

60V 2MHz Buck-Boost Controllers Regulate High Power Voltage and Current with High Efficiency and Low EMI

Design Note 567

Keith Szolusha

Synchronous buck-boost controllers are versatile and highly efficient. They can produce high power as both a boost and a buck with a single inductor, keeping power supply design simple. Normally, a buck-boost controller in a high power application is operated at a standard or low switching frequency, this maximizes efficiency and avoids complications related to shoot-through and switch blanking time, which can arise in synchronous rectification at high frequencies. Nevertheless, a high frequency 2MHz buck-boost controller with a smaller inductor ensures that the EMI content resides above the AM frequency band.

The [LT8390A](#) and [LT8391A](#) buck-boost controllers are unique in that they operate at 2MHz. The high switching speed enables use of a small inductor for a compact solution size, even in high power applications.

Unlike monolithic converters, which save space with power switches inside the IC package, controllers can drive external power switches with much higher peak

currents, such as 10A. Such high peak currents would burn up the small IC packages of typical integrated converters, but external 3mm × 3mm synchronous MOSFETs can handle this power. The MOSFETs can be arranged in tight quarters with hot-loop capacitors for very low EMI. The unique peak switch current sense amplifier architecture places the sense resistor next to the power inductor, outside the critical input and output hot loops, also reducing EMI.

2MHz, 95% Efficiency, 12V, 4A Buck-Boost

The 2MHz, 12V, 4A buck-boost regulator in Figure 1 boasts efficiency to 95%. This relatively compact design uses 3mm × 3mm MOSFETs and a single high power inductor. The temperature rise for this converter is low, even at 48W. At 12V input, no component rises more than 45°C above room temperature. At 7V input, the hottest component rises less than 55°C with a

LT, LT, LTC, LTM, Linear Technology and the Linear logo are registered trademarks of Analog Devices, Inc. All other trademarks are the property of their respective owners.

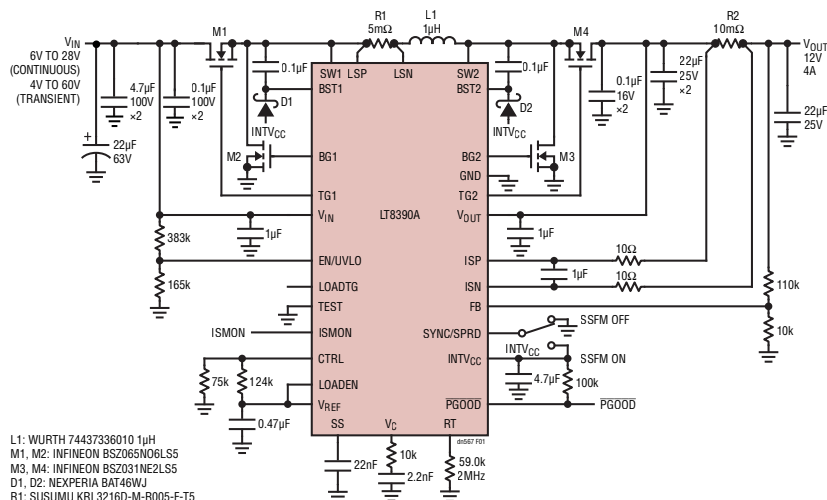


Figure 1. 2MHz 12V, 4A Buck-Boost Voltage Regulator with High Efficiency

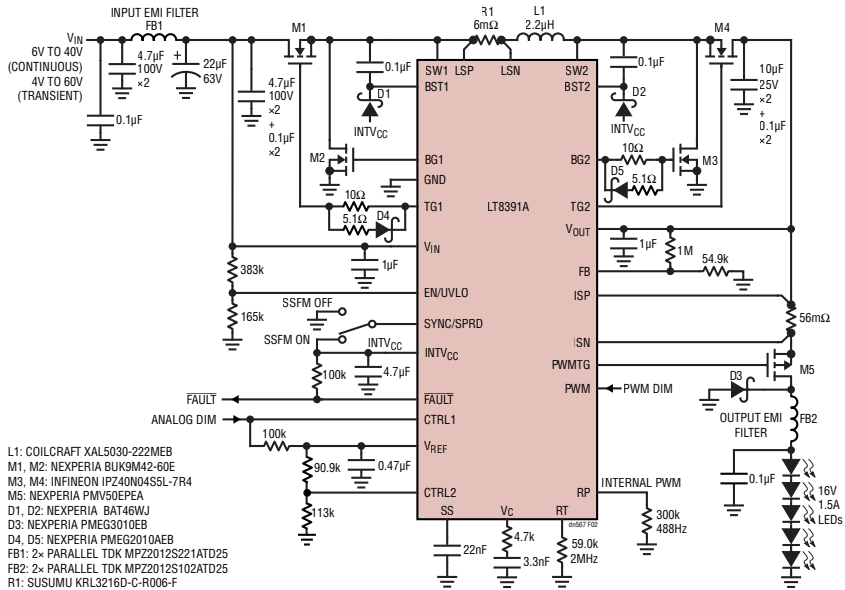


Figure 2. Low EMI 16V, 1.5A Automotive Buck-Boost LED Driver Passes CISPR 25 Class 5 EMI

standard 4-layer PCB and no heat sink or airflow. This converter handles short input transients down to 4V at 4A load, or runs continuously at 4V input with 2A of load (~25W).

The LT8390A's high switching frequency (600kHz to 2MHz) distinguishes it from the field of 4-switch controllers. It also has a variety of notable features like its lower frequency cousin, the LT8390. It has a PGOOD flag, short-circuit protection, and a flexible current-limiting sense resistor for output or inrush current restrictions. Its spread spectrum frequency modulation (SSFM) for low EMI makes it ideal for automotive applications.

2MHz Low EMI Automotive Buck-Boost LED Driver

The LT8391A is a 2MHz LED driver counterpart of the LT8390A. The main difference is that LT8391A includes LED driver PWM dimming features and open LED fault protection. The output sense resistor controls current through a string of LEDs whose voltage may lie within the input voltage range, such as the 9V to 16V car battery. It can run down to 4V cold crank and can withstand up to 60V input transients. LT8391A provides up to 2000:1 PWM dimming ratio at 120Hz and it can use its internal PWM dimming generator (no external clock required) for up to 128:1 accurate dimming.

The 2MHz LT8391A LED driver shown in Figure 1 is optimized for automotive headlights. It uses AEC-Q100

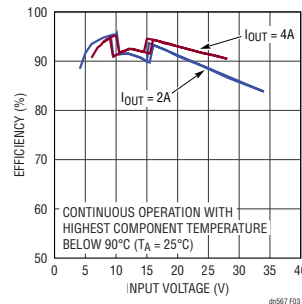


Figure 3. LT8390A Efficiency of Figure 1

components and meets CISPR 25 Class 5 radiated EMI standards. SSFM reduces EMI, and also runs flicker-free simultaneously with PWM dimming.

This compact design features a small inductor and especially small input and output EMI filters. It can run down to 4V and up to 60V. The four synchronous MOSFETs shown can be replaced with two dual MOSFETs for reduced component count when needed. It reaches 93% efficiency. The FAULT flag reports short-circuit and open LED conditions, which are handled with ease.

Conclusion

The LT8390A and LT8391A 2MHz 60V buck-boost controllers can regulate high power voltage and current in compact spaces. The low EMI architecture and SSFM feature make these ideal for low EMI applications.

Data Sheet Download

www.linear.com/LT8390A

For applications help,
call (408) 432-1900, Ext. 3801