

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>

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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}	$V_{IN} = 4.5\text{V to } 14\text{V}$, $I_{OUT1} = 0\text{A to } 30\text{A}$	1.0V $\pm 2\%$
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}	$V_{IN} = 4.5\text{V to } 14\text{V}$, $I_{OUT2} = 0\text{A to } 30\text{A}$	1.5V $\pm 2\%$
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

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

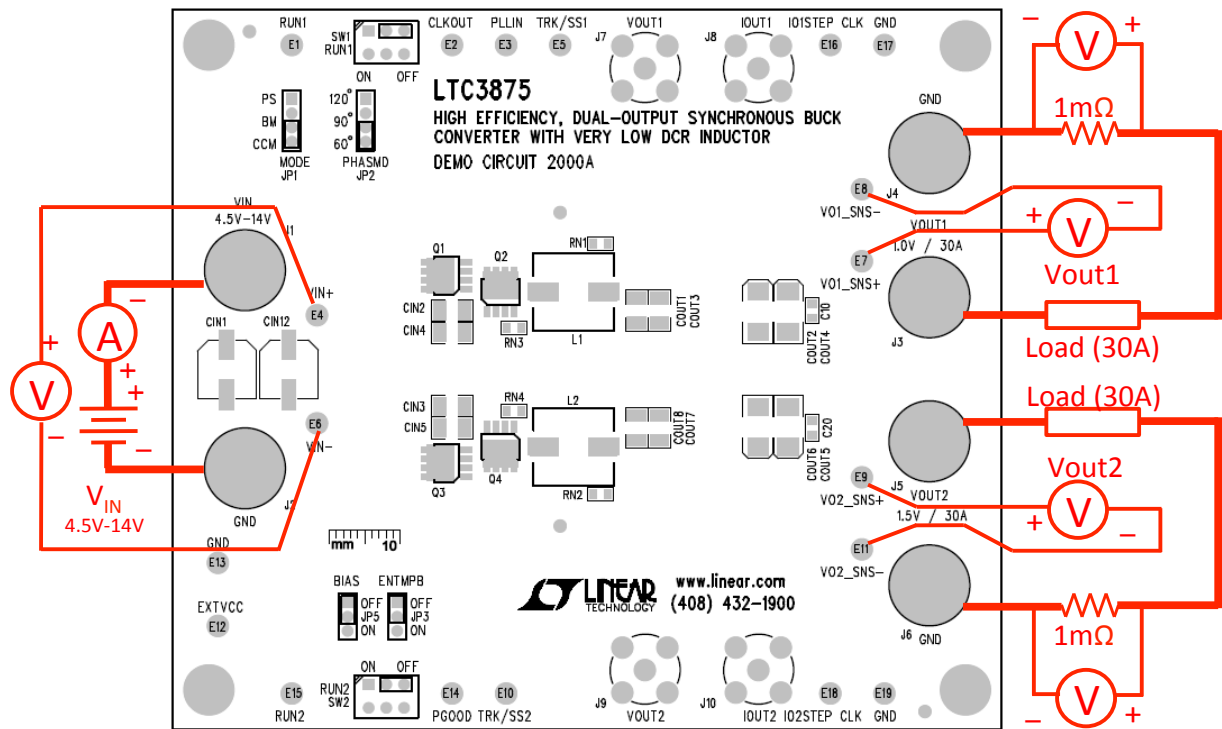


Figure 1. Proper Measurement Equipment Setup

