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# COMPARISIONAND REALIZATION OF MICROSTRIP BAND PASS AND BAND REJECT FILTER AT GSM BAND (850MHz) USING DGS-TECHNIQUE

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**ABSTACT**

Filters are essential high frequency components in microwave communication system. The filters are use for communication purpose, satellite communication as well as in radar communication.A bandpass filter is adevice that allows signals to pass between two specific frequencies,but that supressed against signals at other frequencies.. This paper introduces a compact band stop and band pass filters using DGS for size reduction technique,which is improved by the DGS technique.This DGS technique is proposed version of conventional (circular-head) and slotted ground to improve the performance of filters.A (five pole hairpin) microstrip band pass filter is designed with GSM band center frequency i.e. 850Mhz,as well as the band reject (open circuit stub)filter is having the same frequency,The insertion loss is improved in the band pass filter as well as band stop filter through the DGS technique.In this paper improved results have been obtained by comparing 850Mhz normal with 850Mhz(DGS) in band pass filter as well as in band stop filter,the improved results showing sharp roll off. The insertion lossof band pass filter and band reject filters are improved by applying the DGS technique.The filters are simulated using CST software 2010.

***Keywords- Band pass filter, Band stop filter, Defected ground structure i.e.(circular head and slotted ground),CST (computer simulation technology)***

## I. INTRODUCTION

Combline for the realization of band pass filters have been presented.There is a disadvantage of parallel coupled line Filters are used for communication purpose. There is a requirement of mobility of components and equipment in mobile communication systems [1]. A DGS technique is very popular technique for reducing the size of the filters and achieved the properties of filters like insertion loss.Thus DGS-filters structure has the advantage of compact size and low cost [2].In band pass filter the design is based on Chebyshev response as Butterworth filter is less selective than that of Chebyshev response[2].The cut off frequency of the structure with this slot can be controlled by adjusting the distance, without changing the area occupied by the slot[3].To improve the quality of the system, new techniques such PBG [Photonic band gap],GPA [Ground plane

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aperture].PBG(Photonic Band Gap) is a structure which is designed to reject the particular frequency band. Because of difficulties in modeling and radiation from the periodic etched defects, PBG structures can not be used for the microwave components designing[2].The Band pass filters are the important components to overcome the losses in the microwave for rejecting the undesired frequencies[4].As well as in the band stop filter provide the desired frequencies.DGS disturbs the defending current distribution, which change the inductance and capacitance of the line.The series inductance is increased by DGS which in turn increases the reactance of microstrip at cut-off, high Q with low cost and size and low insertion loss. Numerous design techniques such as parallel coupled line, split ring resonators (SRR) and filter.It suffers from spurious response which degrades the pass band and stop band performance of the filter, Split ring resonators suffers from large from large circuit losses and large frequency variation[2]. The filters using the DGS circuit has a number of attractive features, which include the following.

**1)**The stopband is very wide and more deeper than that of a conventional low-pass filter.

**2)** The structure is very simple

**3)**Extremely small element values for implementation filter can be realized.

**4)** The insertion loss is very low[5]

In this paper the band pass and band stop filters are designed of GSM band i.e,850Mhz which is the center frequency of 800-900 Mhz .A five pole haipin band pass filter is designed with circular head DGS as well as without DGS whereas a open band stop open circuited (slotted ground)is designed with or withoutDGS.To improve the insertion loss of the filters and achieve sharpe cut-off.

## II. Design

### 2.1 Design of Hairpin band pass filter-

In the band pass filter by without DGS the dimensions of the filters are having 10cm×8.5cm.The insertion loss of this filter is -1.4845dB.

