Abstract—Recently, several designs of single fed circularly polarized microstrip antennas have been studied. Relatively, a few designs for achieving circular polarization using triangular microstrip antenna are available. Typically existing design of single fed circularly polarized triangular microstrip antennas include the use of equilateral triangular patch with a slit or a horizontal slot on the patch or addition a narrow band stub on the edge or a vertex of triangular patch.

In other word, with using a narrow band tune stub on middle of an edge of triangle causes of facility to compensate the possible fabrication error and substrate materials with easier adjusting the tuner stub length. Even though disadvantages of this method is very long of stub (approximate 1/3 length of triangle edge). In this paper, instead of narrow band stub, a wide band stub has been applied, therefore the length of stub by this method has been decreased around 1/10 edge of triangle in addition changing the aperture angle of stub, provides more facility for designing and producing circular polarization wave.

Keywords—Circular polarization, Microstrip antenna, single feed, wide band stub.

I. INTRODUCTION

WITH considering to advantage of manufacturing of microstrip antennas with smaller surface, low price and high application on commercial and military has caused a lot of research and study to do on fabricating of several types of microstrip antennas.

One application of microstrip antennas is sending millimeter waves with circular polarization. In order to radiating circular polarization, it is necessarily for two orthogonal modes with equal amplitude and 90° out of phase to be induced slightly perturbation on patch at appropriate location feed [5].

As Fig. 1 shows, field of patch can be divided into two orthogonal degenerated modes 1, 2, improve perturbation segment properly detune the frequency response of modes such that at operating frequency $f_0$, it is the same amplitude but 90° out of phase with respect to mode 1.

Fig. 1 Amplitude and phase of two orthogonal modes vs. frequency [5]

III. DESIGNED ANTENNA

Creation circular polarization using wide band stub on button of triangle patch which has been shown in Fig. 2 has been studied in this paper. In this design we use a FR4 laminate with thickness $h = 1.6$ mm and relative dielectric
constant $\varepsilon_r = 4.4$. Other parameters of the used triangular patch are illustrated in Table I.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>PARAMETERS OF DESIGNED TRIANGULAR PATCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>$d$ (edge of antenna)</td>
<td>48.2 mm</td>
</tr>
<tr>
<td>$w_i$ (inner aperture)</td>
<td>1 mm</td>
</tr>
<tr>
<td>$w_o$ (outer aperture)</td>
<td>6.1 mm</td>
</tr>
<tr>
<td>$l_s$ (length of stub)</td>
<td>3 mm</td>
</tr>
<tr>
<td>$f_o$ (frequency center)</td>
<td>1934 MHz</td>
</tr>
<tr>
<td>$(x_p^<em>, y_p^</em>)$</td>
<td>(-2.85, 9.6) mm</td>
</tr>
</tbody>
</table>

For this purpose, we have used Ansoft HFSS for simulating. Result of simulation is brought in follows.

To concern of $S_{11}$ parameters diagram and Smith chart of designed microstrip antenna which has been presented in Fig. 3 (a) and (b), the resonance frequency of designed triangular patch microstrip antenna is equal 1934 MHz, and band width (BW) is approximately 22 MHz. Circular polarization band width (cp Band width) as Fig. 4 shows, is 6 MHz. Also axial ratio of antenna at frequency 1934 MHz, is 0.25 dB (see Fig. 4). Finally Fig. 5 illustrate LHCP and RHCP diagram in designed antenna.

In [2] the narrow band stub length that has been used for creating perturbation on the patch is 14.7 mm (approximately one third of triangle edge). While in this paper a triangle wide band stub has been used so that the length of stub is approximately one sixteenth of triangle edge (that’s clear length of stub has reduced).

Sensitivity of this antenna to tolerance of dimension and feed point is less than proposed microstrip antennas in [1],[2],[3],[4]. Meanwhile angle ($\theta$) of wide band stub is another parameters which help us to tune the antenna for creating cp radiation.
IV. CONCLUSION

After simulation equilateral triangle microstrip antenna with triangle stub circular polarization radiation correspondent of parameter that is mentioned above, presents an axial ratio of 25dB in central frequency (1934MHz). Also circular polarization band width of 0.31% of band width has been reached in Fig. 4.

REFERENCES


Ramin Irani received B.E degree in electrical engineering from Azad University of Iran in 1996 and M.E. in telecommunication engineering from Azad University of Iran (south Tehran branch) in 2006. From 2006 he had been working in “Cib IT Development” as a BTS engineering Designer. Also he is instructor of Azad university of Iran (Khoramshahr branch). In addition he is member of “Iranian Association of Electrical & Electronics Engineers”.

Ali Ghavidel received B.E degree in electrical engineering from E.E Dept Azad University of Iran, in 2000 and M.E. in telecommunication engineering from Graduate E.E. Dept of Azad University of Iran (south Tehran branch) in 2005. From 2002 to 2006, He was involved to engineer of Designing and Engineering Department of Telecommunication Company of Iran and Cooperative with Iran Telecommunication Research Center (ITRC). he has been teaching in Electrical Engineering Dept Azad University of Iran from 2006.

Farokh Hodjat Kashni received his PhD in Electrical Engineering specializing in Electromagnetic from the University of California Los Angeles in 1970. From 1970 to 1971 he was an Assistant Prof at Higher Institute of Telecommunication and University of Tehran. From 1971 to 1976 he was Assistant Prof. and chairman of E.E. Dept at IUST and from 1976 to 1977 spent sabbatical leave in Hughes Aircraft Company, Aerospace division at Conoga Park, California, US. From June 1976 to June 1988 he took one year sabbatical leave in Communication Department, New South Wales University, Sydney, Australia. He is currently a Professor of Electrical Engineering Department, Iran University of Science and Technology. In April 2002 he was selected as an outstanding professor in Iran. He has published over sixty papers and twelve books in Persian.