

High Efficiency PolyPhase Converter Combines Power from Multiple Inputs

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Introduction

As more functions are integrated into one IC, the power drawn by a single IC can easily exceed the capability of a single input power source. One solution is to use several available power sources to obtain the required output power, drawing some percentage of the total power from each source. The LTC1929 PolyPhase™ controller provides a simple solution to this problem.

Design Details

The LTC1929 is a PolyPhase dual, current mode controller. It is capable of driving two synchronous buck channels 180 degrees out of phase to reduce output switching ripple cur-

rent and voltage. One buck stage receives its input power from the 12V input and the other receives its power from the 5V input. In a 2-phase design, as the inductor current in the 5V circuit increases, the inductor current in the 12V circuit decreases. This results in a smaller net ripple current flowing into the output capacitor. Since there are two intervals in one switching period where ripple cancellation takes place, the output ripple voltage of the 2-phase design is much smaller than that of a single-phase design and fewer output capacitors can be used.

A Typical Application

The currents available from a PCI connector are limited to 2A for the 5V supply and 1A for the 12V supply. In the example shown here, the load can be as high as 6A or 16.8W at 2.8V. Neither the 5V nor the 12V source is capable of providing this power. Hence, it is desirable to design a power supply that can draw currents from two power sources and whose maximum input currents from each source will not exceed the corresponding limit. With only one IC, two SO-8 MOSFETs and two small inductors, a high efficiency, low noise power supply can be built.

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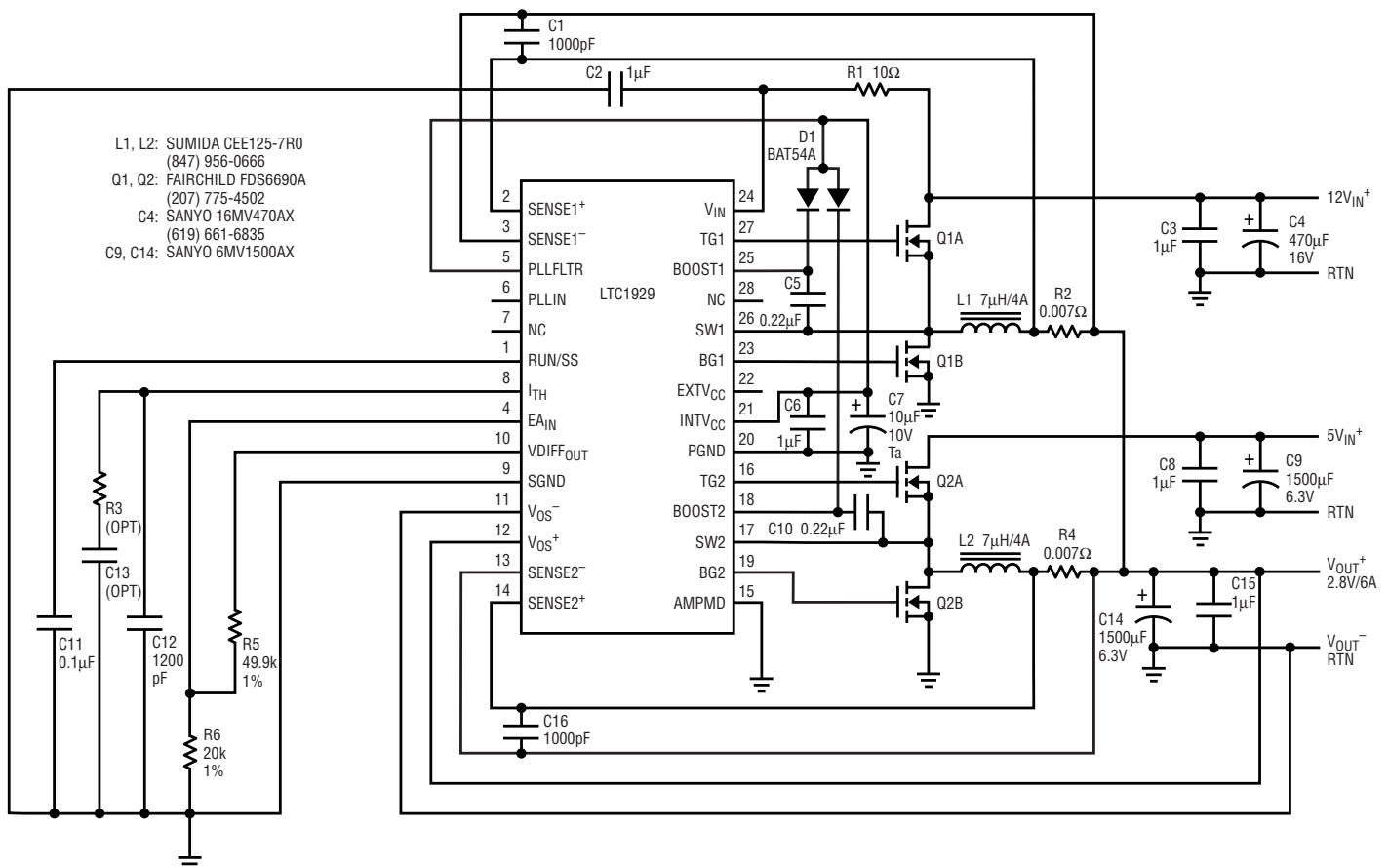


