DESIGN NOTES

Wide Input Voltage Range Boost/Inverting/SEPIC Controller Works Down to an Input Voltage of 1.6V

Design Note 500

Zhongming Ye

Introduction

Many of today's electronic devices require an inverting or noninverting converter or sometimes both. They also need to operate from a variety of power sources including USB, wall adapters, alkaline and lithium batteries. To produce various polarity outputs from variable input voltages, power supply designers often use a variety of regulator ICs, which makes for a long inventory list.

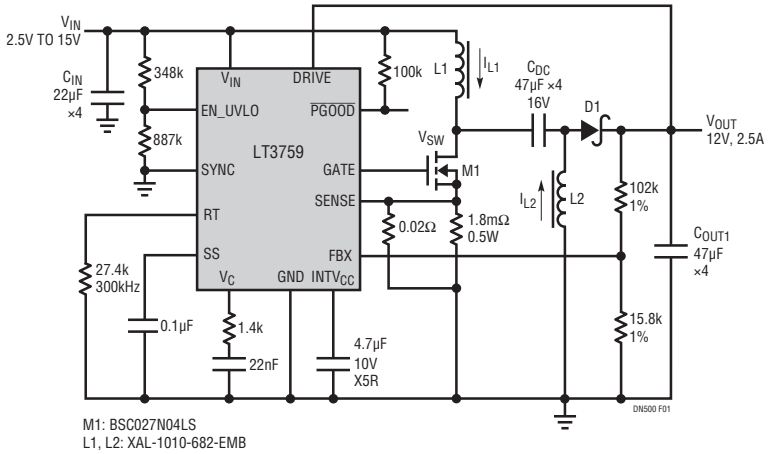
The LT®3759 operates over an input voltage range from 1.6V to 42V and controls either positive or negative outputs using the same feedback pin, thus shortening the inventory list and simplifying design. It also packs many popular features such as soft-start, adjustable frequency and synchronization into a small footprint. The LT3759 comes in a 5mm × 4mm 12-pin MSE package and can be used in multiple configurations such as boost, SEPIC, flyback and Cuk topologies.

Wide Input Voltage Range with Internal LDO

The LT3759's wide input range simplifies the design of power supplies that must be compatible with a wide array of power sources. There is no need to add an external regulator or a slow-charge hysteretic start scheme because the LT3759 includes two internal low dropout (LDO) voltage regulators powered from V_{IN} and DRIVE respectively, allowing simple start-up and biasing. The LT3759's internal $INTV_{CC}$ current limit function protects the IC from excessive on-chip power dissipation.

Sensing Output Voltage Made Easier

LT3759 features a novel FBX pin architecture that simplifies the design of inverting and noninverting converters. It contains two internal error amplifiers—one senses positive outputs and the other negative—allowing the FBX pin to be connected directly to a divider from either a positive output or a negative output, eliminating any confusion associated with positive or negative output sensing and simplifying the board layout. Simply decide the output polarity and topology and the LT3759 does the rest.



M1: BSC027N04LS
L1, L2: XAL-1010-682-EMB
D1: PMEG4030

Figure 1. SEPIC Converter Produces 12V Output from 2.5V to 15V Inputs

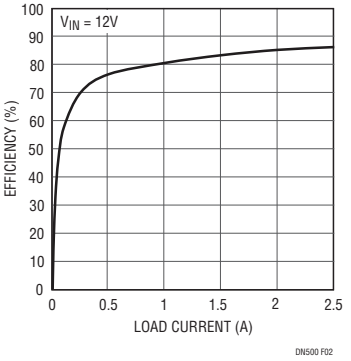


Figure 2. Efficiency for the Converter in Figure 1

Adjustable/Synchronizable Switching Frequency

It is often necessary to operate a converter at a particular frequency, especially if the converter is used in an RF communications product that is sensitive to spectral noise in certain frequency bands. Also, if the area available for a converter is limited, operating at higher frequencies allows the use of smaller component sizes, reducing the real estate required and the output ripple. If power loss is a concern, switching at a lower frequency reduces switching losses, improving efficiency. The switching frequency can be set from 100kHz to 1MHz via a single resistor from the RT pin to ground. The device can also be synchronized to an external clock via the SYNC pin.