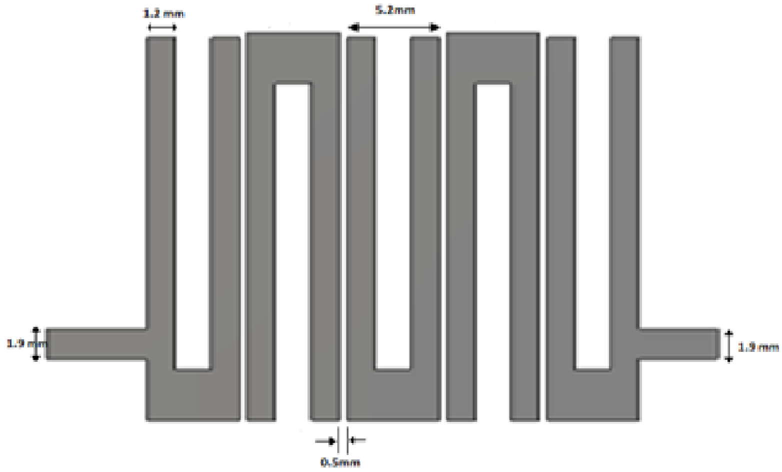


**Fig-1 Hairpin band pass filter**

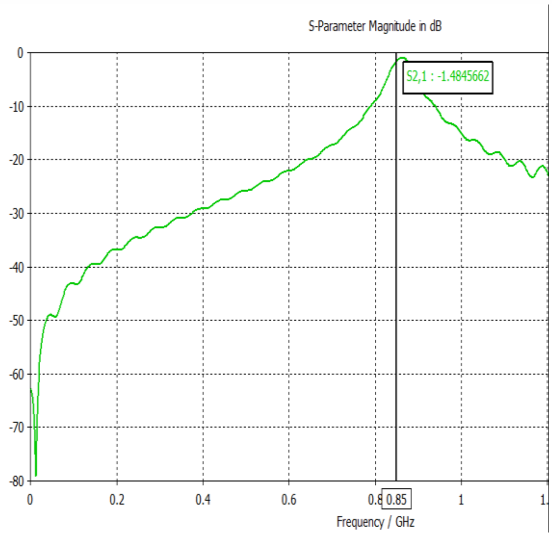


**Fig-2Insertion Loss**

In this figure thesimulated insertion loss of band pass filter wihout DGS is shown i.e, -1.4845dB

## 2.2. Various DB-DGS pattern

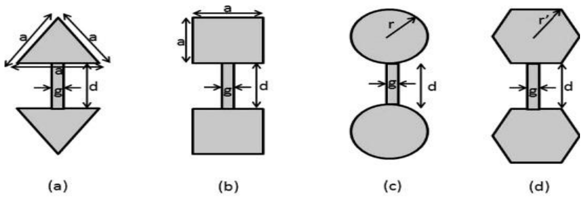


**Fig.3 (1) Triangular head (2) Sqare head (3) circular head (4) Hexagonal head.**

## 2.3Design of Band pass filter with DGS Technique(circular-head)-

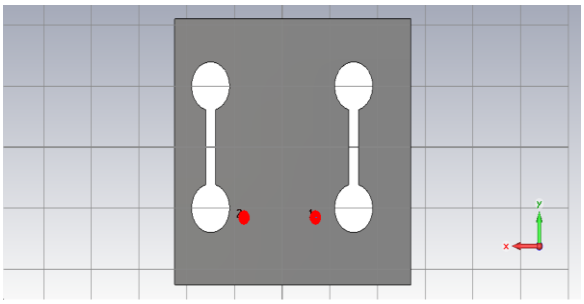

**Fig 4-Circular head Shape**

**Table-1 Dimension of circular head –**

| Dimensions in mm | Circular |
|---|---|
| R | 0.3 |
| G | 0.8 |
| D | 12 |

Hairpin filter is obtained by folding the parallel half wavelength resonators in dumbbled-shape,The microstrip dumbbled-shape filtersare very popular because they have simple structure[5].The circular-head DGS technique is used in the design.Here the combination of capacitor and inductor used for modeling the resonators.

***$Q_{e1}=g_0g_1/FBW$ (1) $Q_{en}=g_ng_{n+1}/FBW$ (2) $M_{i,i+1}=FBW/g_ig_{i+1}$ for i=1 ton-1(3)***

Where the $Q_{e1}$ and $Q_{en}$showing the quality factors of input and output, $M_{i,i+1}$ showing the mutual coupling between the resonators.And the FBW (fractional bandwidth)=BW/$f_0$=0.206dB at center frequency 850Mhz .The parameters are used for determine the gap and size in Hairpin filter which can be derived from theseequations.The dimensions of the filter have 10cm×8.5cm,center frequency of the band pass filter have 850Mhz,substrate thickness (h)=1.6,Di-eleltric constant $\varepsilon_r$=4.4 mm,Band pass ripple=0.1 Db, characterstics line impedence $Z_0$=50 ohm, normalized frequency $\Omega_c$=1,Number of poles=5,circular head pole=2,fractional banwidth of filter is= $F_H$-$F_L$/$F_C$ i.e, 0.995-0.82/0.85=0.206dB.

