

Wide Input Voltage Range Boost/SEPIC/Inverting Converter

DESCRIPTION

The LT[®]3959 is a current mode DC/DC converter with an integrated 6A, 40V switch. It can operate over an input range of 1.6V to 40V, suitable for applications from single-cell lithium-ion battery portable electronics up to high voltage automotive and industrial power supplies. It also exhibits low shutdown quiescent current of <math><1\mu\text{A}</math>, making it an ideal fit for battery-operated systems. Thanks to a novel FBX pin architecture, the LT3959 can be connected directly to a divider from either positive or negative output to ground. It also packs many popular features such as soft-start, input undervoltage lockout, adjustable frequency and synchronization.

Demonstration circuit 1853A features LT3959 in a 300kHz boost converter, designed for 12V output from 2V to 10V input (V_{IN}). The performance is summarized in the table below.

The demo circuit has small circuit footprint, and can be modified to generate different output voltages. The performance can be optimized for different input voltage ranges as well. It is a high performance and cost-effective solution for battery-operated systems, telecom, and automotive applications.

The LT3959 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide. Proper board layout is essential for both proper operation and maximum thermal performance. See the Applications Information section of the data sheet for more information.

Design files for this circuit board are available at <http://www.linear.com/demo>

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PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|--------------------------------------|--|-------|-----|-------|-------|
| Input Voltage Range | | 2 | | 10 | V |
| Input Turn-On Voltage (Rising) | | | 2.5 | | V |
| Input Undervoltage Lockout (Falling) | | | 2 | | V |
| Switching Frequency | $I_{OUT} = 0.5\text{A}$ | | 300 | | kHz |
| Output Voltage | | 11.64 | 12 | 12.36 | V |
| Maximum Output Current | $V_{IN} \geq 2\text{V}$ | 0.5 | | | A |
| | $V_{IN} \geq 5\text{V}$ | 1 | | | A |
| | $V_{IN} \geq 9\text{V}$ | 2 | | | A |
| Output Voltage Ripple | $V_{IN} = 5\text{V}, I_{OUT} = 1\text{A}$ | | 75 | 100 | mV |
| Efficiency | $V_{IN} = 10\text{V}, I_{OUT} = 2\text{A}$ | | 94 | | % |

QUICK START PROCEDURE

Demo circuit 1853A is easy to set up to evaluate the performance of LT3959. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below.

1. With power off, connect the input power supply, load and meters as shown in Figure 1. Preset the load to 0A, and V_{IN} supply to be 0V. Place jumpers in the following positions.

| EN (JP1) | SYNC (JP2) |
|----------|------------|
| ON | OFF |

2. Turn on V_{IN} and increase to 2.5V. Check for proper output voltages. The output should be regulated at 12V ($\pm 3\%$). The switching frequency should be about 300kHz.

NOTE. If there is no output, or the output is out of spec, temporarily disconnect the load to make sure that the load is not set too high.

NOTE. Make sure that the input voltage does not exceed specification. If higher operating voltage is required, power components with higher voltage ratings should be used. The maximum voltage is 40V for the integrated switch of LT3959.

NOTE. The demo circuit configures the shutdown voltage at 2V, which means that the input voltage can be dropped to as low as 2V, once it starts up. The startup voltage is set at 2.5V, and can be adjusted by changing R1 and R2 values.

NOTE. The output current capability depends on the input voltage. The output current is up to 0.5A for V_{IN} higher than 2V, 1A for V_{IN} higher than 5V, and 2A for V_{IN} higher than 9V.

3. Once the proper output voltage is established, adjust the input voltage and load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters. Typical efficiency curve is shown in Figure 3.

NOTE. When measuring the input or output voltage ripples, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the V_{IN} and GND, or V_{OUT} and GND terminals. See Figure 2 for proper scope probe technique.

