

# DESIGN NOTES

## 2-Phase DC/DC Controller Makes Fast, Efficient and Compact Power Supplies – Design Note 334

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High efficiency, fast transient response and small size are often at odds in power supply designs. Fortunately, the 2-phase LTC<sup>®</sup>3708 PWM controller makes it possible to simultaneously achieve all three. Figure 1 shows the LTC3708 in a compact, high efficiency dual-output power supply that has excellent transient response.

The device uses a combination of design features to make all of this possible. High efficiency is attained through a combination of features: a No R<sub>SENSE</sub><sup>™</sup> current sensing technique, 2-phase operation mode, onboard

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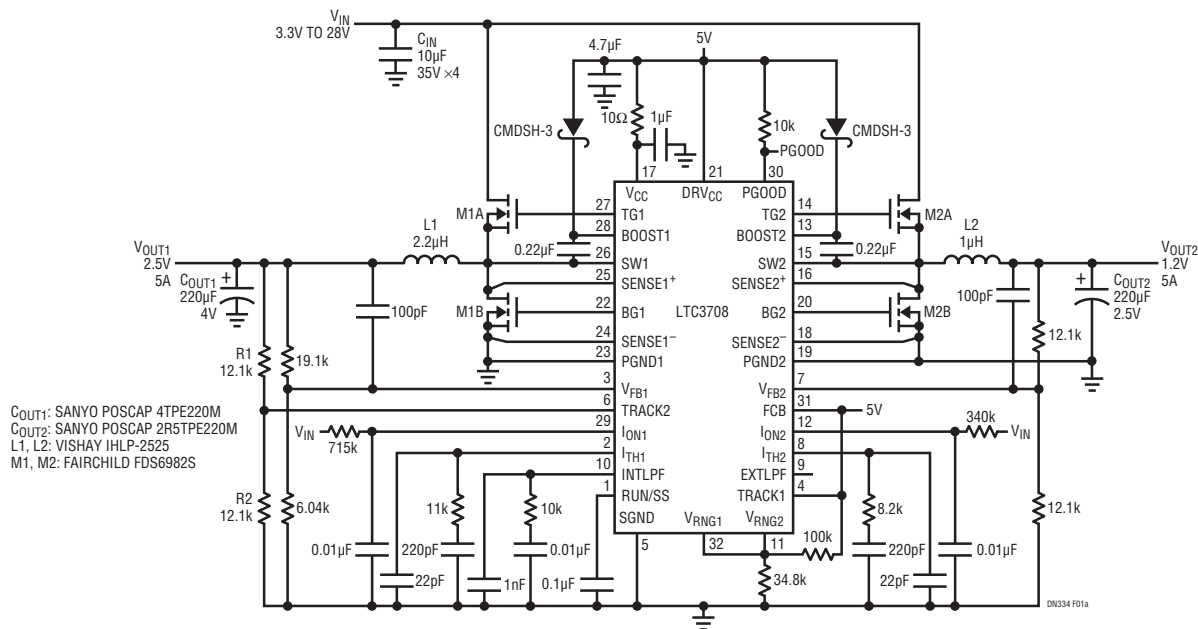


