DESCRIPTION

Demonstration circuit 863 is a 500mA low noise, high efficiency charge pump converter with LTC3203 in 3mmx3mm DFN package. It comes with three assembly versions, DC863A-A, DC863A-B and DC863A-C, featuring the LTC3203B, LTC3203-1, and LTC3203B-1 respectively. The DC863A-A is programmed to generate a regulated 3.3V output, and DC863A-B/DC863A-C generate a user selectable fixed output voltage of 4.5V or 5V, all from a 2.7V to 5.5V input. The output current can reach up to **500mA** with an input voltage above 2.9V (for 4.5V output), 3.1V (for 5V output) or full input range (for 3.3V output).

By choosing the proper operation modes, the DC863A circuit optimizes conversion efficiencies and maintains the maximum output current at each output voltage. Additionally, DC863A-B features Automatic Burst Mode operation at light load to achieve low supply current whereas DC863A-A and DC863A-C operate in constant frequency to achieve low noise at the input. Also, the built-in soft-start prevents excessive inrush 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 a powerful solution to the applications that demand high current with a constrained space in a battery powered portable system.

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

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Table 1. Performance Summary (T_A = 25°C)

PARAMETER	CONDITION		MINIMUM	TYPICAL	MAXIMUM
Input Voltage Range			2.7V		5.5V
Maximum Output Current	DC863A-A: V_{IN} > 2.9V; DC863A-B: V_{IN} > 3.1V; DC863A-C: V_{IN} > 2.7V			500mA	
Output Voltage V_{OUT}	DC863A-B DC863A-C	V_{IN} > 2.9V, I_{OUT} < 500mA 2.7V < V_{IN} < 2.9V, I_{OUT} < 250mA	4.32	4.5	4.68
		V_{IN} > 3.1V, I_{OUT} < 500mA 2.7V < V_{IN} < 3.1V, I_{OUT} < 150mA	4.8	5	5.2
	DC863A-A	V_{IN} > 2.7V, I_{OUT} < 500mA	3.168	3.3	3.432
Output Ripple V_{OUT}	I_{OUT} = 500mA (20MHz BW)	DC863A-B/-C, V_{OUT} = 5V			50mV_{P-P}
		DC863A-B/-C, V_{OUT} = 4.5V			50mV_{P-P}
		DC863A-A, V_{OUT} = 3.3V			53mV_{P-P}
Nominal Switching Frequency				0.9M or 1MHz	
Efficiency	DC863A-B DC863A-C	V_{OUT} = 5V, V_{IN} = 2.7V, I_{OUT} = 150mA		89.5%	
		V_{OUT} = 4.5V, V_{IN} = 3.8V, I_{OUT}= 500mA		77.4%	
	DC863A-A	V_{OUT} = 3.3V, V_{IN} = 3.0V, I_{OUT} = 500mA		71.4%	

QUICK START PROCEDURE

Demonstration circuit 863 is easy to set up to evaluate the performance of the LTC3203BEDD, LTC3203EDD-1 and LTC3203BEDD-1. 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 jumpers in the following positions:

   JP1 On

   JP2 5V (or 4.5V)

2. With power off, connect a 2.7V-5.5V, 1A power supply to Vin and GND.

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 5.5V.

5. Check for the proper output voltages. For DC863A-B and DC863A-C, Vout should measure either a 5V (could vary from 4.8V to 5.2V) or 4.5V (could vary from 4.32V to 4.68V) depending on the position of JP2. For DC863A-A, Vout is typically 3.3V, varying from 3.168V to 3.432V.

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

6. Connect the JP1 jumper to the "off" position to turn off the LTC3203. Returning the jumper to the "on" position will turn on the LTC3203.

7. 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.

