MULTIBAND CPW PATCH ANTENNA FOR C AND X BAND APPLICATIONS

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Abstract: *A Multiband CPW Patch antenna has been proposed to resonate at three bands. Y shaped patch along with ground plane has been etched on one side of FR4 epoxy substrate whose dielectric constant is 4.4 with 1.6mm thickness, copper on other side of the substrate is completely etched. This antenna has good reflection coefficient below -10dB at three different bands covering in the range of frequencies 2.3 GHz to 2.7 GHz, 3.85 GHz to 5.4 GHz and 7.6 GHz to 10.2 GHz with resonant frequency at 2.56 GHz, 4.71 GHz and 9.21 GHz having reflection coefficient of -18 dB, -35 dB & -60 dB respectively. This antenna has bidirectional radiation pattern in E- Plane and omni directional in H-Plane making it suitable for Bluetooth, WIFI, and WLAN which covers entire C-Band & X-Band applications*

Introduction

Wireless communication devices, such as antennas, have received a lot of attention from researchers over the years, it's a challenging task for them to have compact, low profile, inexpensive, multi band or wideband, simple design, and less complex manufacturing process. The demand for a single antenna module that can operate in multiple frequency bands reduces costs and simplifies system integration. A wideband microstrip antenna was proposed in [1], for pattern diversity application, maximum bandwidth achieved was only 775 MHz. [2] proposes a 'F' shaped printed planar antenna with a partial ground plane for dual band RFID/WLAN applications that will resonate at 2.44 GHz and 5.18 GHz. By using protruding stub in the ground plane [3] proposed dual resonant patch antenna centered at 2.4 GHz and 5.81 GHz respectively. Triple band functionalities to operate for WLAN/WiMAX using a circular slot patch antenna with EBG structure has been adopted in [4]. Slots have been cut on the radiating element to obtain multi band frequency, CPW based 3- L shaped slotted rectangular patch antenna has been simulated, where quad band has been achieved for WiMax/WLAN applications as proposed in [5]. Symmetrical L- and U- shaped slots on the rectangular patch have been proposed for WiMAX/WLAN application in [6]. In literature [7-10] different methods where proposed to have multiple resonant bands but by introducing slots in the patch area, gain of the antenna has been fall down. In this paper a CPW antenna has been proposed to radiate in three bands. The advantages of co-planar waveguide fed printed slot antenna over conventional microstrip patch antenna are numerous. Large radiation efficiency and low dispersion, results in superior overall performance. A co-planar waveguide CPW) fed microstrip antenna is made up of single conducting track printed alongside the ground plane on dielectric substrate such as FR-4. HFSS is one of the graphical tools, which divide the radiating surface into clusters and determine how much effective antenna

Antenna Design

A Coplanar Waveguide (CPW) fed microstrip patch antenna (30mm X 30mm X 1.6mm) was printed on one side of Glass Epoxy FR-4 substrate, with the copper on the other side completely etched. The dielectric constant of the substrate is 4.4, and it has a thickness of 1.6mm. The feed line's width was reduced to 3.6mm for better impedance matching. Figure 1 depicts two ground planes of 10.6mm x 12.6mm on either side of the microstrip feed and an extended square ring of width 2mm.

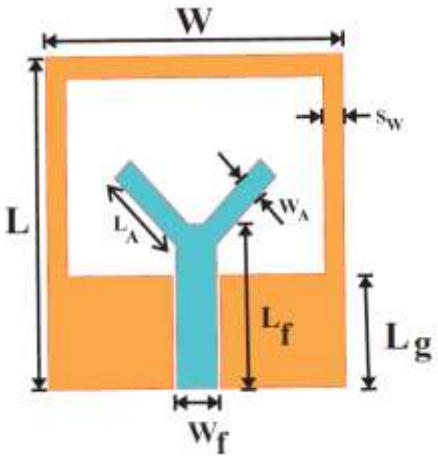


Figure1: Top View of Proposed CPW based Patch Antenna

The above shown is top view of proposed microstrip patch antenna. The optimized antenna dimensions are shown in table1.

Table1: Optimized dimension of proposed CPW based Microstrip Patch Antenna

Parameters	L	W	W_f	L_f	L_A	W_A	S_w	L_g
Dimension in mm	30	30	3.6	13	8	2	2	10.2

Proposed CPW based microstrip patch antenna was designed on one side of FR-4 epoxy substrate and simulated using HFSS software. A schematic design of proposed antenna has been shown in below figure 2.

