

## High Efficiency, Dual-Output Synchronous Buck Converter with Very Low DCR Inductor

### DESCRIPTION

Demonstration circuit 2000A is a high efficiency, high density, synchronous buck converter with a 4.5V to 14V input range. It can supply 30A maximum load current at a 1.0V output and at a 1.5V output separately. The demo board includes a LTC®3875EUJ controller. The **LTC3875** is a feature-rich dual phase synchronous buck controller with very low DCR current sensing capability, on-chip drivers and remote output voltage sensing. This board is set up with a 0.32mΩ DCR inductor. The temperature compensation function can guarantee accurate current limit over a wide temperature range with DCR sensing.

The LTC3875 is suitable for inputs from 4.5V to 38V and outputs up to 3.5V. It can provide a high efficiency, high power density and versatile power solution for telecom and datacom systems, industrial and medical instruments, DC

power distribution systems and computer systems. The LTC3875 is available in a 40-pin 6mm × 6mm QFN package.

To shut down the converter, set the RUN1/RUN2 pin voltage below 1.2V (SW1: OFF; SW2: OFF). Use the JP1 jumper to select burst mode, pulse-skipping mode or forced continuous mode operation at light load. Switching frequency is pre-set at about 400kHz, and it can be easily modified from 250kHz to 770kHz. An on-board dynamic circuit is also available for the transient test. Please see the LTC3875 data sheet for more detailed information.

**Design files for this circuit board are available at**  
<http://www.linear.com/demo/DC2000A>

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	VALUE
Input Voltage Range		4.5V to 14V
Output Voltage, $V_{OUT1}$	$V_{IN} = 4.5\text{V to } 14\text{V}, I_{OUT1} = 0\text{A to } 30\text{A}$	$1.0\text{V} \pm 2\%$
Maximum Output Current, $I_{OUT1}$	$V_{IN} = 4.5\text{V to } 14\text{V}, V_{OUT1} = 1.0\text{V}$	30A
Typical Efficiency, $V_{OUT1}$	$V_{IN} = 12\text{V}, V_{OUT1} = 1.0\text{V}, I_{OUT1} = 30\text{A}$	86.9%
Output Voltage, $V_{OUT2}$	$V_{IN} = 4.5\text{V to } 14\text{V}, I_{OUT2} = 0\text{A to } 30\text{A}$	$1.5\text{V} \pm 2\%$
Maximum Output Current, $I_{OUT2}$	$V_{IN} = 4.5\text{V to } 14\text{V}, V_{OUT2} = 1.5\text{V}$	30A
Typical Efficiency, $V_{OUT2}$	$V_{IN} = 12\text{V}, V_{OUT2} = 1.5\text{V}, I_{OUT2} = 30\text{A}$	89.6%
Typical Switching Frequency		400kHz

# DEMO MANUAL DC2000A

---

## QUICK START PROCEDURE

Demonstration circuit 2000A is easy to set up to evaluate the performance of the LTC3875EUJ. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below:

1. With power off, connect the input power supply to  $V_{IN}$  (4.5V to 14V) and GND (input return).
2. Connect the 1.0V output load between  $V_{OUT1}$  and GND (Initial load: no load).
3. Connect the 1.5V output load between  $V_{OUT2}$  and GND (Initial load: no load).
4. Connect the DVMs to the input and outputs. Set default jumper position: JP1: CCM; SW1: ON; SW2: ON.
5. Turn on the input power supply and check for the proper output voltages.  $V_{OUT1}$  should be  $1.0V \pm 2\%$ . And  $V_{OUT2}$  should be  $1.5V \pm 2\%$ .
6. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage and other parameters.

Note: When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. See Figure 2 for the proper scope probe technique. Short, stiff leads need to be soldered to the (+) and (-) terminals of an output capacitor. The probe's ground ring needs to touch the (-) lead and the probe tip needs to touch the (+) lead.

