Low-Power DC-DC Converter Derives 5V From 3V Battery

The step-up, DC-DC switching regulator of Fig 1 generates a regulated 5V from a 3V lithium battery. Efficiency is 78% at the maximum load current (30mA), and 80% at a load current of 5mA. The circuit’s overall quiescent supply current is an exceptionally low 10μA.

Linear regulator IC2 is included only for its low-power voltage comparator and voltage reference, which normally monitor the chip’s input voltage. In this system they monitor VOUT. The SHDN input, connected high, assures low standby current by shutting down all other circuitry on the chip. The resulting 5μA quiescent current is lower than that of any other IC combination available, for this monitor function.

When LBI (Low Battery Input, pin 3) senses low VOUT, the open-drain LBO (Low Battery Output, pin 7) goes low, allowing the signal from relaxation oscillator IC1A to drive the base of Q1 at 3 kHz. Q1 draws about 100mA through L1 during each 300μsec ON time. During OFF times, the inductor delivers energy to the load.

When the rising output allows LBO to be pulled high by R2, the cross-coupled latch IC1B/IC1C turns Q1 off by driving IC1D low. Thus, Q1 skips pulses as required: the duty cycle varies from 50% at full load to one pulse every four or five seconds at no load. If necessary, you can reduce the 25mV output ripple by increasing the output filter capacitance (C1) to 470μF, for example.

Figure 1. This pulse-skipping, step-up switching regulator exhibits 80% efficiency while converting 3V to a regulated 5V. The linear regulator IC2 contributes a low-power voltage reference and comparator to the circuit.

(Circle 11)