Where $F_H$ is the high frequency,$F_L$ is the low frequency and Fc is cut-off frequency.

$M_{12}=M_{45}=0.1307$

$M_{23}=M_{34}=0.076$

$Q_{e1}=Q_{e5}=5.5669$

The coupling coefficient can be varied by varying the spacing between the resonators by using the formula

**$K= (f_2^2-f_1^2)/(f_2^2+f_1^2)$**

The spacing required quality factor can be obtained by using the above formula where f1 and f2 are the two peak resonance. These frequencies are obtained from the simulated response $S_{21}$ for resonators.

### The elements values are-

| N | $g_1$ | $g_2$ | $g_3$ | $g_4$ | $g_5$ | $g_6$ |
|---|---|---|---|---|---|---|
| 1 | 0.3052 | 1.0 | | | | |
| 2 | 0.8431 | 0.6220 | 1.3554 | | | |
| 3 | 1.0315 | 1.1474 | 1.0315 | 1.0 | | |
| 4 | 1.1088 | 1.3062 | 1.7704 | 0.8181 | 1.3554 | |
| 5 | 1.1468 | 1.3712 | 1.9750 | 1.3712 | 1.1468 | 1.0 |

The five pole hairpin filters have parameters $g_1=g_o=1.0$, $g_1=g_5=1.1468$,$g_2=g_4=$ 1.3712 and $g_3=1.9750$.These values are used to determine the design parameters of band pass filter.By using DGS technique the results are improved, insertion loss is shifted from –1.4845dB to -1.27193dB.

**Design for the filter-**

**Fig.5-U-shape structure**

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Filters are constructed by U-shape structure.These U-shape structures are obtained by folding the resonators of half-wave length resonator filter and parallel-coupled.

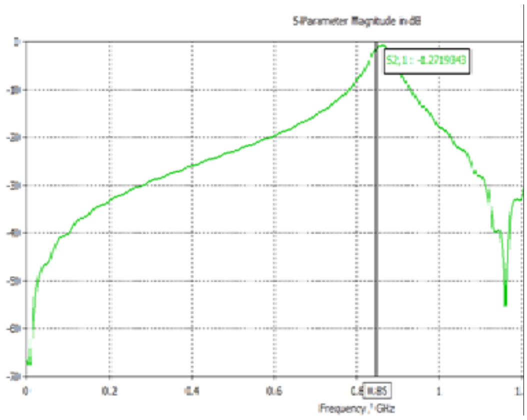

**Fig. 6: Improved insertion loss of band pass filter with DGS**

In this figure the simulated insertion loss of band pass filter with DGS is shown i.e, -1.27dB.

## III. DESIGN OF BAND REJECT FILTER

The length and width of the filters have 16.7cm×4cm.The insertion loss is -42.47dB.The dielectric constant of substrate (FR4-LOSSY) $\varepsilon_r$=4.4mm,loss tangent=0.0025 are used in design configuration.

