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CPW-Fed Band Pass Filter for GSM Application

Akhilesh Kumar Pandey, Rajeev Singh

***Abstract:** A novel band pass filter of a coplanar waveguide fed planar patch is proposed for Global System for Mobile Communication (GSM) (880-965 MHz) applications and is simulated by means of AWR (Microwave Wave Office) and results are compared with ideal transmission line model, balance strip model and lumped element model for GSM applications. Simulated results of insertion loss and transmission loss of models have been discussed.*

***Keywords:** Coplanar plane wave guide (CPW); Micro strip antenna; Band pass filter; Lumped-Distributed element; AWR.*

I. INTRODUCTION

Demand in various communication system of a band pass filter has low insertion loss, low complexity and cost effective. On the above aspects, various efforts have been reported till date. A dual-band band pass filter (BPF) using half-wavelength resonators loaded with a lumped series resonator [1], and a three-pole dual-band band pass filter implemented in coplanar waveguide technology (CPW) by using semi-lumped elements is reported [2].A new approach of band pass filter designed compact micro strip based on semi-lumped resonators [3], band pass filter designed using a ladder circuit based on lumped elements [4],ensuring lower attenuation in pass band, higher rejection in stop band a compact, 4-pole, UHF-band integrated lumped element filter is presented [5].A number of techniques for a band pass filter design, using distributive element extraction of lumped element are available. In this technique, design formulas are obtained for the basic stepped impedance distributed low-pass prototype filter which exhibits a maximally flat, equal ripple, insertion loss response characteristic [6]. The models of the unloaded and loaded unit structures are derived by equivalent circuit approach and full-wave electromagnetic simulation [7]. Conversion of a band-pass resonator to an all-pass or a notch filter [8] has been presented. A three-pole dual-band, band pass filter using coplanar waveguide (CPW) series-connected resonators and impedance inverters [9] are reported. High-temperature superconducting filter based on spiral lumped elements for personal communication system applications [10] and a design methodology and equations for lumped-element filter prototypes having band pass filter [11] are presented. Bands pass filters, including their realizations with lumped-element and distributed-parameter networks [12], E-shaped resonators analyzed with the transmission line theory [13], a wideband microwave filter, and quarter wave transformer approach for band pass filter [14] have been reported. Design of a parallel coupled micro strip band-pass filter [15], micro strip low pass filter on electromagnetic band gap ground plane [16] is reported.

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In the proposed design of a Chebyshev band pass filter of third order using lumped element, applying the Richard's transformation and Kuroda's identity [17], are some special filters.

II. BAND PASS FILTER DESCRIPTION

In proposed design, the drawbacks of lumped element model are removed, a lumped element model have various drawbacks, such as low bandwidth, low frequency, high distortion and high insertion loss. A design of Chebyshev band pass filter of third order using lumped element is shown in figure 1 and has been designed using the Insertion loss method. The power-loss ratio PLR is defined as in [17]

$$P_{LR} = \frac{\text{Power available from the source}}{\text{Power delivered to load}} = \frac{P_{inc}}{P_{load}} = \frac{1}{1-|\Gamma(\omega)|^2} \quad (1)$$

where Γ is reflection coefficient and $\Gamma[\omega]^2$ is defined as

$$|\Gamma(\omega)|^2 = \frac{f_1(\omega^2)}{f_1(\omega^2)+f_2(\omega^2)} \quad (2)$$

and

$$P_{LR=1+}\{f_1(\omega^2)\}/\{f_2(\omega^2)\} \quad (3)$$

where $f_1(\omega^2)$ and $f_2(\omega^2)$ are real polynomial of ω^2 **and gain of the network defined as**

$$|G(\omega)| = \frac{1}{\sqrt{P_{LR}}} = \frac{1}{\sqrt{1+f_1(\omega^2)/f_2(\omega^2)}} \quad (4)$$

