Ultralow Power Boost Converters Require Only 8.5µA of Standby Quiescent Current

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Introduction

Industrial remote monitoring systems and keep-alive circuits spend most of their time in standby mode. Many of these systems also depend on battery power, so power supply efficiency in standby state is very important to maximize battery life. The LT8410/-1 high efficiency boost converter is ideal for these systems, requiring only 8.5µA of quiescent current in standby mode. The device integrates high value (12.4M/0.4M) output feedback resistors, significantly reducing input current when the output is in regulation with no load. Other features include an integrated 40V switch and Schottky diode, output disconnect with current limit, built in soft-start, overvoltage protection and a wide input range, all in a tiny 8-pin 2mm × 2mm DFN package.

Application Example

Figure 1 details the LT8410 boost converter generating a 16V output from a 2.5V-to-16V input source. The LT8410/-1 controls power delivery by varying both the peak inductor current and switch off time. This control scheme results in low output voltage ripple as well as high efficiency over a wide load range. Figures 2 and 3 show efficiency and output peak-to-peak ripple for Figure 1's circuit. Output ripple voltage is less than 10mV despite the circuit's small (0.1µF) output capacitor.

The soft-start feature is implemented by connecting an external capacitor to the V_{REF} pin. If soft-start is not needed, the capacitor can be removed. Output voltage is set by a resistor divider from the V_{REF} pin to ground with the center tap connected to the FBP pin, as shown in Figure 1. The FBP pin can also be biased directly by an external reference.

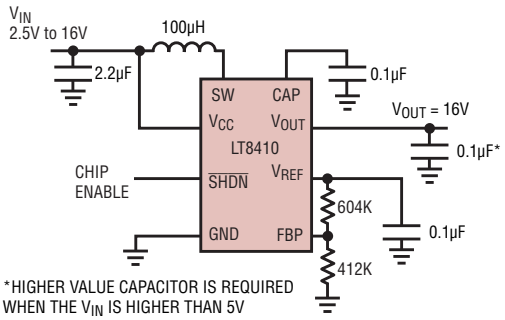

Figure 1. 2.5V–16V To 16V boost converter

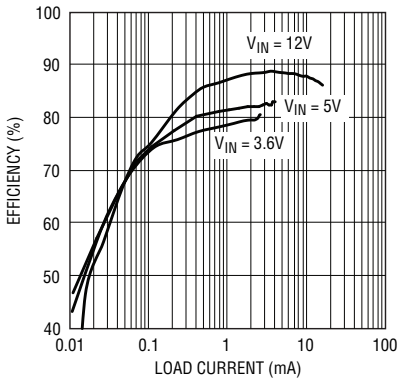

Figure 2. Efficiency vs load current for Figure 1 converter

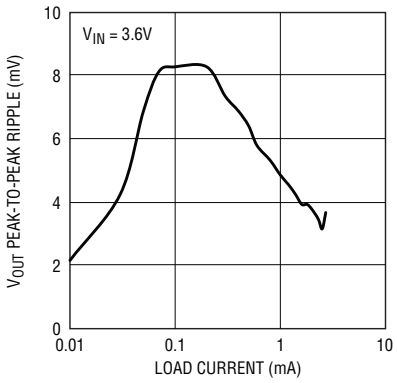

Figure 3. Output peak-to-peak ripple vs load current for Figure 1 converter at 3.6V

The $\overline{SHDN}$ pin of the LT8410/-1 can serve as an on/off switch or as an undervoltage lockout via a simple resistor divider from V_{CC} to ground.

Ultralow Quiescent Current Boost Converter with Output Disconnect

Low quiescent current in standby mode and high value integrated feedback resistors allow the LT8410/-1 to regulate a 16V output at no load from a 3.6V input with about 30µA of average input current. Figures 4, 5 and 6 show typical quiescent and input currents in regulation with no load.

The device also integrates an output disconnect PMOS, which blocks the output load from the input during shutdown. The maximum current through the PMOS is limited by circuitry inside the chip, allowing it to survive output shorts.

Compatible with High Impedance Batteries

A power source with high internal impedance, such as a coin cell battery, may show normal output on a voltmeter, but its voltage can collapse under heavy current demands. This makes it incompatible with high current DC/DC converters. With very low switch current limits (25mA for the LT8410 and 8mA for the LT8410-1), the LT8410/-1 can operate very efficiently from high impedance sources without causing inrush current problems. This feature also helps preserve battery life.

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This connects an internal series RC to the compensation point of the loop, while introducing active voltage positioning to the output voltage: 1.5% at no load and –1.5% at full load. The hassle of using external components for compensation is eliminated. If one wants to further optimize the loop, and remove voltage positioning, an external RC filter can be applied to the ITH pin.

1.2V$_{OUT}$, 10A, 2-Phase Supply

Several LTC3605 circuits can run in parallel and out of phase to deliver high total output current with a minimal amount of input and output capacitance—useful for distributed power systems.

