

LT8310/LT8311  
 48V<sub>IN</sub> to 12V/12A  
 Forward Converter with  
 Synchronous Rectification

## DESCRIPTION

Demonstration circuit 2015A is a resonant reset forward converter with synchronous rectification featuring the [LT<sup>®</sup>8310/LT8311](#) chipset.

This circuit was designed to demonstrate the high levels of performance, efficiency, and small solution size attainable using these parts. It operates at 240kHz and produces a regulated 12V, 12A output from an input voltage range of 36V to 72V: suitable for telecom, industrial, and other applications. It has an eighth-brick footprint area. Synchronous rectification helps to attain efficiency exceeding 94%.

The DC2015A circuit features soft-start which prevents output voltage overshoot on startup or when recovering from overload condition.

The DC2015A takes advantage of the LT8310's input undervoltage and overvoltage protection to shutdown the system when the input voltage is outside of the set limits. The DC2015A also has precise overcurrent protection that allows for continuous operation under short-circuit conditions. The low power dissipation under a short-circuit condition insures high reliability even during a prolonged output voltage short-circuit.

The LT8310/LT8311 data sheets give a complete description of the parts, operation and application information. The data sheets must be read in conjunction with this quick start guide for demo circuit 2015A.

**Design files for this circuit board are available at <http://www.linear.com/demo/DC2015A>**

LT, LT, LTC, LTM, Linear Technology and the Linear logo are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

## PERFORMANCE SUMMARY Specifications are at T<sub>A</sub> = 25°C

| SYMBOL                            | PARAMETER                          | CONDITIONS  | MIN  | TYP  | MAX  | UNITS             |
|-----------------------------------|------------------------------------|---|------|------|------|-------------------|
| V <sub>IN</sub>                   | Input Supply Range                 |   | 36   |      | 72   | V                 |
| V <sub>OUT</sub>                  | Output Voltage                     |   | 11.7 | 12.0 | 12.3 | V                 |
| I <sub>OUT</sub>                  | Maximum Output Current, Continuous | 200LFM Airflow  | 12   |      |      | A                 |
| f <sub>SW</sub>                   | Switching (Clock) Frequency        |   |      | 240  |      | kHz               |
| V <sub>OUT(P-P)</sub>             | Output Ripple                      | V <sub>IN</sub> = 48V, I <sub>OUT</sub> = 12A (20MHz BW)  |      | 80   |      | mV <sub>P-P</sub> |
| I <sub>REG</sub>                  | Output Regulation                  | Line and Load (36V <sub>IN</sub> to 72V <sub>IN</sub> , 0A <sub>OUT</sub> to 12A <sub>OUT</sub> ) |      | ±0.1 |      | %                 |
| P <sub>OUT</sub> /P <sub>IN</sub> | Efficiency (See Figure 3)          | V <sub>IN</sub> = 48V, I <sub>OUT</sub> = 12A   |      | 94   |      | %                 |
|                                   | Isolation                          | Basic   |      | 1500 |      | VDC               |

## QUICK START PROCEDURE

Demonstration circuit 2015A is easy to set up to evaluate the performance of the LT8310/LT8311. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

NOTE. When measuring the output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip and ground ring directly across the last output capacitor as shown in Figure 2.

1. Set an input power supply that is capable of 36V to 72V. Then turn off the supply.
2. Direct an airflow of 200LFM across the unit for sustained operation at full load.
3. With power off, connect the supply to the input terminals  $+V_{IN}$  and  $-V_{IN}$ .
  - a. Input voltages lower than 36V can keep the converter from turning on due to the undervoltage lockout feature of the LT8310/LT8311.
  - b. If efficiency measurements are desired, an ammeter capable of measuring 10ADC can be put in series with the input supply in order to measure the DC2015A's input current.
  - c. A voltmeter with a capability of measuring at least 72V can be placed across the input terminals in order to get an accurate input voltage measurement.
4. Turn on the power at the input.