## QUICK START PROCEDURE

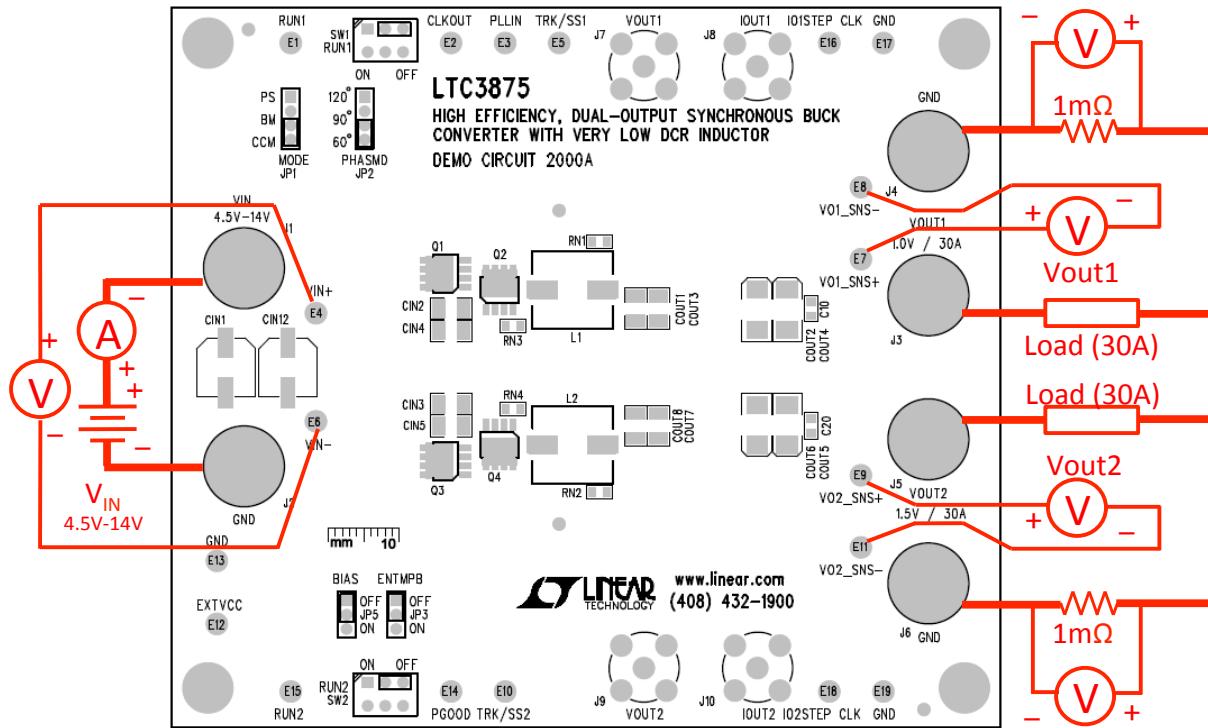


Figure 1. Proper Measurement Equipment Setup

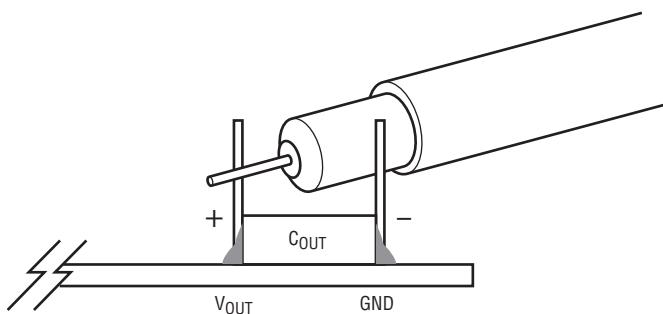
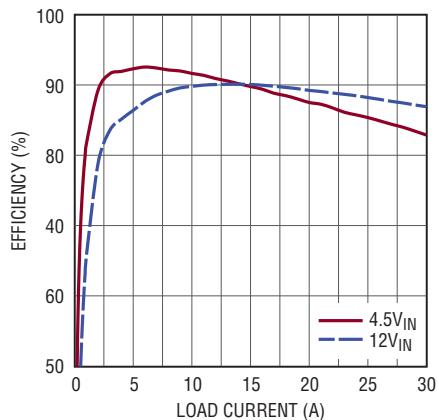


