Tri - band Rectangular Microstrip Patch Antenna

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Outline

- Background
- Introduction
- Design Procedure
- Results
- Conclusion

Background

Rectangular patch, Microstrip patch antenna, via feed, tri-band.

Rrectangular tri-band patch antenna that is fabricated and measured for wireless communication systems. The introduced antenna is designed for WLAN and WiMAX applications.

The multiband antenna was dedicated by many publications, most designs for multi band planar antenna is for dual-band operation (Wong, 2002, Chen, 2003, Yand, 2003).

Introduction

Microstrip or patch antennas are becoming increasingly useful because they can be printed directly into a circuit board. Microstrip antennas are becoming very widespread within the mobile phone market. Patch antennas are low cost, have a low profile and are easily fabricated [1].

Radar systems have been used for various applications such as monitoring and remote sensing. Radar remote sensing techniques have become interesting to researchers. Ultra Wideband radar system based on the transmission of short duration pulses [2].

[1] D. Nalbantoglu and A. Yanik, “A multi-band rectangular patch antenna for wireless communications”, 2004.

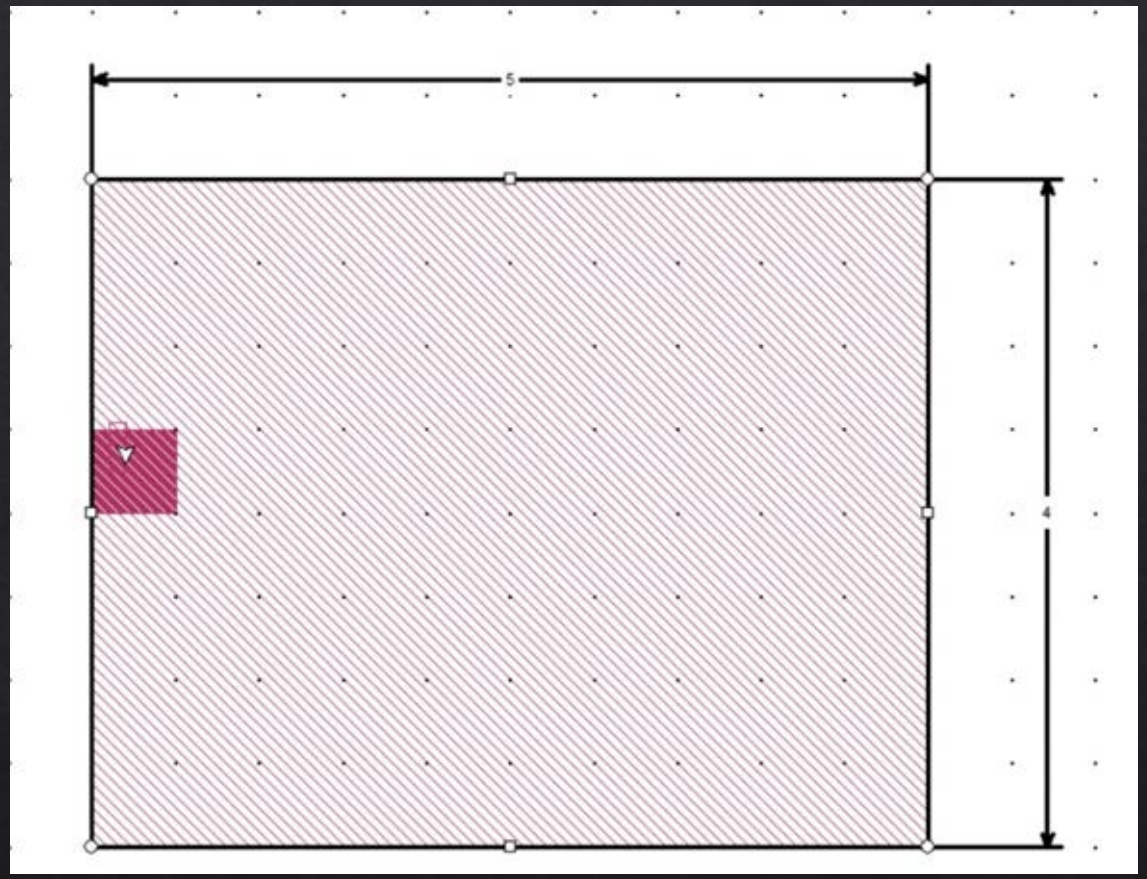
[2] "Intelsat, SES, Eutelsat and Telesat Establish the C-Band Alliance (CBA), a Consortium to Facilitate Clearing of U.S. Mid-band Spectrum for 5G While Protecting U.S. Content Distribution and Data Networks" (Press release). SES. September 27, 2018. Retrieved November 2, 2018.

