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Design Of Wideband Dual Polarized Slot Antenna

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Abstract: A single layer wide band U- slot antenna with polarization diversity using a hybrid feeding technique. Here the feeding techniques used are E- shaped microstrip feed line and co-planar waveguide feeding. The Horizontal polarization mode is excited by aperture coupled microstrip feed line which reduce cross polarization and thereby increasing the isolation level. The vertical polarization mode is excited by circular patch and it is connected to a coplanar waveguide feed line for good impedance matching. Proposed antenna has compact structure, wider bandwidth and improved isolation level. By introducing fan shaped slot antenna with dual polarization and isolation level will be improved to 40 dB .

Index Terms: hybrid feeding, cpw, polarization diversity

I. INTRODUCTION

Slot antenna is consist of metal surface usally a flat plate, with a hole (or)slot cut out. Typically frequency between 300MHz to 24 GHz. Slot antenna was invented in 1938 by Alan blumein. Polarization diversity combines pairs of antennas with orthogonal polarizations (i.e. horizontal/vertical, ± slant 45°). Polarization diversity is one of technique used to provide high channel capacity in modern wireless communication system. Beside the facility to moderate the multipath fading problem, it is also able to provide double transmission channels. Various kinds of polarization diversity antenna have been studied[1-12]Wide band printed slot antenna with polarization diversity were used to realize compact structure, stable gain ,good impedance matching and isolation level between two feeding port is better than 36dB[1] . Dielectric resonator antenna were introduced to obtain a high port isolation and a low cross polarization level and using hybrid feeding mechanism for polarization diversity application[1,3].Printed slot antenna have also been widely applied to achieve polarization performance owing to their compactness, low profile and easy fabrication. However these antenna often have a large size, complicated structure or narrow bandwidth[4]. Square patch with two Triangular

Slot as a compact dual linearly polarized antenna with very good isolation and cross polarization level of antenna is remains below -35dB in E-plane[5]. Horn antenna were used to recognize the high gain and high isolation performance. Here the antenna is designed using the horn radiator on basis of a conical helix which is departed by two ports for TX and RX both ends [6]. A dual polarized microstrip antenna with a good isolation but a narrow bandwidth is reported, where two rectangular slot are placed in a "T" structure. Wideband slot antenna were used dual polarization radiation can be exited by odd and even modes of same CPW feedline. The isolation between two port in the WLAN band is lower than -32.6dB[7]. Loop Antenna has dual polarization, wide bandwidth, low cross polarization is highly desirable by modern wireless communication [8].

The planer inverted F antenna has extensively used to handheld and portable devices due to fact that it has very attractive feature and WLAN WiMAX LTE Application[9]. Planer printed slot antenna horizontally polarized omnidirectional radiation pattern for WLAN application [10]. Asymmetrical bevelled rectangular patch with the u-shaped open slot structure is produced the ultrawide impedance bandwidth with small size which is very suitable for UWB application[11].L-shaped monopole slot antenna with a C-shaped feed was introduced and then low profile, low cost , low-data-rate iridium satellite access for automobile telematics are among the antenna applications[12].

In this letter we propose the single layer wideband printed slot antenna is presented using polarization diversity application. Here antenna is fed by the hybrid feeding stuctures. Horizontal polarization mode is exited by aperture coupled microstrip feed line with a phase difference of 180̊ which can reduce the cross polarization level and improve the isolation level, while vertical polarization mode is exited by rectangular patch is connected to co-planer waveguide feed line for good impedance matching. The isolation between to feeding port is can improved to more than 50dB by introducing fan shaped slot to separated the ground plane. The experimental result of S parameters and radiation pattern are presented and discussed.

