

# LT3667

## 40V Step-Down Regulator with Dual LDOs

### DESCRIPTION

Demonstration circuit 1869A is a triple power supply including one 400mA step-down regulator and two 200mA low dropout linear regulators (LDOs) featuring the LT<sup>®</sup>3667. The demo circuit is designed for 5.0V, 3.3V and 2.5V outputs from a 6V to 40V input. Two LDO outputs are configured as post-regulators of the switching regulator output. The total current capability of three output channels is up to 400mA in this configuration, while the two LDO regulators are capable of 200mA each.

The switching frequency of the step-down regulator can be programmed either via a oscillator resistor over a 250kHz to 2.2MHz range or an external clock over a 300kHz to 2.2MHz range. When the circuit is synchronized to an external clock connected to the SYNC terminal, the RT resistor (R8) should be chosen to set the LT3667 internal switching frequency at least 20% below the final SYNC frequency.

The LT3667 internal boost diode and loop compensation reduce the components count and solution size. The current mode control scheme creates fast transient response and good loop stability. The switching regulator has cycle-by-cycle current limit and diode current sense, providing protection against shorted outputs.

JP1 can be used to set the whole LT3667 in shutdown mode. JP3 and JP4 enable and disable the 2.5V LDO output and 3.3V LDO output respectively.

The LT3667 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide for DC1869A. Proper board layout is essential for both proper operation and maximum thermal performance. See the PCB Layout section in the data sheet.

**Design files for this circuit board are available at <http://www.linear.com/demo/DC1869A>**

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>IN1</sub>	Input Supply Range of V <sub>IN1</sub>		6		40	V
f <sub>SW</sub>	Switching Frequency	V <sub>IN1</sub> = 12V, V <sub>OUT1</sub> = 5V/I <sub>OUT1</sub> = 400mA V <sub>OUT2</sub> = 2.5V/I <sub>OUT2</sub> = 0mA V <sub>OUT3</sub> = 3.3V/I <sub>OUT3</sub> = 0mA	510		690	kHz
V <sub>OUT1</sub>	Output Voltage 1	V <sub>IN1</sub> = 12V, V <sub>OUT1</sub> = 5V/I <sub>OUT1</sub> = 0mA to 400mA V <sub>OUT2</sub> = 2.5V/I <sub>OUT2</sub> = 0mA V <sub>OUT3</sub> = 3.3V/I <sub>OUT3</sub> = 0mA	4.9		5.1	V
V <sub>OUT2</sub>	Output Voltage 2	V <sub>IN1</sub> = 12V, V <sub>OUT1</sub> = 5V/I <sub>OUT1</sub> = 0mA V <sub>OUT2</sub> = 2.5V/I <sub>OUT2</sub> = 0mA to 190mA V <sub>OUT3</sub> = 3.3V/I <sub>OUT3</sub> = 0mA	2.43		2.57	V
V <sub>OUT3</sub>	Output Voltage 3	V <sub>IN1</sub> = 12V, V <sub>OUT1</sub> = 5V/I <sub>OUT1</sub> = 0mA V <sub>OUT2</sub> = 2.5V/I <sub>OUT2</sub> = 0mA V <sub>OUT3</sub> = 3.3V/I <sub>OUT3</sub> = 0mA to 190mA	3.21		3.39	V
I <sub>OUT1</sub> + I <sub>OUT2</sub> + I <sub>OUT3</sub>	Maximum Total Output Current	IN2 and IN3 are powered by V <sub>OUT1</sub>	400			mA
I <sub>OUT2</sub> , I <sub>OUT3</sub>	Maximum LDO Output Current		190	200		mA

