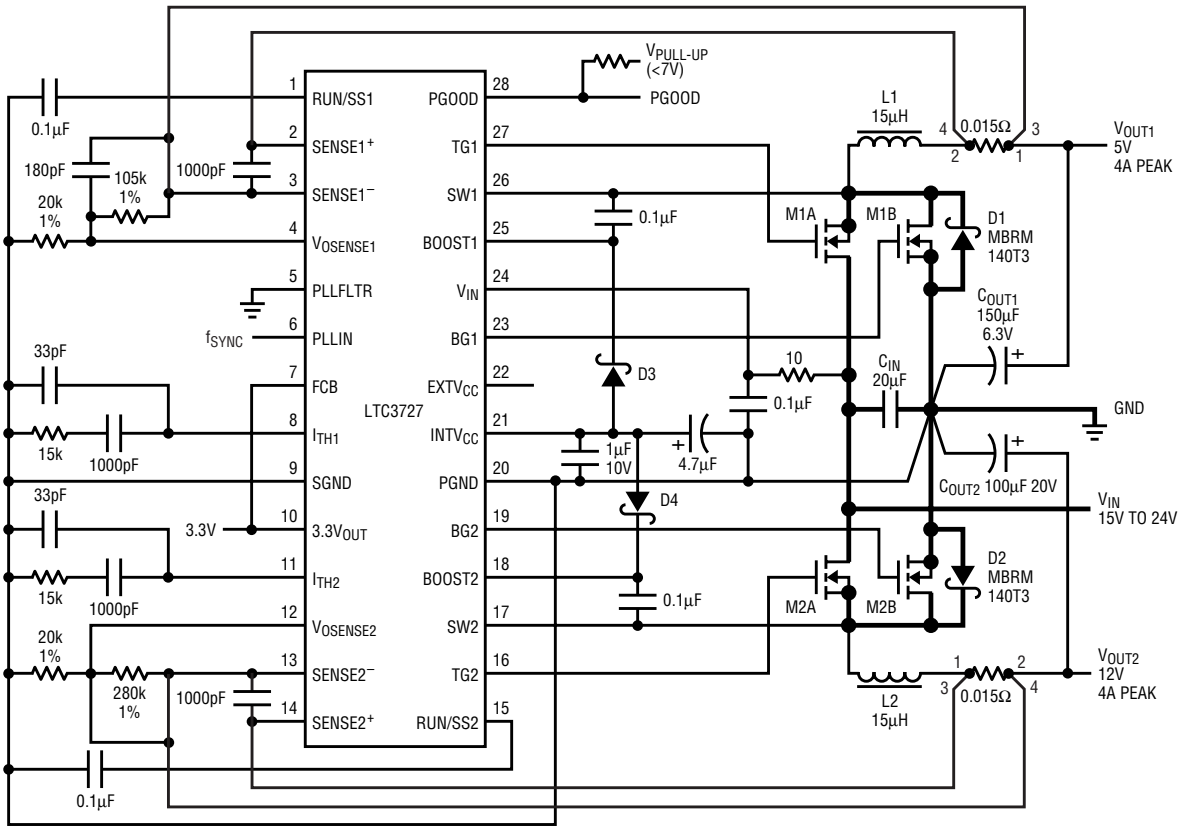
PolyPhase Switching Now Available for High Output Voltage Telecom, Automotive and Industrial Power Supplies

by Eric Gu

Introduction

The LTC3727 brings the advantage of PolyPhase switching techniques to high output voltage telecom, industrial and automotive applications. PolyPhase controllers save design time and cost because they allow for lower input filtering requirements, reduce electromagnetic interference (EMI) and increase efficiency.

The LTC3727 is a dual, true current mode, PolyPhase controller that drives two synchronous buck stages 180 degrees out of phase. The chip features high common mode fast comparators, which allow it to support high output voltages up to 14V. With 2-phase operation, the current pulses drawn by the switches interleave, greatly reducing the overlap time where they add together. The result is a significant reduction in total RMS input current, which in turn provides several benefits, including reducing the cost of the input capacitor, reducing the shielding requirements for EMI and improving operating efficiency.



SWITCHING FREQUENCY = 250kHz

BOLD LINES INDICATE HIGH CURRENT PATHS

MI, M2:	FDS8939A	
D3, D4:	CMDSH-3TR	
C_{IN}:	TAIYO YUDEN TMK432BJ106MM 10µF, 25V, ×2	(408) 573-4150
C_{OUT1}:	PANASONIC SP SERIES	(714) 373-7334
C_{OUT2}:	AVX TPS107M020R0085 100µF, 20V	(843) 946-0362
L1, L2:	TOKO D124C-15µH 892NAS-150M	(847) 699-3430

Figure 1. This automotive or industrial power supply takes a 15V to 24V input and provides outputs of 12V at 4A and 5V at 4A.

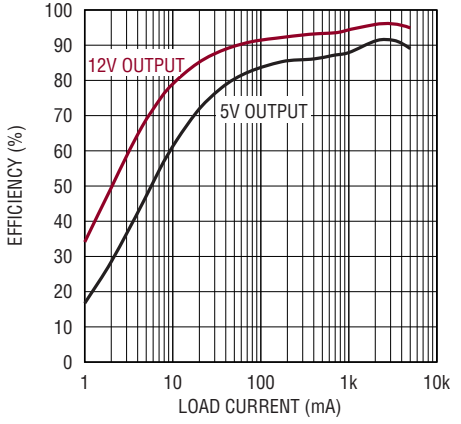


Figure 2. Efficiency for the circuit in Figure 1

The LTC3727 has other features that make it efficient and easy to use. Its OPTI-LOOP® compensation feature allows the transient response to be optimized over a wide range of output capacitance and ESR values. It also provides different operating modes depending on the needs of the application. The Burst Mode feature boosts efficiency at light loads, whereas forced continuous or pulse skipping modes are designed to accommodate applications where low noise and small output voltage ripple is critical. Other features include a phase-lockable frequency of up to 550kHz, a power good output voltage monitor, a programmable output voltage up to 14V, a maximum input voltage of 36V and availability in a small 28-lead SSOP package.

A High Output Voltage Automotive and Industrial Power Supply

Figure 1 illustrates a common automotive and industrial application for the LTC3727. This power supply operates over an input voltage range of 15V to 24V and provides outputs of 12V at 4A and 5V at 4A. The PolyPhase architecture lowers input capacitance requirements, so that this circuit only needs 20µF of ceramic input capacitance for 68W of total output power. Only two 10µF, 25V low cost ceramic surface mount capacitors are used, and there is still minimal input voltage noise.

In this application, in order to reduce the MOSFET gate charge losses and optimize efficiency, the part operates at its lowest frequency of 250kHz, with the PLLFLTR pin grounded. Nevertheless, the LTC3727 could be synchronized to a higher frequency, up to 550kHz, to reduce the inductor size, but the efficiency suffers slightly.

Figure 2 shows that this simple circuit is over 90% efficient for both channels at output currents of 4A.

The 12V channel uses a 100µF, 20V surface mount tantalum output capacitor to maintain an output ripple voltage of less than 100mV.

This versatile design is not limited to 4A. You can adjust the output current by modifying the components (i.e. sense resistor, MOSFETs) around the chip without changing the basic design.