DESIGN AND ANALYSIS OF MONOPOLE ANTENNA FOR ISM, C, AND X-BAND APPLICATIONS

Habibulla Khan, B T P Madhav, S Salma, B Neha Reddy, G Uma Maheswari, K Rama Prathyusha, D Ram Sandeep, M C Rao

Abstract— In this paper, a single element antenna is proposed for wireless communication which works at ISM, C and X-Band applications. The designed antenna dimensions are 23x36 mm on the FR4 substrate with a thickness of 1.6 mm, dielectric constant of 4.4 and loss tangent of 0.02. The tapered microstrip fed slot antenna acts as a single radiating element with inverted L-shaped slits to introduce notches at C band and X-bands. The antenna resonates at 5.8GHz (ISM), 6.9GHz (X Band) and 8.7GHz (C Band).

Index Terms— ISM, C band and X band, Notch, Monopole Antenna.

1 INTRODUCTION

The antenna is the space-propagating interface between radio waves and electrical currents passing through metal conductors which are used with a transmitter or receiver. A radio transmitter conveys electrical flow to the terminals of the transceiver during transmission, and the transceiver emanates the power from the current as electromagnetic waves (radio waves). [1-6]. While receiving, a portion of the vitality of a radio wave is consumed by a transceiver to make an electrical flow at its terminals, which is transmitted to a transmitter to be intensified. Antennas are significant segments of all gadgets for radio. An antenna is a transducer that changes the fields of radio recurrence (RF) to rotating current and the other way around[7-12]. There are reception apparatuses for getting and transmitting radio transmissions. In the activity of all radio hardware, transceiver assumes a significant job. In the past few years, wireless communications have been rising very rapidly and communication devices have become very portable. Wireless communications have grown tremendously, especially in the field of reconfigurable antennas, as day by day. Remote systems administration is a primarily developing piece of the interchanges business, equipped for giving fast and top-notch trade of data between cell phones found anywhere on the planet. Various applications empowered by this innovation incorporate cell phones, Internet-empowered computerized mobile phones, video remotely coordinating and separation learning, intelligent homes and machines, mechanized thruway frameworks and independent sensor systems, to give some examples. For different applications from business to martial applications, the need for low profile multi-band antenna is dramatically increased in modern communication networks. The newly printed monopole antenna is a flexible antenna that has excellent attention. These deliver a wide range and are more conducive for wireless communication so that different applications tend to have less or even one antenna. Printed monopole antennas have additional advantages compared to conventional wire antennas, including planar shape, small size, lightweight and low cost, which are highly suitable for receptor-sensitive applications [13-14]. For mobile contact, planar and written monopole antennas have been used for a long time. We can classify monopoly antennas into different categories depending on the application and the frequency. i) Broadband planar and printed monopole antennas. ii) Planar printed UWB monopole antennas and iii) Band-notched UWB monopole antennas.

Due to their vast impedance transmission capacity and almost omnidirectional azimuthal radiation design, Printed monopole and planar antennas are solid matches for the utilization of remote advancements. The electrical properties of the radio wires rely upon both the monopole radiator and the bottom plane geometry. Either the monopole radiator component is electrically short with a wavelength of substantially less than a quarter with a length around equivalent to quarter wavelengths. The electrical characteristics of the monopole transceiver are necessarily a component of the length of the component, the span of the component and the sweep of the bottom plane only three parameters [15-18]. For a planar monopole transceiver, electrical properties rely upon the design parameters of the monopole radiator, the ground plane and the separation between the ground plane and the radiator. The ISM (Industrial, Scientific, and Medical Band) allude to a gathering of radio groups and segments of the radio range that are all around saved for the utilization of radiofrequency (RF) control for medical, scientific and Industrial purposes instead of for correspondences purposes. ISM groups are open recurrence groups, which change by district and stipend. The ISM recurrence 2.54 GHz is a broadly acknowledged worldwide unit. A few equipments utilizing this ISM radio band were cordless phones, medicinal diathermy gadgets, combat radars, heaters which are used for industrial purposes and microwave ovens. ISM groups are additionally considered groups that are not authorized [19-26]. Utilizing ISM gear can deliver electromagnetic impendence that will upset radio correspondences using a similar recurrence. This gadget was in this way constrained to explicit groups of recurrence. The correspondence gear working in these groups should

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ordinarily oblige the disturbance created by ISM hardware, and in this manner, buyers have no administrative assurance from utilizing ISM gear. In spite of the genuine reason for ISM groups, its utilization in low-control, a short-go correspondences stage has been developing quickly. ISM groups are utilized by Bluetooth gadgets, cordless telephones, Wi-Fi PC systems, and NFC gadgets. The X band is the assignment for a recurrence band in the electromagnetic range’s microwave radio. At times, for example, correspondence building, the X band’s recurrence run, is set at around 7.0–11.2 GHz somewhat uncertainly [27-30]. For regular radars, the X band is frequently utilized. The X band’s shorter wavelengths permit higher goals symbolism from high-goals imaging radars to recognize and oppress targets. The X-Band is most broadly used for radar applications as it has a short wavelength taking into account higher goals symbolism to acknowledge and understand aims. It is utilized for typical, military and government radar applications, including climate, aviation authority, oceanic vessel traffic control, resistance checking, and law authorization vehicle speed discovery. The X-Band is additionally utilized in satellite and earthly correspondences, notwithstanding radar. Meteorological satellites typically use the frequency range of 8,175 to 8,215 GHz to track weather conditions [31-34]. The X Band has meager atmospheric attenuation rates compared to frequencies above 10 GHz, making this band ideal for the harshest weather conditions, offering exceptionally high availability for SATCOM and radar applications for weather monitoring. The frequency range of super-extended c band for transmitter frequency is 5.85 GHz to 6.725 GHz and receiver Frequency is 3.4 GHz to 4.2 GHz. The C-Band is mainly used to communication satellites between ground stations and satellites. The uplink direction is used with frequencies from 5.925 to 6.425 GHz and downlink direction is used with wavelengths from 3.7 to 4.2 GHz [35-40]. Here Uplink refers to satellite ground station and downlink refers to ground station satellite. The process parameters considered fabricating the component and surrounding media also widely influence the strength and surface finishing of materials while it is indirectly affecting the corrosion rate of metals.

