A Novel Design and Development of Square Microstrip Antennas by Truncation and Slot Loading Techniques

Channabasamma[1] Dr. Kishan Singh[2]
[1,2]Department of Electronics & Communication Engineering
[1,2]Guru Nanak Dev Engineering College Bidar Karnataka, India

Abstract— A novel design of square microstip antenna for single and triple band operation is shown here. The single band with 5.73% bandwidth is achieved by truncating the corners of square patch. The triple band operation is achieved placing the H-slot in the square microstrip antenna with a bandwidth of 3.3%, 3.9% and 6%. These antennas may find applications in microwave communications systems.

Keywords: Antennas, Square Microstrip Antenna, Single, Triple band, Bandwidth, Microwave

I. Introduction

Antennas plays a very important role in any communications systems, without antennas any communications is not possible, If we consider any type of communications like radar, satellite, wireless etc every were antenna is needed so in any sort of communications antenna is must and needed. There are various types of antennas in day today life but among all antennas the microstrip antennas are very special because of so many merits like low cost, easy to handle, fabrication is very simple etc. There are some many types of microstrip antennas like rectangular, circular, elliptical, square etc. and these microstrip antennas can be design by so many techniques and can be used for various applications. Many researchers have shown the techniques in the literature like aperture, proximity, slot, truncations, stubs etc. These microstrip antennas are feed with various feeding techniques like microstripline feeding, probe feeding, coaxial feeding etc. So in this paper the square microstirp antennas is design at 3.5 GHz with microstrip line feeding and truncating the comers of the square patch and inserting the H-slot in the patch is shown here. These antennas are simulated by using the software HFSS.

II. Description of Antenna Geometry

The conventional square microstrip antenna is design at the frequency of 3.5 GHz using the substrate thickness 0.16 cm with the relative permittivity of $\varepsilon r = 4.2$. The length and width of square patch is calculated by using the equations given in the literature (1-2). The patch is provided with microstripline feeding to feed the power. To match the impedance between patch and feedline a quarter wave transformer is connected. The length and width of same is also calculated by the basic equation given in the literature (1-2). The geometry is as shown in the below fig. 1 named as conventional square microstrip antenna (CSQMA).

The study is carried out by truncating the corners of CSQMA. In this geometry all the four corners are truncated by 0.2 cm. It is named as corner truncated square micosrtrip antenna (CTSQMA). The geometry of CTSQMA is as shown in below fig. 2.

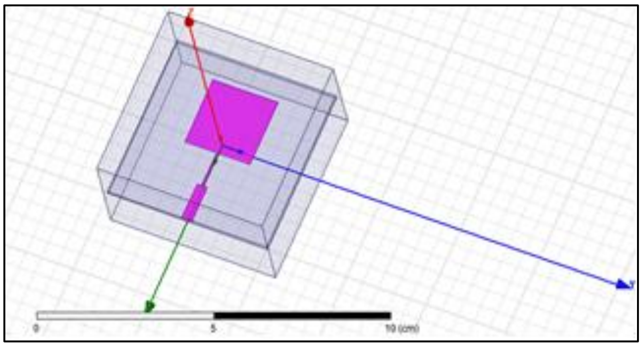

Fig. 1: Geometry of CSQMA

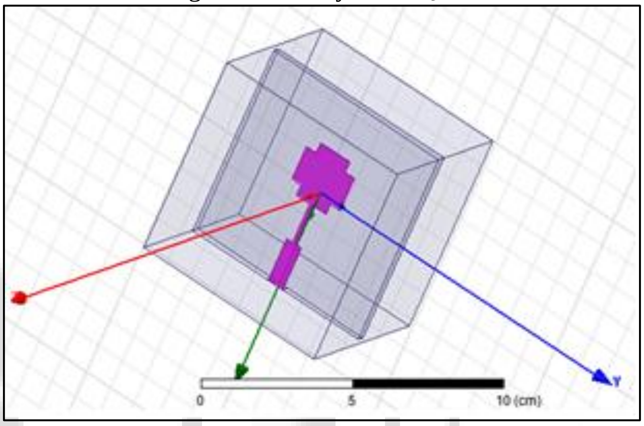

Fig. 2: Geometry of CTSQMA

Further by taking same antenna CQSMA the antenna is design by placing the H slot in the patch and the antenna is named as H-Slot square microstrip antenna (HSQMA). The antenna geometry is shown in below fig. 3.

