

# CMOS inverter VCO tunes octave to UHF

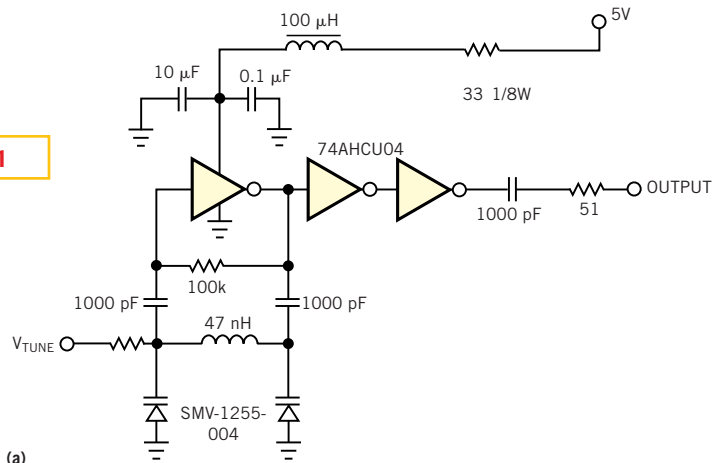
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**A** robust and versatile VCO provides a stable output to 300 MHz (Figure 1). The circuit's simplicity, unconditional stability, and consistent high-drive capability over an octave make the oscillator ideal for many applications, such as synthesized sources, local oscillators, and transmitters. The AHC logic family (Texas Instruments, www.ti.com) makes the circuit's performance possible. AHC is a relatively new line of CMOS logic whose high speeds and good noise performance allow oscillator operation into regions in which bipolar-junction-transistor and FET designs prevail.

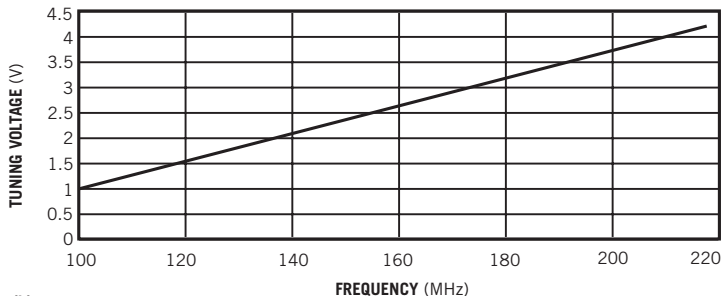
The oscillator topology is a modified Colpitts oscillator for which two hyperabrupt varactor diodes create the capacitive divider. The SMV-1255-004 (Alpha Industries, www.alphaind.com) encloses two varactors in one SOT-23 package (Figure 1a). The capacitance-voltage ratio of these varactors allows linear tuning over an octave with less than 4V (Figure 1b). You can substitute other varactors as long as the loaded Q of the resonant circuit is high enough to ensure start-up oscillation, but tuning characteristics may change. The inductor is a wound spring type chosen to maximize resonant Q. Oscillation is unstable when you use a low-Q, surface-mount-wound, chip-type inductor. The 100-k $\Omega$  resistor biases the gate to provide the gain and the 180° of phase shift necessary for oscillation. A lowpass filter with a low-frequency cutoff is highly recommended on the IC's power pin. Without this filter, incidental modulation from power-supply noise and pickup easily contaminate the oscillator signal. A dedicated voltage regulator is also recommended in noisy environments, but the filter is still necessary to keep the signal as clean as possible.

With a 5V supply, current consumption is approximately 25 mA $\pm$ 1 or 2 mA, depending on the frequency of oscillation. Using a 33 $\Omega$  series resistor can reduce the current to 18 mA and supply enough power for reliable oscillation. The cascaded gates provide extra buffering and drive; the output resistor improves match with additional buffering. If your design needs a known constant output imped-

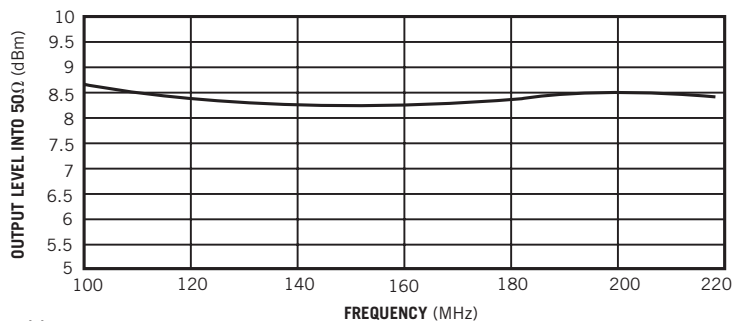
Figure 1



(a)



(b)



(c)

A 300-MHz VCO (a) uses varactor diodes with a capacitance-voltage ratio that allows linear tuning over an octave with less than 4V (b). A high-drive capability over an octave (c) makes the oscillator ideal for many applications.

ance, you can substitute a resistive match pad for the output resistor and maintain a considerable output level. Figure 1c shows the drive capability over frequency at mid-VHF, as well as level variation of less than 0.5 dB over the selected octave. Temperature effects on level are minimal with less

than 1-dB change over 0 to 75°C, and worst-case harmonics are always better than -12 dBc. (DI #2294)

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