

A Simple Solution to Low Noise, Isolated Power Conversion

by Tom Sheehan

Introduction

The LT3439 is a DC transformer driver tailored for applications that require an efficient, low noise isolated step-up or step-down power supply, such as noise sensitive medical instruments and precision measurement equipment. The LT3439 includes a proprietary technique for reducing conducted and radiated electromagnetic interference (EMI) that shortens the design cycle time and saves costs.

To maximize efficiency in power supplies, switch transitions are designed to occur as quickly as possible. Most EMI produced by a power supply is caused by the high speed slewing of currents and voltages. The result is input and output ripple that contains numerous harmonics of the switching frequency. Also, fast edges couple through circuit parasitics to nearby signal lines causing sensitive circuitry performance to be corrupted. Typically, mechanical shielding and careful layout is required to control the effects of EMI, but this can be an expensive and time consuming effort

involving multiple PCB layout iterations.

The LT3439 gives the user the ability to reduce the EMI at the source of the noise. Switch current and voltage slew rates are programmable with a single resistor. Reducing the switch transition times can yield a large improvement in EMI with only a minor reduction in efficiency. Expensive shielding and filtering are not required and system performance is less sensitive to circuit layout. Also, the noise performance of the final system can be adjusted and tested by changing only one resistor.

Circuit Operation

The LT3439 DC transformer driver has two 1A internal switches which drive each end of a center tapped transformer. The two switches are turned on out of phase at 50% duty cycles. The input voltage is applied across the primary side of the transformer. The voltage on the secondary side is simply the input voltage times

the turns ratio. Rectifiers on the secondary side generate the DC output voltage. The output capacitor is for hold up and filtering. If required, an additional inductor and capacitor can be added to reduce the output noise even further.

Control of the voltage and current slew rate is maintained via two control loops. One loop controls the output switch dV/dt and the other loop controls the output switch dI/dt . Output slew control is achieved by comparing the two currents generated by these slewing events to a current set by the external resistor R_{SL} .

The frequency of the internal oscillator can be set from 20kHz to 250kHz with an external resistor and capacitor, R_T and C_T . Each output switch is driven at half the frequency of the oscillator. The SYNC pin can be used to synchronize the switching to an external clock. A \overline{SHDN} pin can be used to place the part into shutdown mode where the part draws less than

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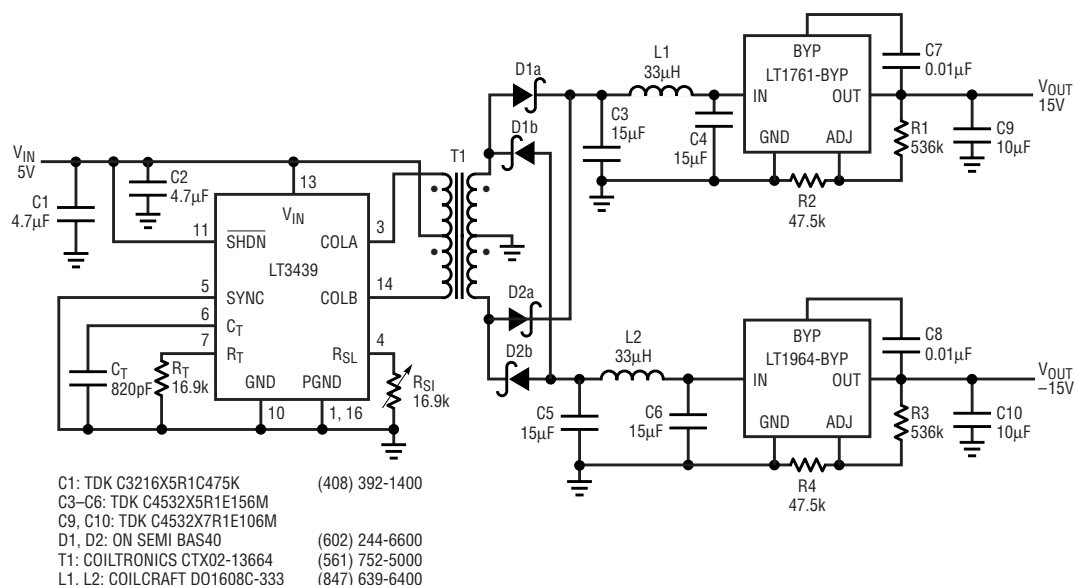


Figure 1. Dual output isolated step-up converter has well-controlled EMI

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20 μ A. The $\overline{\text{SHDN}}$ pin can easily be configured to provide a supply under-voltage lockout (UVLO) function.

Protection features include current limiting, which facilitates startup into a high capacitance load; and cross conduction prevention circuitry, which keeps the two switches from being on simultaneously.


The LT3439 is available in a thermally enhanced 16-pin TSSOP with exposed underside metal.

Low Noise Step-up Converter Produces $\pm 15\text{V}$ at 100mA from a 5V Input

Figure 1 shows a design that provides regulated $\pm 15\text{V}$ at 100mA outputs from a $5\text{V} \pm 5\%$ input. Output ripple is less than 150 μV or 0.001% of V_{OUT} measured at full load. Efficiency of the supply is approximately 71% measured at full load.

The LT1964-BYP and the LT1761-BYP linear regulators regulate the output to within 0.1% of nominal over the full line and load range.

Conclusion

The LT3439 DC Transformer Driver greatly simplifies the design of efficient low noise isolated power supplies. By reducing a major source of the EMI with voltage and current slew control, designs using the LT3439 avoid expensive shielding and filtering requirements and save the cost and time incurred by multiple iterative layouts. 

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