Design of Parallel Coupled Microstrip Bandpass Filter for FM Wireless Applications

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***Abstract*— Design, analysis and optimization of a parallel-coupled microstrip bandpass filter for FM Wireless applications is presented in this paper. The filter is designed and optimized at a center frequency of 6 GHz. Half wavelength long resonators and admittance inverters are used to design the filter. A brief description of coupled microstrip lines and immittance inverters is also included. Design equations to compute physical dimensions of the filter are given in the paper. The filter is simulated using ADS (Advanced Design System) design software and implemented on Roger 4003C substrate.**

Keywords- Bandpass filter; coupled microstip lines; immittance inverter; Method of moments.

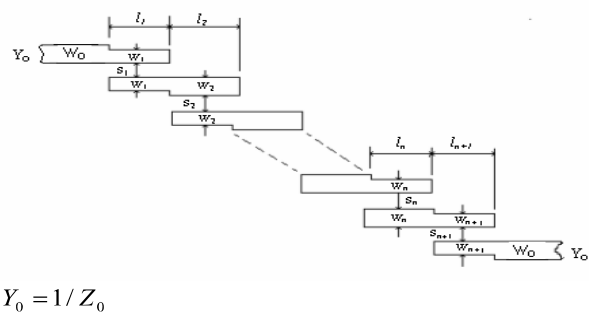
I. INTRODUCTION

Parallel coupled transmission-line filter in microstrip and stripline technology are very common for implementation of bandpass and band-stop filters with required bandwidth up to a 20% of central frequency. Due to their relatively weak coupling, this type of filter has narrow fractional bandwidth but instead has desired advantages such as low-cost fabrication, easy integration and simple designing procedure (designing equations for the coupled line parameters such as space-gap between lines and line widths and lengths, can be found in classical microwave books [1]. This way, following a well-defined systematic procedure, the required microstrip-filter parameters can be easily derived for Butterworth and Chebyshev prototypes [2].

This paper presents the design of a parallel-coupled microstrip bandpass filter centered at 6 GHz, bandwidth BW of 200 MHz with minimum attenuation of -15 dB at 6.2 GHz, pass-band ripple of 0.5 dB. This frequency band is used by FM Wireless communication. The filter is designed using half wave long resonators and admittance inverters. Theory of general immittance inverters and coupled lines is briefly described.

General layout of a parallel coupled microstrip bandpass and odd- mode characteristic impedances of parallel-coupled half-wave resonators are computed using admittance inverters. These even and odd mode impedances are then used to compute physical dimensions of the filter [3].

The filter is implemented on Roger 4003C substrate with dielectric constant of 3.38, loss tangent of 0.0021 and substrate height of 0.508 mm.



$$Y_0 = 1/Z_0$$

Figure 1. General layout of parallel coupled microstrip bandpass filter.

II. IMMITTANCE INVERTER

Immittance inverters play a very important role in filter design. They are used to transform a filter circuit into an equivalent form that can be easily implemented using various microwave structures. Immittance inverters are either impedance or admittance inverters. Because of the inverting action, a series inductance with an inverter on each side looks like a shunt capacitance and a shunt capacitance with an inverter on each side looks like a series inductance. Immittance inverters are shown in Fig.2.