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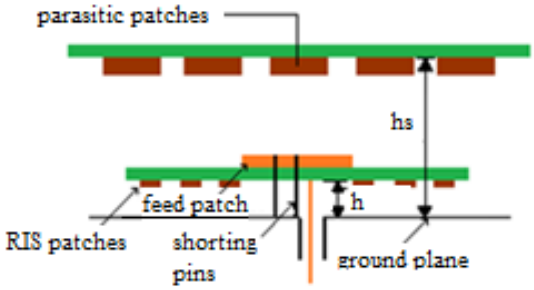
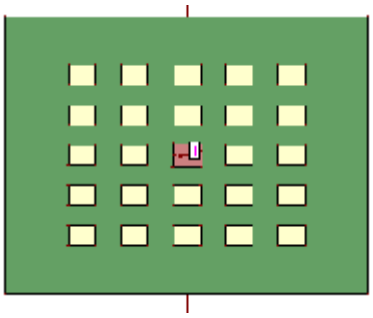


a) Side view



b) Top view

Fig.1 Geometry of antenna

The geometry of the proposed antenna structure is shown in Fig.1. The Microstrip antenna is fabricated on upper side of substrate FR4 and RIS is placed on bottom side of substrate FR4. The FR4 substrate is at 1 mm from ground. The parasitic patches are fabricated on the lower side of FR4 superstrate which is of thickness 1.59 mm and located at height of hs from ground plane. Relative permittivity and loss tangent of this superstrate is 4.4 and 0.02 respectively. In order to achieve high efficiency, air gap acts as a dielectric medium between superstrate and feed patch. A coaxial probe of 50Ω is used to feed MSA. The diagonal feed and two shorting pins along X axis on both side of the centre of MSA are used to achieve circularly polarized waves. The antenna is designed to operate over 5.725– 5.875 GHz ISM band. All dimensions mentioned here are in mm.

3. Analysis on infinite ground plane

Microstrip antenna is fabricated on upper side of substrate of thickness 1.59 mm and RIS is placed on bottom side of substrate. This substrate is at 1 mm from ground plane which is infinite and perfectly reflecting. The length and width of MSA is 14.3 mm and 14.7 mm respectively. MSA is fed diagonally at (3, 3.1). Circular polarization is achieved by using two shorting pins. This method also suppresses unwanted modes and helps to improve quality of circular polarization achieved. RIS consists of square patches of 3 mm with spacing of 1 mm. Array of parasitic patches are fabricated on lower side of superstrate layer of thickness 1.59 mm and it is placed at height of $\lambda_0/2$ from feed patch. The MSA dimension, MSA height, parasitic patch dimension, spacing between parasitic patches, shorting pin locations are optimized in order to improve gain of an antenna.

Variation of gain of MSA0 (superstrate with no parasitic patch), 1×1, 2×2, 3×3, 4×4 and 5×5 structures is shown Fig 2(a) and 2(b). Variation of axial ratio and VSWR of 3×3, 4×4 and 5×5 is shown in Fig 3 and 4 respectively.

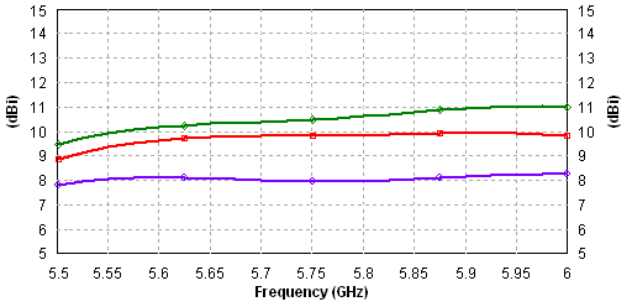


Fig.2 (a) Gain variations vs. frequency (MSA0, MSA 1x1, MSA 2x2)

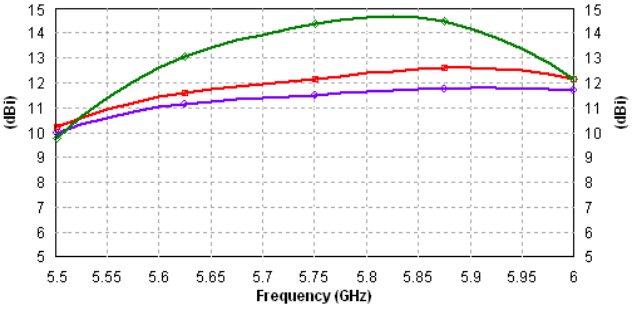


Fig.2 (b) Gain variations vs. frequency (MSA 3x3 MSA 4x4, MSA 5x5)

