

## LTC3646/LTC3646-1

### High Efficiency Low Quiescent Current Step-Down Converter

## DESCRIPTION

Demonstration circuit 1731A-A/1731A-B is a step-down DC/DC converter using LTC3646/LTC3646-1 monolithic synchronous buck regulator. The input voltage range is from 4V to 40V. The output voltage range of LTC3646 is 2V to 30V, for LTC3646-1 is 0.6V to 15V. It can deliver up to 1A of output current. At light load conditions, DC1731A can operate in Burst Mode<sup>®</sup> operation to improve the efficiency. The user can choose to use internal or external compensation. The switching frequency of LTC3646/LTC3646-1 is programmable from 200kHz to 3MHz. It can

be synchronized to an external clock through the MODE/SYNC pin. The LTC3646/LTC3646-1 data sheet must be read in conjunction with this demo manual prior to working on or modifying demonstration circuit 1731A.

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

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## PERFORMANCE SUMMARY

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

| PARAMETER                         | CONDITIONS/NOTES                           | VALUE              |
|-----------------------------------|--|--------------------|
| Input Voltage Range               |  | 4V to 40V          |
| Output Voltage $V_{OUT}$          | Jumper Selectable                          | 3.3V, 5V           |
| Maximum Continuous Output Current |  | 1A                 |
| Default Operating Frequency       |  | 1.5MHz             |
| Efficiency                        | $V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 1A$ | 91.0% See Figure 3 |
| Load Transient                    | $V_{IN} = 12V, V_{OUT} = 5V$               | See Figure 4       |

# DEMO MANUAL

## DC1731A-A/DC1731A-B

### QUICK START PROCEDURE

Demonstration circuit 1731A is an easy way to evaluate the performance of the LTC3646/LTC3646-1. Please refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Place jumpers in the following positions for a typical application:

| MODE | EXTVCC | RUN | V <sub>OUT</sub> SELECT |
|------|--------|-----|-------------------------|
| FCC  | GND    | ON  | 3.3V                    |

2. With power off, connect the input power supply, load and meters as shown in Figure 1. Preset the load to 0A and V<sub>IN</sub> supply to be 0V.

- Turn on the power at the input. Increase V<sub>IN</sub> to 12V (**Do not hot-plug the input supply or apply more than the rated maximum voltage of 40V to the board or the part may be damaged**). The output voltage should be regulated and deliver the selected output voltage ±2%.
- Vary the input voltage from 4V to 40V and adjust the load current from 0A to 1A. Observe the output voltage regulation, ripple voltage, efficiency, and other parameters.
- To measure input or output ripple, please refer to Figure 2 for proper measurement setup.