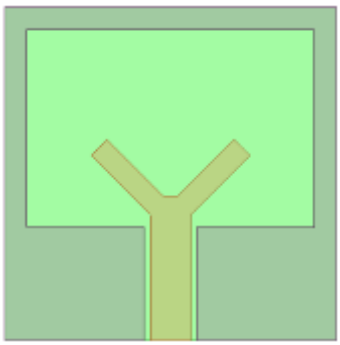


Figure2: Schematic of Proposed CPW based Patch Antenna

RESULTS & DISCUSSIONS

The CPW fed microstrip patch antenna printed on one side of FR-4 substrate and copper etched completely on other was simulated using HFSS software and reflection coefficient verses frequency was plotted as shown in figure 3. First band from 2.3 GHz to 2.7 GHz with a bandwidth of 400 MHz and a maximum return loss of -18dB was achieved. Second band from 3.85 GHz to 5.4 GHz with a bandwidth of 1.55 GHz and a maximum return loss of -35dB was noticed. Third band from 7.6 GHz to 10.2 GHz with a bandwidth of 2.6 GHz and a maximum return loss of -60dB was achieved. Figure 3 shows the reflection coefficient of proposed CPW fed microstrip patch antenna, reflection coefficient below -10dB was found in the frequency ranges from 2.3 GHz to 2.7 GHz, 3.85 to 5.4 GHz and, 7.6 GHz to 10.2 GHz. Width of microstrip feed has been optimized for better impedance matching. The

proposed antenna is designed for C- band & X-band applications. Applications like LTE/LTE-A and WLAN technologies were used as it also covers the sub-6 GHz band.

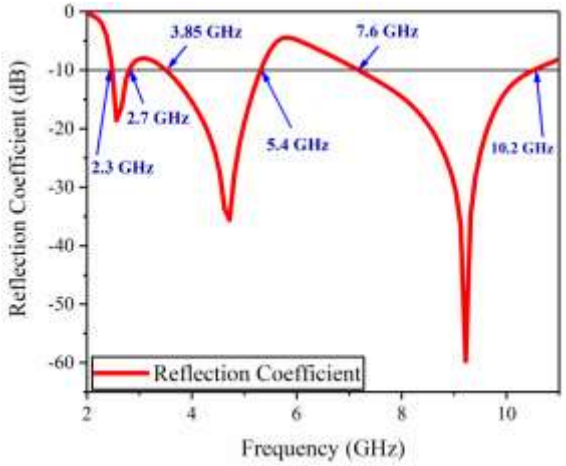


Figure3. Reflection Coefficient of Proposed CPW based Microstrip patch antenna.

A maximum gain of 6.67dBi was achieved with an average of 3 dBi in all the three bands as shown in figure 4.

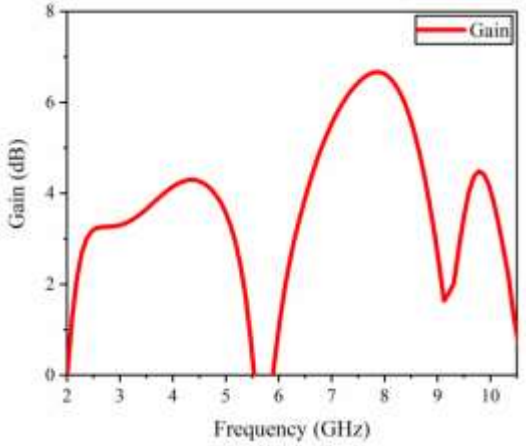
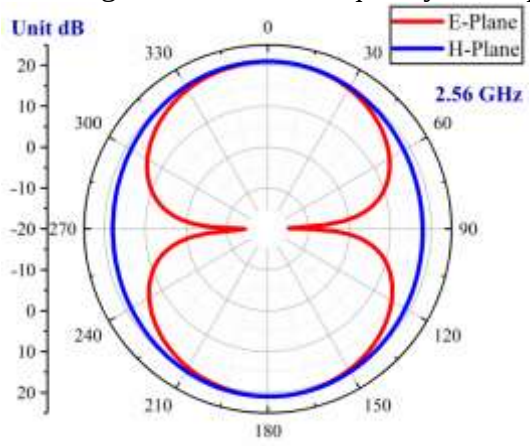
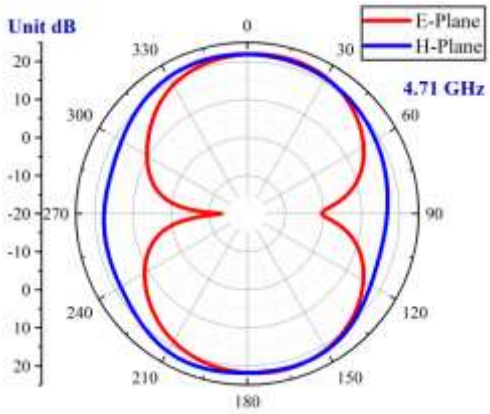


Figure4. Gain vs. Frequency of Proposed CPW based Microstrip patch antenna.





