

DESIGN NOTES

3A, 2MHz Monolithic Synchronous Step-Down Regulator Provides a Compact Solution for DDR Memory Termination – Design Note 309

Joey M. Esteves

Introduction

The LTC[®]3413 is a monolithic synchronous, step-down switching regulator that is capable of generating a bus termination voltage for DDR/DDR2 memory applications. While sourcing and sinking up to 3A of current, the LTC3413 allows switching frequencies as high as 2MHz. Increasing the switching frequency makes compact solutions possible by allowing the use of smaller inductors and capacitors. The internal power switches have a mere 85mΩ of on-resistance making it possible to achieve efficiencies as high as 90% while generating an output voltage as low as 0.6V. For improved thermal handling, the LTC3413 is offered in a 16-Lead TSSOP package with an exposed pad.

The LTC3413 utilizes a constant frequency, current mode architecture that operates from an input voltage range of 2.25V to 5.5V and provides a regulated output voltage equal to $V_{REF}/2$. The switching frequency can be set between 300kHz to 2MHz by a single external resistor.

Output voltage ripple is inversely proportional to the switching frequency and the inductor value. Having the ability to increase the switching frequency as high as 2MHz allows lower inductor values to be used while still maintaining low output voltage ripple. Because smaller case sizes are usually offered for lower inductor values, the overall solution footprint can be reduced. An internal voltage divider halves the reference voltage, eliminating the need for external resistors to perform this task.

3A, 2.5V to 1.25V Step-Down DC/DC Converter

Figure 1 illustrates a design solution for a 2.5V to 1.25V step-down DC/DC converter that is capable of sourcing and sinking up to 3A of output current. Efficiency for this circuit is as high as 90% as shown in Figure 2. Because of their low cost and low ESR, ceramic capacitors were selected for the input and output capacitors. Although many switching regulators have difficulty operating with ceramic capacitors and rely on the zero that is generated by the larger ESR of tantalum capacitors, OPTI-LOOP[®] compensation allows the LTC3413 to operate successfully with ceramic input and output capacitors. The frequency for this circuit is set at 1MHz by a single external

LTC, LT and OPTI-LOOP are registered trademarks of Linear Technology Corporation.

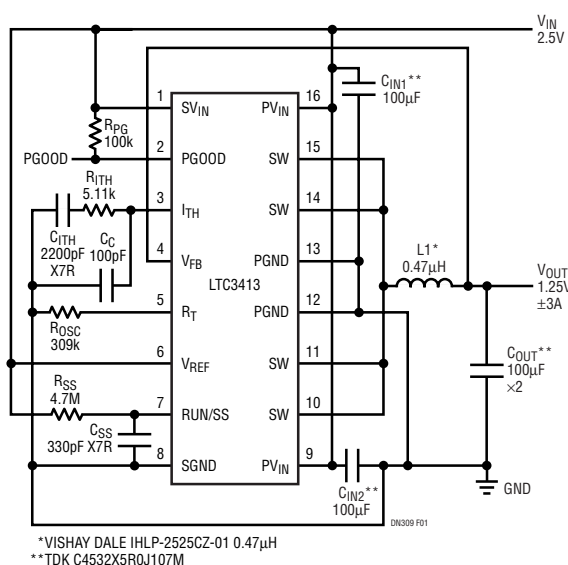


Figure 1. 2.5V to 1.25V, ±3A DDR Memory Termination Supply

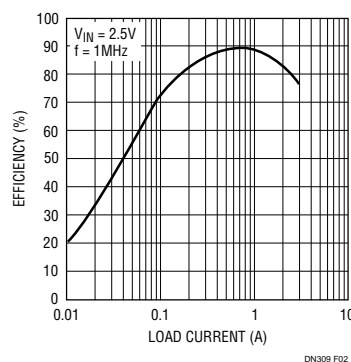


Figure 2. Efficiency vs Load Current, $V_{IN} = 2.5V$

resistor. Operating at frequencies this high allows the use of smaller external components such as the inductor and capacitors shown in Figure 1.

