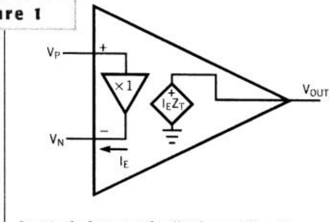
Edited by Bill Travis

RF oscillator uses current-feedback op amp

Victor Koren, Tioga Technologies Ltd, Tel Aviv, Israel

A CURRENT-FEEDBACK AMPLIFIER is a well-known component with many uses. Its basic block diagram shows that its input stage is a voltage follower—in practice, a symmetrical emitter follower (**Figure 1**). The configuration samples the output current, converts it to voltage across a large impedance, and amplifies it to the output using a high-power, low-output-impedance amplifier. The idea is to use the amplifier's input stage as a voltage follower in a basic Colpitts oscillator. This circuit uses the noninverting input of the current-feedback amplifier as the follower input and the inverting input of the amplifier as the follower output. You use the output amplifier to obtain a relatively high-power buffered output. The circuit in **Figure 2** shows a basic Colpitts oscillator that uses the amplifier's input-voltage follower as the active element of the oscillator.

Figure 1



In a typical current feedback amplifier, the input stage is a voltage follower.

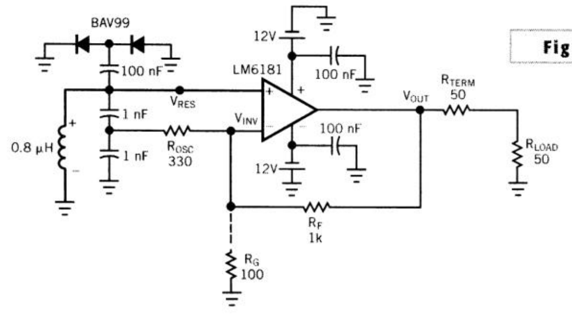
Take note of two aspects of this oscillator circuit: First, back-to-back diodes connect across the resonator to limit the oscillations to a specific level, thus maintaining the linearity of the voltage follower. Second, the voltage follower output connects to the resonator tap through resistor R_{OSC} to improve the linearity and define the feedback magnitude. The value of R_{OSC}, 330Ω, lets you obtain soft clipping operation of the diodes across the resonator (V_{RES}=1V p-p, which is 0.5V peak across each diode). **Figure 3** shows V_{RES}, the measured voltage at the top of the resonator. R_F is the amplifier's feedback resistor; the amplifier's manufacturer recommends its value. This design uses the LM6181 from National Semiconductor (www.national.com), and the value of R_F is 1 kΩ.

It is easy to calculate the output voltage: V_{RES}=1V p-p, and $V_{INV}=V_{RES}$=1V p-p. The voltage-buffer gain is unity: $V(R_{OSC})=V_{INV}-V_{RES}/2$. The voltage at the resonator tap is $V_{RES}/2$, because the resonator capacitors are equal in value. $V(R_{OSC})=V_{RES}-V_{RES}/2$=0.5V p-p. $I(R_{OSC})=V(R_{OSC})/R_{OSC}$. $I(R_F)=I(R_{OSC})$. The negative feedback nulls the amplifier's inverting-input current. $V_{OUT}=V(R_F)+V_{INV}=R_F\times I(R_F)+V_{INV}=1000\times(0.5/330)+1$=2.51V p-p. If you need more voltage, you can add R_G—in this case, 100Ω—from the inverting input to ground. $I(R_G)=V_{INV}/R_G$. Now, the current through R_F is the sum of the currents through R_{OSC} and R_G. So, $V_{OUT}=V(R_F)+V_{INV}=R_F\times I(R_F)+V_{INV}=1000\times(0.5/330+1/100)+1$=12.51V p-p. **Figure 4** shows the measured output voltage.

The LM6181's maximum output current is 100 mA, so it can easily drive a current of ±63 mA p-p (±6.3V/100Ω) into a total load of 100Ω (50Ω output-termination resistor and 50Ω load resistor). The voltage across the 50Ω load is 3.15V peak, or 2.23V rms, which is close to 20 dBm (100 mW). This power level can directly drive high-level diode double-balanced mixers, or it can drive a higher power amplifier while delivering a clean sinusoidal waveform. You can modify the resonator circuit to accommodate differ-

Publish your Design Idea in *EDN*. See the What's Up section at www.edn.com.

