

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 893

## MONOLITHIC BUCK REGULATOR WITH DUAL VLDO REGULATORS

LTC3446

### DESCRIPTION

Demonstration circuit 893A is a triple output converter, using the LTC3446 monolithic synchronous buck regulator with dual very low drop-out linear regulators (VLDOs). The DC893A has an input voltage range of 2.7V to 5.5V, and is capable of delivering up to 300 mA of load current on each output. The buck regulator output voltage of the DC893A can be set as low as 0.8V, and the dual VLDOs can be set as low as 0.4V. The DC893A can operate in noise sensitive applications, due to the LTC3446 buck regulator operating in pulse-skipping mode at low load currents. This feature, together with the inherent low noise operation of the VLDOs, allows the DC893A to

provide three reasonably quiet outputs. The DC893A is meant for powering sub-2V logic circuits and I/O circuitry from a single Li-Ion battery. With the dual VLDOs running off the output voltage of the buck regulator, the efficiency of the linear regulators can rival that of the buck regulator. These features make the DC893A an ideal circuit for use in Battery powered, hand-held applications.

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

LTC is a trademark of Linear Technology Corporation

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

| PARAMETER                               | CONDITIONS                                                                             | VALUE                                   |
|-----------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------|
| Minimum Input Voltage                   |                                                                                        | 2.7V                                    |
| Maximum Input Voltage                   |                                                                                        | 5.5V                                    |
| Run/Shutdown                            | GND = Shutdown                                                                         |                                         |
|                                         | $V_{IN}$ = Run                                                                         |                                         |
| Output Voltage $V_{OUTBUCK}$            | $V_{IN} = 2.7\text{V to } 5.5\text{V}$ , $I_{OUTBUCK} = 0\text{ mA to } 400\text{ mA}$ | $1.8\text{V} \pm 5\%$ (1.7V – 1.9V)     |
| Output Voltage Regulation $V_{OUTBUCK}$ | Line                                                                                   | $\pm 1.5\%$                             |
|                                         | Load                                                                                   | $\pm 1.5\%$                             |
| Typical Output Ripple $V_{OUTBUCK}$     | $V_{IN} = 3.3\text{V}$ , $I_{OUTBUCK} = 400\text{ mA}$ (20 MHz BW)                     | $< 40\text{mV}_{P-P}$                   |
| Nominal Switching Frequency             |                                                                                        | 2.25 MHz                                |
| Operation Modes                         | Burst Mode - $V_{IN} = 3.3\text{V}$ , $V_{OUTBUCK} = 1.8\text{V}$                      | $< 0.4\text{A} \pm 0.1\text{A}\%$       |
|                                         | Pulse-Skipping - $V_{IN} = 3.3\text{V}$ , $V_{OUTBUCK} = 1.8\text{V}$                  | $< 0.2\text{A} \pm 50\text{ mA}\%$      |
| Output Voltage $V_{OUTLDO1}$            | $V_{IN} = 2.9\text{V to } 5.5\text{V}$ , $I_{OUT1} = 0\text{ mA to } 300\text{ mA}$    | $1.5\text{V} \pm 5\%$ (1.4V - 1.6V)     |
| Output Voltage Regulation $V_{OUTLDO1}$ | Line                                                                                   | $\pm 1.5\%$                             |
|                                         | Load                                                                                   | $\pm 1.5\%$                             |
| Typical Output Ripple $V_{OUTLDO1}$     | $V_{IN} = 3.3\text{V}$ , $I_{OUTLDO1} = 300\text{ mA}$ (20 MHz BW)                     | $< 20\text{mV}_{P-P}$                   |
| Output Voltage $V_{OUTLDO2}$            | $V_{IN} = 2.7\text{V to } 5.5\text{V}$ , $I_{OUTLDO2} = 0\text{ mA to } 300\text{ mA}$ | $1.2\text{V} \pm 5\%$ (1.125V - 1.275V) |
| Output Voltage Regulation $V_{OUTLDO2}$ | Line                                                                                   | $\pm 1.5\%$                             |
|                                         | Load                                                                                   | $\pm 1.5\%$                             |
| Typical Output Ripple $V_{OUTLDO2}$     | $V_{IN} = 3.3\text{V}$ , $I_{OUTLDO2} = 300\text{ mA}$ (20 MHz BW)                     | $< 20\text{mV}_{P-P}$                   |

