DESIGN NOTES

LT1619: Tiny Boost Controller Provides Efficient Solutions for Low Voltage Inputs – Design Note 255

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Introduction

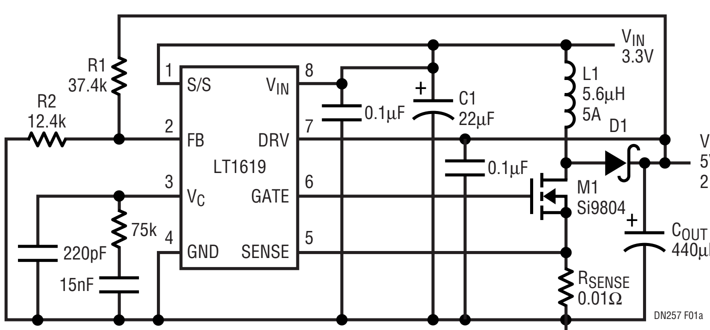
The expanding world of low voltage portable and microprocessor electronics has created the need for small, highly efficient, low cost, low voltage boost controllers with high current capabilities. The new LT®1619, available in a tiny MS8 package, is a high current, low input voltage boost controller with a powerful rail-to-rail MOSFET driver and ultralow current-sense voltage (53mV). These features, used in the common boost or versatile SEPIC topologies, provide low cost, efficient and tiny DC/DC solutions for many applications, including 3.3V to 5V converters and automotive-range 12V to 5V converters.

The LT1619 provides a complete solution for low input voltage applications that require low side MOSFET drive. It is a 300kHz, current mode PWM controller capable of operating from inputs ranging from 1.9V to 18V. The rail-to-rail, 1A MOSFET driver is capable of driving an external MOSFET gate to within 350mV of the supply rail and to within 100mV of ground. Bootstrapping the driver supply pin (DRV) to the output enables the power supply to operate from input voltages as low as 1.9V yet still drive the MOSFET gate voltage high enough for full enhancement. The 53mV low side current limit threshold improves efficiency by reducing the sense resistor's power dissipation. At light loads, the controller automatically switches to Burst Mode™ operation to conserve power. In shutdown, the LT1619 requires only 15µA of quiescent current.

3.3V to 5V Converters

Figure 1 shows a 3.3V to 5V/2.2A boost supply using the LT1619. Low parts count, small size and high efficiency (greater than 90%) make it a perfect solution when a moderate amount of 5V power is required in a predominately 3.3V system. The output voltage can be returned to the DRV pin, further enhancing M1.

Low current-sense voltage, although more efficient, can be more susceptible to switching noise. However, the internal current sense amplifier is blanked for 280ns to prevent spurious switching spikes (and therefore PWM jitter) across the sense resistor caused by the gate charging current at switch turn-on. Although this blanking sets a minimum switch on-time, the controller is capable of skipping cycles at light load with Burst Mode operation disabled.



C1: PANASONIC EEFCDOK220R
C_{OUT}: KEMET T495X227K010AS (×2)
D1: MBRD835L
L1: COILCRAFT DO5022P-562
M1: VISHAY Si9804
R_{SENSE}: IRC LRC-LRF1206-01-R010-F

Figure 1a. 3.3V to 5V Step-Up Converter Rated for 2.2A

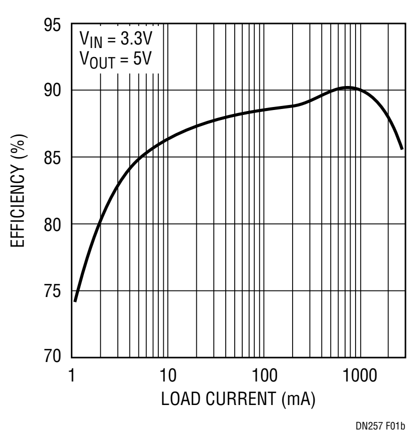


Figure 1b. Efficiency of Figure 1

Choosing the MOSFET

The LT1619 is designed to drive an N-channel MOSFET with up to 60nC of total gate charge (Q_G). Recently, significant advances have been made in low voltage (<30V) power MOSFETs. 10mΩ, low voltage, low threshold FETs with less than 60nC of gate charge are readily available. MOSFETs with less than 60nC of gate charge can be driven directly by the LT1619, resulting in a simple, low cost design.

