LTC3884EUK

PolyPhase Single 240A Output Synchronous Buck Converter with Power System Management

DESCRIPTION

Demonstration circuit 2084A is a high efficiency, high density, single-output Buck converter with a 10V to 14V input voltage range. The output voltage is adjustable from 0.5V to 1.5V and can supply up to 240A of load current. The demo board features the LTC®3884, a dual output PolyPhase® step-down controller for ultralow DCR sensing with digital power system management. Please see the LTC3884 data sheet for more detailed information.

The DC2084A powers up to default settings and produces power based on configuration resistors or with its non-volatile memory without the need for any serial bus communication. This allows easy evaluation of the DC/DC converter. To fully explore the extensive power system management features of the part, download the GUI software LTpowerPlay® on-to your PC and use LTC's I²C/SMBus/PMBus dongle DC1613A to connect to the board. LTpowerPlay allows the user to reconfigure the part on the fly and store the configuration in EEPROM, view telemetry of voltage, current, temperature and fault status.

GUI Download—the software can be downloaded from:

http://www.linear.com/ltpowerplay

For more details and instructions of LTpowerPlay, please refer to LTpowerPlay GUI for LTC3884 demo manual.

Design files for this circuit board are available at http://www.linear.com/demo/DC2084A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		10V to 14V
Output Voltage, V_{OUT}	V_{IN} = 10V to 14V, Single Output, I_{OUT} = 0A to 240A	Default: 1V
Maximum Output Current, I_{OUT}	V_{IN} = 10V to 14V, Single Output, V_{OUT} = 0.5V to 1.5V[1]	240A
Typical Efficiency	V_{IN} = 12V, Single Output, V_{OUT} = 1.0V, 240A Load	90.4%
Peak Efficiency	V_{IN} = 12V, Single Output, V_{OUT} = 1.0V, 140A Load	91.3%
Default Switching Frequency		425kHz

Note 1: For V_{OUT} < 0.75V, f_{SW} needs to be reduced due to $t_{ON(MIN)}$ limitation.

QUICK START PROCEDURE

Demonstration circuit 2084A is easy to set up to evaluate the performance of the LTC3884. 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} (10V to 14V) and GND (input return).
2. Connect the output loads between V_{OUT} and GND (Initial load: no load). Refer to Figure 1.
3. Connect the DVMs to the input and output.
4. Check the default jumper/switch position: JP1: OFF; JP2: LOWDCR; JP3: RANGE_HIGH; JP4: OFF; JP5: INT; SW2: OFF.
5. Turn on the input power supply and adjust voltage to 12V.

   NOTE: Make sure that the input voltage does not exceed 14V.
6. Turn on the switch: SW2: ON.
7. Check for the proper output voltages from V_{OUT}^+ to V_{OUT}^-.
8. Once the proper output voltage is established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage and other parameters.
9. Connect the dongle and control the output voltage from the GUI. See the LTpowerPlay Quick Start Procedure section for details.

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.

Connecting a PC to DC2084A

You can use a PC to reconfigure the power management features of the LTC3884 such as: nominal V_{OUT}, margin set points, OV/UV limits, temperature fault limits, sequencing parameters, the fault log, fault responses and other functionality. The DC1613A dongle may be plugged when V_{IN} is present.

