

DESIGN NOTES

Low EMI LED Driver Features 2A, 40V, Integrated, Synchronous Switches for Automotive Lighting

Design Note 557

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Introduction

The breadth of LED applications has grown to encompass everything from general lighting to automotive, industrial and test equipment, sign boards and safety instruments. Feature requirements for LED drivers have become more extensive. The latest LED solutions require drivers that are compact, efficient, low noise, and have high dimming ratios and advanced fault protection. The [LT3922](#) meets these demands.

The LT3922 synchronous LED driver with integrated 2A, 40V switches can be configured as a boost, buck or boost-buck LED driver. Its high efficiency integrated switches fit into a tiny 4mm × 5mm QFN package. This device integrates Linear's most advanced switching technologies, condensing high power capability into tight spaces while controlling the edge rates and mitigating unwanted EMI. The LT3922 features controlled switching edges that do not ring—offering just the

right balance of high efficiency and low noise. They can be run at up to 2.5MHz for compact solutions.

The tiny LT3922 LED driver features low EMI, high efficiency and fault protection required in automotive environments. It can handle 36V automotive transients and 3V cold crank. Its Silent Switcher® architecture, spread spectrum frequency modulation (SSFM) and controlled switching edges make it ideal for powering LEDs with low EMI. Its flexible topology is useful in daytime running lights, signal lights, taillights, and headlight segments as well as dashboard and heads-up displays with high dimming ratios. Built-in fault protection reduces the number of extra components required to protect against short and open LEDs.

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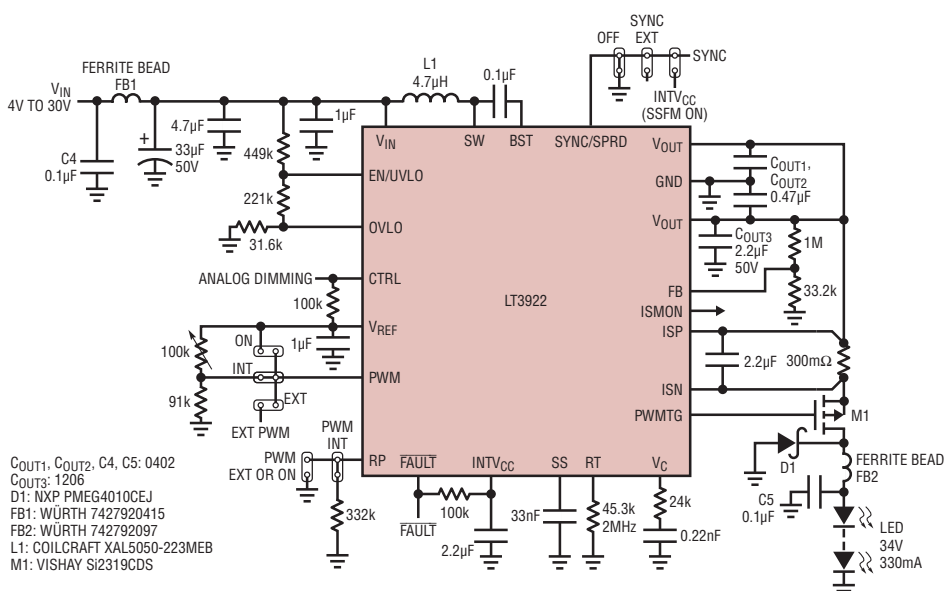


Figure 1. 2MHz Automotive Boost LED Driver Features Low EMI and Internally Generated PWM Dimming Has 91% Efficiency and Passes CISPR 25 Class 5 EMI

Built-In Features Enable Low EMI

The LT3922 includes a number of features that allow it to easily achieve low EMI. First, it incorporates Linear's patented Silent Switcher architecture, where internal synchronous switches minimize hot-switching-loop size and controlled switching edges that do not ring. Its pinout enables placement of small, high frequency capacitors near the two V_{OUT} pins to minimize hot-loop size and EMI. The switching edge rate is controlled by the IC, eliminating high frequency ringing that is common to converters without this feature, reducing high frequency EMI without degrading power or efficiency.