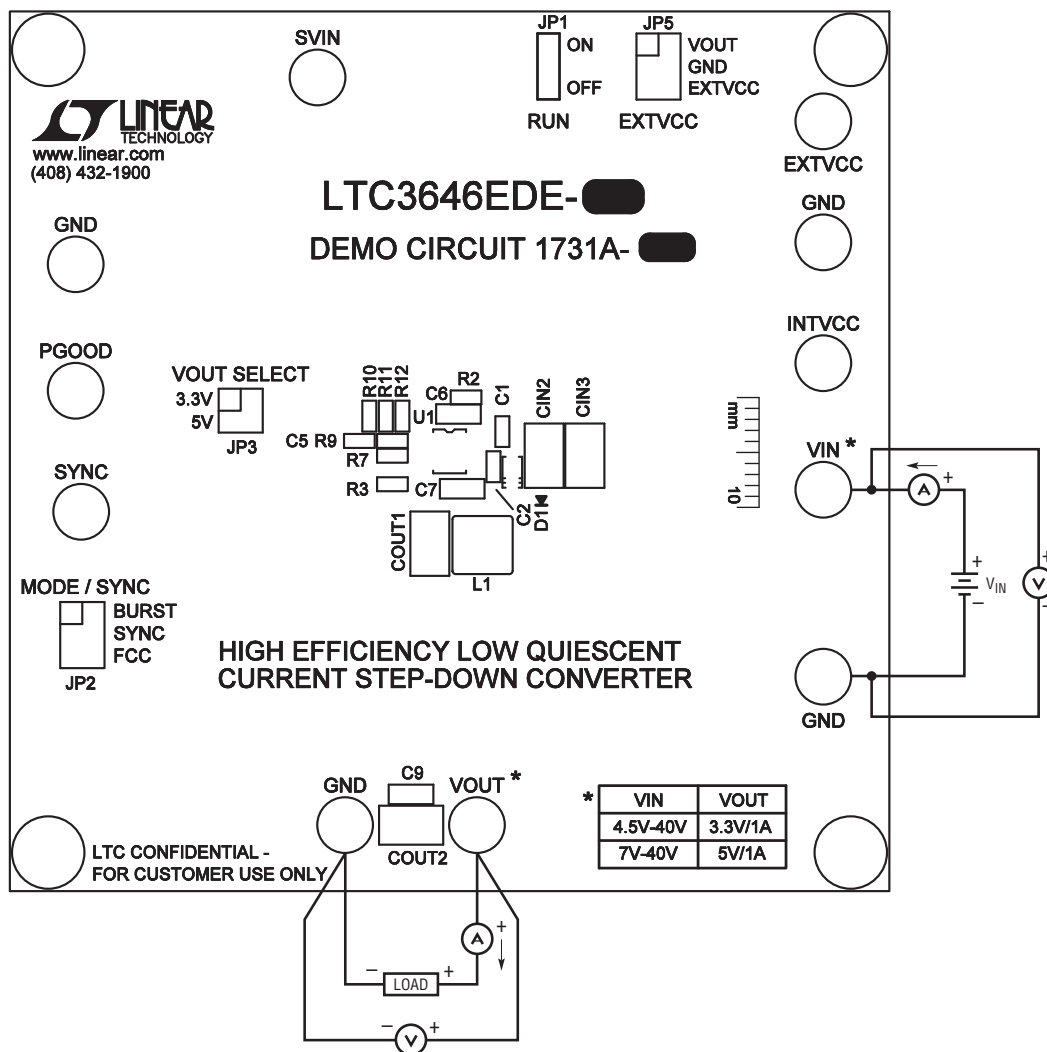


Figure 1. Proper Measurement Equipment Setup

## QUICK START PROCEDURE

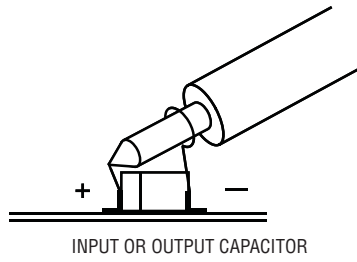
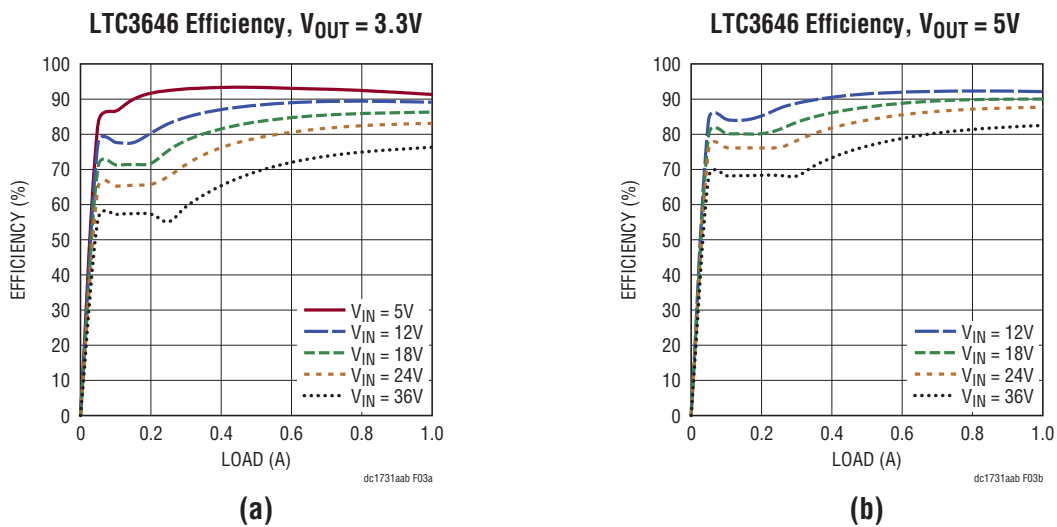