# DEMO MANUAL DC1869A

## QUICK START PROCEDURE

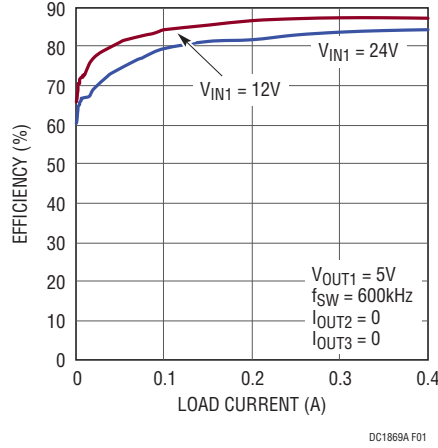


Figure 1.  $V_{OUT1}$  Typical Efficiency vs Load Current

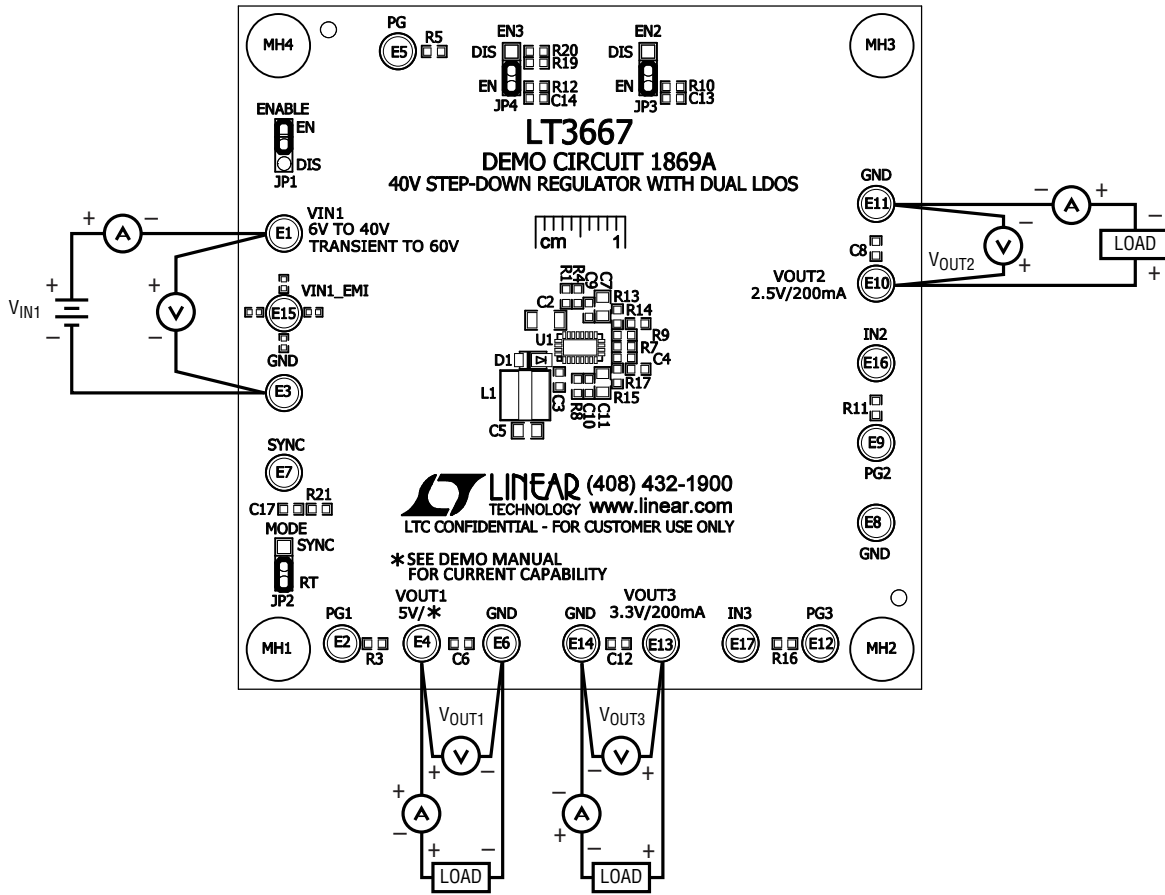


Figure 2. Proper Measurement Equipment Setup

## QUICK START PROCEDURE

Demonstration circuit 1869A is easy to set up to evaluate the performance of the LT3667. Refer to Figure 2 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 3 for the proper scope technique.

1. Place JP1, JP3 and JP4 on the EN position. Place JP2 on the RT position.
2. With power off, connect the input power supply to  $V_{IN1}$  and GND.
3. With power off, connect loads from  $V_{OUT1}$  to GND, from  $V_{OUT2}$  to GND, and from  $V_{OUT3}$  to GND.

4. Turn on the power at the input.

NOTE: Make sure that the input voltage do not exceed 40V.

5. Check for the proper output voltages:

$$V_{OUT1} = 5V, V_{OUT2} = 2.5V, V_{OUT3} = 3.3V$$

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

6. Once the proper output voltages are established, adjust the loads 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 (JP2 on the SYNC position). Please make sure that RT should be set to provide a frequency at least 20% below the final SYNC frequency. See the Synchronization section in the data sheet.

