

# LT3045EDD

## 20V, 500mA, Ultralow Noise Ultrahigh PSRR RF LDO Regulator

### DESCRIPTION

Demo circuit DC2491A features the [LT<sup>®</sup>3045EDD](#), a 500mA, ultralow noise and ultrahigh power supply rejection ratio (PSRR) low dropout (LDO) regulator with programmable current limit.

DC2491A operates over an input voltage range of 3.8V to 20V. The LT3045 delivers a maximum output current of 500mA. In addition to featuring ultralow noise and ultrahigh PSRR, the regulator offers programmable power good functionality as well as programmable current limit. Current monitoring is also achieved by sensing the ILIM pin voltage.

Built-in protection includes reverse battery protection, reverse current protection, internal current limit with foldback, and thermal limit with hysteresis.

The LT3045 data sheet gives a complete description of the device, operation and applications information. The data sheet must be read in conjunction with this demo manual for DC2491A. The LT3045EDD is assembled in a 10-lead (3mm × 3mm) plastic DFN package with an exposed pad on the bottom-side of the IC. Proper board layout is essential for maximum thermal performance.

**Design files for this circuit board are available at <http://www.linear.com/demo/DC2491A>**

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  $T_A = 25^{\circ}\text{C}$

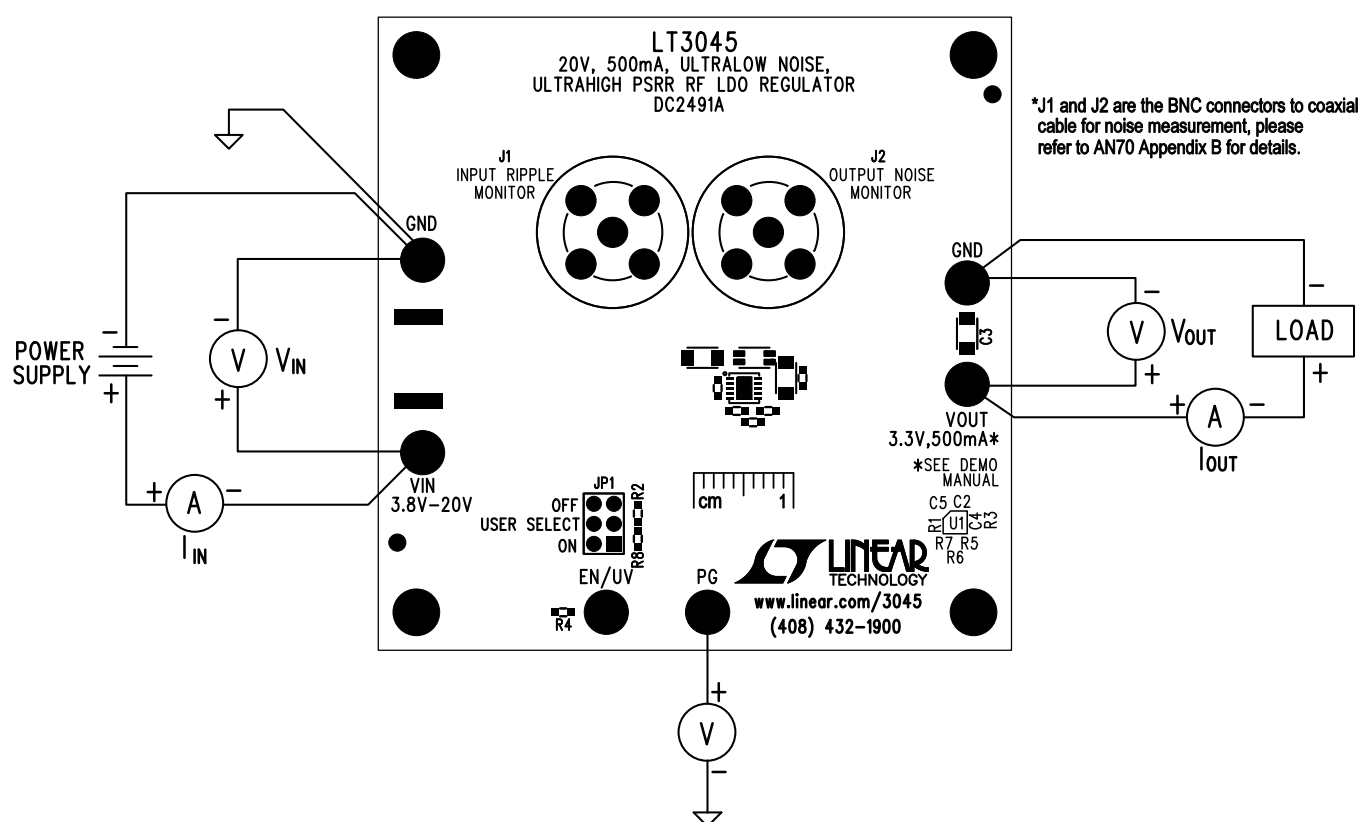
| PARAMETER                           | CONDITIONS                                         | MIN  | TYP               | MAX   |
|-------------------------------------|----------------------------------------------------|------|-------------------|-------|
| Input Voltage Range ( $V_{IN}$ )    | $I_{OUT} = 150\text{mA}$ , $V_{OUT} = 3.3\text{V}$ | 3.8V |                   | 20V   |
| Input Voltage Range ( $V_{IN}$ )    | $I_{OUT} = 500\text{mA}$ , $V_{OUT} = 3.3\text{V}$ | 3.8V |                   | 8.3V* |
| Output Voltage ( $V_{OUT}$ )        | $V_{IN} = 5\text{V}$ , $I_{OUT} = 500\text{mA}$    | 3.2V | 3.3V              | 3.4V  |
| Shutdown Input Current ( $I_{IN}$ ) | JP1 = OFF, $V_{IN} = 5\text{V}$                    |      | 0.1 $\mu\text{A}$ |       |