Figure 2. Measuring  $V_{IN}$  or  $V_{OUT}$  Ripple



Figures 3a and 3b. Measured DC1731A Efficiency at Different  $V_{IN}$  and  $V_{OUT}$  (Burst Mode Operation Enabled)

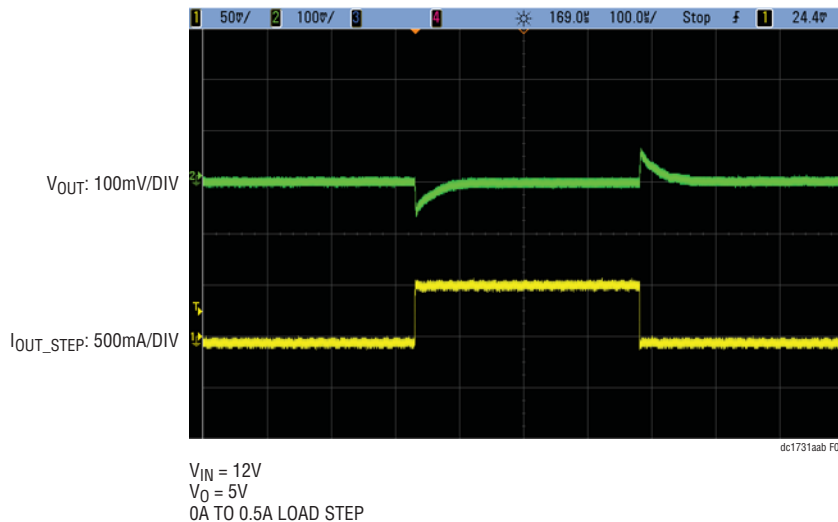


Figure 4. Measured Load Transient Responses

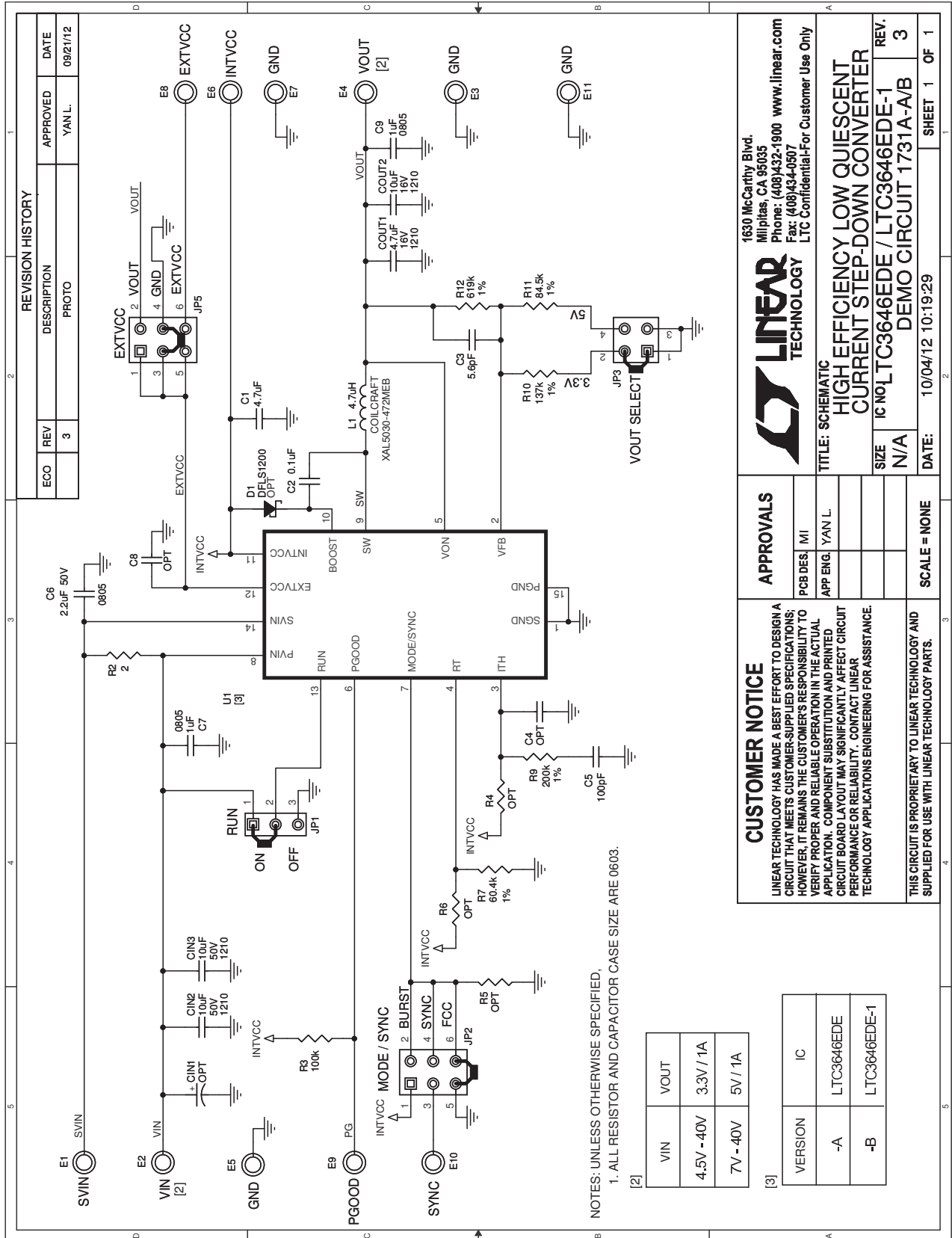
# DEMO MANUAL

## DC1731A-A/DC1731A-B

### PARTS LIST

| ITEM  | QTY | REFERENCE          | PART DESCRIPTION  | MANUFACTURER/PART NUMBER                            |
|---|-----|--------------------|---|---|
| <b>Required Circuit Components</b>              |     |                    |   |   |
| 1   | 1   | U1                 | IC, HIGH EFFICIENCY LOW QUIESCENT CURRENT STEP-DOWN CONVERTER | LTC3646EDE FOR DC1731A-A LTC3646EDE-1 FOR DC1731A-B |
| 2   | 2   | CIN2, CIN3         | CAP, 1210 10 $\mu$ F 20% 50V X5R                              | TAIYO YUDEN UMK325BJ106MM-T                         |
| 3   | 1   | COUT1              | CAP, 1210 4.7 $\mu$ F 20% 16V X7R                             | TAIYO YUDEN EMK325BJ475MN-T                         |
| 4   | 1   | COUT2              | CAP, 1210 10 $\mu$ F 20% 16V X5R                              | TDK C3225X7R1C106M                                  |
| 5   | 1   | C1                 | CAP, 0603 4.7 $\mu$ F 10% 10V X5R                             | TDK C1608X5R1A475K-T                                |
| 6   | 1   | C2                 | CAP, 0603 0.1 $\mu$ F 10% 50V X7R                             | AVX 06035C104KAT2A                                  |
| 7   | 1   | C3                 | CAP, 0603 5.6pF 0.25pF 50V NPO                                | AVX 06035A5R6CAT2A                                  |
| 8   | 1   | C5                 | CAP, 0603 100pF 10% 50V X7R                                   | AVX 06035C101KAT2A                                  |
| 9   | 1   | C6                 | CAP, 0805 2.2 $\mu$ F 20% 50V Y5V                             | TDK C2012Y5V1H225Z                                  |
