a CPW transmission line.

- Why CPW Monopole Antenna?

CPW Monopole Antenna has a broader bandwidth, a higher gain, and a more compact size. The CPW monopole antenna also has a lower radiation pattern than other types of monopole antennas, which makes it suitable for use in applications where low radiation patterns are required, such as in mobile phones and wireless communication systems. It also provides good radiation performance, low loss, and high impedance bandwidth.

- Proposed Antenna:

The proposed CPW monopole antenna is a specific design of the CPW monopole antenna that has been optimized for specific frequency bands or applications. The design of the proposed antenna may include modifications to the dimensions of the radiating element, the shape of the ground plane, or the type of dielectric substrate used. These modifications are made to improve the performance of the antenna in terms of its bandwidth, gain, radiation pattern, or impedance matching.

Overall, the CPW monopole antenna is a versatile and widely used type of antenna that is well-suited for a range of applications in wireless communication systems, including mobile phones, Wi-Fi routers, and Bluetooth devices.

Simulation results and measurements results:

A new dual-band design of a finite ground coplanar waveguide (CPW)-fed monopole antenna is designed for wireless local area network (WLAN) and worldwide interoperability for Microwave Access (WiMAX) applications. The proposed antenna, comprising a rectangular planar patch element embedded with L shape. The simulated -10 dB bandwidth for return loss is from 2.8GHz to 3.1 GHz, covering some of the WiMAX and WLAN bands. The Antenna has a return loss of -26 dB at 2.89 GHz frequency and has a gain of 2.925.

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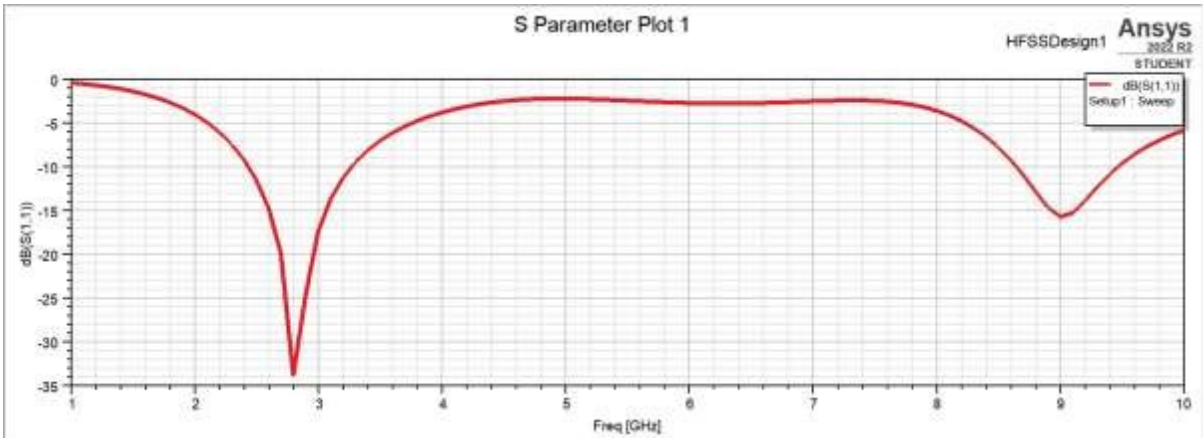
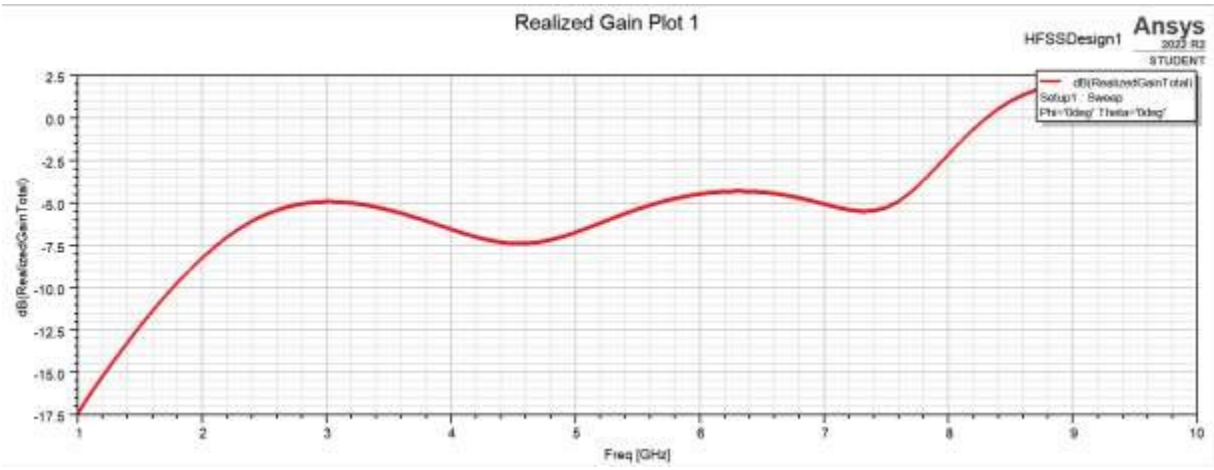
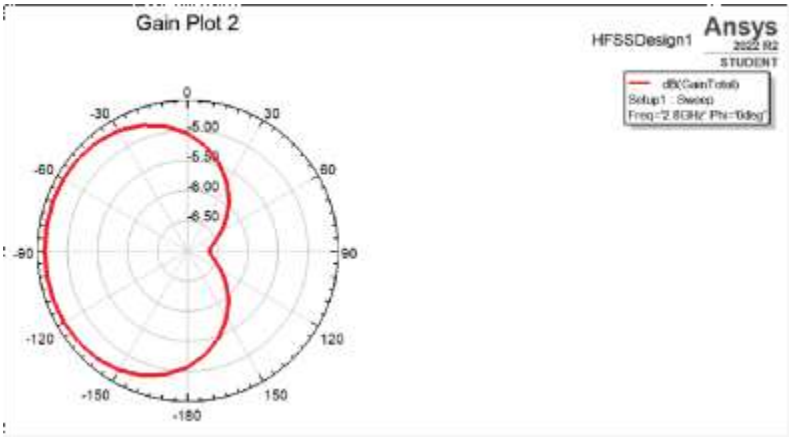


