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Design of Wideband Printed Slot Antenna with E-Shaped Microstrip Feeding Line Techniques

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ABSTRACT: The single layer wide band printed slot antenna with E-shaped microstripfeeding techniques.The feeding techniques used are aperture coupled E- shaped microstripfeeding and co-planar waveguide feeding. The Horizontal polarization mode is excited by aperture coupled microstripfeedline with 180° phase difference to 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 feedline 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 38dB.

KEYWORDS*:* hybrid feeding,printed slot antenna, polarization diversity.

I. INTRODUCTION

Slot antenna consists of metal surface usually a flat plate, with a hole(or)slot cut out. Typically frequency between 300MHz to 24 GHz. Slot antennawas 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.Besides 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[1-11]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 feedingmechanism 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].

Slot has a compact dual linearly polarized antenna with very good isolation and cross polarization level of antenna 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 excited by odd and even modes of same CPWfeedline. The isolation between two port in the WLAN band is lower than -32.6dB[7].

LoopAntenna 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].

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 structures. Horizontal polarization mode is excited by aperture coupled E-shaped microstripfeedline with a phase difference of 180° which can reduce the cross polarization level and

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improve the isolation level, while vertical polarization mode is excited by circular patch is connected to co-planer waveguide feedline for good impedance matching. The isolation between to feeding port is can improved to more than 38dB by introducing fan shaped slot to separated the ground plane.

II. ANTENNA DESIGN

The configuration of the proposed dual port dual polarized printed slot antenna is shown in Fig.1 The antenna is printed on 1mm 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 E-shapedmicrostrip feed line and circular slot is embedded in the ground plane. An antenna is consist of aperture coupled E-shaped microstripfeedline with 180^0 phase difference 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 circular slot and the horizontal polarization mode can be motivated.As for port 2,feeding network consist of a circular 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.

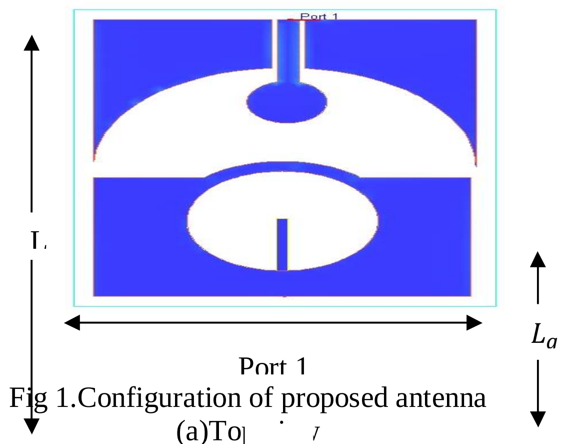
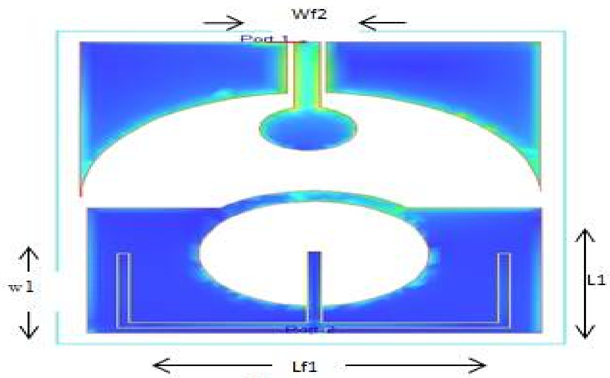


Fig 1.Configuration of proposed antenna
(a)To[illegible]

The impedance bandwidths 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 6.09dB.



Port 2

(b)Bottom view

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In reference to Fig 1,there are number of parameter that is influence the antenna characteristics. W=39.5mm, L=50mm. The area of rectangular antenna size value is given by, L_g =24mm, $L_1 = 13.2mm$ $L_2 = 14mm$ d = 8.9mm$w_1 = 1mm$ $w_2 = 0.8mm$. R1=10, R2=12, R3=4, R4=20,the width and length of 50Ω microstrip feed linefor 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 $w_g = 0.6mm$.