II. ANTENNA DESIGN

The configuration of the proposed dual port dual polarized U slot antenna is shown in Fig.1 The antenna is printed on 1.5mm thickness FR4substrate with dielectric constant (εr) of 4.4 and loss tangent(tanδ) of 0.02. As described in Fig.1a, the ground plane separated by the fan shaped slot is printed on the top side of the substrate. The fan shaped slot can improve the isolation level between the two feeding ports. The antenna width and length value is w=39.5mm, L=50mm.The feeding network of port 1 is negotiated of straight 50Ω microstrip feed line and U- slot is embedded in the ground plane. An antenna is consist of

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U-shaped slot and E-shaped microstrip feed line which can reduce the cross polarization level and increase the isolation level, is printed on the back side of the substrate. Subsequently, the energy is coupled from the microstrip line to feed the U-shaped slot and the horizontal polarization mode can be motivated. As for port 2, feeding network consist of a rectangular patch is connected to the coplanar feed line to realize the good impedance matching. Coplanar waveguide feed line is used to stimulate the vertical polarization.

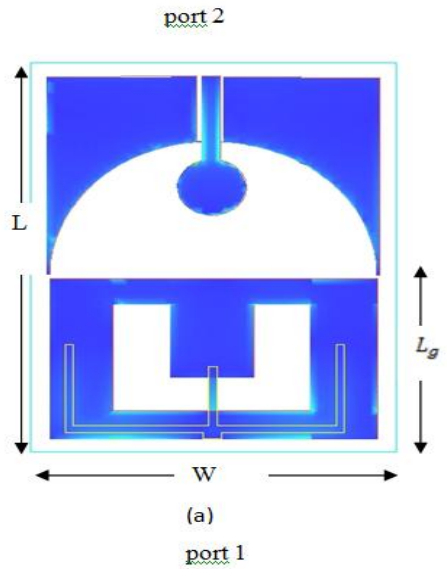
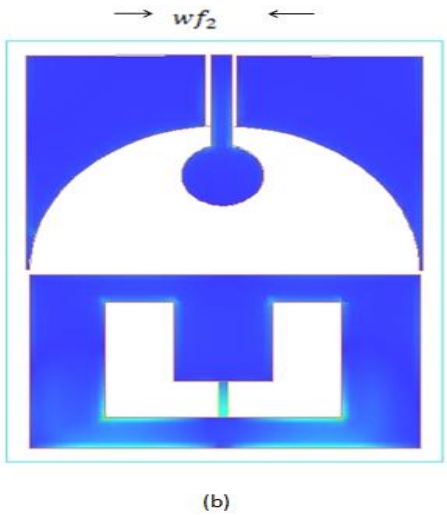


Fig 1.Configuration of proposed antenna

a) Top view

The impedance bandwidth of patch antenna for strongly influenced by the spacing between patch and ground plane. The patch is moved closer to ground plane. Less energy is radiated and more energy is stored in the patch capacitance and inductance. That is quality factor Q of antenna is increase. The gain value of patch antenna is 8.31859dB.



b) Bottom view

In reference to Fig 1,there are number of parameter that is influence the antenna characteristics. W=39.5mm, L=50mm. The area of u slot antenna size value is given by Ls=16mm ,Ws=24mm , $Ls_1 = 5mm$, $Ws_1 = 7mm$,L_g=24mm, $L_1, L2 = 13.2mm$ $L_3 = 10mm$ d = 8.9mm, $w_1 = 1mm$ $w_2 = 0.8mm$.The width and length of 50Ω microstrip feed line for port 1 are chosen to be $L_{f1} = 1mm$, $w_{f1} = 2.2\ mm$. As a port 2 the width and length of Coplanar waveguide feed line is $w_{f2} = 2.5mm$, $L_{f2} = 8.2\ mm$, and $w_g = 0.6mm$.R1=4mm, R2=20mm.