Figure 1. LTC1929 PCI-bus powered, dual-input PolyPhase power supply

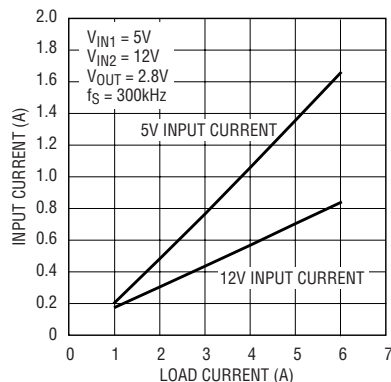


Figure 2. Input currents vs load current for Figure 1's circuit

Figure 1 shows the schematic diagram of the complete power supply. The switching frequency is about 300kHz per-channel for an effective output ripple frequency of 600kHz. The inductors in both stages are 7 μ H. The current sense resistor is 0.007 Ω for each channel.

Test Results

The overall efficiency is above 90% from 0.5A to 6A. Figure 2 shows the distribution of two input currents as the load current varies. The maximum input currents for the 5V and

12V sources are 1.66A and 0.84A, respectively, which are well below the PCI connector's current limits. Figure 3 shows the waveforms of the inductor ripple currents and output ripple voltages. Note the ripple cancellation phenomenon. The peak-to-peak switching ripple voltage at the output terminal is only 50mV_{P-P} with one 1500 μ F/6.3V aluminum electrolytic capacitor. If two buck circuits are synchronized in phase, the ripple voltage will be 70mV_{P-P}, almost a 50% increase.

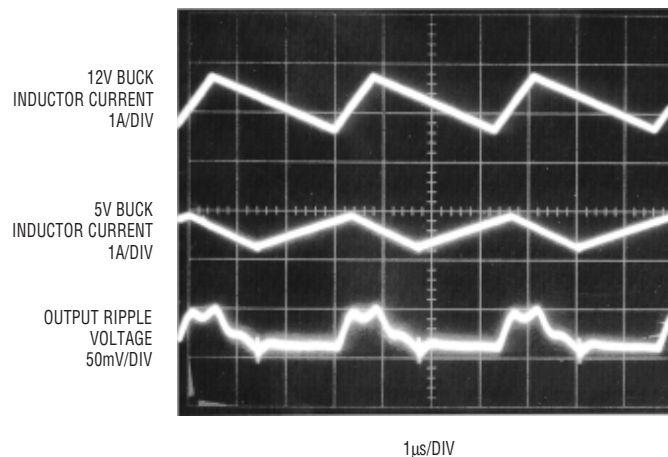


Figure 3. Ripple current and voltage waveforms

Conclusion

The PolyPhase technique reduces the output ripple voltage without increasing the switching frequency. High efficiency can be obtained for low output voltage applications. The LTC1929 PolyPhase controller provides a small, low cost solution for multi-input applications. If more than two inputs are needed, use the LTC1629 rather than the LTC1929. Multiple LTC1629s can be configured for 3-, 4-, 6- or even 12-phase operation. 