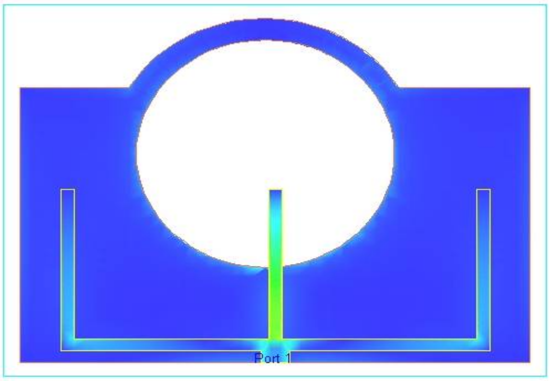

Fig 2 .Antenna 1design value is L_g=24mm, $L_1 = 13.2mm L_2 = 14mm$ d = 8.9mm g = 6mm ,$w_1 = 1mm w_2 = 0.8mm$

It begins with the design of Antenna 1 consist of a rectangular patch antenna with aperture coupled microstripfeedline with 180° phase difference to reduce cross polarization. As shown in Fig.3 when the circular slot antenna is fed by microstripfeedline,-10 dB return loss bandwidth of from 3to 10GHz is achieved.

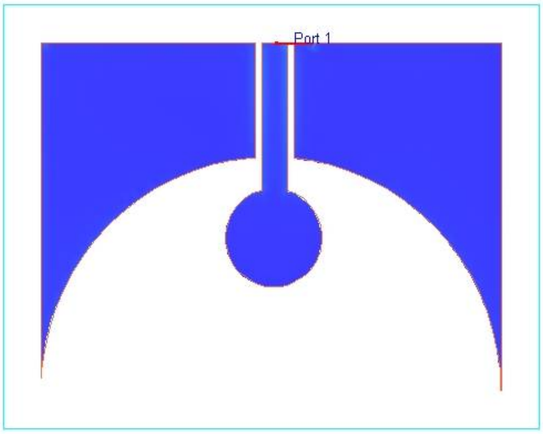

Fig 3.Antenna 2 port2 value is$w_{f2} = 2.5mm$,$L_{f2} = 8.2\ mm$, and $w_g = 0.6mm$.r3= 4mm

Antenna2 consists of circular patch which is connected to coplanar waveguide for good impedance matching. As shown in Fig 6 when the rectangular patch is connected to coplanar wave guide -10dB return loss bandwidth from 3 to 10 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 DISCUSSION

The prototype of proposed polarization diversity antenna has simulated and measured. The measured and simulated S parameters, including return loss, isolation level and impedance bandwidth. The measured -10dB impedance bandwidth are (3.95-8.9GHz) and(3.72-7.2GHz) for vertical and horizontal polarization. Respectively .both covering

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the 5.2 (5.15–5.35)/5.8 (5.725–5.825) GHzwireless local area network (WLAN) and the 5.5 (5.25–5.85) GHzWi-MAXband.

As for aperture coupled microstripfeedline of slot antenna return loss and isolation value,as shown in Fig.5.isolation value is -38dB increased and return loss value is 10dB.

Table 1.Antenna parameters

Power radiated(watts)	0.0128346
Effective angle(steradians)	3.08424
Directivity(dB)	6.100
Gain(dB)	6.09
Maximum intensity	0.0416137
Angle of U max	156,94
E(theta)max(mag, phase)	1.71201, 174.484
E(phi) max(mag, phase)	0.45216,-102.73
E(x) max(mag, phase)	0.450557,91.169
E(y) max(mag, phase)	1.56446,-4.36991
E(z) max(mag , phase)	0.696, -5.516

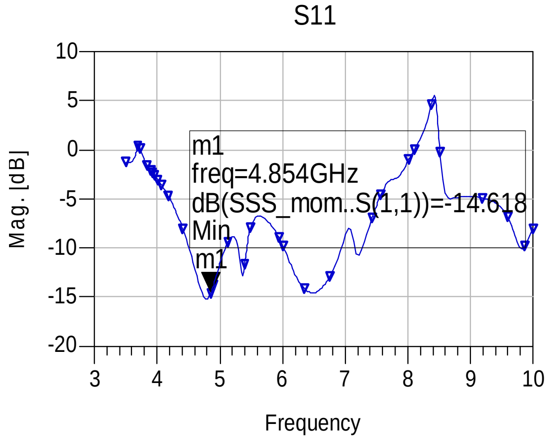

Fig 4. Measured and simulated S parameter of proposed antenna s11.

