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Design of a compact and sharp-rejection low-pass filter with a wide stopband

R.-Y. Yang[a], Y.-L. Lin[b], C.-Y. Hung[c]* and C.-C. Lin[d]

[a]*Department of Materials Engineering, National Ping-Tung University of Science and Technology, No. 1, Syuefu Road, Neipu Township, Pingtung 91201, Taiwan;* [b]*General Education Center, Wenzao Ursuline College of Languages, Mitsu 1st Road, Kaohsiung 807, Taiwan;* [c]*Medical Devices and Opto-electronics Equipment Department, Metal Industries Research & Development Center, 3F, No. 88, Luke 5th Road, Lujhu Township, Kaohsiung 82151, Taiwan;* [d]*Testing Application Section, Burn-In & Testing Application Develop-ment Division, King Yuan Electronics Co., Ltd., No. 118, Chung-Hua Road, Miaoli 350, Taiwan*

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In this paper, a compact and sharp-rejection low-pass filter is proposed and analyzed. By combining a stepped-impedance shunt open stub and two additional shunt open stubs, a compact low-pass filter with wide upper stopband and very high passband selectivity is realized. Wide stopband and sharp rejection characteristics are achieved by realizing three transmission zeros near the passband edges. This filter demonstrated very good measured characteristics at cut-off frequency (f_c) of 2.49 GHz, including a low insertion loss of 0.21 ± 0.05 dB, a wide stopband from 2.8 to 7 GHz and an attenuation slope of 49 dB/GHz. Experimental results also show a good agreement with the predicted results.

1. Introduction

In recent years, microwave communication system has been developed rapidly [1–5]. Low-pass filters (LPFs) are key components in modern microwave communication systems, especially in wireless and mobile communications [6]. For the demand of continuous developments, more stringent restrictions for LPF design are regulated to improve the quality of communication products, such as low insertion loss, high selectivity, high band rejection level, wide upper stopband, and minimum size. According to the above description, more and more reports about the LPF design are proposed. The most common design method of the LPF is using stepped-impedance microstrip line to form a wide upper stopband [7–10]. Hsieh and Chang proposed stepped-impedance hairpin resonator to form a low-pass response with the equivalent circuit analysis [11,12]. Some researches used defected ground structure (DGS) to create transmission zeros and the upper stopband. In general, the shapes of the DGS are designed according to the prototype of the lumped equivalent circuits of LPF [13,14]. However, the LPF of the above researches exhibit some disadvantage such as complex design process, poor passband selectivity, inaccurate design parameters, inevitable double-faced carving process, and less sharp attenuation.

In this paper, we propose a LPF with a simple design process. The proposed LPF is constructed mainly by a uniform microstrip line, a stepped-impedance shunt open stub, and

*Corresponding author. Email: goliro@mail.mirdc.org.tw

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