A proper selection of the patch parameters (length, thickness, shape, feed point position and method) and shorting-pin position will excite desired bands. Shorting pins change the field distribution and provides inductive loading to the patch and hence changes its resonance frequency.
An antenna both transmitting and receiving the pulse wave. The last element is designed to radiates and receiving a signal carrying an information to be processed. [3].

[3] Mcewan T.E. Ultra-Wideband Radar Motion Sensor. 5,361,070. US Patent. 1994 Nov 1;

Design Procedure

The geometry and the top view of the antenna is shown. The size of the antenna is 4.8×4.1 cm. The antenna is designed by Rogers RT5870 with thickness of 0.287 mm. The feeding of the antenna is located at the left edge with a rectangular modeled and simulated via. This geometry is simple, based on it cost will be low. Via can help us to use lowest memory. The design of a low profile, wide band multiband patch antenna is very complicated. The fact is that the lowest antenna profile, the widest impedance bandwidth.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Results

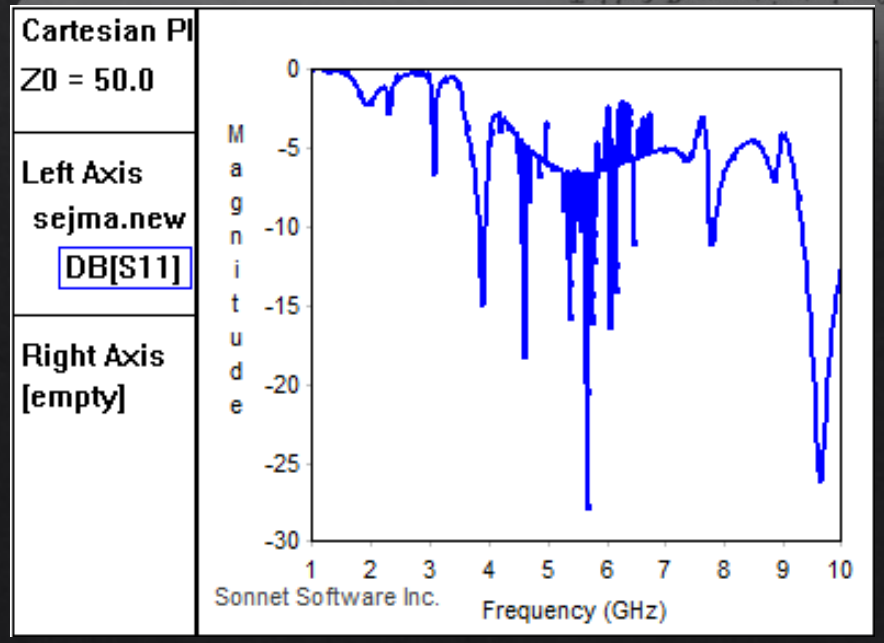
The antenna is modelled and analyzed using Sonnet Suites. The gain values at different operating frequencies are tabulated in Table 1 and 2. Table 1 and 2 proves the fabrication tolerances of the antenna is good enough. Picture has the input match of the antenna.

DIELECTRIC THICKNESS cm	FREQUENCY GHz	GAIN dB	S11 dB
0.275	3.80	5.03	-7.17
0.290	3.85	6.55	-17.76
0.295	3.86	6.49	-18.60
0.300	3.83	6.71	-16.25