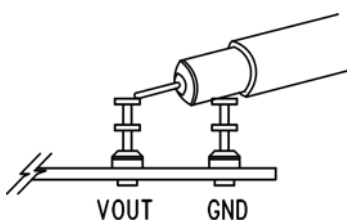


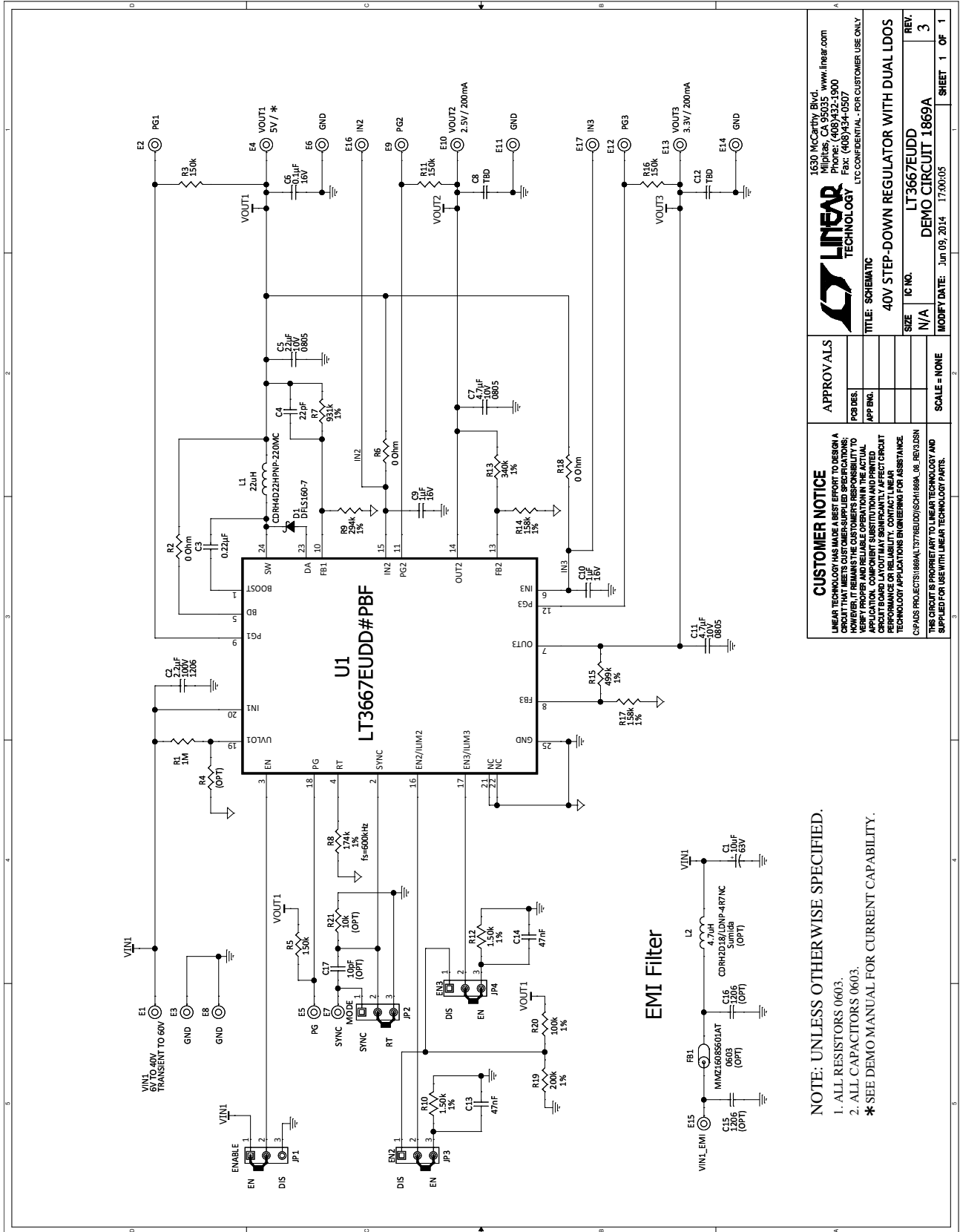
Figure 3. Measuring Input or Output Ripple

