

## 25V, 600mA Buck-Boost DC/DC Converter with 1.6 $\mu$ A Quiescent Current

### DESCRIPTION

Demonstration Circuit 2355A features the [LTC<sup>®</sup>3130](#), a wide input voltage, wide output voltage operating range, high efficiency, low noise monolithic DC/DC buck-boost converter.

The LTC3130 operates from input voltages of 2.4V to 25V. The demo board has been designed with the output voltage set to 5V. The LTC3130 incorporates a proprietary low noise switching algorithm which optimizes efficiency with input voltages above, below or equal to the output voltage and ensures seamless transitions between operating modes.

The DC2355A demo board has two user selectable operating modes: Burst Mode<sup>®</sup> operation and Fixed Frequency PWM (JP2). In PWM Mode, the LTC3130 operates at 1.2MHz to allow high efficiency while minimizing the solution footprint.

The LTC3130 features pin selectable 850mA/450mA average inductor current limit. To set the current limit to 850mA set jumper JP1 to “HIGH”. For 450mA current limit set JP1 to “LOW”. The lower current limit function is useful when operating from weak, or current limited sources.

A PGOOD open drain output is provided and is pulled up to  $V_{OUT}$ . This output asserts low when  $V_{OUT}$  is below regulation.

An accurate RUN threshold can be set to enable the converter at a desired input voltage. The DC2355A demo board is set up to use R10 in conjunction with R11 to set this

threshold. Jumper JP4 is provided to pull this input up to  $V_{IN}$  or tie it directly to GND. See the data sheet for details.

Maximum power point control (MPPC) allows for simple optimization of power transfer between the converter and a non-ideal supply such as a photovoltaic panel or another high impedance source. The DC2355A demo board can be set to operate in MPPC mode by setting jumper JP3 to “ON”, removing R8 and populating R7 and R9. In most applications this function can also be realized, often with better efficiency, by using the accurate RUN comparator functionality. See the data sheet for details.

The LTC3130 allows the internal  $V_{CC}$  rail to be fed externally from the  $EXTV_{CC}$  pin. In some applications the efficiency of the converter can be improved by allowing  $V_{CC}$  to be back-fed from a supply, such as  $V_{OUT}$ . Setting the  $EXTV_{CC}$  jumper (JP5) on the demo board to “EXT” back-feeds  $V_{CC}$  through  $EXTV_{CC}$  from  $V_{OUT}$ . Setting this jumper to internal (“INT”) powers  $V_{CC}$  from the  $V_{IN}$  input. See the data sheet for additional details.

The LTC3130/LTC3130-1 data sheet has detailed information about the operation, specifications, and applications of the device. The data sheet should be read in conjunction with this quick start guide.

**Design files for this circuit board are available at <http://www.linear.com/demo/DC2355A>**

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### PERFORMANCE SUMMARY

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

Input Voltage Range	2.4V to 25V
$V_{OUT}$	5V
$I_{OUT}$ (see Note 1)	600mA
Efficiency	See Figure 1

**Note 1:** The demo board output current is a function of  $V_{IN}$ . Please refer to the data sheet for more information.

## QUICK START PROCEDURE

Using short twisted pair leads for any power connections and with all loads and power supplies off, refer to Figure 4 for the proper measurement and equipment setup. The power supply (PS1) should not be connected to the circuit until told to do so in the procedure below.

When measuring the input or output voltage ripple, 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  $V_{IN}$  or  $V_{OUT}$  and GND terminals (see Figure 5), or by using an oscilloscope probe tip jack.

1. Jumper and PS1 settings to start:

<b>PS1:</b>	OFF
<b>JP1: ILIM</b>	HIGH
<b>JP2: MODE</b>	FIXED FREQ
<b>JP3: MPPC</b>	OFF
<b>JP4: RUN</b>	ON
<b>JP5: EXT<math>V_{CC}</math></b>	EXT

2. With power OFF connect the power supply (PS1) as shown in Figure 4. If accurate current measurements are desired (for efficiency calculation for example) then connect ammeters in series with supplies as shown. The ammeters are not required however.

