Dual Hexa Plus Shape Penta Band Microwave Absorber For EMI/EMC Applications

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Abstract—An advanced, effective, and novel Penta band microwave absorber is presented in this paper. To improve the electromagnetic shielding in various bands' performance. This Penta band has a height of 1.77mm. The proposed absorber is designed to cover various targeted applications and especially Wi- max and satellite communication devices. This structure gives five transmission nulls and five reflection nulls at 2.45, 3.91, 6.42, 11.16, 1.62 with grate peak absorptivity of 94.2%, 93.0%, 95.0%, 99.5%, 98.1% respectively.

Keywords—Penta- band, Microwave Absorber, Electromagnetic shielding, Polarization-insensitive.

I.Introduction

In current wireless systems, the various frequenciesare used to communicate fluently and in this research paper we targeted five different bands with one novel dual Hexa absorber design that cover five frequency ranges with peak absorption the rapid growth of wireless electronic devices. Electromagnetic waves have been used as the barrier of information in civil-military aeronautical astronautical industries over the last decade.[1]Which causes interference in wireless communication devices that's whyusing electromagnetic interference shielding reduces the unwanted cause and increases the ability of the devices.[2]

In the field of wireless communication, the existence of electromagnetic wave interference (EMI) is reduced by microwave absorbers [3-5]. In this research paper's first frequency, we obtained 2.4 GHz which is stand in the range of the ISM band (2.400 GHz to 2.483 GHz).the ISM radio bands are portions of the radio spectrum reservedinternationallyfor industrial, scientific, and medical purposes, excluding applications in telecommunication. As we moving fast in the future with the wireless devices, we build a surrounding field of electromagnetic interference(EMI) and electromagnetic compatibility (EMC) so the author purpose this pentaband absorber as useful for effecting electromagnetic shielding.[6]and also while used for a long time the equipment heating because ofelectromagnetic wave interference (EMI) is not prevented and that problem is faced by every wireless device at high frequency, like frequency leakage of the signal. Sometimes signal gets back-reflected by the surround of the device. The reflected signals are in phasewith traveling signals at a certain frequency this will lead to an increase the energy. it produces EMI in the form of heat which affectsthe function of certain electronics equipment EMI effect can be avoided after microwave absorbers protect the closed media.[7] and also by creating a creative design that gives Penta band absorber.[8]and this purposed design give covers almost every local device which we use in everyday life like Wi-Fi and Wi max[9]and wide band application is covered by one investment that made easy to handle for security purposes as well in the defense and as well in banking equipment needs a secure connection[10]

II Design Geometry

The author proposed a pentaband microwave absorber. A proposed design is built on an FR4 substrate with relative permittivity of ε_r = 4.4 thickness (T_s)1.7mmand 0.025 loss tangent. Fig. 1 illustrated thedesignlike many microstrip bands is getting together for a which very attractive shape that handles five different frequency band capability structures which are placed on the metal-back dielectric substrate. The dimensions of the unit cell are 17x17 (mm^2). The thickness of the metallic strip and metallic ground plane is 0.035mm, the dimensions for the proposed structure are sl=17mm, ts=1.7mm, s=17mm, t=0.035mm, q=1.6mm, a=1mm, cut=4.2mm, w=0.86mm, o=7mm, side=6mm, w_1=0.9mm, u=6mm, z=5mm, y=6mm, j=0.5mm, e=6.3mm, d=0.8mm, J_1=0.7mm, f=0.5mm. Designsare specially chosen to work in S-band (2-4GHz), C-band (4-8GHz), X-band (8-12GHz), and Ku-band(12-18).

III. Simulation ResultsandDiscussions

The absorption principle of Absorberdepends on the effective medium parameters. Perfect absorption (100% or unity absorption) is achieved by individually regulating effective electric permittivity εeff(ω) and effective magnetic permeability μeff(ω) of the homogeneous structure.The absorption efficiency is the key parameter of Absorber and is defined by the equation

The absorptivity (A) is defined as,

$$A = 1- |S_{11}|^2-|S_{21}|^2$$

In the proposed structure $|S_{21}| = 0$,
$A = 1 - |S_1|^2$

TABLE DETAILS OF ACHIEVED ABSORBER RESONANCE

Resonance band No.	TE Mode Resonance frequency (GHz)	Absorption	TM Mode Resonance frequency (GHz)	Application band (GHz)
1	2.4	94.2%	2.4	Ism band (2.40-2.48 GHz)
2	3.91		3.91	Wi-Fi MAX and WLAN (2.5-5 GHz)
3	6.42	95.0%	6.42	Small capacity satellite communication (C band 4-8 GHz)
4	11.16	98.1	11.16	DBS downlink satellites 10.95GHz-12.75GHz
5	13.62	99.5	13.62	High-resolution mapping, satellite altimetry (12 to18 GHz)

