

LTC3875EUJ

High Efficient, Single Output Synchronous Buck Converter with Very Low DCR Inductor

DESCRIPTION

Demonstration circuit 2055A is a high efficiency, high density, 4-phase synchronous buck converter with a 4.5V to 14V input voltage range. It can supply up to 120A of load current with a 1.0V output. This demo board has two each LTC®3875EUJ feature-rich dual-phase synchronous current mode buck controllers with very low DCR current sensing capability, on-chip drivers and remote output voltage sensing. This board is set up with 0.32mΩ DCR output inductors. 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, medical instruments,

and DC power distribution. The LTC3875 is available in a 40-lead 6mm × 6mm QFN package.

To shut down the converter, set the RUN pin voltage below 1.0V (SW1 and SW2: both OFF). Use JP1 jumper to select Burst Mode® operation, pulse-skipping mode or forced continuous mode operation at light load. The switching frequency is pre-set at about 400kHz, and it can be easily modified from 250kHz to 720kHz. An onboard dynamic circuit is also available for a load transient test. Please see LTC3875 data sheet for more detailed information.

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

LT, LT, LTC, LTM, Linear Technology, the Linear logo and Burst Mode 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°C

PARAMETER	CONDITION	VALUE
Input Voltage Range		4.5V to 14V
Output Voltage, V _{OUT}	V _{IN} = 4.5 to 14V, I _{OUT} = 0A to 120A	1.0V ±2%
Maximum Output Current, I _{OUT}	V _{IN} = 4.5 to 14V, V _{OUT} = 1.0V	120A
Typical Efficiency, V _{OUT}	V _{IN} = 12V, V _{OUT} = 1.0 V, I _{OUT} = 120A	87.1%, See Figure 3
Typical Switching Frequency		400kHz

QUICK START PROCEDURE

Demonstration circuit 2055A 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 VIN (4.5V-14V) and GND (input return).
2. Connect the 1.0V output load between VOUT1 and GND (Initial load: no load).
3. Connect the DVMs to the input and outputs. Set default jumper position:

4. Turn on the input power supply and check for the proper output voltages. V_{OUT1} should be $1.0V \pm 2\%$.
5. 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.

<i>JP1</i>	<i>JP2</i>	<i>JP3</i>	<i>JP4</i>	<i>JP5</i>	<i>JP6</i>	<i>SW1</i>	<i>SW2</i>
MODE	PHASMD1	ENTMPB1	ENTMPB1	BIAS	PHASMD1	RUN1	RUN2
CCM	90°	OFF	OFF	OFF	90°	ON	ON