Precision UVLO and Soft-Start

Input supply undervoltage (UVLO) for sequencing or start-up overcurrent protection is easily achieved by driving the UVLO with a resistor divider from the V_{IN} supply. The divider output produces 1.22V at the UVLO pin when V_{IN} is at the desired UVLO rising threshold voltage. The UVLO pin has an adjustable input hysteresis, which allows the IC to ignore a settable input supply droop before disabling the converter. During a UVLO event, the IC is disabled and V_{IN} quiescent current drops to 1µA or lower.

The SS pin provides access to the soft-start feature, which reduces the peak input current and prevents output voltage overshoot during start-up or recovery from a fault condition. The SS pin reduces the inrush current by lowering the switch peak current. In this way soft-start allows the output capacitor to charge gradually toward its final value.

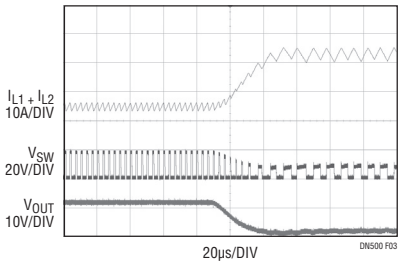


Figure 3. Short-Circuit Event for the Converter in Figure 1

A 2.5V to 15V to 12V SEPIC Converter

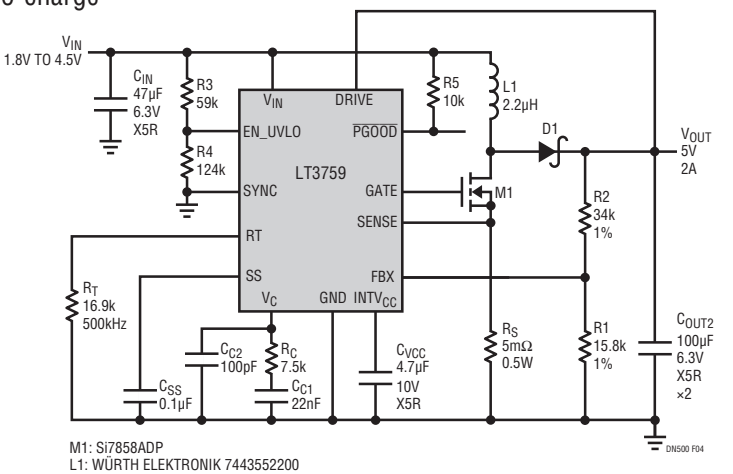
Figure 1 shows a 2.5V to 15V input, 12V/2.5A output SEPIC power supply using the LT3759. The typical efficiency for this converter is shown in Figure 2. Figure 3 shows the switch waveform during an output short-circuit event. Notice how the switching frequency folds back to one-third of the regular frequency as soon as the output voltage is shorted to ground. This feature enhances short-circuit performance of both Cuk and SEPIC converters.

A 1.8V to 4.5V to 5V/2A Boost Converter

Figure 4 shows a 5V, 2A output converter that takes an input of 4.5V to as low as 1.8V. The LT3759 is configured as a boost converter for this application, where the converter output voltage is higher than the input voltage. The 500kHz operating frequency allows the use of small inductor and output capacitors.

Conclusion

The LT3759 is a versatile IC that integrates a rich set of unique features in a tiny 5mm × 4mm 12-pin MSE package. It accepts wide input voltage range from 1.6V to 42V, with low shutdown current and frequency foldback at output short-circuit. The LT3759 is ideal for wide input voltage applications from single-cell, lithium-ion powered systems to automotive, industrial and telecommunications power supplies. The high level of integration yields a simple, low parts-count solution for boost, SEPIC and Inverting converters.



M1: Si7858ADP
L1: WÜRTH ELEKTRONIK 7443552200
D1: SBR3U20SA

Figure 4. Boost Converter Produces 5V/2A Output from 1.8V to 4.5V Input

Data Sheet Download

www.linear.com

For applications help,
call (408) 432-1900, Ext. 3798

Linear Technology Corporation
1630 McCarthy Blvd., Milpitas, CA 95035-7417
(408) 432-1900 • FAX: (408) 434-0507 • www.linear.com