LINEAR TECHNOLOGY

DESIGN NOTES

The LTC1267 Dual Switching Regulator Controller Operates from High Input Voltages – Design Note 114

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Introduction

The LTC®1267 dual switching regulator controller is the latest addition to Linear Technology's family of better than 90% efficient step-down DC/DC converters. The LTC1267 features an extremely wide 4V to 40V input operating voltage range and reduced supply currents. The quiescent current is a low 320μA and current in Shutdown mode drops to less than 20μA. The combination of low supply currents and high input voltage capability is ideal for battery-powered applications that require high voltage AC wall adapters.

Linear Technology offers three versions of the LTC1267, all in the space-saving 28-lead SSOP package. The LTC1267 provides fixed output voltages of 3.3V and 5V with individual shutdown capability. The LTC1267-ADJ provides two user-programmable output voltages set by external resistive dividers. The LTC1267-ADJ5 is configured with a fixed 5V output and a programmable output set by an external resistor divider.

High Efficiency with Dual Output Voltages

To boost efficiency, a unique EXT V_{CC} pin on the LTC1267 (also present on the single output LTC1159) allows the MOSFET drivers and control circuitry to be powered from an external source, such as the output of the regulator itself. Obtaining control and driver power from V_{OUT} improves efficiency at high input voltages, since the resulting current drawn from V_{IN} is scaled by the duty cycle of the regulator. During start-up and short-circuit conditions, operating power is supplied by an internal 4.5V low dropout regulator. This regulator automatically turns off when the EXT V_{CC} pin rises above 4.5V.

This 28-pin controller uses Linear Technology's high performance, current mode architecture and Burst Mode™ operation. The LTC1267 automatically switches to Burst Mode operation at low output currents to maintain high efficiency over two decades of load current range. The wide operating range is illustrated by the typical efficiency curve of Figure 1. Battery life is extended by providing high efficiencies at load currents from a few milliamps (when the device is in standby or sleep modes) to amps (under full power conditions).

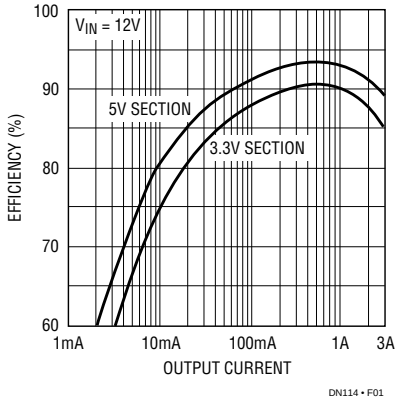

Figure 1. LTC1267 Efficiency vs Output Current of the Figure 2 Circuit

Description

Both regulator blocks in the LTC1267 use a constant off time, current mode architecture. This results in a power supply that has very high efficiency over a wide load current range, fast transient response and very low dropout. The LTC1267 is ideal for applications that require 3.3V and 5V to be implemented with the highest conversion efficiencies over a wide load current range in a small board space. The LTC1267-ADJ has two externally adjustable outputs which allow remote load sensing and user customized output voltages.

Each regulator section employs a pair of external, complementary MOSFETs and a user programmable current sense resistor to set the operation current level to optimize performance for each application. A master Shutdown pin turns off both main outputs and the 4.5V LDO. Both outputs in the LTC1267 and LTC1267-ADJ5 have individual Shutdown capability, whereas the LTC1267-ADJ has a Shutdown pin for only one of its two outputs.

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Burst Mode is a trademark of Linear Technology Corporation.

The higher input voltage capability of the LTC1267 is required by battery-powered systems that use many cells in series to provide more power and longer battery life. For applications requiring 12 cells or more, the AC adapter voltage can be as high as 30V, well below the 40V maximum of the LTC1267, allowing operation directly from the AC adapter. At low input voltages, the internal 4.5V low dropout regulator stays in regulation with an input of only 5V, extracting the maximum possible energy from the battery pack.

All members of the LTC1142/LTC1267 family are capable of 100% duty cycle, providing very low dropout operation (lower than that of most linear low dropout regulators) and all have built-in current limiting. As the input voltage on the LTC1267 drops, the loop extends the on time for the P-channel switch (off time is constant) thereby keeping the inductor ripple current constant. Eventually the on time extends so far that the P-channel MOSFET is on at DC or 100% duty cycle. Load and line regulation are excellent for a wide variety of conditions, including making the transition from Burst Mode operation to continuous mode operation.

