

# DESIGN NOTES

## Dual Monolithic Buck Regulator Provides Two 1.4A Outputs with 2-Phase Switching to Reduce EMI – Design Note 305

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### Introduction

Advanced electronic systems that use a single voltage supply are a thing of the past. Today's electronic systems require several regulated voltages; even relatively simple subsystems need a minimum of two supplies. Microprocessors and DSPs, for example, might require both a 1.8V core supply and a 3.3V supply for I/O and memory. Many board level systems require both 3.3V and 5V. Added to this mix is the ever increasing packaging density of electronic products. Voltage regulators must fit in a small space in close proximity to sensitive circuits, meaning they must be small, efficient and low noise. Linear regulators may generate too much heat, or be too bulky for some applications, and switching regulators present possible EMI problems.

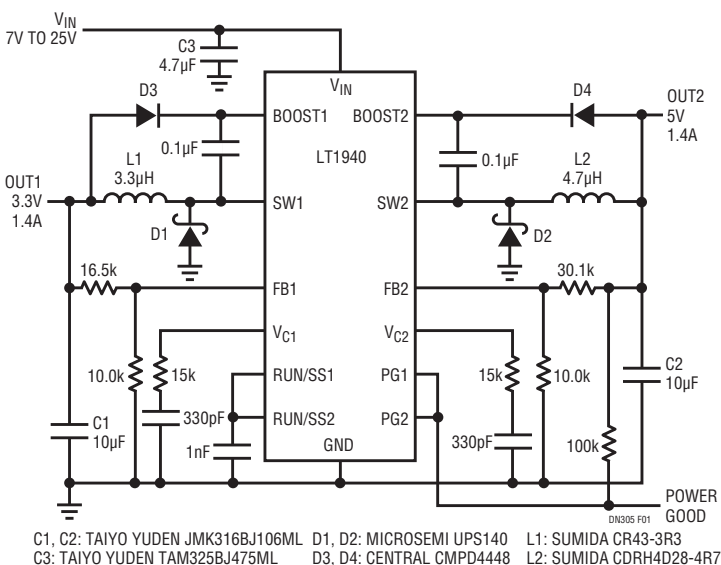
### Circuit Description

The LT<sup>®</sup>1940 is a dual step-down switching regulator that solves these problems for systems requiring two or

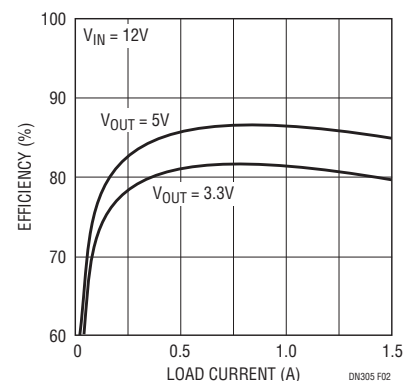
more regulated voltages. Its wide input range, 3.6V to 25V, accepts a variety of power sources. The low profile 16-lead TSSOP package has an exposed metal backside, improving thermal performance and allowing the LT1940 to produce two 1.4A outputs without additional heat sinks. High frequency, 2-phase switching minimizes ripple and EMI while each channel has independent soft-start and power good indicators. These features make it possible to design small, low noise supplies that interface easily with existing systems.

The circuit in Figure 1 generates 3.3V and 5V from an input of 7V to 25V. In this circuit, the two RUN/SS pins are tied together and a single capacitor programs the soft-start. Also, the two power good pins are tied together providing a single power good signal that goes high when both outputs are in regulation.

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**Figure 1. The LT1940 Produces Two Low Noise Outputs Using Small Ceramic Capacitors**



**Figure 2. The Efficiency of the Circuit in Figure 1 Remains High, Even at Full Load**

## High Frequency, Current Mode Switching Minimizes Component Size

The LT1940's high 1.1MHz switching frequency and current mode control allow the use of small components including low profile inductors and ceramic capacitors. Because the control loop can be easily compensated even with a high loop bandwidth, the output capacitors can have relatively low values and still provide fast and stable transient performance. The high switching frequency, combined with the low ESR of the ceramic capacitors, results in a very low output ripple (<5mV<sub>P-P</sub>).

## 2-Phase Switching Eases EMI Concerns

A buck regulator draws pulses of current from its input supply, resulting in large AC currents that can cause EMI problems. The LT1940's two regulators are synchronized to a single oscillator and switch out of phase by 180°. This substantially reduces the input ripple current, thereby lowering EMI and allowing the

use of a single input capacitor. Synchronization also eliminates the audible noise that can occur when two switchers run at slightly different frequencies.

## Soft-Start and Power Good Pins Simplify Supply Sequencing

Multisupply systems often require output sequencing. For example, a microprocessor's core supply should be in regulation before power is applied to the I/O circuits. Figure 3 shows a simple way to sequence the two outputs of the LT1940. Channel 1 produces the 1.8V core supply. Its power good pin pulls V<sub>C2</sub> low, disabling channel 2 until the 1.8V output is in regulation.

## Conclusion

The LT1940 has the right set of features to implement a high performance, dual output power supply. High switching frequency, 2-phase operation and all ceramic capacitors produce a small, low ripple, low EMI circuit that interfaces easily to any system.

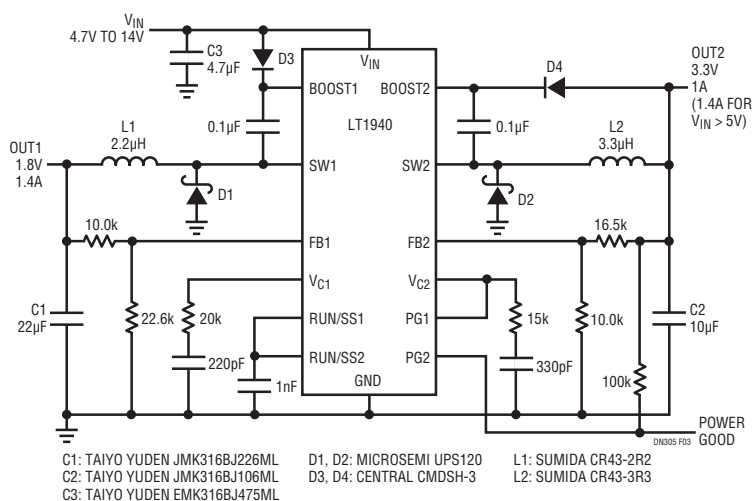


Figure 3. This 1.8V/3.3V Circuit Uses the Power Good Output of Channel 1 to Sequence the Two Outputs (Channel 1 Starts First)

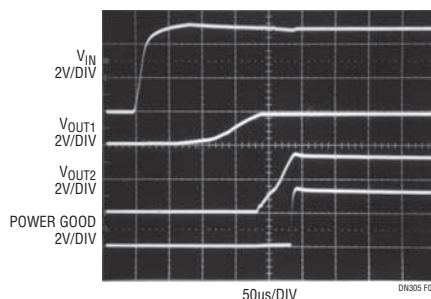


Figure 4. Start-Up Waveforms of the Circuit in Figure 3

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