QUICK START PROCEDURE

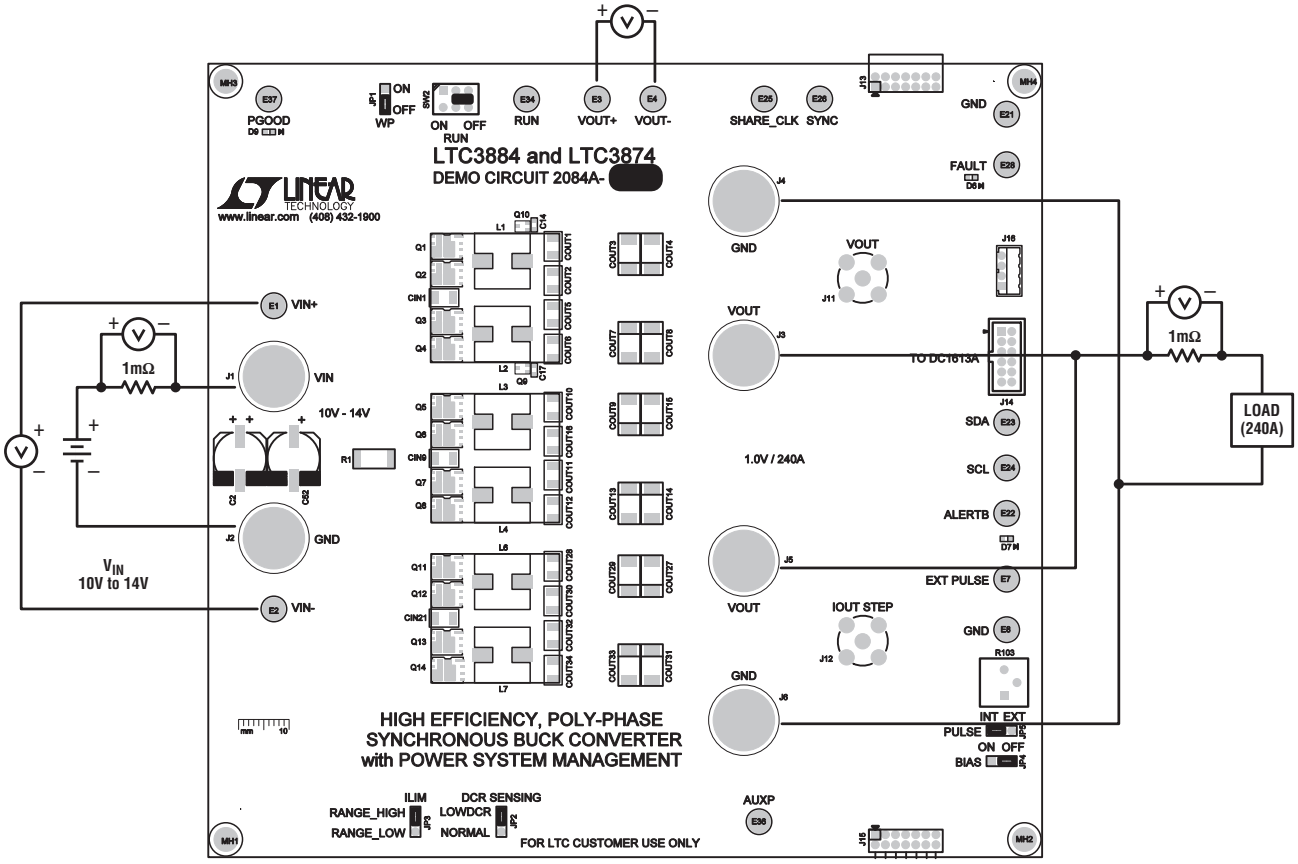


Figure 1. Proper Measurement Equipment Setup

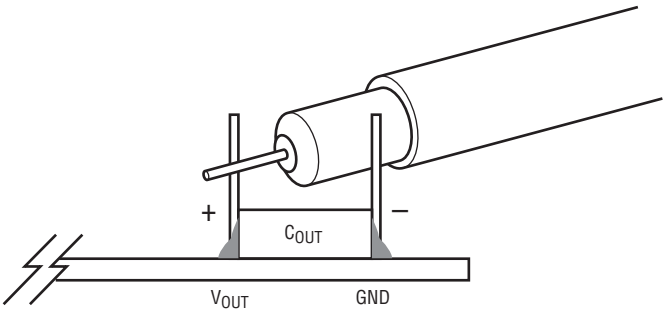


Figure 2. Measuring Output Voltage Ripple

QUICK START PROCEDURE

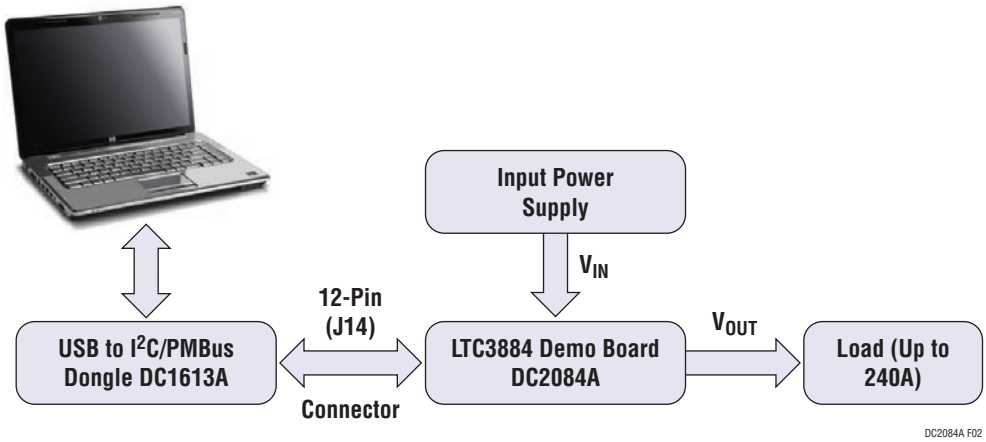


Figure 3. Demo Setup with PC

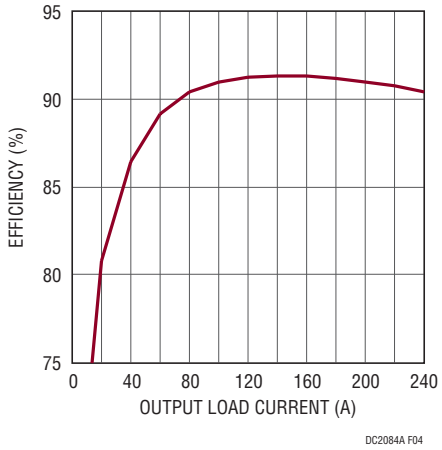


Figure 4. Efficiency vs Load Current at V_{IN} = 12V, V_{OUT} = 1V, f_{SW} = 425kHz

