

DESIGN NOTES

60V Buck-Boost Controller Drives High Power LEDs, Charges Batteries and Regulates Voltage with Up to 98.5% Efficiency at 100W and Higher – Design Note 501

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Introduction

The LT[®]3791 is a 4-switch synchronous buck-boost DC/DC converter that regulates both constant-current and constant-voltage at up to 98.5% efficiency with a single inductor. It can deliver hundreds of watts and features a 60V input and output rating, making it ideal for driving high power LED strings and charging high voltage batteries when both step-up and step-down conversion is needed. It can also be used as a constant-voltage buck-boost regulator with current limiting and monitoring for both input and output.

Buck-Boost Controller Drives 100W LED String for Airplane and Truck Lights

Airplanes and big trucks with 24V batteries need powerful, efficient and robust headlights and spotlights. Figure 1 shows a 33.3V, 3A (nine Luminus SSR-90 LEDs)

buck-boost LED driver that runs from 15V to 58V input with up to 98.5% efficiency.

The 4-switch synchronous topology drives high power LEDs with minimal switch power loss (and minimal temperature rise). Unlike other topologies, the LT3791 buck-boost can be shorted from LED+ to both LED– and GND and, as a feature, can be programmed to latch off or keep trying to turn back on if the short is removed. Diagnostic output flags report both short-circuit and open-LED conditions.

The solution in Figure 1 features up to 100:1 PWM dimming at 100Hz for accurate brightness adjustment without color shift and analog LED dimming when a PWM oscillator is not present.

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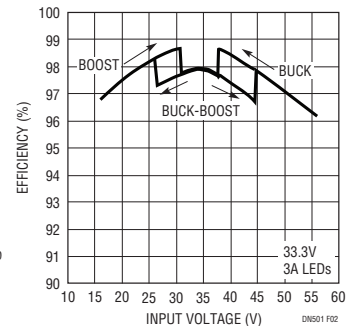
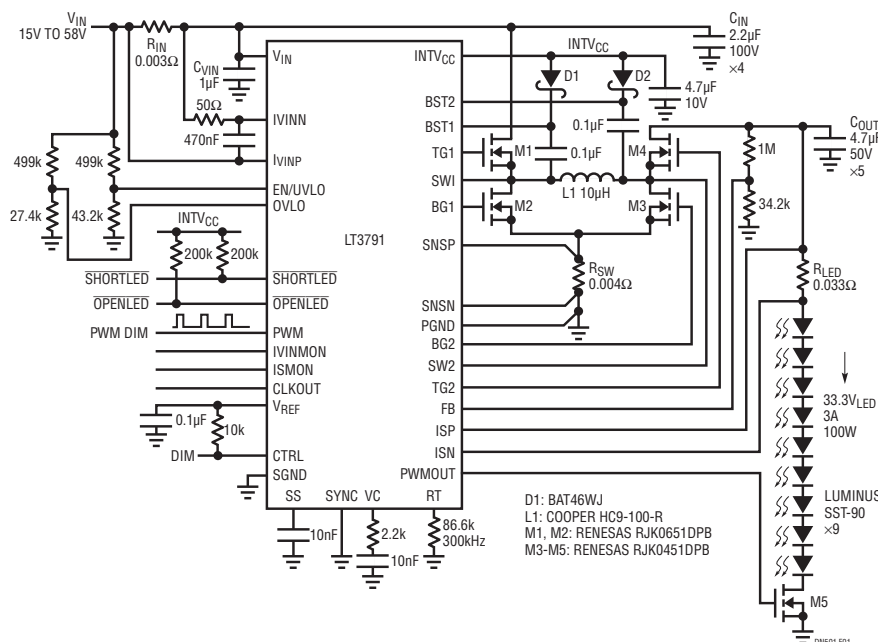


Figure 2. Efficiency of Figure 1

Figure 1. 15–58VIN to 33.3V 3A LED Driver with Up to 98.5% Efficiency

36V, 2.5A SLA Battery Charger

The buck-boost converter shown in Figure 3 charges a 36V 12Ah SLA battery at 44V with 2.5A DC from a 9V to 58V input.