3. Connect a 500mA load ( $10\Omega$ ) to  $V_{OUT}$  as shown in Figure 4.
4. Turn on PS1 and slowly increase the voltage until the voltage at  $V_{IN}$  is 5V.
5. Verify  $V_{OUT}$  is  $\sim 5V$ .
6.  $V_{IN}$  can now be varied between 2.4V and 25V. The load may need to be reduced for  $V_{IN} < 5V$  for  $V_{OUT}$  to remain in regulation.
7. The load can be varied. The maximum load is a function of  $V_{IN}$  and the device current limit. Consult the data sheet for more information on output current vs  $V_{IN}$ .
8. For operation in Burst Mode, move jumper JP2 to "BURST MODE". See the data sheet for more information on Burst Mode operation.
9. For operation with the lower current limit move jumper JP1 to "LOW". Output current capability is reduced with the lower current limit. See the data sheet for more information.
10. For operation with  $V_{CC}$  powered from  $V_{IN}$ , move jumper JP5 to "INT".

NOTE: If  $V_{OUT}$  drops out of regulation, check to be sure the maximum load has not been exceeded, and that  $V_{IN}$  is not below the minimum value for regulation (see data sheet).

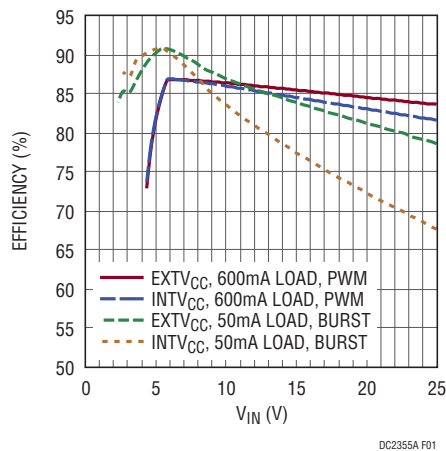


Figure 1. DC2355A Typical Efficiency vs Load with and without Externally Feeding  $V_{CC}$

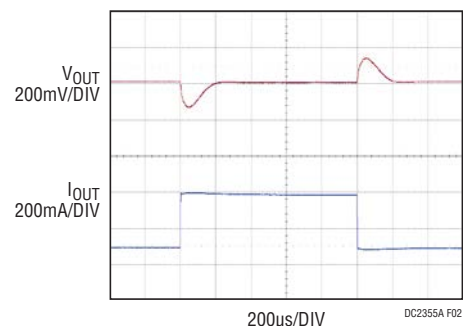


Figure 2. DC2355A Step Load Response,  $V_{IN} = 5V$ . Load Step Is from 100mA to 400mA

