

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 903A

## STEP-UP /STEP-DOWN DC-DC CHARGE PUMP CONVERTER

### LTC3240-3.3 and LTC3240-2.5

## DESCRIPTION

Demonstration circuit 903A is a step-up/step-down charge pump dc-dc converter. It comes with two assembly versions, DC903A-A and DC903A-B featuring the LTC3240-3.3 and LTC3240-2.5 respectively, each in a tiny 2mmx2mm DFN package.

The DC903A-A and DC903A-B generate a fixed regulated output of 3.3V and 2.5V respectively over a wide input voltage range from 1.8V to 5.5V. The output current can reach up to **150mA** when the input voltage is above 2.5V in DC903A-A. The maximum output current of DC903A-B is designed at 60mA over the full input range.

The DC903A optimizes the output efficiency by operating in the LDO step-down mode during most of the battery life time when the input is higher than the output voltage. When the battery voltage gets low enough it auto-

matically switches into charge-pump doubling mode to maximize the battery usage.

Additionally, DC903A features Automatic Burst Mode operation at light load to achieve low supply current (65 $\mu$ A, no load). Also, the built-in soft-start limits in-rush current at turn-on, and short-circuit current limit/thermal protection help the part survive a continuous short-circuit. All these features make the circuit ideally suited for efficient DC-DC conversion in space-constrained applications such as battery-powered handheld electronics.

**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		1.8V		5.5V
Maximum Output Current	DC903A-A, $V_{IN} \geq 2.5\text{V}$ DC903A-B, $1.8\text{V} < V_{IN} < 5.5\text{V}$		150mA 60mA	
Output Voltage $V_{OUT}$	DC903A-A, $V_{IN} \geq 2.5\text{V}$ , $I_{OUT} < 150\text{mA}$ $1.8\text{V} < V_{IN} < 2.5\text{V}$ , $I_{OUT} < 40\text{mA}$	3.168V	3.3V	3.432V
	DC903A-B, $V_{IN} > 1.8\text{V}$ , $I_{OUT} < 60\text{mA}$	2.4V	2.5V	2.6V
Output Ripple $V_{OUT}$	(20MHz BW)	DC903A-A, $I_{OUT} = 150\text{mA}$		32mV <sub>P-P</sub>
		DC903A-B, $I_{OUT} = 60\text{mA}$		22mV <sub>P-P</sub>
Load Regulation	DC903A-A		-1.7%	-2.1%
	DC903A-B		-0.6%	-0.68%
Nominal Switching Frequency			1.2MHz	
Efficiency	DC903A-A, $V_{IN} = 3.7\text{V}$ , $I_{OUT} = 150\text{mA}$		85.8%	
	DC903A-B, $V_{IN} = 1.8\text{V}$ , $I_{OUT} = 60\text{mA}$		69.4%	

## QUICK START PROCEDURE

1. Demonstration circuit 903A is easy to set up to evaluate the performance of the LTC3240-3.3 and LTC3240-2.5.

Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

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**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  $V_{in}$  or  $V_{out}$  and GND terminals. See Figure 2 for proper scope probe technique.

- Place JP1 jumper in the ON position.
- With power off, connect a 1.8V-5.5V, 500mA power supply to  $V_{in}$  and GND.
- Connect a load (preset load current to 0A) to  $V_{out}$  and GND.

- Turn on the power at the input.

**NOTE:** Make sure that the input voltage does not exceed 5.5V.

- Check for the proper output voltages.  $V_{out}$  should measure a typical 3.3V (could vary from 3.168V to 3.432V) for DC903A-A, and a typical 2.5V (could vary from 2.4V to 2.6V) for DC903A-B.
- 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.

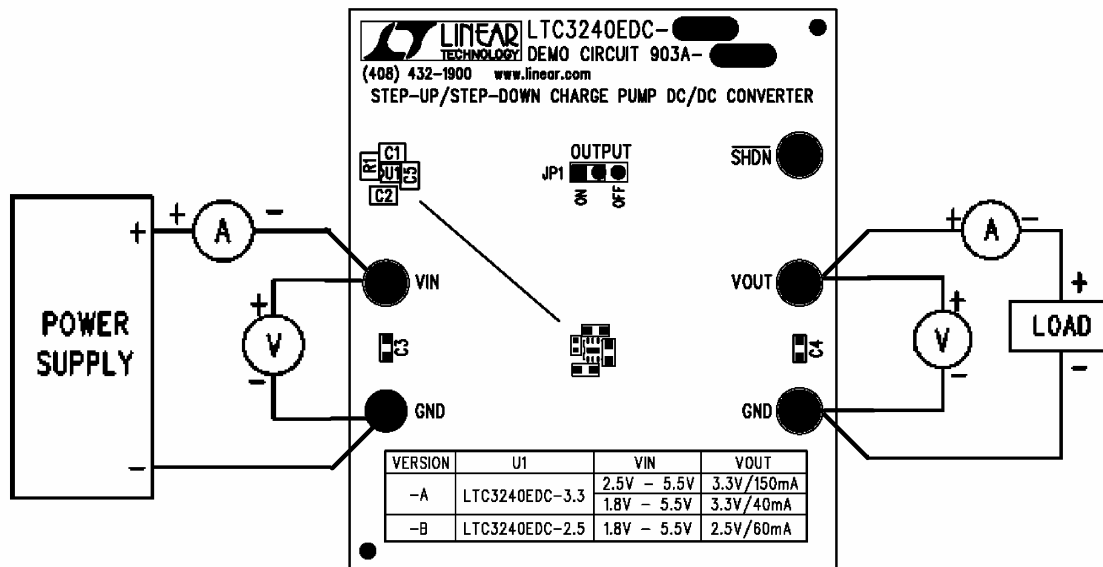


Figure 1. Proper Measurement Equipment Setup

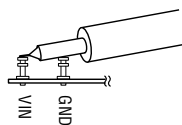


Figure 2. Measuring Input or Output Ripple

## OPERATING PRINCIPLES

The LTC3240 is a step-up/step-down charge pump DC/DC converter. For  $V_{in}$  greater than  $V_{out}$  by about