\*The maximum input voltage for 500mA load current is set by the 60°C temperature rise of LT3045 on the demo circuit. Higher input voltage can be reached if larger copper area or force-air cooling is applied. The output current is also limited by the differential of input and output voltage, please refer the data sheet for details.

## QUICK START PROCEDURE

DC2491A is easy to set up to evaluate the performance of the LT3045EDD. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below.

1. Connect load between  $V_{OUT}$  and GND terminals.
2. With power off, connect the input power supply to the  $V_{IN}$  and GND terminals.
3. Make sure the shunt of JP1 is at ON option.
4. Turn the input power supply on and make sure the voltage is between 3.8V and 20V.
5. Refer to Application Notes AN70 and AN159 for measuring output noise and PSRR.
6. With JP1 at USER SELECT option, R6 and R7 can be used to set an accurate undervoltage lockout (UVLO) threshold.



\*The maximum output current will be limited by internal current limit based on differential voltage of input and output voltage, please refer to the data sheet.

Figure 1. Test Procedure Setup Drawing for DC2491A

## PCB LAYOUT

### Best PSRR Performance: PCB Layout for Input Trace

For applications utilizing the LT3045 for post-regulating switching converters, placing a capacitor directly at the LT3045 input results in AC current (at the switching frequency) to flow near the LT3045. Without careful attention to PCB layout, this relatively high frequency switching current generates an electromagnetic field (EMF) that couples to the LT3045 output, thereby degrading its effective PSRR. While highly dependent on the PCB, the switching pre-regulator, and the input capacitor size, among other factors, the PSRR degradation can easily be 30dB at 1MHz. This degradation is present even if the LT3045 is de-soldered from the board, because it effectively degrades the PSRR of the PCB board itself. While negligible for conventional low PSRR LDOs, LT3045's ultrahigh PSRR requires careful attention to higher order parasitics in order to realize the full performance offered by the regulator.

The LT3045 demo board alleviates this degradation in PSRR by using a specialized layout technique. On layer 3, the input trace ( $V_{IN}$ ) is highlighted in red, with the return path (GND) highlighted on the bottom layer together with input capacitor C1. When an AC voltage is applied to the input of the board, AC current flows on this path, thus generating EMF. This EMF couples to output capacitor C2 and related traces, making the PSRR appear worse than it actually is. **With the input trace directly above the return path, the EMFs are in opposite directions, and consequently cancel each other out. Making sure these traces exactly overlap each other maximizes the cancellation effect and thus provides the maximum PSRR offered by the regulator.**

