

# LT8613: 42V, 6A Micropower Synchronous Step-Down Regulator with Current Sense

## DESCRIPTION

Demonstration Circuit 2011A is a 42V, 6A micropower synchronous step-down regulator with current sense featuring the **LT<sup>®</sup>8613**. The demo board is designed for 5V output from a 5.8V to 42V input. The wide input range allows a variety of input sources, such as automotive batteries and industrial supplies. The LT8613 is a compact, high efficiency, and high speed synchronous monolithic step-down switching regulator. The integrated power switches and inclusion of all necessary circuitry reduce the components count and solution size. Ultralow 3 $\mu$ A quiescent current in Burst Mode<sup>®</sup> operation achieves high efficiency at very light loads. Fast minimum on-time of 40ns enables high  $V_{IN}$  to low  $V_{OUT}$  conversion at high frequency.

The LT8613 switching frequency can be programmed either via oscillator resistor or external clock over a 200kHz to 2.2MHz range. The SYNC pin on the demo board is grounded by default for low ripple Burst Mode operation. To synchronize to an external clock, move JP1 to SYNC and apply the external clock to the SYNC turret. Once JP1 is on SYNC position, a DC voltage of 3V or higher can be applied to the SYNC turret for pulse skipping operation.

The DC2011A has output current limit set at 6A by default. The current limit can be moved to the input side for

application where input supply current is limited.  $I_{CTRL}$  and  $I_{MON}$  on the board set and monitor the regulated current, respectively.

Figure 1 shows the efficiency of DC2011A circuit. Figure 2 shows the LT8613 temperature rising on DC2011A demo board under different load conditions. The rated maximum load current is 6A, while derating is necessary for certain  $V_{IN}$  and thermal conditions. The demo board has an EMI filter installed. To use the EMI filter, the input should be tied to  $V_{EMI}$  terminal, not  $V_{IN}$  terminal.

The LT8613 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this demo manual for DC2011A. The LT8613 is assembled in a 3mm  $\times$  6mm plastic QFN package with exposed pads for low thermal resistance. Proper board layout is essential for minimum EMI and maximum thermal performance. See the data sheet section "PCB Layout" and "High Temperature Considerations".

**Design files for this circuit board are available at <http://www.linear.com/demo/DC2011A>**

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## PERFORMANCE SUMMARY

Specifications are at  $T_A = 25^\circ\text{C}$

| SYMBOL    | PARAMETER              | CONDITIONS                                                        | MIN   | TYP | MAX   | UNITS |
|-----------|------------------------|-------------------------------------------------------------------|-------|-----|-------|-------|
| $V_{IN}$  | Input Supply Range     |                                                                   | 5.8   |     | 42    | V     |
| $V_{OUT}$ | Output Voltage         |                                                                   | 4.875 | 5   | 5.125 | V     |
| $I_{OUT}$ | Maximum Output Current | Derating Is Necessary for Certain $V_{IN}$ and Thermal Conditions | 6     |     |       | A     |
| $f_{SW}$  | Switching Frequency    |                                                                   | 665   | 700 | 735   | kHz   |
| EFE       | Efficiency at DC       | $V_{IN} = 12\text{V}$ , $I_{OUT} = 3\text{A}$                     |       | 94  |       | %     |

## QUICK START PROCEDURE

Demonstration Circuit 2011A is easy to set up to evaluate the performance of the LT8613. Refer to Figure 3 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  $V_{IN}$  or  $V_{OUT}$  and GND terminals. See Figure 4 for the proper scope technique.

1. Place JP1 on GND position.
2. With power off, connect the input power supply to  $V_{IN}$  and GND.
3. With power off, connect the load from  $V_{OUT}$  to GND.

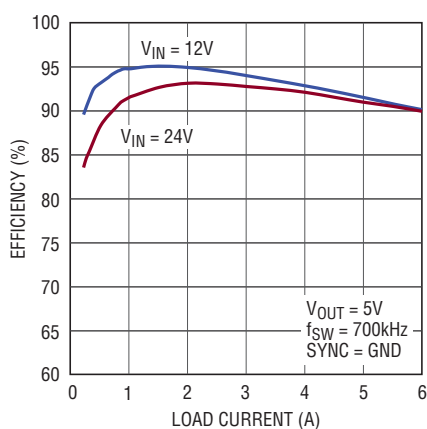
4. Turn on the power at the input.

