Cheap and easy inductance tester uses few components

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In the absence of expensive test equipment, the circuit in Figure 1 offers a simple and rapid alternative method of measuring inductance. Its applications include verifying that an inductor’s value falls close to its design parameters and characterizing magnetic cores of unknown parameters that accumulate in the “junk box.” As designed, the circuit tests most inductors for use in power supplies and many inductors for RF circuits.

The circuit comprises two cascaded common-emitter-amplifier stages that form a nonsaturating, cross-coupled flip-flop. A common-emitter stage performs a phase inversion, and two cascaded stages form a noninverting feedback amplifier with gain that produces regeneration. Without the presence of the inductor that is undergoing test, L, regeneration occurs at dc, and the circuit behaves as a bistable flip-flop that assumes either of two stable states. Connecting the inductor reduces the dc positive feedback to below the regeneration level. Thus, regeneration can occur only at ac, and the circuit becomes an astable oscillator.

Keeping the transistors out of saturation speeds the circuit’s operation by minimizing the transistors’ storage time. Although virtually any type of high-speed, small-signal RF transistor provides adequate switching speed, lower frequency devices also work but decrease the low-
inductance-measurement range. The circuit’s frequency of oscillation is inversely proportional to the inductance that is undergoing test, and you can use either a frequency counter or an oscilloscope to measure the frequency of oscillation.

**Figure 2** shows the waveform produced by an inductor with a value of approximately 100 µH. The frequency of oscillation depends on the L/R time constant comprising the inductance under test and resistors $R_L$ and $R_C$. The time the waveform takes to change its state is directly proportional to the inductance, and, for one-half cycle, it approaches $T_{\text{HALF}} = L/100$. The period of a full oscillation cycle is twice that amount, or $T_{\text{FULL}} = L/50$. Solving for the inductance yields $L = 50 \times T_{\text{FULL}}$. As an alternative, the frequency is inversely proportional to the inductance, or $f_{\text{OSC}} = 50/L$. Using a frequency counter allows measurement of inductance as $L = 50/f_{\text{OSC}}$.

![Waveform](image)

**Figure 2** Testing an inductor with a value of approximately 100 µH produces this output waveform.

The circuit’s finite switching speed of approximately 10 nsec imposes a lower floor of 1 µH on its measurement range. You can measure a small inductance by connecting it in series with a larger inductance, noting the reading, measuring the larger inductance alone, and subtracting the two measurements.

Although the circuit imposes no upper limit on inductance values, when the inductor’s ESR (equivalent-series resistance) exceeds approximately 70Ω, the circuit stops oscillating and reverts to bistable operation. The circuit measures values of all inductors and transformer windings except for small, low-frequency iron-core devices that present a high ESR. For greatest accuracy, use a low-input-capacitance instrument to measure the frequency of oscillation.

A single NiCd (nickel-cadmium) or NiMH (nickel-metal-hydride) rechargeable cell provides power for the circuit. These cells present a relatively flat voltage-versus-time discharge characteristic that enhances the circuit’s measurement accuracy. The circuit consumes approximately 6 mA during operation.

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