A Capacitor-Transformer Gyrator Realization

Recently [1] we have shown that some nonreciprocal time-invariant networks are equivalent to time-variable ones constructed only from resistors, inductors, capacitors, and transformers. For all linear finite time-variable networks it is further known that, even in the active case, all the time variation can be placed in the transformers, provided reasonable smoothness constraints are imposed on the element values associated with the time variation [2]. The natural question then arises: "Can all linear, finite, nonreciprocal time-invariant networks be realized by time-invariant resistors, capacitors, inductors, and time-varying transformers?" The answer is in the affirmative, since, as we now show, the gyrator can be so realized.

For a realization of the gyrator in the desired form we merely cancel the capacitors in a previous realization [see [1] Fig. 2(a)], to obtain Fig. 1. It should be observed that a three-terminal gyrator results and that active elements (negative capacitors) are used. In the standard manner [see [3] p. 161] the two-port (four-terminal) gyrator can be obtained by inserting an isolation transformer (one-one turns ratio) at the input or output. The case of nonunity gyration resistance can be handled in a similar manner with a transformer at one of the ports to change the impedance level, or simply by scaling the capacitors.

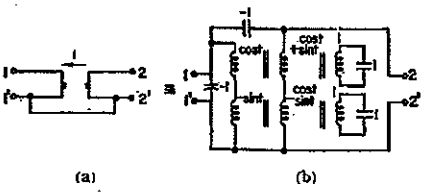

Fig. 1. Gyrator equivalent circuit.

In summary, besides adding another method of gyrator realization to the somewhat more practical ones already in existence, [4]–[8], we have shown, in conjunction with a previous note [2], the theoretically important result that all finite networks can be realized with time-invariant resistors, capacitors, and time-variable transformers.

B. D. O. Anderson
R. W. Newcomb
Stanford Electronics Labs.
Stanford, Calif.

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