

DESIGN NOTES

Dual Monolithic Step-Down Switching Regulator Provides 1.6A Outputs with Reduced EMI and V_{OUT} as Low as 0.8V

Design Note 404

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Introduction

Electronic devices are becoming smaller while the power requirements are increasing to satisfy ever more functionality. To preserve power and manage heat, switching regulators are desirable because of their high efficiency compared to linear regulators.

The LT3506 and the LT3506A are examples of how to squeeze power out of a supply without overheating the end product. These are dual 1.6A step-down monolithic regulators that simplify the lives of system engineers. They eliminate the need for external power switches, thereby reducing solution size and BOM cost. Their outputs can be as low as 0.8V, satisfying the needs of the latest DSPs. Integrated dual output channels reduce the part count, while anti-phase switching of the two channels maximizes efficiency and reduces input current ripple and EMI. Both

the LT3506 and the LT3506A have 0.8V high accuracy voltage references.

Typical LT3506A and LT3506 Applications

The primary difference between the LT3506A and the LT3506 is the switching frequency. The LT3506A's switching frequency is 1.1MHz while the LT3506's is 575kHz. Higher switching frequency allows smaller components. For lower output voltages, i.e., less than 3.3V, the LT3506 is recommended if $V_{OUT}/V_{IN(MAX)}$ is less than 15%. The lower switching frequency option usually results in higher efficiency due to the lower switching and inductor core losses.

The circuit in Figure 1 generates a 3.3V and a 5V output. The overall efficiency of the circuit (both channels) is shown in Figure 2. The circuit shown in Figure 3 generates a 1.2V and a 1.8V from a 3.6V to 21V input. The wide input voltage of both the LT3506 and the LT3506A (3.6V to 25V) can accept a variety of power sources, from lead-acid batteries and 5V rails to unregulated wall adapters and distributed power supplies.

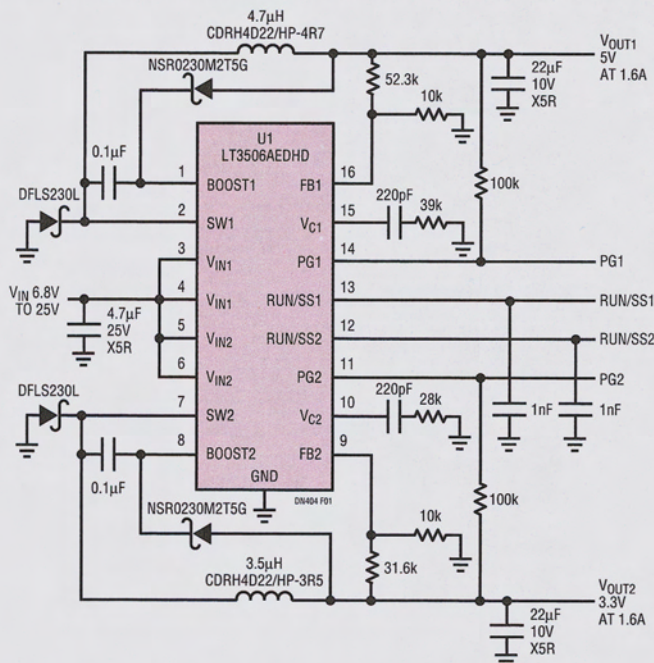


Figure 1. LT3506A Application Circuit Provides Dual Outputs of 5V at 1.6A and 3.3V at 1.6A

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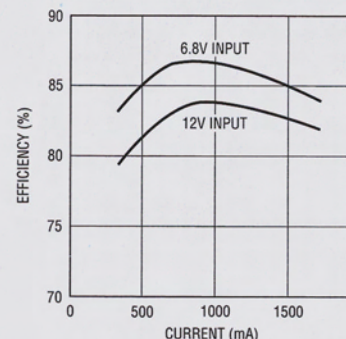


Figure 2. Overall Circuit Efficiency (Both Outputs Loaded Identically)

The LT3506's high switching frequencies allow the use of small, low profile surface mount inductors and ceramic capacitors, resulting in smaller solution size and lower assembly cost. Furthermore, the low ESR of ceramic capacitors and high switching frequency results in very low, predictable output voltage ripple.