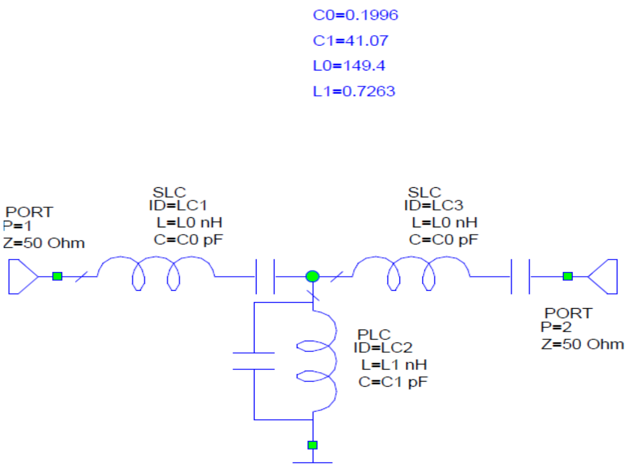

Fig.1. Lumped element model for proposed CPW fed GSM band pass filter.

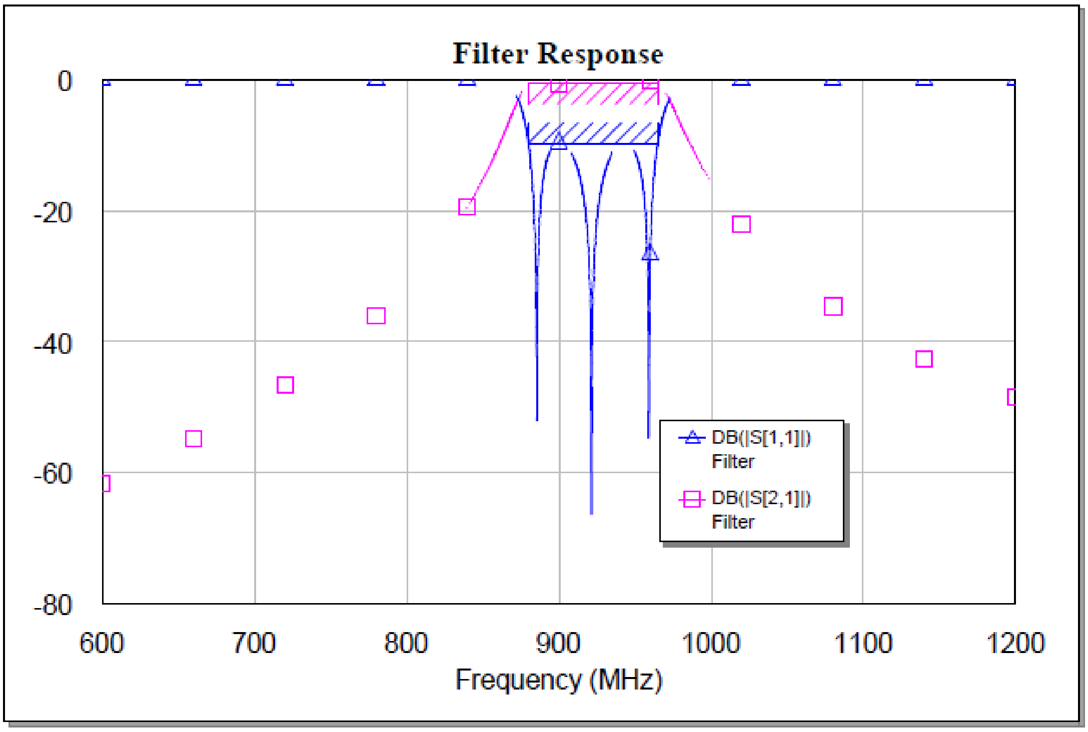

Fig.2. Simulated plots of insertion loss s[1,1] and transmission loss s[2,1].

