The Effect of Chamfering Structure towards the Design of Open Loop Resonator Bandpass Filter for Microwave Applications

N. N. M. Noor, D. A. A. Mat, A. Amira, D. K. A. Zaidel, A. Joseph
Department of Electrical and Electronic, Faculty of Engineering,
Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak.
amdazra@feng.unimas.my

***Abstract*—Filter is the most essential components in the transceiver system. It is used to accept and reject any unwanted frequencies that falls out of the bands. Recently, the design of bandpass filter (BPF) has been a great challenges for RF designer. Although many researches have designed filter in the unlicensed frequency but most of the filter suffered from high insertion loss, inadequate selectivity and wider bandwidth. Therefore, this project design an Open-Loop Resonator Bandpass Filter (OLRBPF) to produce a low loss filter to operate at 2.4 GHz frequency. In order to overcome the high insertion loss, chamfered bend is introduced and implemented at the OLRBPF's structure. This will reduce the radiation loss produced and enhanced the coupling between both resonators of the filter. The results show that the proposed OLRBPF produce better insertion loss compare to conventional filter.**

***Index Terms*—Bandpass Filter; Chamfering; Coupling; Low Loss; Radiation Loss.**

I. Introduction

Recently, the design of bandpass filter (BPF) has been a great challenges for RF designer. Although many passive filters have been designed in the unlicensed frequency, but there are some lack in their filters such as high insertion loss and larger bandwidth allocated. Therefore, BPF with low insertion loss is preferable due to their importance in the transmission system. A perfect filter is able to pass the desired signal with zero insertion loss. But, this filter cannot be accomplished because there are always some loss happen due to reflections from the end terminations [1]. In order to design OLRBPF with low insertion loss, a method of chamfering the filter's structure is proposed. Chamfered bend is design to overcome the inevitable discontinuities at the bends of microstrip filters [2]. Besides, chamfered bend also help to minimize return and insertion loss in BPFs. As in previous research, the implementation of chamfered bend at the microstrip transmission line reduce the insertion loss significantly [3]. The research achieves a very good RF performance by utilizing chamfered bend on the signal conductor.

This paper presented the design of OLRBPF implemented with different types of chamfering bend to reduce the losses of the proposed filter design. The OLRBPF is designed on FR4 substrate with 1.6mm thickness and relative permittivity, ε_r of 4.6.

II. Design of OLRBPF

OLRBPF was introduced by a researcher name Hong in 1995 [4]. The filter structures has been widely used in many RF filter and wireless systems. The structures of OLRBPF can be constructed as a building block for planar microstrip filters that consist of folded half-wavelength resonator. It is composed of microstrip line with both ends loaded with folded stubs. The folded arms of the open stubs helps to increase the loading capacitance and it is designed for the purpose of inter-stage or cross couplings. The resonators shape could be design with any shape as long as it can match with different size of substrate. Obviously, OLRBPF help to obtain the transmission zeros in determining desired filter performance. The transmission zeros can be achieved by introduce cross coupling between the nonadjacent resonators. OLRBPF also provide some advantages to get the best filter performance such as easier to achieve a narrow bandwidth in order to produce the two attenuation poles. The cross-coupled structure is utilized to increase the selectivity characteristics with transmission zeros that can enhance the skirt rejection of microstrip filters. Figure 1 shows the configuration of OLRBPF filter.

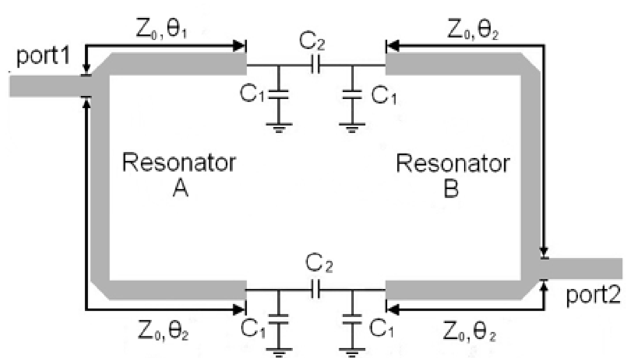

Figure 1: The equivalent circuit of OLRBPF [5]

OLRBPF with Chebyshev design is proposed to achieve a better filter performance. Chebyshev filter is a filter that can provide a great advantage to design the filter with the desired operating frequency.

Different types of filter shows the difference in terms of pass-band, transition region, stop-band and step response is