# DEMO MANUAL DC1869A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	1	C2	CAP, X7S 2.2 $\mu$ F 100V 20% 1206	TDK C3216X7S2A225M
2	1	C3	CAP, X7R 0.22 $\mu$ F 25V 10% 0603	AVX 06033C224KAT2A
3	1	C4	CAP, NPO 22pF 25V 5% 0603	AVX 06033A220JAT2A
4	1	C5	CAP, X5R 22 $\mu$ F 10V 20% 0805	TAIYO YUDEN LMK212BJ226MG-T
5	2	C7, C11	CAP, X7R 4.7 $\mu$ F 10V 10% 0805	TAIYO YUDEN LMK212B7475KG-T
6	2	C9, C10	CAP, X5R 1 $\mu$ F 16V 10% 0603	TAIYO YUDEN EMK107BJ105KA-T
7	1	D1	SCHOTTKY DIODE 1A/60V POWERDITM123	DIODES INC. DFLS160-7
8	1	L1	INDUCTOR, 22 $\mu$ H	SUMIDA CDRH4D22HPNP-220MC
9	1	R1	RES., CHIP 1M 0.10W 5% 0603	VISHAY CRCW06031M00JNEA
10	4	R3, R5, R11, R16	RES., CHIP 150k 0.10W 5% 0603	VISHAY CRCW0603150KJNEA
11	1	R7	RES., CHIP 931k 0.10W 1% 0603	VISHAY CRCW0603931KFKEA
12	1	R8	RES., CHIP 174k 0.10W 1% 0603	VISHAY CRCW0603174KFKEA
13	1	R9	RES., CHIP 294k 0.10W 1% 0603	VISHAY CRCW0603294KFKEA
14	1	R13	RES., CHIP 340k 0.10W 1% 0603	VISHAY CRCW0603340KFKEA
15	2	R14, R17	RES., CHIP 158k 0.10W 1% 0603	VISHAY CRCW0603158KFKEA
16	1	R15	RES., CHIP 499k 0.10W 1% 0603	VISHAY CRCW0603499KFKEA
17	1	U1	I.C., VOLTAGE REG. QFN(24) (UDD) 3mm x 5mm	LINEAR TECH. CORP. LT3667EUDD#PBF
<b>Additional Demo Board Circuit Components</b>				
1	1	C1	CAP, ALUM 10 $\mu$ F 63V 20% OSCON-CE-6.3	SUN ELECTRONIC INDUSTRIES 63CE10GA
2	1	C6	CAP, X7R 0.1 $\mu$ F 16V 10% 0603	AVX 0603YC104KAT2A
3	0	C8, C12 (OPT)	CAP, 0603	
4	2	C13, C14	CAP, X7R 47nF 25V 20% 0603	AVX 06033C473MAT2A
5	0	C15, C16 (OPT)	CAP, 1206	
6	0	C17 (OPT)	CAP, X7R 10pF 25V 10% 0603	AVX 06033C100KAT2A
7	0	FB1 (OPT)	FERRITE BEAD, 600 $\Omega$ /500mA 0603	TDK MMZ1608S601AT
8	0	L2 (OPT)	INDUCTOR, 4.7 $\mu$ H	SUMIDA CDRH2D18/LDNP-4R7NC
9	3	R2, R6, R18	RES./JUMPER, CHIP 0 $\Omega$ 0.1W 5A 0603	VISHAY CRCW06030000Z0EA
10	0	R4 (OPT)	RES., 0603	
11	2	R10, R12	RES., CHIP 1.50k 0.10W 1% 0603	VISHAY CRCW06031K50FKEA
12	1	R19	RES., CHIP 200k 0.10W 1% 0603	VISHAY CRCW0603200KFKEA
13	1	R20	RES., CHIP 100k 0.10W 1% 0603	VISHAY CRCW0603100KFKEA
14	0	R21 (OPT)	RES., CHIP 10k 0.10W 5% 0603	VISHAY CRCW060310K0JNEA
<b>Hardware: For Demo Board Only</b>				
1	17	E1-E17	TURRET, TESTPOINT	MILL-MAX 2501-2-00-80-00-00-07-0
2	4	JP1, JP2, JP3, JP4	HEADERS, 3 PINS 2mm CTRS.	SULLINS NRPN031PAEN-RC
3	4	XJP1, XJP2, XJP3, XJP4	SHUNT, 2mm CTRS.	SAMTEC 2SN-BK-G
4	4	MH1, MH2, MH3, MH4	STAND-OFF, NYLON 0.25" TALL	KEYSTONE 8831(SNAP ON)

**SCHEMATIC DIAGRAM**



<b>CUSTOMER NOTICE</b>		<b>APPROVALS</b>	
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 THAT THE CIRCUIT MEETS ALL APPLICABLE ELECTRICAL AND MECHANICAL REQUIREMENTS. ANY CHANGES TO THE ORIGINAL APPLICATION COMPONENT SUBSTITUTION AND BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.		PCB DES.	
COPALUS PROJECTS\1869A\13778EJ\DC1869A_08_REV3.DSN		APP ENG.	
THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.		SCALE = NONE	
1630 McCarthy Blvd Milpitas, CA 95035 Phone: (408) 432-1900 Fax: (408) 434-0507 LTC CONFIDENTIAL - FOR CUSTOMER USE ONLY			
TITLE: SCHEMATIC		REV: 3	
SIZE: N/A		IC NO. LT3667EUDD	
MODIFY DATE: Jun 09, 2014 17:00:05		DEMO CIRCUIT 1869A	
SHEET 1 OF 1			

# DEMO MANUAL DC1869A

---

## 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