Miniscule Step-Up Controller Yields Wide Input and Output Ranges

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Introduction
Small in stature, but big in power, the LTC3872 boost controller can produce an expansive range of output voltages with the bare minimum in components. Its design forgoes a few features and pins (TRACK, SYNC, and MODE, for instance) to squeeze into a slender 8-pin 3mm × 2mm DFN or leaded TSOT-23 package. Nevertheless, it gives up little in versatility, providing up to 60V in regulated output from a 2.75V–9.8V input. This input range accommodates one or two lithium-ion batteries, in addition to the common 3.3V and 5V input rails.

Space-Saving Design
Matching the LTC3872’s small size, its 550kHz constant frequency operation allows the use of a small-footprint surface mount inductor and ceramic capacitors. This saves space over boost controllers that use a constant on-time switching scheme, which can result in a lower operating frequency and physically larger filter components. No RSENSE™ technology eliminates the need for a separate current-sensing resistor. Just a few additional resistors and capacitors are needed to program the output voltage and close the feedback loop; the user can adjust OPTI-LOOP® compensation to accommodate whatever output voltage and filter components are chosen.

Light Load Efficiency
At light loads, pulse skip mode maintains constant frequency operation. This has the dual benefit of minimizing ripple and keeping switching noise within a predictable, easily filtered band. Output voltage remains stable in the presence of transients, due to the LTC3872’s current mode architecture.

Figure 1. A 3.3V input, 5V output boost regulator delivering up to 2A. The large input capacitor CIN protects against inductive ringing in long traces to the main input supply, which could happen during load transients and startup.

Figure 2. Efficiency and Power Loss for the application circuit of Figure 1.

Figure 3. A 5V input, 48V output boost regulator delivering up to 0.5A

Figure 4. Startup and load transient for the circuit of Figure 3
A 3.3V Input, 5V/2A Output Boost Converter

Figure 1 shows a typical LTC3872 application—a 3.3V input to 5V output boost regulator which can deliver up to 2A load current. Figure 2 shows the efficiency/power loss curve. In spite of the converter’s small size, efficiency peaks at 90% and stays above 80% down to 20mA. In shutdown mode it draws only 8µA.

The LTC3872 uses the drain to source voltage of the external N-channel MOSFET to sense the inductor current. Eliminating a separate sense resistor can increase efficiency by 1%-2% at heavy loads. Absent a short circuit at the output, the maximum current that the converter can draw from $V_{IN}$ is determined by the $R_{DS(ON)}$ of the MOSFET (a function of the gate drive voltage $V_{IN}$). This maximum current can be adjusted by using the three-state current limit programming pin IPRG.

A 5V Input, 48V/0.5A Output Boost Converter

Figure 3 shows the LTC3872’s ability to deliver high output voltage. In this topology, the limitation on $V_{OUT}$ is the 60V maximum rating of the SW pin. Where even higher output voltages are required, a sense resistor can be inserted between the source of the MOSFET and ground, with the SW pin tied to the high side of the sense resistor. The output is well-controlled against overshoot and undershoot during startup and load transients (Figure 4). At high duty cycle under heavy loads, the commutation cycle (here, 1/550kHz) is too brief to allow the average inductor current to equal the converter’s required input current. In this case, the on-time of MOSFET M1 is extended, and inductor current ramps up to the level required to maintain output regulation (Figure 5).

**Conclusion**

The LTC3872 is a tiny current-mode, non-synchronous boost controller that requires no sense resistor—a typical design occupies 2.25cm² (Figure 6). The small solution size and wide input voltage range make it an easy fit for a variety of applications.