2A, 40V, SOT-23 Boost Converter Provides High Power in Small Spaces

by Jeff Witt

Introduction

The LT1935 is a current mode boost regulator in a tiny 5-lead ThinSOT package. With its small package, high switching frequency (1.2MHz) and internal 2A, 40V power switch, the LT1935 can deliver high power while occupying very little circuit board space. For instance, from a 5V input, the LT1935 delivers 500mA average and 600mA peak current at 12V (7.2W) using only 100mm^2 of PCB.

The LT1935's power switch drops just 180mV at 2A, minimizing power loss and temperature rise on the circuit board. Current mode control and internal compensation allow the use of small ceramic capacitors, resulting in very low input and output ripple. The input voltage range is 2.3V to 16V. Supply current is less than 1µA in shutdown.

The small size eases system design in many applications. Large digital systems with dense layouts often need point-of-load converters to generate secondary logic supplies. With a minimum input voltage of 2.3V, the LT1935 can convert power from 2.5V, 3.3V or 5V logic rails to a higher output voltage. Even handheld electronics such as cell phones, digital cameras and music players require peak power levels of several watts to drive LEDs, audio amplifiers or large displays. And space is always at a premium in these products.

SOT-23 Boost with 2A Switch

Figure 1 shows the LT1935 generating 5V. Maximum load with V_{IN} = 3.3V is 1A; from 2.5V the maximum load is 600mA. Note that the circuit efficiency remains high even at low input voltage and high load current. The LT1935's bipolar NPN power switch maintains its low forward drop when the input voltage is at its minimum of 2.1V (2.3V max), unlike some MOS devices that suffer increased $R_{DS,ON}$ with low gate drive. The circuit in Figure 1 occupies 80mm^2. Figure 2 shows a 12V circuit that generates 600mA from 5V or 320mA from 3.3V. This higher power circuit requires 100mm^2 of PCB.

Soft-Start Reduces Peak Input Current

During start-up, the input current of an LT1935 circuit can reach 3A. This can cause problems if the input source is current-limited or if other circuits are sensitive to disturbances at V_{IN}. The $\overline{SHDN}$ pin can be used to soft start

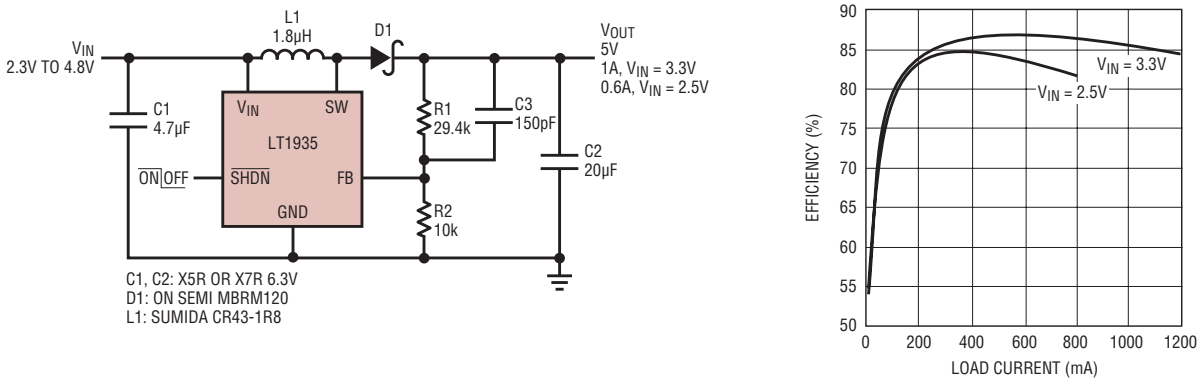

Figure 1. The LT1935 can deliver 1A at 5V from a 3.3V input in a circuit that occupies only 80mm^2.

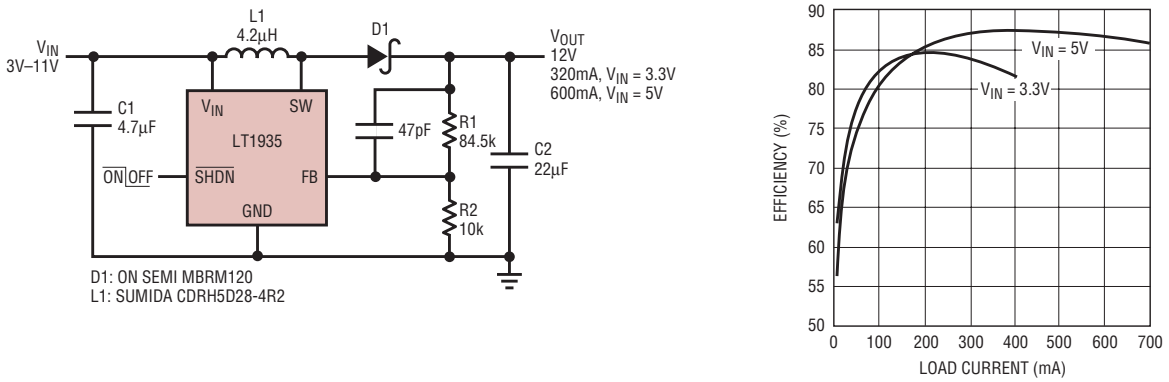

Figure 2. The LT1935 delivers 600mA at 12V from a 5V input. High power density is achieved using the internal 2A, 40V, 90mΩ switch and the high 1.2MHz operating frequency.

the LT1935, reducing the maximum input current during start-up.