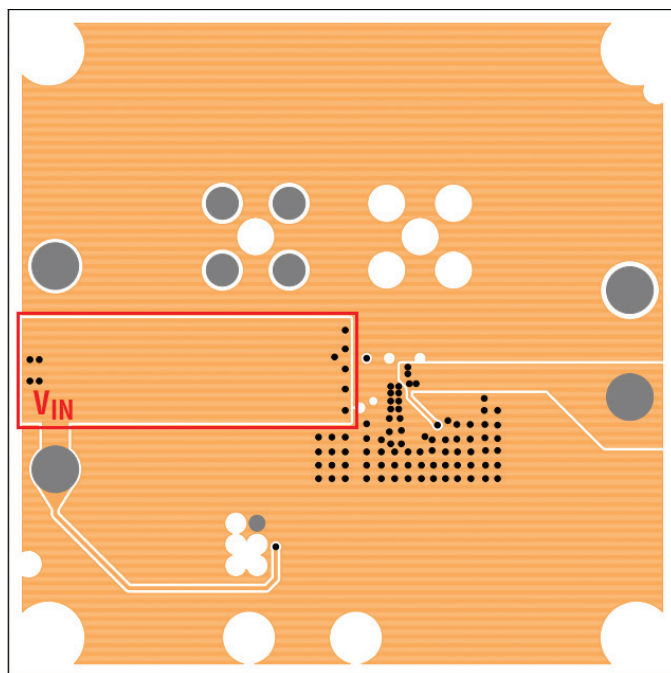


Figure 2. Layer 3 of DC2491A

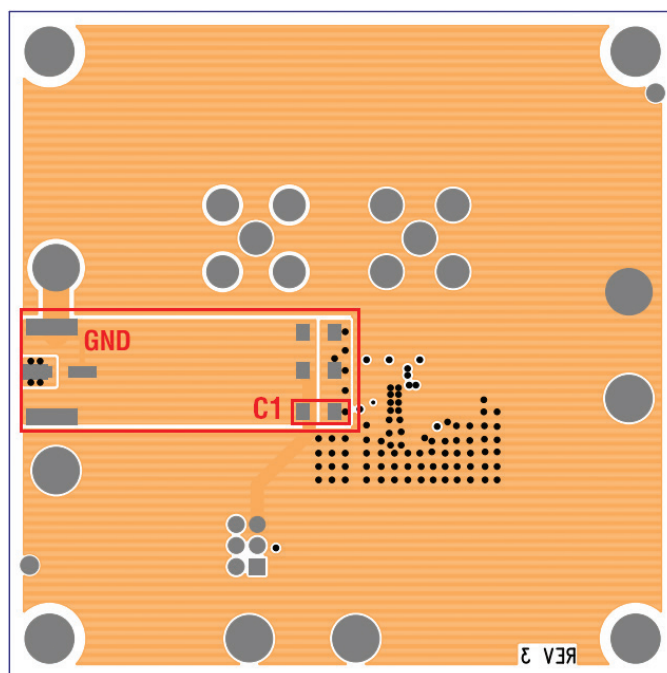


Figure 3. Bottom Layer of DC2491A

## PCB LAYOUT

### Best AC Performance: PCB Layout for Output Capacitor C2

For ultrahigh PSRR performance, the LT3045 bandwidth is made quite high (~1MHz), making it very close to the output capacitor's self-resonance frequency (~1.6MHz). Therefore, it is very important to avoid adding extra impedance (ESL and ESR) outside the feedback loop. To that end, minimize the effects of PCB trace and solder inductance by Kelvin connecting OUTS and SET pin capacitor ( $C_{SET}$ ) GND directly to output capacitor ( $C_2$ ) terminals using split capacitor techniques. Pad 4 connects to the OUTS pin and Pad 1 connects to the GND side of the SET pin capacitor. With only small AC current flowing through these connections, the impact of solder joint/PCB trace inductance on stability is eliminated. While the LT3045 is robust enough not to oscillate if the recommended layout is not followed, phase/gain margin and PSRR will degrade.

