Balanced Dual-Bandpass Filter Based on Embedded Resonators with Magnetic Coupling

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Balanced or differential circuit implementations provide better S/N ratio and noise immunity than the single-ended ones. Besides, they lead to the reduction of crosstalk and electromagnetic interference (EMI). These facts have stimulated the rise of the use of balanced circuits in digital/analog applications. In the microwaves range, this growth has been experienced during the last decade. Nowadays, due to the current trend towards multiband services, the development of balanced versions of multiband components, especially filters, has become mandatory since they play a fundamental role in any modern communication system. For correct and ideal operation, any balanced dual-band filter must provide good differential-mode (DM) performance and, simultaneously, strong common-mode (CM) rejection ratio (CMRR) over the whole range of frequency of interest. Several strategies and technologies have recently been proposed in the open literature to achieve the aforementioned goals. Thus, classical coupled microstrip resonators with defected ground structures (DGS) [1] and filters based on substrate integrated waveguide (SIW) technology [2] are good examples. In this work, magnetic coupling [3] is used to design a balanced dual-bandpass filter with intrinsic common-mode rejection. The two differential passbands are created by means of embedded resonators, whose layout is depicted in Figure 1(a). Embedded structures allow not only to design multiple pass-bands but also reduce the filter size, thus leading to high levels of miniaturization. A filter prototype is fabricated and measured to experimentally demonstrate these concepts. Simulated and measured scattering parameters are depicted in Figure 1(b), and very good agreement has been found. A reasonably good DM response can be observed, with two well-defined differential passbands and good isolation between them. In addition, a CMRR better than 45 dB has been measured in the low-frequency passband, being this parameter about 30 dB in the second band. A photo of the fabricated prototype is included as an inset in Figure 1(b).

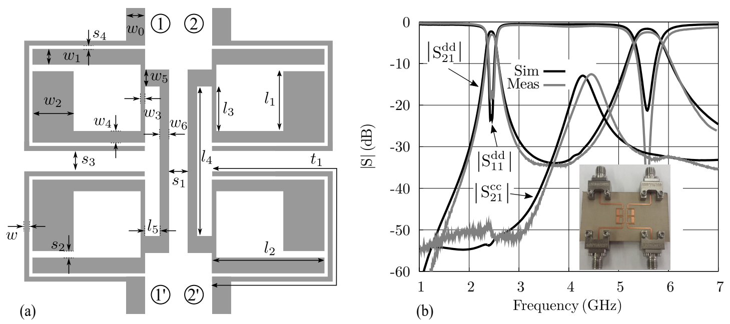

Figure 1. (a) Layout of the filter. Dimensions (in mm): $w = w_3 = s_2 = 0.2$, $w_0 = 0.75$, $w_1 = 0.21$, $w_2 = 1.58$, $w_4 = 0.33$, $w_5 = 0.6$, $w_6 = 0.35$, $s_1 = 0.58$, $s_3 = 0.22$, $s_4 = 0.15$, $l_1 = 2.9$, $l_2 = 3.97$, $l_3 = 2.41$, $l_4 = 6.4$, $l_5 = 0.55$ and $t_1 = 12.97$. Substrate: $\varepsilon_r = 5.9$, $h = 0.508$ mm, $\tan\delta = 0.0025$. (b) Simulated and measured response.

References

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