Comments

Comments on "Simple and Accurate Formula for the Resonant Frequency of the Equilateral Triangular Microstrip Patch Antenna"

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***Index Terms*—Microstrip patch antenna, resonance capacitance.**

In the above communication,[1] the authors have given a formula for the resonant frequency of an equilateral triangular microstrip patch antenna. They have used the capacitance formula of a circular microstrip disk given by [2, Eq. (23)], which takes into account the fringing field effects. The capacitance formula given by [1] is

$$C = \frac{a^2 \pi \varepsilon_r \varepsilon_0}{h}\left[1 + \frac{2h}{\pi \varepsilon_r a}\left\{\ln\left(\frac{a}{2h}\right) + (1.41\varepsilon_r + 1.77) + \frac{h}{a}(0.268\varepsilon_r + 1.65)\right\}\right] \tag{1}$$

where a is the radius of the circular microstrip disk. For an equilateral triangular microstrip patch antenna with sides of length l, the corresponding fringing capacitance of an equivalent circular microstrip disk of same area is given by

$$C = \frac{a_{\mathrm{eq}}^2 \pi \varepsilon_r \varepsilon_0}{h}\left[1 + \frac{2h}{\pi \varepsilon_r a_{\mathrm{eq}}}\left\{\ln\left(\frac{a_{\mathrm{eq}}}{2h}\right) + (1.41\varepsilon_r + 1.77) + \frac{h}{a_{\mathrm{eq}}}(0.268\varepsilon_r + 1.65)\right\}\right] \tag{2}$$

where $a_{\mathrm{eq}} = \sqrt{S/\pi}$ and S is the area of the original triangular patch. The effective radius of the circular microstrip disk is given by

$$a_{\mathrm{ef}} = a_{\mathrm{eq}}\left[1 + \frac{2h}{\pi \varepsilon_r a_{\mathrm{eq}}}\left\{\ln\left(\frac{a_{\mathrm{eq}}}{2h}\right) + (1.41\varepsilon_r + 1.77) + \frac{h}{a_{\mathrm{eq}}}(0.268\varepsilon_r + 1.65)\right\}\right]^{1/2}. \tag{3}$$

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[1]N. Kumprasert and W. Kiranon, *IEEE Trans. Antennas Propagat.*, vol. 42, pp. 1178–1179, Aug. 1994.

TABLE I

Modes	Measured resonant frequency (GHz)	Calculated resonant frequency (GHz)	
		Reported [4]	Correctly calculated
$TM_{10,-1}$	1.280	1.289	1.258
$TM_{11,-2}$	2.242	2.233	2.179
$TM_{20,-2}$	2.550	2.579	2.516
$TM_{21,-3}$	3.400	3.411	3.329
$TM_{30,-3}$	3.824	3.868	3.774

a = 10 cm, ε_r = 2.32, h = 0.159 cm.

The effective side length l_{ef} of the triangular microstrip patch antenna is calculated by an approach given in [2] and implemented in [3]. The authors[1] have followed the same approach for the calculation of effective side length l_{ef}. Following the procedure of the paper cited,[1] the formula for l_{ef} is obtained as

$$l_{\mathrm{ef}} = l\left(\frac{a_{\mathrm{ef}}}{a_{\mathrm{eq}}}\right) \tag{4}$$

where a_{ef} is given by (3).

Equation (6)[1] is not in agreement with (4) and, hence, the resonance frequencies calculated from (6)[1] are not in agreement with results obtained from (4). Table I gives the correctly computed results.

References

[1] W. C. Chen and J. A. Kong, "Effects of fringing fields on the capacitance of circular microstrip disk," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-28, pp. 98–104, 1980.
[2] Y. Suzuki and T. Chiba, "Computer analysis method for arbitrary shaped microstrip antenna with multiterminals," *IEEE Trans. Antennas Propagat.*, vol. AP-32, pp. 585–590, 1984.
[3] R. Singh, A. De, and R. S. Yadava, "Comments on 'An improved formula for the resonant frequency of the triangular microstrip patch antenna'," *IEEE Trans. Antennas Propagat.*, vol. 39, pp. 1443–1444, 1991.