A DUAL WIDEBAND MILLIMETER-WAVEMICROSTRIP ANTENNA WITH ASYMMETRIC PATCH

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Abstract: Anew dual widebandmillimeter-wavemicrostrippatch antenna proposed in this paper which is assigned to extremely high frequency (EHF) band applications. First, the antenna is design symmetrically onRO4360G2 substrate with dielectric constant 6.15. Second, the antenna is shifted about 0.6 mmthat leads to increase bandwidth, gain and also make dual resonance. The resonances of the asymmetric patch antenna has main bandwidth of 48.3 GHz (147.6 to 195.9 GHz) and 4.25 GHz bandwidth (38.28 to 42.53 GHz). Finally, the voltage standing wave ratio (VSWR), gain and radiation pattern are studied.

Keywords: Microstrip antenna, Wideband, Millimeter Wave, Extremely High Frequency.

I. INTRODUCTION

The various benefits of microstrip antennas such as small size, low profile, easiness of fabrication and conformability are major considerable factors for practical applications of them [1]. Because of easiness of simulation, microstripantennasare so popular for antenna designers. Todays, due to need for high speed data communications, existence of so many wireless systems in lower extremely high frequency band(EHF covers 30 – 300 GHz frequency range) and shortage of free frequency bands, paying attention to EHF frequency band is become progressively increased [2]. On the other hand, high attenuation of atmosphere in EHF frequency band in compare to lower band, increasing antenna gain is critical in these frequencies. So many efforts have been done for increasing bandwidth and gain of antennas and providing wideband high gain antennas in this frequency band [3]-[6].

In medicine, we use millimeter waves to detection and cure many diseases [7]. Moreover in military systems, EHF frequency band has more advantages rather than other frequencies, like more accuracy and less dependence on atmospheric conditions in compare of microwave and infra-red, respectively[8].

The dual wideband millimeter-wave microstripantenna is presented in this paper. Forunder standing the process of providing asymmetric antenna first we present wideband millimeter-wave microstrip antenna with symmetric patch and then for more increasing the bandwidth, parametric method were used to shift and optimize the patch of the antenna leading to displacement of patch and the feeding point. Finally, we achieve dual wideband antenna with asymmetric patchand improved gain.Finally, return loss, gain and VSWRresults are provided.

II. ANTENNA DESIGN

The proposed microstrip antenna is shown in fig. 1. The used substrate is RO4360G2 from Rogers company with dielectric constant of 6.15, loss tangent 0.0038 and thickness of 0.091 mm. The others characteristics are as bellow. W=3.5 mm, L=3 mm also the same copper patch and ground 0.017 mm (1/2 oz) are used.The feed line width W_f is 0.1 mmand feed length is L_f=1.76 mm, ground dimensions are W_g=2.5 mm and L_g= 1.2 mm.For convenience, other antenna dimensions are shown in table 1.It is notable that the patch shape same as yagi antenna.

In the next step for more increasing the gain and bandwidth, we shift patch 0.6 mm that leads to made asymmetric patch, as seen in fig. 1 (b).Please note the bottom side of the substrate which the ground in mounted is provided in fig. 1 (c). The antenna is single layer and overall dimensions are 3.5*3*0.091 mm^3.

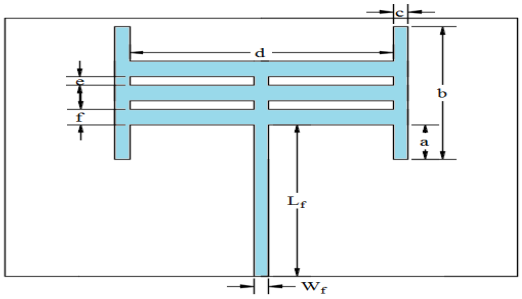


Fig.1(a)

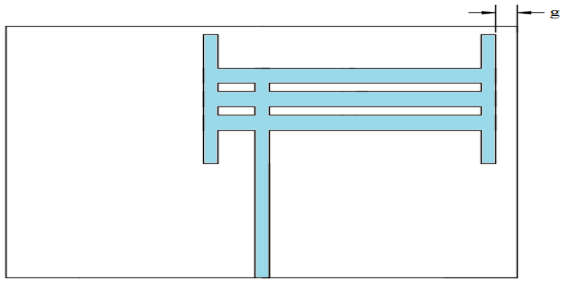


Fig.1(b)

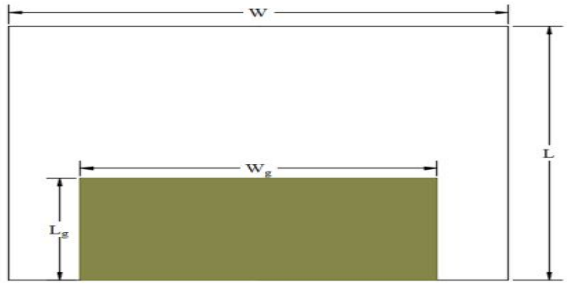


Fig. 1(c)

Fig. 1, (a) Top view of symmetric antenna,(b) Top view of asymmetric antenna, (c) Bottom view

a	b	c	d	e	f	g
0.4 mm	1.54 mm	0.1 mm	1.8 mm	0.1 mm	0.18 mm	0.15 mm

Table 1: Antenna dimensions

III. RESULTS AND DISCUSSIONS

The millimeter-wave antenna of fig. 1(a), has 22.66%bandwidth (152.6 – 191.6 GHz) with -26.43minimum return loss at 180.57 GHz while is the first resonant frequency is occurred in 163 GHz and the second one is placedin180.57 GHz.

