

# Miniaturized Broadband Microwave Filter and Coupler

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## Abstract

This thesis introduces three kinds of microwave circuits including thin-film filter, broadband rat-race coupler, and broadband vertically installed planar (VIP) bandpass filter.

In this thesis, a thin-film filter is designed by utilizing the characteristic of thinner thin-film to realize the transmission line with very low characteristic impedance and combined with original transmission line to form a resonant cavity to minimize the dimensions. Besides, coupling coefficient method is used to analyze external quality factor and internal coupling coefficient, and then electromagnetic simulation tools are used to find out the corresponding dimensions of filter resonant cavity. In the end, second order and third order minimized filter with center frequency at 900MHz and ten percent bandwidth is designed and the length is minimized to the ten percent of the original dimensions.

A broadband rat-race coupler is designed by utilizing  $\lambda/4$  short-end coupler to replace the traditional  $3\lambda/4$  transmission line. This kind of short-end coupler can be equivalent to a quarter wave transmission line and a

ideal 180 degree phase shifter under the request that even mode impedance is much greater than odd mode impedance. This tight coupler is designed by using VIP to reach the wanted odd and even mode impedances. At last, a broadband rat-race coupler with center frequency at 2GHz and 77.5% bandwidth is implemented.

Then, a wideband filter is designed by using VIP coupler to get the characteristic of tight coupler; parallel coupler-line filter is adopted as the structure and the  $\lambda/2$  resonator is replaced by step impedance resonator(SIR). Utilizing the resonance characteristic of SIR to put the second resonance frequency farther to improve the upper stopband rejection. Finally, a broadband filter with center frequency at 3GHz and 66.67% bandwidth, and second resonance frequency at the four times center frequency is presented.