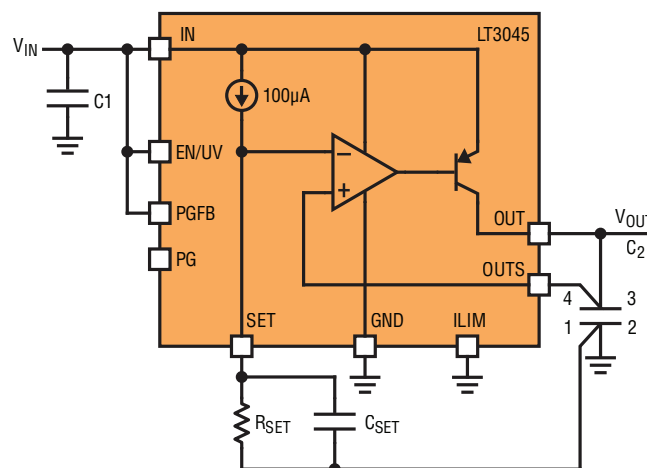


Figure 4.  $C_2$  and  $C_{SET}$  Connections for Best Performance

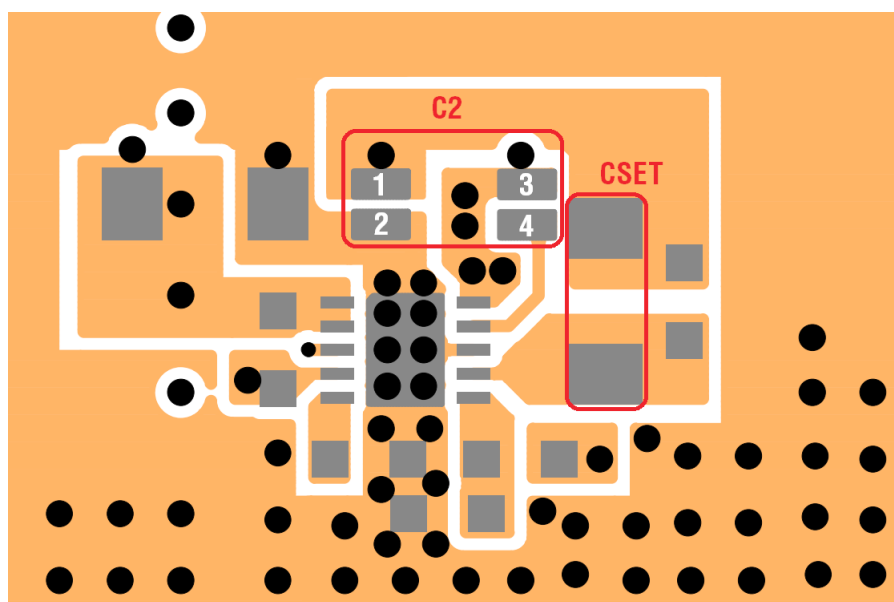
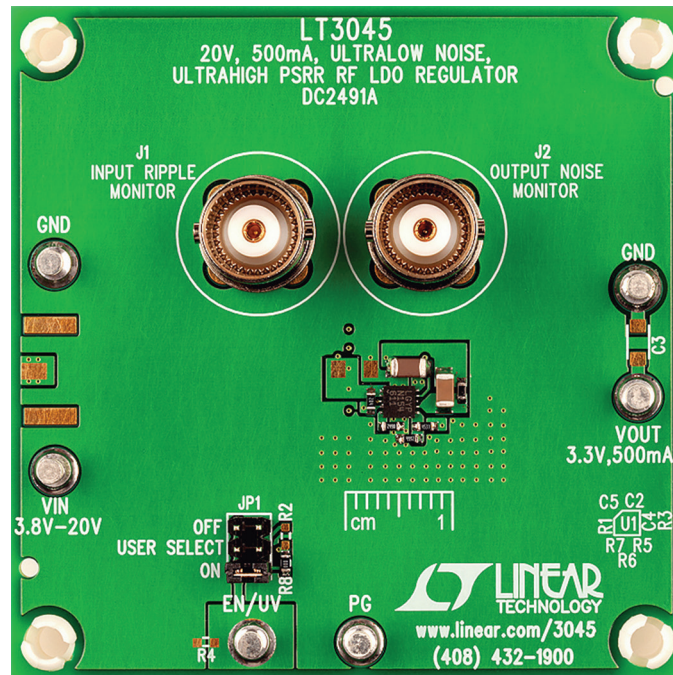


