LINEAR TECHNOLOGY

DESIGN NOTES

Inverting Regulator Takes Inputs Up to 50V and Supports Outputs to 4A

Design Note 552

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Introduction

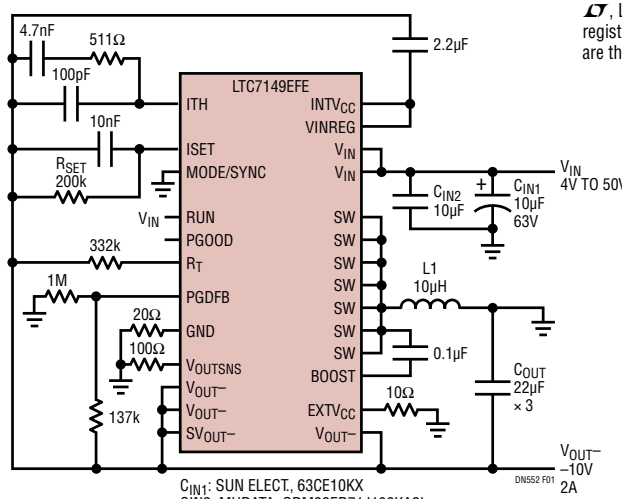
Positive-to-negative DC/DC conversion (inverting output) is widely used in LCD devices, OLED displays, audio amplifiers, industrial equipment, measurement tools, test systems, LED drivers and battery chargers. In all of these cases, the inverting converter must be compact, support high power and accommodate an extended input voltage range. The LTC®7149 satisfies all of these requirements. Its integrated 4A switches and wide 3.4V to 60V input voltage range exceed the requirements of the most demanding applications, including those in automotive environments.

Circuit Description and Functionality

Figure 1 shows a positive-to-negative converter based on the LTC7149. This solution delivers –10V at 2A from an input voltage of 12V—an automotive rail, for instance. The power train components were selected for a nominal 12V input, but with proper derating, the input voltage of this application can be as low as 4V or as high as 50V.

In automotive applications, the LTC7149's ability to handle high voltage inputs eliminates the need for costly voltage suppressors. The very low minimum input voltage keeps sensitive systems operational even during cold crank conditions. Guidelines for calculating voltage and current stress on the components around the LTC7149 are detailed in the LTC7149 data sheet. As an example, derating of the output current at input voltages below 12V is shown in Figure 2.

The circuit of Figure 1 uses external loop compensation. Connecting ITH to $INTV_{CC}$ allows internal compensation to be used, as shown in Figure 3. Tying the



C_{IN1}: SUN ELECT., 63CE10KX
CIN2: MURATA, GRM32ER71J106KA2L
COUT: TDK, C4532X7R1E226M250KC
L1: COILCRAFT, SER1360-103KL

Figure 1. LTC7149, Positive-to-Negative Converter (V_{IN}: 4V – 50V, V_{OUT}: –10V at 2A)

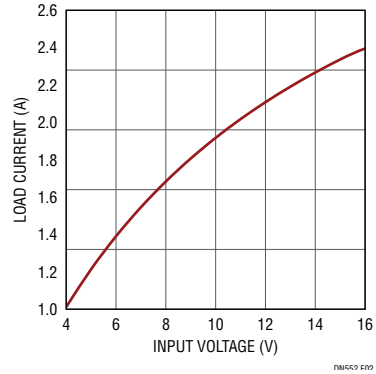


Figure 2. Output Current Derating vs Input Voltage for Figure 1

MODE/SYNC to GND activates Burst Mode® operation. Synchronization pulses referenced to GND can be applied to this pin if needed. Efficiency of this solution reaches 94%.

Voltage Controlled Variable Negative Output Circuit

A significant number of applications require on-the-fly changes to the negative bias, including LCD, OLED monitors and test equipment systems. The LTC7149 includes features to simplify this task.

Figure 3 shows a negative voltage source, where the negative output is controlled by a positive signal voltage. The positive control voltage, referenced to GND, is applied to the V_{OUTSNS} pin. In Figure 3, this is V_{CTRL}, in the range of 0V to 5V. The resulting negative output voltage V_{OUT}– is determined by:

$$V_{OUT}– = –50\mu A \bullet R_{SET} + V_{CTRL}$$

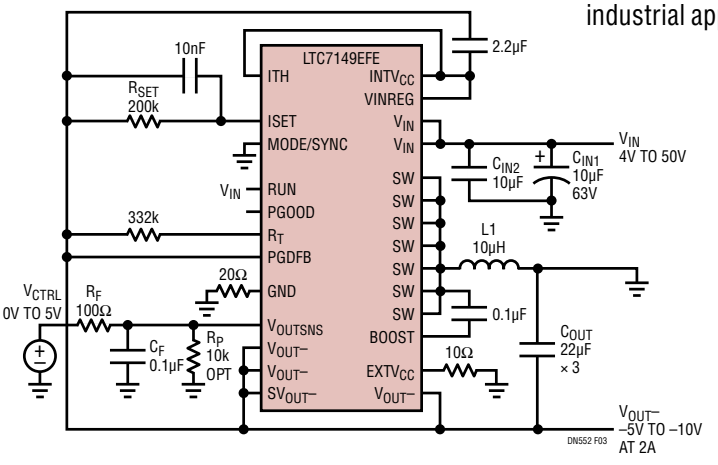


Figure 3. Positive-to-Negative Converter with Variable V_{OUT}– from –5V to –10V

The lowpass filter R_F/C_F provides noise suppression. The V_{OUTSNS} pin cannot be left floating under any circumstances—some voltage potential must be present on this pin at all times. If this requirement cannot be met, for example during system testing, then resistor R_P should be installed.

Figure 4 shows V_{OUT}– as a function of V_{CTRL}. Figure 5 illustrates the broad application potential of this approach as the V_{CTRL} voltage is shaped as a sine wave with a 2.5V amplitude.

Conclusion

The LTC7149 is a high efficiency 50V, 4A synchronous monolithic regulator for negative output power supplies. It combines wide input and output voltage ranges and integrated switching transistors, which simplify the converter design. The solutions and circuitry discussed in this design note can assist with the implementation of this regulator in automotive and industrial applications, display and monitor systems.

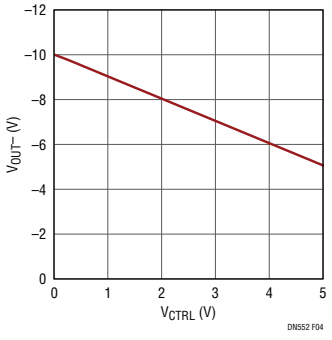


Figure 4. Variable Negative Output V_{OUT}– as a Linear Function of V_{CTRL}

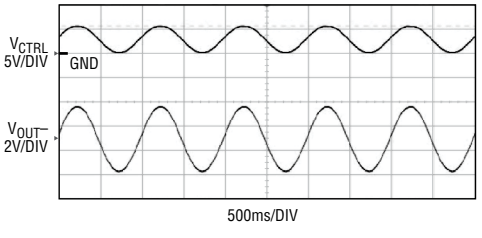


Figure 5. Variable Negative Output V_{OUT}– Following the Sine Waveform on V_{CTRL}

Data Sheet Download

www.linear.com/LTC7149

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