

DESIGN NOTES

2-Phase Boost Converter Delivers 10W from a 3mm × 3mm DFN Package – Design Note 354

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Introduction

Small size, high efficiency, low noise and simplicity are all key features for battery-powered applications and point-of-load converters in low voltage systems. The LTC[®]3428 is well suited for these applications because it offers these features as well as minimum output ripple and component count. It can start up with as little as 1.5V and operates with inputs up to 4.5V. Its dual phase architecture allows for an effective switching frequency of 2MHz (1MHz/phase), which minimizes inductor and capacitor size.

Dual Phase Converter Reduces Output Ripple

The LT3428 incorporates two internal 93mΩ, N-channel MOSFET switches—enabling it to supply 2A of current at 5V from an input of 3.3V.

Figure 1 shows a dual phase 5V, 2A design. This converter switches at 1MHz per phase. The two phases are 180° out of phase, effectively doubling the output ripple frequency.

This reduces the peak-to-peak output ripple current, which in turn makes it easier to filter out switching frequency ripple and noise. Input ripple current is also reduced, which minimizes stress on other components and reduces required input capacitance. The circuit in Figure 1 produces only 20mV_{p-p} of output voltage ripple, as shown in Figure 2.

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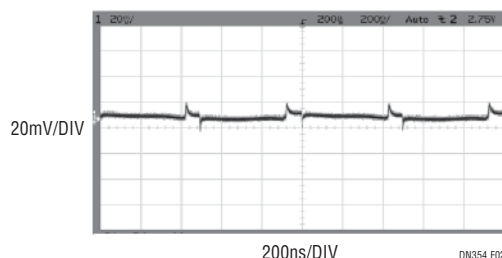


Figure 2. Output Ripple for the 5V Dual Phase Boost Converter in Figure 1

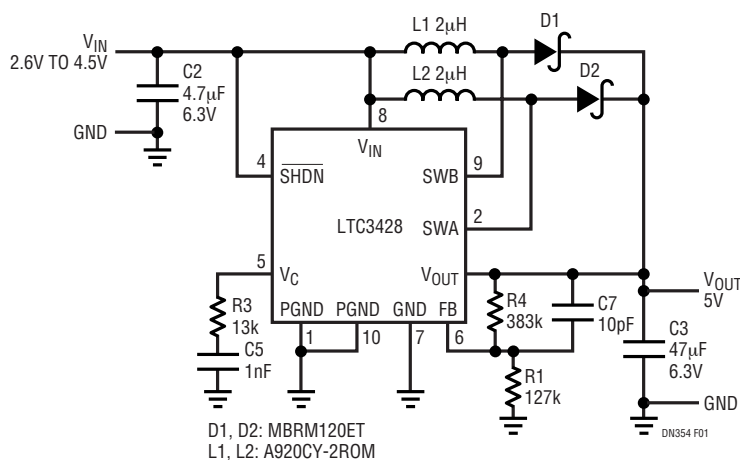


Figure 1. A Dual Phase, 5V at 2A Output Boost Converter

Smaller Layout is Possible by Reducing the Number of External Components

The LTC3428 requires very few external components for a complete boost circuit (see Figure 1). This, combined with its 3mm × 3mm footprint and 0.75mm profile make for an extremely compact, but feature rich converter. It can provide as much as 10W of power at 3.3V_{IN}, and includes integrated features including internal soft-start and thermal shutdown. Figure 3 shows a photo of a typical layout, while Figure 4 shows the efficiency of this circuit at 3.3V_{IN}.



Figure 3. Typical Layout for a 5V Dual Phase Boost Converter

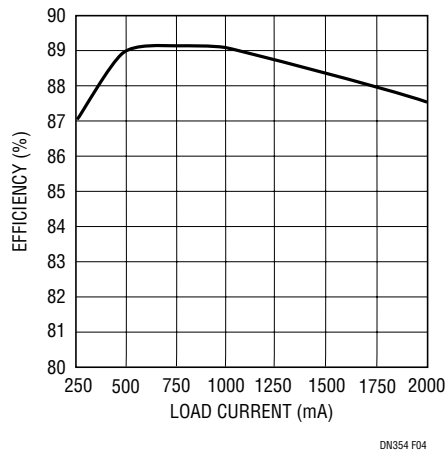


Figure 4. Efficiency for the 5V Dual Phase Boost Converter in Figure 1 with 3.3V_{IN}

Antiringing Feature in Discontinuous Operation

During discontinuous mode operation, the inductor current is discharged to zero before the end of the switching period. Once the diode is turned off, there is high frequency ringing (caused by the inductor and parasitic capacitance) on the switch node, which can cause EMI radiation. The LTC3428 features an antiringing circuit that significantly reduces the discontinuous operation ringing. Figure 5 shows a switch waveform of a converter with antiringing control and Figure 6 shows one without.

Conclusion

The LTC3428's dual phase architecture reduces input and output ripple when compared to a single phase design, while providing high efficiency for up to 2A at 5V from a 3.3V input. Its 3mm × 3mm footprint and integrated features keep the circuit layout simple and small.

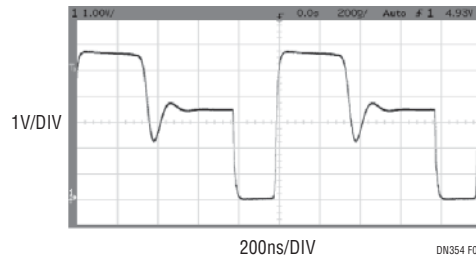


Figure 5. Switch Waveform for the 5V Dual Phase Boost Converter in Discontinuous Mode with Antiringing Circuit

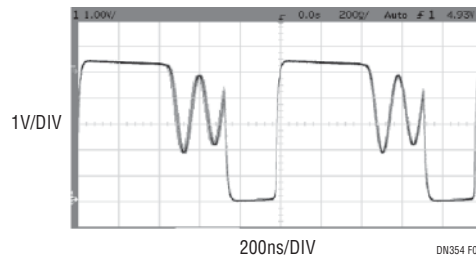


Figure 6. Switch Waveform for a 5V Single Phase Boost Converter in Discontinuous Mode

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