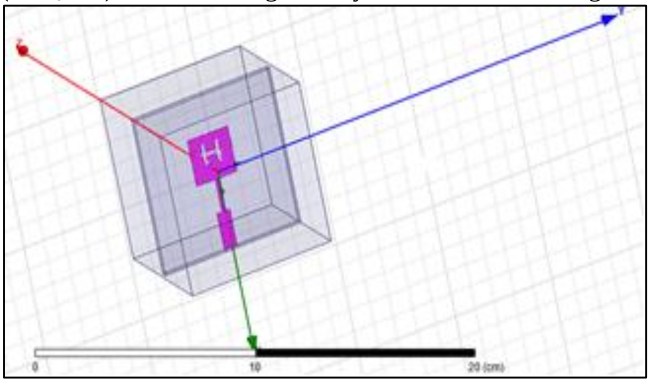

Fig. 3: Geometry of HSQMA

III. Experimental Result

The CSQMA is simulated with the help of HFSS Software and the result of variation of return loss vs frequency is as shown in below fig. 4. From this figure it seen that the antenna is resonating at 3.5 GHz which is the design frequency of the antenna. The bandwidth achieved for this antenna is 2.58% and calculated by using the equation given in the literature. [4].

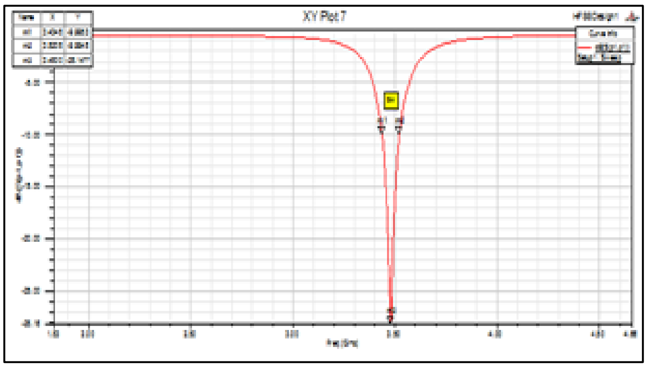

Fig. 4: The variation of return loss versus frequency of CSQMA

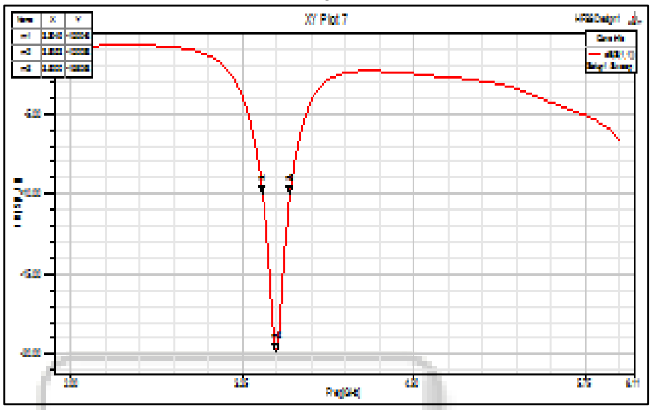

Fig. 5: The variation of return loss versus frequency of CTSQMA

The variation of return loss vs frequency of CTSQMA is as shown in below fig.5, from this figure it is seen that, when the antenna is truncated the antenna is achieving the bandwidth of 5.73% with a return loss of -19.8 dB.

