Quasi-Reflectionless Bandpass Filters with Flat In-band Group Delay

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This paper reports on a new class of input-reflectionless RF bandpass filters (BPFs) with flat in-band group delay (τ_g) to address the issue of undesired power reflection in the active stages of sensitive RF front-ends. The power that is reflected back into components such as LNAs can disrupt their operation and desensitize the receiver chain. To this end, the realization of BPFs that are able to absorb the reflected power at the stopband areas (i.e, input-reflectionless or absorptive) is highly desirable to obviate the need for isolators and circulators that are traditionally used as matching blocks between stages. In this manner, RF front-ends that are significantly smaller in size and exhibit higher levels of signal-to-noise-ratio can be created. Whereas significant work has been presented on reflectionless bandstop filters (BSFs) (*D. R. Jachowski, "Compact, frequency-agile, absorptive bandstop filters, IEEE MTT-S IMS, 2005)* the design of reflectionless BPFs remains unexplored.

Taking into consideration the aforementioned limitations, this work reports on the design of a quasi-reflectionless BPF with flat in-band τ_g. It is based on a complementary duplexer approach that comprises two channels with opposite transfer functions. The main channel is shaped by a second order BPF whereas the auxiliary channel is formed by a terminated first order BSF. The filter design is performed as follows. First, the impedance inverters of the main channel are specified through coupled resonator synthesis using the normalized element values of the low-pass Gaussian-type prototype. Then, the inverter values of the auxiliary channel are optimized with the purpose of retaining flat in-band τ_g and input reflection <10 dB for both its passband and stopband areas. For proof-of-concept demonstration purposes the RF performance of a microstrip-type BPF was analyzed using linear circuit analysis and electromagnetic simulations. It exhibits a center frequency of 3 GHz, bandwidth of 320 MHz, insertion loss of 0.21 dB and in-band τ_g of 1.40 ns. Further details on this concept will be presented at the conference.

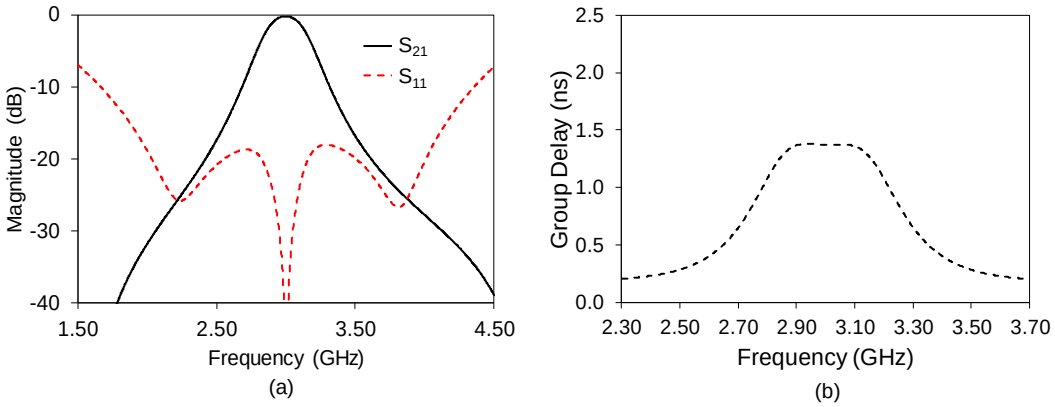

Figure Frequency response of the quasi-reflectionless BPF (a) S-parameters (b) τ_g