

# LTC3109EUF Auto-Polarity, Ultralow Voltage Step-Up Converter and Power Manager

## DESCRIPTION

Demonstration Circuit 1664A featuring the LTC3109 is a highly integrated DC/DC converter optimized for harvesting and managing energy from extremely low input voltage sources such as thermoelectric generators (TEG). Its unique, proprietary auto-polarity topology allows it to operate from input voltages as low as 30mV, regardless of polarity.

The DC 1664A Demonstration Circuit has been optimized for low start-up voltage with a 100:1 turns ratio transformer. For application where it is desirable to trade-off a higher start-up voltage for higher current, a lower turns ratio transformer can be used. Refer to the LTC3109 datasheet for more information.

The LTC3109 is designed to accumulate and manage energy over a long period of time to enable short bursts of power to be used to acquire and transmit data. The burst must occur at a low enough duty cycle such that the total output energy during the burst does not exceed

the average source power integrated over the accumulation time between bursts.

The Demonstration Circuit has been set up with a storage capacitor that makes it easy to evaluate the general functionality of the circuit. The lower value capacitor allows for a fast charge time but limits the pulsed energy that can be drawn from it. Space is provided, and alternate part footprints have been built into the PCB to allow experimentation with larger capacitors for more energy storage. In a typical application, the larger output capacitors may be used. Refer to the datasheet for more information including equations to properly size the output capacitors for a given application.

**Design files for this circuit board are available. Call the LTC factory.**


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TABLE 1. Typical Specifications (25°C)

Input Voltage Range	50mV-400mV (Typical no load start-up = 30mV)
VLDO	2.2V
VOUT	Jumper Selectable from 2.35 to 5.0V
VOUT2	Switched Output, VOUT2=VOUT
VSTORE	5.25V

## QUICK START PROCEDURE

Using short twisted pair leads for any power connections and with all loads and power supplies off, refer to Figure 1 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 VOUT and GND terminals. See Figure 2 for proper scope probe technique.

1. Jumper, Power Supply and LOAD Settings to start:  
PS1= OFF  
LOADS = OFF  
JP1(VOUT2) = PULSED  
JP2= VAUX  
JP3 = VAUX
2. Turn on PS1 and connect (+) to VINA and (-) to VINB as shown in Figure 1. Slowly increase voltage until the voltage from VINA to VINB is 100mV. Monitor input current. If input current exceeds 60 mA turn off PS1 and look for shorts.
3. Confirm VLDO = 2.2V
4. Confirm LED D3 is lit and blinking. It may take up to 10 seconds for D3 to start blinking.
5. Turn off PS1 and reverse the connection polarity, i.e. connect PS1 (+) to VINB and PS1 (-) to VINA.
6. Move jumper JP1(VOUT2) to OFF.
7. Turn on PS1 and Increase VINA-VINB = -100mV
8. Set LOAD on VLDO to 50 $\mu$ A. Set LOAD on VOUT = 25  $\mu$ A.
9. Verify VLDO = 2.2V, Verify VOUT = 5.0V, Verify VSTORE = 5.2V

The board is now ready for operation. The voltage on VOUT and VOUT2 can be modified by changing jumpers JP2 and JP3. The jumper combinations are shown on the demo board.

Several variations of this design are possible, including increasing the energy storage by populating C11, or C12. Please refer to the datasheet for design equations.