Note. Make sure that the input voltage does not exceed 100V.
5. Check for the proper output voltage of 12V. Turn off the power at the input.
6. Once the proper output voltages are established, connect a variable load capable of sinking 12A at 12V to the output terminals  $+V_{OUT}$  and  $-V_{OUT}$ . Set the current for 0A.
  - a. If efficiency measurements are desired, an ammeter or a resistor shunt that is capable of handling 12ADC can be put in series with the output load in order to measure the DC2015A's output current.
  - b. A voltmeter with a capability of measuring at least 12V can be placed across the output terminals in order to get an accurate output voltage measurement.
7. Turn on the power at the input.

Note. If there is no output, temporarily disconnect the load to make sure that the load is not set too high.
8. Once the proper output voltage is again established, adjust the load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other desired parameters.

## QUICK START PROCEDURE

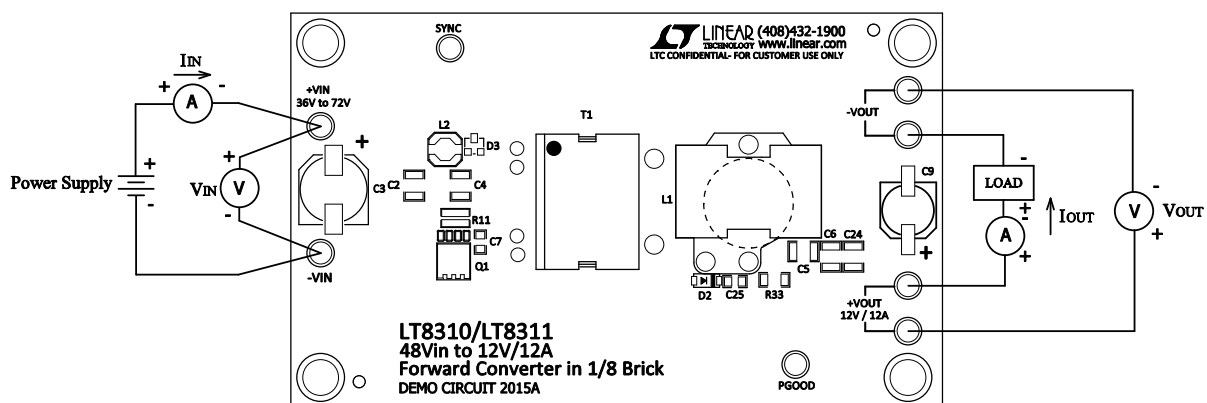


Figure 1. Proper Measurement Equipment Setup

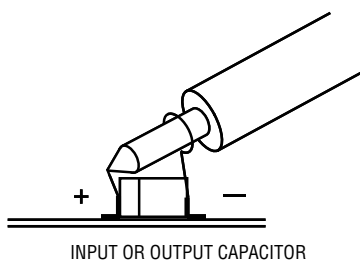


Figure 2. Proper Scope Probe Placement for Measuring Input/Output Ripple

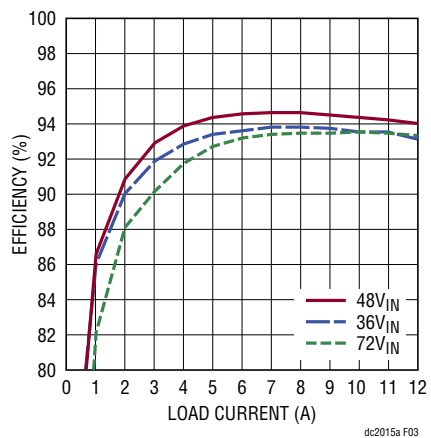


Figure 3. Typical Efficiency Curve

## QUICK START PROCEDURE

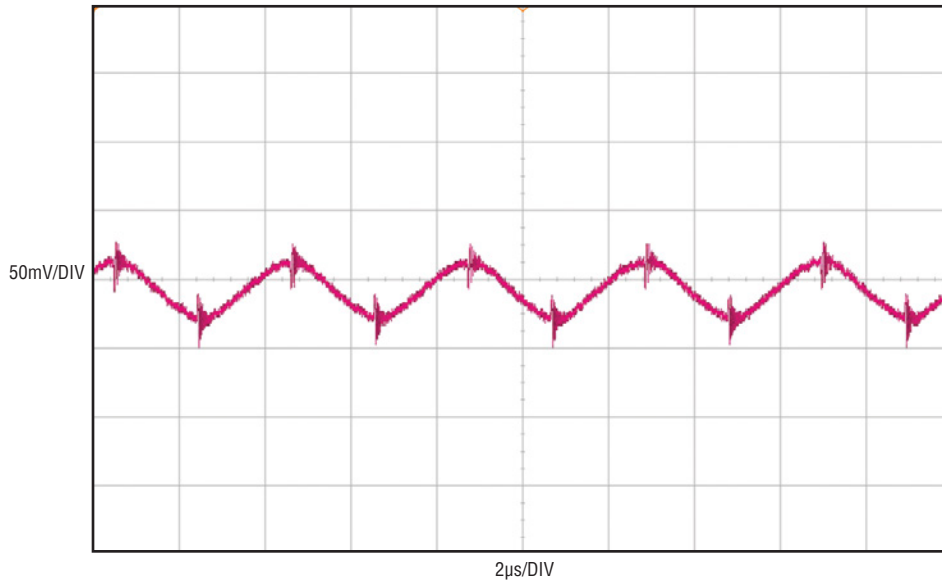


Figure 4. Output Ripple at 48V<sub>IN</sub> and 12A<sub>OUT</sub> (20MHz BW)

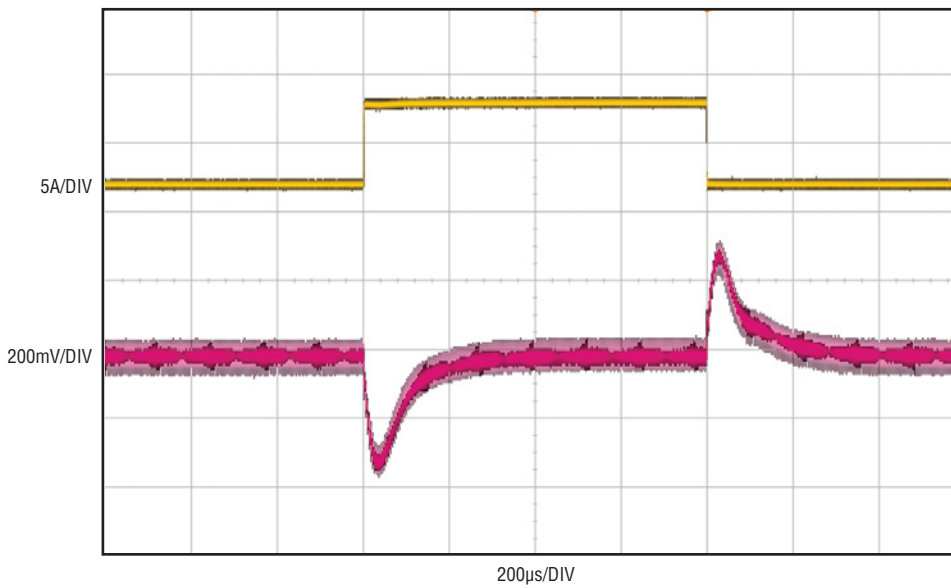


Figure 5. Load Transient Response Waveform at 48V<sub>IN</sub> and 6A<sub>OUT</sub> to 12A<sub>OUT</sub>

