Application Brief

Benenfits of Quasi Dual-Phase In High Power Applications

Introduction

As power requirements continue to increase across battery-powered applications, battery charger designers are challenged to deliver higher output power without compromising efficiency or thermal performance. This trend has accelerated with the adoption of USB Type-C PD Extended Power Range (EPR) , particularly in high-performance notebooks and other portable devices. To address these challenges, TI has developed its patented quasi dual-phase architecture, which enhances power handling capability while improving efficiency and thermal performance across a wide range of operating conditions.

What is Quasi Dual-Phase?

The quasi dual-phase architecture is an enhanced buck-boost topology that utilizes two buck phases and a shared boost phase. During dual-phase operation, both buck phases switch with 180° interleaving, allowing the converter to distribute current across multiple power components. The converter can automatically transition between dual-phase and single-phase operation based on load conditions. At lighter loads, the converter operates using a single buck phase to reduce switching losses, as power demand increases, the second buck phase is automatically enabled, allowing current to be shared between both phases.

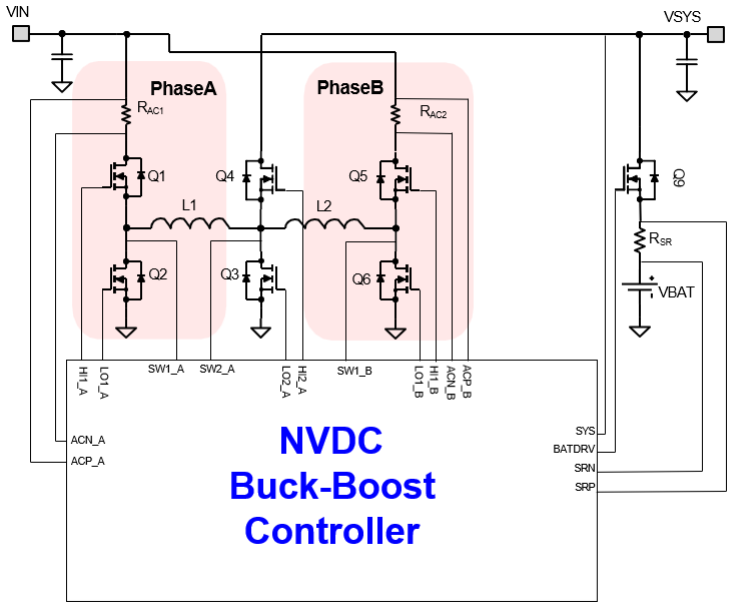
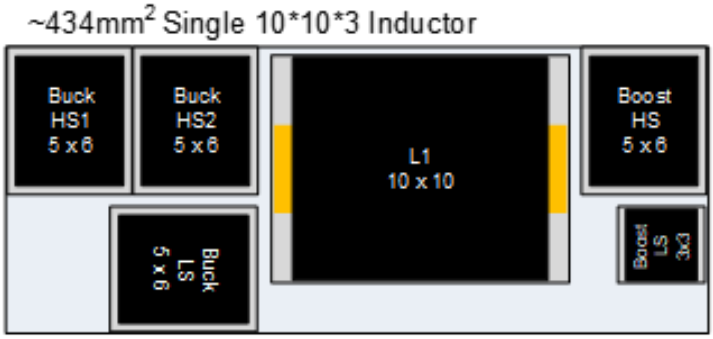


Figure 1. Quasi Dual-Phase Architecture

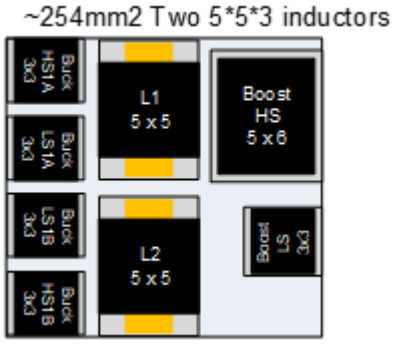
Benefits Of Quasi Dual-Phase

The quasi dual-phase architecture provides several advantages over traditional single-phase charger implementations. By distributing current between two buck phases, the current stress on each inductor and MOSFET is reduced, improving thermal performance and enabling higher power operation. The lower current per phase also enables the use of smaller magnetic components, resulting in a more compact solution size. In addition, 180° phase interleaving reduces input and output current ripple, while automatic phase shedding maintains high efficiency at lighter loads by disabling the second phase when full power capability is not required. These benefits make the quasi dual-phase architecture preferred for high-power notebook charging applications that require high power density, improved thermal performance, and efficient operation across a wide load range.



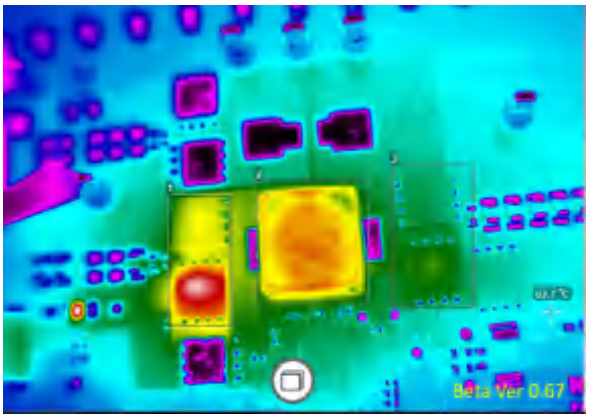
Larger inductor with high saturation current. Increase thermal stress at high-power buck operation. No current balancing between parallel high-side FETs

Figure 2. Typical 140W Single Phase Solution Size



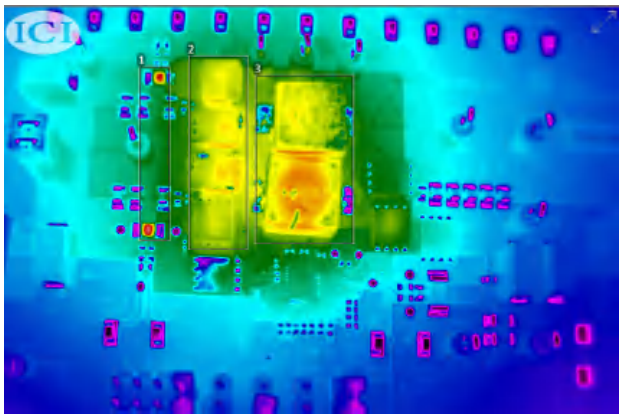
- 41% smaller PCB design area
- Improved thermal distribution
- Integrated current balancing

Figure 3. Typical 140W Dual Phase Solution Size



V_{BAT} = 9V V_{ADPT} = 28V Hotspot(MOSFET)= 99.4**°C**

Figure 4. 140W Single Phase Thermal Performance



V_{BAT} = 9V V_{ADPT} = 28V Hotspot(Inductor)= 57.6**°C**

Figure 5. 140W Dual Phase Thermal Performance

Conclusion

As power requirements continue to increase across battery-powered applications, TI's quasi dual-phase architecture provides a robust design for achieving higher power density, improved thermal performance, and high efficiency. By combining dual-phase current sharing with automatic phase shedding, the architecture delivers efficient operation across a wide operating range, making it preferred for applications supporting USB Type-C PD Extended Power Range (EPR).

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