QUICK START PROCEDURE

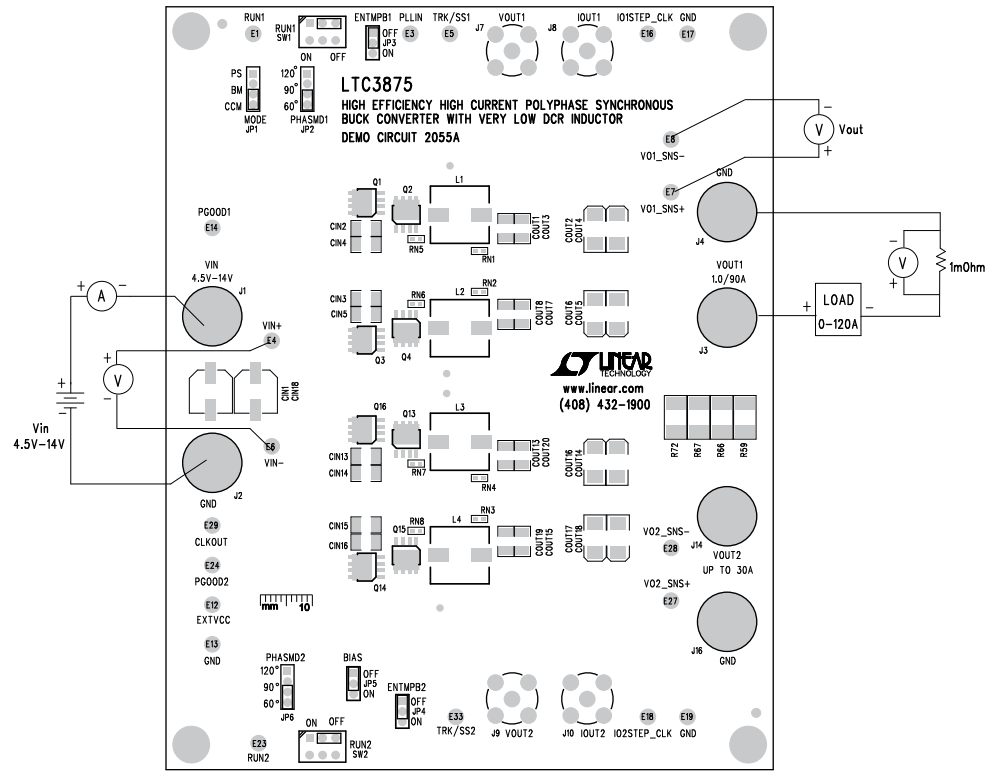


Figure 1. Proper Measurement Equipment Setup

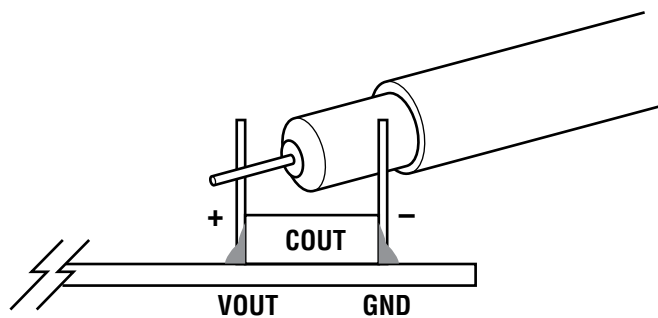


Figure 2. Measuring Output Voltage Ripple

QUICK START PROCEDURE

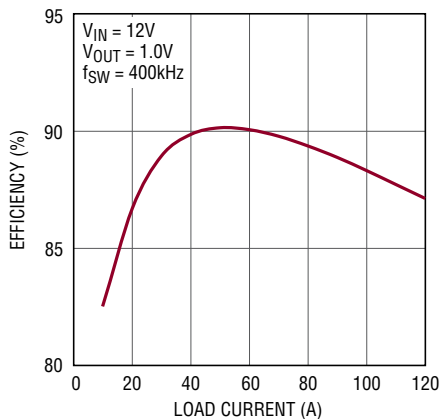


Figure 3. Efficiency vs Load Current

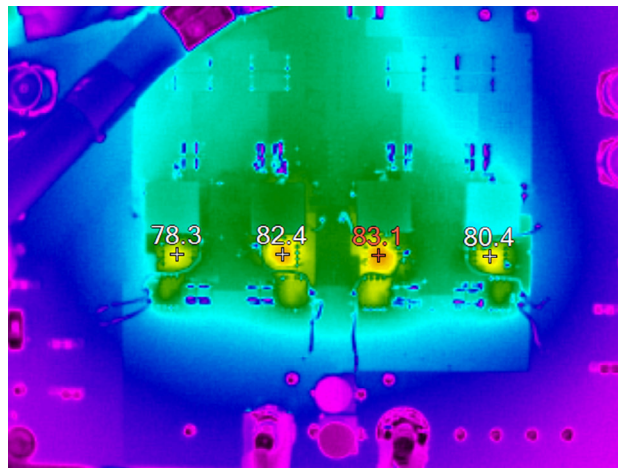


Figure 4. Thermal Performance at $V_{IN} = 12V$, $V_{OUT} = 1.0V$, $I_{OUT} = 120A$, 200LFM Forced Air Flow

