

DESIGN NOTES

Dual Output Monolithic Synchronous Buck Regulator Operates from 3.6V to 15V Inputs and Delivers 3A Per Channel – Design Note 1020

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Introduction

The LTC3633 is a high efficiency, dual output monolithic synchronous step-down switching regulator, capable of delivering 3A of output current per channel from input voltages between 3.6V and 15V. Its compact 4mm × 5mm QFN package has very low thermal impedance eliminating the need for an external heat sink. Its high input voltage capability makes the LTC3633 ideal for 12V distributed power systems.

1.8V and 3.3V 2MHz Buck Regulator

Figure 1 shows a LTC3633 12V_{IN} to 1.8V_{OUT} and 3.3V_{OUT}, 3A, buck regulator. With the frequency setting pin, RT, connected to the internal 3.3V regulator rail (INTV_{CC}), this circuit runs at 2MHz—the LTC3633 switching frequency is programmable from 500kHz to as high as 4MHz, and can also be synchronized to an external clock—reducing the value and size of the output capacitors and inductor. Even with this high switching frequency, the efficiency of this circuit is good: 87% at full load for the 3.3V regulator and 82% at full load for the 1.8V regulator, at 12V_{IN} (see Figure 2).

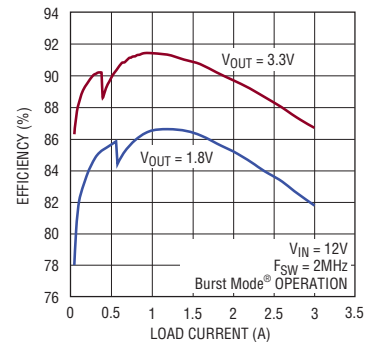


Figure 2. High Efficiency from Each Channel for the Circuit in Figure 1

By connecting the phase mode pin (PHMODE) to INTV_{CC}, the two internal regulators operate 180 degrees out-of-phase with respect to each other, reducing the input current ripple, and thus, the number and value of input capacitors. Due to a controlled on-time design, the LTC3633 achieves very fast load transient response

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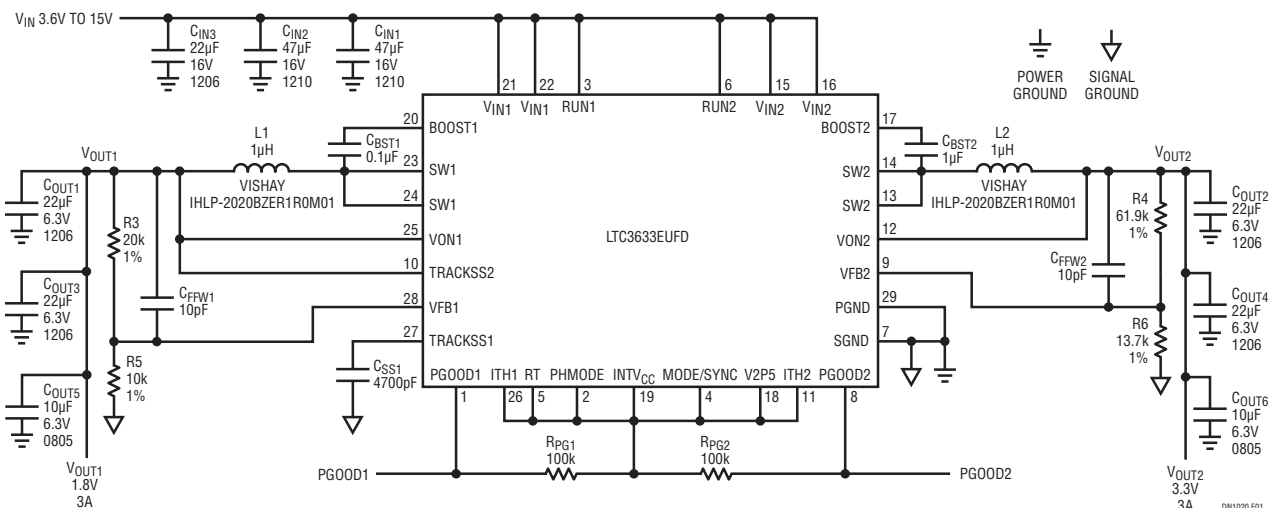


Figure 1. LTC3633: 1.8V_{OUT} and 3.3V_{OUT}, 2MHz Buck Regulator

with minimal output capacitance, as shown in Figure 3. With only 50µF of output capacitance, it takes only 10µs to recover from a 3A load step that results in less