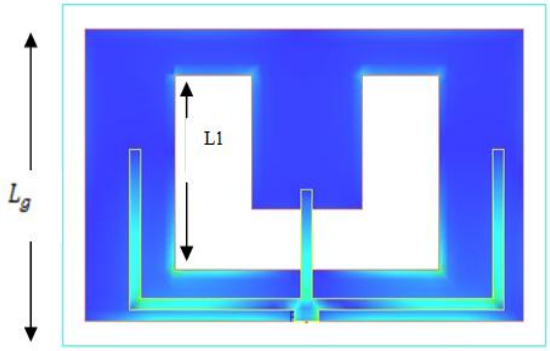


Fig 2 .Antenna 1 design value is L_g=24mm, $L_1 = 13.2mm L_2 = 14mm$ d = 8.9mm ,$w_1 = 1mm$ $w_2 = 0.8mm$

The antenna 1 is consist of U-slot is connected to E-shaped microstrip feed line for reduce the cross polarization and increase the isolation level.

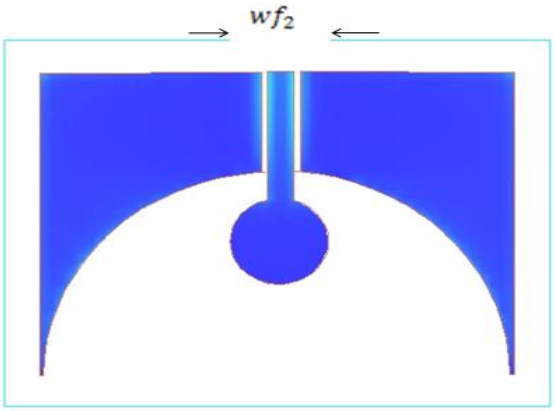


Fig 3.Antenna 2 port2 value is$w_{f2} = 2.5mm$,$L_{f2} = 8.2\ mm$, and $w_g = 0.6mm$.

Antenna 2 is consist of circular patch and its connected to coplanar waveguide for good impedance matching. As shown in Fig 6 when the circular patch is connected to coplanar wave guide -10dB return loss bandwidth from 3 to 8 GHz is achieved.

The measured -10 dB impedance bandwidth of proposed antenna is wide bandwidth with good impedance match reduce cross polarization and increase the isolation level.

III. RESULT AND DISCOUSSION

The prototype of proposed polarization diversity antenna has simulated and measured. The Fig. 5 shows the measured and simulated S parameters, including return loss, isolation level and impedance bandwidth. The measured -10dB impedance bandwidth are (3.2-8GHz)

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and (3.72-7.GHz) for vertical and horizontal polarization. Respectivelyboth covering the 5.2 (5.15–5.35)/5.8 (5.725–5.825) GHz wireless local area network (WLAN) and the 5.5 (5.25–5.85) GHz WiMAX band. The measured isolation between the two feeding ports is better than 50 dB in the whole operating band. Moreover, the isolation level is higher than 50 dB in the desired 5.2/5.8 GHz WLAN and 5.5 GHz WiMAX bands.

As for aperture coupled microstrip feed line of slot antenna return loss and isolation value, as shown in Fig.5. isolation value is 40dB increased and return loss value is 10dB. The simulated result is good excitation at around 5.2 GHz are exhibited by both the feeding ports, and the impedance bandwidth(also referred to as 10 dB return loss) measured at Port 1 and Port 2 meets the demand for WLAN applications from 5.2 (5.15-5.35 GHz)/5.8(5.7-5.8GHz)WiMAX band.

Table 1.Antenna parameters

Power radiated(watts)	0.0009567
Effective angle(steradians)	1.8746
Directivity(dB)	8.26
Gain(dB)	8.68
Maximum intensity	0.0051
Angle of U max	141, 271
E(theta)max(mag, phase)	1.96033,168.763
E(phi) max(mag, phase)	0.0226,170.144
E(x) max(mag, phase)	0.0039,-18.96
E(y) max(mag, phase)	1.50186,168.764
E(z) max(mag , phase)	1.20,-11.23

