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 IC_2 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 V_{OUT}. 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 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 Q_1 at 3 kHz. Q_1 draws about 100mA through L_1 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 R_2, the cross-coupled latch IC_{1B}/IC_{1C} turns Q_1 off by driving IC_{1D} low. Thus, Q_1 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 (C_1) – to 470µF, for example.

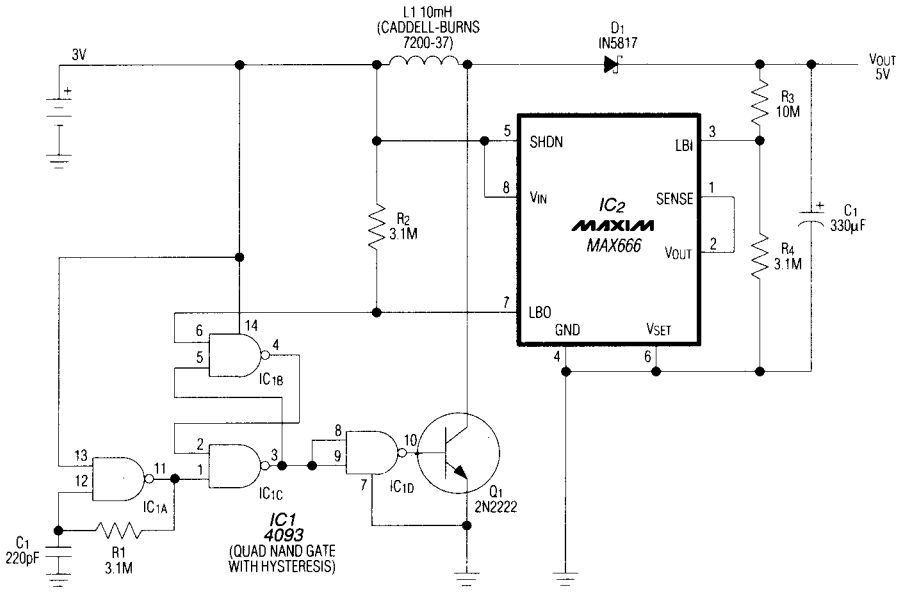

Figure 1. This pulse-skipping, step-up switching regulator exhibits 80% efficiency while converting 3V to a regulated 5V. The linear regulator IC_2 contributes a low-power voltage reference and comparator to the circuit.

(Circle 11)