Keywords: negative stepdown converters, charge pumps, inverting charge pumps, doubler charge pumps,

APPLICATION NOTE 4500

Negative Step-Down Converter Requires No Inductor

Aug 09, 2010

Abstract: This circuit uses two charge-pump devices to step down a negative voltage. 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. Input and output capabilities for the circuit depend on the input/output voltages allowed by the IC components chosen.

A similar version of this article appeared in the May 7, 2009 issue of *Electronic Design* magazine.

To step down a negative voltage in a low-current application, a non-inductor configuration combines ease of use with 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. Input and output capabilities for the circuit depend on the input/output voltages allowed by the IC components chosen (**Figure 1**).

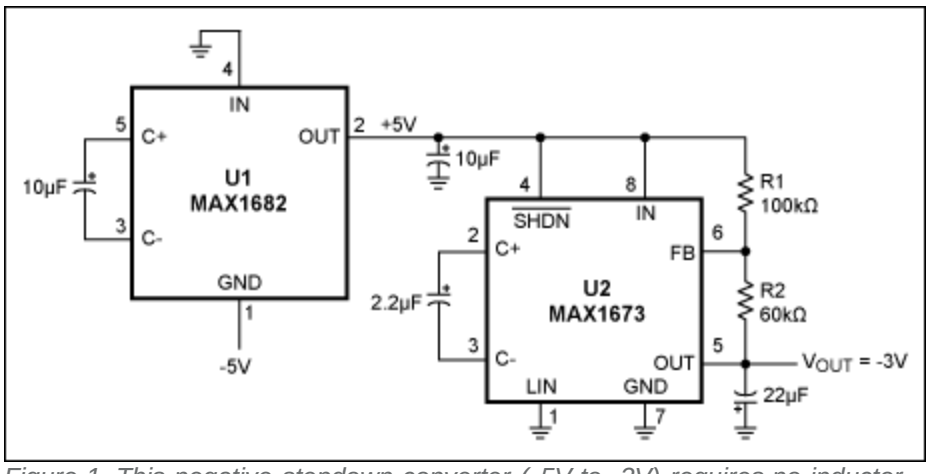

Figure 1. This negative stepdown converter (-5V to -3V) requires no inductor.

U1 (MAX1682) operates as a voltage doubler that accepts the negative 5V input and produces a positive 5V output. A regulated voltage inverter (U2, MAX1673) then accepts the +5V and produces a -3V output. A voltage divider at the U2 output (R1/R2) provides feedback for regulating U2's output voltage to the desired level (V_{OUT}). At the FB input, the threshold voltage is factory-set to zero. You can choose the values for R1 and R2 using R2(5V/R1) = -V , plus the condition that their sum should allow a

OUT
minimum current flow of 50µA. The accuracy of V_{OUT} depends largely on the accuracy of the -5V input. **Figures 2** and **3** depict the circuit efficiency and output regulation for inputs of -4.75V, -5V, and -5.25V.

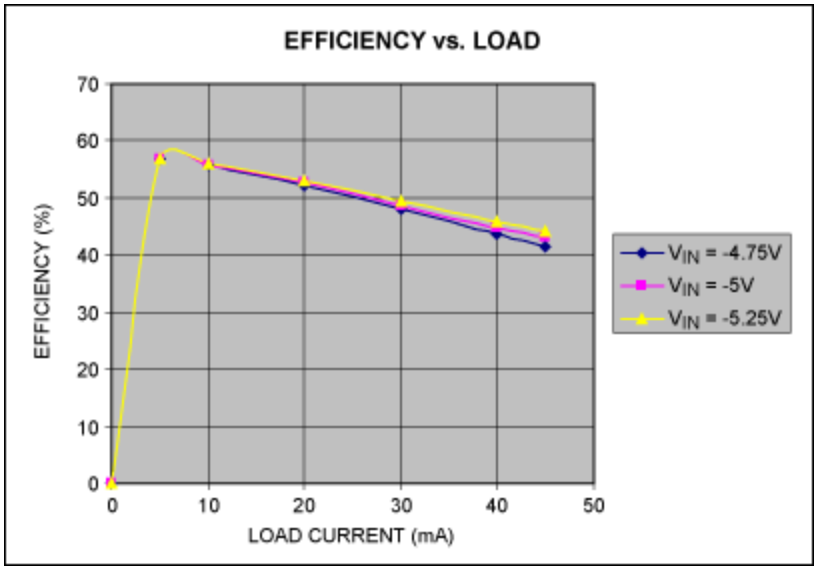

Figure 2. Efficiency vs. load for the Figure 1 circuit at V_{IN} levels of -4.75V, -5V, and -5.25V.

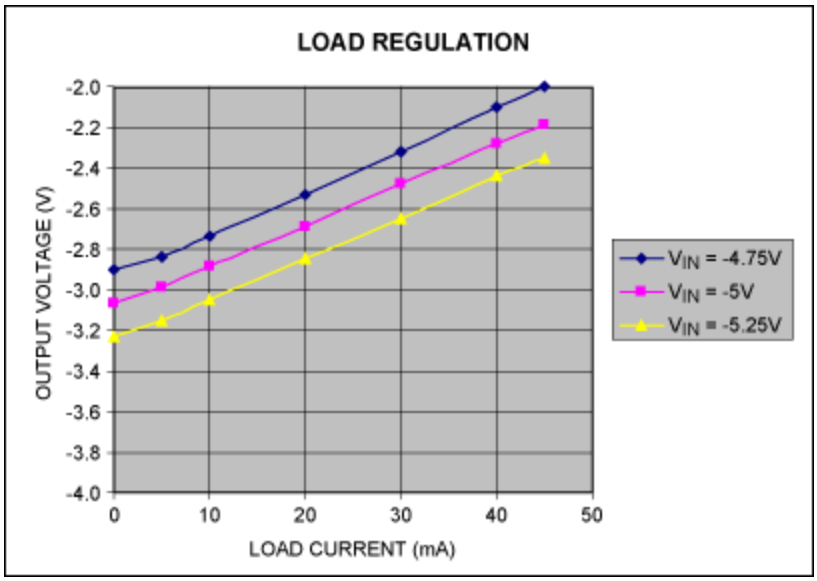

Figure 3. Load regulation for the Figure 1 circuit at V_{IN} levels of -4.75V, -5V, and -5.25V.

Related Parts		
MAX1673	Regulated, 125mA Output, Charge Pump DC-DC Inverter	Free Samples
MAX1682	Switched-Capacitor Voltage Doublers	Free Samples

More Information

For Technical Support: http://www.maximintegrated.com/support
For Samples: http://www.maximintegrated.com/samples
Other Questions and Comments: http://www.maximintegrated.com/contact

---

Application Note 4500: http://www.maximintegrated.com/an4500
APPLICATION NOTE 4500, AN4500, AN 4500, APP4500, Appnote4500, Appnote 4500
Copyright © by Maxim Integrated Products
Additional Legal Notices: http://www.maximintegrated.com/legal