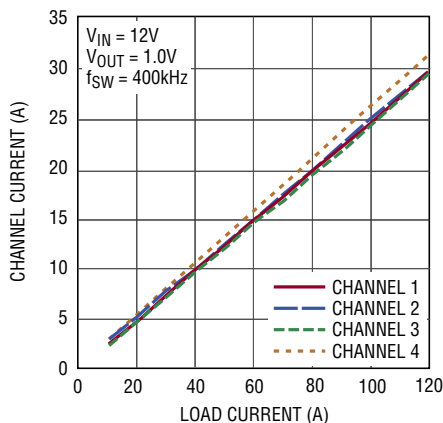


Figure 5. Current Sharing vs Load Current

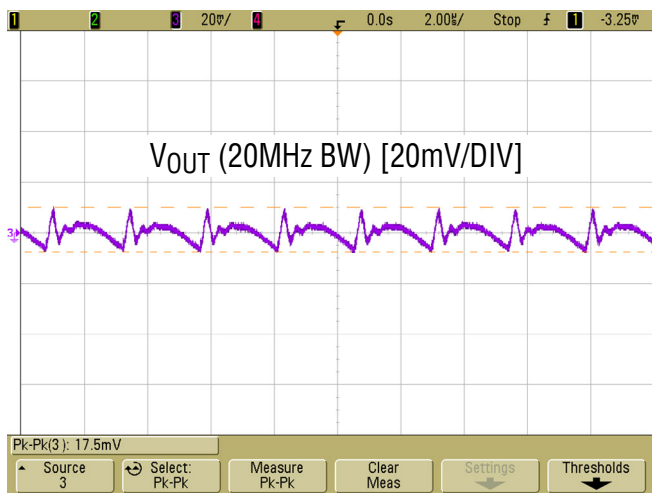


Figure 6. Output Voltage Ripple at $V_{IN} = 12V$, $V_{OUT} = 1.0V$, $I_{OUT} = 120A$, $f_{SW} = 400kHz$

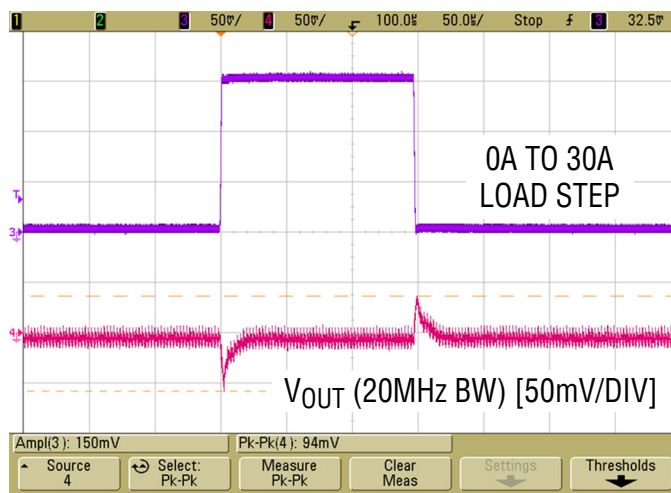


Figure 7. Transient Performance at $V_{IN} = 12V$, $V_{OUT} = 1.0V$, $I_{OUT} = 0A$ to $30A$, $f_{SW} = 400kHz$