and from figure 2 it is clear that the designed filter is for GSM (880-965 MHz) applicating insertion loss has within pass band which is below -17 dB and transmission loss is 0 dB. Applying Richard's transformation, Kuroda's identity and AWR transmission line calculator, length and width of two CPW- Lin, one CPW-bend of a proposed CPW fed GSM band pass filter is calculated which is shown in figure 3. CPW–fed Chebyshev band pass filter is designed on economical FR4 substrate having dielectric constant 4.4 and height 1.5 mm which is shown in figure 3.From figure 3 it is clear that the variation of current at resonant frequency, the edge of CPW lin and CPW bend current varies. From figure 4, lower mode of excitation is present and there is no random variation in current. Response of CPW–fed Chebyshev band pass filter for GSM application in term of insertion loss and transmission loss which is good agreement for GSM (880-965 MHz) applications can be observed in fig5. Ideal transmission model of Chebyshev band pass filter is shown in fig6. It is clear that, insertion loss below -50 dB and transmission loss is 0 dB which are of microwave filters, the distinct advantages are depicted in fig7.The proposed CPW-fed GSM band filter is shown [cf.fig8] using balance strip model and its insertion loss of [-40 dB] and transmission loss of 0 dB is observed in fig9.

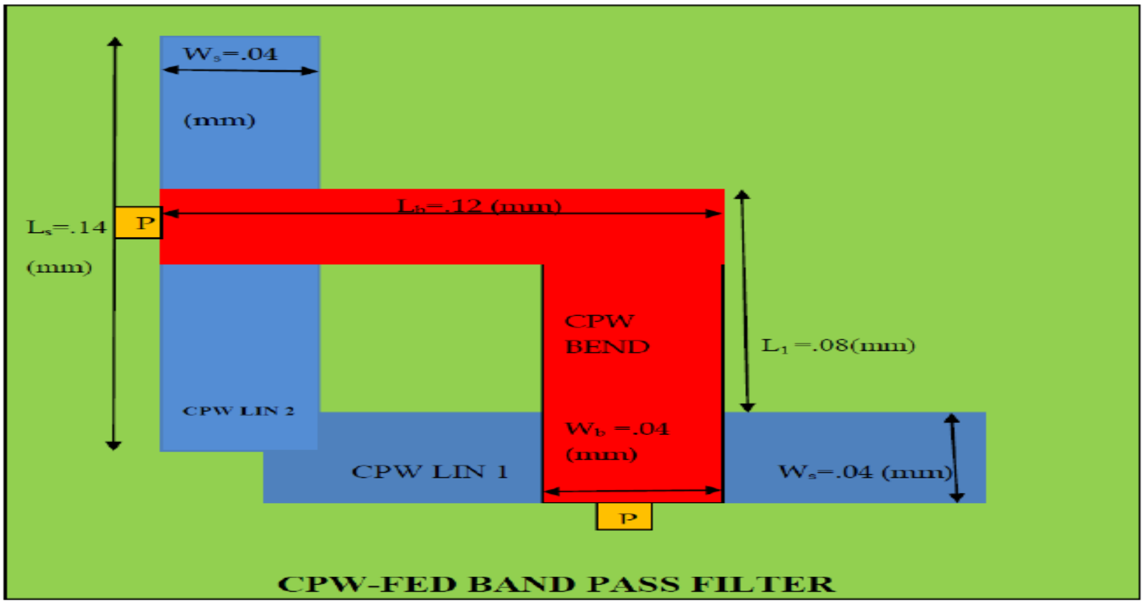

Fig.3. Geometry of proposed CPW fed GSM band pass filter.