Figure 5. Split Pads for  $C_2$  on Top Layer of DC2491A

## BOARD PHOTO

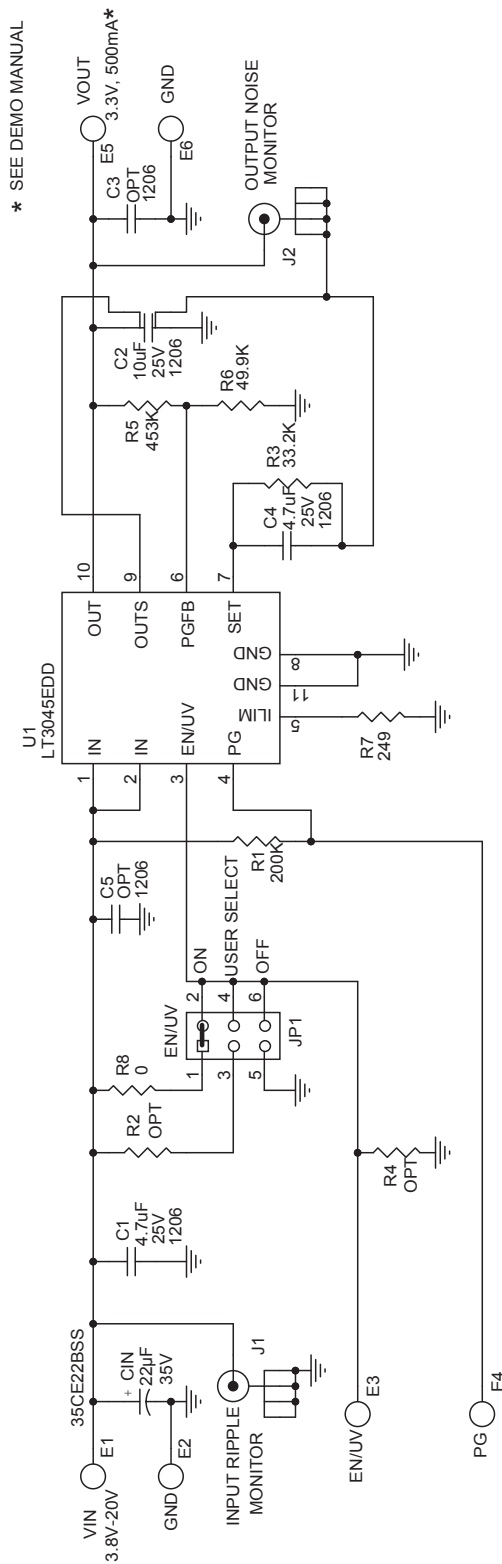


# DEMO MANUAL DC2491A

## PARTS LIST

| ITEM                                  | QTY | REFERENCE    | PART DESCRIPTION                                | MANUFACTURER/PART NUMBER                   |
|---------------------------------------|-----|--------------|-------------------------------------------------|--------------------------------------------|
| <b>Required Circuit Components</b>    |     |              |                                                 |                                            |
| 1                                     | 1   | C1N          | CAP., ALUM, 22 $\mu$ F, 35V, 5mm $\times$ 5.4mm | SUN ELECTRONIC INDUSTRIES CORP., 35CE22BSS |
| 2                                     | 2   | C1, C4       | CAP., X7R, 4.7 $\mu$ F, 25V, 10% 1206           | MURATA, GRM31CR71E475KA88L                 |
| 3                                     | 1   | C2           | CAP., X5R, 10 $\mu$ F, 25V, 10% 1206            | MURATA, GJ831CR61E106KE83L                 |
| 4                                     | 1   | R1           | RES., CHIP, 200k, 1/16W, 5% 0603                | VISHAY, CRCW0603200KJNED                   |
| 5                                     | 1   | R3           | RES., CHIP, 33.2k, 1/8W, 1% 0603                | VISHAY, CRCW060333K2FKEA                   |
| 6                                     | 1   | R5           | RES., CHIP, 453k, 1/8W, 1% 0603                 | VISHAY, CRCW0603453KFEA                    |
| 7                                     | 1   | R6           | RES., CHIP, 49.9k, 1/8W, 1% 0603                | VISHAY, CRCW060349K9FKEA                   |
| 8                                     | 1   | R7           | RES., CHIP, 249 $\Omega$ , 1/16W, 1% 0603       | VISHAY, CRCW0603249RFKEA                   |
| 9                                     | 1   | U1           | IC, LT3045EDD DFN 3mm $\times$ 3mm              | LINEAR TECH., LT3045EDD#PBF                |
| <b>Optional Electronic Components</b> |     |              |                                                 |                                            |
| 1                                     | 0   | C3, C5 (OPT) | CAP., 1206                                      |                                            |
| 2                                     | 0   | R2, R4 (OPT) | RES., 0603                                      |                                            |
| 3                                     | 1   | R8           | RES., CHIP, 0 $\Omega$ , 1/16W, 5% 0603         | VISHAY, CRCW06030000Z0EA                   |
| <b>Hardware</b>                       |     |              |                                                 |                                            |
| 1                                     | 6   | E1 – E6      | TESTPOINT, TURRET, 0.094" PBF                   | MILL-MAX, 2501-2-00-80-00-00-07-0          |
| 2                                     | 1   | JP1          | HEADER 3-PIN 0.079" DOUBLE ROW                  | WURTH ELEKTRONIK, 62000621121              |
| 3                                     | 1   | XJP1         | SHUNT, 0.079" CENTER                            | WURTH ELEKTRONIK, 60800213421              |
| 4                                     | 2   | J1, J2       | CONN, BNC, 5 PINS                               | CONNEX, 112404                             |
| 5                                     | 4   | MH1 – MH4    | STAND-OFF, NYLON 6.4mm                          | WURTH ELEKTRONIK, 702931000                |

# SCHEMATIC DIAGRAM



NOTE: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE 0603.

# DEMO MANUAL DC2491A

---

## 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