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	CIN1, CIN18	CAP., OS-CON, 270µF, 16V, 20%, E12	SANYO, 16SVPC270M
2	12	COUT1, COUT3, COUT7, COUT8, COUT13, COUT15, COUT19, COUT20, C29, C30, C33, C34	CAP., X5R, 100µF, 6.3V, 20%, 1210	AVX 12106D107MAT2A
3	12	COUT2, COUT4-COUT6, COUT9-COUT12, COUT14, COUT16-COUT18	CAP., OS-CON, 330µF, 2.5V, 20%, 7343	SANYO, 2R5TPE330M9
4	4	L1, L2, L3, L4	IND, 0.25µH	WURTH ELECT., 744301025
5	4	Q1, Q3, Q14, Q16	OPTIMOS POWER-TRANSISTOR, PG-TDSON-8 25V	INFINEON, BSC050NE2LS
6	4	Q2, Q4, Q13, Q15	OPTIMOS POWER-TRANSISTOR, PG-TDSON-8 25V	INFINEON, BSC010NE2LSI
7	2	U1, U3	IC, LTC3875IUJ, QFN 6mm × 6mm	LINEAR TECH., LTC3875IUJ#PBF
8	1	U2	IC, LT1763CDE, DFN 4mm × 3mm	LINEAR TECH., LT1763CDE-SD
Additional Demo Board Circuit Components				
9	10	CIN2-CIN5, CIN13-CIN16, C27, C28	CAP., X5R, 10µF, 16V, 10%, 1210	AVX 1210YD106KAT2A
10	0	C1, C5, C6, CIN6-CIN12, CIN17, C23, C24, C26, C37, C48, C49, C54, C55, C58, C59, C63	CAP., OPTIONAL	
11	5	C2, C7, C18, C38, C42, C43	CAP., X5R, 0.1µF, 16V, 10%, 0603	AVX 0603YD104KAT2A
12	8	C3, C4, C16, C19, C44, C46, C52, C62	CAP., X5R, 220nF, 25V, 10%, 0603	AVX 06033D224KAT2A
13	1	C8	CAP., X7R, 4.7nF, 25V, 10%, 0603	AVX 06033C472KAT2A
14	2	C9, C57	CAP., NPO, 220pF, 25V, 10%, 0603	AVX 06033A221KAT2A
15	3	C13, C22, C56	CAP., X5R, 1µF, 25V, 10%, 0603	AVX 06033D105KAT2A
16	2	C14, C60	CAP., X5R, 4.7µF, 16V, 10%, 0805	TDK C2012X5R1E475K
17	4	C31, C32, C35, C36	CAP., X5R, 0.22µF, 16V, 10%, 0805	AVX 0805YC224KAT2A
18	4	D1, D2, D3, D4	DIODE, SCHOTTKY, SOD-323	CENTRAL CMDSH-3TR
19	0	Q5, Q6, Q9-Q12, Q17, Q18	OPTIONAL	
20	2	Q7, Q8	MOSFET SPEED SRS 30V 30A LFPK	RENESAS RJK0305DPB
21	2	R1, R14	RES., CHIP, 20k, 1%, 0603	NIC NRC06F2002TRF
22	0	R2, R3, R5-R8, R22, R27, R31, R33, R38, R39, R41, R42, R47, R63, R65, R68, R69, RN1-RN8, R73, R74, R75, R76, R79, R83, R84, R88, R89, R90, R91, R92, R93, R94, R96, R97	RES., OPTIONAL	
23	12	R4, R17, R23, R46, R48, R51, R53, R54, R60, R61, R64, R82	RES., CHIP, 0Ω, 0603	NIC NRC06Z0TRF
24	4	R59, R66, R67, R72	RES., CHIP, 0Ω, 2512	VISHAY CRCW25120000Z0ZG
25	2	R9, R80	RES., CHIP, 3.01k, 1%, 0603	NIC NRC06F3011TRF
26	2	R10, R81	RES., CHIP, 1k, 1%, 0603	NIC NRC06F1001TRF
27	4	R11, R34, R77, R86	RES., CHIP, 3.57k, 1%, 0603	NIC NRC06F3571TRF
28	4	R12, R35, R70, R85	RES., CHIP, 715Ω, 1%, 0603	VISHAY CRCW0603715RFKEA
29	1	R13	RES., CHIP, 13.3k, 1%, 0603	VISHAY CRCW060313K3FKEA
30	8	R37, R40, R49, R52, R55, R57, R78, R101	RES., CHIP, 10k, 1%, 0603	NIC NRC06F1002TRF
31	1	R15	RES., CHIP, 2k, 1%, 0603	NIC NRC06F2001TRF
32	2	R16, R20	RES., CHIP, 10Ω, 1%, 0603	NIC NRC06F10R0TRF
33	2	R18, R62	RES., CHIP, 2.2Ω, 1%, 0603	NIC NRC06F2R20TRF