**QUICK START PROCEDURE**

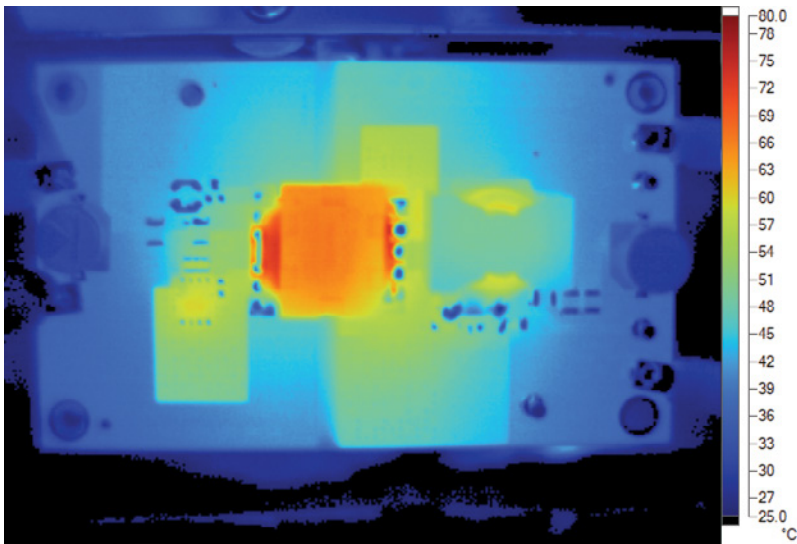


Figure 6. Thermal Map, Frontside at 48V<sub>IN</sub> and 12A<sub>OUT</sub> (T<sub>A</sub> = 25°C, 200LFM)

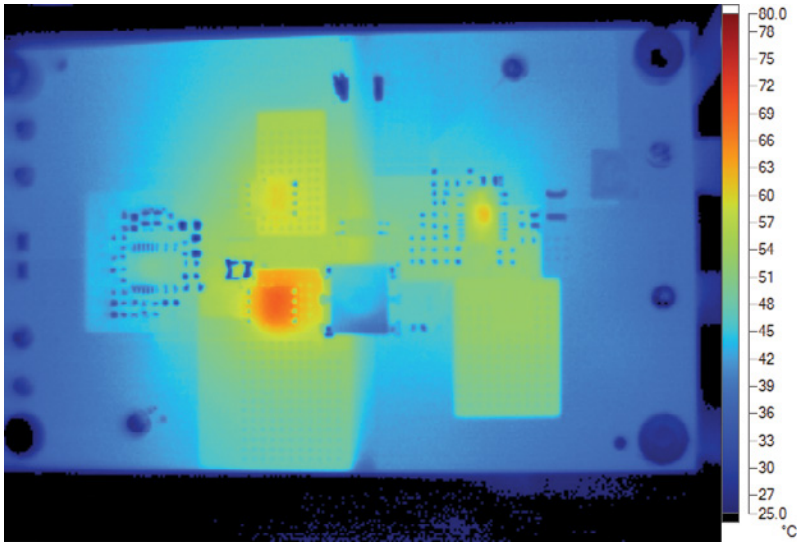


Figure 7. Thermal Map, Backside at 48V<sub>IN</sub> and 12A<sub>OUT</sub> (T<sub>A</sub> = 25°C, 200LFM)

