DALLAS SEMICONDUCTOR /\/\/XI/\/\   **Application Note**

Regulated LCD–Bias Generator Requires No Inductor

A stringent height limitation on the PC boards for personal digital assistants (PDAs) and palmtop computers compels the use of expensive, low–profile inductors in switch–mode power supplies. As an alternative, however, certain switch–mode circuits can be replaced with one based on a charge pump (**Figure 1**). This example generates a regulated negative voltage suitable for biasing an LCD.
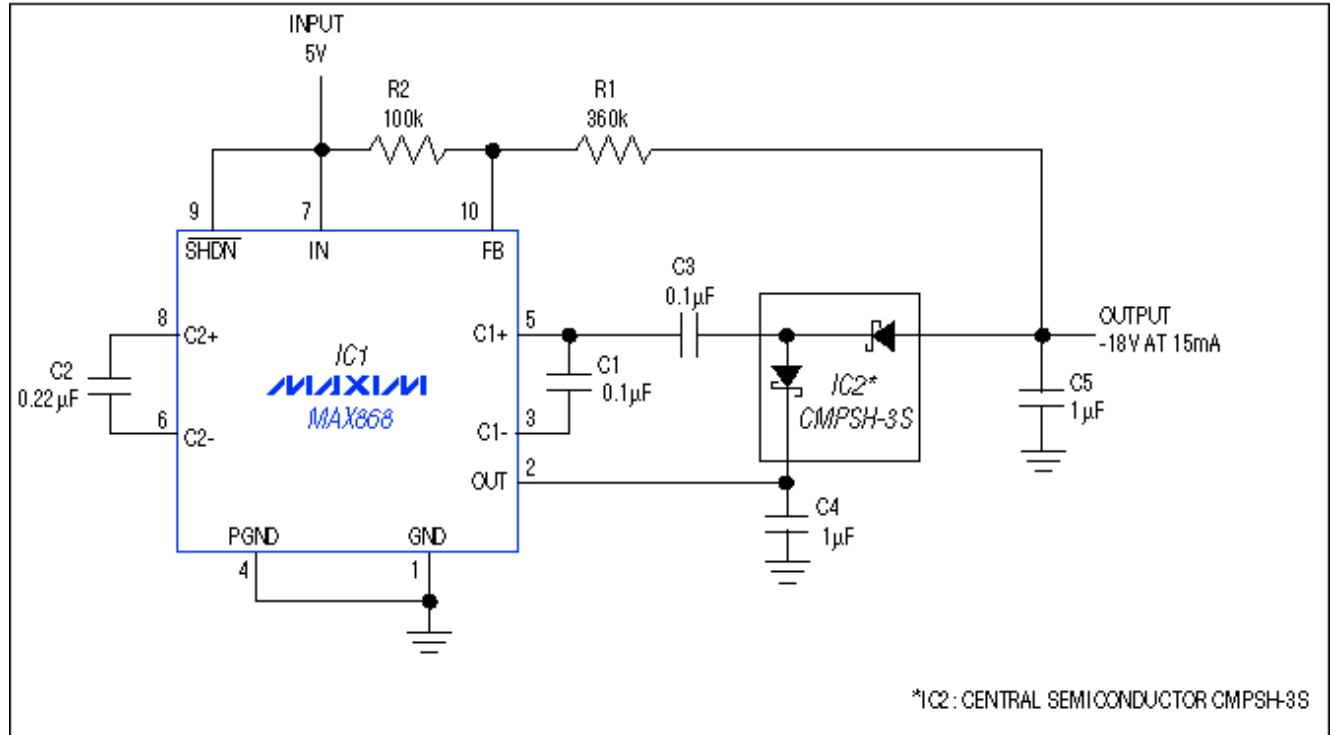

Figure 1. Adding a few inexpensive components in the feedback path of IC1 enables the generation of regulated output voltages nearly as high as $-4V^{IN}$.

IC1 contains a regulated, inverting charge pump that produces output voltages as high as $-2V^{IN}$, in which the supply voltage (V^{IN}) can range from +1.8V to +5.5V. The IC regulates V^{OUT} through pulse–frequency modulation (PFM), with a maximum frequency of 450kHz. The IC's low quiescent current (30µA) provides excellent light–load efficiency without sacrificing full–load capability.

Inserting an external, discrete charge pump (consisting of C3, C4, and the Schottky diodes) in the feedback path of IC1 produces an "inverter–quadrupler" circuit whose regulated output level is set by the ratio of feedback resistors R1 and R2:

$$V_{OUT} = -V_{IN} (R1/R2)$$

Configured as shown, the circuit provides up to 15mA at $V^{OUT} = -18V$, with 76% efficiency and 60mV of output voltage ripple. Lower V^{OUT} allows higher output currents: $V^{OUT} = -15V$ yields 20mA, and $V^{OUT} =$

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–12V yields 30mA.

A similar idea appeared in the 3/9/98 issue of Electronic Design.