The 1.2V$_{OUT}$ 2-phase LTC3605 regulator shown in Figure 4 can support 10A of output current. Figure 3 shows the 180° out-of-phase operation of the two LTC3605s. The LTC3605 requires no external clock device to operate up to 12 devices synchronized out of phase—the CLKOUT and CLKIN pins of the devices are simply cascaded, where each slave's CLKIN pin takes the CLKOUT signal of its respective master. To produce the required phase offsets, simply set the voltage level on the PHMODE pin of each device to INTV$_{CC}$, SGND or INTV$_{CC}$/2 for 180°, 120° or 90° out-of-phase signals, respectively, at the CLKOUT pin.

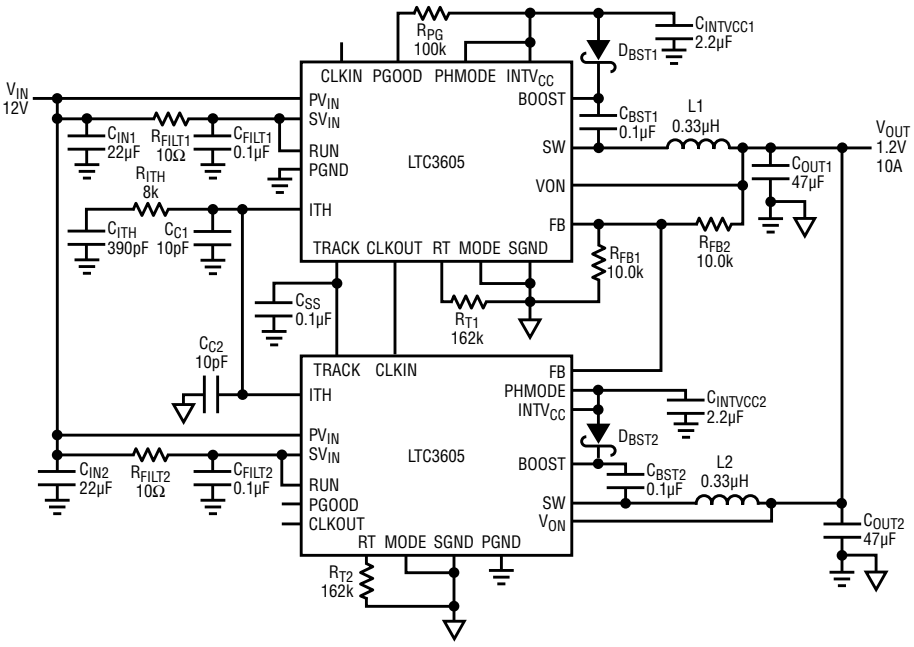

Figure 4. 12V to 1.2V at 10A 2-phase buck converter

Conclusion

The LTC3605 offers a compact, monolithic, regulator solution for high current applications. Due to its PolyPhase capability, up to 12 LTC3605s can run in parallel to produce 60A of output current. PolyPhase operation can also be used in multiple output applications to lower the amount of input ripple current, reducing the necessary input capacitance. This feature, plus its ability to operate at input voltages as high as 15V, make the LTC3605 an ideal part for distributed power systems.

LT8410, continued from page 34

Conclusion

The LT8410/-1 is a smart choice for applications which require low standby quiescent current and/or require low input current, and is especially suited for power supplies with high impedance sources. The ultralow quiescent current and high value integrated feedback resistors keep average input current very low, significantly extending battery operating time. The LT8410/-1 is packed with features without compromising performance or ease of use and is available in a tiny 8-pin 2mm × 2mm package.

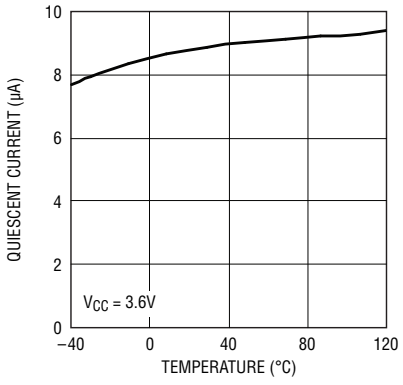

Figure 4. Quiescent current vs temperature (not switching)

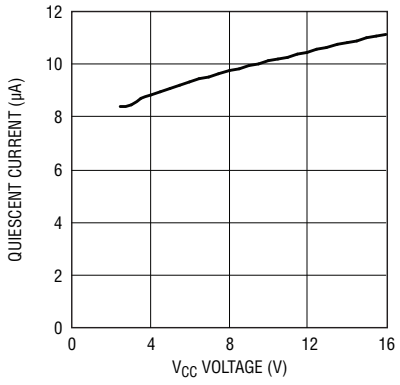

Figure 5. Quiescent current vs V_{CC} voltage (not switching)

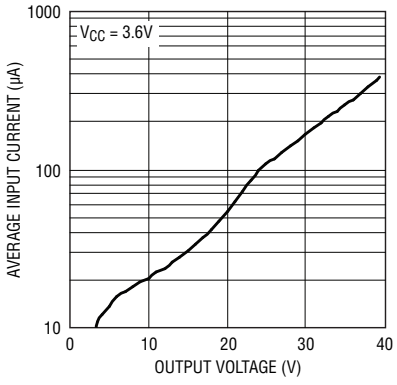

Figure 6. Average input current in regulation with no load