| 10  | 2   | C7, C9             | CAP, 0805 1 $\mu$ F 10% 50V X7R                               | MURATA GRM21BR71H105KA12L                           |
| 11  | 1   | L1                 | IND, 4.7 $\mu$ H  | COILCRAFT XAL5030-472MEB                            |
| 12  | 1   | R2                 | RES, 0603 2 $\Omega$ 5% 1/10W                                 | VISHAY CRCW06032R00FNEA                             |
| 13  | 1   | R3                 | RES, 0603 100k $\Omega$ 5% 1/10W                              | VISHAY CRCW0603100KJNEA                             |
| 14  | 1   | R7                 | RES, 0603 60.4k $\Omega$ 1% 1/10W                             | VISHAY CRCW060360K4FKED                             |
| 15  | 1   | R9                 | RES, 0603 200k $\Omega$ 1% 1/10W                              | VISHAY CRCW0603200KFKEA                             |
| 16  | 1   | R10                | RES, 0603 137k $\Omega$ 1% 1/10W                              | YAGEO RC0603FR-07137KL                              |
| 17  | 1   | R11                | RES, 0603 84.5k $\Omega$ 1% 1/10W                             | VISHAY CRCW060384K5FKEA                             |
| 18  | 1   | R12                | RES, 0603 619k $\Omega$ 1% 1/10W                              | VISHAY CRCW0603619KFKEA                             |
| <b>Additional Demo Board Circuit Components</b> |     |                    |   |   |
| 1   | 0   | CIN1               | CAP, 56 $\mu$ F 20% 50V ALUM. ELEC. OPTION                    | SUN ELEC 50HVH56M OPTION                            |
| 2   | 0   | C4, C8             | CAP, 0603 OPTION  | OPTION  |
| 3   | 0   | D1                 | DIODE, OPTION   | OPTION  |
| 4   | 0   | R4, R5, R6         | RES, 0603 OPTION  | OPTION  |
| <b>Hardware: For Demo Board Only</b>            |     |                    |   |   |
| 1   | 11  | E1-E11             | TURRET  | MILL-MAX 2501-2-00-80-00-00-07-0                    |
| 2   | 1   | JP1                | HEADER, 2mm, 3PIN   | SAMTEC TMM-103-02-L-S                               |