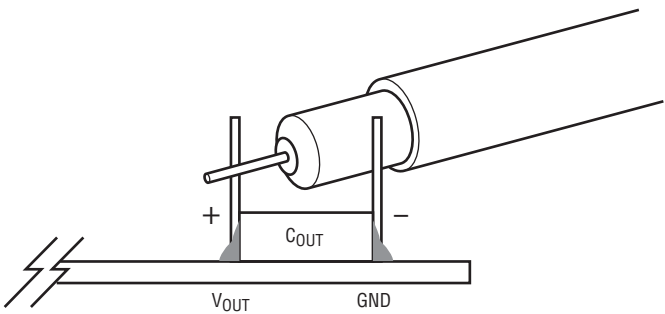


Figure 2. Measuring Output Voltage Ripple

QUICK START PROCEDURE

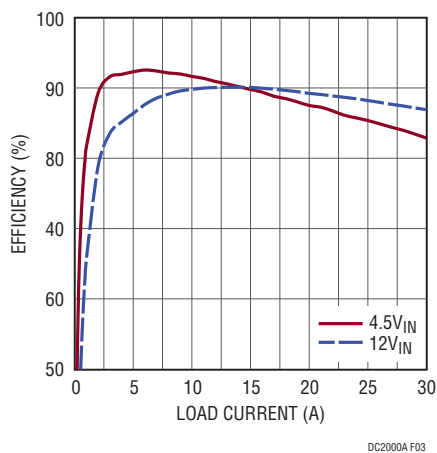


Figure 3. Efficiency vs Load Current at $V_{OUT1} = 1V$

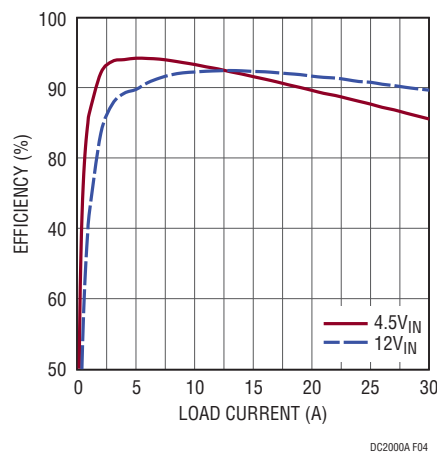


Figure 4. Efficiency vs Load Current at $V_{OUT2} = 1.5V$

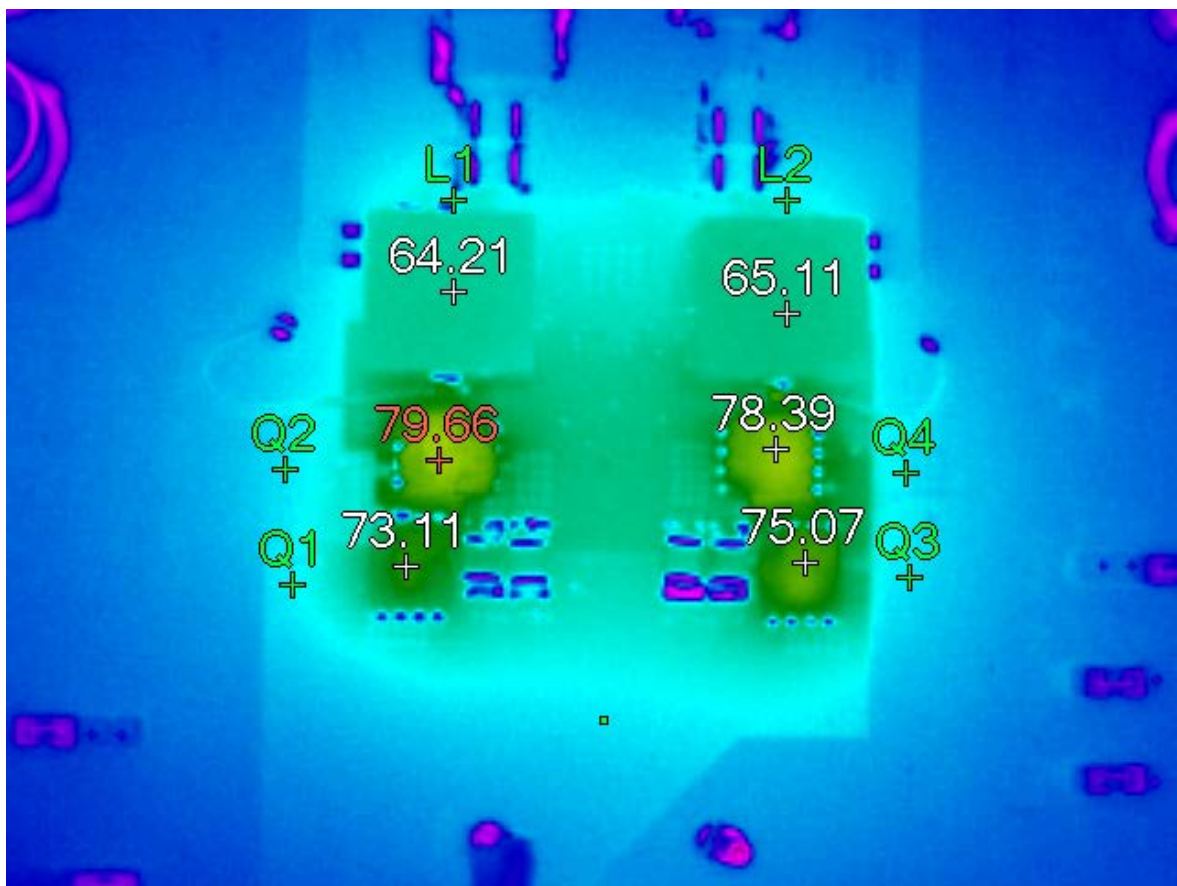


Figure 5. Thermal Performance at $V_{IN} = 12V$, $V_{OUT1} = 1V$, $I_{OUT1} = 30A$, $V_{OUT2} = 1.5V$, $I_{OUT2} = 30A$, No Forced Air

QUICK START PROCEDURE

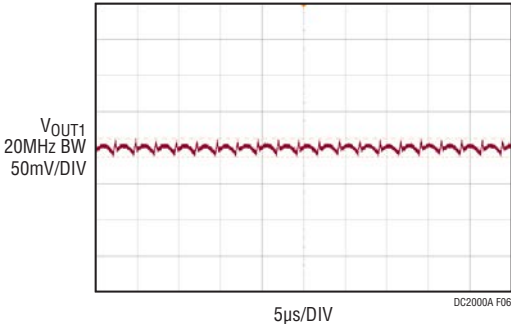


Figure 6. Output Voltage Ripple at $V_{IN} = 12V$, $V_{OUT1} = 1V$, $I_{OUT1} = 30A$

