APPLICATION NOTE 3659

Simple Circuit Converts +5V to -10V

Dec 14, 2005

Abstract: This simple charge-pump voltage inverter produces more than -10V at no load, and more than 200mA while the output voltage remains greater than the input.

The versatile switched-capacitor charge pump is easy to use and requires no inductor. It can double a positive voltage or convert a positive voltage to negative.

For some applications in which only a positive supply is available, the system must generate a negative voltage of larger magnitude than the positive rail. For that purpose, the circuit of Figure 1 inverts the input voltage and doubles the resulting negative output at the same time. The voltage inverter shown (IC1) converts a positive input to a negative output voltage, normally with an absolute magnitude lower than that of the input. But in this circuit, the two Schottky diodes and the two capacitors at the output produce a higher output voltage.

![Circuit Diagram](image)

Figure 1. This simple circuit derives -10V from +5V.

The expected output is \( V_{\text{OUT}} = -(2V_{\text{IN}} - 2V_D - I_{\text{OUT}}^* R_O) \), where \( V_D \) is the voltage drop across a diode,
$I_{OUT}$ is the output current, and $R_O$ is the output resistance. While the maximum expected voltage is -10V, overshoot across the capacitors due to parasitic inductance in the capacitors and traces produces more than -11V at no load (Figure 2).

![Charge-Pump Output Voltage vs. Current Graph](image)

**Figure 2.** The circuit in Figure 1 above produces more than -10V at no load, and more than 200mA while the output voltage remains greater than the input.

This design idea appeared in the May 26, 2005 issue of *EDN* magazine.

### Related Parts

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<td>High-Frequency, Regulated, 200mA, Inverting Charge Pump</td>
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