Specially integrated C/10 current sensing and battery voltage detection drops the battery voltage from its charging voltage (44V) to its float voltage (41V) when the battery is near full charge. The OPENLED flag is used to change the state of the charger from charge to float. When the battery voltage drops far enough, voltage feedback returns the charger to its charge state.

The LT3791 can be tailored to charge a range of battery chemistries and capacities from a variety of input sources regardless of the voltage relationship between them. An external microcontroller can be programmed and used to create a maximum power point tracking device to charge the battery from a solar panel. The output diagnostics and dimming input pins make this a simple interface for high power solar panel applications design.

120W, 6V to 55V Voltage Regulator

The LT3791 can also be used in high power constant-voltage buck-boost applications. The FB pin doubles as both the main voltage feedback for the buck-boost, and the overvoltage protection detection and regulation when used as an LED driver.

Figure 1 can be easily turned into a 100W voltage regulator with V_{OUT} between 6V and 55V by placing a 100k resistor between the SS and V_{REF} pins to defeat soft-start reset during a fault.

The voltage regulator is short-circuit proof. The SHORTLED flag reports when there is a short circuit on the output. The input current monitor can still be used in constant-voltage regulation to protect any system that is input-current limited. R_{LED} sets the output current limit for short circuit, but can be removed to provide a PGOOD flag using OPENLED by shorting ISP to ISN.

Conclusion

The LT3791 synchronous buck-boost controller delivers 100W and higher power at up to 98.5% efficiency to a number of different loads. The wide, 4.7V to 60V input and 0V to 60V output voltage range make it both powerful and versatile, and its short-circuit capability makes this a robust choice for many applications in potentially hazardous environments. This seemingly limitless IC can be used in applications where a typical buck or boost converter cannot because of the crossover of input and output voltage ranges.

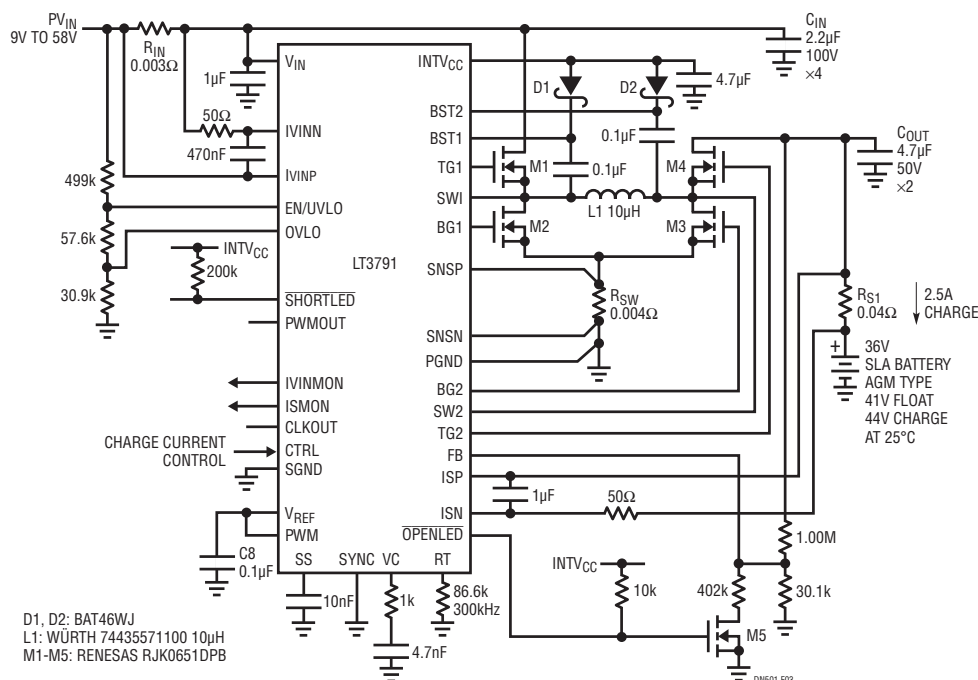


Figure 3. 36V, 2.5A SLA Battery Charger with C/10 Charge Termination

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