LDO white-LED driver TPS7510x provides incredibly small solution size

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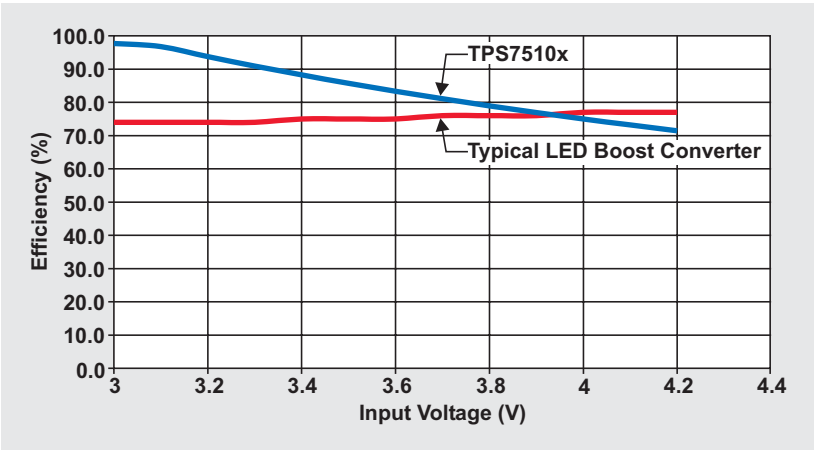
Introduction

Use of white-LED drivers has increased in recent years due to the popularity of color LCD screens on most portable electronic equipment. The white backlight required to bring out the color in these screens is most often provided by white LEDs. In applications powered by a one-cell Li-ion battery, charge pumps or boost converters have been required to drive these LEDs because of their high forward voltage (4 V typical). As white-LED technology has advanced, the forward voltage required has significantly dropped. Today, white LEDs such as Nichia's NHSW046 or NSSW100C are available with a typical forward voltage of less than 3 V. The lower forward voltage eliminates the need for voltage boosting, permitting the use of linear regulation topologies that reduce costs and solution size and increase efficiency across the battery-discharge range. Figure 1 compares the efficiency and battery voltage of the Texas Instruments TPS7510x and a typical series LED boost converter.

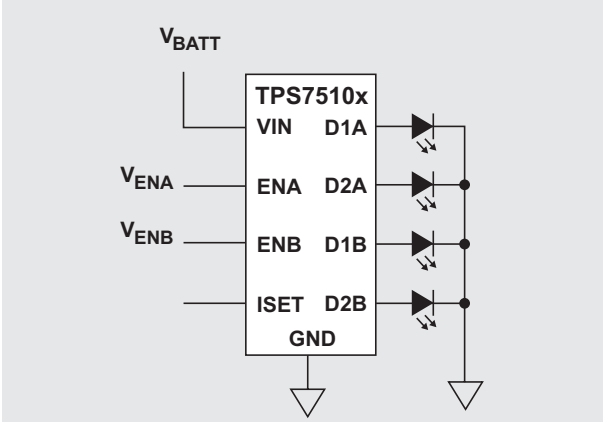
Figure 1. Efficiency versus battery voltage of TPS7510x and typical LED boost converter



TPS7510x family

The TPS7510x low-dropout (LDO) matching LED current source is a highly integrated white-LED driver optimized for low-power keypad and navigation pad LED backlighting applications. The device provides a constant, matched current for up to four unmatched LEDs organized into two banks of two LEDs, each in a common-cathode topology. Inputting a PWM signal on each EN pin allows brightness to be varied from off to full brightness. Each bank has independent enable control, but all four channels are concurrently current-matched. The input supply range is ideally suited to single-cell Li-ion battery supplies and provides up to 25 mA of current per LED over the entire input range. The typical 70-mV dropout voltage allows the circuit to drive the white LEDs from a standard one-cell Li-ion battery. No internal switching signals are used, eliminating troublesome EMI. The TPS7510x is offered in an ultra-small 9-ball, 0.4-mm ball-pitch wafer chip scale package (WCSP) and a 3 × 3-mm QFN package. The package size coupled with the high integration yields a very small solution footprint. Figure 2 shows the typical operating circuit for the TPS7510x.

Figure 2. TPS75105 LDO white-LED driver



The output of each LED is regulated independently, and all of the outputs are typically within 2% of each other. The ISET input allows the user to program any LED current up to 25 mA. If ISET is unconnected, the TPS7510x uses the factory default current setting. The default current settings available in the general catalog are 3 mA (TPS75103) and 5 mA (TPS75105). Default settings are available between 1 and 10 mA in 1-mA increments but may require minimum order quantities.

The TPS7510x does not require input or output capacitors for stability. If the default current setting is used, no external parts other than the LEDs are required. This results in a solution size of less than 1.5 mm^2. A photograph of the EVM layout, including pads for the optional set resistor and input capacitor, is shown in Figure 3. The solution size for this layout with the extra components is still only 25 mm^2.

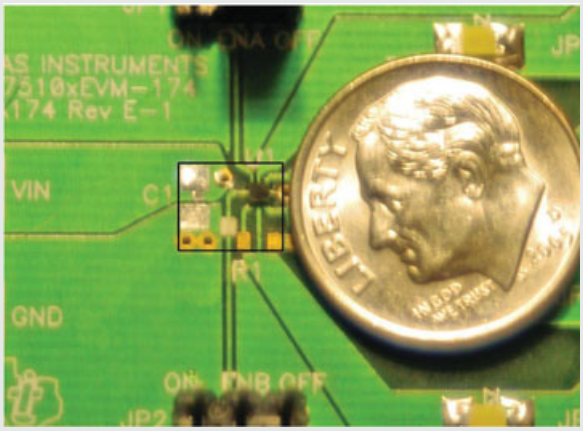
Conclusion

Historically, charge pumps or inductor boost converters have been used to drive white LEDs in most backlighting applications. As the LED technology has improved, forward voltages have dropped. In many low-power applications, the LED forward voltage is less than 3 V. In these applications, the TPS7510x LDO white-LED driver IC provides an excellent solution. The LDO topology eliminates EMI and, with no required external components and the ultrasmall WCSP or QFN package, the total solution size is drastically reduced to just 1.5 mm^2 or 9 mm^2, respectively.

Related Web sites

power.ti.com
www.ti.com/sc/device/TPS75103
www.ti.com/sc/device/TPS75105

Figure 3. EVM solution layout (25 mm^2)



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