# DEMO MANUAL DC2015A

## PARTS LIST

| ITEM                               | QUANTITY | REFERENCE         | PART DESCRIPTION                         | MANUFACTURER/PART #                 |
|------------------------------------|----------|-------------------|--|-------------------------------------|
| <b>REQUIRED CIRCUIT COMPONENTS</b> |          |                   |  |                                     |
| 1                                  | 1        | C1                | Cap., X7R 4700pF 250V 20% 1812           | Murata GA343DR7GD472KW01L           |
| 2                                  | 3        | C2, C4, C23       | Cap., X7S 4.7µF 100V 10% 1210            | TDK C3225X7S2A475K                  |
| 3                                  | 1        | C3                | Cap., Alum 10µF 100V 20%                 | Sun Elect. Ind. Corp. 100HVH10M     |
| 4                                  | 3        | C5, C6, C24       | Cap., X5R 47µF 16V 20% 1210              | Taiyo Yuden EMK325BJ476MM           |
| 5                                  | 1        | C7                | Cap., U2J 390pF 250V 5% 0805             | Murata GRM21A7U2E391JW31D           |
| 6                                  | 1        | C9                | Cap., Alum 470µF 16V 20%                 | Sun Elect. Ind. Corp. 16SVPE470M    |
| 7                                  | 2        | C10, C14          | Cap., X7R 22nF 25V 10% 0603              | AVX 06033C223KAT1A                  |
| 8                                  | 1        | C11               | Cap., X7S 1µF 100V 10% 0805              | TDK C2012X7S2A105K                  |
| 9                                  | 1        | C12               | Cap., X7R 0.01µF 25V 10% 0603            | AVX 06033C103KAT2A                  |
| 10                                 | 3        | C13, C17, C19     | Cap., X5R 4.7µF 16V 20% 0805             | TDK C2012X5R1C475M                  |
| 11                                 | 1        | C15               | Cap., NPO 100pF 25V 5% 0603              | AVX 06033A101JAT2A                  |
| 12                                 | 1        | C16               | Cap., X7R 0.1µF 25V 10% 0603             | AVX 06033C104KAT2A                  |
| 13                                 | 1        | C18               | Cap., X7R 3.9nF 25V 20% 0603             | AVX 06033C392MAT2A                  |
| 14                                 | 1        | C20               | Cap., NPO 220pF 25V 5% 0603              | AVX 06033A221JAT1A                  |
| 15                                 | 1        | C25               | Cap., U2J 3.9nF 250V 5% 0805             | Murata GRM21B7U2E392JW32L           |
| 16                                 | 1        | C26               | Cap., X5R 1µF 25V 20% 0603               | AVX 06033D105MAT2A                  |
| 17                                 | 1        | D2                | Diode, 1A/200V SOD-123                   | Central Semi. CMMR1U-02             |
| 18                                 | 1        | ISO1              | Opto Iso., 2.5kV TRANS 4SOIC PbF         | NEC PS2801C-1-P-A                   |
| 19                                 | 1        | L1                | Inductor, 8µH                            | Champs Tech. PQA2050-08-LTC         |
| 20                                 | 1        | L3                | Inductor, 1µH                            | Coilcraft XAL6030-102MEC            |
| 21                                 | 1        | Q1                | MOSFET N-Channel, 200V/36A SuperSO8      | Infineon BSC320N20NS3G              |
| 22                                 | 1        | Q2                | MOSFET, Single N-Chan. 100V/60A POWER-56 | Fairchild Semi. FDMS86101           |
| 23                                 | 1        | Q3                | MOSFET N-Channel, 75V/100A SuperSO8      | Infineon BSC042NE7NS3G              |
| 24                                 | 1        | R1                | Res., Chip 86.6k 0.10W 1% 0603           | Vishay CRCW060386K6FKEA             |
| 25                                 | 1        | R3                | Res., Chip 100k 0.10W 1% 0603            | Vishay CRCW0603100KFKEA             |
| 26                                 | 3        | R4, R14, R36      | Res., Chip 10k 0.10W 5% 0603             | Vishay CRCW060310K0JNEA             |
| 27                                 | 1        | R5                | Res., Chip 11.3k 0.10W 1% 0603           | Vishay CRCW060311K3FKEA             |
| 28                                 | 1        | R6                | Res., Chip 1.74k 0.10W 1% 0603           | Vishay CRCW06031K74FKEA             |
| 29                                 | 4        | R7, R17, R34, R35 | Res/Jumper, Chip 0Ω 0.25W 5A 0603        | Vishay CRCW06030000Z0EA             |
| 30                                 | 1        | R8                | Res., Chip 1.43k 0.10W 1% 0603           | Vishay CRCW06031K43FKEA             |
| 31                                 | 1        | R10               | Res., Chip 10.0Ω 0.10W 1% 0603           | Vishay CRCW060310R0FKEA             |
| 32                                 | 1        | R11               | Res., RL Vert. 0.010Ω 1W 1% 0815         | SSM Thin Film Tech. RL3720WT-R010-F |
| 33                                 | 2        | R13, R38          | Res., Chip 4.02k 0.10W 1% 0603           | Vishay CRCW06034K02FKEA             |
| 34                                 | 1        | R16               | Res., Chip 3.32k 0.10W 1% 0603           | Vishay CRCW06033K32FKEA             |
| 35                                 | 1        | R18               | Res., Chip 113k 0.10W 1% 0603            | Vishay CRCW0603113KFKEA             |
| 36                                 | 1        | R19               | Res., Chip 20.0k 0.10W 1% 0603           | Vishay CRCW060320K0FKEA             |
| 37                                 | 1        | R23               | Res/Jumper, Chip 0Ω 0.33W 6A             | Vishay CRCW08050000Z0EA             |
| 38                                 | 1        | R26               | Res., Chip 41.2k 0.10W 1% 0603           | Vishay CRCW060341K2FKEA             |
| 39                                 | 1        | R27               | Res., Chip 100k 0.10W 5% 0603            | Vishay CRCW0603100KJNEA             |
| 40                                 | 1        | R28               | Res., Chip 178Ω 0.10W 1% 0603            | Vishay CRCW0603178RFKEA             |
| 41                                 | 1        | R29               | Res., Chip 499k 0.10W 1% 0603            | Vishay CRCW0603499KFKEA             |