**NOTE.** Make sure that the input voltage does not exceed 42V.

5. Check for the proper output voltage ( $V_{OUT} = 5V$ ).

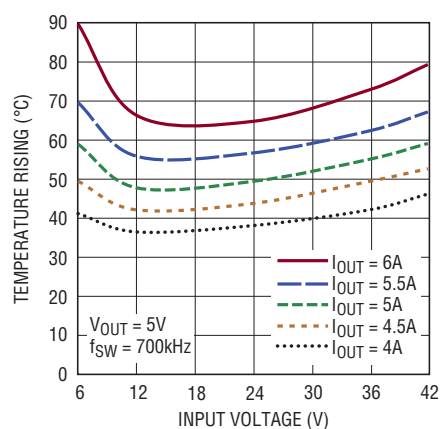
**NOTE.** If there is no output, temporarily disconnect the load to make sure that the load is not set too high or is shorted.

6. Once the proper output voltage is established, adjust the load within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency and other parameters.
7. An external clock can be added to the SYNC terminal when SYNC function is used (JP1 on the SYNC position). Please make sure that RT should be chosen to set the LT8613 switching frequency equal to or below the lowest SYNC frequency. See the data sheet section "Synchronization".



DC2011A G01

Figure 1. Efficiency vs. Load Current (Using  $V_{IN}$  Terminal)



