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Low Loss Wide Band Microwave Filters Using SAW Devices Combined with Microstrip Lines
マイクロストリップ線路と SAW 素子を用いたマイクロ波帯広帯域低損失フィルタ

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1. Introduction

Recently, surface acoustic wave (SAW) filters are used for mobile communication apparatus including the celler phone widely. In the next generation, inclease of communication capability and number of subscribers are expected. To deal with this problem, high frequency filters which have wide band and low loss are required. The authors believe that one of the filters which satisfies these demands can be reallized by combining SAW transducers and microstrip lines efficiently.

In the past study, we obtained a filter with excellent characteristics experimentally; insertion loss is less than 1dB, band width is approximately 40% at center frequency of 3.5GHz using two microstrip lines which were connected in parallel [1]. We also sdudied that combineing the proposed microstrip line filter and additional admittance elecents changes the filter characteristics [1]. According to the sdudies, there is a possibility to improve the filter charecteristics using SAW transducer as an admittance element, because the values of conductanse and susceptance of the SAW transducer are changed as the function of the frequency.

As the first step of the study, we simulate the filter characteristics asumming the admittance of the additional elements changes like SAW transducers.

2. Structure of proposed filter

Figure 1 shows a structure of proposed filter. Two microstrip lines are connected in parallel. Admittance element $\dot{Y}$ is connected between the points A and B, which are located with different length from the connected poins. In pass pand of the filter, phase difference of the signal between A and B is 0 degree, so that there are no effects of admittance element $\dot{Y}$. On the other hand, in rejection band, the admittance element $\dot{Y}$ shunt the signal because there is a phase differece.

Figure 2 shows frequency response of the filter. Fig.2 (a) is a simulation result and Fig.2 (b) is

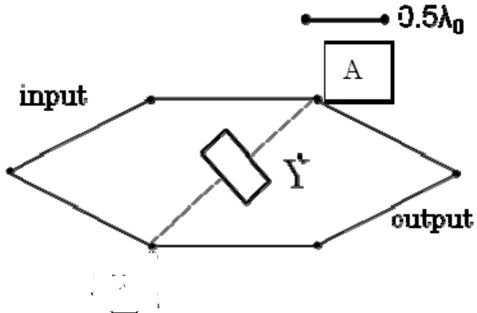
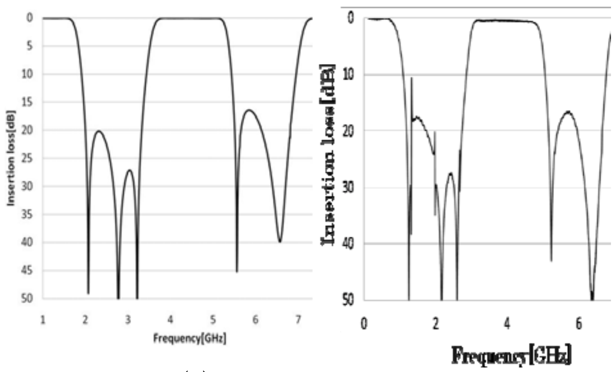


Fig.1 Structure of proposed filter.



(a) (b)

Fig.2 Filter characteristic.
(a) Simulation, (b) Experiment

Table1 Parameters of filter in Fig.2.

stripline width:w[mm]	1.064
The thickness of the coppert[μm]	35
The thickness of the dielectric:h[mm]	1.25
Dielectric	RT/duroid5880
Relative permittivity	2.2
Center frequency:f[GHz]	4
Characteristic impedance[Ω]	100

an experimental result. In this case the points A and B is shorted (i.e. $Y = \infty$). The parameters of the filter in Fig. 2 are shown in **table 1**. The experimental result shows good agreement with the simulation result. Insertion loss of less than 1dB and band width of approximately 40% in the center frequency of 3.5GHz are obtained experimentally.

3. Simulation

As described in introduction, the conductance and the susceptance of SAW transducers are changed rapidly as changing the frequency. Therefore, using SAW transducer or SAW resonator as the element $\dot{Y}$ in Fig.1, we could expect that more steeper cut-off characteristic were obtained.

As the first step of this study, we assume that the conductance of SAW device will be expressed as polygonal line shown in **Fig. 3** (line G), and susceptance of the SAW device are obtained by calculating with Hilbert transform [2] denoted in **Eq. (1)** from the assumed conductance.

$$B(\omega) = \frac{1}{\pi} \int_{-\infty}^{\infty} \frac{G(\omega')}{\omega - \omega'} d\omega' \qquad (1)$$

Obtained sucseptance is shown as curve B in Fig. 3.

We simulated the insertion loss of the filter with the admittance characteristics of Fig.3 as the element $\dot{Y}$ in Fig. 1. The results are shown in **Fig.4**. Solid line shows an insertion loss of the simulated filter. Doted line shows that of the conventional filter in which the point A and B in Fig.1 are shorted (i.e. $Y = \infty$). By comparing these characteristics, we can expect that cut-off property will be improved. using the SAW devices combined with the microstiop line filter.

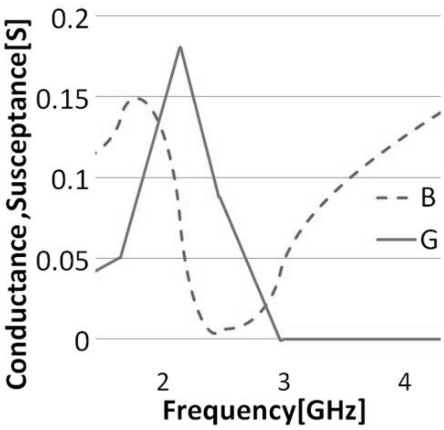


Fig.3 Admittance property of inserted element.

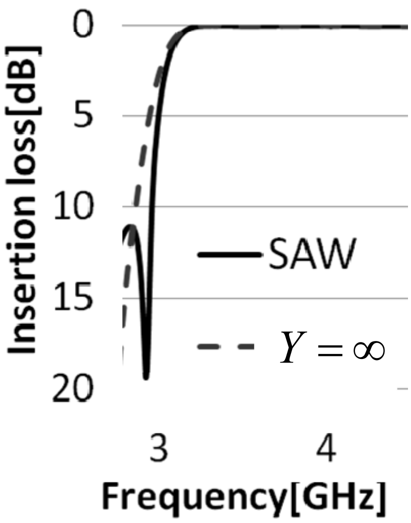


Fig.4 Simulation result.

4. Summary

In this study, we propose a new type of wide band low loss microwave filter, in which SAW device and microstrip line are effectively combined. The results shows the possibility of improving the cut-off property of the band-pass filter by using SAW devices.

References

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