### QUICK START PROCEDURE

The DC893 is easy to set up to evaluate the performance of the LTC3446. For a proper measurement equipment configuration, set up the circuit according to the diagram in Figure 1.

**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 the probe measurement diagram in Figure 2 for proper scope probe technique.

Please follow the procedure outlined below for proper operation.

1. Connect the input power supply to the Vin and GND terminals. Connect the loads between the Vout and GND terminals. Refer to figure 1 for the proper measurement equipment setup.
2. Before proceeding to operation, insert shunt XJP1 into the pulse-skip position of jumper JP1. Also, insert shunts XJP2, XJP3, and XJP4 into the OFF positions of jumpers JP2, JP3, and JP4, respectively.
3. Apply 5V at Vin, and turn on VoutBuck, LVout1, and LVout2 by changing shunts XJP2, XJP3, and XJP4 from the OFF positions to the ON positions. All three output voltages should be within a tolerance of +/- 2.5%.
4. Vary the input voltage from 2.9V to 5V. The three output voltages should be within +/- 3.5% tolerance.
5. Vary the load current, of each output, from 0 to full load (400 mA for VoutBuck, 300 mA for LVout1 and LVout2). Each output voltage should be within a tolerance of +/- 5%.
6. Set the load current of all outputs to full load and measure the ripple voltage of each output (refer to Figure 2 for proper measurement

technique); they should measure less than 40 mVAC each. Also, observe the voltage waveform of the VoutBuck regulator at the switch node (pin 14). The switching frequency should be between 1.8 MHz and 2.7 MHz ( $T = 555 \text{ ns}$  and  $370 \text{ s}$ ).

7. Insert shunts XJP2, XJP3, and XJP4 into the OFF position(s). Move shunt XJP1 into the Burst-Mode position. Turn on VoutBuck by moving shunt XJP2 into the on position and lower the load current to less than 40 mA. Observe the output ripple voltage. It should measure less than 100 mVAC.
8. Measure the output voltage; it should measure +/- 2.5% tolerance for static line and load conditions and +/- 6% tolerance under dynamic line and load conditions (3.5% total).

When finished, turn off the VoutBuck circuit by inserting a shunt into the OFF position of JP2, and disconnect the power.

**Warning** - If the power for the demo board is carried in long leads, the input voltage at the part could "ring", which could affect the operation of the circuit or even exceed the maximum voltage rating of the IC. To eliminate the ringing, insert a small tantalum capacitor (for instance, AVX part # TAJW476M010) on the pads between the input power and return terminals on the bottom of the demo board. The (greater) ESR of the tantalum will dampen the (possible) ringing voltage due to the use of long input leads. On a normal, typical PCB, with short traces, the capacitor is not needed.