DC2011A G2

Figure 2. Temperature Rising vs. Input Voltage

## QUICK START PROCEDURE

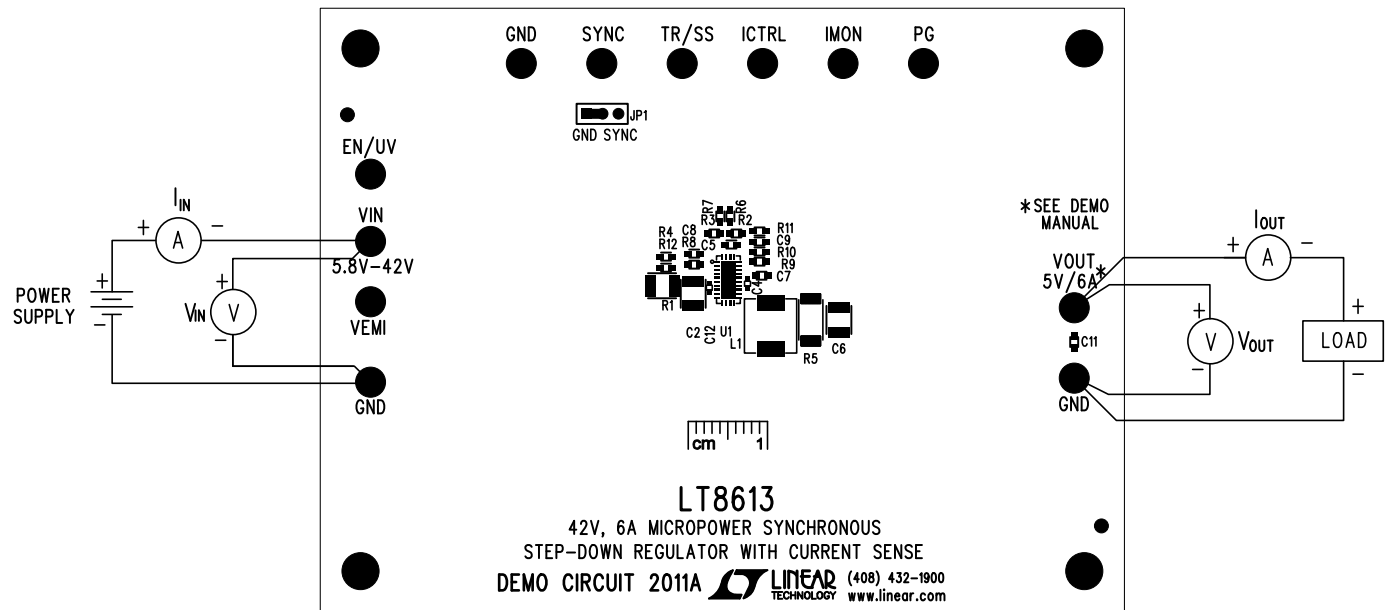


Figure 3. Proper Measurement Equipment Setup

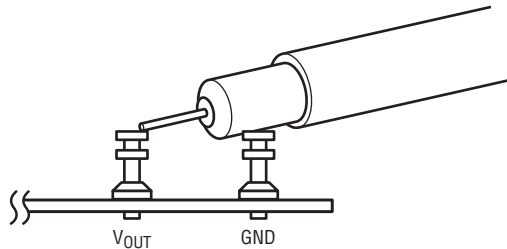


Figure 4. Measuring Output Ripple

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## PARTS LIST

| ITEM                                             | QTY | REFERENCE        | PART DESCRIPTION                             | MANUFACTURER/PART NUMBER          |
|--------------------------------------------------|-----|------------------|----------------------------------------------|-----------------------------------|
| <b>Required Circuit Components</b>               |     |                  |                                              |                                   |
| 1                                                | 1   | C2               | CAP., X5R, 10 $\mu$ F, 50V, 10% 1210         | MURATA, GRM32ER61H106KA12L        |
| 2                                                | 2   | C4, C12          | CAP., X5R, 0.1 $\mu$ F, 50V, 10% 0402        | TDK, C1005X5R1H104K               |
| 3                                                | 1   | C6               | CAP., X5R, 100 $\mu$ F, 10V, 20% 1210        | MURATA, GRM32ER61A107ME20L        |
| 4                                                | 2   | C7, C11          | CAP., X7R, 1.0 $\mu$ F, 25V, 10% 0603        | MURATA, GRM188R71E105KA12D        |
| 5                                                | 1   | C8               | CAP., X7R, 0.1 $\mu$ F, 50V, 10% 0603        | MURATA, GRM188R71H104KA93D        |
| 6                                                | 1   | C9               | CAP., C0G, 10pF, 50V, 5% 0603                | MURATA, GRM1885C1H100JA01D        |
| 7                                                | 1   | L1               | IND, 3.3 $\mu$ H, IHLP2525EZ-01              | VISHAY, IHLP2525EZER3R3M01        |
| 8                                                | 1   | R1               | RES., CHIP., 0 $\Omega$ , 1/2W, 1% 1210      | VISHAY, CRCW12100000Z0EA          |
| 9                                                | 1   | R5               | RES., CHIP., 0.008 $\Omega$ , 1/2W, 1%, 2010 | VISHAY, WSL20108L000FEA           |
| 10                                               | 2   | R6, R7           | RES., CHIP., 0 $\Omega$ , 1/10W, 0603        | VISHAY, CRCW06030000Z0EA          |
| 11                                               | 1   | R8               | RES., CHIP., 60.4k, 1/10W, 1%, 0603          | VISHAY, CRCW060360K4FKE           |
| 12                                               | 2   | R9, R12          | RES., CHIP., 100k, 1/10W, 1%, 0603           | VISHAY, CRCW0603100KFKEA          |
| 13                                               | 1   | R10              | RES., CHIP., 1M, 1/10W, 1%, 0603             | VISHAY, CRCW06031M00FKEA          |
| 14                                               | 1   | R11              | RES., CHIP., 243k, 1/10W, 1%, 0603           | VISHAY, CRCW0603243KFKEA          |
| 15                                               | 1   | U1               | IC, REGULATOR, 28-QFN, UDE                   | LINEAR TECH., LT8613EUDE#PBF      |
| <b>Additional Demo Board Circuit Components</b>  |     |                  |                                              |                                   |
| 1                                                | 1   | C1               | CAP., ALUM 22 $\mu$ F 63V                    | SUNCON, 63CE22BS                  |
| 2                                                | 2   | C3, C10          | CAP., X5R, 10 $\mu$ F, 50V, 10% 1210         | MURATA, GRM32ER61H106KA12L        |
| 3                                                | 0   | C5 (OPT)         | CAP., 0603                                   |                                   |
| 4                                                | 1   | C15              | CAP., X5R, 0.1 $\mu$ F, 50V, 10% 0402        | TDK, C1005X5R1H104K               |
| 5                                                | 1   | FB1              | FERRITE BEAD 100 $\Omega$ 8A SMD 1812        | WÜRTH ELEKTRONIK, 74279226101     |
| 6                                                | 1   | L2               | IND., 6.8 $\mu$ H, IHLP3232DZ-01             | VISHAY, IHLP3232DZER6R8M01        |
| 7                                                | 0   | R2, R3, R4 (OPT) | RES., 0603                                   |                                   |
| 8                                                | 1   | R7               | RES., CHIP., 0 $\Omega$ , 1/10W, 1%, 0603    | VISHAY, CRCW06030000Z0EA          |
| <b>Hardware/Components (For Demo Board Only)</b> |     |                  |                                              |                                   |
| 1                                                | 12  | E1-E12           | TESTPOINT, TURRET, 0.094"                    | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 2                                                | 1   | JP1              | HEADER, 3-PIN 0.079" SINGLE ROW              | SULLINS, NRPN031PAEN-RC           |
| 3                                                | 1   | XJP1             | SHUNT, 0.079" CENTER                         | SAMTEC, 2SN-BK-G                  |
| 4                                                | 4   | MH1-MH4          | STAND-OFF, NYLON 0.50" TALL                  | KEYSTONE, 8833 (SNAP ON)          |



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