

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 862

## MICROPWER REGULATED CHARGE PUMP DC/DC CONVERTER

### LTC3221-3.3, LTC3221-5 and LTC3221

## DESCRIPTION

Demonstration circuit 862 is a micropower regulated charge pump DC/DC converter with the LTC3221 in a 2mmx2mm DFN package. It comes in three assembly versions, DC862A-A, DC862A-B and DC862A-C, featuring LTC3221EDC-3.3, LTC3221EDC-5, and LTC3221EDC, respectively. The DC862A-A generates a fixed 3.3V output. The DC862A-B generates a fixed 5V output. The DC862A-C generates a programmable regulated 3V output. The maximum output current is **60mA**.

The LTC3221 draws ultra low quiescent current at no load to extend battery life. The quiescent current is even lower than the self-discharging current of many batteries. By adopting a constant current to charge the output, the output ripple is low even at high input and light load

and is rather constant over the full input voltage range. This minimizes output capacitor size and reduces solution cost and space. Built-in soft-start prevents excessive inrush current at turn-on and short-circuit current limit/thermal protection helps the part survive continuous short-circuit. All these features make the circuit ideal for the low power and space-constrained applications in battery powered portable systems.

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

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**Table 1. Performance Summary ( $T_A = 25^\circ\text{C}$ )**

PARAMETER	CONDITION		MINIMUM	TYPICAL	MAXIMUM
Input Voltage Range	DC862A-A		1.8V		4.4V
	DC862A-B		2.7V		5.5V
	DC862A-C		1.8V		3.8V
Maximum Output Current	DC862A-A: $V_{IN} > 2V$ ; DC862A-B: $V_{IN} > 3V$ ; DC862A-C: $V_{IN} > 1.8V$			60mA	
Output Voltage $V_{OUT}$	DC862A-A	$V_{IN} > 2V, I_{OUT} < 60mA$ $1.8V < V_{IN} < 2V, I_{OUT} < 25mA$	3.168	3.3	3.432
	DC862A-B	$V_{IN} > 3V, I_{OUT} < 60mA$ $2.7V < V_{IN} < 3V, I_{OUT} < 25mA$	4.8	5	5.2
	DC862A-C	$V_{IN} > 1.8V, I_{OUT} < 60mA$	2.88	3	3.12
Output Ripple $V_{OUT}$	$I_{OUT} = 0mA$ (20MHz BW)	DC862A-A $V_{IN} = 4.4V$			40mV <sub>p-p</sub>
		DC862A-B $V_{IN} = 5.5V$			90mV <sub>p-p</sub>
	$I_{OUT} = 60mA$	DC862A-C $V_{IN} = 3.8V$			57mV <sub>p-p</sub>
Nominal Switching Frequency				600kHz	
Efficiency	DC862A-A	$V_{IN} = 2V, I_{OUT} = 60mA$		82%	
	DC862A-B	$V_{IN} = 2.7V, I_{OUT} = 60mA$		86%	
	DC862A-C	$V_{IN} = 1.8V, I_{OUT} = 60mA$		82.8%	

### QUICK START PROCEDURE

Demonstration circuit 862 is easy to set up to evaluate the performance of the LTC3221EDC-3.3, LTC3221EDC-5, and LTC3221EDC. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

**NOTE:** 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 Vin or Vout and GND terminals. See Figure 2 for proper scope probe technique.

1. Place jumper JP1 to the ON position.
2. With power off, connect a 1.8V-5.5V power supply to Vin and GND. The supply should be capable of providing 200mA current.
3. Connect a load to Vout and GND.

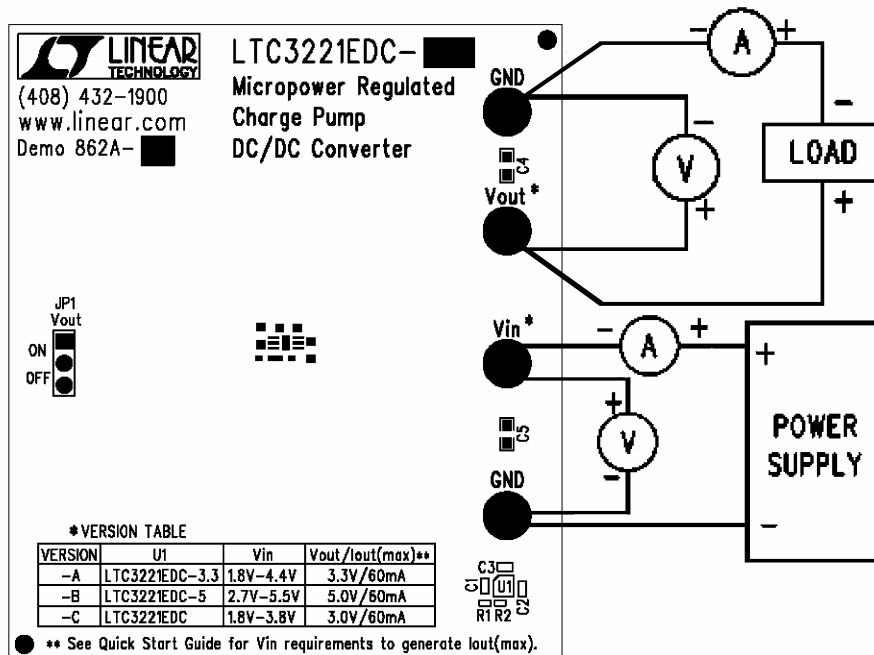
4. Turn on the power at the input.