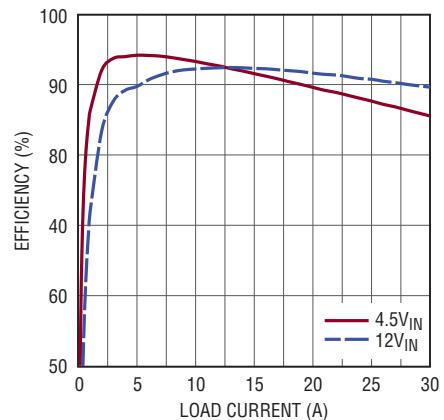
Figure 2. Measuring Output Voltage Ripple

# DEMO MANUAL DC2000A

## QUICK START PROCEDURE



DC2000A F03



DC2000A F04

Figure 3. Efficiency vs Load Current at  $V_{OUT1} = 1V$

Figure 4. Efficiency vs Load Current at  $V_{OUT2} = 1.5V$

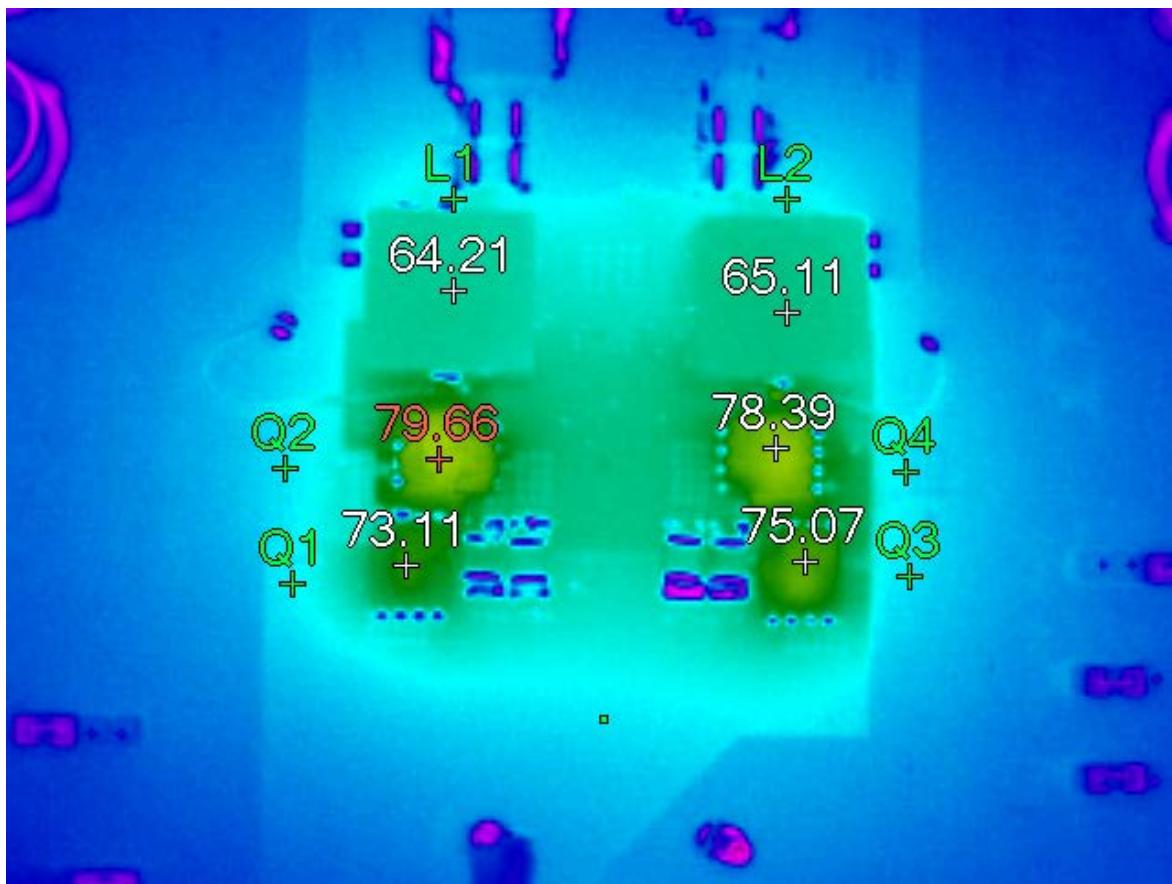
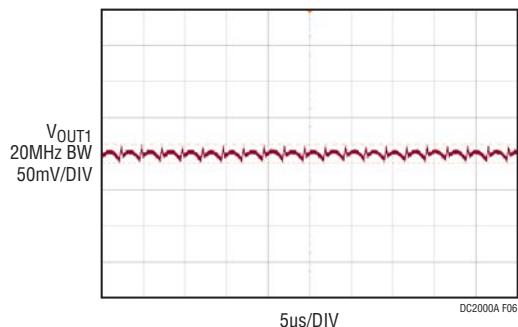
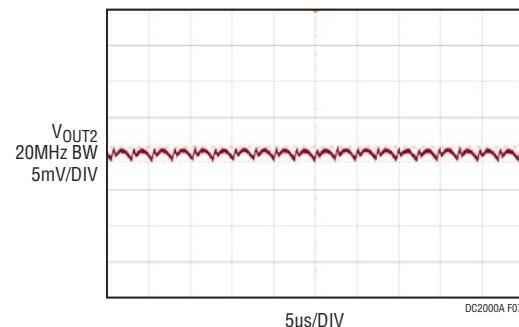


