# Design Note

## Dual Channel 42V, 4A Monolithic Synchronous Step-Down Silent Switcher 2 with 6.2µA Quiescent Current

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### Introduction

The LT®8650S 42V, dual channel, 4A, synchronous Silent Switcher®2 regulator features a wide input voltage range of 3V to 42V, ideal for automotive, industrial and other step-down applications. Its quiescent current is only 6.2µA, with the outputs in regulation, a critical feature in automotive environments, where always-on systems can drain the battery even when the car is not running. EMI can be, and a problem if overlooked in the board layout. The Silent Switcher 2 design of the LT8650S can save the day when it comes to passing stringent automotive EMI standards, since layout becomes less critical than in other designs.

### 7.5V/4A and 3.3V/4A Outputs Have Fast Transient Response

Figure 1 shows a dual output regulator designed to optimize transient response. Although the LT8650S includes internal compensation, external compensation is used here to minimize transient response time and output voltage excursions. Switching is at 2MHz, which allows higher loop bandwidth and faster transient response.

Figure 2 shows the output response to a 0A to 4A load step, where $V_{OUT}$ drops less than 100mV for both the 3.3V and 7.5V outputs. This response is combined with high initial accuracy for a solution that meets tight $V_{OUT}$ tolerances.

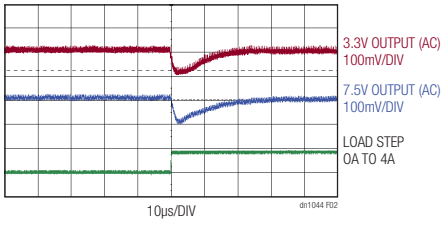


**Figure 2. 0A to 4A Transient Responses of the Circuit in Figure 1 (Burst Mode® Operation)**

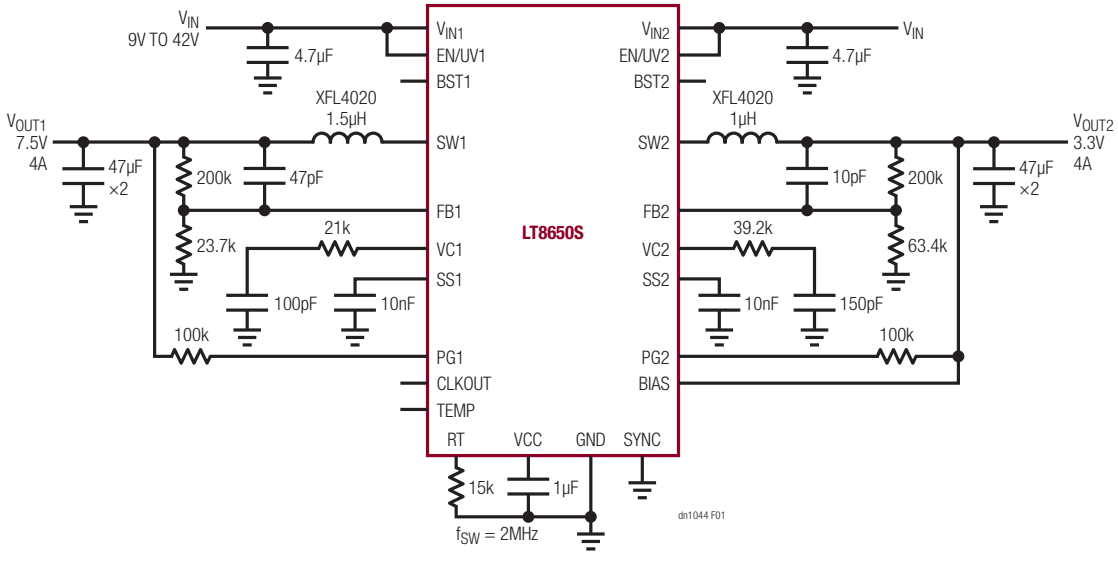


**Figure 1. 7.5V/4A and 3.3V/4A Outputs Feature Fast Transient Response**





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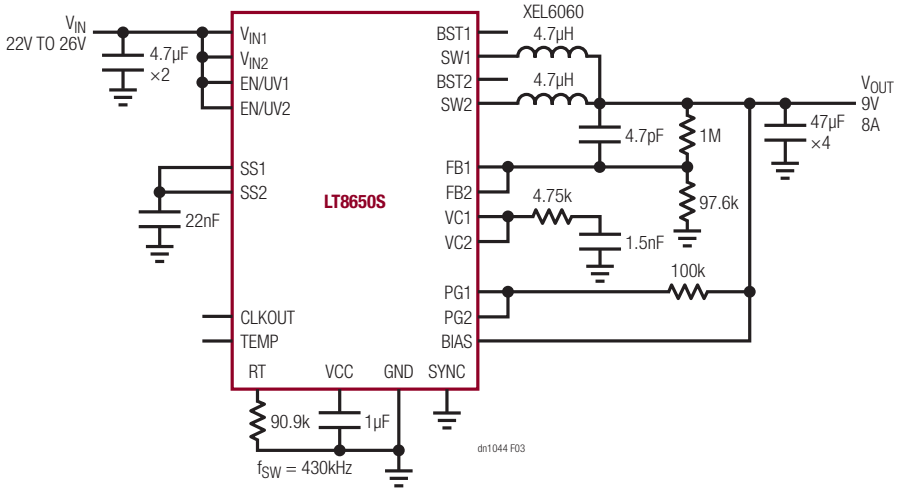


