Study of Dual-band Circularly Polarized Microstrip Antenna

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***Abstract* — A new dual-band circularly polarized microstrip antenna is presented. In this paper, the proposed dual-band antenna is designed by dual-radiator. The frequency ratio (higher frequency over lower frequency) is quite flexible (more than 1.4).**

I. Introduction

Because the parameters of a dual-band circularly polarized (CP) antenna are more than those of dual-band linear polarized antenna, the difficulty is more than dual-band linear polarized antenna. Dual-band CP operation has many categories such as microstrip antenna with slot perturbation [4.1] [4.2], dual-feed traveling wave antenna [4.3], p-i-n diode control antenna [4.4], dielectric resonator antenna (DRA) and microstrip antenna combination type [4.5]. However, due to the limitation of structure such that variance of frequency ratio is not flexible. In opposition, the design of dual-feed and dual-radiator can make flexible variance of frequency ratio. On the one hand dual-feed can be transferred to one feed via a duplexer; on the other hand the two signals of dual-feed are conducted to the two ports of the radio frequency integrated circuit (RFIC) directly if the RFIC has two ports for different frequency signal. In this paper, we present a dual-band circularly polarized antenna by two new miniature techniques. Details of the proposed dual-band circularly polarized antenna are described, and experimental results of the proposed antenna are presented and discussed.

II. Antenna Geometry

Fig. 1 shows the proposed dual band circularly polarized antenna, which consists of two compact CP antennas with different minimized techniques. In Fig. 1, the dual-band antenna consist of two radiators which one is outer radiator (feeding by port 2) of using shorting pin antenna with large slot the other is inner radiator (feeding by port1) of miniaturized microstrip antenna with capacitors.

The operation frequency can be decreased by means of that arrange a square slot at center of microstrip antenna with truncated corners. However, the matched feed point on longer locate in the square-ring patch if inner side length L2 larger than 1/3 outer side length L2 [6]. In this paper, the right-up corner of the radiator be shorted by shorting pin and thus the matched feed point can be moved to approach outer edge. The matched feed point steel present at patch as inner side length L2 equals 1/2 outer side length L1.Microstrip antenna has very low intensity of radiation at plane of radiator (x-y plane). By this reason, a miniaturization antenna can be arranged at center of square-ring antenna owing to their less mutual influence. Capacitors are added at four corner-truncated and to use capacitance a square miniaturization antenna. The side length of square miniaturization antenna with capacitors L5 is 21mm, side length of upper-left and lower-right truncated corner is 2.5mm and side length of upper-right and lower-left truncated corner is 3.3mm. A dual-feed and dual-band CP antenna with very flexible frequency ratio is implemented by collocating a square ring antenna with large inner square slot and a miniaturization antenna with capacitors. The port A is for right-hand CP and port b is for left-hand CP operation.

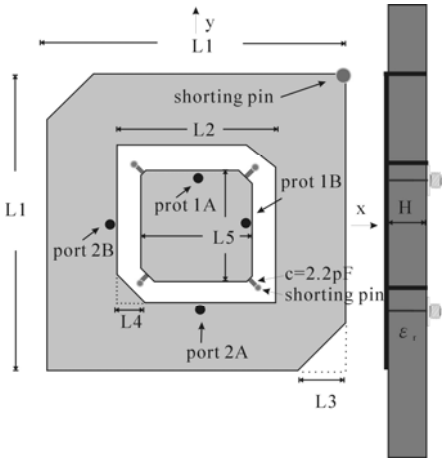

Fig. 1 Geometry of the proposed dual band circularly polarized microstrip antenna

III. Experimental Results

Fig. 2 shows the measured S parameter, S11 at 10dB impedance bandwidth is about 34MH (the bandwidth around 2% at 1715MHz), S22 at 10dB impedance bandwidth is about 27MHz (the bandwidth around 2.2% at 1228.5MHz). S21 at lower band is around -20dB; at higher band is around-15dB. Fig. 3 is smith chart. Fig. 4(a) is the x-z plane pattern when antenna is fed by port1 and port2 is connected 50 ohm for matching. Fig. 4(b) c is the pattern when antenna is fed by port2 and port1 is connected 50 ohm for matching. In Fig. 5, the 3dB axial ration bandwidth at higher frequency is around 7.5MHz

(0.44% at 1717MHz) and at lower frequency is around 7MHz (0.57% at 1235MHz).

