

# Wide Input Voltage Range Boost/SEPIC/Inverting Converter

## DESCRIPTION

The LT<sup>®</sup>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.

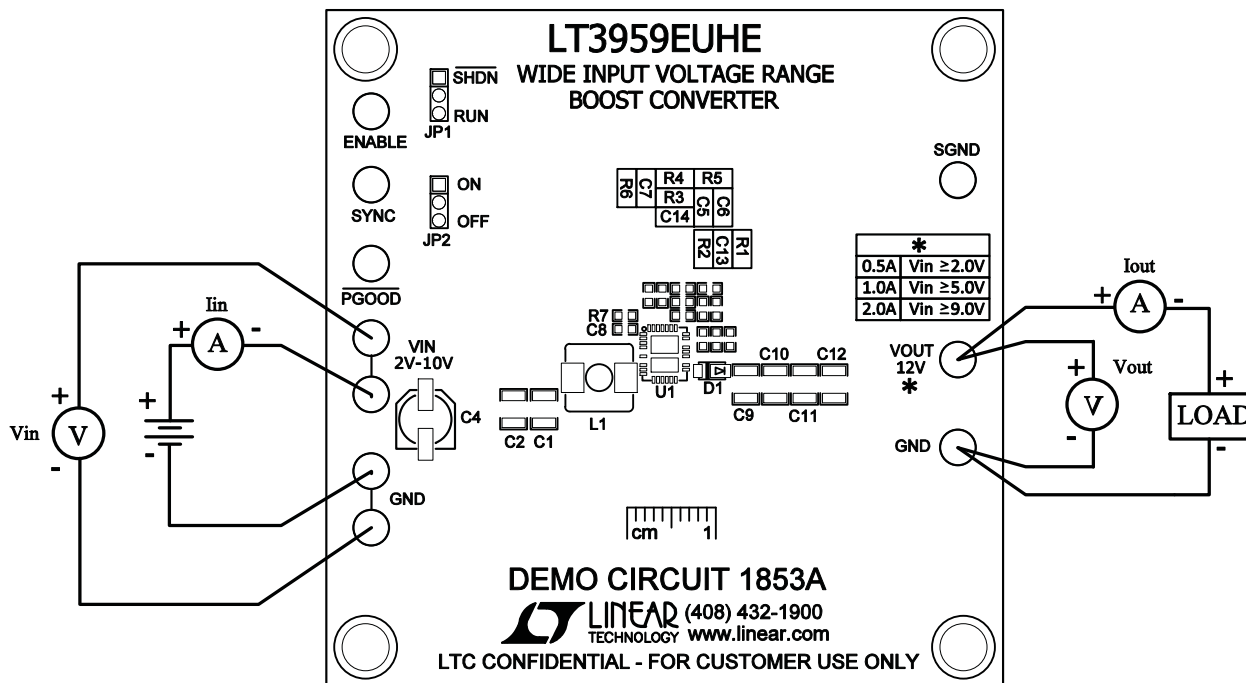
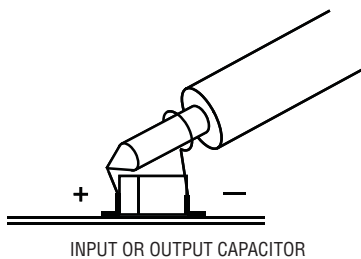
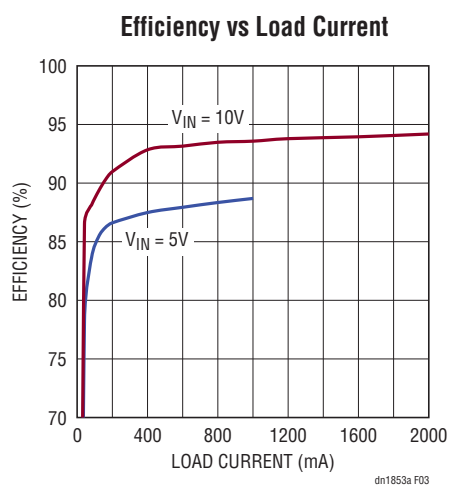