Figure 5. Thermal Performance at  $V_{IN} = 12V$ ,  $V_{OUT1} = 1V$ ,  $I_{OUT1} = 30A$ ,  $V_{OUT2} = 1.5V$ ,  $I_{OUT2} = 30A$ , No Forced Air

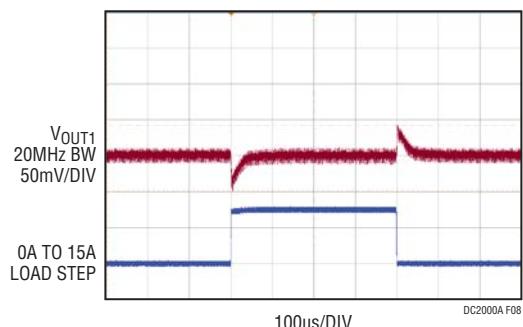
## QUICK START PROCEDURE



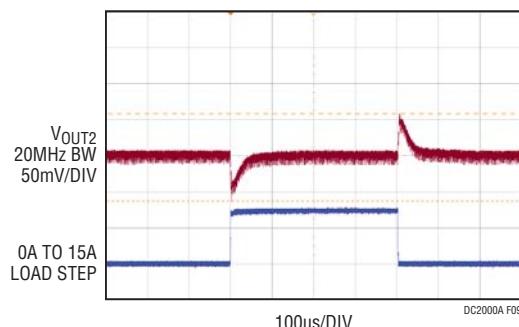
**Figure 6. Output Voltage Ripple at  $V_{IN} = 12V$ ,  $V_{OUT1} = 1V$ ,  $I_{OUT1} = 30A$**