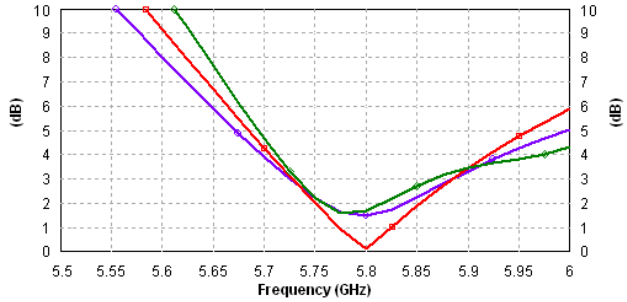


Fig.3 Axial ratio vs. frequency (MSA 3x3 MSA 4x4, MSA 5x5)

ISSN 2348 – 7968

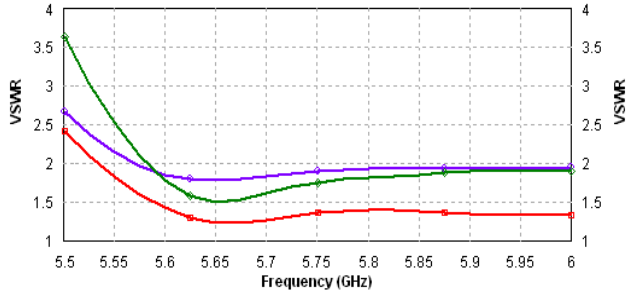
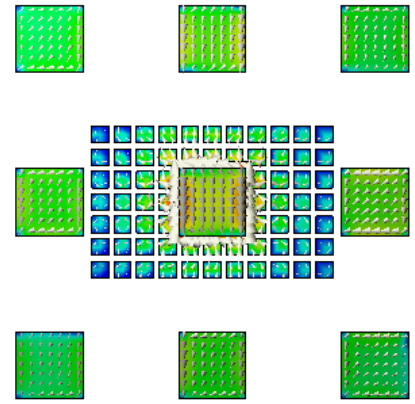
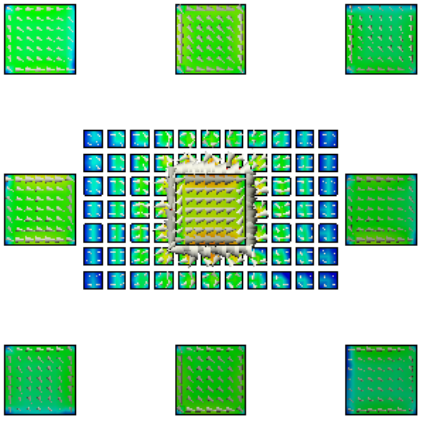


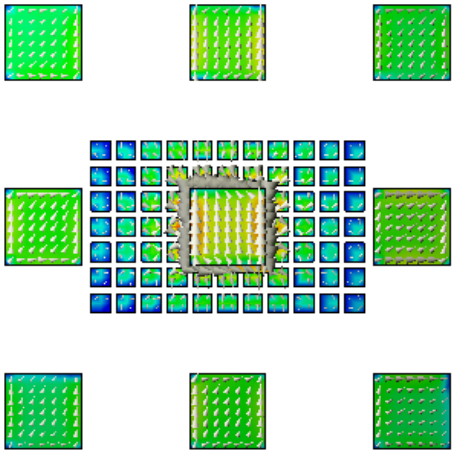
Fig.4 VSWR ratio vs. frequency (MSA 3x3 MSA 4x4, MSA 5x5)



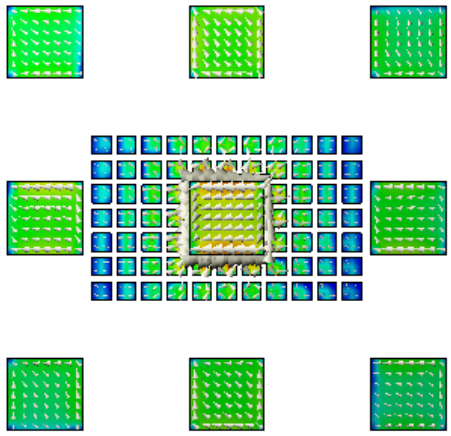
a) t = 0



b) t = 0.25T



c) t = 0.5T



d) t = 0.75T

Fig.5. Current distribution of 3x3 array structure at 5.8 GHz

Average and vector current distribution at the feed, parasitic patches and RIS at 5.8 GHz at different time that is at t = 0, t = 0.25T, t = 0.5T, t = 0.75T is shown in fig.5. Here T is time period of the wave at central operating frequency 5.8 GHz. From current distribution, it is clear that the fields rotate clockwise by 90° in order to produce right handed circular polarization. The amplitude of current induced in parasitic patches is nearly in phase and decrease as its distance from feed element increases.

4. Conclusion

High gain right hand circularly polarized microstrip antenna is proposed here. The feed patch is placed in fabry perot cavity to increase the gain. The gain is further

ISSN 2348 – 7968

improved by using RIS layer which also reduces size. Gain increases as we increases the size of array of parasitic patches on superstrate layer. The proposed antenna can be used for satellite and terrestrial communication.

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