Automotive Supply

Figure 2 shows a 5V, 1A SEPIC (single-ended primary inductance converter) designed to operate from a 12V battery. The bias supply on V_{IN} and DRV limits the voltage to about 4V maximum at start-up, limiting the amount of quiescent power lost and maintaining a high efficiency. The LT1619 is powered from the output through D2 after regulation is achieved, increasing efficiency.

The low input voltage threshold of the LT1619 allows the battery voltage to drop to 3V or less during normal operation (cold-crank support). With a sublogic-level MOSFET, this converter can still be started at voltage levels as low as 3V without having to add extra components. The power supply will also work well with a battery voltage as high as 18V, which provides margin for battery charging voltage (15V) plus several volts of inductive spiking.

SEPIC capacitor C2 provides a path for continuous input current and directs T1's leakage energy to the output. Using C2 increases efficiency and reduces input capacitor ripple current requirements. The LT1619's 300kHz operating frequency allows for smaller magnetics (0.45" × 0.45" × 0.25" h) and smaller capacitors than required by lower frequency controllers.

Conclusion

The LT1619 solves many of the problems associated with low input voltage source DC/DC converters. Its numerous features make it an ideal choice for a wide range of applications requiring low side MOSFET power transistors, high efficiency, low cost and high currents in very little board space.

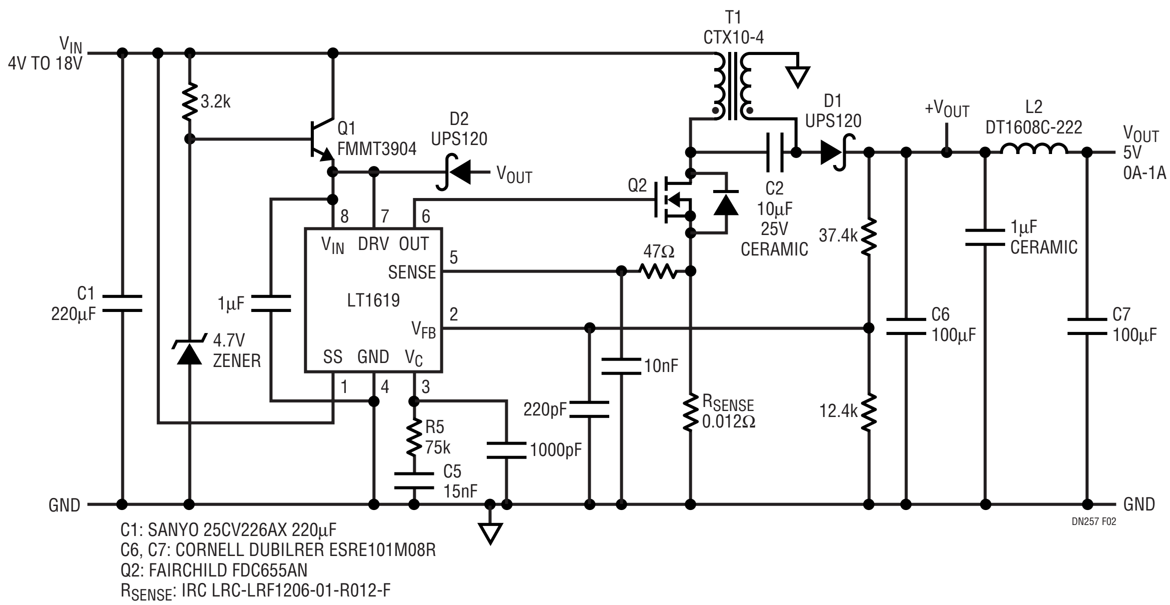


Figure 2. SEPIC Conversion Delivers 5V at 1A from a 12V Battery

Data Sheet Download

http://www.linear-tech.com/go/dnLT1619

For literature on our DC/DC Converters, call **1-800-4-LINEAR**. For applications help, call (408) 432-1900, Ext. 2593

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