Bootstrapped boost converter operates at 1.8V

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Many circuits, such as those that use batteries or solar cells, must operate in the face of decreasing supply voltages. The circuit in **Figure 1** maintains the maximum load current as the supply voltage drops. The regulator boosts a 2.5 to 4.2V input to 5V and provides 2A load current, for 10W of output power. The circuit is a bootstrapped synchronous boost regulator that uses an LTC1266 synchronous-regulator controller. Diodes D_1 through D_5 allow the circuit to start up using the low input voltage and then to receive its power from the higher output voltage during normal operation. The crucial elements in the circuit are the switches: two IRF7401 n-channel MOSFETs. The MOSFETs receive full enhancement at low gate-source voltages. (At V_{GS}=2V, the peak drain current is 15A.) The low enhancement voltages allow the circuit to start with low input voltages.

This low-voltage capability is important for low-series-cell-count, battery-powered systems. Diodes D_3 and D_4, along with capacitor C_2, form a charge-pump circuit, which the controller uses for the MOSFETs' gate drive. Because the circuit receives its power from the 5V output voltage, the circuit still operates if the input supply voltage drops below the IC's minimum input voltage. This bootstrapping allows the circuit to start up when the input voltage is below the IC's 3.5V minimum input spec. With a 1A load, the regulator operates with inputs as low as 1.8V. **Figure 2** shows the regulator's efficiency vs the input voltage with three load currents. With 2A load current, the efficiency drops as the input voltage decreases, because of the higher power losses in the inductor. A larger inductor would provide increased efficiency or allow for greater load currents. (DI #2185) EDN

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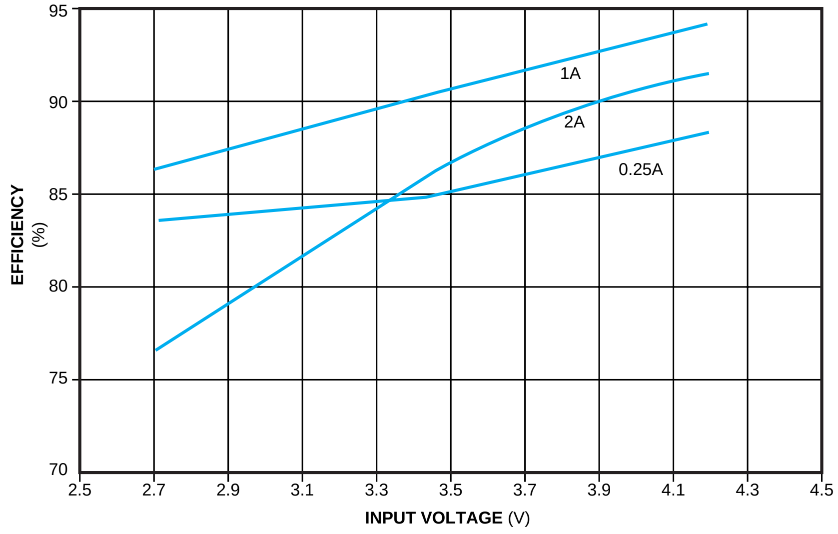
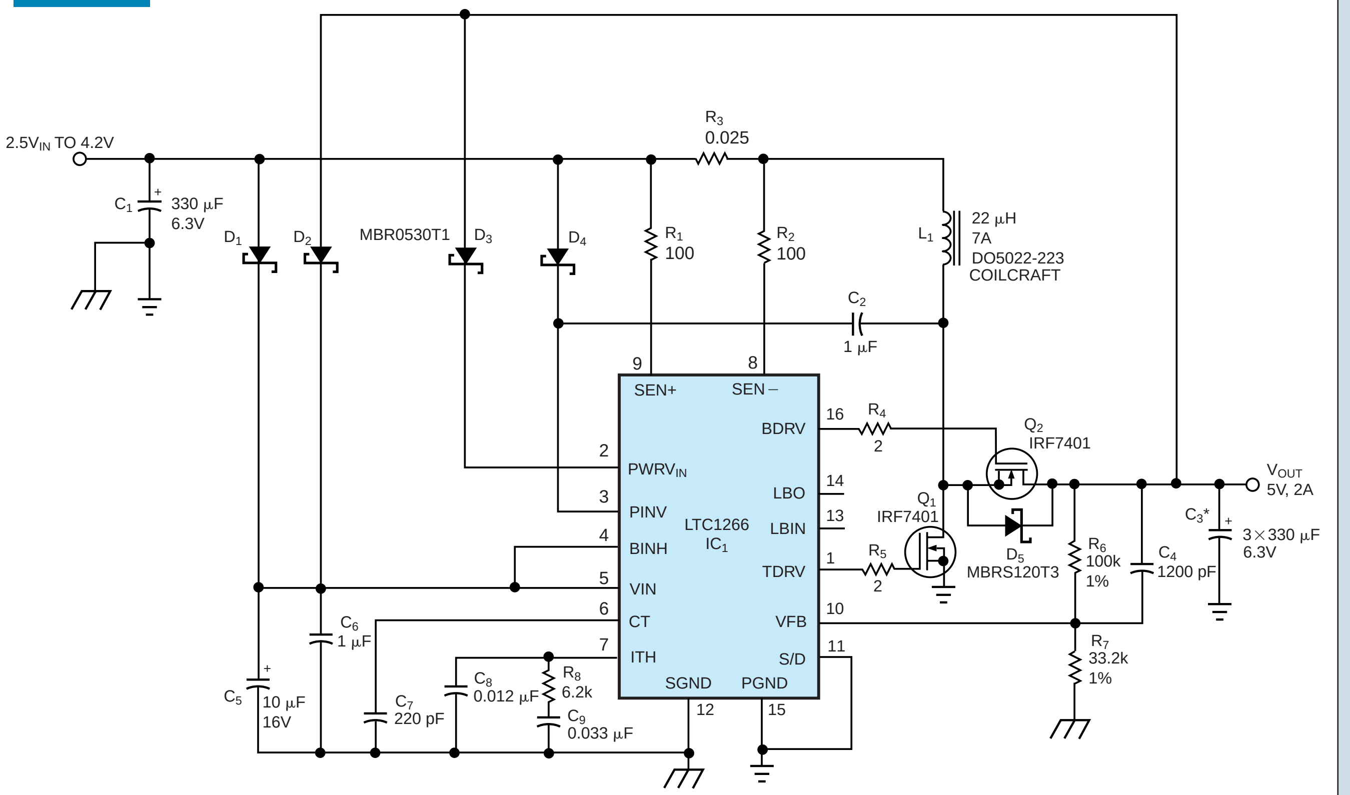
FIGURE 2



The conversion efficiency for the boost regulator in Figure 1 averages 87% overall. The circuit provides its best efficiency for all input voltages with a 1A load.

FIGURE 1



A charge-pump arrangement allows this boost regulator to operate with input voltages far below the minimum specified value for the regulator IC.