Figure 3. Paralleled Outputs Deliver 9V/8A from a 24V Input While Remaining Cool

## Paralleled Outputs Deliver 9V/8A from 24V While Remaining Cool

The LT8650S packs two synchronous step-down regulators into a 4mm × 6mm package. The two outputs can be easily paralleled for high current as shown by the 72W output, 24V input design in Figure 3. Efficiency at full load is 95%, with the thermal performance of the board shown in Figure 4. Running at the room temperature, the hottest part of the IC reaches about 75°C without active cooling.

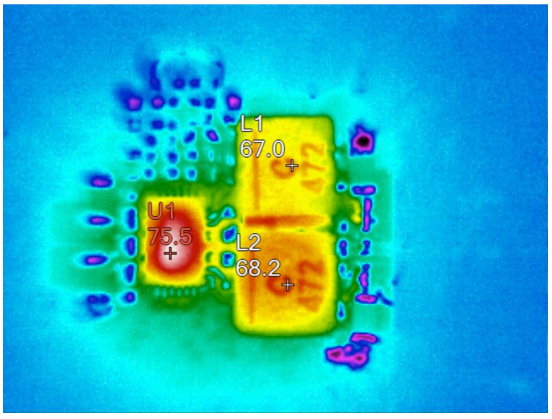


Figure 4. Thermal Performance of the Circuit in Figure 3

The temperature and efficiency are even better for a 12V input. When paralleling, it is important to balance the current between the outputs by tying the outputs of error amplifiers together. This can be achieved by connecting VC1 and VC2 together and using external compensation. For applications that may need more thermal budget, the LT8650H operates with a 150°C junction temperature.

## 3.3V/3A and 1V/5A Running at 2MHz for a System on Chip (SoC) Application

Many SoC applications require 3.3V for peripherals and 1V for the core. Figure 5 shows how the LT8650S can be used in a cascade topology, where the input for the 1V converter is powered by the 3.3V output. The benefits of a cascade configuration over powering $V_{IN2}$ from the main supply include reduced solution size and constant 2MHz operation.

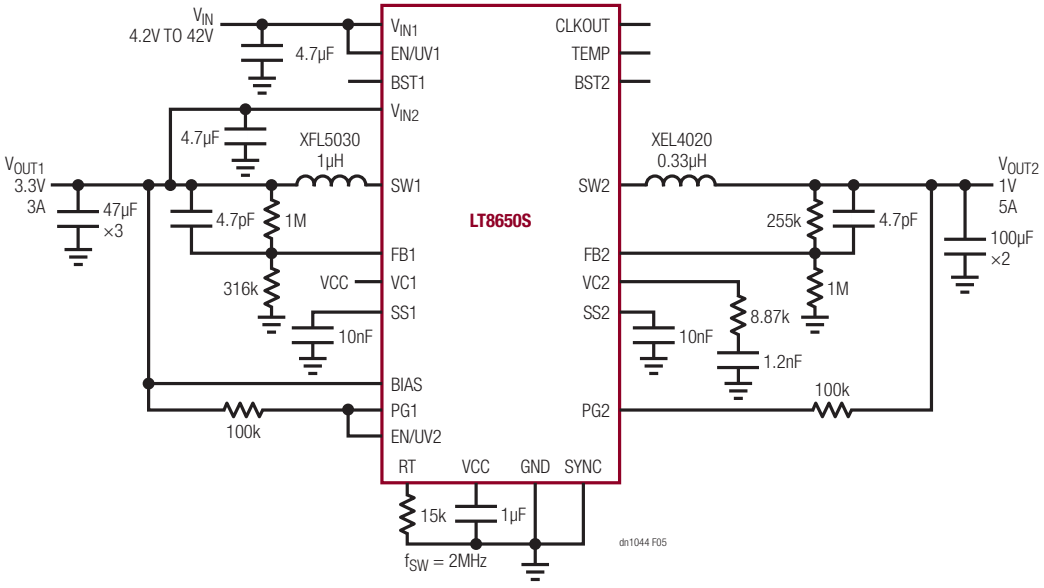


**Figure 5. 3.3V/3A and 1V/5A Circuit Running at 2MHz for a System on Chip (SoC) Application**

The 4A current rating per channel of the LT8650S is set at this value due to thermal limitations. Each channel could electrically deliver 6A if the temperature rise is managed with additional cooling. In this application, the output power of channel 2 is low, so that it can deliver 5A.

## Conclusion

The LT8650S features a wide input range, low quiescent current and its Silent Switcher 2 design. Packing two 4A synchronous step-down regulators in a 4mm × 6mm package reduces part count and solution size while allowing design flexibility for a broad range of applications.

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