**Figure 7. Output Voltage Ripple at  $V_{IN} = 12V$ ,  $V_{OUT2} = 1.5V$ ,  $I_{OUT2} = 30A$**



**Figure 8. Transient Performance at  $V_{IN} = 12V$ ,  $V_{OUT1} = 1V$ ,  $I_{OUT1} = 0A$  to  $15A$**



**Figure 9. Transient Performance at  $V_{IN} = 12V$ ,  $V_{OUT2} = 1V$ ,  $I_{OUT2} = 0A$  to  $15A$**

# DEMO MANUAL DC2000A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	1	CIN1	CAP., OS-CON, 270µF, 16V, 20%, E12	SANYO, 16SVPC270M
2	6	CIN2, CIN3, CIN4, CIN5, C27, C28	CAP., X5R, 10µF, 16V, 10%, 1210	
3	2	C10, C20	CAP., X5R, 10µF, 16V, 10%, 0805	
4	6	COUT1, COUT3, COUT7, COUT8, C29, C33	CAP., X5R, 100µF, 6.3V, 20%, 1210	
5	7	COUT2, COUT4, COUT5, COUT6, COUT9, COUT10, COUT11	CAP., OS-CON, 330µF, 16V, 20%, 7343	SANYO, 2R5TPE330M9
6	4	C2, C7, C18, C21	CAP., X5R, 0.1µF, 16V, 10%, 0603	
7	4	C3, C4, C16, C19	CAP., X5R, 220nF, 25V, 10%, 0603	
8	2	C8, C12	CAP., X5R, 1.5nF, 25V, 10%, 0603	
9	1	C9	CAP., X5R, 220pF, 25V, 10%, 0603	
10	1	C11	CAP., X5R, 150pF, 25V, 10%, 0603	
11	2	C13, C22	CAP., X5R, 1µF, 16V, 10%, 0603	
12	1	C14	CAP., X5R, 4.7µF, 16V, 10%, 0805	
13	4	C31, C32, C35, C36	CAP., X5R, 0.22µF, 16V, 10%, 0805	
14	2	D1, D2	DIODE, SCHOTTKY, SOD-323	CENTRAL CMDSH-3TR
15	1	L1	0.25µH	WÜRTH ELECT., 744301025
16	1	L2	0.33µH	WÜRTH ELECT., 744301033
17	2	Q1, Q3	OPTIMOS POWER-TRANSISTOR, PG-TDSON-8 25V	INFINEON, BSC050NE2LS
18	2	Q2, Q4	OPTIMOS POWER-TRANSISTOR, PG-TDSON-8 25V	INFINEON, BSC010NE2LSI
19	2	Q7, Q8	MOSFET SPEED SRS 30V 30A LFPAK	RENESAS RJK0305DPB
20	3	R1, R14, R25	RES., CHIP, 20k, 1%, 0603	
21	4	R4, R17, R23, R26	RES., CHIP, 0Ω, 0603	
22	1	R9	RES., CHIP, 3.01k, 1%, 0603	
23	1	R10	RES., CHIP, 1k, 1%, 0603	
24	1	R11	RES., CHIP, 3.57k, 1%, 0603	
25	1	R12	RES., CHIP, 715Ω, 1%, 0603	
26	1	R13	RES., CHIP, 13.3k, 1%, 0603	
27	7	R19, R37, R40, R49, R52, R55, R57	RES., CHIP, 10k, 1%, 0603	
28	1	R15	RES., CHIP, 10.7k, 1%, 0603	
29	4	R16, R20, R24, R36	RES., CHIP, 10Ω, 1%, 0603	
30	1	R18	RES., CHIP, 2.2Ω, 1%, 0603	
31	1	R21	RES., CHIP, 30.1k, 1%, 0603	
32	1	R50	RES., CHIP, 34.8k, 1%, 0603	
33	2	R28, R32	RES., CHIP, 100k, 1%, 0603	
34	1	R34	RES., CHIP, 4.64k, 1%, 0603	
35	1	R35	RES., CHIP, 931Ω, 1%, 0603	
36	1	R43	RES., CHIP, 4.99k, 1%, 0603	
37	2	R56, R58	RES., CHIP, 0.005Ω, 1%, 2512	IRC., LRF2512-01-R005-F