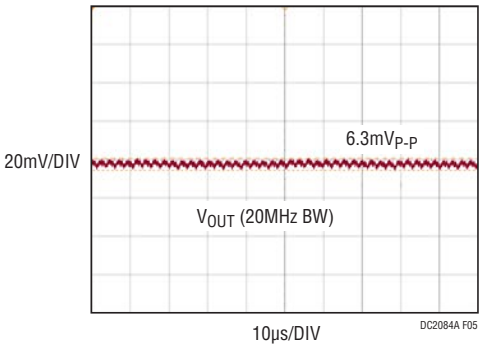


Figure 5. Output Voltage Ripple at V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 240A

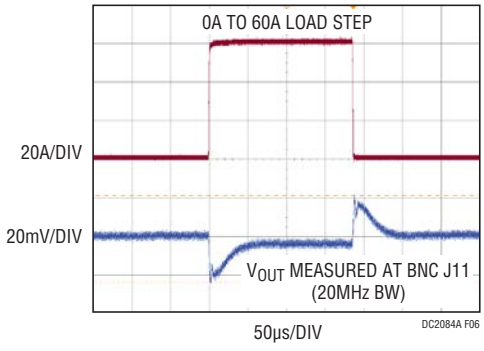


Figure 6. Transient Response at V_{IN} = 12V, V_{OUT} = 1V

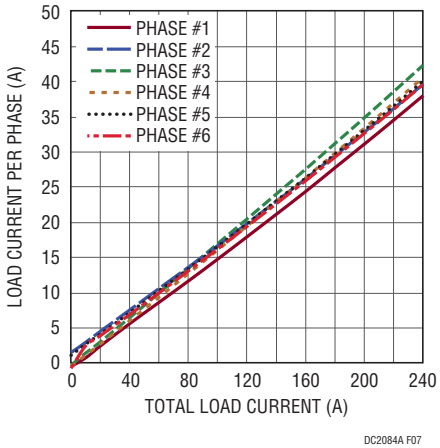


Figure 7. Current Sharing vs Load Current at V_{IN} = 12V, V_{OUT} = 1V, f_{SW} = 425kHz

