

60V, Synchronous Step-Down High Current LED Driver

Design Note 508

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Introduction

The meaning of the term “high power LED” is rapidly evolving. Although a 350mA LED could easily earn the stamp of “high power” a few years ago, it could not hold a candle to the 20A LED or the 40A laser diodes of today. High power LEDs are now used in DLP projectors, surgical equipment, stage lighting, automotive lighting and other applications traditionally served by high intensity bulbs. To meet the light output requirements of these applications, high power LEDs are often used in series. The problem is that several series-connected LEDs require a high voltage LED driver circuit. LED driver design is further complicated by applications that require fast LED current response to PWM dimming signals.

The **LT[®]3763** is a 60V synchronous, step-down DC/DC controller designed to accurately regulate LED current at up to 20A with fast PWM dimming. It is a higher voltage version of its predecessor, the LT3743. It can be applied in a number of other applications thanks to its three additional regulation loops:

- 1) An output voltage regulation loop enables constant output voltage operation. This can be used to provide open LED protection or charging termination for a battery charger.
- 2) A second current regulation loop can be used to set an input current limit.
- 3) An input voltage regulation loop can be used for maximum power tracking (MPPT) in solar-powered applications.

48V Input to 35V Output, 10A LED Driver Optimized for Efficiency

Figure 1 shows a design that delivers 350W output power to drive up to seven LEDs in series from a 48V source. At this high power level, dissipated power is a major concern, so high efficiency is critical. Each 1% of efficiency improvement reduces the loss by 3.5W—significant if the total power loss budget is less than 7W. This circuit is optimized to operate with 98.2% efficiency at full load—Figure 2 shows the efficiency reaching 98% when LED current is above 3A and peaking at 98.4% at ~6A.

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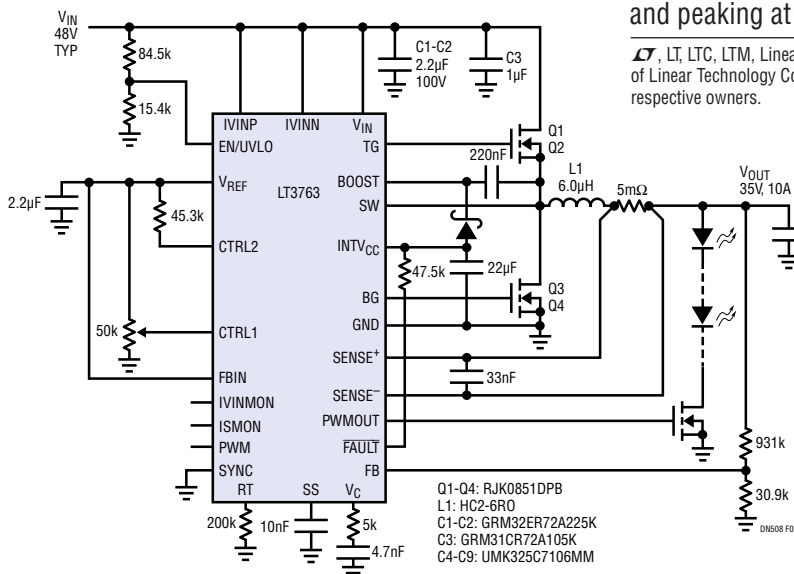


Figure 1. 48V Input to 35V Output, 10A

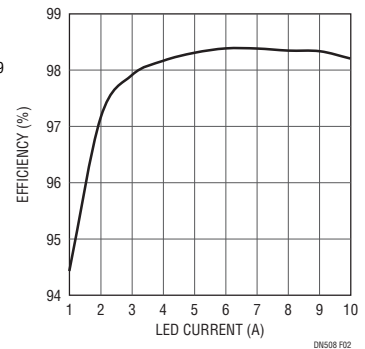


Figure 2. Efficiency of the 48V Input to 35V Output Circuit

At high voltage, the switching losses of the MOSFETs and the inductor outweigh conduction losses. The switching frequency is set to 200kHz to minimize switching losses while maintaining small solution size. Running at full load, this circuit's hot spot occurs at the top MOSFETs, which settles at less than 50°C temperature rise—a very comfortable range for the MOSFETs.