DEMO MANUAL DC2055A

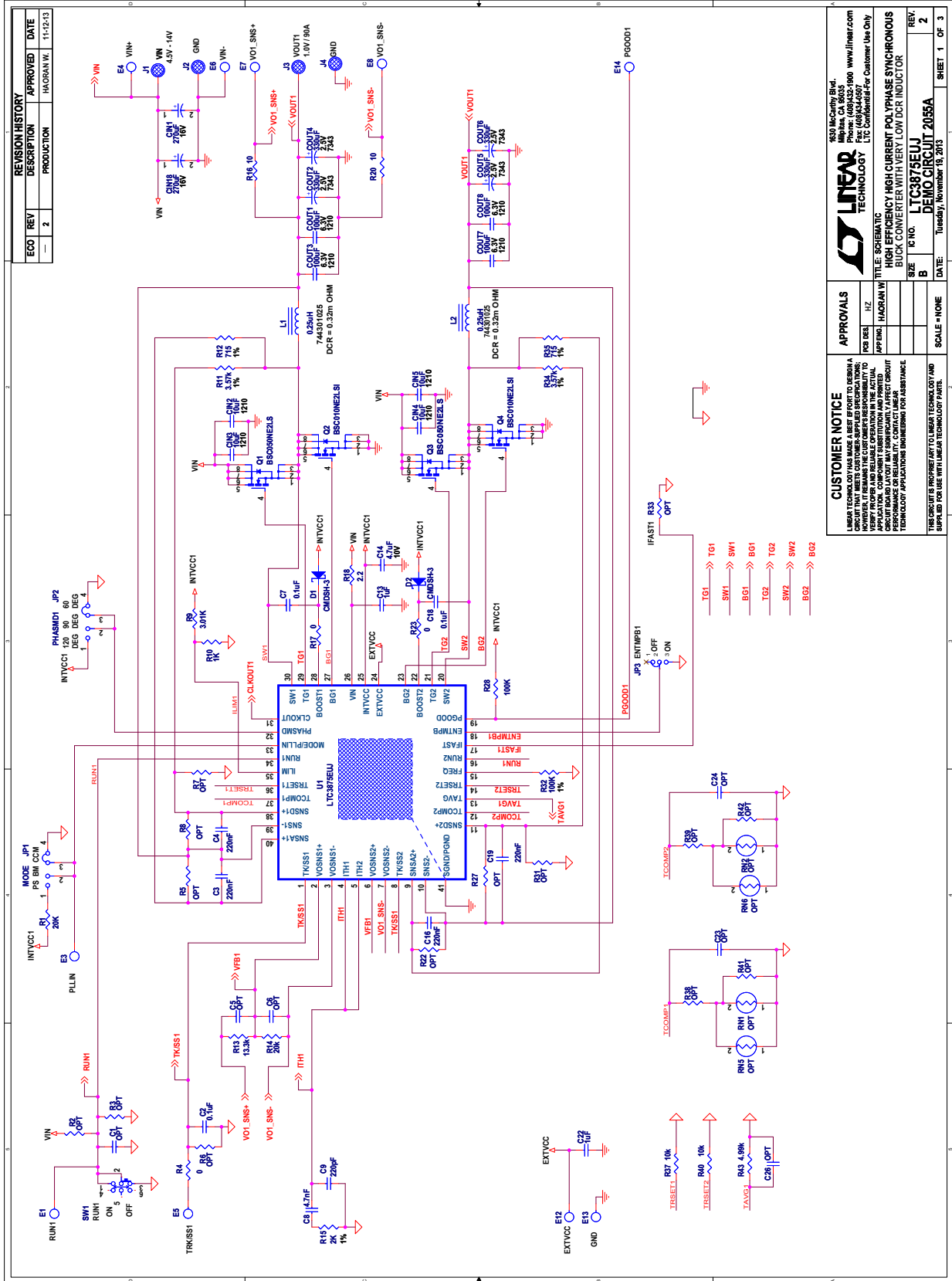
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
34	4	R28, R32, R87, R99	RES., CHIP, 100k, 1%, 0603	NIC NRC06F1003TRF
35	2	R43, R44	RES., CHIP, 4.99k, 1%, 0603	NIC NRC06F4K99TRF
36	1	R50	RES., CHIP, 34.8k, 1%, 0603	VISHAY CRCW060334K8FKEA
37	2	R56, R58	RES., CHIP, 0.005 Ω , 1%, 2512	VISHAY WSL25125L000FEA

