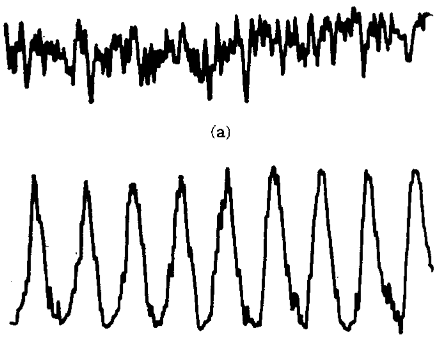
(a)

(b)

Fig. 1. Current variations with applied voltage slightly above threshold. (a) No magnetic field. (b) 3 000-Gs field perpendicular to current.

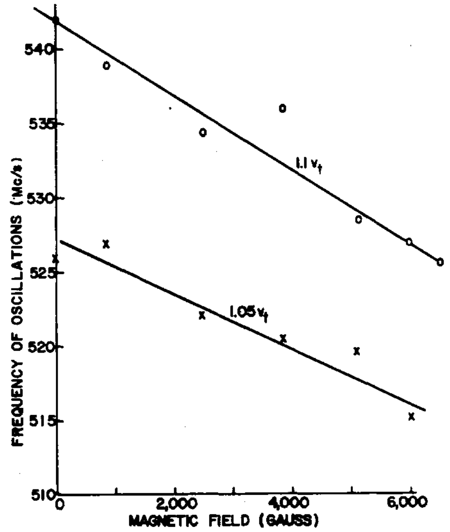

Fig. 2. Frequency variation with magnetic field for constant applied voltages.

sampling oscilloscope [Fig. 1(a)]. A magnetic field was applied, transverse to the current direction, and rotated about the sample. The current variations with time became coherent at about 500 Mc/s for three orientations of the magnetic field, separated by 120 degrees for the triangular samples [Fig. 1(b)]. This corresponded to the magnetic field being parallel to each of the cleaved faces so that the electrons would be deflected from the surface if the Hall Effect is neglected.

The current instability was damped when the magnetic field was reversed by 180° from the favorable orientation. The current would not oscillate coherently regardless of the applied voltage with magnetic fields above approximately 3000 Gs in this unfavorable orientation.

The parallelogram-shaped samples with four cleaved edges showed no variation with the rotation of the magnetic field. This could be explained by two parallel cleaved edges. When one edge was in the favorable orientation, the other was unfavorably orientated. A variation was observed by damaging one of the parallel edges. The single cleaved edge then had the same dependence on magnetic field as previously discussed for the triangular samples.

An additional effect of the transverse magnetic field was to decrease the frequency of oscillations (Fig. 2). This occurred when the applied voltage was on the lower edge of the region for coherent current oscillations. The field was again orientated parallel to a cleaved edge with the electrons being deflected from the surface. The expected decrease in frequency due to a magnetic field was calculated. These results approximated the experimental values for low values of the magnetic field. At the higher fields there was considerable deviation due to the quadratic dependence of the calculations.

With higher applied voltages the amplitude of the current oscillations was decreased regardless of field orientation as previously reported by Foyt and McWhorter.

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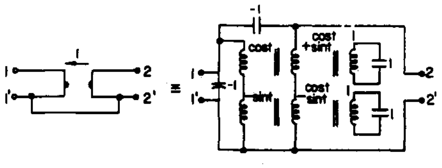
A Capacitor-Transformer Gyrator Realization

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.



(a) (b)

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.

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Optimum Estimation of the Mean of a Gaussian Random Process

The restricted utility of the linear mean value estimator of a continuous time random process was discussed in the correspondence by Fine and Johnson.[1] It is the object of this correspondence to show a reasonable intuitive connection to a more generally arrived at "optimum" estimator for the case of Gaussian distributions.

In discrete time formulation, both general maximum likelihood and minimum variance estimations lead to the same result,

$$m^* = \frac{\tilde{V}K^{-1}U}{\tilde{U}K^{-1}U}$$

where V is an $n \times 1$ column matrix of observations with Gaussian distribution and mean

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[1] T. Fine and N. Johnson, On the estimation of the mean of a random process, *Proc. IEEE* (*Correspondence*), vol. 53, pp 187–188, February 1965.