| 3   | 2   | JP2, JP5           | HEADER, 3PIN, DBL ROW 2mm                                     | SAMTEC TMM 103-02-L-D                               |
| 4   | 1   | JP3                | HEADER, 2mm DBL ROW (2X2) 4PIN                                | SAMTEC TMM-102-02-L-D                               |
| 5   | 4   | MH1, MH2, MH3, MH4 | STANDOFF, SNAP ON   | KEYSTONE_8831                                       |
| 6   | 4   | JP1, JP2, JP3, JP5 | SHUNT, 2mm  | SAMTEC 2SN-BK-G                                     |

### SCHEMATIC DIAGRAM



| REVISION HISTORY |     |             |          |
|------------------|-----|-------------|----------|
| ECO              | REV | DESCRIPTION | DATE     |
|                  | 3   | PROTO       | 09/21/12 |
|                  |     | YAN L.      |          |

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**TITLE: SCHEMATIC**  
**HIGH EFFICIENCY LOW QUIESCENT**  
**CURRENT STEP-DOWN CONVERTER**

|      |                        |      |   |
|------|------------------------|------|---|
| SIZE | IC NO. LTC3646EDE-1    | REV. | 3 |
| N/A  | DEMO CIRCUIT 1731A-A/B |      |   |

DATE: 10/04/12 10:19:29      SHEET 1 OF 1

| APPROVALS    |                 |
|--------------|-----------------|
| PCB DES. MI  | APP ENG. YAN L. |
| SCALE = NONE |                 |

**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.

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|         |              |
|---------|--------------|
| VERSION | IC           |
| -A      | LTC3646EDE   |
| -B      | LTC3646EDE-1 |

|            |           |
|------------|-----------|
| VIN        | VOUT      |
| 4.5V - 40V | 3.3V / 1A |
| 7V - 40V   | 5V / 1A   |

# DEMO MANUAL

## DC1731A-A/DC1731A-B

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### DEMONSTRATION BOARD IMPORTANT NOTICE

Linear Technology Corporation (LTC) provides the enclosed product(s) under the following **AS IS** conditions:

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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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