Further the study is carried out by placing the H-slot in the CSQMA and the variation of return loss vs frequency of this antenna is shown in fig. 6. From this figure it noted that the antenna is radiating for triple band operation by giving the bandwidth of 3.3%, 3.9%, 6% and with a minimum return loss of -23.42 dB,-19.27 dB and -30.46 dB respectively [5].

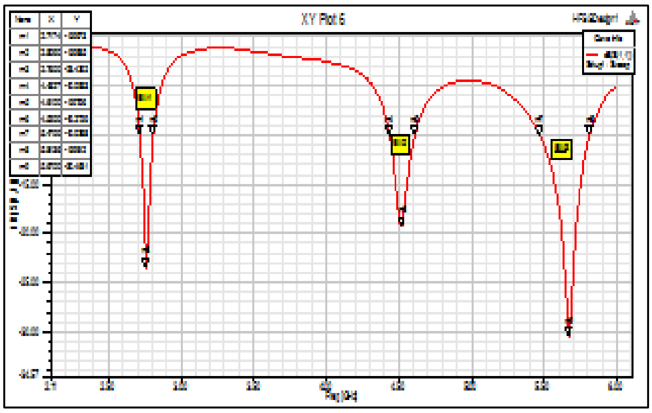

Fig. 6: The variation of return loss versus frequency of HSQMA

Figures 7 and 8 it is seen that the co and cross-polar radiation patterns of CSQMA and CTSQMA are broad sided in nature.

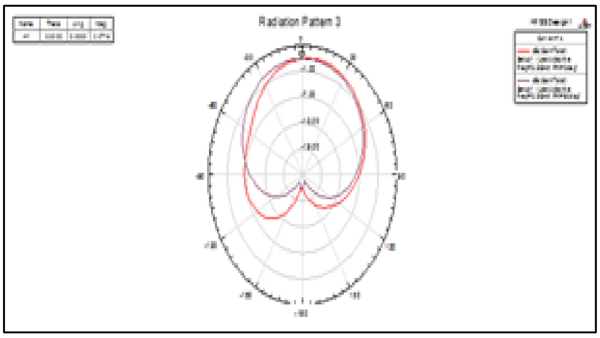

Fig. 7: Radiation Pattern of CSQMA

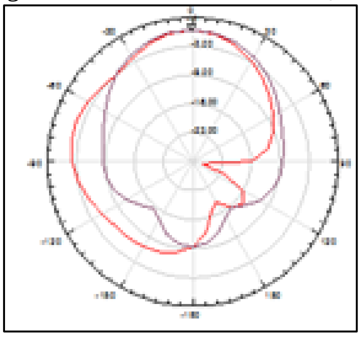

Fig. 8: Radiation Pattern of CTSQMA

IV. CONCLUSIONS

From the detailed study it is concluded that, the CSQMA is design at 3.5 GHz. When the CSQMA is truncated it is radiating for single band and having the bandwidth of 5.73%. Further the study is extended by pacing the H-slot in the CSQMA and the antenna is radiating for triple band with the bandwidth 3.3%, 3.9%, 6%. These antennas are having broad side radiation characteristics and may find applications in microwave communication systems.

REFERENCES

[1] John D. Kraus, Antennas for All Applications, (Mc Graw-Hill, New Delhi), 2006.
[2] Contantine A. Balanis, Antenna theory analysis and design. John Willey & Sons, Inc., New York, 1982.
[3] Kin lu wong, Compact and Broadband Microstrip Antenna. John Willey & Sons, Inc., New York, 2002.
[4] Kishan Singh,N. M. Sameena, R. B. Konda and S. N. Mulgi, “Design and development of dual band square microstrip antennas and effect of corner truncation on the operating bandwidth”, International Journal of Electronics, Engineering,vol. 2, no. 2, pp. 239-243, Dec. 2010.
[5] Kishan Singh, R. B. Konda, N. M. Sameena, and S. N. “Design of square microstrip antenna for dual abnd operations antenna for dual operation”, MicrowaveOpt. Technol. Lett Vol. 51 No. 11 Nov. 2009.