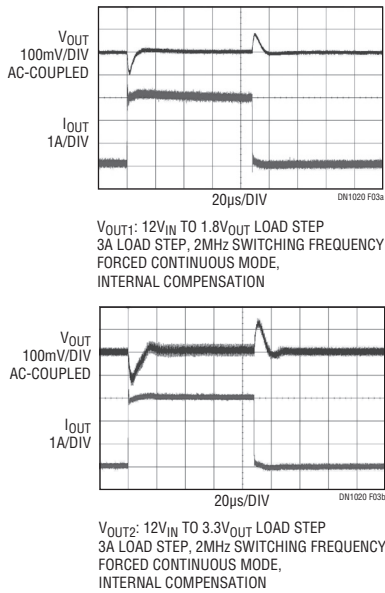


Figure 3. Load Step Responses for the Figure 1 Circuit

than 100mV of output voltage deviation. Note that compensation is internal, set up by tying the compensation pin (ITH) to INTV_{CC}. This connects an internal series RC to the compensation point of the loop, eliminating the need for external compensation components. To further optimize the loop, an external RC circuit can be applied to the ITH pin.

1.2V_{OUT}, 6A, Out-of-Phase Supply

The LTC3633's two internal regulators can be combined form a single output circuit, operating out-of-phase to deliver high total output current with minimal input and output capacitance—useful for distributed power systems. This design also generates lower high-frequency EMI noise than a single-phase design, due to the lower input ripple current caused by the out-of-phase switching currents with respect to each other (see Figure 4). The 12V_{IN} to 1.2V_{OUT} dual-phase LTC3633 regulator is shown in Figure 4, with Figure 5 showing its load step response.

Conclusion

The dual 3A output LTC3633 provides a high performance compact regulator solution for powering low voltage loads in 12V intermediate bus systems. Configured as a two-phase, single output regulator, it can deliver up to 6A with minimum input ripple and an effective switching frequency up to 8MHz.

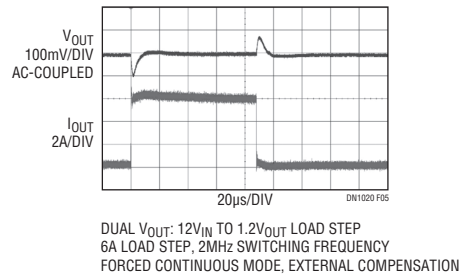


Figure 5. Load Step Response

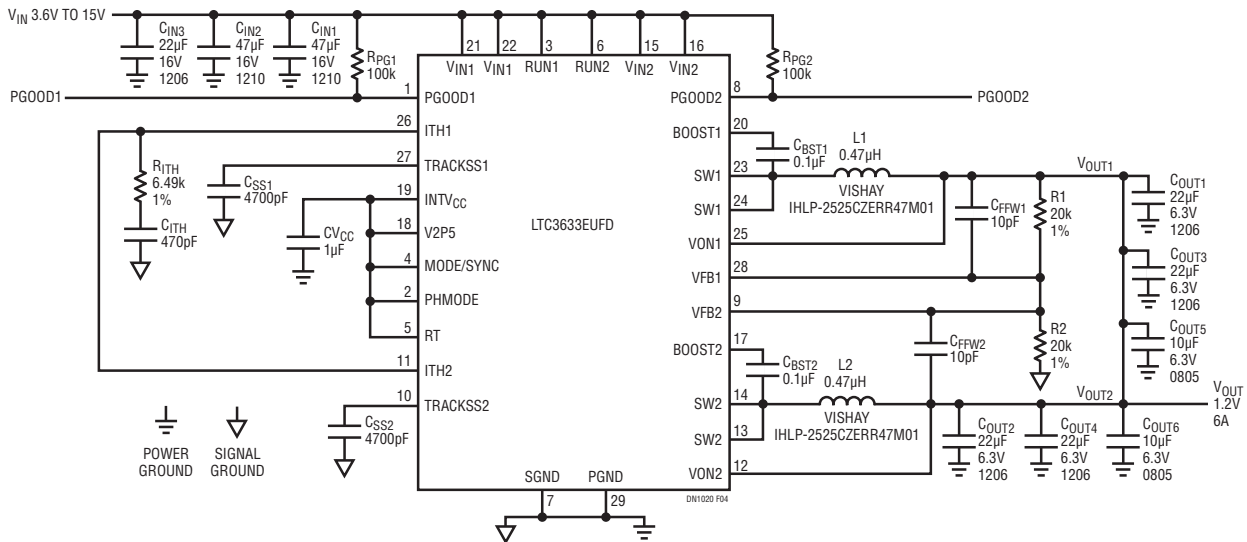


Figure 4. 6A Out-of-Phase Buck Regulator Using the LTC3633

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