Fig. 2 depicts the resonances of the proposed antenna. Here 158 GHz is the first resonant frequency and the second one is at 188.45 GHz. The resonant frequency in Ka - V frequency bands is at 39.7 GHz. Also, the max gain is 6.29 dB at 189 GHz.

Figs. 3, 4 show return loss and VSWR plots, respectively. The gain of the proposed antenna is depicted in fig. 5. The max gain is 5.58 dB at 190 GHz frequency and it belongs to asymptotic antenna.

In the next step we shift 0.6 mm antenna patch that leads to increase bandwidth, gain and also make dual resonance (fig. 1 (b)).

The antenna has main bandwidth of 28.12% (147.6-195.9 GHz) in mm frequency band and 10.51% bandwidth (38.28-42.53GHz) in Ka–V frequency bands with the minimum return loss of-25.97 at 158 GHz

The 3d simulated antenna gain at f=38.2 GHz is shown in fig. 6. The main bandwidth increase 9.3 GHz in asymmetric antenna, and also antenna has dual bandwidth, in compare with symmetric antenna. The minimum asymmetric antenna gain increase 1.17 dB in compare with symmetric antenna in main bandwidth.

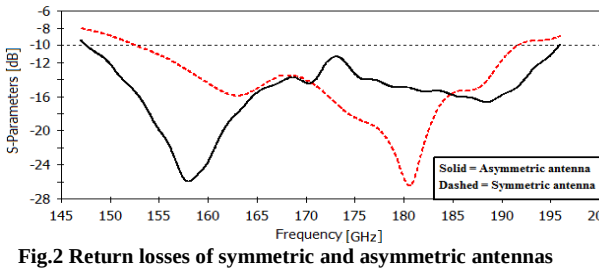


Fig.2 Return losses of symmetric and asymmetric antennas

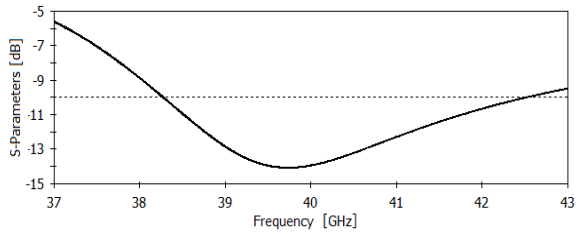


Fig.3 Return loss of the asymmetric antenna in Ka-V frequency bands

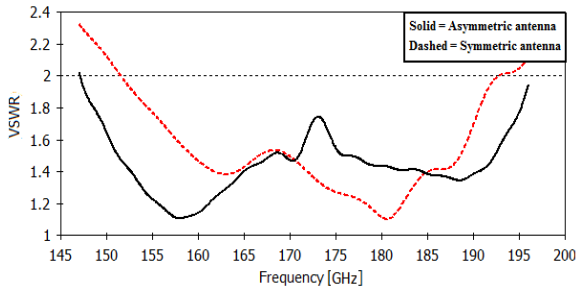


Fig.4 VSWR (symmetric and asymmetric antennas)

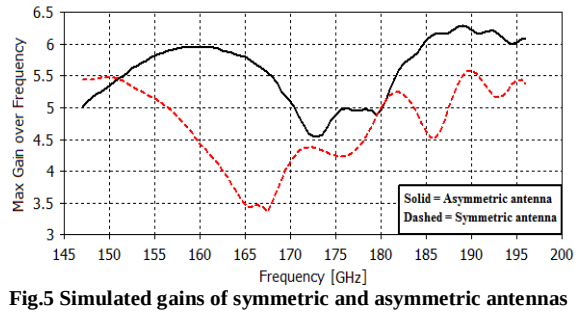


Fig.5 Simulated gains of symmetric and asymmetric antennas

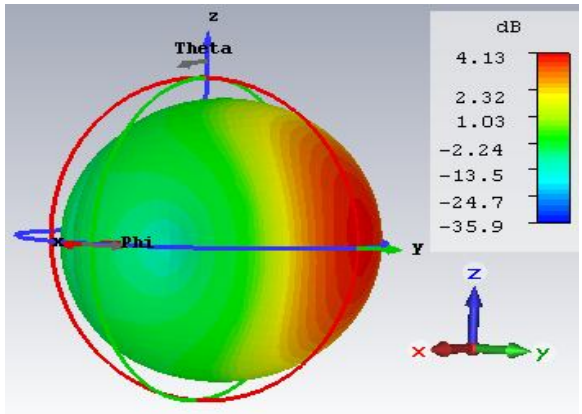


Fig.6The 3D simulated antenna gain at 38.2 GHz

CONCLUSIONS

Asymmetric dual widebandmicrostrip antenna is shown with bandwidth of 48.3 GHz (147.6 to 195.9 GHz) and 4.25 GHz (38.28 to 42.53 GHz) in extremely high frequency(EHF band)with three resonant frequencies. The maximum antenna gain is 6.29 dBat 189 GHz and minimum return loss is -25.97 at 158 GHz. Also, return loss, VSWR and gainplots are presented. Antenna dimensions are optimized with parametric method and the simulation is done with CST Microwave Studio simulator. The

presented antenna is desired for high-speed communications, millimeter wave scanner and military application.

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