The internal supplies of both the LT3506 and LT3506A are powered from V_{IN1} pins. It is possible to supply power via the V_{IN2} pin from a different source, or it can be simply tied to V_{OUT1} , provided V_{OUT1} can supply sufficient current. The efficiency of V_{OUT2} can be improved when supplying V_{IN2} from a separate, lower supply voltage. Cascading V_{IN2} to V_{OUT1} also enables some low duty cycle applications for V_{OUT2} .

The thermally enhanced 16-lead DFN or TSSOP packages have an exposed ground pad on the bottom. This ground must be soldered to a ground pad on the PCB. Adding a dozen thermal vias to this pad improves thermal performance. A higher temperature grade part, I-grade, is also available.

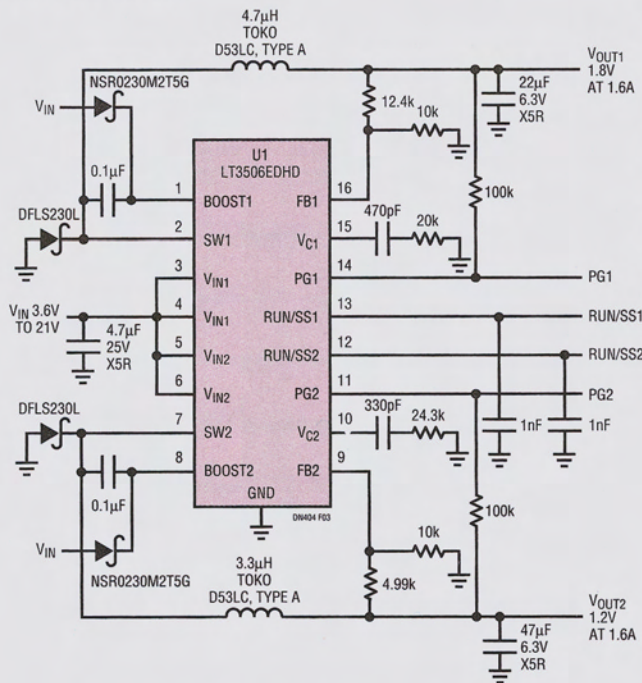


Figure 3. LT3506 Application Circuit Provides Dual Outputs of 1.8V at 1.6A and 1.2V at 1.6A

Power Sequencing without Adding Components

Supply sequencing is critical in many systems in order to prevent possible latch-up and to improve system reliability. Independent PG (Power Good) indicators, RUN/SS pins and V_C pins of the LT3506 and the LT3506A simplify supply sequencing. The PG pin remains low until the FB pin is within 10% of the final regulated output voltage. The easiest way to sequence outputs is to tie the PG1 pin to the V_{C2} pin. Then remove the pull-up resistor on PG1. This enables V_{OUT1} to come up before V_{OUT2} as shown in Figure 4.

2-Phase Switching Eases EMI Concerns

A step-down switching regulator draws current from its input supply and its input capacitor, resulting in a large AC current that can generate EMI. The LT3506's two regulators are synchronized to a single oscillator and switch out of phase by 180 degrees. Compared with two completely independent regulators, the input current ripple of the LT3506 is substantially reduced and its effective frequency doubled, thereby lowering EMI and allowing the use of a smaller input capacitor without reducing efficiency.

Conclusion

Both the LT3506 and LT3506A step down the output voltage to as low as 0.8V and provide 1.6A of current capability per channel. 2-channel anti-phase switching substantially reduces the input current ripple and eases EMI concerns. The PG, V_C , and RUN/SS pins make supply sequencing simple and straightforward. Two package options (leadless and leaded) and two switching frequency options allow optimal solutions for most applications.

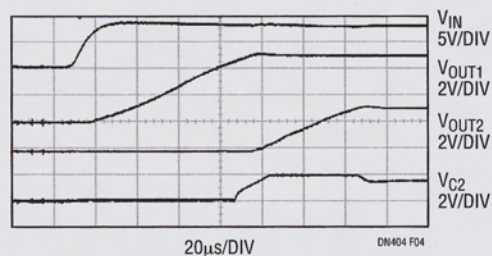


Figure 4. Start-Up Waveforms of the Circuit in Figure 1 with Power Sequencing

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