dc2015af

## PARTS LIST

| ITEM | QUANTITY | REFERENCE | PART DESCRIPTION                               | MANUFACTURER/PART #              |
|------|----------|-----------|--|----------------------------------|
| 42   | 1        | R30       | Res., Chip 560Ω 0.10W 5% 0603                  | Vishay CRCW0603560RJNEA          |
| 43   | 1        | R32       | Res., Chip 178Ω 0.125W 1% 0805                 | Vishay CRCW0805178RFKTA          |
| 44   | 1        | R33       | Res., Chip 20k 0.25W 5% 1206                   | Vishay CRCW120620K0JNED          |
| 45   | 1        | R37       | Res., Chip 499Ω 0.10W 1% 0603                  | Vishay CRCW0603499RFKEA          |
| 46   | 1        | R39       | Res., Chip 61.9k 0.10W 1% 0603                 | Vishay CRCW060361K9FKEA          |
| 47   | 1        | T1        | Transformer, 8:4 / (w/4T Pri. Aux)             | Pulse PA0423                     |
| 48   | 1        | T2        | Transformer, 1.25:1                            | Pulse PA3493NL                   |
| 49   | 1        | U1        | I.C., Converter Controller TSSOP20-FE20(16)/CB | Linear Tech. Corp. LT8310EFE#PBF |
| 50   | 1        | U2        | I.C., Converter Controller TSSOP20-FE20(16)/CB | Linear Tech. Corp. LT8311EFE#PBF |
| 51   | 1        |           | FAB, 2015A_Rev3.pcb                            | Demo Circuit 2015A               |