# DEMO MANUAL DC2000A

## PARTS LIST

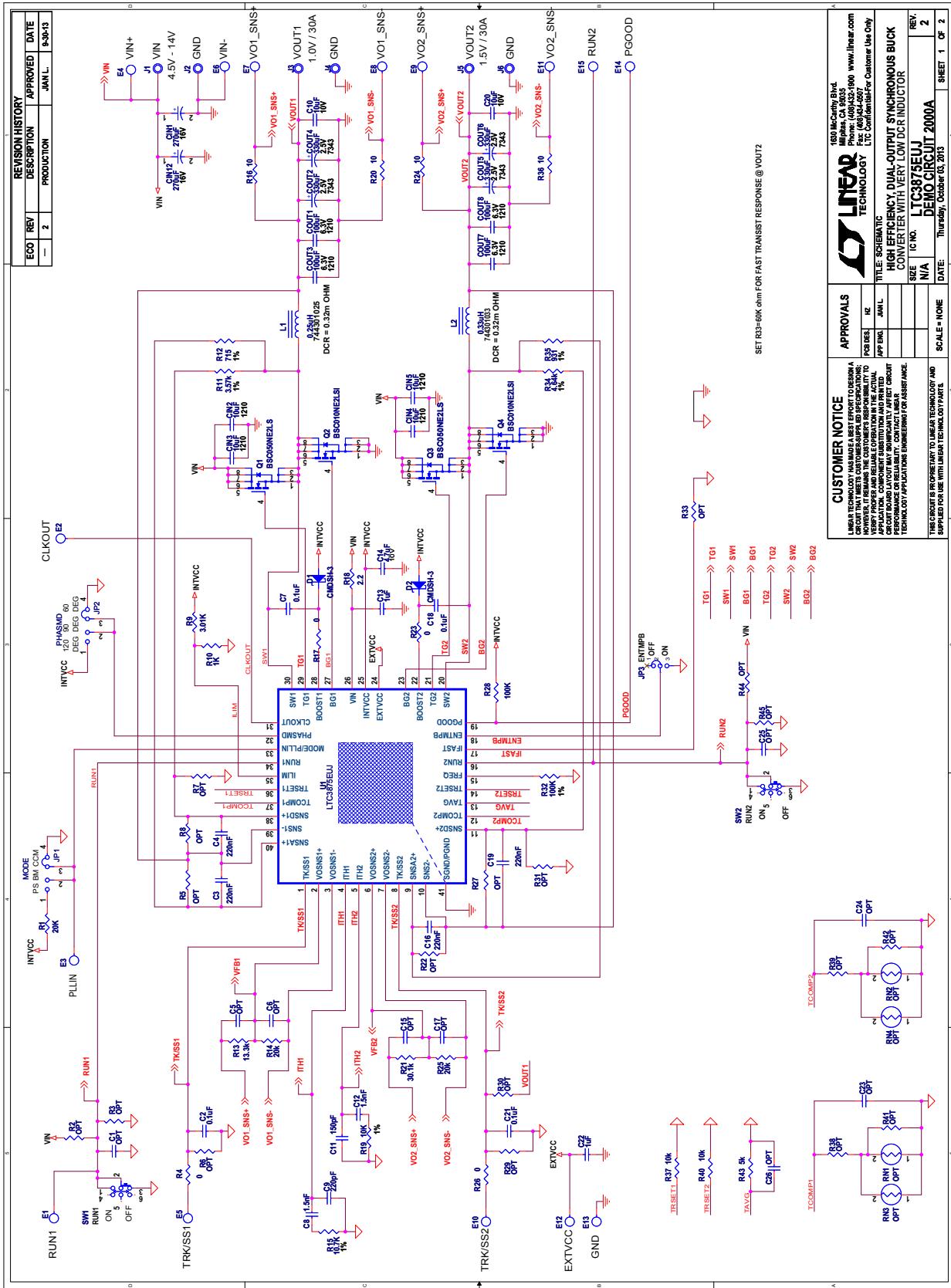
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
38	1	U1	IC, LTC3875EUJ, QFN 6mm × 6mm	LINEAR TECH., LTC3875EUJ#010J-1PBF
39	1	U2	IC, LT1761ES5-SD, TSOT-23	LINEAR TECH., LT1761ES5-SD

### Additional Demo Board Circuit Components

1	0	C1, C5, CIN6, C6, CIN7, C30, C34, CIN8, CIN9, CIN10, CIN11, C15, C17, C23, C24, C25, C26, COUT12	CAP., OPTIONAL	
2	0	RN1-RN4, R2, R3, R5, R6, R7, R8, R22, R27, R29, R33, R30, R31, R38, R39, R41, R42, R44, R45, R46, R47, R48, R51, R53, R54	RES., OPTIONAL	
3	0	Q5, Q6, Q11, Q12	DUAL N-CHANNEL MOSFET 25V	FAIRCHILD FDMS3620S
4	0	Q9, Q10	DUAL N-CHANNEL MOSFET 25V	FAIRCHILD FDPC8011S

