Study of Microstrip Circuitry Band Pass Filter Designed for Planar Patch Antenna

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Abstract: A microstrip band pass filter circuit presented can be used to regulate the characteristic of the planar antenna. In this article, a simple rectangular slot radiator is used to depict the function of the microstrip band pass filter circuit designed for a proposed patch antenna. [The Journal of American Science. 2007;3(1):88-92].

Keywords: SWR, microstrip circuit, equivalent circuit

1. Introduction

The characteristic of microstrip circuit can regulate the patch antenna. Design a coupling microstrip circuit connecting the signal source to radiator can control the receiving and transmitting function of microstrip antenna [1]. Size and shape of the patch antenna are important parameters for design. The equivalent circuit of microstrip presented in transmission line model can re-establish the Kirchhoff's rules of being determined size and shape parameters of a patch antenna. However, it is very difficult to construct the circuit due to the characteristics of the distributed microstrip elements being coupled to the antenna. The dilemma exists in both Thevenin and Norton equivalents [2]. In this article, we proposed a patch antenna including a microstrip band pass filter circuit and a simple rectangular slot radiator as the loading device for the circuit via a short transmission line in connection to radiator [4, 5, 6, 7]. The microstrip circuit functions to regulate the patch antenna with keeping the characteristic of the microstrip circuit. Prototype antenna is constructed

2. Configuration

Figure 1 shows photo of the top view of the proposed microstrip circuit. In Figure 2, the photo of the proposed patch antenna depicts a circuit with three components, connecting path and a copper metal radiator. As shown in the figure, the filter circuit via path connecting to the metal radiator can be analyzed by using transmission line mode

3. Results and Discussion

The proposed antenna is depicted in Figure 1. The thickness and dielectric constant of the FR4 plate are indicated d = 0.4 mm, ε_r = 4.4. Figure 2 depicts the return loss of the measurement of the antenna including microstrip strip circuit coupled to a major metal radiator as loading device. Figure 3 depicted the prototype of the design constructed. Figure 4 demonstrates the field-patterns of the antenna, including radiator and the microstrip circuit impedance matching regulator, that the filter circuit via path being connected to radiator. The presence of the forward and backward scattering current driven by filter circuit delivers the excitation power via path for the modes of resonances of the metal radiator. In Figure 5, the gain of the proposed antenna is depicted. The filter circuit can improve the impedance matching and select 3.55 GHz in S band as well as reducing XPL at elevation plan. Moreover, at other available operating frequencies, we can observe much better omnidirectional field pattern and reduced XPL (not shown in figure).

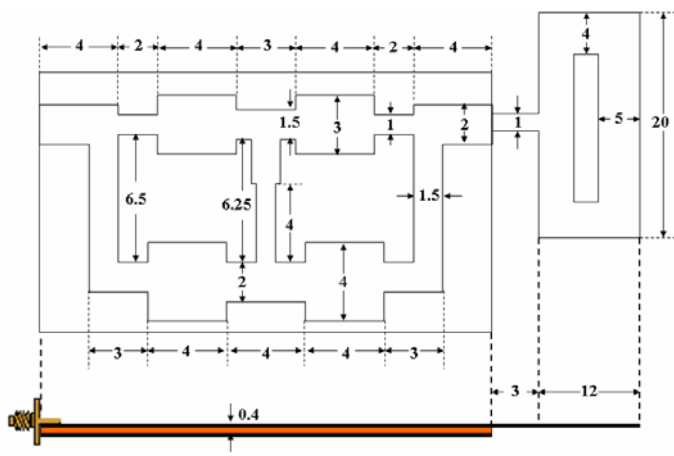

Figure 1. Size and shape parameters of the patch antenna

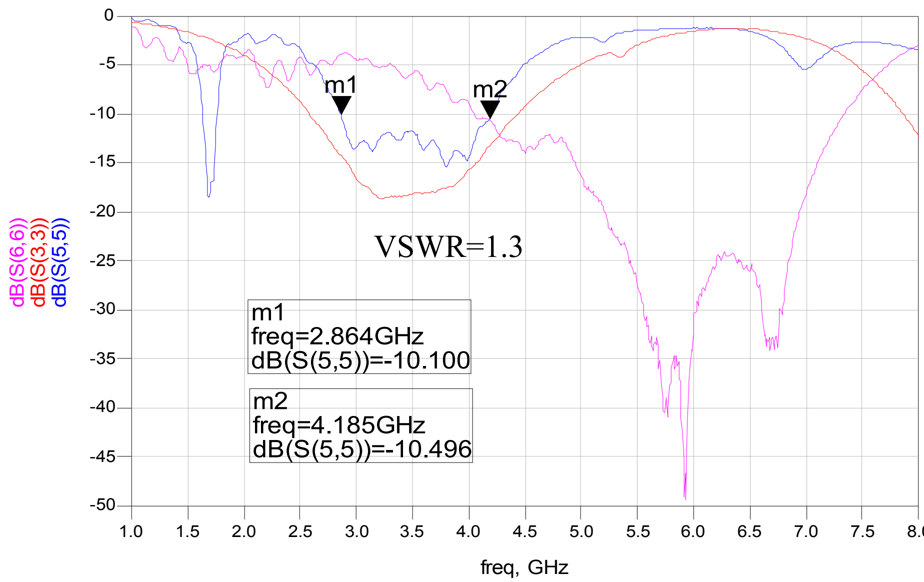

Figure 2. Measurement of the Return Loss. The impedance matching of the metal antenna at 3.5GHz is shown being improved by coupling to microstrip circuit regulator.