Figure 1a. Dual Power Supply with V<sub>OUT2</sub> Tracking V<sub>OUT1</sub>

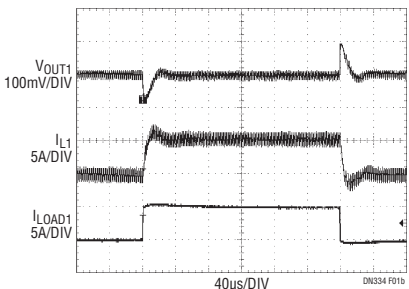


Figure 1b. Load Step on V<sub>OUT1</sub>

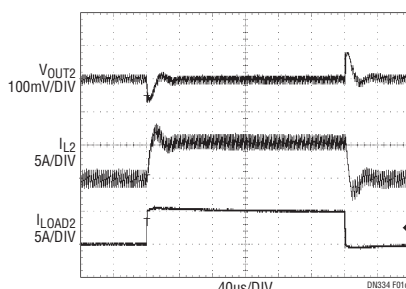


Figure 1c. Load Step on V<sub>OUT2</sub>

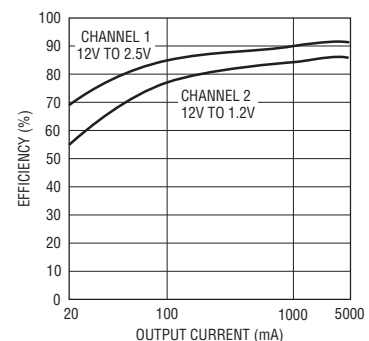


Figure 1d. Efficiency

high current synchronous MOSFET gate drivers and a pulse skipping function that reduces the switching and gate driving losses at light loads. Fast transient response comes from the constant on-time control architecture with a very narrow pulse width (minimum  $t_{ON} < 85\text{ns}$ ). Compact solution size is achieved because of the LTC3708's high frequency capability, minimized input and output capacitance requirements and high levels of circuit integration. All control circuitry and MOSFET gate drivers are incorporated within a small  $5\text{mm} \times 5\text{mm}$  QFN package. The LTC3708 also provides accurate voltage tracking over the entire output range at both ramp-up and ramp-down transitions (Figure 2). Table 1 explains these features in more detail.

The LTC3708 hosts other features that make it an ideal controller for high performance power management applications. The input voltage can be as high as 36V and the output regulates down to 0.6V. The current limit is user programmable to accommodate the variation of MOSFET  $R_{DS(ON)}$  values. Protection functions include cycle-to-cycle current limit, an overvoltage crowbar and an optional short-circuit timer. When either output is out of regulation, a Power Good indicator falls low after 100 $\mu\text{s}$  masking—a technique that prevents transitory glitches and noise from falsely triggering system protection.

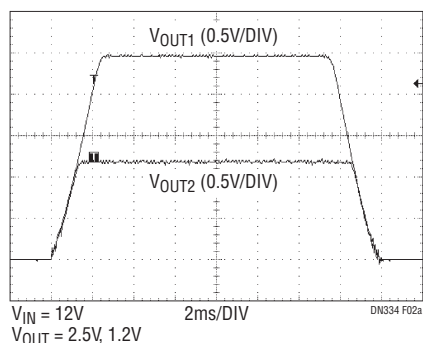


Figure 2a. Coincident Tracking ( $R1 = R2 = 12.1\text{k}$ )

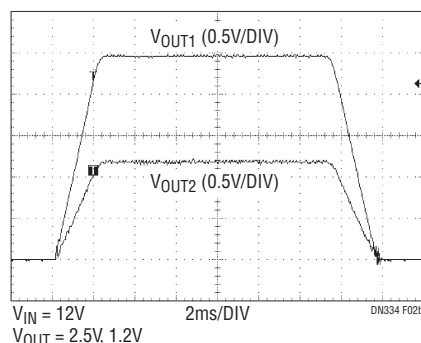


Figure 2b. Ratiometric Tracking ( $R1 = 19.1\text{k}$ ,  $R2 = 6.04\text{k}$ )

Table 1. LTC3708 Design Features

Features	Functions	Benefits
Output Tracking	Various Modes of Tracking and Sequencing can be Programmed: Coincident, Ratiometric, etc	Simplifies the Timing Design of Multiple Supply Systems
No $R_{SENSE}$	Output Current is Sensed Through the Synchronous MOSFET	Improves the Efficiency of Low Output Applications ( $V_{OUT} \leq 5\text{V}$ )
2-Phase Operation	Two Output Channels Operate at Same Frequency with $180^\circ$ Phase Shift	Reduces Input RMS Current and EMI Noises; Minimizes Input Capacitance
Constant On-Time Control Architecture	The Top MOSFETs Can Be Turned on Immediately Without Clock Latency	Expedites Transient Response and Reduces Output Capacitance
Minimum $t_{ON} < 85\text{ns}$	This is the Minimum Duration That the Top MOSFETs Need to Be On	Expedites Transient Response and Enables High Frequency Designs
Frequency Synchronization	The Switching Frequency Can be Synchronized to an External Clock	Maintains Constant Frequency Operation and Synchronizes all Switching Regulators in a System
Pulse Skipping at Light Loads	The Switching Period Extends at Light Loads and Reverse Current is Inhibited	Improves Light Load Efficiency with Minimum Switching and Gate Driving Loss

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