# QUICK START GUIDE FOR DEMONSTRATION CIRCUIT 893

## MONOLITHIC BUCK REGULATOR WITH DUAL VLDO REGULATORS

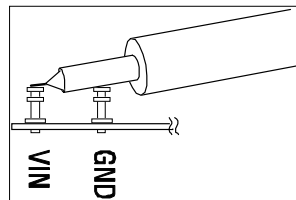
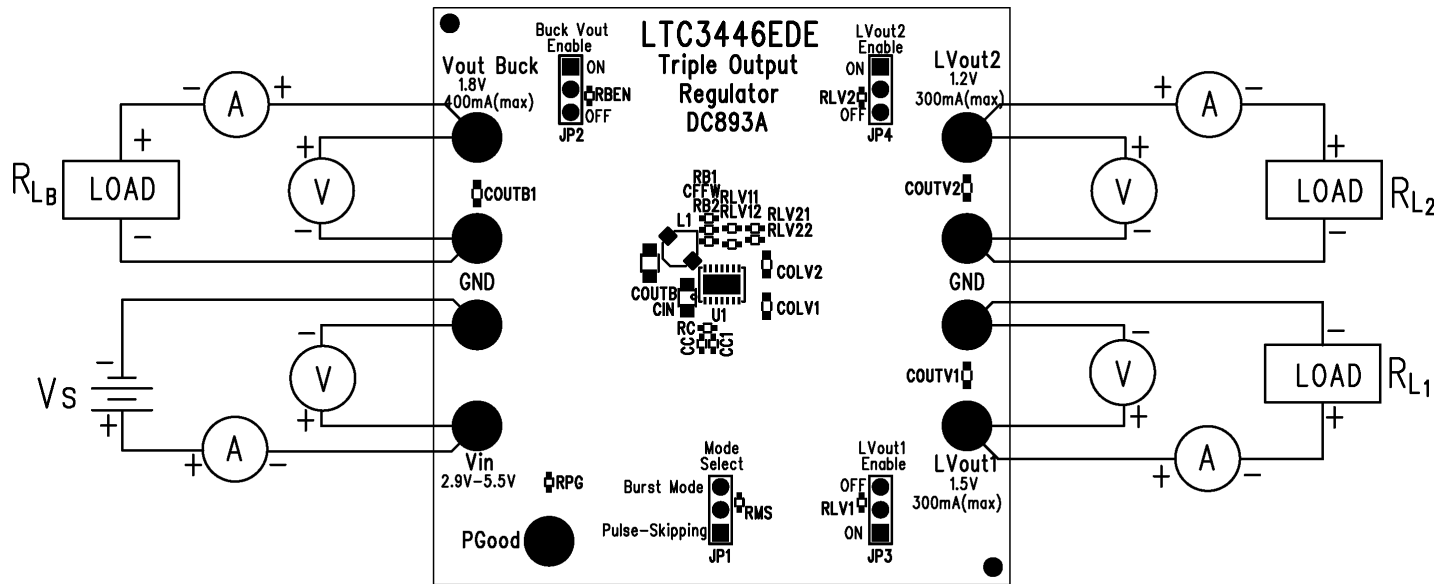
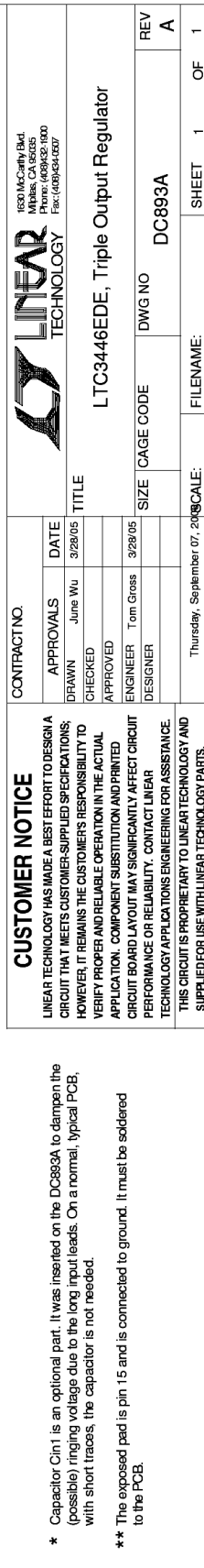


Figure 1. Measuring Input or Output Ripple



\* Capacitor C1m1 is an optional part. It was inserted on the DC993A to dampen the (possible) ringing voltage due to the long input leads. On a normal, typical PCB, with short traces, the capacitor is not needed.

**\*\*** The exposed pad is pin 15 and is connected to ground. It must be soldered to the PCB.