

Design Note

42V Monolithic Synchronous Step-Down Regulators with 2.5µA Quiescent Current and Ultralow EMI

Dong Wang

Introduction

High efficiency, low EMI step-down regulators are found throughout automotive, industrial, medical and telecom environments, where they power a wide variety of applications from a broad array of input sources. Particularly in battery powered applications, a significant amount of time is spent in standby mode, requiring all electrical circuits to operate with a low quiescent current in order to preserve battery run times.

The [LT8606/LT8607/LT8608](#) are a series of monolithic step-down regulators optimized for applications with a wide input voltage range, low EMI levels and small solution sizes. All share the same thermally enhanced 10-lead MSE package and 8-pin 2mm × 2mm DFN package, enabling them to fit into tight spaces. They differ in their output current capabilities, as shown in Table 1.

The low I_Q of the LT8606/LT8607/LT8608 is indispensable in battery-powered applications where idle current must be kept low. They feature a Burst Mode® option, which consumes only 2.5µA quiescent current from the input source even while regulating the output voltage, maintaining battery standby time for as long as possible. The 3V~42V wide input voltage range satisfies the demanding

requirements of industrial and automotive applications, which are distinguished by their lack of stable, high quality voltage sources. The devices come in the 10-lead MSE package and also include spread spectrum operation to meet ultralow EMI emission requirements.

Table 1.

Part#	Current Level	Package	Operation Mode
LT8606	350mA	MSE-10	Burst Mode Operation Pulse-Skipping Mode Spread Spectrum Mode Sync Mode
		DFN-8	Burst Mode Operation Only
LT8607	750mA	MSE-10	Burst Mode Operation Pulse-Skipping Mode Spread Spectrum Mode Sync Mode
		DFN-8	Burst Mode Operation Only
LT8608	1.5A	MSE-10	Burst Mode Operation Pulse-Skipping Mode Spread Spectrum Mode Sync Mode
		DFN-8	Burst Mode Operation Only

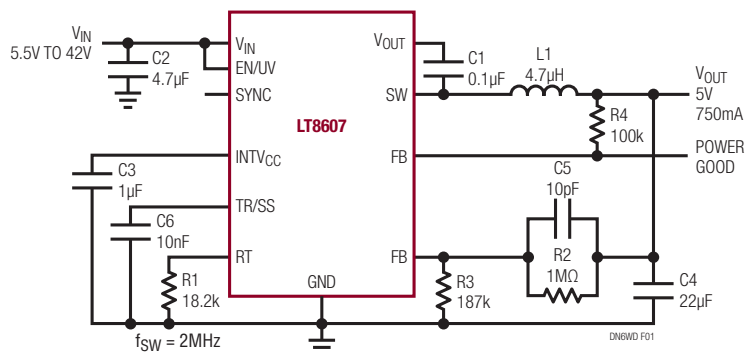


Figure 1. High Efficiency LT8607 12V to 5V Synchronous Step-Down Converter

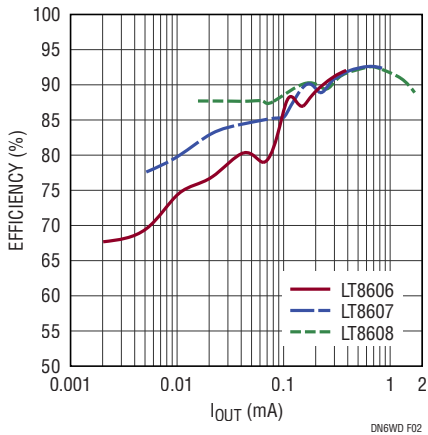


Figure 2. Efficiency vs. Load Current for LT8606/LT8607/LT8608 Based $12V_{IN}$ to $5V_{OUT}$ Step-Down Converter

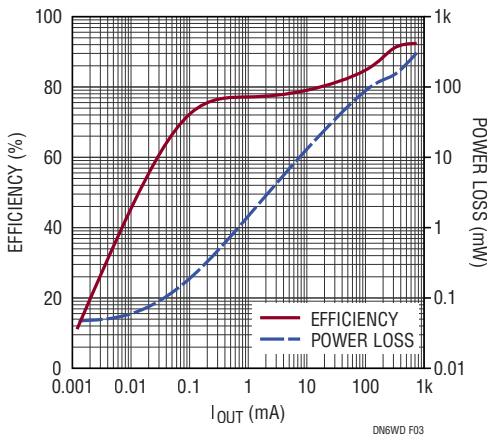


Figure 3. Efficiency and Power Loss vs Load Current for the Circuit in Figure 1

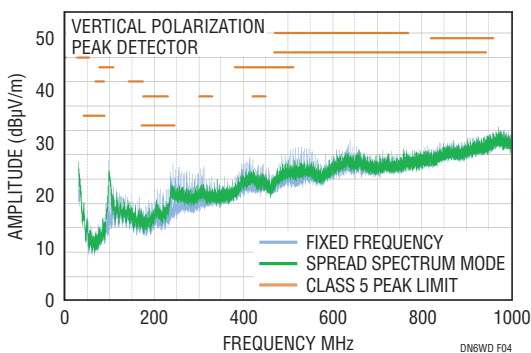


Figure 4. CISPR25 Radiated EMI Performance for the Circuit in Figure 1

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Circuit Description and Functionality

Figure 1 shows a 5V output power supply based on the 10-lead LT8607 regulator. The input voltage extends up to 42V and the output is set to 5V at 750mA with 2MHz switching frequency. Only a few additional components are required for the complete solution, including inductor L1 and a few passive components. Figure 2 shows that this circuit can achieve 92.5% peak efficiency.

Burst Mode Operation Improves Light Load Efficiency

During light load operation and no-load standby mode, high efficiency and low idle current are very important for battery powered applications. The LT8606/LT8607/LT8608's 2.5µA quiescent current and Burst Mode operation option are perfect solution for these requirements. During light load and no-load conditions, an LT8606/LT8607/LT8608-based converter gradually reduces the switching frequency, which reduces switching power losses while maintaining low output voltage ripple. Figure 3 shows the light load efficiency of the solution shown in Figure 1.

High Switching Frequency with Ultralow EMI Emission

In addition to efficiency, EMI/EMC compliance is demanded in automotive, industrial, computational and telecom environments. A higher switching frequency allows a smaller solution size but often at the cost of increased EMI emission. The LT8606/LT8607/LT8608's integrated MOSFETs, built-in compensation circuit and 2.2MHz operation minimize solution size, but they also achieve excellent EMI performance, due to advanced process technology. Spread spectrum mode operation of the switching frequency can further reduce EMI emissions. Figure 4 shows the CISPR25 EMI test result of the solution shown in Figure 1.

Conclusion

The LT8606/LT8607/LT8608 are easy-to-use monolithic step-down regulators with integrated power MOSFETs and built-in compensation. They are optimized for applications with wide input voltage ranges and low EMI noise requirements. Their 2.5µA quiescent current and Burst Mode operation option makes them ideal solutions for battery powered step-down converters, significantly extending battery standby times. The 200kHz to 2.2MHz switching frequency range makes them suitable for most low power to micropower applications. Integrated MOSFETs, together with up to 2.2MHz switching frequency ability greatly minimize the total solution size. CISPR25 scanning results show their excellent radiated EMI performance, making them compliant with most stringent EMI standards.