Many DDR termination applications require the bus termination voltage to be stepped down from a higher system voltage while tracking one-half of a reference voltage. This option is allowable in most systems since a reference voltage is typically available. Figure 3 shows a design solution for a 3.3V to 1.25V, $\pm 3A$ DDR memory

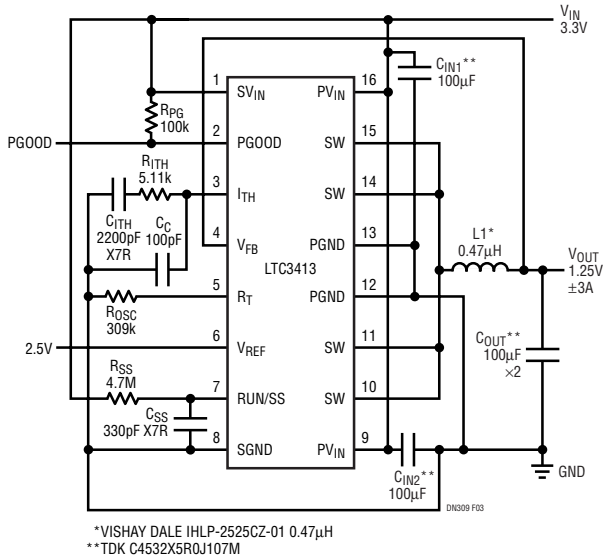


Figure 3. 1.25V, $\pm 3A$ DDR Memory Termination Supply from 3.3V

termination supply with a 2.5V external reference. Efficiency for this circuit is as high as 90% as shown in Figure 4. Figure 5 shows another design solution for a 3.3V to 0.9V, $\pm 3A$ termination supply with a 1.8V external reference. Stepping down from a higher system voltage has the advantage of reducing the resistive losses due to the internal power switches, thus improving efficiency.

Conclusion

The LTC3413 is a monolithic, synchronous step-down DC/DC converter that is well suited for DDR memory termination applications requiring up to $\pm 3A$ of output current. Its high switching frequency and internal low $R_{DS(ON)}$ power switches allow the LTC3413 to offer compact, high efficiency design solutions.

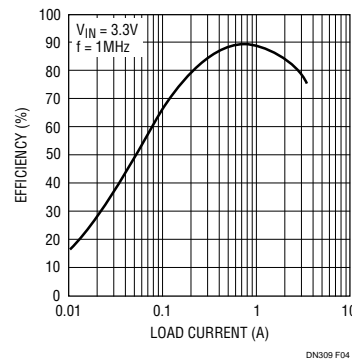


Figure 4. Efficiency vs Load Current, $V_{IN} = 3.3V$

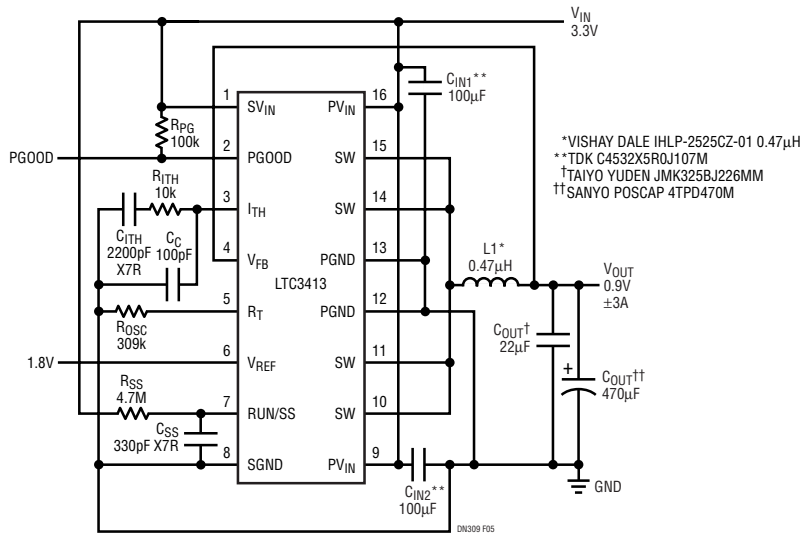


Figure 5. 0.9V, $\pm 3A$ HSTL Memory Termination Supply

Data Sheet Download

<http://www.linear.com/go/dnLTC3413>

For literature on our Switching Regulators, call **1-800-4-LINEAR**. For applications help, call (408) 432-1900, Ext. 2759