DESIGN SHOWCASE

Bootstrapping Raises Efficiency of DC-DC Converter

The switching converter of **Figure 1** normally operates in a "step-down" mode, generating 5V from a positive input of 6 to 16.5V. The unorthodox connections shown, however, force the chip into an inverting mode, producing -5V from 5V and providing higher load current than that available from a switching-converter IC dedicated to inverting applications (such as the MAX635).

The IC's internal P-channel MOSFET switch drives the basic circuit (**Figure 2**). Inductor current (I_M) ramps upward and charges the inductor while the switch is closed. When the switch opens, the passively discharging inductor creates a current (I_D) that flows through the diode and charges the output capacitor. (The low-EMI, 100-µH toroidal inductor is available from Maxim.)

Note that certain connections in **Figure 1**, though peculiar, trick the IC into regulating its output negatively with respect to ground: the GND and V_{FB} terminals connect to the -5V output, and V_{OUT} connects to ground. The internal switching MOSFET receives a 10V gate drive (from positive input to negative output), which, relative to a 5V drive, reduces the MOSFET's on resistance from 9Ω to 6Ω. This enhancement raises the conversion efficiency above 80%, and increases the maximum-available output current by 25%, to 33mA.

To obtain negative output voltages other than 5V, connect a two-resistor voltage divider between GND and V_{OUT}, and tie the midpoint to V_{FB}. The resistor ratio then determines V_{OUT}, subject to limitation by the maximum allowed differential (16.5V) between input and output.

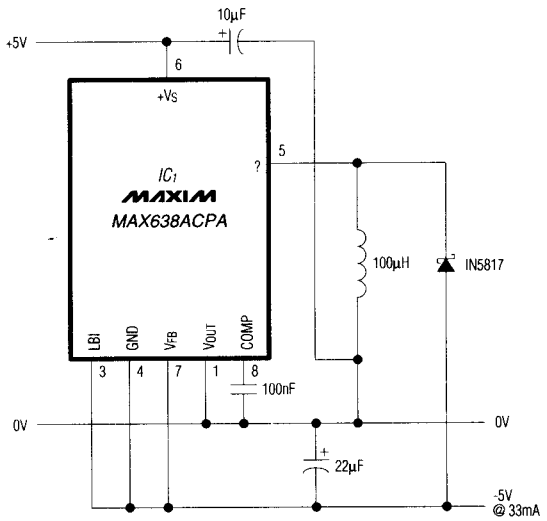

Figure 1. The connections shown enable this step-down switching-regulator IC to function as an inverting regulator. The circuit derives -5V from 5V and delivers 33mA.

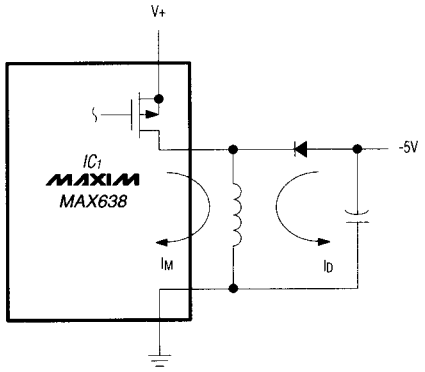

Figure 2. Basic circuit action in Figure 1 focuses on the inductor, which charges from V+ and discharges to the load.

(Circle 5)