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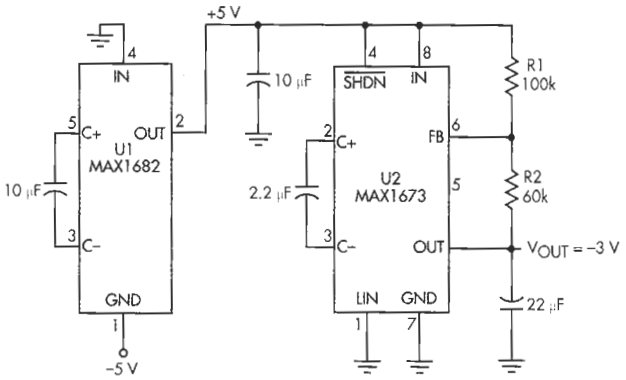
Step Down A Negative Voltage Without Using An Inductor

When you need to step down a negative voltage in a low-current application, a non-inductor configuration offers two advantages: ease of use and a low number of external components. Such step-down converters can be implemented with two charge-pump devices. The first produces a positive output by doubling and inverting the negative input voltage, and the second acts as an inverter to produce the desired negative output *(Fig. 1)*. Input and output capabilities for the circuit depend on the input/output voltages allowed by the IC components chosen.

U1, a switched-capacitor voltage doubler, accepts the −5-V input and produces a +5-V output. A regulated voltage inverter (U2) then accepts the +5 V and produces a −3-V output. A voltage divider at U2's output (R1/R2) provides feedback for regulating U2's output voltage to the desired level (V_{OUT}). The threshold voltage at U2's FB input is factory-set to zero.

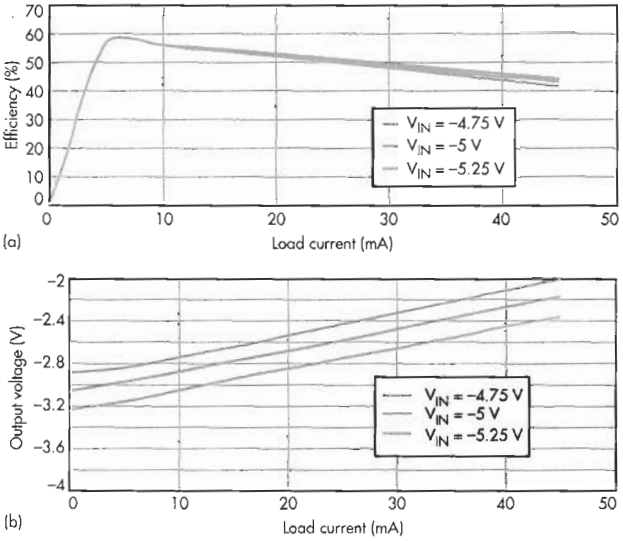
You can choose the values for R1 and R2 using:

$$R2 \times (5\ V/R1) = -V_{OUT}$$



1. Using two charge-pump devices and very few external components, this circuit steps down a negative voltage without requiring an inductor.

plus the condition that their sum should allow a minimum current flow of 50 µA. The accuracy of V_{OUT} depends largely on the accuracy of the −5-V input. Figure 2 depicts the circuit efficiency and output regulation for inputs of −4.75 V, −5 V, and −5.25 V.



2. These graphs show the efficiency versus load (a) and load regulation (b) for the circuit in Figure 1 at V_{IN} levels of −4.75 V, −5 V, and −5.25 V.

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