**NOTE:** Make sure that the input voltage does not exceed the corresponding maximum voltage (e.g. 4.4V for DC862A-A, 5.5V for DC862A-B, 3.8V for DC862A-C).

5. Check for the proper output voltages. For DC863A-A, Vout should be within 3.168V to 3.432V. For DC862A-B, Vout should be within 4.8V to 5.2V. For DC862A-C, Vout is should be within 2.88V to 3.12V.

**NOTE:** If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

6. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.



**Figure 1. Proper Measurement Equipment Setup**

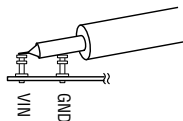


Figure 2. Measuring Input or Output Ripple

## OPERATION PRINCIPLES

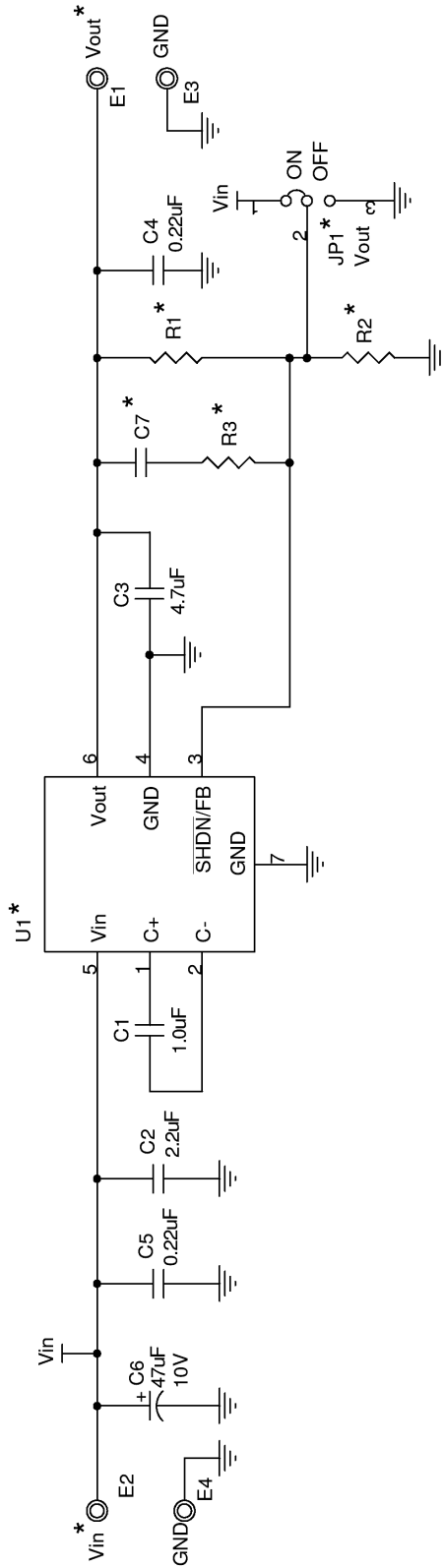
The LTC3221 family regulator uses a switched capacitor charge pump to boost  $V_{in}$  to a regulated output voltage. Regulation is achieved by monitoring the output voltage,  $V_{out}$ , using a comparator and keeping it within a hysteresis window. If  $V_{out}$  drops below the lower trip point,  $V_{out}$  is charged by the controlled current in series with the flying capacitor. Once  $V_{out}$  goes above the upper trip point, the flying capacitor is disconnected from  $V_{out}$ .  $V_{out}$  is discharged and the

flying capacitor is then replenished by the controlled current for a certain time. Once the lower threshold is reached,  $V_{out}$  is charged by the controlled current again.

Burst Mode operation, soft-start and short-circuit /thermal protection can be found on the LTC3221 data-sheet at [www.linear.com](http://www.linear.com).

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## MICROPWER REGULATED CHARGE PUMP DC/DC CONVERTER



\* VERSION TABLE

ASSEMBLY VERSION	U1	Vin	Vout/Iout(max) **	R2	R1	R3	C7	JP1
DC862A-A	LTC3221EDC-3.3	1.8V-4.4V	3.3V/60mA	3.32M	DO NOT INSTALL	DO NOT INSTALL	DO NOT INSTALL	INSTALL
DC862A-B	LTC3221EDC-5	2.7V-5.5V	5.0V/60mA	3.32M	DO NOT INSTALL	DO NOT INSTALL	DO NOT INSTALL	INSTALL
DC862A-C	LTC3221EDC	1.8V-3.8V	3.0V/60mA	107K	154K	0 OHM	220pF	DO NOT INSTALL

\*\* See Quick Start Guide for Vin requirements to generate Iout(max).

### CUSTOMER NOTICE

LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE. THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.

### CONTRACT NO.

APPROVALS	DATE
DRAWN June Wu	12/29/04
CHECKED	
APPROVED	
ENGINEER Julian Zhu	12/29/04
DESIGNER	

Wednesday, August 02, 2005



1630 McCarthy Blvd.  
Milpitas, CA 95035  
Phone: (408)432-1900  
Fax: (408)434-0507

TITLE LTC3221EDC-3.3 / LTC3221EDC-5 / LTC3221EDC  
Micropower Regulated Charge Pump DC/DC Converter

SIZE	CAGE CODE	DWG NO	REV
154K	0 OHM	DC862A	A

FILENAME: SHEET 1 OF 1