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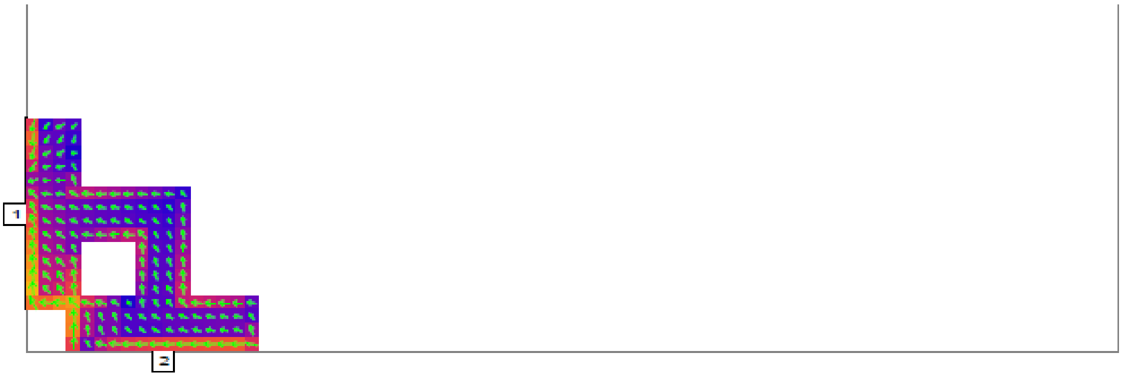

Fig.4. Current distribution of proposed CPW fed GSM band pass filter.

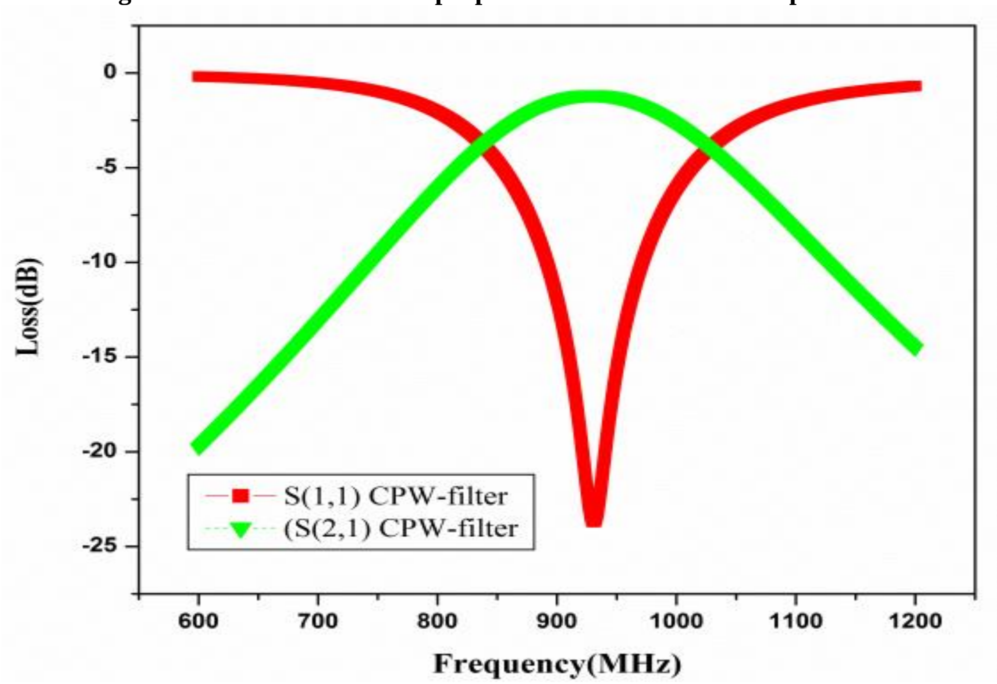

Fig.5. Simulated plots of insertion loss s[1,1] and transmission loss s[2,1] for proposed CPW fed GSM band pass filter.

