Abstracts

Active Impedance Matching for Microwave Acoustic Delay Lines

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Recently, it has been shown that an inverted common-collector transistor circuit can be used to synthesize a high-Q inductance that is useful at microwave frequencies for realizing filters, matching networks, multiplexer, and other normally passive components. The basic transistor circuit is shown in Fig. 1(a). The principle of operation may be explained with the aid of Fig. 1(b), which shows the focus of the quantity (1 - alpha) in the complex plane as a function of frequency. (alpha is the short-circuit current gain of the transistor and omega/sub alpha/ is the alpha-cutoff frequency.) It is seen that the circuit is basically an impedance rotator. If Z is a resistor (in the base), a virtual inductance is seen at the emitter; if Z is an inductance, a virtual negative resistance appears at the emitter. Typical experimental plots of the real and imaginary parts of Z', the impedance seen at the emitter, as functions of frequency are shown in Fig. 2. The ability to synthesize both an inductance and a negative resistance places this circuit in a unique position with regard to its use in the realization of impedance-matching networks for microwave acoustic delay lines. This is because the negative resistance can be used to compensate exactly for the positive resistances that represent electrical dissipation losses in the transducer and matching network. The significance of this technique will be made clear in what follows.

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