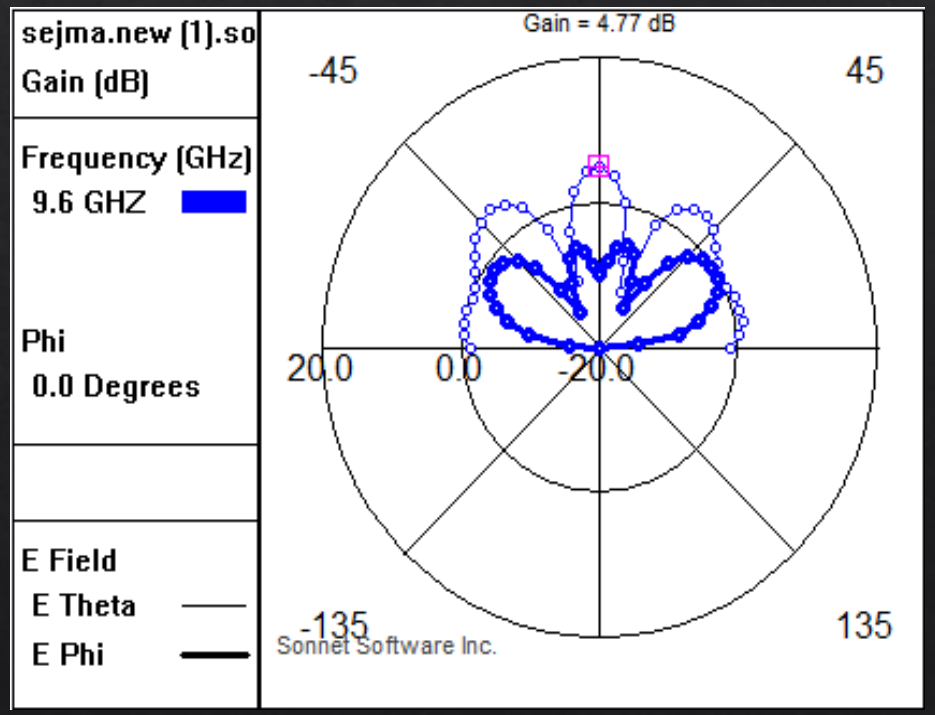
Table 1. Parametric study of changing the dielectric thickness

DIELECTRIC CONSTANT	FREQUENCY GHz	GAIN dB	S11 dB
2.17	3.98	7.52	-15.29
2.20	3.92	7.19	-16.79
2.25	3.95	6.49	-14.23
2.27	3.91	6.85	-16.03

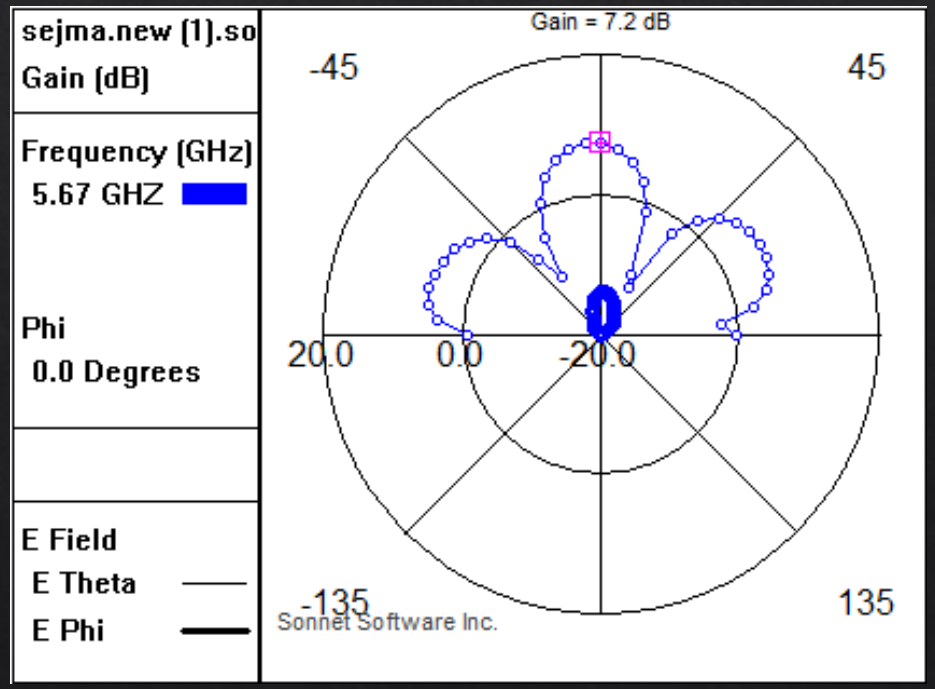
Table 2. Parametric study of changing the dielectric constant