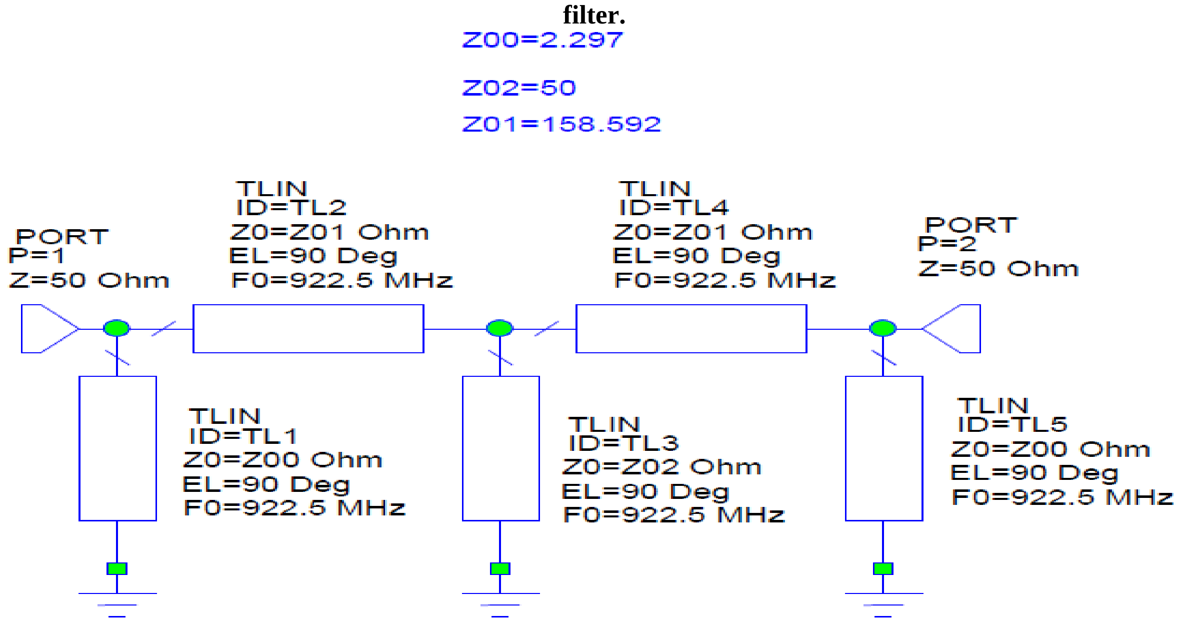

Fig.6. Ideal transmission model for proposed CPW fed GSM band pass filter.

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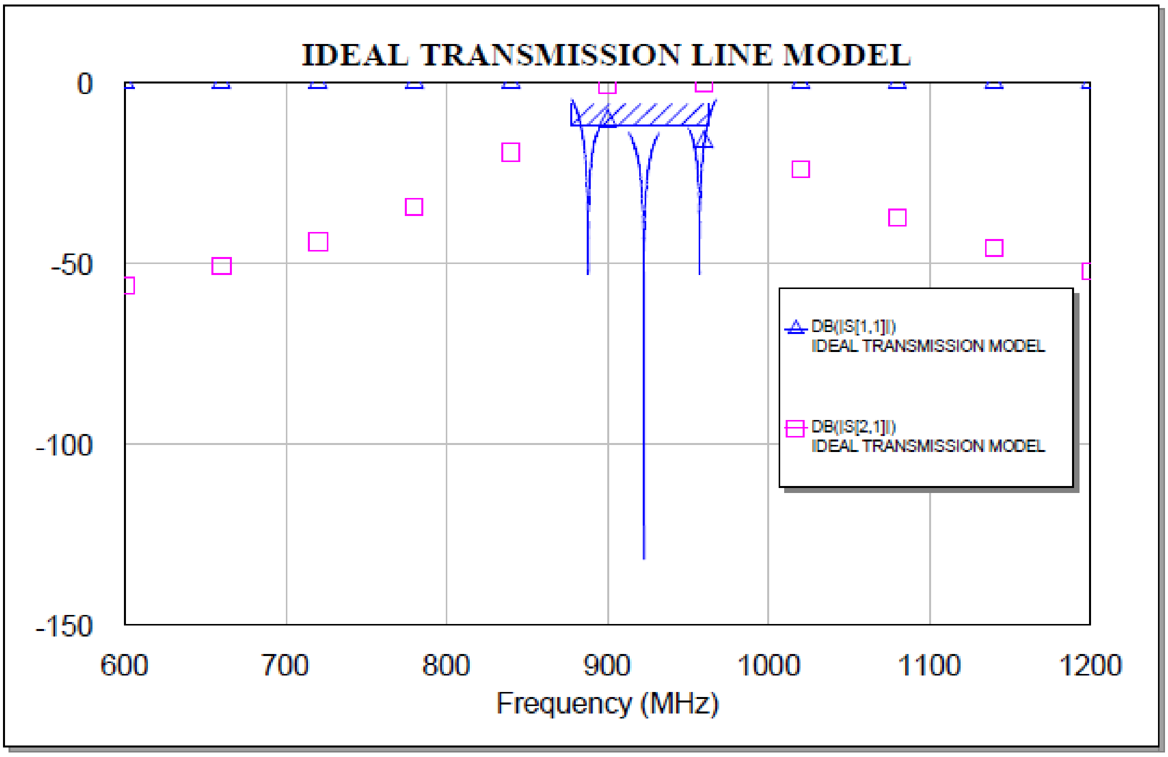