### ADDITIONAL DEMO BOARD CIRCUIT COMPONENTS

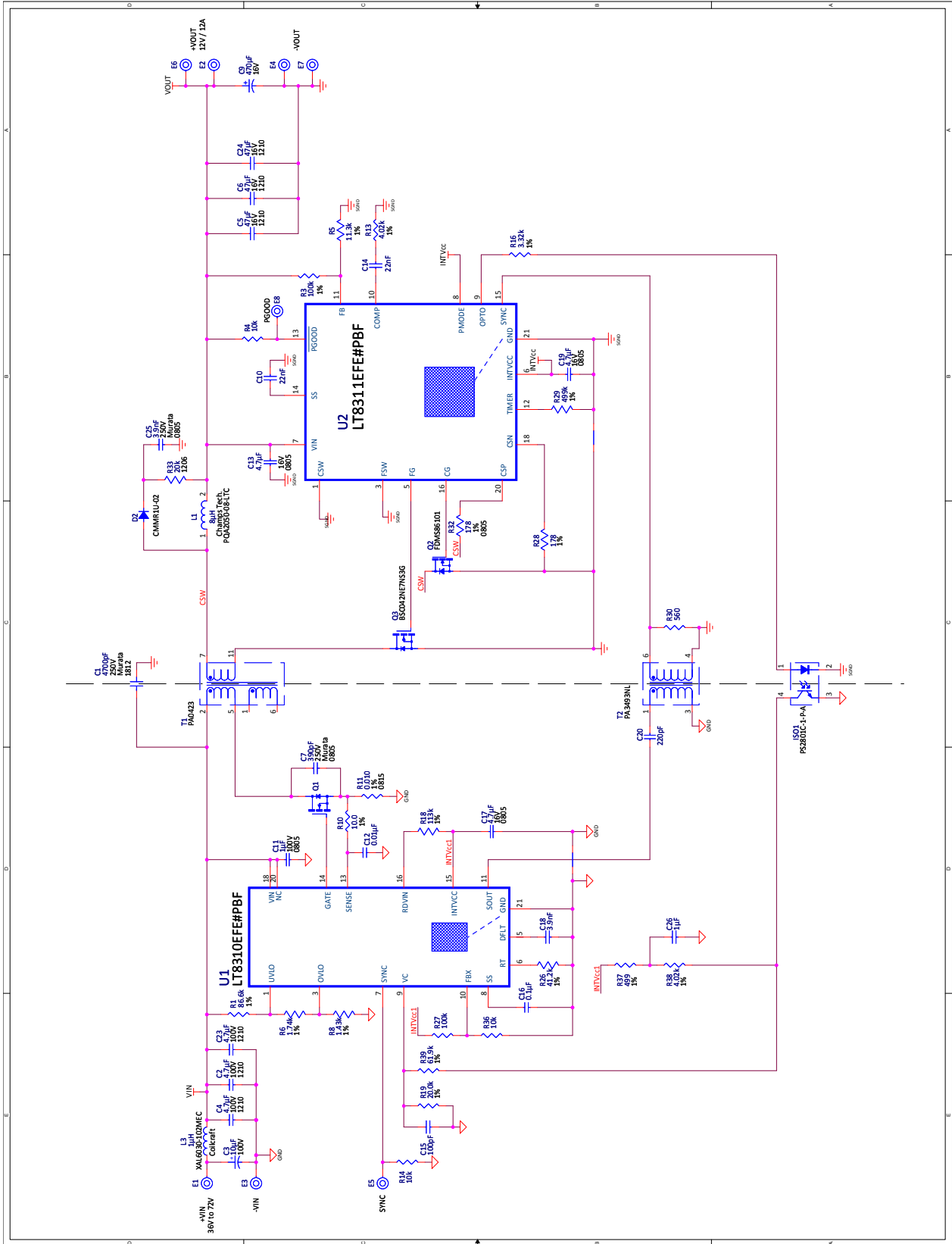
|   |   |          |                              |                              |
|---|---|----------|------------------------------|------------------------------|
| 1 | 0 | C27,C28  | Cap., 0603                   |                              |
| 2 | 0 | D1       | Schottky Diode SMA           |                              |
| 3 | 0 | D3       | Diode, Common Cathode SOT-23 | Central Semi. Corp. CMSD2838 |
| 4 | 0 | L2       | Inductor                     | Coilcraft LPS4414 series     |
| 5 | 0 | R9, R12  | Res., 0805                   |                              |
| 6 | 0 | R21, R22 | Res., 0603                   |                              |

### HARDWARE-FOR DEMO BOARD ONLY

|   |   |                                   |                        |                                  |
|---|---|-----------------------------------|------------------------|----------------------------------|
| 1 | 8 | E1, E2, E3, E4,<br>E5, E6, E7, E8 | Turret, Testpoint      | Mill Max 2501-2-00-80-00-00-07-0 |
| 2 | 4 | MH1-MH4                           | Standoff, Nylon 0.25"  | Keystone, 8831 (Snap-On)         |
| 3 | 2 |                                   | Stencil (Top & Bottom) | Stencil DC2015A                  |

