GaAs MMIC Interferometer for Interference Cancellation

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Broadband receivers are often subject to unwanted signals from both internal and external sources, which can overload the analog to digital converter (ADC). These unwanted signals may be at any frequency in the band and may change over time, so a static notch filter cannot always be used. A possible solution are electronically-tuneable passive filters, but these are often large and lossy. Another approach are analog finite impulse response (FIR) filters, which have been implemented as equalizers in optical communication systems (S. Reynolds et al., *IEEE International Solid-State Circuits Conference, pp. 330-601, 2005* and J. Lee and A. Freundorfer, *IEEE Photonics Technology Letters, 12, 2, pp. 196–198, 2000.*). A similar idea was used in RFID for leaking carrier suppression with an interferometer circuit designed for the carrier signal (G. Lasser et al., *2012 IEEE/MTT-S International Microwave Symposium Digest, pp. 1–3, 2012*).

Here this idea is extended to an active circuit that applies vector addition to eliminate interference by using just one input signal. The circuit has an interferometer architecture that creates a tunable spectrum notch placed over an unwanted signal to reduce the needed dynamic range on the ADC. The block diagram of the circuit is shown in Fig. 1(a). The input signal is split equally into two paths by a coupler. One path consists of just a gain stage while the other has a gain stage followed by an artificial transmission line. The artificial line is made of discrete inductors and varactors implemented with transistors with grounded drain and source terminals. By controlling the varactor reviser bias voltages, the total phase delay of the path is adjusted. When the two paths are 180° out of phase, destructive interference allows only small amounts of total transmission. Due to more loss in the path with the tunable transmission line, the gate voltages of the two gain stages can be adjusted to keep the amplitude of the signals at the end of the two paths similar. This topology is demonstrated in WIN Semiconductors' GaAs enhancement (E-mode) PIH10 process. The simulated and measured results are shown in Fig. 1(b) and (c) respectively. The circuit is well matched ($|S_{11}|$ and $|S_{22}|$ below -10 dB) from 8–12 GHz. The null is tunable across most of X-band, in simulations from 11.3 GHz to 8.5 GHz, and in measurements from 10.8 GHz to 8.2 GHz when adjusting the dc tuning voltage from -0.7 V to 0.7 V.

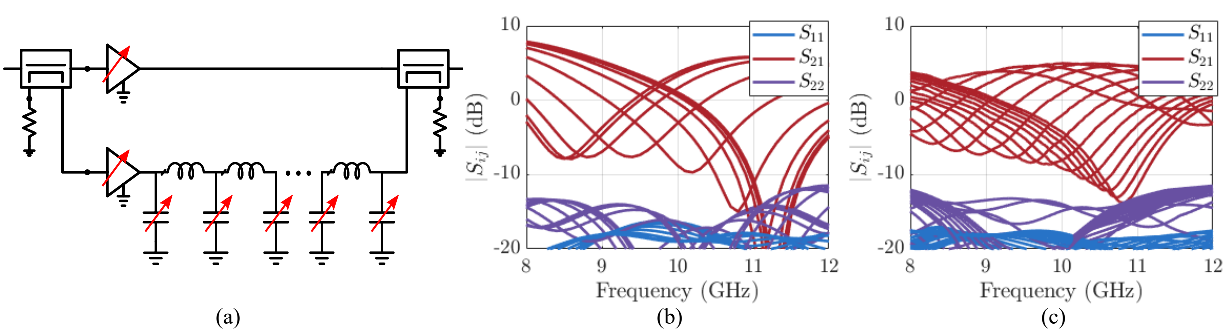

Figure 1: (a) Block diagram of the interferometer topology. Simulated (b) and measured (c) performance of the interferometer chip when the control bias is varied from -0.7 V to 0.7 V.