QUICK START PROCEDURE

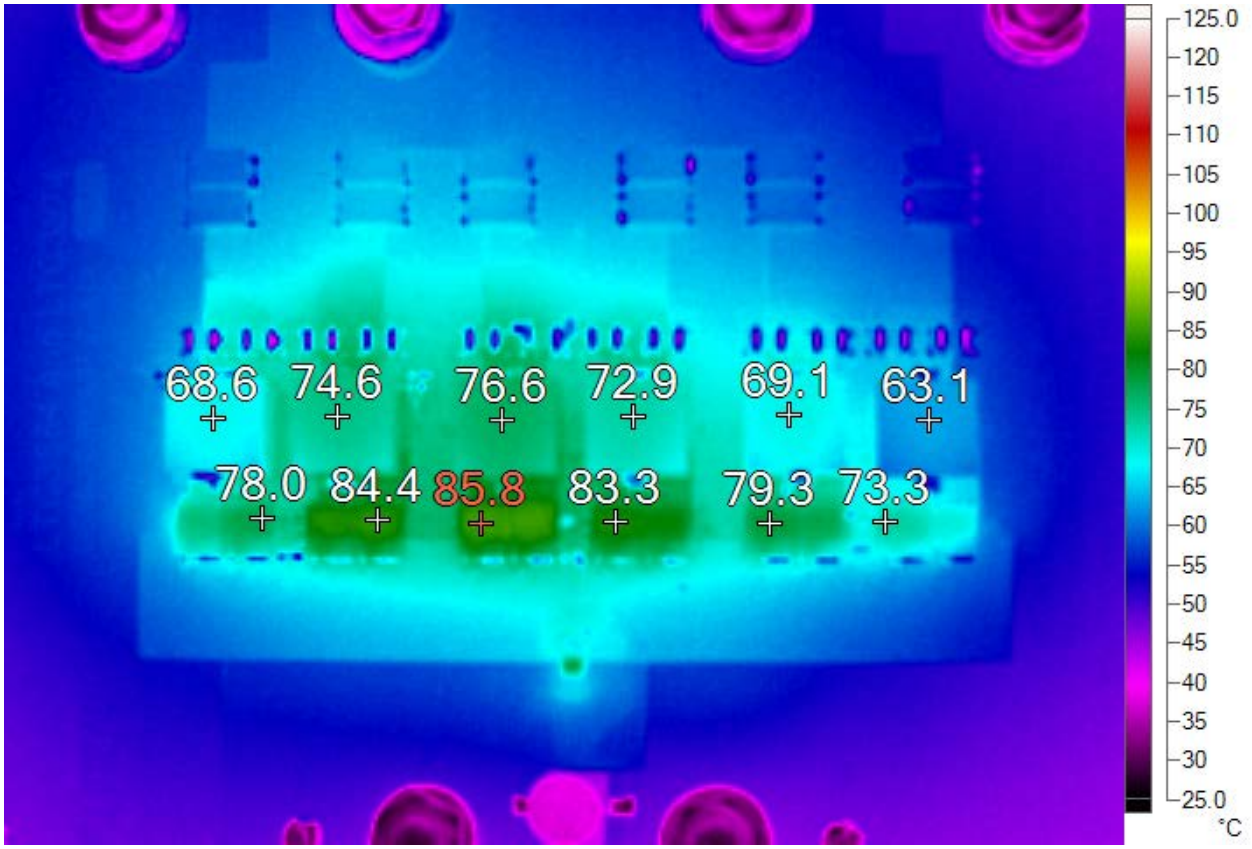


Figure 8. Thermal Performance at V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 240A, T_A = 23°C, 200LFM Airflow

LTpowerPlay SOFTWARE GUI

LTpowerPlay is a powerful Windows based development environment that supports Linear Technology power system management ICs, including the LTM4676, LTC3880, LTC3883, LTC3884, LTC2974 and LTC2978. The software supports a variety of different tasks. You can use LTpowerPlay to evaluate Linear Technology ICs by connecting to a demo board system. LTpowerPlay can also be used in an offline mode (with no hardware present) in order to build a multichip configuration file that can be saved and reloaded at a later time. LTpowerPlay provides unprecedented diagnostic and debug features. It becomes a valuable diagnostic tool during board bring-up to program or tweak the power management scheme in a system, or to diagnose power issues when bringing up rails. LTpowerPlay utilizes the DC1613A USB-to-SMBus controller to communicate with one of many potential targets, including the LTM4676, the LTC3880, LTC3884 and the LTC3883's demo system, or a customer board. The software also provides an automatic update feature to keep the software current with the latest set of device drivers and documentation. The LTpowerPlay software can be downloaded from:

http://www.linear.com/ltpowerplay

To access technical support documents for LTC Digital Power Products visit Help. View online help on the LTpowerPlay menu.

