



[Maxim](#) > [Design Support](#) > [Technical Documents](#) > [Application Notes](#) > [Power-Supply Circuits](#) > APP 1025

Keywords: SEPIC, SEPIC switching regulator, step-up DC-DC controller, step-up linear regulator, step-down regulator, flyback transformer

APPLICATION NOTE 1025

Highly Efficient SEPIC Switching Regulator Generates 3V from Multiple Cells

Nov 21, 1996

Abstract: This design note explains some advantages of a single-ended primary-inductance converter (SEPIC) over flyback-transformer and step-up linear regulator circuits. Here a SEPIC switching regulator maintains a 3.3V output with 78% efficiency from multiple battery cells. As advantages of this design, the simple SEPIC design has no output current flowing during shutdown and output voltage is well regulated. The [MAX608](#) step-up DC-DC controller is featured.

A similar idea appeared in the November 21, 1996 issue of *EDN*.

Generating 3.3V from two or three cells poses a challenge to design engineers. The regulator must step down when the cells are fresh, but it must also step up when the cells are semidischarged and weak. One solution to this problem is a flyback-transformer design, which requires that you select transformer ratios to ensure a constant output voltage under varying load conditions.

Alternatively, a single-ended primary-inductance converter (SEPIC) offers simpler circuitry (**Figure 1**). This circuit generates 3.3V at 400mA with 78% efficiency. Input voltage can range above and below the output, and a capacitor (C2) couples the output to the switching circuitry. This configuration offers two advantages over flyback-transformer circuits and step-up linear-regulator circuits: no output current flows during shutdown, and V_{OUT} remains well regulated as V_{IN} passes through the V_{OUT} level.

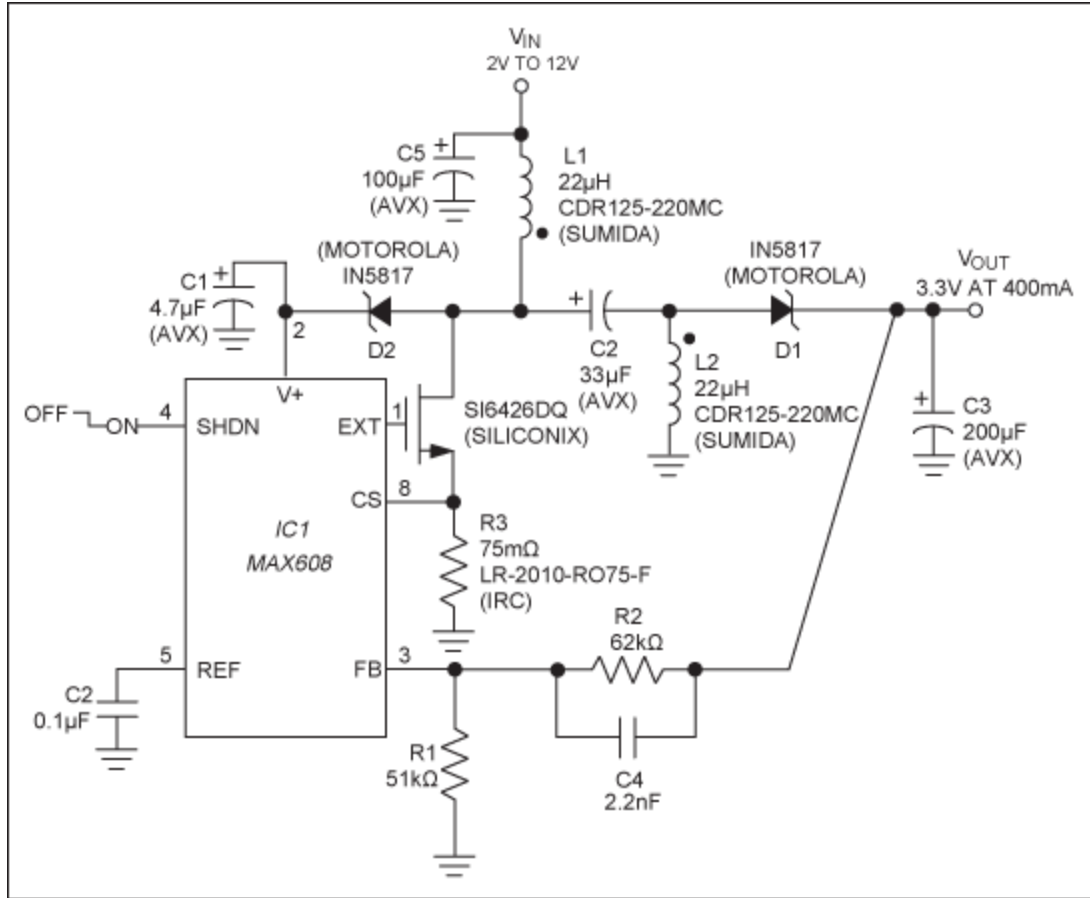


Figure 1. This SEPIC switching regulator maintains a 3.3 output for V_{IN} that ranges above and below 3.3V (as does the voltage from a 2-cell or 3-cell battery, for example).

The two inductors in this circuit can be separate components or can be wound on a common core for convenience. They don't work as a transformer, so you can wind them without regard to coupling. Capacitors C2, C3, and C5 should have low equivalent series resistance for best efficiency. C2's voltage rating must exceed the maximum input voltage, and the external switch (Q1) must withstand the sum of ($V_{IN} + V_{OUT}$).

By capturing Q1's switching pulses, Schottky diode D2 boosts the V+ voltage to ($V_{IN} + V_{OUT}$). The resulting higher gate drive lowers the losses in Q1, especially for low input voltage, but it also limits V_{IN} to 12V (max). Output capabilities are 300mA at $V_{IN} = 2V$ and 400mA at $V_{IN} = 3V$, with efficiency versus load current as shown in **Figure 2**.

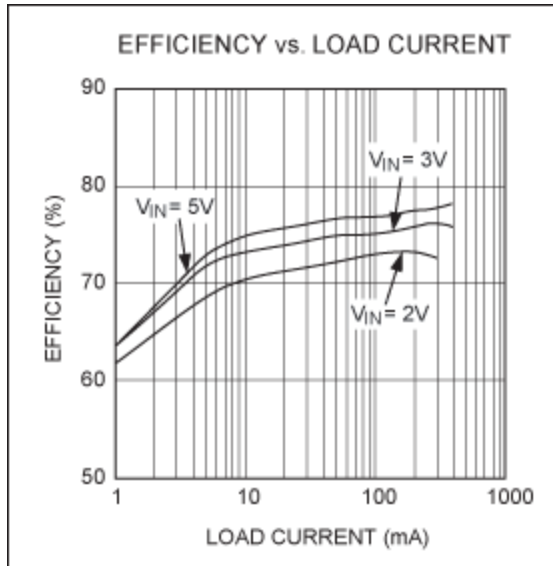


Figure 2. Efficiency for the Figure 1 circuit approaches 80%.

Related Parts

MAX608

5V or Adjustable, Low-Voltage, Step-Up DC-DC Controller

[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 1025: <http://www.maximintegrated.com/an1025>

APPLICATION NOTE 1025, AN1025, AN 1025, APP1025, Appnote1025, Appnote 1025

Copyright © by Maxim Integrated Products

Additional Legal Notices: <http://www.maximintegrated.com/legal>