Fig.7. Simulated plots of insertion loss s[1,1] and transmission loss s[2,1].

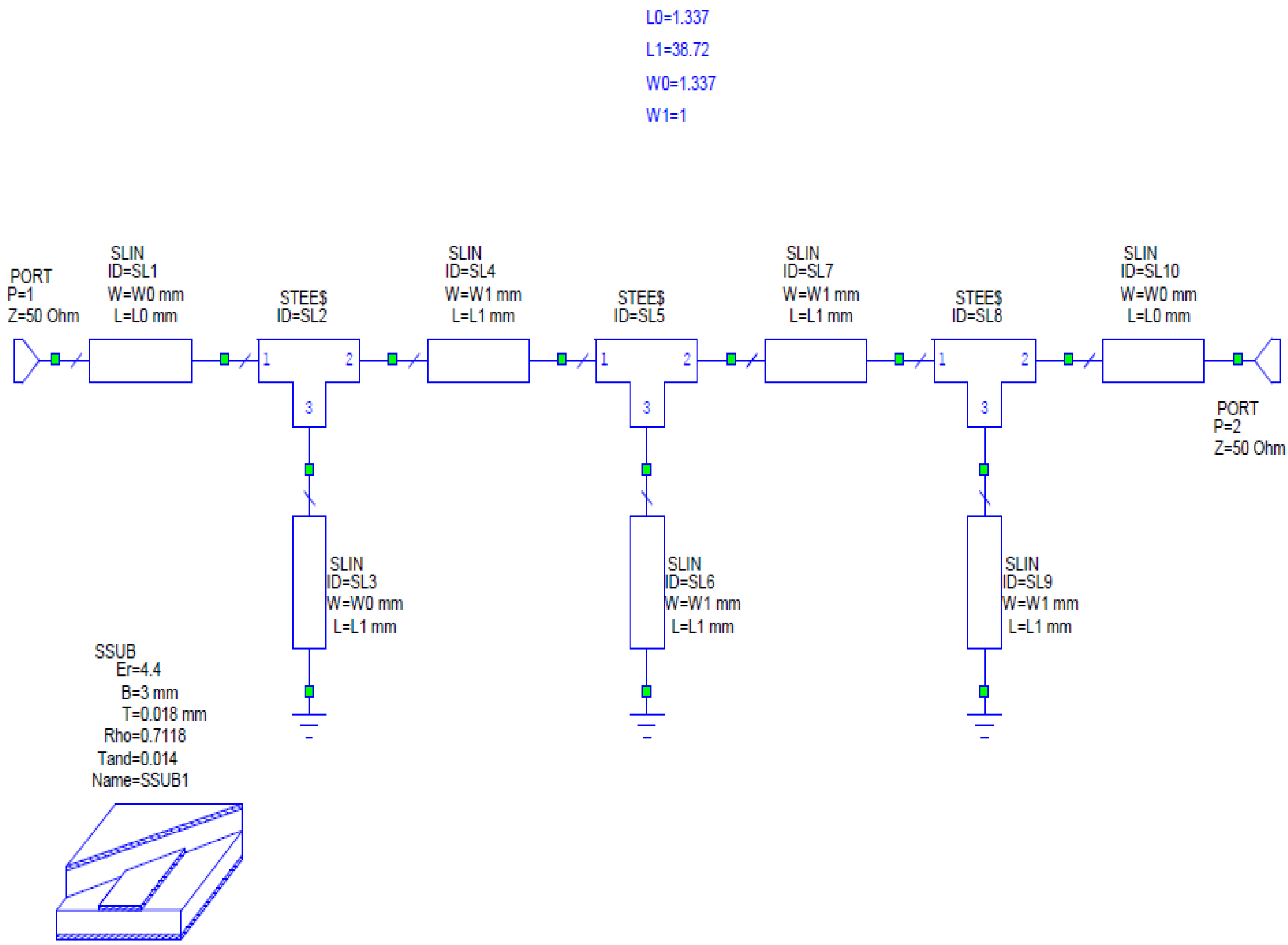

Fig.8. Balance strip model for proposed CPW fed GSM band pass filter.