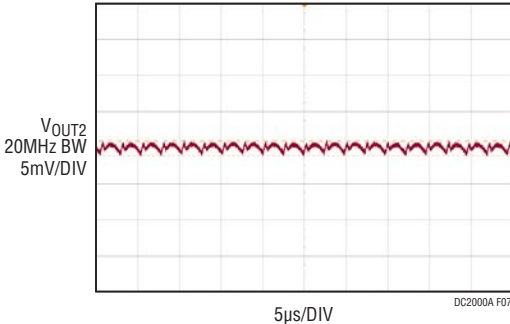


Figure 7. Output Voltage Ripple at $V_{IN} = 12V$, $V_{OUT2} = 1.5V$, $I_{OUT2} = 30A$

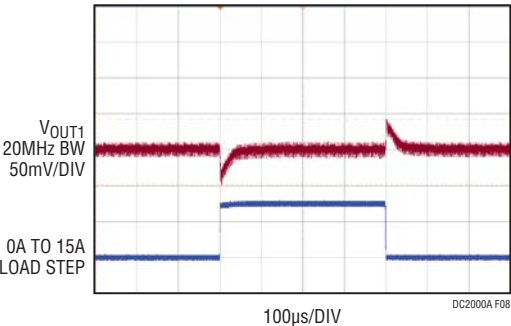


Figure 8. Transient Performance at $V_{IN} = 12V$, $V_{OUT1} = 1V$, $I_{OUT1} = 0A$ to 15A

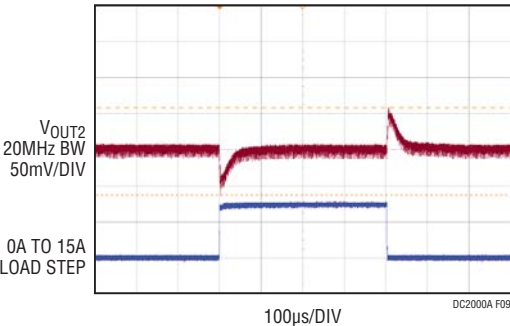


Figure 9. Transient Performance at $V_{IN} = 12V$, $V_{OUT2} = 1V$, $I_{OUT2} = 0A$ to 15A

DEMO MANUAL DC2000A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
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 LPAK	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