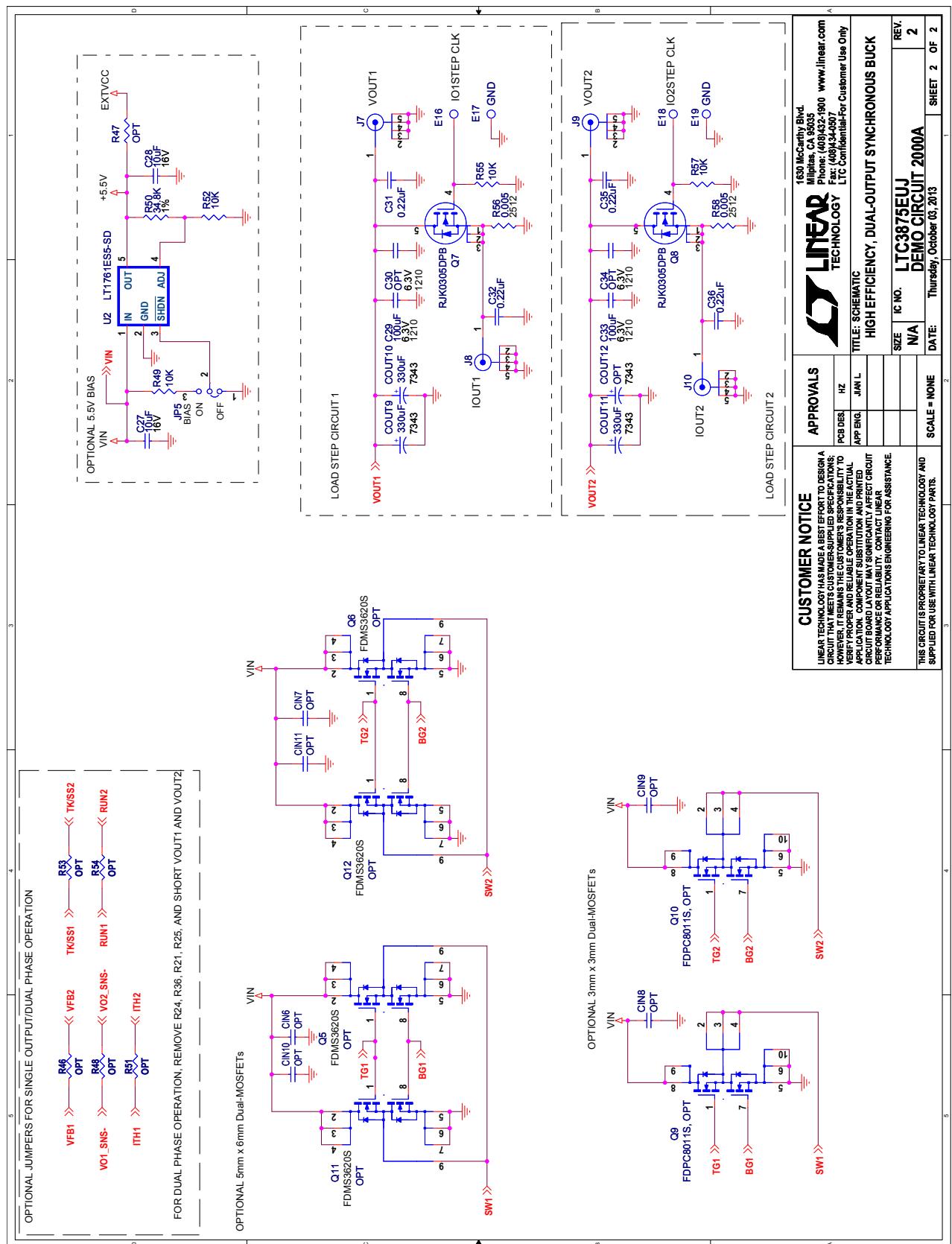
# DEMO MANUAL DC2000A

## SCHEMATIC DIAGRAM



dc2000af

## SCHEMATIC DIAGRAM



# DEMO MANUAL DC2000A

---

## 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

dc2000af



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

#### Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помошь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помошь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: [org@eplast1.ru](mailto:org@eplast1.ru)

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.