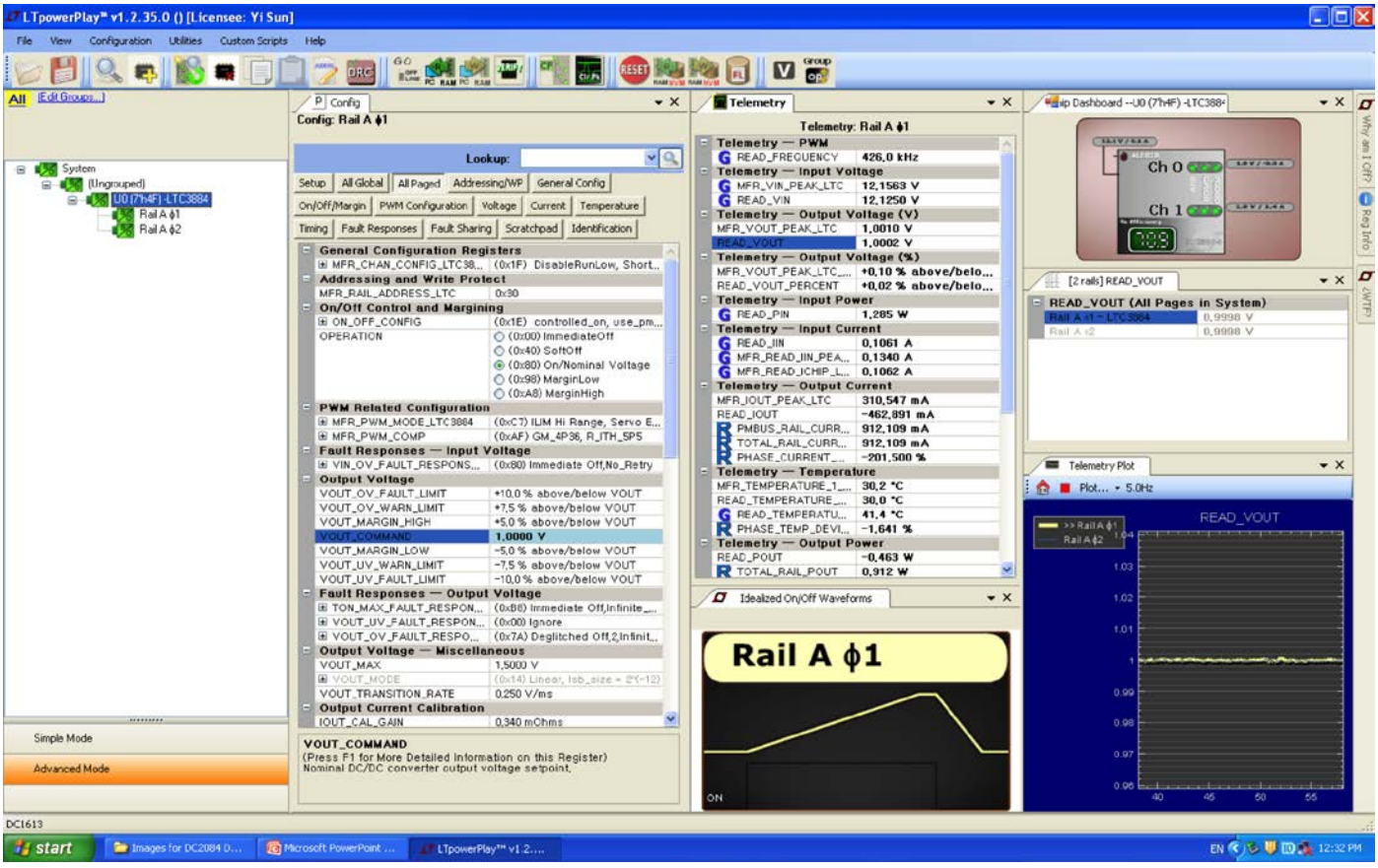


Figure 9. LTpowerPlay Main Interface

LTpowerPlay QUICK START PROCEDURE

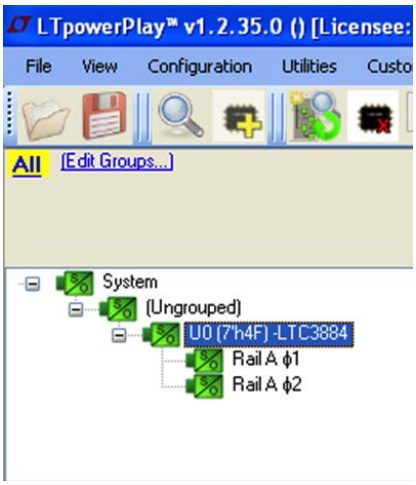
The following procedure describes how to use LTpowerPlay to monitor and change the settings of LTC3884.

1. Download and install the LTPowerPlay GUI:

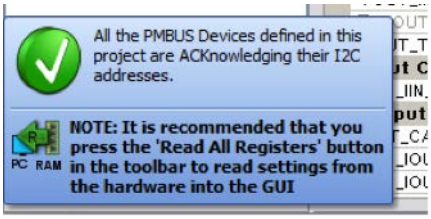
   http://www.linear.com/ltpowerplay

2. Launch the LTpowerPlay GUI.

   a. The GUI should automatically identify the DC2084A. The system tree on the left hand side should look like this:

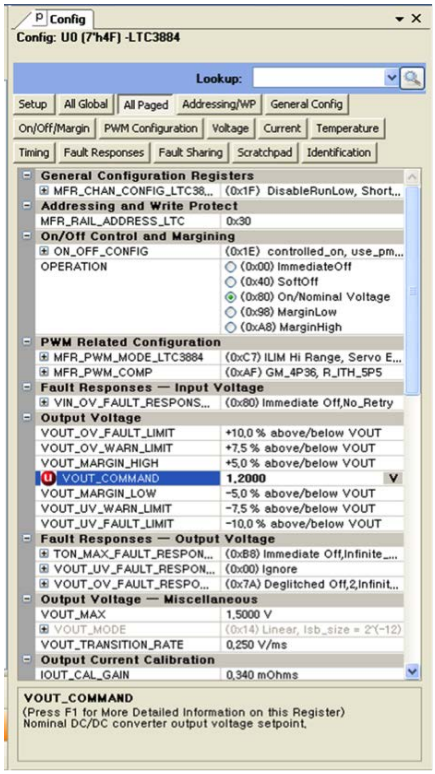


   b. A green message box shows for a few seconds in the lower left hand corner, confirming that LTC3884 is communicating:



   c. In the Toolbar, click the “R” (RAM to PC) icon to read the RAM from the LTC3884. This reads the configuration from the RAM of LTC3884 and loads it into the GUI.

   d. If you want to change the output voltage to a different value, like 1.2V. In the Config tab, type in 1.2 in the VOUT_COMMAND box, like this:



   Then, click the “W” (PC to RAM) icon to write these register values to the LTC3884. After finishing this step, you will see the output voltage will change to 1.2V.

   If the write is successful, you will see the following message:

   e. You can save the changes into the NVM. In the tool bar, click “RAM to NVM” button, as following

   f. Save the demo board configuration to a (*.proj) file. Click the Save icon and save the file with a user filename.