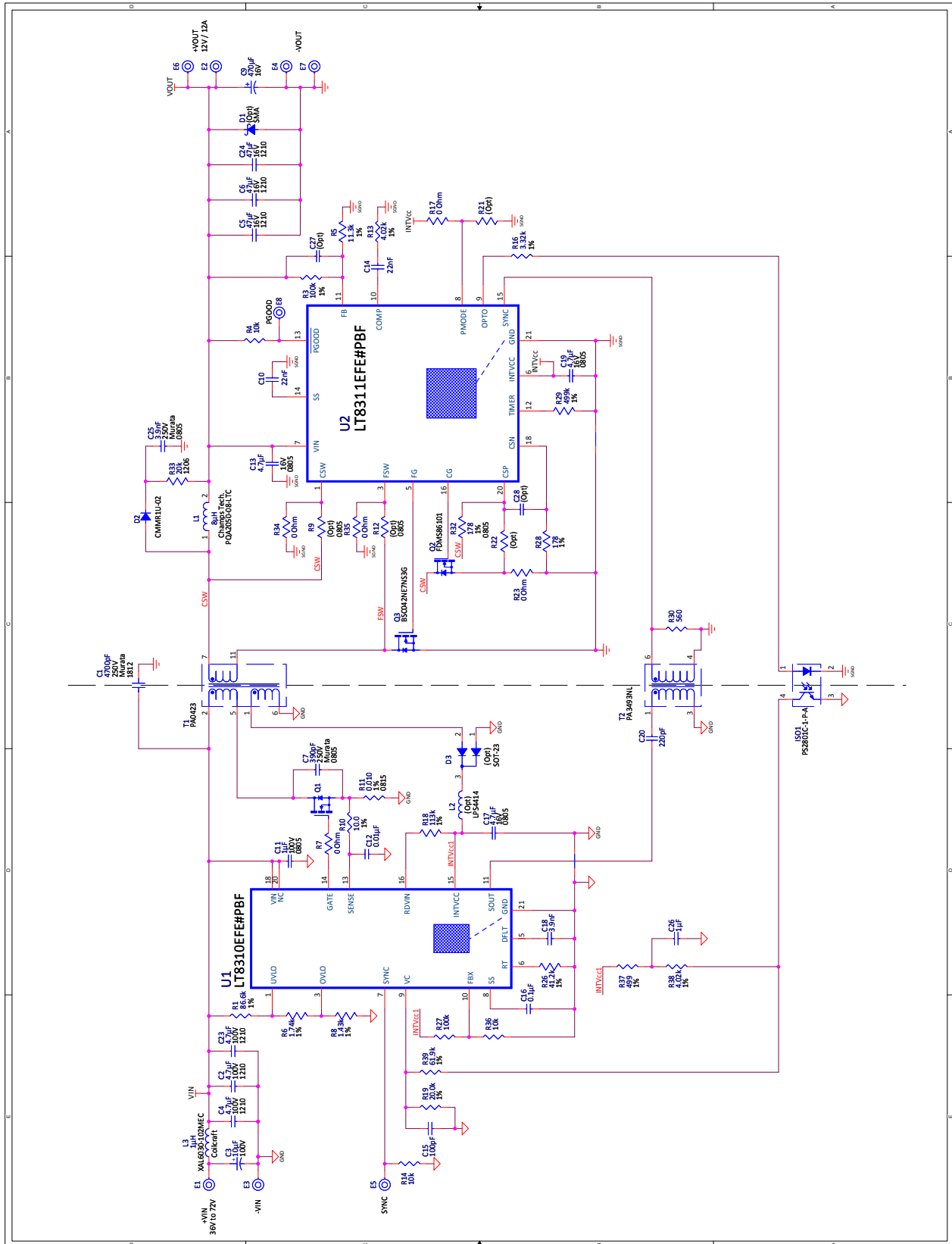
# DEMO MANUAL DC2015A

## SIMPLE SCHEMATIC DIAGRAM





FULL SCHEMATIC DIAGRAM



# DEMO MANUAL DC2015A

---

## DEMONSTRATION BOARD IMPORTANT NOTICE

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

This demonstration board (DEMO BOARD) kit being sold or provided by Linear Technology is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not provided by LTC for commercial use. As such, the DEMO BOARD herein may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including but not limited to product safety measures typically found in finished commercial goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may or may not meet the technical requirements of the directive, or other regulations.

If this evaluation kit does not meet the specifications recited in the DEMO BOARD manual the kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY THE SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THIS INDEMNITY, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user releases LTC from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. Also be aware that the products herein may not be regulatory compliant or agency certified (FCC, UL, CE, etc.).

No License is granted under any patent right or other intellectual property whatsoever. **LTC assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind.**

LTC currently services a variety of customers for products around the world, and therefore this transaction **is not exclusive**.

**Please read the DEMO BOARD manual prior to handling the product.** Persons handling this product must have electronics training and observe good laboratory practice standards. **Common sense is encouraged.**

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

Mailing Address:

Linear Technology  
1630 McCarthy Blvd.  
Milpitas, CA 95035

Copyright © 2004, Linear Technology Corporation