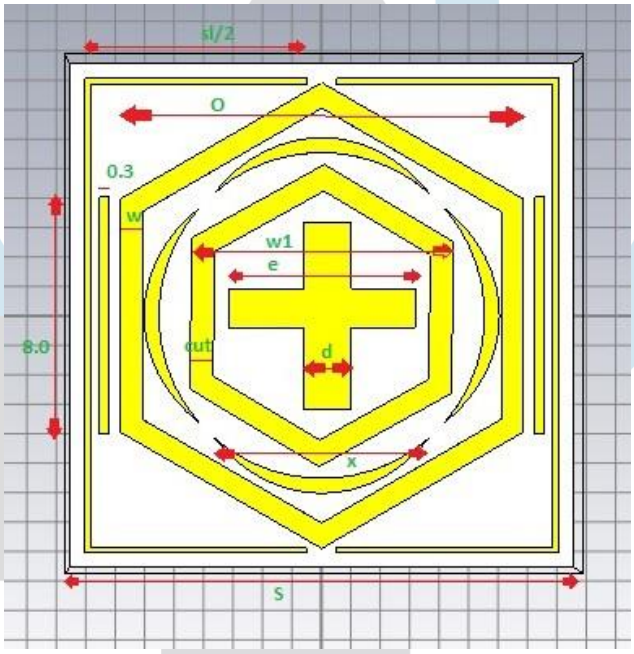


Fig. 1. The unit cell structure of the proposed pentaband microwave absorber

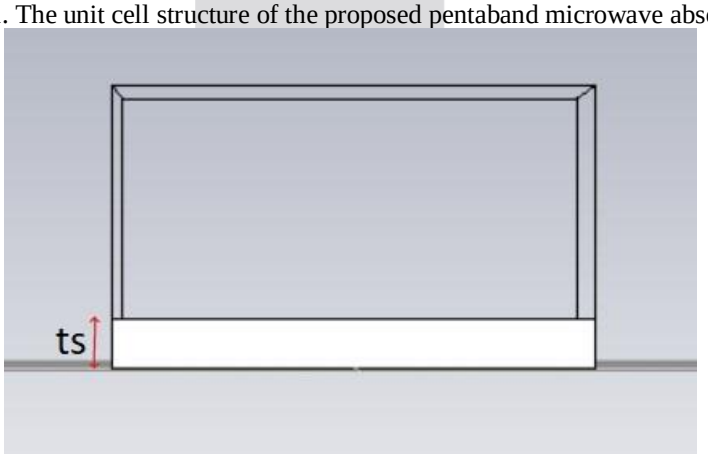
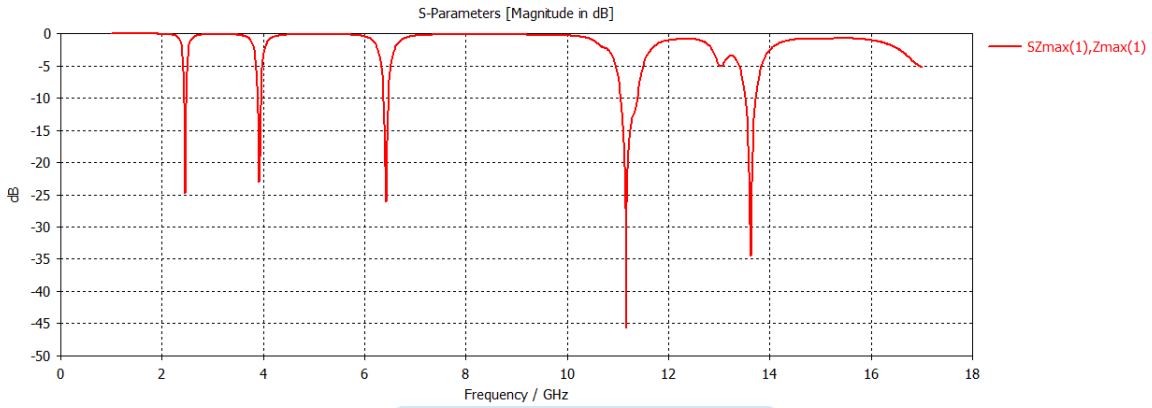
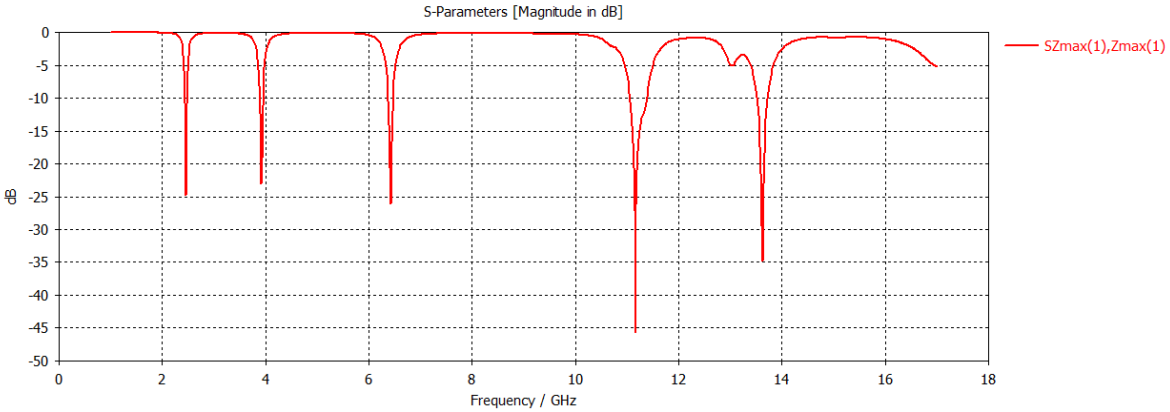