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	24	CIN1, CIN2, CIN3, CIN4, CIN5, CIN6, CIN7, CIN8, CIN9, CIN10, CIN11, CIN12, CIN13, CIN14, CIN15, CIN16, CIN21, CIN22, CIN23, CIN24, CIN25, CIN26, CIN27, CIN28	CAP, 1210 22µF 10% 25V X7R	MURATA GRM32ER71E226KE15L
2	19	COUT1, COUT2, COUT5, COUT6, COUT10, COUT11, COUT12, COUT16, COUT19, COUT20, COUT24, COUT25, COUT28, COUT30, COUT32, COUT34, C34, C35, COUT41	CAP, 1210 100µF 20% 6.3V X5R	TDK C3225X5R0J107M
3	22	COUT3, COUT4, COUT7, COUT8, COUT9, COUT13, COUT14, COUT15, COUT17, COUT18, COUT22, COUT23, COUT27, COUT29, COUT31, COUT33, COUT35, COUT36, COUT37, COUT38, COUT39, COUT40	CAP, 7343 470µF 20% 2.5V TANT. POLYMER	PANASONIC ETPF470M5H
4	6	C7, C19, COUT26, C41, C42, C48	CAP, 0603 1µF 20% 25V X5R	AVX 06033D105KAT2A
5	1	C1	CAP, 0603 2.2µF 20% 6.3V X5R	TAIYO YUDEN JMK105BJ225MV-T
6	4	C2, C52, C53, C54	CAP, 270µF 20% 16V OSCON	PANASONIC 16SVPC270M
7	1	C3	CAP, 0805 2.2µF 10% 16V X7R	MURATA GRM21BR71C225KA12L
8	6	C4, C6, C18, C20, C46, C47	CAP, 0603 4.7µF 10% 10V X5R	AVX 0603ZD475KAT2A
9	6	C8, C15, C25, C27, C37, C38	CAP, 0603 0.1µF 10% 25V X5R	AVX 06033C104KAT2A
10	6	C9, C16, C21, C32, C33, C36	CAP, 0603 220nF 10% 25V X7R	TDK C1608X7R1E224K
11	1	C12	CAP, 0603 330pF 5% 50V C0G	MURATA GRM1885C1H331JD01D
12	1	C13	CAP, 0603 6.8nF 10% 50V X7R	MURATA GRM188R71H682KA01B
13	3	C14, C17, C28	CAP, 0603 10nF 10% 25V X7R	AVX 06033C103KAT2A
14	2	C23, C45	CAP, 0603 22pF 5% 50V C0G	MURATA GRM1885C1H220JA01B
15	2	C30, C44	CAP, 1210 100µF 20% 10V X5R	TAIYO YUDEN LMK325ABJ107MM-T
16	1	C31	CAP, 1210 10µF 10% 16V X7R	MURATA GRM32DR71C106KA01
17	2	C39, C50	CAP, 0603 100nF 20% 16V X7R	AVX 0603YC104MAT2A
18	1	C40	CAP, 0603 150pF 5% 50V NPO	AVX 06035A151JAT2A
19	1	C43	CAP, 0603 220pF 10% 50V X7R	AVX 06035C221KAT2A
20	1	C49	CAP, 0603 47nF 10% 25V X7R	AVX 06033C473KAT
21	6	D1, D2, D3, D4, D8, D12	DIODE, SCHOTTKY 30V, 100mA	CENTRAL SEMI CMDSH-3-TR
22	2	D6, D9	LED, 0603 GREEN	WURTH ELEKTRONIK 150060GS75000
23	1	D7	LED, 0603 RED	WURTH ELEKTRONIK 150060SS75000
24	1	D13	DIODE, ULTRA LOW SCHOTTKY RECTIFIER	NXP SEMI. PMEG2005AEL,315
25	6	L1, L2, L3, L4, L6, L7	IND, 0.25µH	WURTH ELEKTRONIK 744301025
26	1	L5	IND, 68µH	SUMIDA CDRH105RNP-680N
27	12	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q11, Q12, Q13, Q14	XSTR, DUAL CHANNEL OptiMOS MOSFET	INFINEON BSG0811ND
28	2	Q9, Q10	XSTR, PNP GENERAL PURPOSE	DIODES INC. MMST3906-7-F
29	2	Q20, Q29	XSTR, P-CHANNEL DMOS FET	DIODES INC. DMP3130L-7
30	2	Q21, Q26	XSTR, N-CHANNEL DMOS FET	FAIRCHILD 2N7002A
31	2	Q23, Q24	XSTR, MOSFET, N-CHANNEL 30V	VISHAY SUD50N03-10CP-E3