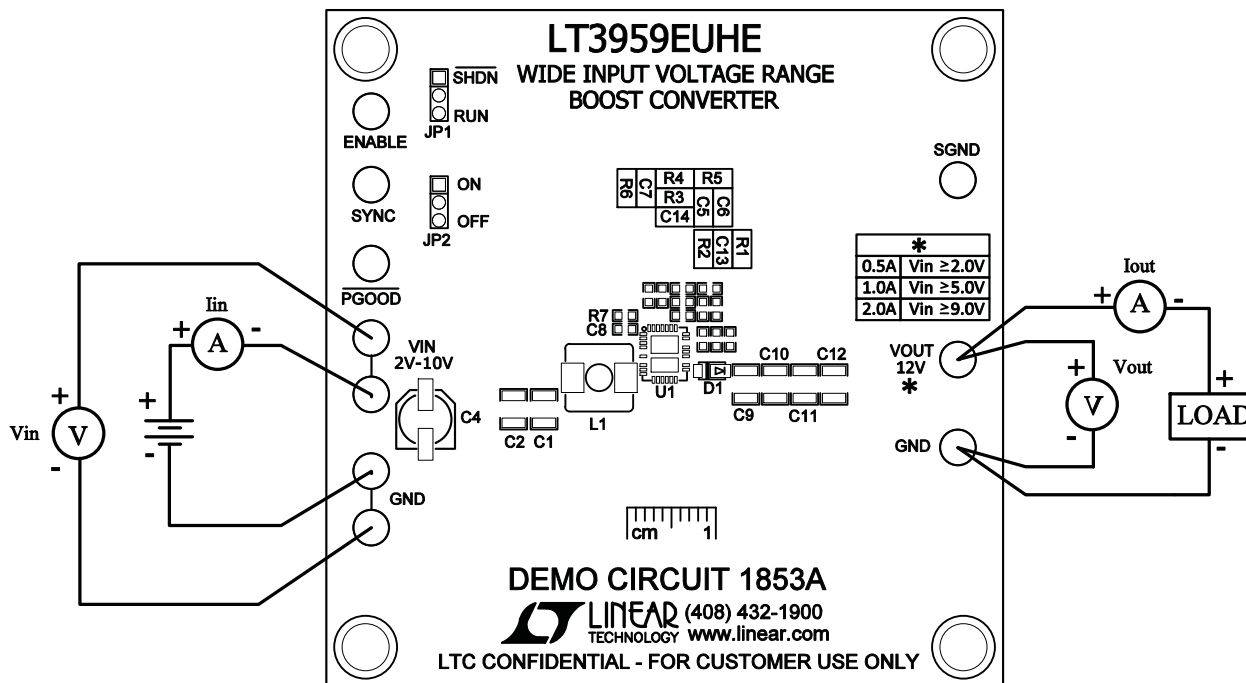


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

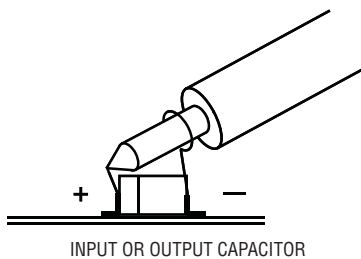


Figure 2. Proper Scope Probe Placement for Measuring Input or Output Ripple

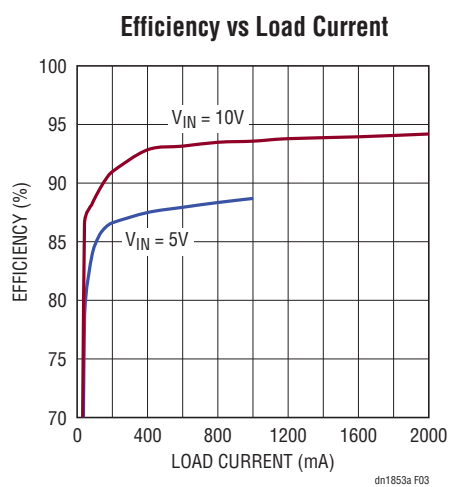


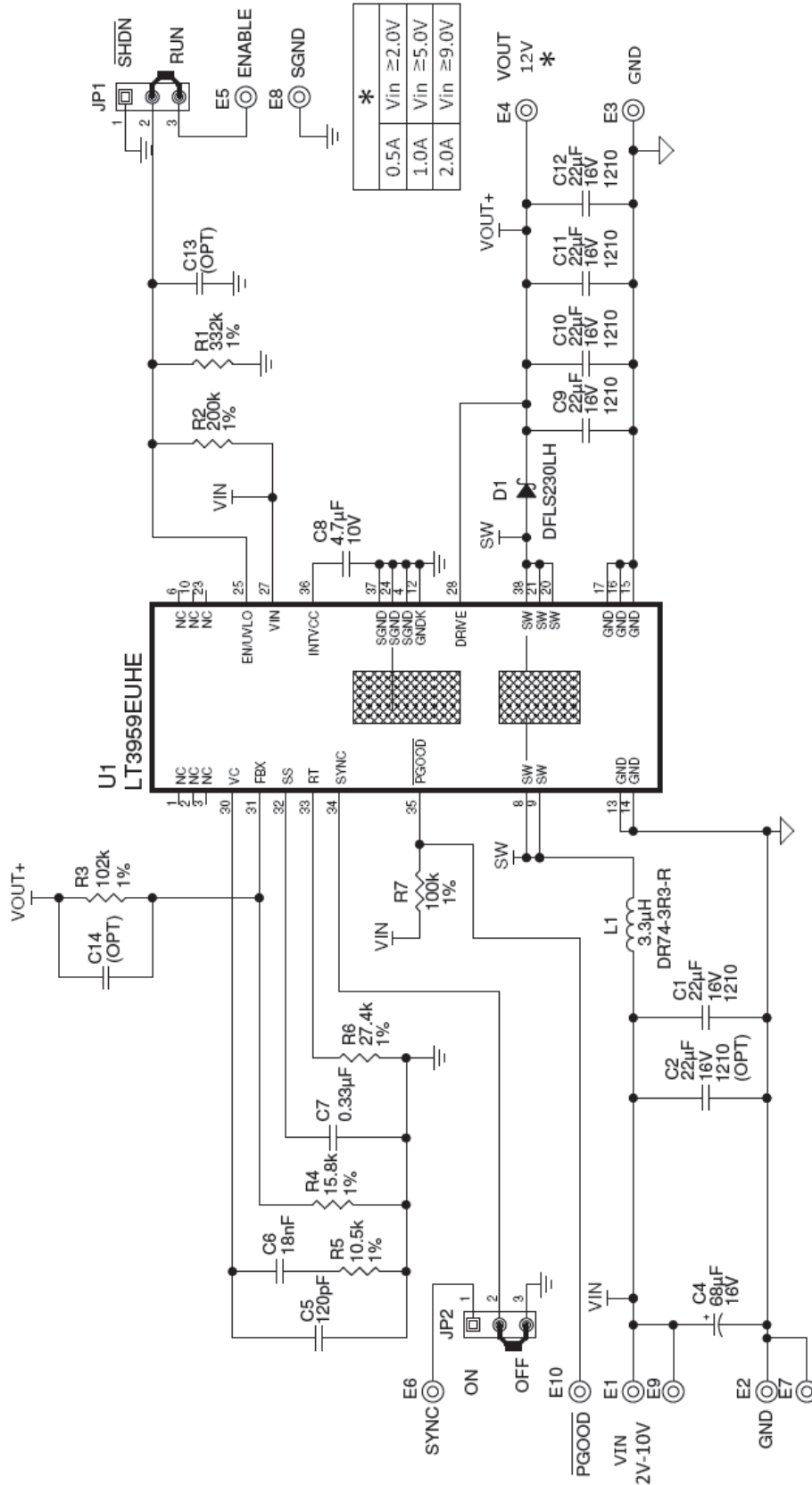
Figure 3. Efficiency with Different Input Voltages