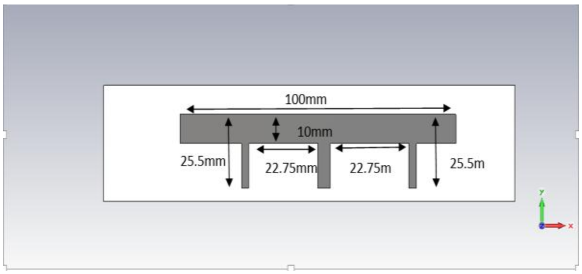


**Fig7- Band reject filter-**

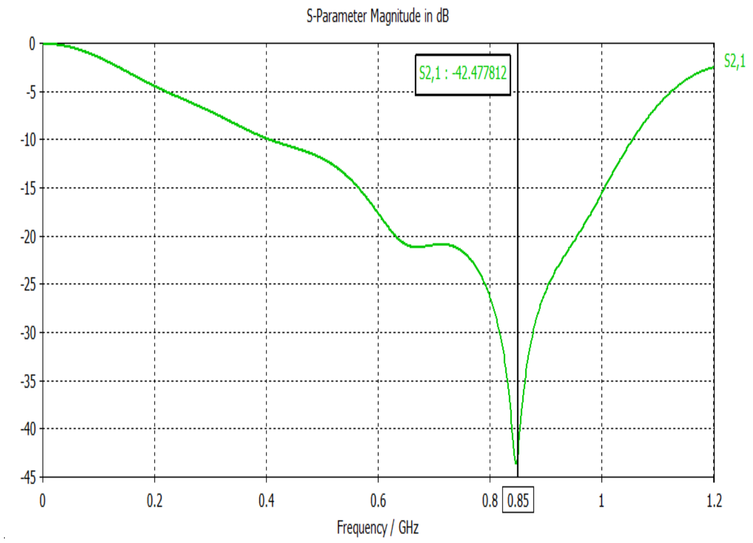


**Fig-8: Insertion loss without DGS**

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In this figure the simulated insertion loss of band reject filter wihout DGS is shown i.e, -42.47Db

## IV. DESIGN OF BAND REJECT FILTER WITH DGS

All thefilters are designed using 50Ω microstrip line. The size of band pass reject fixed are kept fixed which is 16.7cm×4cm.The dielectric constant of substrate(FR4-LOSSY) $\varepsilon_r$=4.4mm,loss tangent=0.0025,conductor height is=1.53mm are used in design configuration.The simulated results are shown in fig.7

The insertion loss of the band is improved by using DGS technique i.e, -44.61dB.In order to design the band stop filter with a sharpe cut-off,DGS slot is used.The slot consists of 9cm×3.5cm Performance of filter depend upon the number of factors such as slotted ground, shape radius and position of DGS.

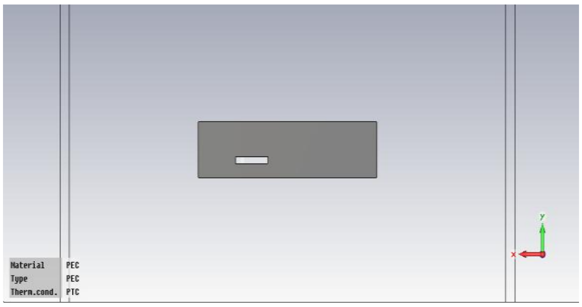


**Fig. 9: Band reject filter with slotted ground-**

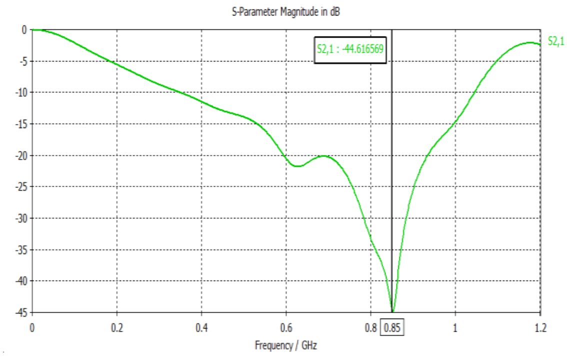


**Fig-10 Improved insertion losswith DGS**

In this figure the simulated improved insertion loss of band reject filter with DGS is shown i.e,-44.61dB.

## RESULTS

### Table2: Comparison of filter's results-

| FILTERS | WITHOUT DGS (INSERTION LOSS) | WITH DGS (INSERTION LOSS) |
|---|---|---|
| **Band pass** | -1.4845Db | -1.27193Db |
| **Band Reject** | -42.47dB | -44.6165Db |

The filters are simulated with CST software 2010.The band pass and band reject center frequency is 850Mhz.The insertion loss is improved by applying DGS-technique.

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**FABRICATED RESULTS-**

## V. CONCLUSION

In this paper,the performance of filters is improved by using DGS-structure.The insertion loss of filter is improved by designing BPF (Band pass filter) and BRF (Band reject filter) with DGS technique. Good agreement was achieved.

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