

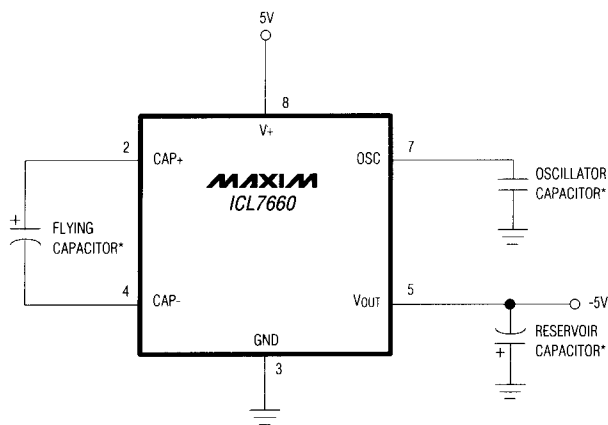
DESIGN SHOWCASE

Lower Operating Frequency Improves ICL7660 Voltage-Conversion Efficiency

You can improve the efficiency of an ICL7660 voltage-conversion circuit by lowering the oscillator frequency and increasing the external capacitor values. Though useful for modest levels of I_O , this technique is not clearly described in the data sheet. (The CMOS ICL7660, available in an 8-lead DIP or TO-99 can, is a charge-pump device that converts inputs in the range 1.5 to 10V to corresponding negative outputs in the range -1.5 to -10V.)

The ICL7660's conversion efficiency depends on its quiescent supply current, which in turn depends on the internal charge pump's drive frequency. The chip's oscillator and divide-by-two circuit normally set the frequency between 4 and 5kHz. Using the recommended 10 μ F values for the flying capacitor and the reservoir capacitor, this configuration consumes about 70 μ A of quiescent supply current while providing a conservative 20mA of output current.

Increasing the frequency by overriding the oscillator with an externally applied signal causes a proportional increase in the quiescent current. Or, connecting an external oscillator capacitor to pin 7 (Figure 1) slows the oscillator,



* See Text For Values

Figure 1. Adding an oscillator capacitor to the typical ICL7660 application lowers the oscillator frequency, which for lower values of I_O results in more efficient voltage conversion.

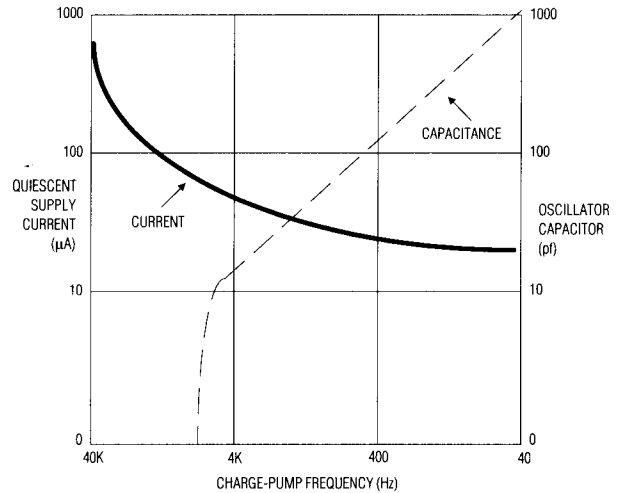


Figure 2. The "capacitance" curve relates the value of oscillator capacitor chosen in Figure 1 to the resulting charge-pump frequency. The "current" curve relates charge-pump frequency to the resulting quiescent supply current (left vertical axis).

causing supply current to approach a minimum value of about 10 μ A at 40Hz (Figure 2).

Slowing the oscillator improves efficiency, but to avoid a corresponding increase in ripple voltage you must also make inversely proportional changes in the flying capacitor and the reservoir capacitor. For example, setting the oscillator to 400Hz by connecting 100pF to pin 7 requires that you increase the flying and reservoir capacitors to 100 μ F. Such an arrangement still provides 20mA of output current but consumes only one fifth the quiescent current (15 μ A).

Note that you can reduce the capacitor values if lower I_O is allowed. Setting the oscillator to 40Hz, for example, (by connecting 1000pF to pin 7) provides the highest efficiency possible. Leaving the flying and reservoir capacitors at 100 μ F gives a maximum I_O of 2mA, a no-load quiescent current of 10 μ A, and a power-conversion efficiency of 98%.

(Circle 5)