100mV, the LTC3240 operates as a low dropout regulator. Once  $V_{in}$  drops to within 100mV of regulated  $V_{out}$ , the

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part automatically switches into charge pump step-up mode to maintain the regulated output voltage. Regulation is achieved by sensing the output voltage through an internal resistor divider and modulating the charge pump output current based on the feedback error signal.

In the charge pump mode, a 2-phase non-overlapping clock activates the charge pump switches. The flying

capacitor is charged from  $V_{IN}$  on the first phase of the clock. On the second phase of the clock it is stacked in series with  $V_{IN}$  and connected to  $V_{OUT}$ .

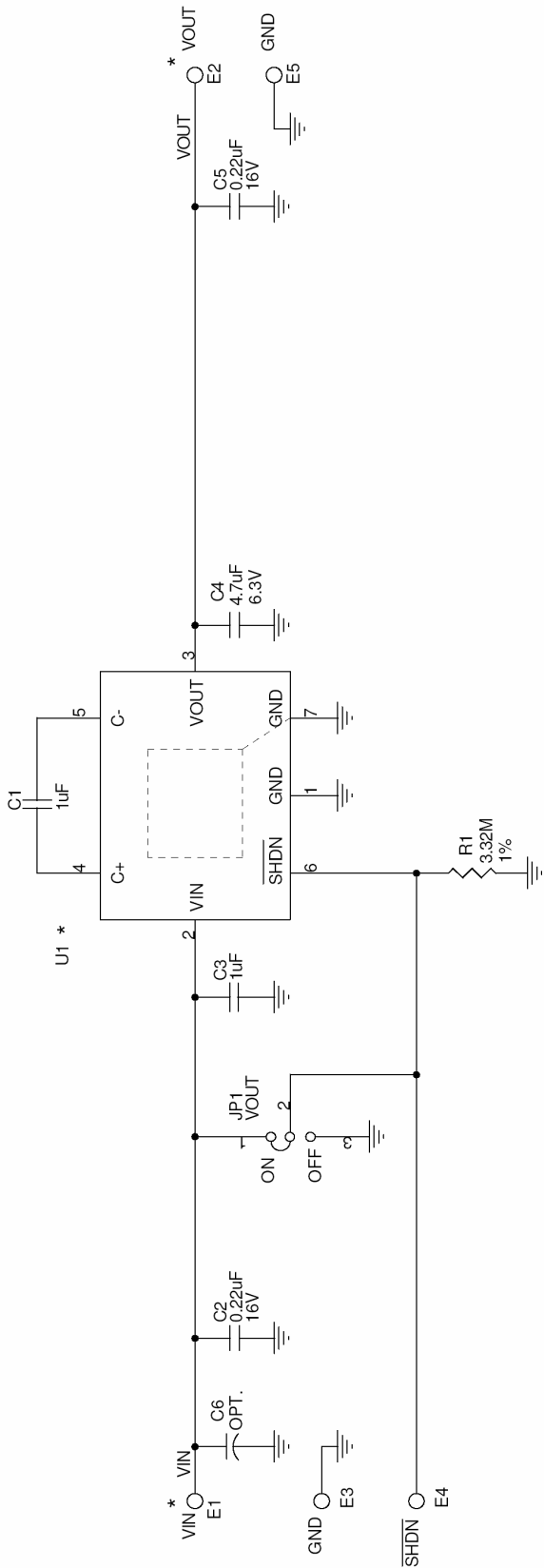
Burst Mode operation, soft-start and short-circuit /thermal protection can be found on the LTC3240 data-sheet at [www.linear.com](http://www.linear.com).

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This circuit is proprietary to Linear Technology and supplied for use with Linear Technology parts.

**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 Applications Engineering for assistance.



VERSION	U1	VIN	VOUT
-A	LTC3240EDC-3.3	2.5V - 5.5V 1.8V - 5.5V	3.3V/150mA 3.3V/40mA
-B	LTC3240EDC-2.5	1.8V - 5.5V	2.5V/60mA

REVISION HISTORY				
ECO	REV	DESCRIPTION	DATE	APPROVED
	1	PROTO	04/06/05	
	2	Change: Title, Current load	09/26/05	

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**CONTRACT NO.**

APPROVALS	DATE
DRAWN: mel	08/06/04
CHECKED:	
APPROVED:	
ENGINEER:	
DESIGNER:	

**TITLE** SCH, LTC3240EDC-3.3/-2.5, STEP-UP/STEP-DOWN CHARGE PUMP DC/DC CONVERTER

SIZE	CAGE CODE	DWGNO	REV
		DC903A	2

**SCALE:** Thursday, October 20, 2005

FILENAME:	SHEET	OF
903A-2.DSN	1	1