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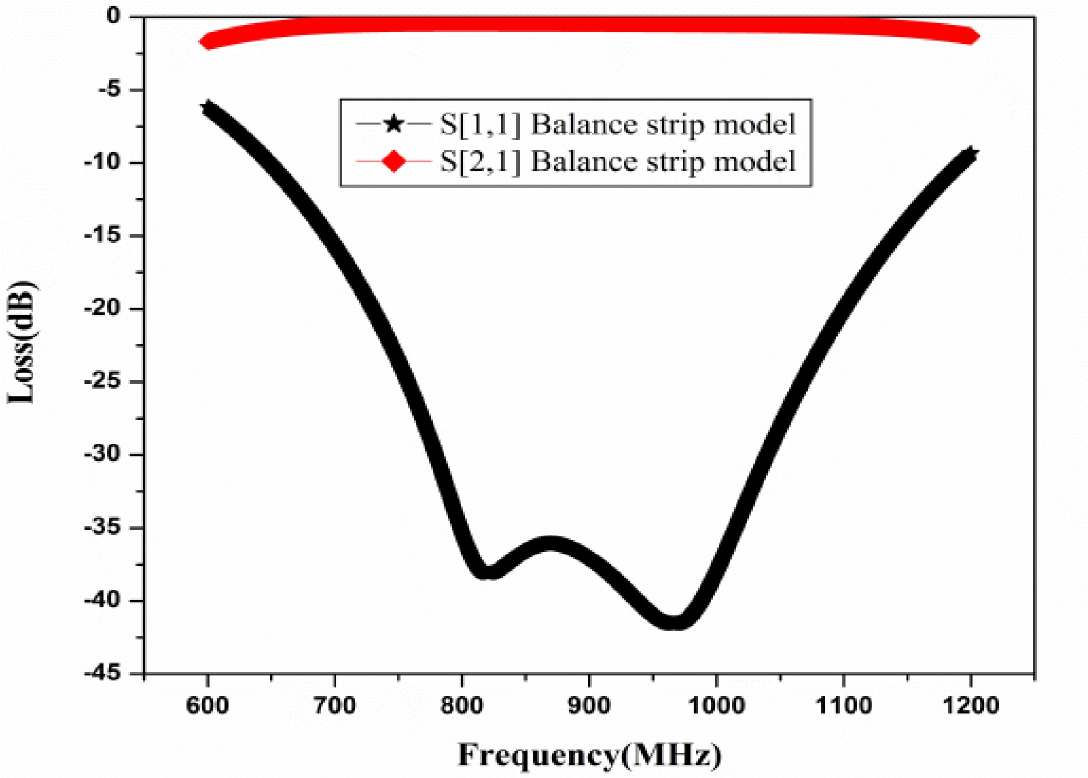

Fig.9. Simulated plots of insertion loss s[1,1] and transmission loss s[2,1].