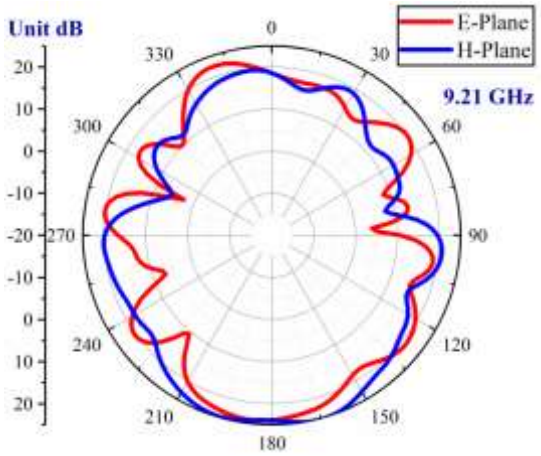


Figure 5: Radiation Pattern of proposed CPW based Microstrip Patch Antenna

The radiation pattern of proposed CPW based microstrip patch antenna for E-Plane and H-Plane for three different bands is shown in figure 5, A conventional microstrip patch antenna with patch on one side & ground plane on other side of substrate has radiation in only one direction but in CPW based antennas, both ground plane & patch are on one side of substrate with other side completely etched, there is backward wave propagation. As a result antenna radiates equally in both directions having Omni directional in E-Plane and nearly isotropic in H-Plane as shown as in figure 5. In higher band both E-Plane & H-Plane are isotropic making this antenna suitable for ideal case of dipole antenna.

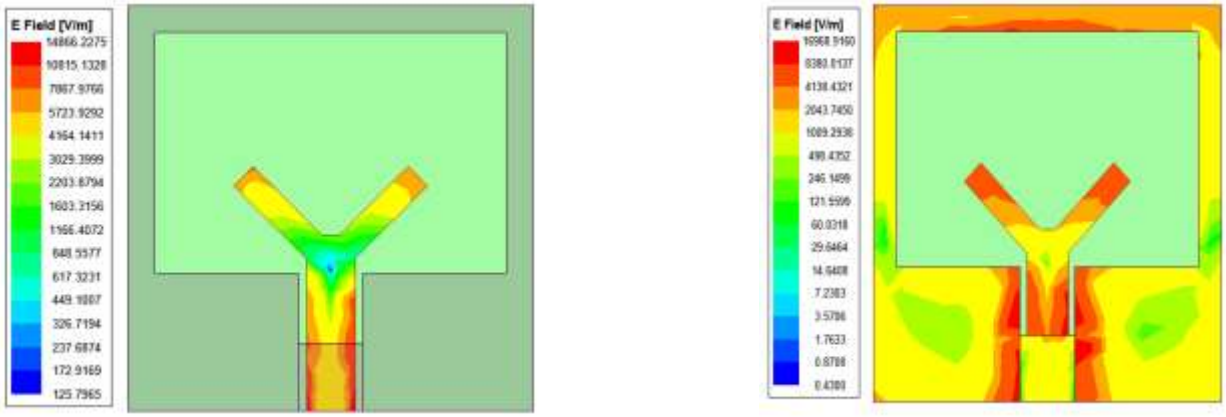


Figure 6: Surface Electric Fields of proposed CPW based Patch Antenna

The surface current distribution of proposed CPW patch antenna is shown in figure 6. When both the radiating feed & ground has been perfectly matched and they are effectively radiating electric fields of desired frequencies. The distribution of electric fields found to be similar in all the three bands.

VI CONCLUSION

Conventional CPW based microstrip patch antenna has three bands from 2.3 GHz to 2.7 GHz, 3.85 GHz to 5.4 GHz & 7.6 GHz to 10.2 GHz having bandwidths of 400 MHz, 1.55 GHz & 2.6 GHz respectively which covers C and lower X band making it suitable for many applications like Wi-Fi, WLAN, Satellite communication between Ground station to satellite communication between Ground station to satellite, Wideband has been observed which make CPW antenna suitable to operate downlink for satellite communication, WLAN & WiMAX.

VII REFERENCES

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