**QUICK START PROCEDURE**

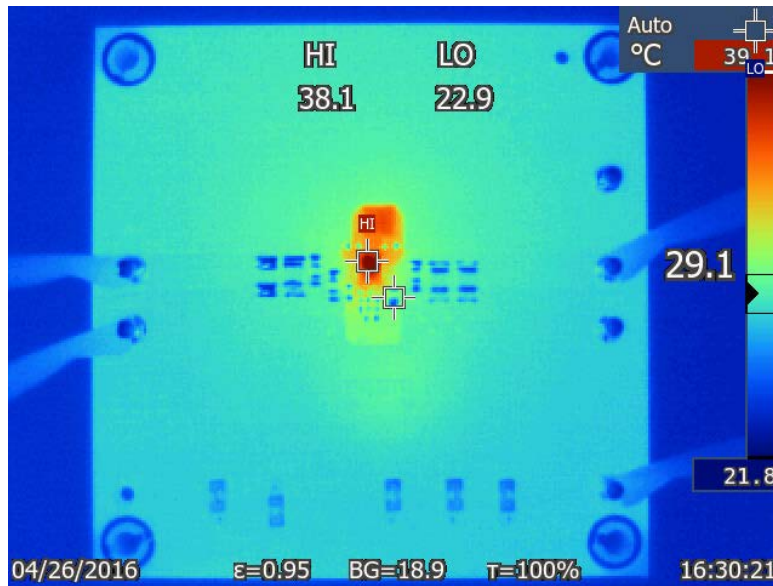


Figure 3. DC2355A Thermal Performance.  $V_{IN} = 12V$ , Load = 600mA

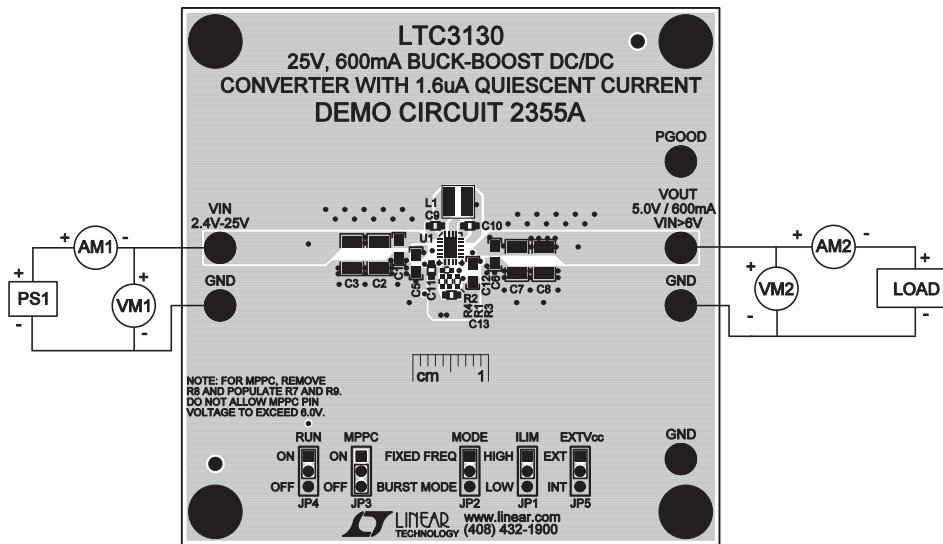


Figure 4. Proper Measurement Equipment Setup

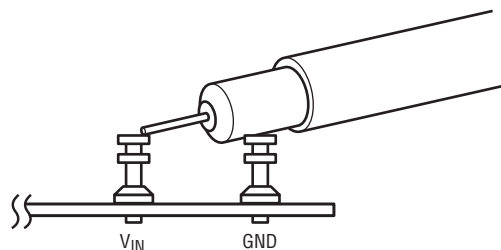


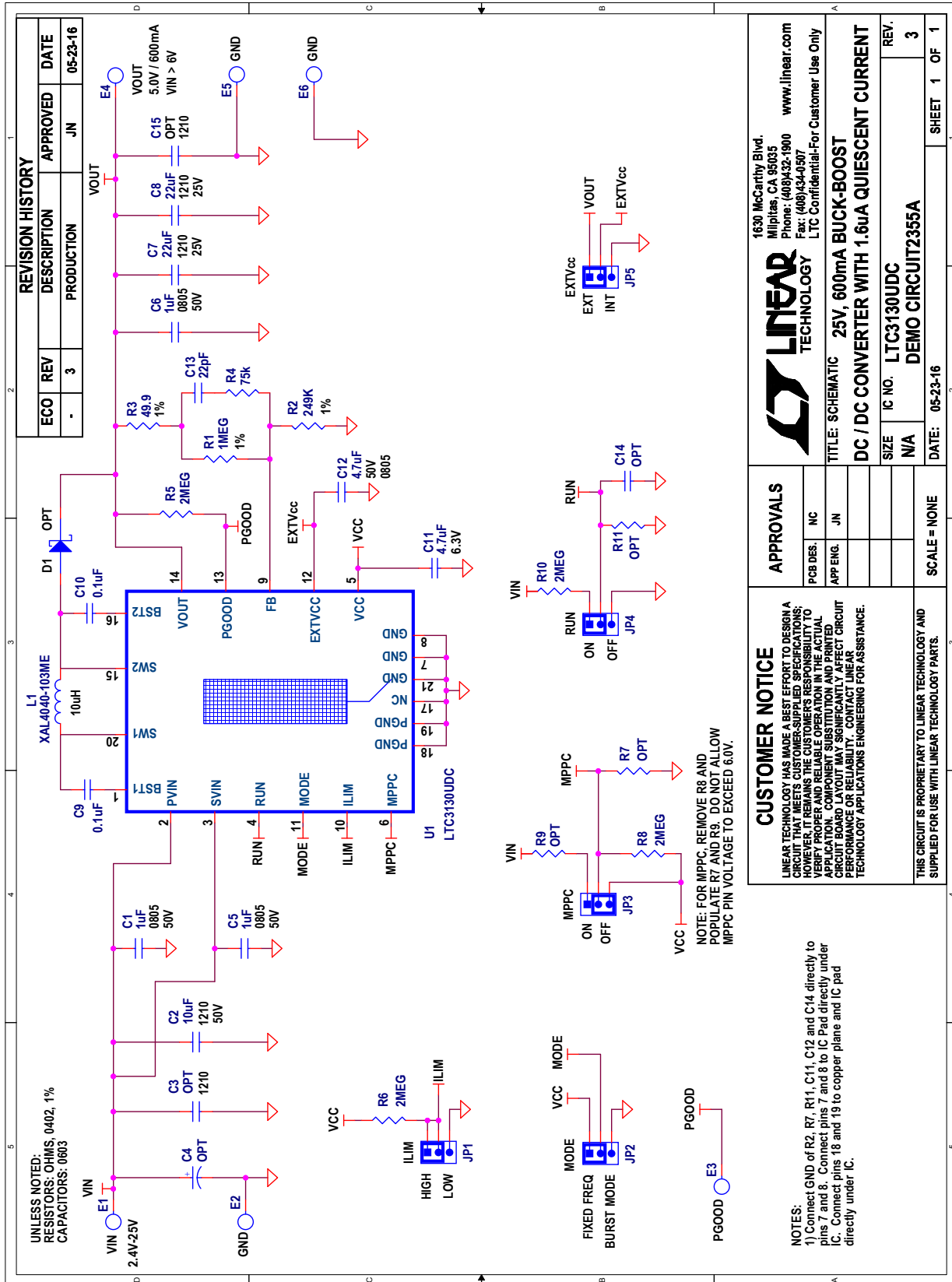
Figure 5. Measuring Input or Output Ripple