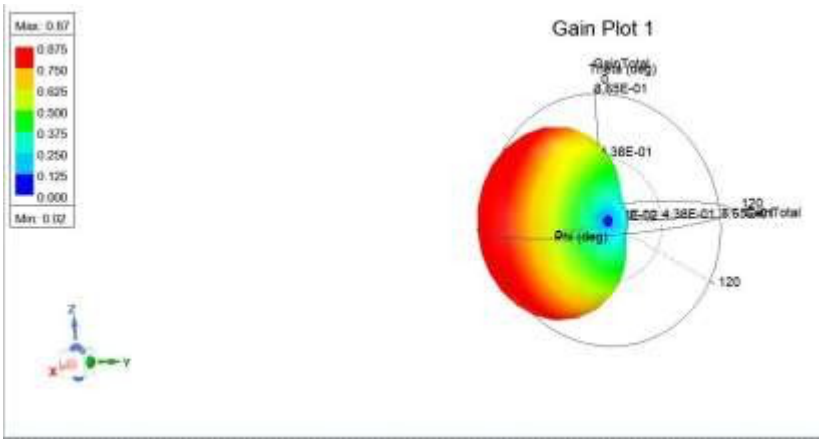
Gain vs Frequency



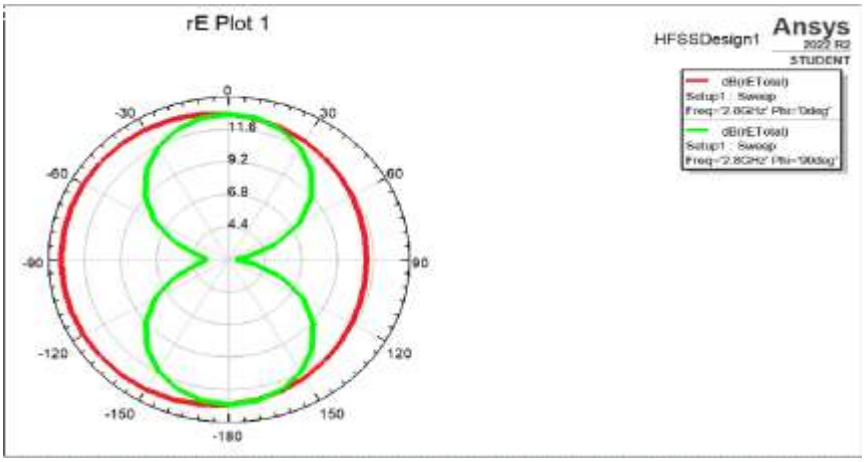
Radiation Pattern 2D:



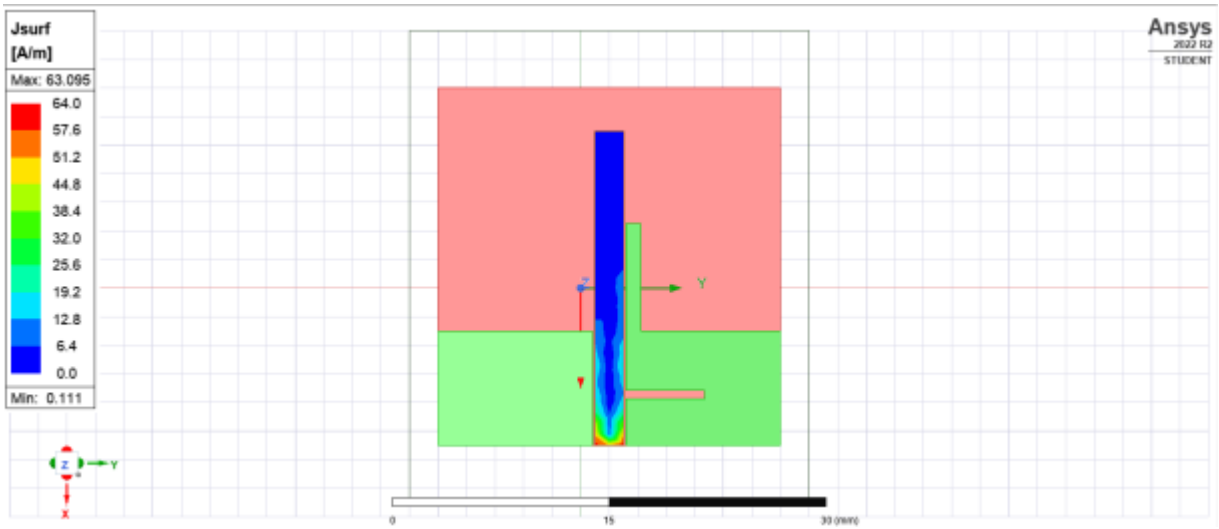
3D:



E-Plane and H-Plane



Surface Current Distribution on patch



CONCLUSION:

As a result of its capacity to offer a broad bandwidth and circular polarisation, the CPW-fed planar monopole antenna with broadband circular polarisation is a well-liked design for wireless communication applications. A planar patch with many slots and a CPW feeding mechanism make up most antenna designs. The radiation properties of the antenna, such as gain, axial ratio, and impedance bandwidth, are used to assess its performance. A review of the literature revealed that various designs with various slot arrangements and operating frequencies have been put forth. It has been shown that the slots are effective for boosting circular polarisation and expanding the bandwidth. The CPW-fed planar monopole antenna with broadband circular polarization offers an attractive solution for achieving high data rates with low power consumption in wireless communication systems. Therefore, the design and analysis of such antennas hold significant importance in the field of wireless communication.