SSFM in the LT3922 spreads the resistor-set switching frequency up and down from 100% to 125% of its value. This decreases both peak and average EMI in the converter at low and high frequencies.

Boost, Buck and Boost-Buck

Since LEDs are light sources driven by controlled current, either or both of LED^+ and LED^- can be attached to non-ground potentials. This opens options for LED driver topologies, including boost-buck (step-up and step-down) and buck mode (step-down). The high side PWM TG driver and low EMI switches can be configured as boost, buck, or boost-buck LED drivers while retaining use of all of the IC's desirable features—low EMI, SSFM and internal PWM dimming.

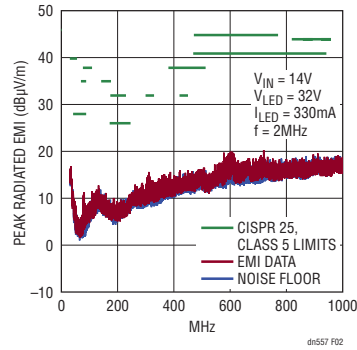


Figure 2. LT3922 Boost Passes CISPR 25 Class 5 Radiated and Conducted EMI

The LT3922 can power LEDs up to 34V as a boost converter. For automotive applications it can be configured as a highest efficiency 400kHz converter or a smallest size 2MHz converter with up to 5000:1 PWM dimming range.

The LT3922 boost-buck topology in Figure 3 supports an input voltage range extending above and below the LED string voltage. This patented low EMI topology features a boost-type low ripple input inductor and a buck-type low ripple output-facing inductor. A 4V to 18V input can drive an LED string voltage between 3V and 16V.

Conclusion

The LT3922 synchronous LED driver meets the many demands of automotive and industrial LED drivers.

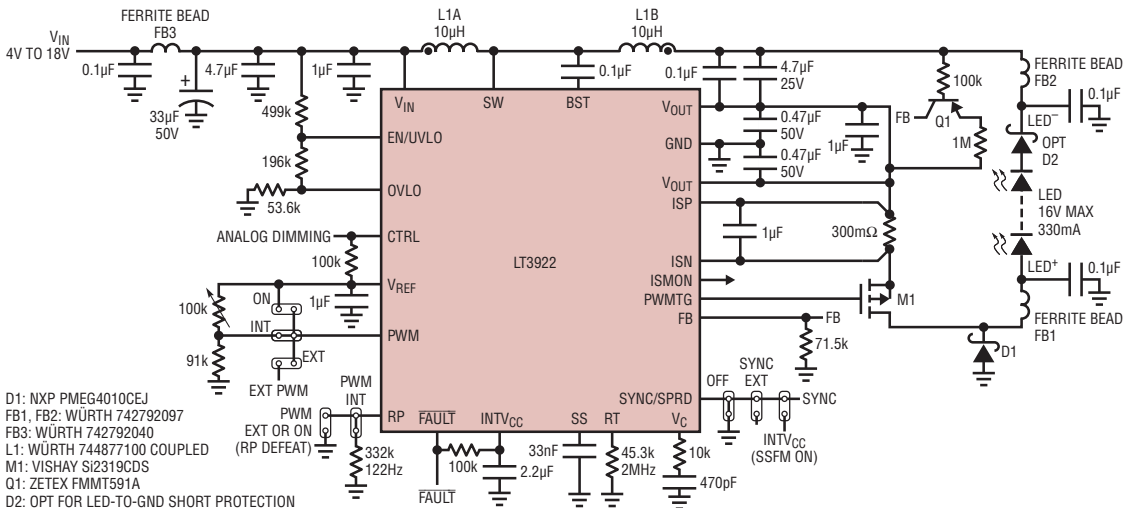


Figure 3. 2MHz Boost-Buck LED Driver with Low Input and Output Ripple. Passes CISPR 25 Class 5 EMI

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