# DEMO MANUAL DC2355A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	3	C1, C5, C6	CAP, 1 $\mu$ F 50V 10% X7R 0805	MURATA, GRM21BR71H105KA12L
2	1	C2	CAP CER 10 $\mu$ F 50V X7R 1210	MURATA, GRM32ER71H106KA12L
3	2	C7, C8	CAP CER 22 $\mu$ F 25V X7R 1210	MURATA, GRM32ER71E226KE15L
4	2	C9, C10	CAP CER 0.1 $\mu$ F 50V X7R 0603	MURATA, GRM188R71H104KA93D
5	1	C11	CAP, 4.7 $\mu$ F 6.3V 10% X5R 0603	MURATA, GRM188R60J475KE19D
6	1	C12	CAP, 4.7 $\mu$ F 50V 10% X5R 0805	MURATA, GRM21BR61H475KE51L
7	1	C13	CAP CER 22pF 50V C0G 0603	MURATA, GRM1885C1H220JA01D
8	1	R1	RES 1M, 1/10W 1% 0402	VISHAY, CRCW04021M00FKED
9	1	R2	RES 249k, 1/16W 1% 0402	VISHAY, CRCW0402249KFKED
10	1	R3	RES 49.9, 1/10W 1% 0402	VISHAY, CRCW040249R9FKED
11	1	R4	RES SMD 75k $\Omega$ 1% 1/10W 0402	VISHAY, CRCW040275K0FKED
12	4	R5, R6, R8, R10	RES SMD 2M $\Omega$ 1% 1/16W 0402	VISHAY, CRCW04022M00FKED
13	1	L1	INDUCTOR, 10 $\mu$ H, $\pm$ 20%	COILCRAFT, XAL4040-103ME
14	1	U1	25V, 600mA BUCK BOOST DC/DC CONVERTER	LINEAR TECHNOLOGY, LTC3130EUDC#PBF
<b>Additional Demo Board Circuit Components</b>				
15	0	C3, C15	CAP, 1210 (OPT)	
16	0	C4	CAP ALUM 220 $\mu$ F 35V 20% SMD (OPT)	PANASONIC, EEE-FP1V221AP
17	0	C14	CAP, 0603 (OPT)	
18	0	R7, R9, R11	RES, 0402 (OPT)	
19	0	D1	DIODE SCHOTTKY 40V 2A SOD123 (OPT)	ROHM, RB068M-40TR
<b>Hardware: For Demo Board Only</b>				
20	6	E1-E6	TP, TURRET, 0.094", PBF	MILL-MAX, 2501-2-00-80-00-00-07-0
21	5	JP1-JP5	CONN., HEADER, 1 $\times$ 3, 2mm	SULLINS, NRPN031PAEN-RC
22	5	XJP1-XJP5	SHUNT, 2mm	SAMTEC, 2SN-BK-G
23	4		STANDOFF, NYLON, SNAP-ON, 0.500"	KEYSTONE, 8833

**SCHEMATIC DIAGRAM**



Information furnished by Linear Technology Corporation is believed to be accurate and reliable. However, no responsibility is assumed for its use. Linear Technology Corporation makes no representation that the interconnection of its circuits as described herein will not infringe on existing patent rights.

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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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