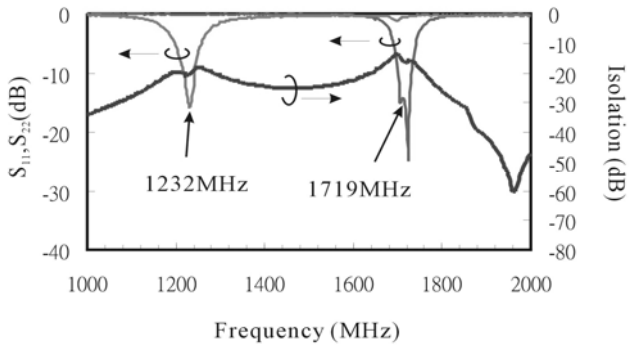

Fig. 1. Measured S parameter for this dual band CP antenna

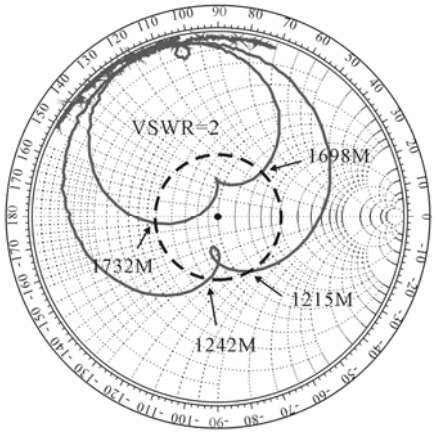

Fig. 3 Smith chart of dual band CP antenna.

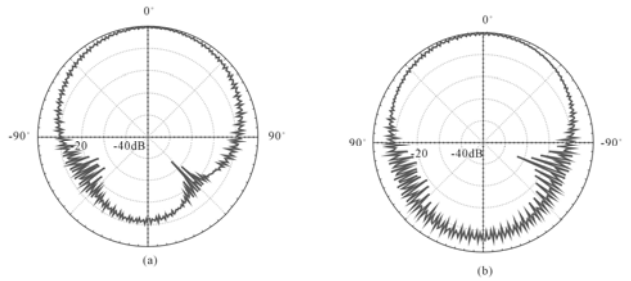

Fig. 4 Measured radiation patterns for dual band CP antenna at two operation frequencies
(a) port1-1713 MHz (b) port2-1235 MHz

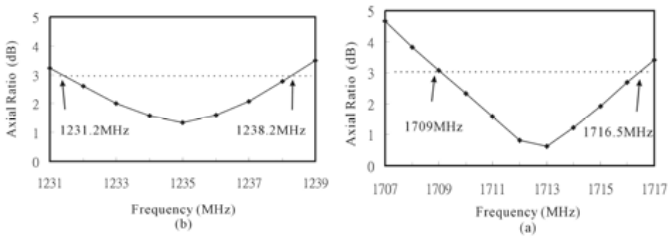

Fig. 5 Measured axial ratio for CP antenna at two operation frequencies.
(a) Port 1 (b) port 2

IV. CONCLUSION

A new dual-band circularly polarized microstrip antenna with dual probe feeds has been implemented. The proposed dual CP design has very flexible frequency ratio (more than 1.4) by way of new minimization techniques and it has good measured result on return lose, pattern and axial ratio. A more intensive study is being carried out.

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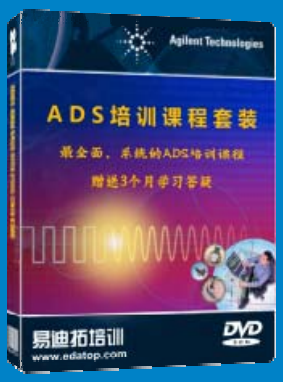

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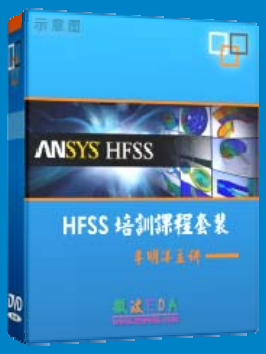

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