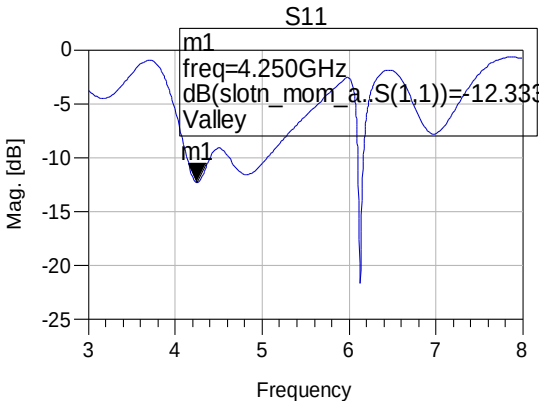

Fig 4. Measured and simulated S parameter of proposed antenna s11.

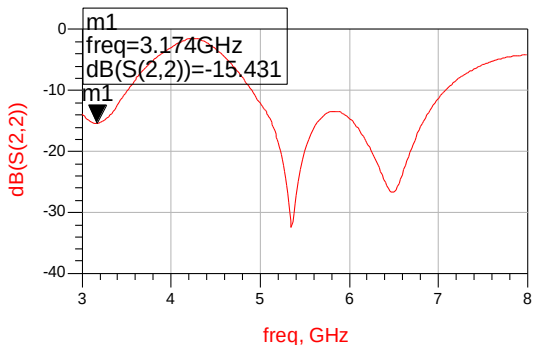

Fig 5. Measured and simulated S parameter of proposed antenna s22.

The isolation level between the two feeding ports of the prototype is shown in Fig. 6, and an isolation of more than 50 dB over the entire impedance bandwidth is demonstrated. By introducing fan shaped slot to separated the ground plane. The measured impedance bandwith of antenna -10dB at port 1 and port2 respectively.

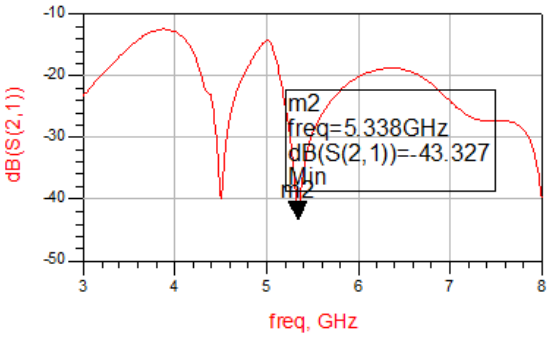

Fig.6 Isolation level of proposed antenna

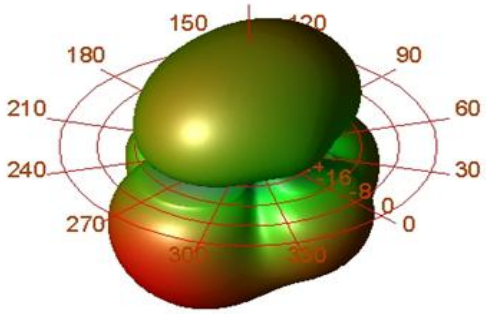

Fig 7 Radiation pattern of antenna isometric view.

Radiation pattern is graphical representation of radiation properties of antenna as a function of space co-ordinates. Radiation pattern is determined in the far field region and represented as function of directional co-ordinates. Radiated power value is 0.0009567 watts.

Antenna gain describes how much power is transmitted in the direction of peak radiation to that of an isotropic source. Antenna gain related to directivity (D). The wide band slot antenna gain value is 8dB.

IV. CONCLUSION

A new U-slot antenna with dual polarization and wide impedance bandwidth has been designed for polarization diversity applications. Two orthogonal polarization modes are excited by the hybrid feeding structures. Proposed antenna has fan-shaped slot to separate the ground plane, the measured isolation between the two feeding ports is better than 40dB in the operating band. The gain, directivity value is increased. Because of the advantages of this antenna is compact dimensions, wide impedance bandwidth, stable gain and good isolation. The proposed antenna has potential applications for WLAN/ WiMAX systems.

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