Hardware-For Demo Board Only

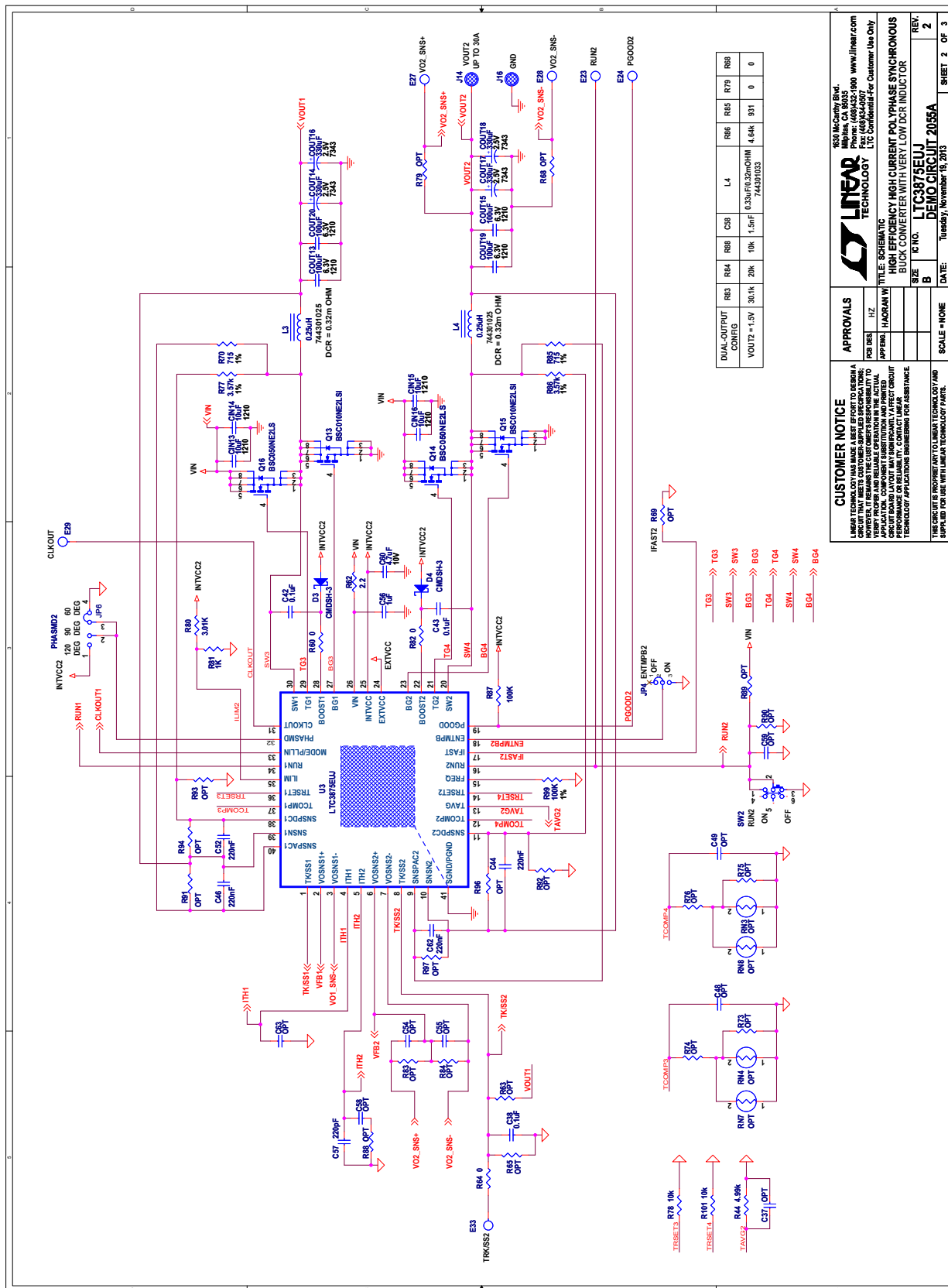
38	19	E1, E3-E8, E12-E14, E16-E19, E23, E24, E27-E29, E33	TESTPOINT, TURRET, 0.062"	MILL-MAX, 2308-2-00-80-00-00-07-0
39	6	J1, J2, J3, J4, J14, J16	STUD, TESTPIN	PEM KFH-032-10
40	12	J1-J4, J14, J16 (X2)	NUT, BRASS 10-32	ANY #10-32
41	6	J1-J4, J14, J16	RING, LUG #10	KEYSTONE, 8205, #10
42	6	J1-J4, J14, J16	WASHER, TIN PLATED BRASS	ANY #10
43	3	JP1, JP2, JP6	2MM SINGLE ROW HEADER, 4-PIN	SAMTEC, TMM-104-02-L-S
44	3	JP3-JP5	HEADER 3-PIN 0.079 SINGLE ROW	SAMTEC, TMM103-02-L-S
45	6	JP1-JP6	SHUNT	SAMTEC, 2SN-BK-G
46	2	SW1, SW2	CONNECTOR, SUB MINIATURE SLIDE SWITCHES	C&K., JS202011CQN
47	4	J7, J8, J9, J10	CONN, BNC, 5PINS	CONNEX, 112404