Figure 1. Proper Measurement Equipment Setup

**QUICK START PROCEDURE**



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



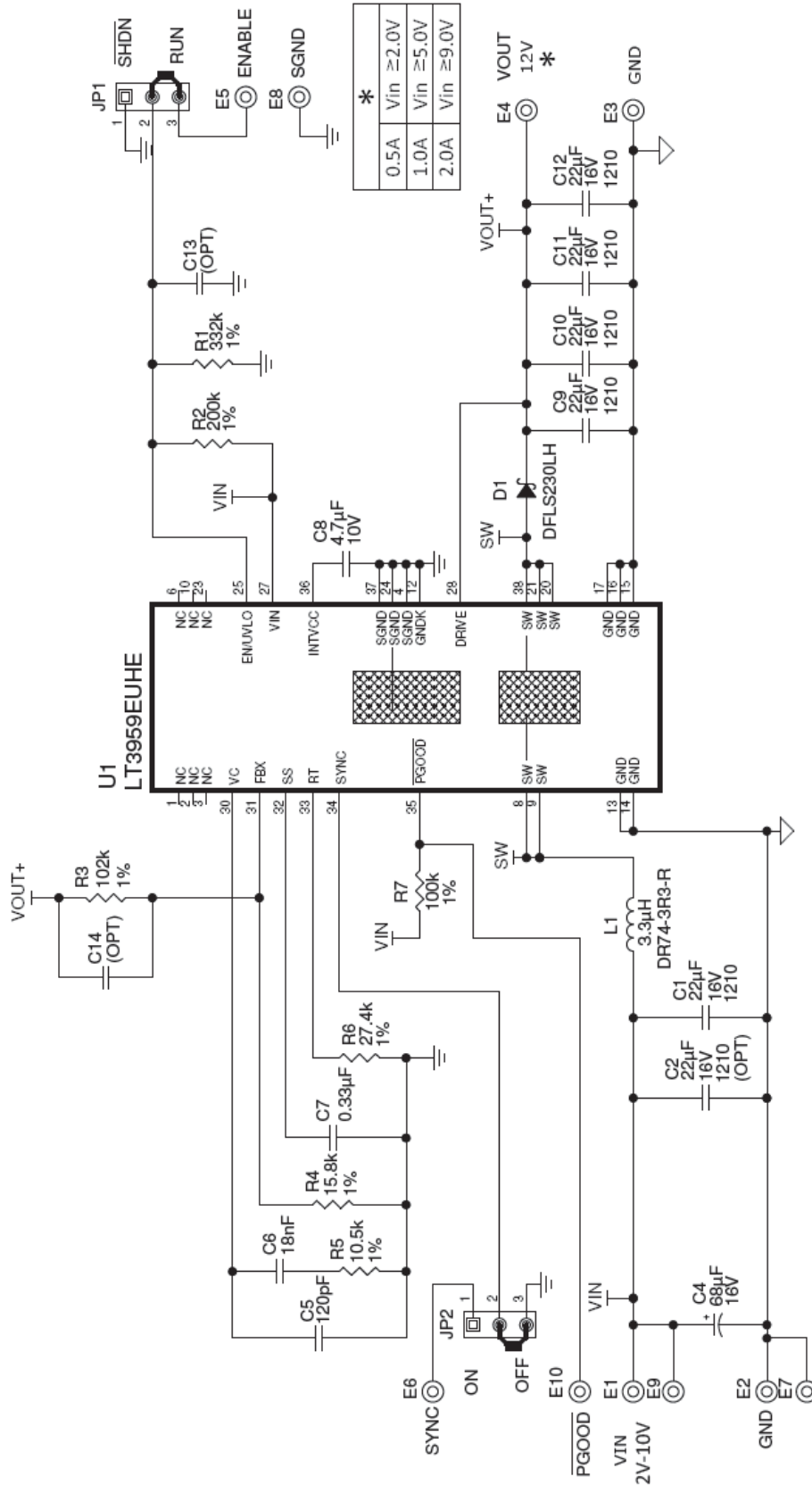
**Figure 3. Efficiency with Different Input Voltages**

# DEMO MANUAL DC1853A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
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
<b>Additional Demo Board Circuit Components</b>				
1	0	C2	CAP., X7R, 22µF 16V, 10%, 1210	AVX, 1210YC226KAT2A
2	0	C13, C14	CAP., 0603	
<b>Hardware: For Demo Board Only</b>				
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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