# LTC3109EUF

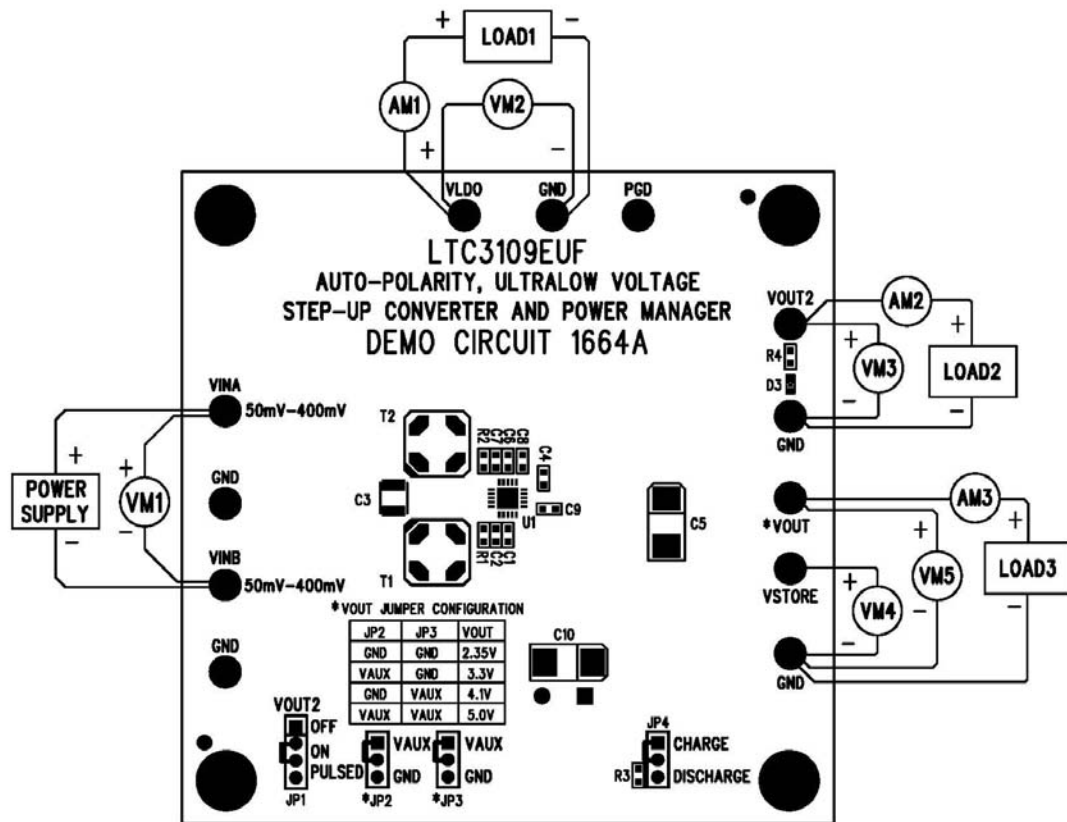


Figure 1. Connection Diagram

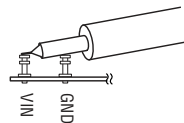


Figure 2. Measuring Input or Output Ripple

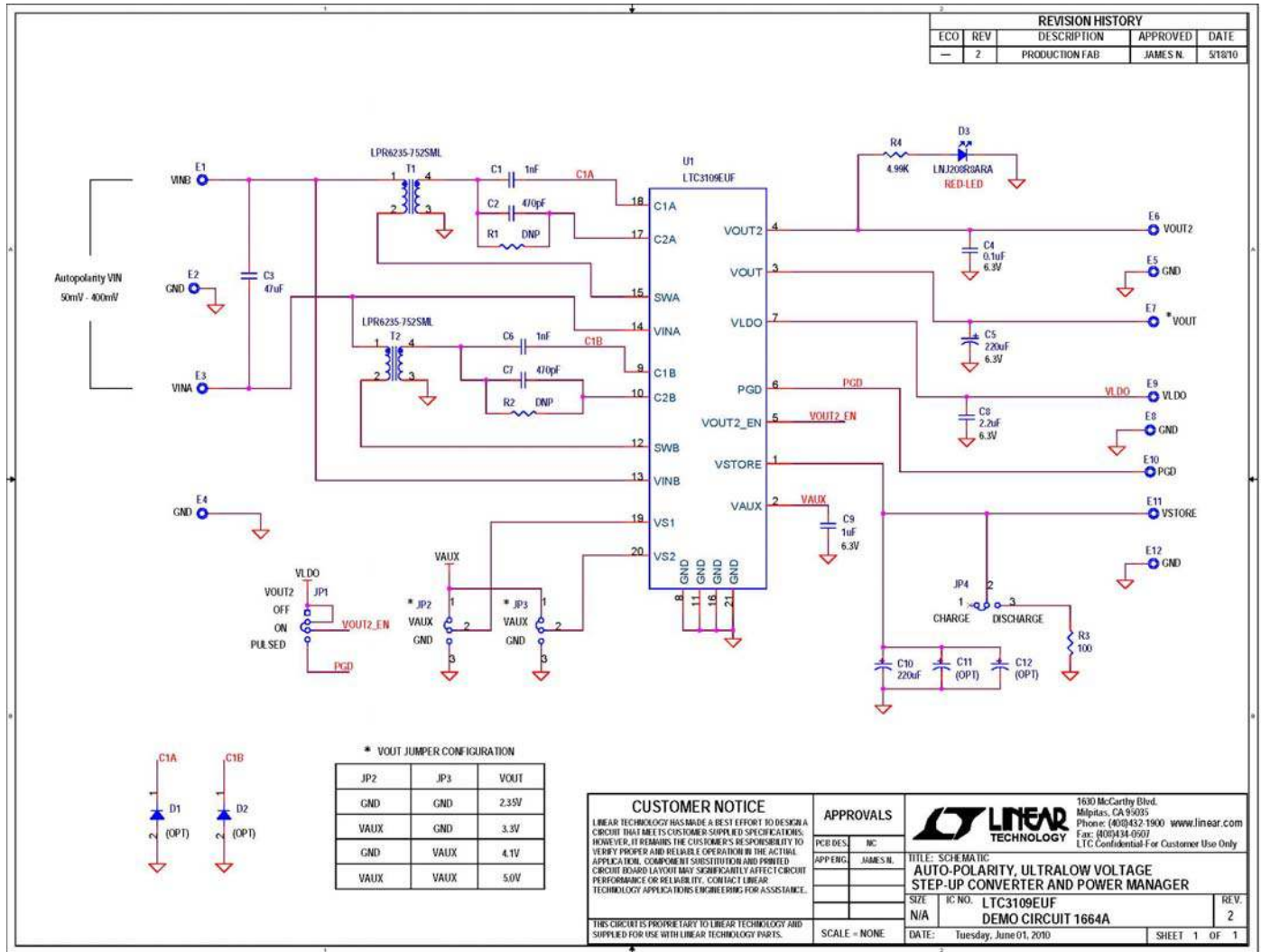


Figure 3. Circuit Schematic

Item	Qty	Reference	Part Description	Manufacturer / Part #
<b>REQUIRED CIRCUIT COMPONENTS:</b>				
1	2	C1,C6	CAP CER, X7R, 1000pF, 50V, 10%, 0603	TDK, C1608X7R1H102K
2	2	C2, C7	CAP CER, X7R, 470pF, 50V, 10%, 0603	TDK, C1608X7R1H471M
3	1	C3	CAP CERAMIC 47UF 10V X5R 1210	Kemet, C1210C476M8PACTU
4	1	C4	CAP CER, X7R, 0.1uF, 16V, 10%, 0603	TDK, C1608X7R1C104K
5	2	C5,C10	CAP., POLYMER SMD, 220uF, 6.3V, 20%	Panasonic, EEFUE0J221ER
6	1	C8	CAP CER, X5R, 2.2uF, 6.3V, 20%, 0603	TDK, C1608X5R0J225M
7	1	C9	CAP CER, X5R, 1.0uF, 25V, 10%, 0603	TDK, C1608X5R0J105K
8	1	D3	LED RED HI BRT SS TYPE LO CUR SM	Panasonic, LNJ208R8ARA
9	1	R3	RES., CHIP, 100, 1/10W, 0603	Panasonic, ERJ-3EKF1000V