SCHEMATIC DIAGRAM



DEMO MANUAL DC2055A

SCHEMATIC DIAGRAM



CUSTOMER NOTICE
 THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.

APPROVALS

FOR DESIG: IZ
 APPR: HAORAN WU
 TITLE: SCHEMATIC
 HIGH EFFICIENCY HIGH CURRENT POLYPHASE SYNCHRONOUS BUCK CONVERTER WITH VERY LOW DCR INDUCTOR

REV: 2
 SHEET 2 OF 3

DATE: Tuesday, November 09, 2015

SCALE: NONE

CUSTOMER NOTICE
 THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.

APPROVALS

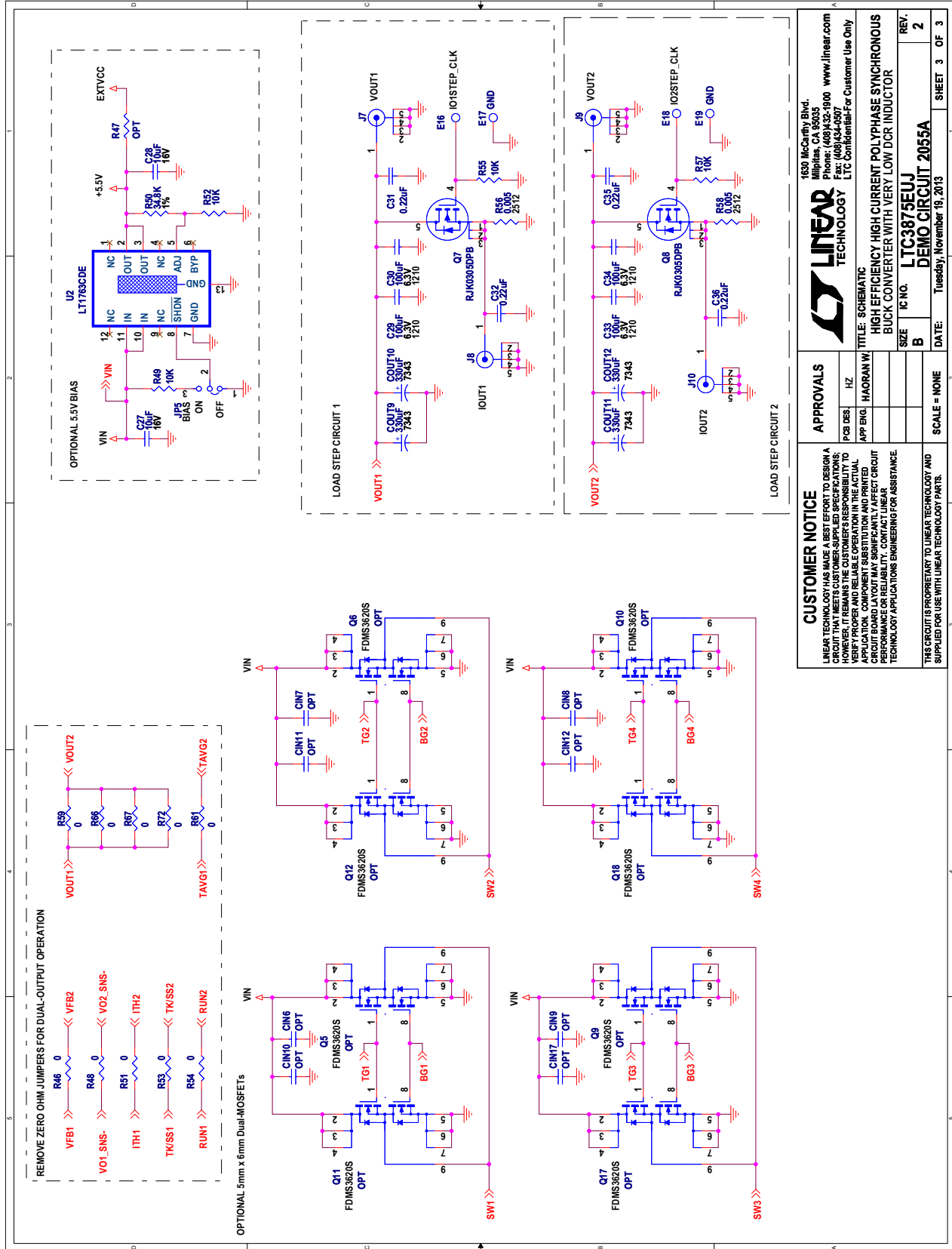
FOR DESIG: IZ
 APPR: HAORAN WU
 TITLE: SCHEMATIC
 HIGH EFFICIENCY HIGH CURRENT POLYPHASE SYNCHRONOUS BUCK CONVERTER WITH VERY LOW DCR INDUCTOR

REV: 2
 SHEET 2 OF 3

DATE: Tuesday, November 09, 2015

SCALE: NONE

SCHEMATIC DIAGRAM



APPROVALS		1630 McCarthy Blvd. Milpitas, CA 95035 Phone: (408)321-9100 www.linear.com Fax: (408)321-4507 LTC Confidential-For Customer Use Only	
DESIGN	HAORAN W	DATE:	Tuesday, November 19, 2013
APP ENG	HAORAN W	SCALE	NONE
TITLE: SCHEMATIC		SIZE	B
HIGH EFFICIENCY HIGH CURRENT POLYPHASE SYNCHRONOUS BUCK CONVERTER WITH VERY LOW DCR INDUCTOR		IC NO.	LTC3875EUJ
		REV.	2
		DEMO CIRCUIT 2055A	
		SHEET	3 OF 3

CUSTOMER NOTICE
 LINEAR TECHNOLOGY HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS. HOWEVER, LINEAR TECHNOLOGY DOES NOT WARRANT TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT LINEAR TECHNOLOGY APPLICATIONS ENGINEERING FOR ASSISTANCE.
 THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.

DEMO MANUAL DC2055A

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