The $\overline{SHDN}$ pin is driven through an external RC filter to create a voltage ramp at this pin. Figure 3 shows the start-up waveforms with and without the soft-start circuit. Without soft-start, the input current peaks at ~3A. With soft start, the peak current is reduced to 1A. By choosing a large RC time constant, the peak start-up current can be reduced to the current that is required to regulate the output, with no overshoot. (The value of the resistor should be chosen so that it can supply 100µA when the $\overline{SHDN}$ pin reaches 1.8V.)

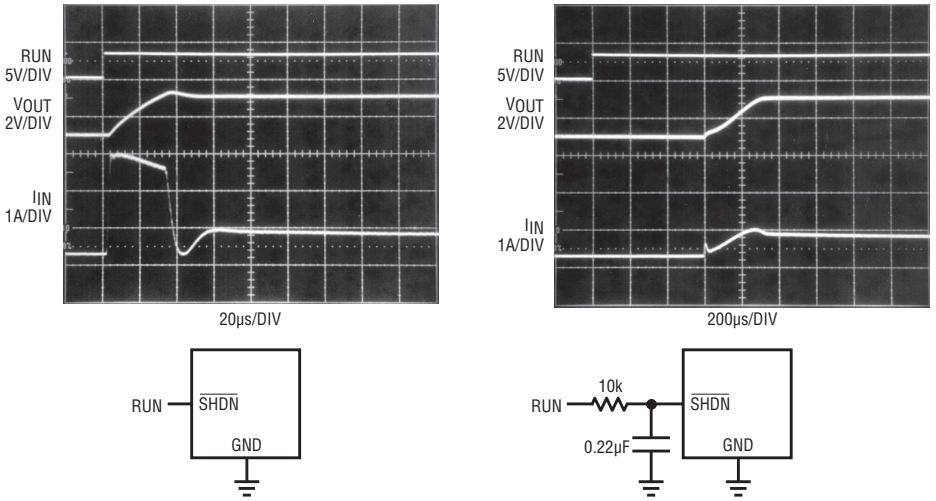

Figure 3. The $\overline{SHDN}$ pin can be used to soft start the LT1935 reducing the peak input current during start up.

More Power for Larger LCD Panels

TFT LCD display panels continue to grow in size in every type of product from cell phones to televisions. Power requirements grow as well, but the basic need for three supply voltages remains. In Figure 4 the LT1935 produces three outputs using a single inductor. From a 3.3V input, the boost circuit produces the main output of 8V at 450mA. Two discrete charge pumps produce the secondary outputs of 16V and –8V.

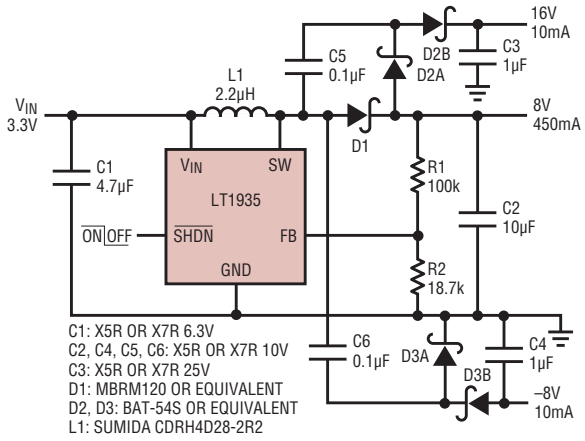

Figure 4. This TFT-LCD supply produces three outputs using a single inductor.

Conclusion

By integrating a high frequency, current mode control with 2A, 90mΩ switch in a SOT-23, the LT1935 delivers outsized power in a small space. The 40V switch rating and the wide input range (2.3V to 16V) allow a wide variety input sources, output voltages and circuit topologies, unlike many regulators with restrictive 5V ratings.

LTC3709, continued from page 30

PLL monitors the switching of the two channels and forces the switching frequency of the second channel to follow that of the first channel. The interleaved operation of two channels minimizes the input RMS current and power loss along the input supply path.

A second PLL is provided for external clock synchronization. The LTC3709 is synchronized by adjusting its on-time, indirectly adjusting its switching frequency. When synchronized, the LTC3709 combines the advantages of constant frequency and constant on-time architectures. The switching frequency stays constant despite the changes of input voltage, output voltage (if programmable) and load current. The LTC3709 can still respond to load transients without clock latency because of the indirect adjustment of switching frequency during synchronization. The time constant of the PLL is much longer than the load transient duration, so the switching frequency of the LTC3709 is temporarily altered to take advantage of a constant on-time architecture.

Other Features

The LTC3709 has a differential amplifier for remote sensing of both the high and low sides of the output voltage. An output tracking function makes the LTC3709 easy to use in multiple power supplies applications. The LTC3709 also has a short-circuit shutdown timer which is easily defeated.

Conclusion

The LTC3709 employs a constant on-time with PLLs and a valley current control architecture. It has fast transient response, very short minimum on-time and high efficiency from light to full load. The LTC3709 is well suited to high output current, high step-down ratio applications.