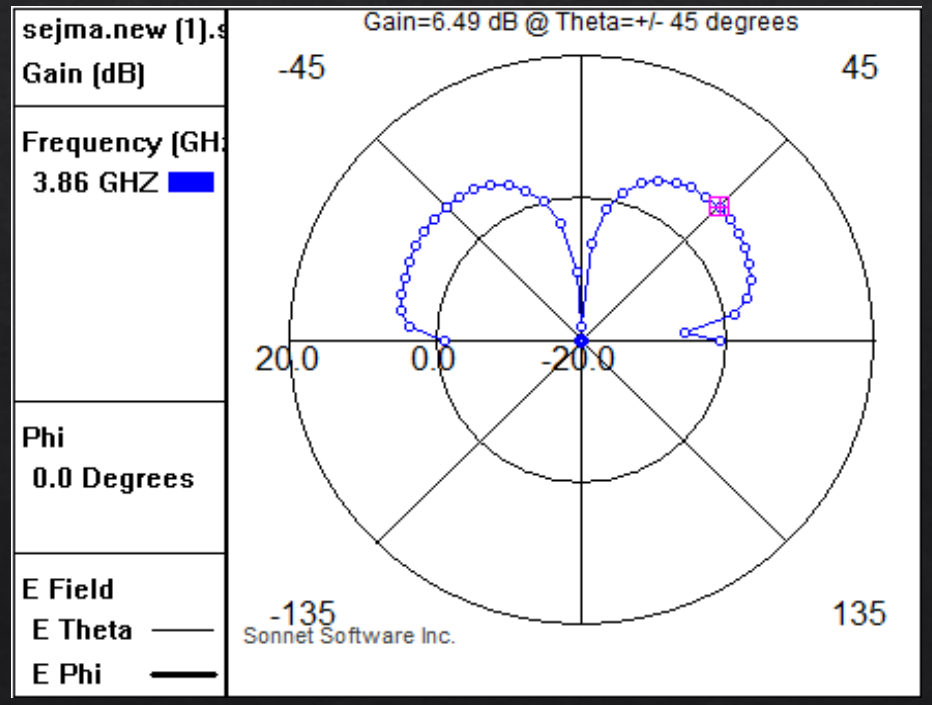
The gain has three spot beams at $\theta = 0$ degrees and ± 40 degrees.
While cross polarization is a bit high.



As it is seen in picture the gain has three spot beams at $\theta = 0$ degrees and ± 70 degrees.
Also, gets very low cross polarization.



Picture shows the gain pattern of two wide beams at $\theta = \pm 45$ degrees.
Also, gets very low cross polarization.



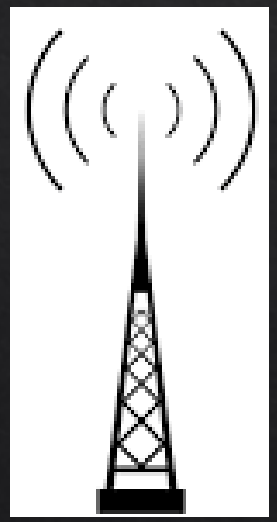
Conclusion

Rectangular patch antenna with simple geometry and tri resonances were presented. A parametric study was conducted to see the changes in dielectric thickness and the dielectric constants. Those results were shown in Tables and ensures that fabrication tolerances of the antenna is inacceptable levels. According to simulation results, the antenna operates between 3.86 and 9.6 GHz. Resonance frequencies are 9.6 GHz, 5.67 GHz, 3.86 GHz. Gain for those values are 6.49 dB, 7.2 dB and 4.77 dB. Next step is fabrication of the antenna.

References

1. D. Nalbantoglu and A. Yanik, “A multi-band rectangular patch antenna for wireless communications”, 2004.
2. "Intelsat, SES, Eutelsat and Telesat Establish the C-Band Alliance (CBA), a Consortium to Facilitate Clearing of U.S. Mid-band Spectrum for 5G While Protecting U.S. Content Distribution and Data Networks" (Press release). SES. September 27, 2018. Retrieved November 2, 2018.
3. Mcewan T.E. Ultra-Wideband Radar Motion Sensor. 5,361,070. US Patent. 1994 Nov 1;
4. T. Imeci and A. Saral, Corners Truncated Microstrip Patch Antenna, Haliç University, Department of Electronics and Communication Engineering, ACES, Tampere, Finland, 2010.
5. M. A. Layegh, C. Ghobadi and J. Nourinia, “The optimization design of a novel slotted microstrip patch antenna with multi-bands using adaptive network-based fuzzy inference system”, 2017.

Thank you for your attention!



“Impossible is just an opinion.” – Paulo Coelho