Negative-to-negative switch-mode converter offers high current and high efficiency

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When converting a negative-output power supply to one with less-negative output, you must ensure that variations in input voltage don't affect the output voltage. All such supplies include an internal reference voltage that enables output-voltage regulation. You usually refer this reference to the most negative rail, which is ground. Thus, the output voltage of such a converter depends on the accuracy of its negative input supply voltage. The circuit in **Figure 1** lacks that limitation. Delivering output currents as high as 4A with efficiencies better than 90%, it generates a negative output with the help of an op amp and a switch-mode boost converter. Closed-loop feedback regulates the output voltage with respect to ground, the most positive rail,

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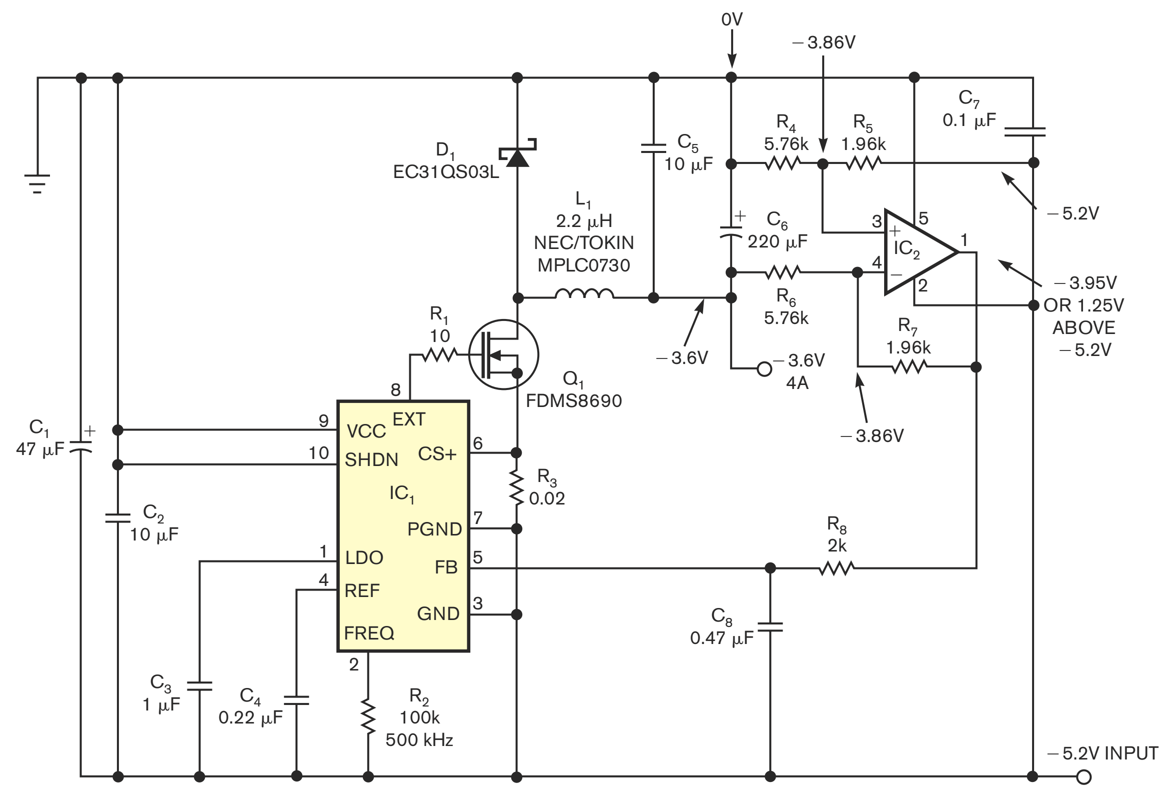

Figure 1 A switch-mode converter generates a regulated negative supply voltage from a more-negative input voltage.

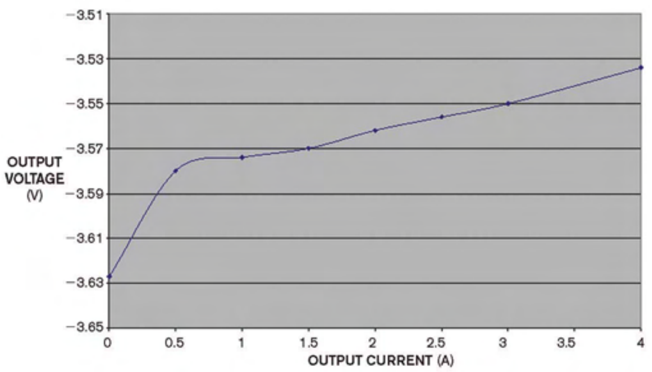

Figure 2 Output voltage for the circuit in Figure 1 varies with output current.

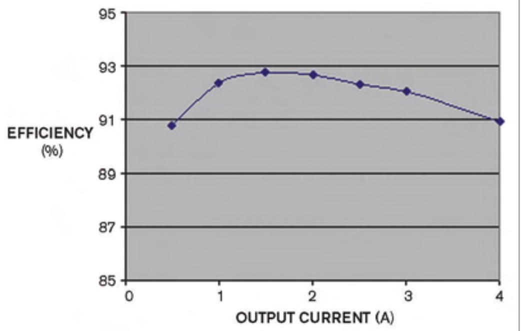

Figure 3 Conversion efficiency for the circuit in Figure 1 varies with output current.

which is also the node from which current is delivered to the load.

The circuit converts a −5.2V supply voltage to −3.6V. The boost converter, IC_1, regulates its output voltage to maintain its feedback voltage at −3.95V—1.25V above −5.2V. Resistor R_8 and capacitor C_8 form a lowpass filter that stabilizes the voltage at FB. You must then select the R_4/R_6 and R_5/R_7 pairs to produce the desired output voltage. Making R_4 and R_5 equal and making R_6 and R_7 equal improves the common-mode performance. The ratio of R_4 to R_5 determines the voltage level at the positive input of op amp IC_2, whose closed-loop configuration ensures that the same voltage appears at its negative input. Knowing IC_2's output voltage, −3.95V, and its negative input voltage lets you determine the output voltage using the values of R_6 and R_7: $V_{OUT}=-V_{REF}(R_6/R_7)$, where V_{REF} is the 1.25V nominal reference voltage of IC_1, $R_4=R_6$, and $R_5=R_7$.

The component values in **Figure 1**—for example, 1.96 kΩ for R_5 and R_7 and 5.76 kΩ for R_4 and R_6—produce an output voltage of −3.76V. Graphs of output voltage versus output current (**Figure 2**) and efficiency versus output current (**Figure 3**) illustrate this circuit's performance. EDN