One-chip gyrator simplifies active filter

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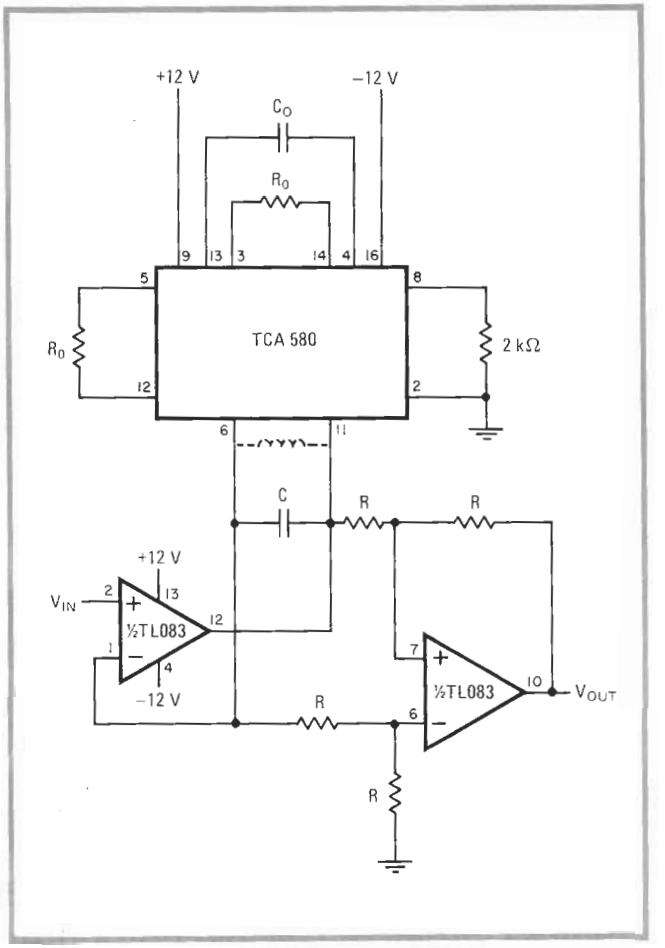
Now that gyrators, or impedance inverters, are available on a single integrated circuit, active filters with both high input impedance and few component-sensitivity problems can be easily built in a small area with a minimum of parts. This one uses only one other active component—a dual operational amplifier—to provide low-pass, high-pass, bandpass, or band-reject response at reasonable cost over the dc range to 10 kilohertz.

The low-cost TL-083 op amp has been selected for use in the circuit because of its virtually negligible input-offset voltage and input-bias current. These characteristics are required to achieve a high input impedance over the range of interest and to realize the optimum response of the filter.

The Signetics TCA 580 gyrator simulates the relatively large inductor needed for the required LC (passive) network. The inductance across pins 6 and 11, and thus in parallel with capacitor C, is $L = C_0R_0^2$. The resonant (center) frequency of the LC combination, in turn, is $f_0 = 1/2\pi\ (LC)^{1/2}$, with its quality factor $Q = R(C/L)^{1/2}$. Thus the filter, which is shown configured on the bandpass mode, can be made to work at any frequency and Q, once its components are suitably selected.

The circuit can be transformed into a low-pass filter if its output is applied to an integrator whose time constant is RC. Similarly, it will function as a high-pass filter if its output is applied to a differentiator whose time constant is RC. For band-reject operation, C must be placed in series with the simulated inductor. □



Optimal. Gyrator and operational amplifier comprise a simple two-chip bandpass filter with high impedance and state-of-the-art stability. Filter configuration remains the same for high-pass and low-pass operation; only an external differentiator or the integrator, respectively, need be added. For the band-reject mode, C is placed in series with a simulated inductor.