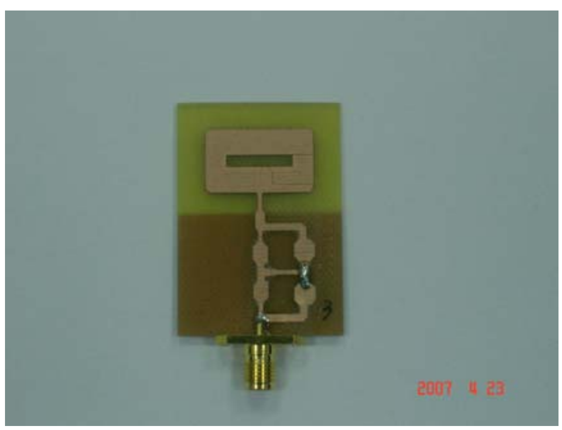

Figure 3. Prototype of the proposed antenna design

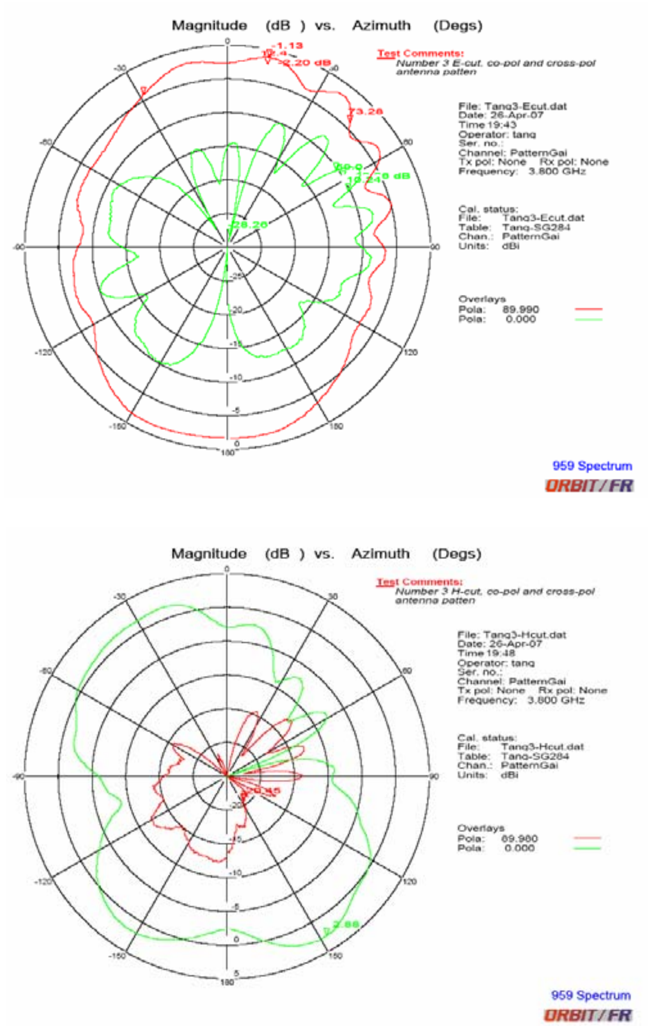

Figure 4. The measured radiation pattern at 3.8 GHz

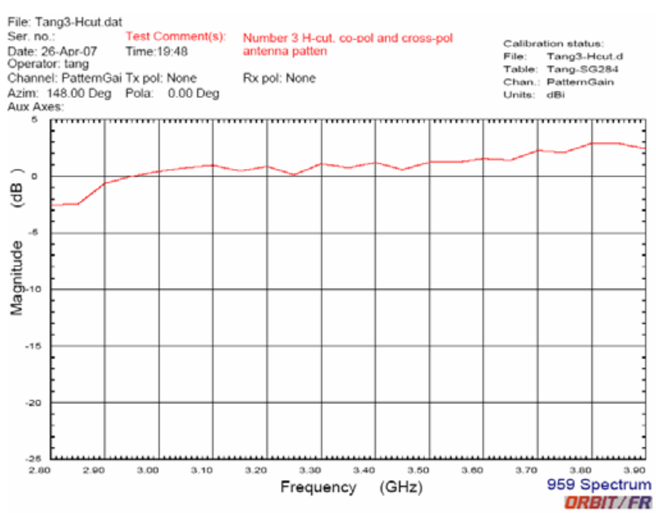

Figure 5. Fixed antenna Gain for the prototype design

4. Conclusion

The proposed antenna with a functional microstrip filter circuit via transmission line coupling to metal radiator can be used to select available frequency-bands for carrying out specific gain for the mobile system, for instance, in space shuttle or WiMAX consideration. Under the conditions of least impedance matching, the optional design of the filter circuit can be conducted to satisfy the specification for the users.

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References

1. KL Wong, Planar antennas for wireless communications, Chapter 5~7, John Wiley & Sons, New York, NY.2003
2. JV Bladel, " On equivalent circuit of a receiving antenna ," IEEE Antennas and Propagation Magazine, vol.44, No.1, pp164~165, February, 2002
3. KL Wong, CH Wu and FS Chang, "A compact wideband omnidirectional cross plate monopole antenna," Microwave and Optical Technology Letters, vol.44, No.6, pp492~494, March 20, 2005
4. JP Kim, "Analysis and equivalent circuit of aperture-coupled cavity-fed microstrip patch antenna," Microwave and Optical Technology Letters, vol.48, No.5, pp843~846, May, 2006
5. AW Love," Comment : On equivalent circuit of a receiving antenna," IEEE Antennas and Propagation Magazine, vol.44, No. 5, pp124~125, October, 2002
6. JV Bladel, " On equivalent circuit of a receiving antenna ," IEEE Antennas and Propagation Magazine, vol.44, No.1, pp164~165, February, 2002
7. TW Chiou and KL Wong, "Designs of compact microstrip antennas with a slotted ground plan," 2001 IEEE Antennas Propagat. Soc. Int. Symp. Dig., pp732~735