PARTS LIST

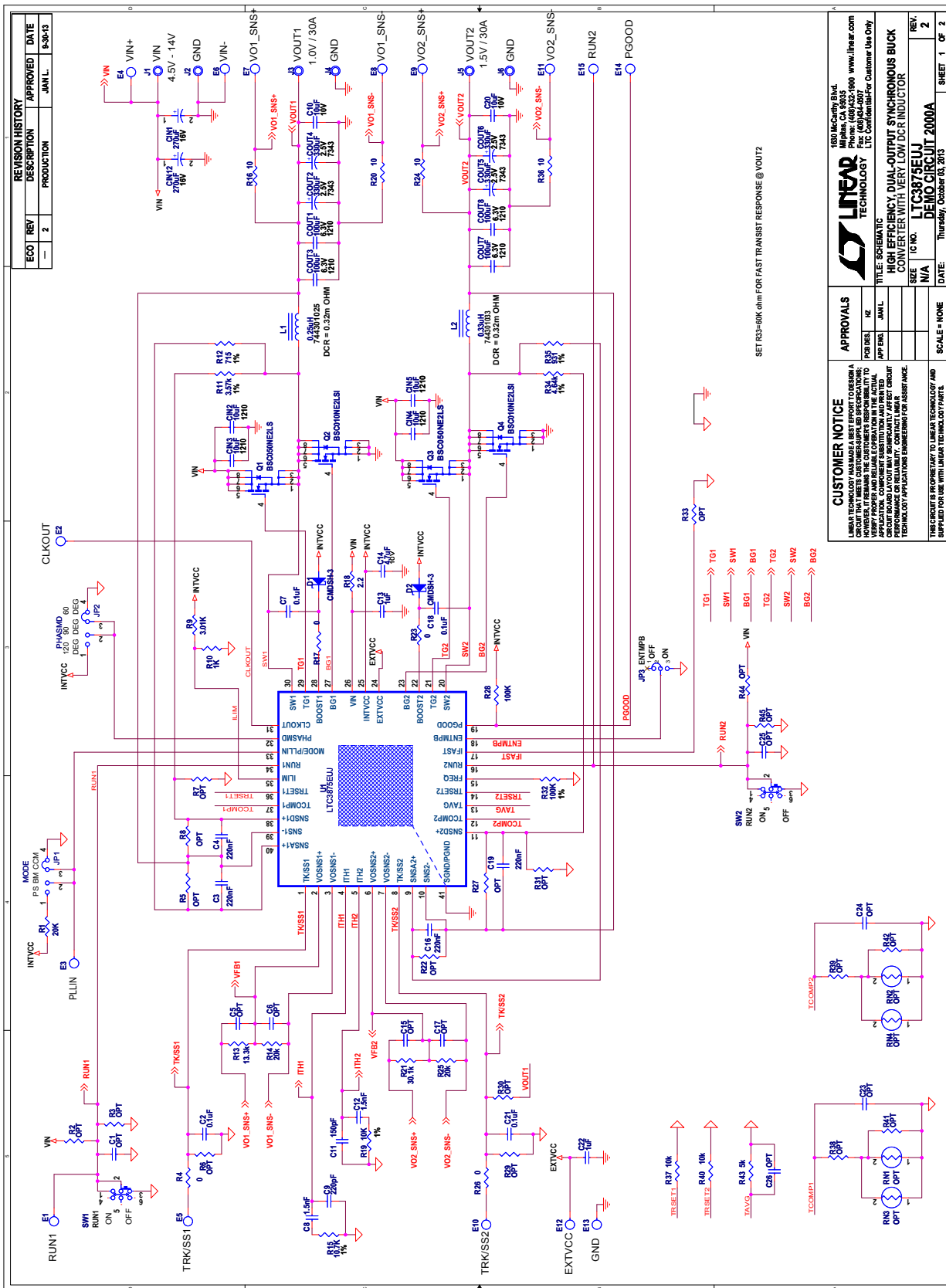
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
38	1	U1	IC, LTC3875EUJ, QFN 6mm × 6mm	LINEAR TECH., LTC3875EUJ#010J-1PBF
39	1	U2	IC, LT1761ES5-SD, TSOT-23	LINEAR TECH., LT1761ES5-SD