The Fig. 5 shows the measured and simulated S parameters, including return loss, isolation level and impedance bandwidth. The measured -10dB impedance bandwidth are (3.95-8.9GHz) and (3.72-7.2GHz) for vertical and horizontal polarization. Respectively .both 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 Wi-MAX band

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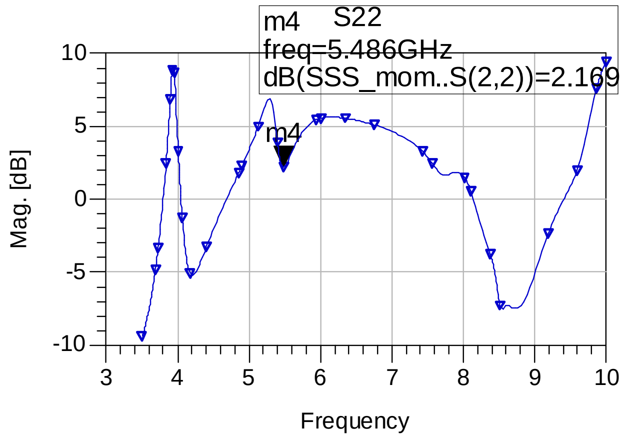

Fig 5. Measured and simulated S parameter of proposed antenna s22.

The isolation level between the two feeding ports of the prototype is shown in Fig. 6, and an isolation of more than 36 dB over the entire impedance bandwidth is demonstrated. By introducing fan shaped slot to separated the ground plane. Themeasured impedance bandwidth of antenna -10dB at port 1 and port2 respectively.

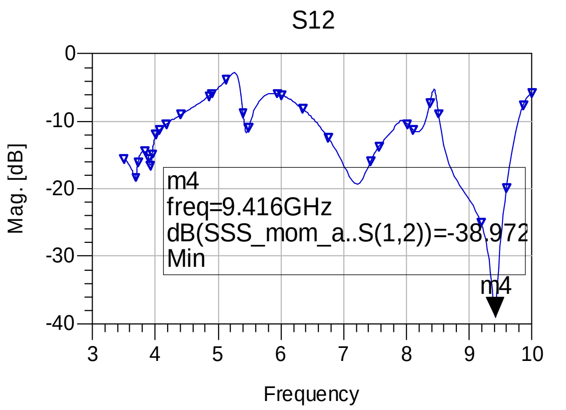

Fig.6 Isolation level of proposed antenna

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 0.0128346 watts.

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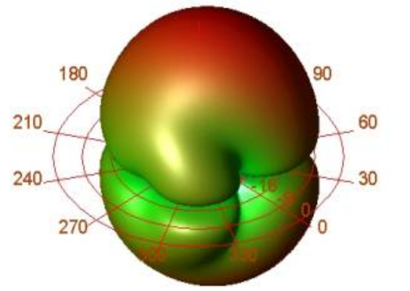

Fig 7 Radiation pattern of antenna isometric view.

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 6dB. 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 2meets the demand for WLAN applications from 5.2 (5.15-5.35 GHz)/5.8(5.7-5.8GHz) WiMAX band.

IV. CONCLUSION

A new printed slot antenna with dual polarization and wide impedance bandwidth has been designed for polarization diversity applications. Twoorthogonal polarization modes are excited by the hybrid feedingstructures. By introducing a fan-shaped slot to separate the groundplane, the measured isolation between the two feeding ports is better than 36dB in the operating band. Because of the advantages of this antenna iscompact dimensions, wide impedance bandwidth, stable gain andgood isolation. The proposed antenna has potential applications forWLAN/WiMAX systems.

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