36V Input to 20V Output, 10A LED Driver with Fastest PWM Dimming

PWM LED dimming is the standard dimming method for high power, high performance lighting applications. Fast LED current response to a PWM signal is important in image-producing applications, such as DLP projectors. Figure 3 shows the LT3763 in an application optimized for fast LED PWM dimming.

To achieve fast LED current response to the PWM signal, the LT3763 includes many innovative features. For a given input voltage, the smaller the inductance, the faster the inductor current ramps up, which translates to faster LED current response. This circuit takes only a few microseconds to reach full LED current from zero current when a PWM dimming signal is turned on. Figure 4 shows the performance in the PWM dimming application. Efficiency is 97% at full load.

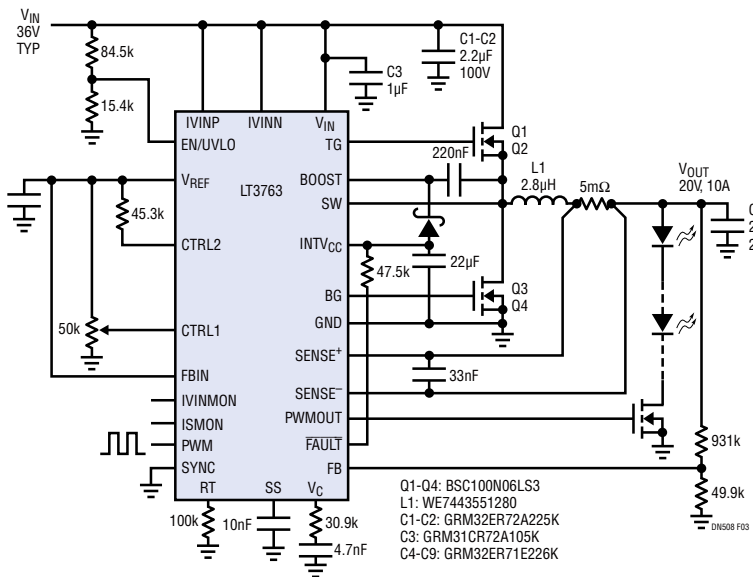


Figure 3. 36V Input to 20V Output, 10A

Solar-Powered Battery Charger

The LT3763 can also regulate its input voltage by adjusting its output current. This is useful for applications that must track peak input power such as in a solar-powered battery charger.

Every solar panel has a point of maximum output power that depends on panel illumination, voltage and output current of the panel. In general, peak power is achieved by maintaining the panel voltage in a small range by reducing output current when needed to prevent the panel voltage from moving out of this range. This is called maximum power point tracking (MPPT).

The LT3763's input voltage regulation loop keeps the panel voltage in maximum power point range by adjusting output current. The constant current, constant voltage (CCCV) operation and C/10 function make the part a natural fit for battery charger applications.

Conclusion

The LT3763 is a 60V, synchronous, high current step-down LED driver controller that can be used to drive the latest high power LEDs, with fast PWM dimming response if needed. The LT3763 is not limited to LED driver applications, due to its three additional voltage and current regulation loops and a number of other powerful features.

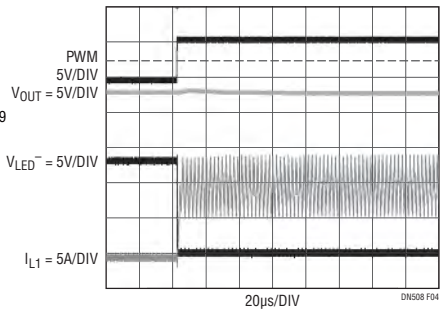


Figure 4. PWM Dimming Performance of Figure 3 Circuit

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