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

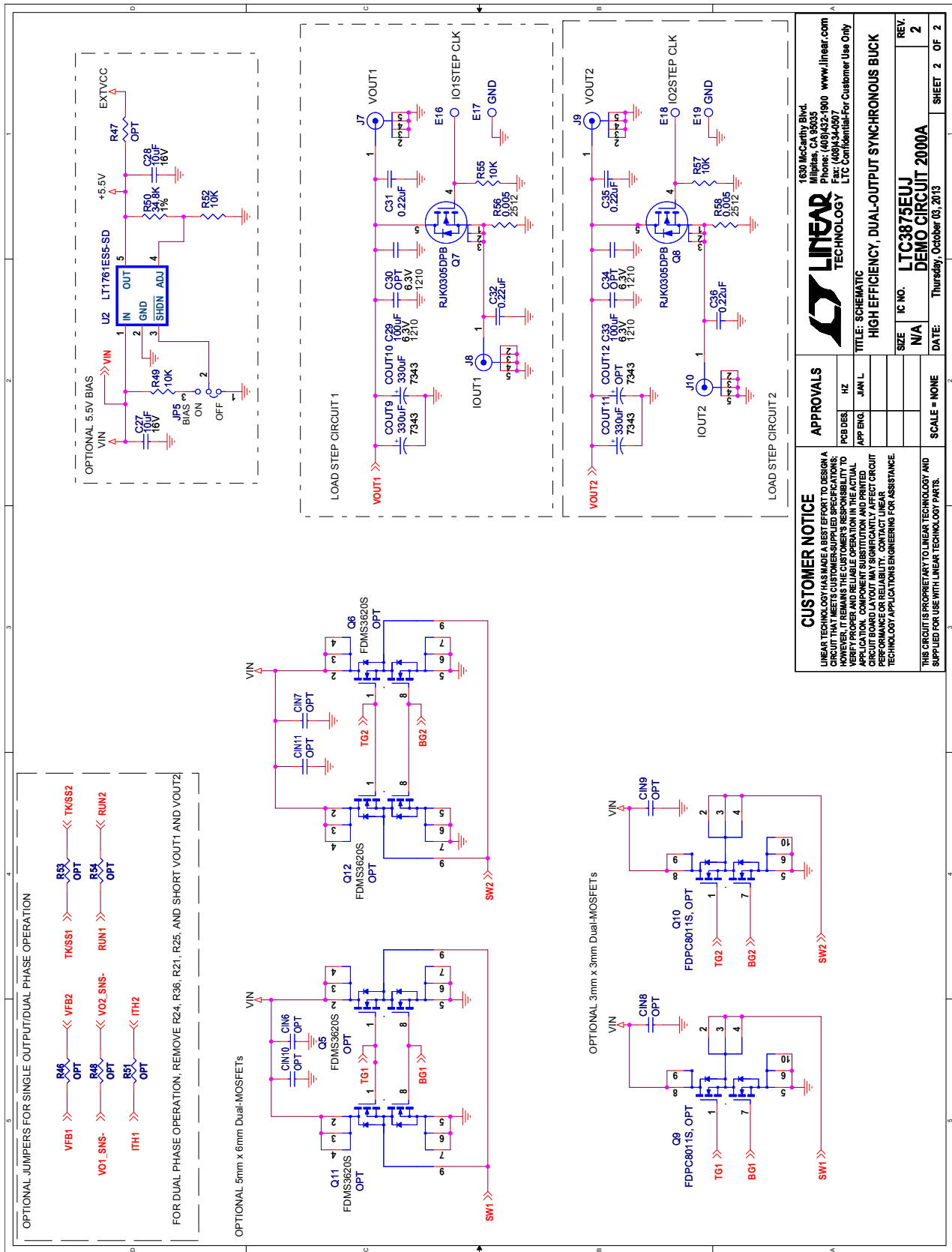
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SCHEMATIC DIAGRAM



dc2000af

SCHEMATIC DIAGRAM



APPROVALS PCB DES: HZ APP ENG: JAN L		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 DESIGN, BUILD, TEST, AND VALIDATE THE CIRCUIT FOR THE INTENDED APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.	
TITLE: SCHEMATIC HIGH EFFICIENCY, DUAL-OUTPUT SYNCHRONOUS BUCK		1630 McCarthy Blvd. Milpitas, CA 95035 Phone: (408)432-1900 www.linear.com Fax: (408)34-0907 LTC Confidential-For Customer Use Only	
SIZE	IC NO.	LTC3875EUJ	REV.
N/A		DEMO CIRCUIT 2000A	2
DATE:	Thursday, October 03, 2013	SHEET	2 OF 2
SCALE = NONE			

DEMO MANUAL DC2000A

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Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

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Как с нами связаться

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

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

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