III. CONCLUSION

We have presented a design of CPW fed GSM band pass filter and its simulation is successfully done for GSM application, using AWR (Microwave Wave Office). A simulated insertion loss and transmission loss is verified with lumped element model, ideal transmission model, balance strip model, which are in close agreement with each other and it is observed that a CPW-fed GSM band pass filter having good performance of low insertion loss and 0 dB transmission loss is achieved.

REFERENCES

1. Y.H. Cho, I.S. Jeon, X.G. Wang, S.W. Yun, Balanced dual-band bandpass filter using microstrip resonator loaded with lumped-elements, IEEE CONFRENCE. (2011) 1286 – 1289.
2. M. D. Sindreu, J. Bonache, F. Martín, Compact CPW dual-band bandpass filters based on semi-lumped elements and metamaterial concepts, IEEE CONFRENCE. (2010) 670 – 673.
3. J. Bonache, I. Gil, J. G.Garcia, F. Martin, Compact microstrip band-pass filters based on semi-lumped resonators, IET Microwaves. Antennas & Propagation. 1 (4) (2007) 932 – 936.
4. R. Sorkin, Waveguide band-pass filters on the lumped elements, IEEE Conference, (2001) 119 -120.
5. L. Hepburn, J. Hong, Compact integrated lumped element LCP filter, IEEE Microwave and Wireless Components Letters. 26 (1) (2015) 19-21.
6. J. Rhodes, Design formulas for stepped impedance distributed and digital wave maximally flat and Chebyshev low-pass prototype filters, IEEE Transactions on Circuits and Systems. 22 (11) (1975) 866 - 874.
7. M. F. Karim, A. Q. Liu, A. Alphones, X. J. Zhang, CPW band-stop filter using unloaded and loaded EBG structures, IEE Proceedings – Microwaves. Antennas and Propagation. 152 (6) (2005) 434 -440.
8. M. Soliman, Conversion of a band-pass resonator to an all-pass or a notch filter, International Journal of Electronics. 38 (4) (1975) 559-562.
9. L. A. Khateeb, O. A. Safia, Dual-band bandpass filter based on CPW series-connected resonators, Electronics Letters. 49 (12) (2013) 761 – 762.
10. J. S. Kwak, J. H. Lee, J.P. Hong, S. K. Han, Narrow pass band high-temperature superconducting filters of highly compact sizes for personal communication service applications, IEEE Transcations on Applied Superconductivity. 13 (1) (2003) 17 –19.
11. M.A. Morgan, T. A. Boyd, theoretical and experimental study of a new class of reflection less filter, IEEE Transactions on Microwave Theory and Techniques. 59 (5) (2011) 1214 –1221.
12. R. Djordjevic, A. G. Zajic, Low-reflection band pass filters with a flat group delay, IEEE Transactions on Microwave Theory and Techniques. 53 (4) (2005) 1164 – 1167.
13. J. Lu, D. La, Novel band-pass filters using E-shape resonator, Journal of Electromagnetic Waves and Applications. IEEE Transactions on Microwave Theory and Techniques. 27 (4) (2013) 458-463.
14. K. KAMAL, S. C. Gupta, N. K. Agrawal, K. Singh, Design of band-pass wideband microwave filters in X-band and their use as time-delay filters, International Journal of Electronics. 22 (11) (1976) 723-727.
15. K. N. SHAMANNA, V. S. RAO, S. P. KOSTA, Design of parallel coupled microstrip band-pass filters, IEEE Transactions on Microwave Theory and Techniques. (1977) 89-96.
16. K. Tiwary, N. Gupta, Performance of microstrip low-pass filter on electromagnetic band gap ground Plane, IETE Journal of Research. 56 (5) (2010) 230-234.
17. D. Pozar, Microwave Engineering.2nd Edition. J. Wiley. 1998.

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