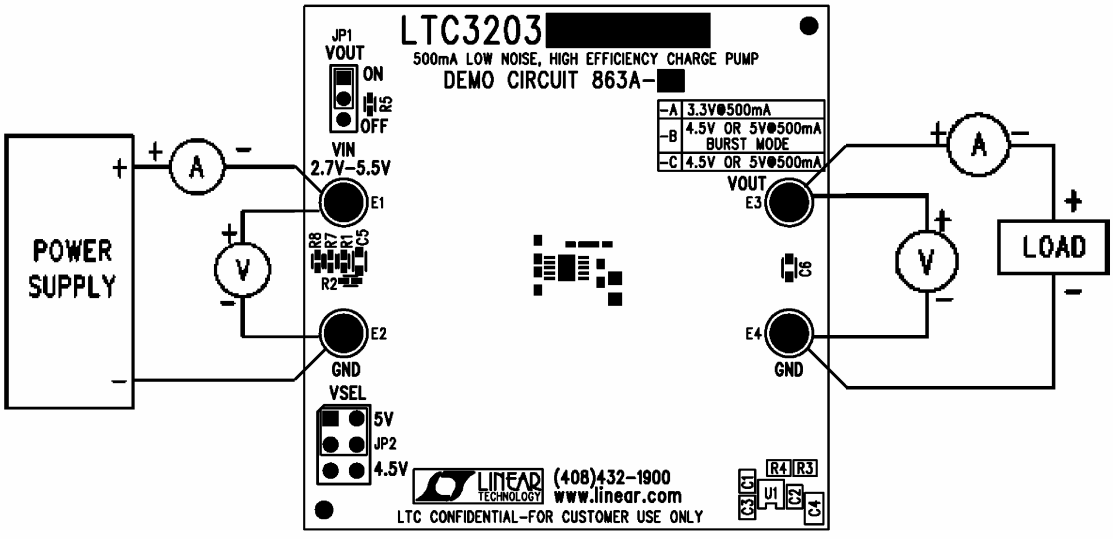


Figure 1. Proper Measurement Equipment Setup

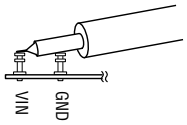


Figure 2. Measuring Input or Output Ripple

OPERATION PRINCIPLES

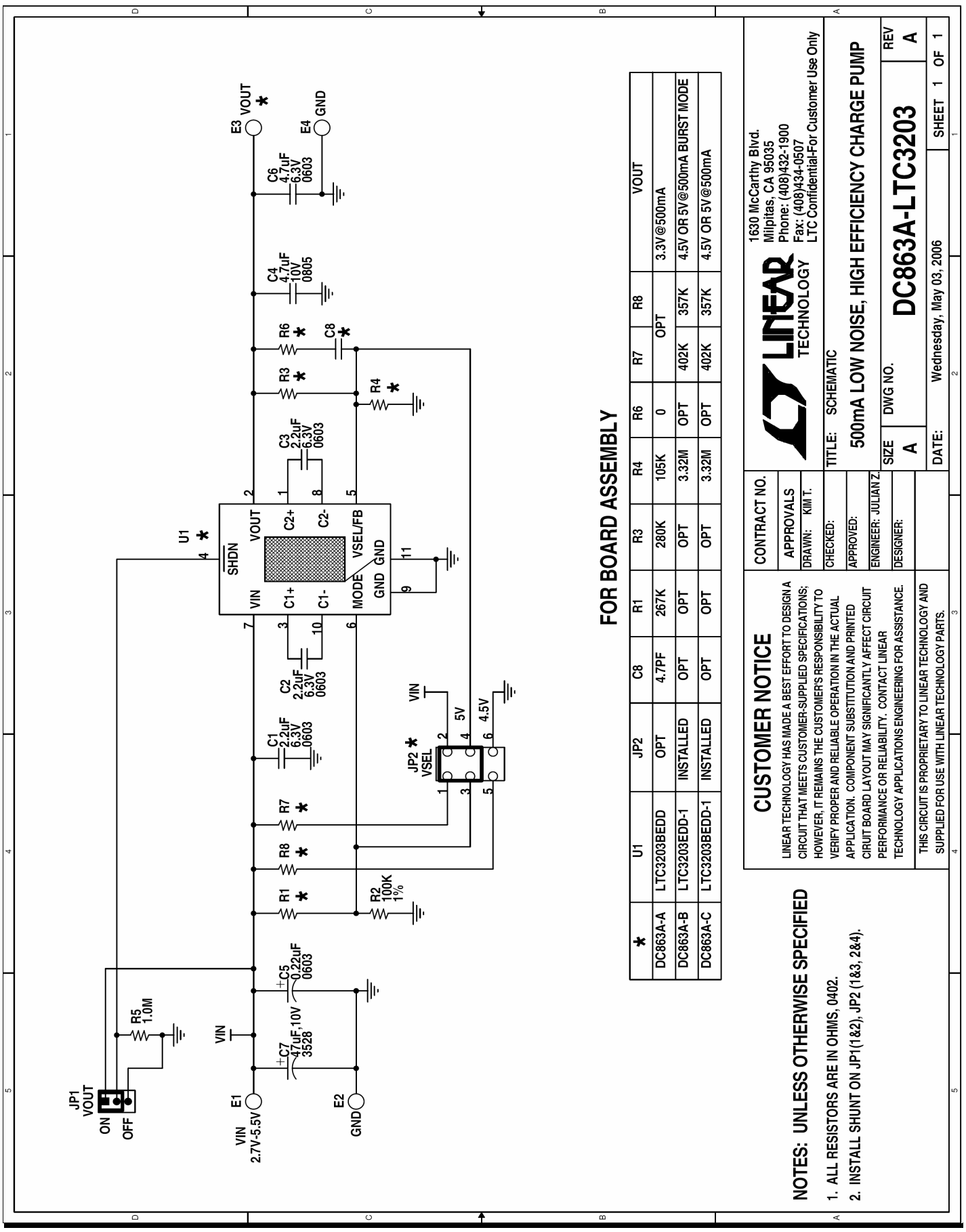
The LTC3203-1/LTC3203B/LTC3203B-1 use a switched capacitor charge pump to step up V_{IN} to a regulated output voltage. Regulation is achieved by sensing the output voltage through a resistor divider and modulating the charge pump output current based on the error signal. A two-phase nonoverlapping clock activates the charge pump switches. The typical frequency of charging and discharging the flying capacitors is 1MHz (2x mode) or 0.9MHz (1.5x mode). A unique architecture maintains relatively constant input current for the lowest possible input noise.

