Bootstrapped Synchronous Boost Converter Operates at 1.8V Input

by Tom Gross

Some applications, such as those powered by batteries or solar cells, see their input voltage decrease as they operate. The circuit in Figure 1 maintains the maximum load current as the input voltage drops. The regulator boosts a 2.5V–4.2V input to 5V. The maximum load current is 2A (10W of output power).

The circuit is a bootstrapped synchronous boost regulator using an LTC1266 synchronous regulator controller. Diodes D2 through D5 allow the circuit to start-up using the (low) input voltage and then to be powered during normal operation by the higher output voltage. The crucial elements in this circuit are the switches: two IRF7401 N-channel MOSFETs. These MOSFETs are fully enhanced at very low gate-to-source voltages (at 2V of V_{GS}, the peak drain current is rated at 15A). The low enhancement voltages allow the circuit to start up at low input voltages (crucial for low series-cell-count, battery-powered applications). Diodes D3 and D4, along with capacitor C2, form a charge-pump circuit, which the controller uses for the MOSFETs' gate drive. The switches are driven by an LTC1266 synchronous regulator controller.

Because the circuit is powered from the 5V output, it will still operate if the input supply voltage drops below the minimum input voltage of the IC. This bootstrapping allows the circuit to start up even when the input voltage is below the minimum input voltage of the IC (3.5V). With a 1A load, the regulator operates down to 1.8V.

Figure 2 shows the efficiency of the regulator versus the input voltage at three different load currents. At 2A of load current, efficiency drops as the input voltage is decreased due to the higher power losses in the inductor. A larger inductor will increase efficiency and/or allow for larger load currents. The efficiency with the indicated inductor is good, averaging 87% overall. Higher efficiency will help to increase the run time of battery-powered applications.

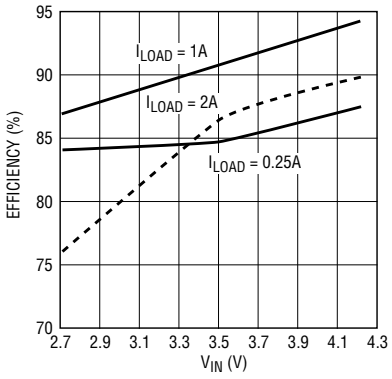

Figure 2. Efficiency of Figure 1's circuit

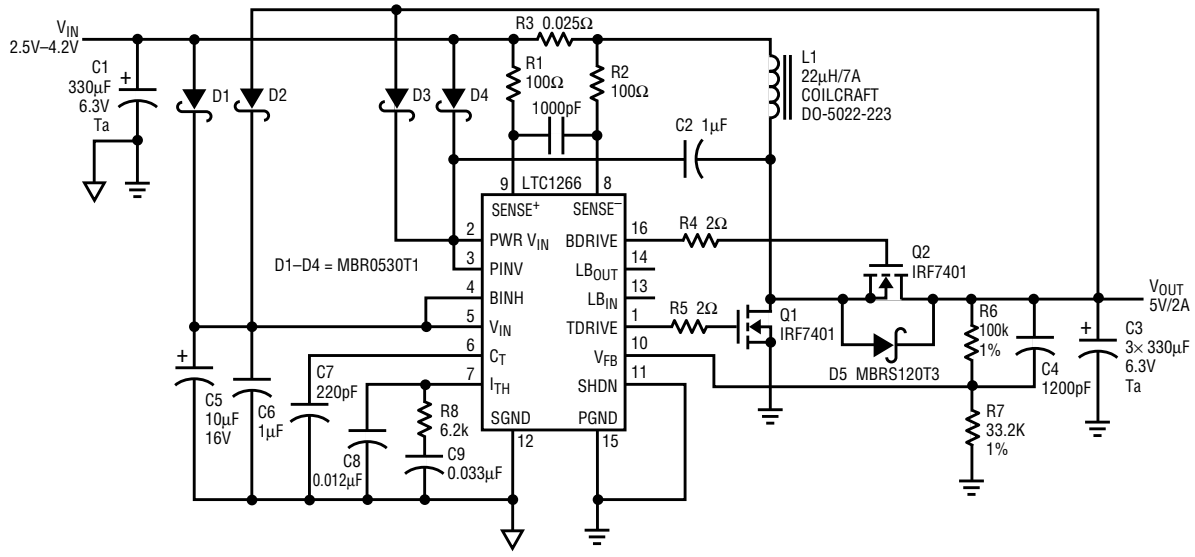

Figure 1. Bootstrapped synchronous boost converter