Figure 2



This Colpitts oscillator uses a current-feedback amplifier to provide a clean sinusoidal output.

ent tuning elements. You can use the circuit as a crystal oscillator by changing the inductor to a crystal and changing the resonator capacitors to an appropriate value, such as 2×68 pF. You need a high-value, such as 10-kΩ, bias resistor from the noninverting input to ground to provide bias current to this input.

Is this the best Design Idea in this issue? Select at www.edn.com.

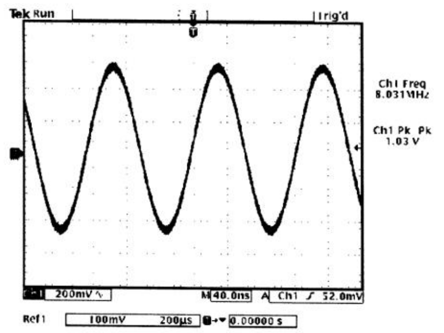


Figure 3 This clean sinusoid is the signal at the top of the resonator, V_{RES}, in Figure 1.

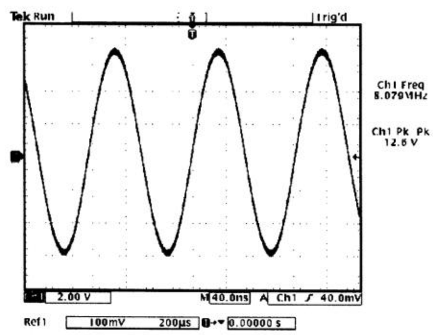


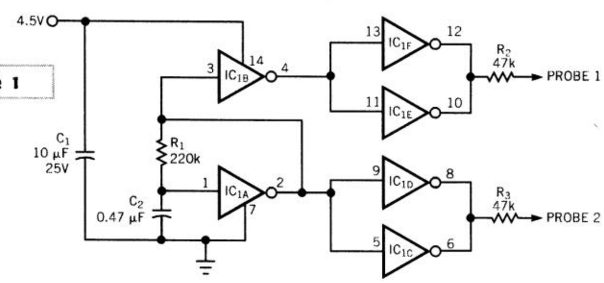
Figure 4 The Colpitts oscillator in Figure 2 produces a pure sinusoidal output.

Simple tester checks LCDs

D Prabakaran, NL Polytechnic College, Tamil Nadu, India

MANUFACTURERS of electronic equipment use LCDs for calculators, watches, mini-videogames, and pagers, for example. In comparison with LED-based displays, which consume power on the order of tens of milliwatts, an LCD consumes only a few microwatts. The LCD thus saves power by a factor of approximately 1000. Checking an LED is as simple as checking a semiconductor diode but, in the case of LCDs, involves some added complexity. An LCD requires an ac electric field to excite the organic compound in the display. Applying a dc voltage could permanently damage the LCD. The circuit in **Figure 1** is a simple configuration to test the performance of an LCD. The circuit produces biphase square waves with negligible dc content. The circuit is based on a CD40106 hex Schmitt-trigger inverter. The circuit comprises an oscillator, IC_{1A}; a phase splitter, IC_{1B}; and a pair of buffer/drivers comprising IC_{1C}/IC_{1D} and IC_{1E}/IC_{1F}.

Figure 1



This simple circuit tests LCDs by producing a biphase square wave with no dc component.

The buffers and drivers connect to test probes through 47-kΩ series resistors, which protect the IC in the event of short circuits. With the component values shown in **Figure 1**, oscillator IC_{1A} provides a square-wave frequency of approximately 45 Hz. The circuit can operate from 3 to 5V. To test any segment of an LCD, touch the backplane using either of the two test probes while touching the segment with the other probe. If the segment under test is operational, it will light up. If the LCD under test is a multiplexed type, then all segments, which are connected, will glow if they are operational. Usually, the rightmost or leftmost connection is the backplane of the LCD. If it is not, you have to find it by trial and error.

Is this the best Design Idea in this issue? Select at www.edn.com.