The LTC3203-1/LTC3203B/LTC3203B-1 charge pump can operate in two modes of voltage conversion: 1.5x or 2x.

In the 1.5x mode the flying capacitors are charged in series during the first clock phase, and stacked in parallel on top of V_{IN} on the second clock phase. Alternatively, in the 2x mode the flying capacitors are charged on alternate clock phases from V_{IN}. While one capacitor is being charged from V_{IN}, the other is stacked on top of V_{IN} and connected to the output. The two flying capacitors operate out of phase to minimize both input and output ripple.

When the input voltage is higher than the threshold, the charge pump operates in 1.5x mode and when the input voltage is lower than the threshold, the charge pump operates in 2x mode to enhance output current. By properly combining the two modes, the efficiency, V_{OUT} ripple can be optimized for the required output current.

Burst Mode operation, soft-start and short-circuit /thermal protection can be found on the LTC3203 datasheet at www.linear.com.



FOR BOARD ASSEMBLY

*	U1	JP2	C8	R1	R3	R4	R6	R7	R8	VOUT
DC863A-A	LTC3203BEDD	OPT	4.7PF	267K	280K	105K	0	OPT		3.3V@500mA
DC863A-B	LTC3203EDD-1	INSTALLED	OPT	OPT	OPT	3.32M	OPT	402K	357K	4.5V OR 5V@500mA BURST MODE
DC863A-C	LTC3203BEDD-1	INSTALLED	OPT	OPT	OPT	3.32M	OPT	402K	357K	4.5V OR 5V@500mA

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 CIRUIT 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.

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TITLE: SCHEMATIC

500mA LOW NOISE, HIGH EFFICIENCY CHARGE PUMP

SIZE A | DWG NO. DC863A-LTC3203 | REV A

DATE: Wednesday, May 03, 2006 | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE IN OHMS, 0402.
2. INSTALL SHUNT ON JP1(1&2), JP2 (1&3, 2&4).