2 THE ANTENNA DESIGN AND ITS GEOMETRY

Nowadays, electronic systems are compact, and people are looking towards weightless electronic systems so, antennas should be in a smaller size. Using the FR4 substrate, the antenna designed with a permittivity of 4.4 and with the loss curvature 0.02. The Figure-1 indications the bounds of the antenna that we designed those are \( L_s = 36 \text{ mm} \), \( W_s = 23 \text{ mm} \), \( L_p = 11 \text{ mm} \), \( W_p = 22.6 \text{ mm} \), \( L_g = 14 \text{ mm} \), \( L = 19 \text{ mm} \), \( W = 3 \text{ mm} \), \( L_{slot1} = 0.4 \text{ mm} \), \( L_{slot2} = 3 \text{ mm} \), \( W_{slot1} = 0.8 \text{ mm} \), \( W_{slot2} = 7.4 \text{ mm} \), \( h = 1.6 \text{ mm} \). The design has two slots in the patch and has been expected this on the substrate with a thickness of 1.6 mm. The 50-ohm feed line is embedded into the surface of the material with a height of 1.6 mm and a length of 3 mm. Table.1 shows the components of the proposed single-component receiving wire with dimensional transceiver parameters. In the radio wire configuration lumped port has been set. The excitation is applied as a voltage or current at a point/cell with the knot port. Applications are simple and individuals have discovered great/sensible outcomes while utilizing lumped port. The wave would then be able to portray some voltage or current when the recurrence is low adequately, or if excitation is given lacking little region that must be de-installed, and so on determined, in the correct design. The main way is if the discontinuities of geometry content are like the lumped dock of excitation.

![Image](image_url)

**Fig 1 Proposed single element antenna**

<table>
<thead>
<tr>
<th>Antenna Parameters</th>
<th>Dimensions in mm</th>
</tr>
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<tbody>
<tr>
<td>( L_s )</td>
<td>36</td>
</tr>
<tr>
<td>( W_s )</td>
<td>23</td>
</tr>
<tr>
<td>( L_p )</td>
<td>11</td>
</tr>
<tr>
<td>( W_p )</td>
<td>22.6</td>
</tr>
<tr>
<td>( L_g )</td>
<td>14</td>
</tr>
<tr>
<td>( L )</td>
<td>19</td>
</tr>
<tr>
<td>( W )</td>
<td>3</td>
</tr>
<tr>
<td>( L_{slot1} )</td>
<td>0.4</td>
</tr>
<tr>
<td>( L_{slot2} )</td>
<td>3</td>
</tr>
<tr>
<td>( W_{slot1} )</td>
<td>0.8</td>
</tr>
<tr>
<td>( W_{slot2} )</td>
<td>7.4</td>
</tr>
<tr>
<td>( h )</td>
<td>1.6</td>
</tr>
</tbody>
</table>

**TABLE: 1 DIMENSION OF THE PROPOSED ANTENNA**
3 RESULTS AND DISCUSSIONS

The single-component transceiver is projected in this part. The S-parameter has been resonating in three groups underneath -10db where -10db is the loss of return. We have 5.8 GHz recurrence in this first band parameter and the subsequent band happens at 6.9 GHz recurrence and the third band happens at 8.7 GHz recurrence. Figure 2 shows the above qualities.

![Fig 2 Assessment of antenna model S-parameters](image1)

**Fig 2** Assessment of antenna model S-parameters

VSWR is a reflection coefficient work that characterizes the vitality that the transceiver speaks to. If the coefficient of reflection is given by s11 or the coefficient of reflection or loss of return, the accompanying equation characterizes the VSWR:

\[
VSWR = \frac{1 + |\Gamma|}{1 - |\Gamma|}
\]

![Fig 3 Frequency vs VSWR Graph](image2)

**Fig 3** Frequency vs VSWR Graph

The radiation patterns of the single element antenna are taken from HFSS, which characterize the radiated energy of the proposed antenna.

![Fig 4 The proposed Antenna Radiation Pattern at distinct operative bands in E-plane and H-plane in two Dimensional (a) 5.8 GHz (b) 6.9GHz](image3)

**Fig.4** The proposed Antenna Radiation Pattern at distinct operative bands in E-plane and H-plane in two Dimensional (a) 5.8 GHz (b) 6.9GHz

Its plots of gain can portray the antenna’s output. Toward top radiation, the radio wire ingests records the moved vitality. The thunderous frequencies of three-dimensional polar addition 5.8GHz, 6.9GHz are displayed as appeared in Figure 5 underneath.
The proposed antenna is regulated with dual E-shaped currents, as the way of the feed component. Figure 6 shows the surface current distribution of the proposed antenna.

The proposed antenna is regulated with double E-molded flows. By the side of the feed component with a double E-shaped antenna, the full amount of power is appropriated. The proposed antenna surface current distributions are shown in figure 7.
CONCLUSION
In this study, a single component antenna is intended for remote applications which work at ISM, C-band and X-band applications. The reflection coefficient parameters have three resonating groups under -10 dB return-loss, and the peak gain is more than 4 dB.

REFERENCES