10	1	R4	RES., CHIP, 4.99K OHM 1/10W 1% 0603	Panasonic, ERJ-3EKF4991V
11	2	T1,T2	TRANSFORMERS, 100:1 Turns Ratio	COILCRAFT, LPR6235-752SML
12	1	U1	I.C LTC3109EUF AUTO-POLARITY ULTRALOW VOLTAGE STEP-UP CONVERTER AND POWER MANAGER	LINEAR TECH., LTC3109EUF#PBF
<b>ADDITIONAL DEMO BOARD CIRCUIT COMPONENTS:</b>				
1	0	C11 (OPT)	CAP, (OPT)	
2	0	C12,(OPT)	CAP, (OPT)	
3	0	D1,D2 (OPT)	DIODE, SWITCHING DIODE, SOD-123	DIODES INC, 1N4148W-7
4	2	R1,R2 (DNP)	RES., CHIP, 499K, 1/10W, 0603, (DNP)	Panasonic, ERJ-3EKF4993V
<b>HARDWARE-FOR DEMO BOARD ONLY:</b>				
1	12	E1-E12	TESTPOINT, TURRET, .095"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	3	JP1-JP3	3 PIN 0.079 SINGLE ROW HEADER	SAMTEC, TMM-103-02-L-S
3	1	JP4	4 PIN 0.079 SINGLE ROW HEADER	SAMTEC, TMM-104-02-L-S
4	4	JP1-JP4	SHUNT	SAMTEC, 2SN-BK-G
5	4	STAND OFF	STAND-OFF, NYLON 0.50" tall	KEYSTONE, 8832 (SNAP ON)

Figure 4. Bill of Materials