

MULTILAYER HAIRPIN BANDPASS FILTER FOR DIGITAL BROADCASTING

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Abstract

A design of multilayer hairpin bandpass filter at digital broadcasting frequency has been presented. This filter has been presented based on the design specification together with the analyses of the response on the parameter sweeps of coupling gap, width and length of the resonators, metal thickness, substrate thickness and the measurement result of the fabricated circuit. This research has proposed 2.45-2.53 GHz bandpass filter using hairpin resonator in multilayer configuration for digital broadcasting application. The four-pole hairpin resonators centered at 2.5 GHz with bandwidth less than 100 MHz were designed. The best return and insertion losses in the passband are -42.96 dB and -2.55 dB, respectively. Combination of hairpin resonator operating at desired frequency has been optimized and simulated on Flame Retardant 4 (FR-4) with dielectric constant 4.6 together with the analysis using Computer Simulation Technology (CST). Design filter has been fabricated and measured using Network Analyzer and have a good agreement with simulated response. The measurement results of S_{11} and S_{21} obtained from the fabricated circuit are -19.56 dB and -7.64 dB, respectively. The analyses have proven that the design work according to the microwave theory. In addition it was observed that a wider bandwidth was achieved by increasing the number of resonators.

1. Introduction

Digital broadcasting denotes a set of standards that aim to distribute broadcast signals in digital form in a specific and standardized way. The mode of distribution can be satellite, terrestrially or through cable. Recently, many countries worldwide are moving towards a revolutionary change to digital broadcasting including Malaysia. The digital signal broadcasting begins with a transmitter located at an uplink facility and finally received radio wave from satellite transponder at downlink receiver. The digital signal at the end users' site can be fed directly into the integrated digital receivers, or in a transition period, e.g. regarding TV, through a digital multimedia receiver or set-top-box (STB) to a regular analogue TV receiver. The latest spectrum allocations in Malaysia issued on June 2009 by Malaysia Communications and Multimedia Commission (MCMC) listed all frequency spectrum used for many applications which include the commercial broadcasting purposes such as FM radio and television channel.

Microwave bandpass filters are widely used in communication system as an electronic device or circuit that allows signals between two specific frequencies to pass through, and discriminates unwanted signals at other frequencies. Some bandpass filters require an external source of power and employ active components such as transistors and integrated circuits known as active bandpass filters. Other bandpass filters use no external source of power and consist only of passive components such as capacitors and inductors called passive bandpass filters.

Simple Multilayer Hairpin Bandpass Filter

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Abstract

This paper presents a 2.52 - 2.65 GHz two bandpass filters using hairpin resonators in a multilayer configuration for digital broadcasting application. A combination of four-pole hairpin resonators was designed to operate at center frequency of 2.58 GHz with a bandwidth of 60 MHz and 90 MHz, respectively. The circuit was simulated using Computer Simulation Technology (CST). The Rogers RO3003 and FR4 substrates with dielectric constant, ϵ_r of 3.0 and 4.6 each was used as material based. The results from the design show that the circuits are working well. Few parameters in the circuit were analyzed and have a good relationship to the microwave theory.

Keywords: Multilayer, hairpin, bandpass filter, digital broadcasting.

1. Introduction

Digital broadcasting is a set of transmission standards that aim to broadcast signals in digital form with a specific slant. The mode of distributions can be through a medium of satellite, terrestrial or cables. Recently, many countries worldwide are moving towards a revolutionary change to digital broadcasting including Malaysia. The digital signal broadcasting begins from a transmitter located at