Fig. 2. Side view of the Absorber with a height of ts=1.6

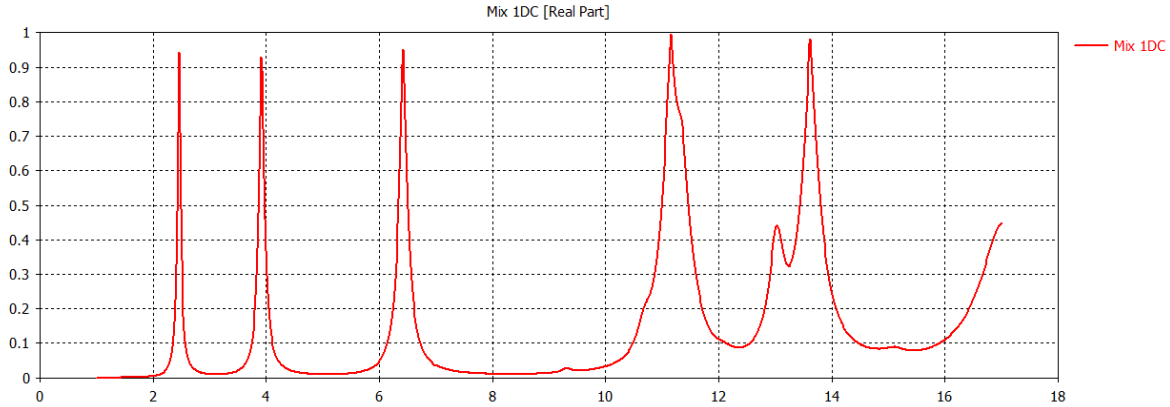


(a)



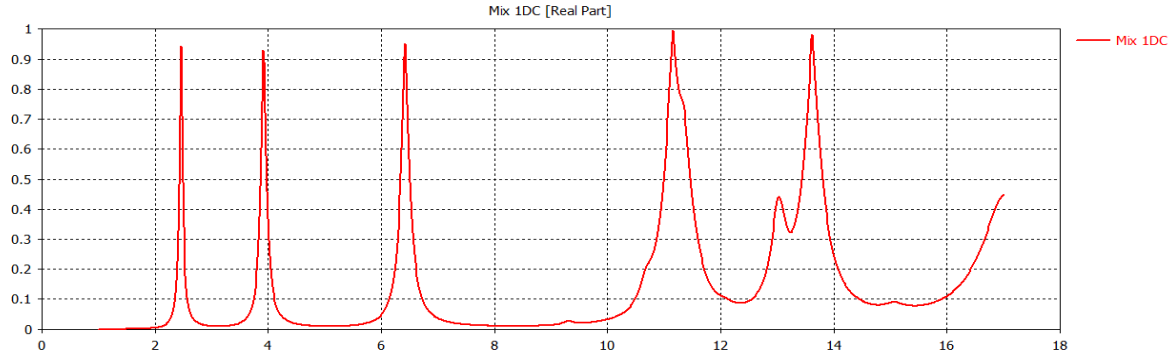
(b)

Fig. 3. Simulated$|s_{11}|$ response of the proposed pentaband microwave absorber under (a)TE polarization and (b) TM polarization



(a)

Fig.4. Simulated absorption response of the proposed pentaband microwave absorber under(a) TE polarization



(b)

Fig. 5. Simulated absorption response of the proposed pentaband microwave absorber under (b) TM polarization

III. Conclusion

In this proposed Penta- band absorber is designed to cover S-band C- band X -band and Ku -band and in the structure TE and TM mode of S11 are getting same due to its special design of engineering they cover a huge range from 2 GHz to 14 GHz from just one dual Hexa design microwave absorber and providing the peak 99.5% absorbability and that can be useful for effective electromagnetic shielding thus finding its application in electromagnetic interference (EMI) and electromagnetic compatibility(EMC) cases.

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