DEMO MANUAL DC1853A

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|---|-----|-----------------------|---|-----------------------------------|
| Required Circuit Components | | | | |
| 1 | 5 | C1, C9, C10, C11, C12 | CAP., X7R, 22µF 16V, 10%, 1210 | AVX, 1210YC226KAT2A |
| 2 | 1 | C4 | CAP., SVPC 68µF 16V, 20%, OSCON-C6 | SANYO, 16SVPC68MV |
| 3 | 1 | C5 | CAP., NPO, 120pF 25V, 10%, 0603 | AVX, 06033A121KAT |
| 4 | 1 | C6 | CAP., X7R 18nF 25V, 20%, 0603 | AVX 06033C183MAT2A |
| 5 | 1 | C7 | CAP., X5R, 0.33µF 16V, 10%, 0603 | AVX, 0603YD334KAT |
| 6 | 1 | C8 | CAP., X5R, 4.7µF 10V, 10%, 0603 | TAIYO YUDEN, LMK107BJ475KA-T |
| 7 | 1 | D1 | SCHOTTKY DIODE, 2A/30V POWERDI-123 | DIODES/ZETEX DFSL230LH-7 |
| 8 | 1 | L1 | IND., 3.3µH | COOPER BUSSMANN, DR74-3R3-R |
| 9 | 1 | R1 | RES., CHIP 332k 1/10W, 1%, 0603 | VISHAY, CRCW0603332KFKEA |
| 10 | 1 | R2 | RES., 200k 1%, 1/10W, 0603 | VISHAY, CRCW0603200KFKEA |
| 11 | 1 | R3 | RES., 102k 1%, 1/10W, 0603 | VISHAY, CRCW0603102KFKEA |
| 12 | 1 | R4 | RES., 15.8k 1%, 1/10W, 0603 | VISHAY, CRCW060315K8FKEA |
| 13 | 1 | R5 | RES., CHIP 10.5k 1/10W, 1%, 0603 | VISHAY, CRCW060310K5FKEA |
| 14 | 1 | R6 | RES., 27.4k 1%, 1/10W, 0603 | VISHAY, CRCW060327K4FKEA |
| 15 | 1 | R7 | RES., 100k 1%, 1/10W, 0603 | VISHAY, CRCW0603100KFKEA |
| 16 | 1 | U1 | I.C., DC/DC CONVERTER QFN (36) (UHE28MA) (5MMX6MM) (1836-REVC) | LINEAR TECH., LT3959EUHE |
| Additional Demo Board Circuit Components | | | | |
| 1 | 0 | C2 | CAP., X7R, 22µF 16V, 10%, 1210 | AVX, 1210YC226KAT2A |
| 2 | 0 | C13, C14 | CAP., 0603 | |
| Hardware: For Demo Board Only | | | | |
| 1 | 10 | E1-E10 | TESTPOINT, TURRET, 0.094" | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 2 | 2 | JP1, JP2 | HEADER, 3 PIN 1 ROW, 0.079" | SAMTEC, TMM-103-02-L-S |
| 3 | 2 | XJP1, XJP2 | SHUNT, 0.079" CENTER | SAMTEC, 2SN-BK-G |
| 4 | 4 | M1-M4 | STANDOFF, NYLON 0.25" | KEYSTONE, 8831 (SNAP-ON) |
| 5 | 1 | | FAB, 1853A_REV2 | DEMO CIRCUIT 1853A |
| 6 | 1 | | STENCIL - TOP | STENCIL 1853A |

SCHEMATIC DIAGRAM



DEMO MANUAL DC1853A

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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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