DESIGN SHOWCASE

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 10μ A.

Linear regulator IC₂ is included only for its lowpower voltage comparator and voltage reference, which normally monitor the chip's input voltage. In this system they monitor V_{OUT}. The SHDN input, connected high, assures low standby current by shutting down all other circuitry on the chip. The resulting 5 μ A 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 V_{OUT} , the open-drain LBO (Low Battery Output, pin 7) goes low, allowing the signal from relaxation oscillator IC_{1A} 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 IC_{1B}/IC_{1C} turns Q₁ off by driving IC_{1D} 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)