Fixed Output 3.3V and 5V Converter

A fixed LTC1267 application circuit creating 3.3V/3A and 5V/3A is shown in Figure 2. The operating efficiency shown in Figure 1 exceeds 90% for both the 3.3V and 5V sections. The 3.3V section of the circuit in Figure 2 comprises the main switch Q1, synchronous switch Q2, inductor L1 and current shunt R_{SENSE3}.

The 5V section is similar and comprises Q3, Q4, L2 and R_{SENSE5}. Each current sense resistor (R_{SENSE}) monitors the inductor current and is used to set the output current according to the formula $I_{OUT} = 100mV/R_{SENSE}$. Advantages of current control include excellent line and load transient rejection, inherent short-circuit protection and controlled start-up currents. Peak inductor currents for L1 and L2 are limited to $150mV/R_{SENSE}$ or 4.5A. The EXT V_{CC} pin is connected to the 5V output, increasing efficiency at high input voltages. The maximum input voltage is limited by the external MOSFETs and should not exceed 28V.

Conclusion

The LTC1267 adds even more versatility to Linear Technology's family of high efficiency step-down regulator controllers. Providing for up to 40V input voltage, the LTC1267 allows the use of higher voltage wall adapters. The 28-lead SSOP package and associated external components make dual output voltage, high efficiency DC/DC conversion feasible in the extremely small board space available in today's portable electronics.

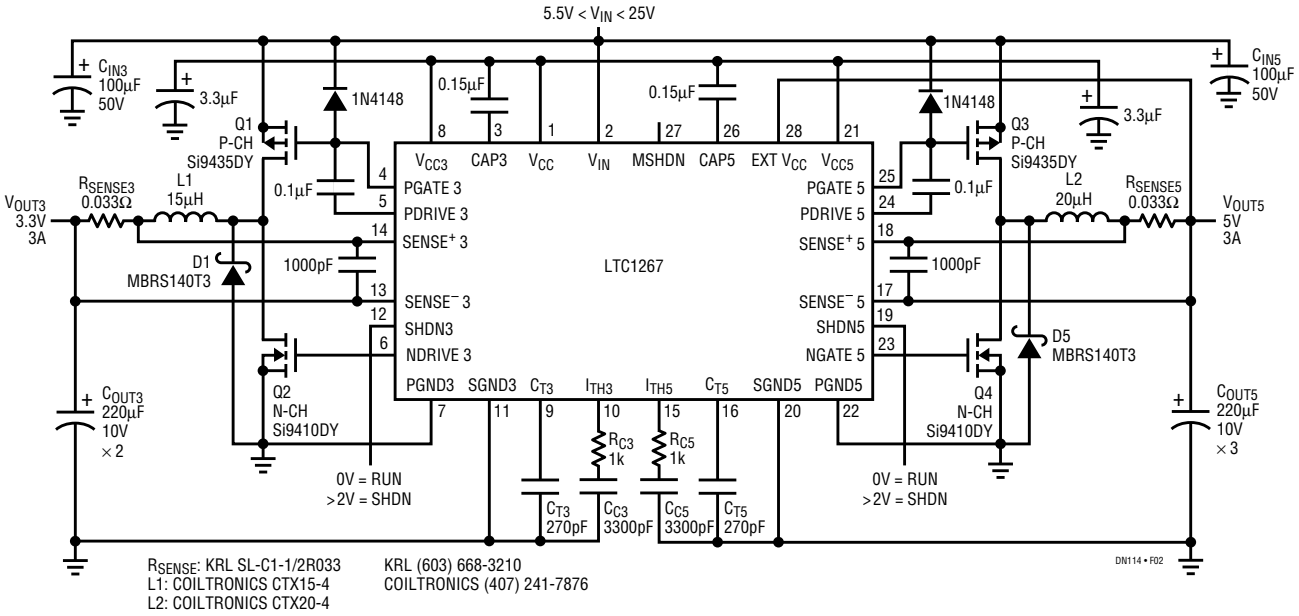

Figure 2. LTC1267 Dual Output 3.3V and 5V High Efficiency Regulator

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