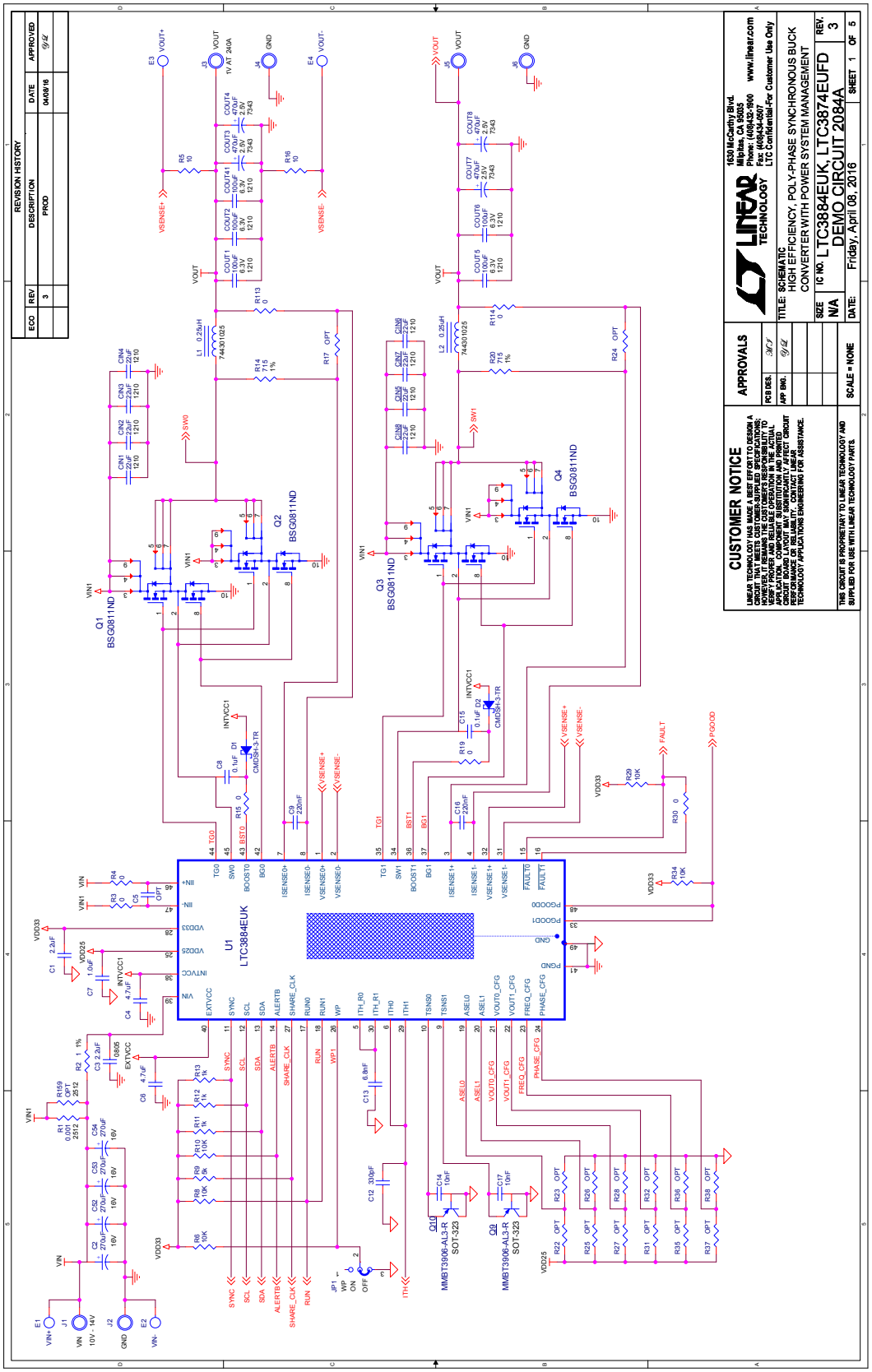
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
32	1	R1	RES, 2512 0.001Ω 1% 1W	VISHAY WSL25121L000FEA
33	1	R2	RES, 0603 1Ω 1% 1/10W	VISHAY CRCW06031R00FNEA
34	23	R3, R4, R15, R19, R30, R51, R52, R53, R54, R60, R83, R84, R91, R113, R114, R117, R118, R127, R137, R138, R140, R148, R149	RES, 0603 0Ω JUMPER	VISHAY CRCW06030000Z0EA
35	1	R5	RES, 0603 10Ω 1% 0.1W	VISHAY CRCW060310R0FKEA
36	7	R6, R8, R10, R56, R98, R108, R123	RES, 0603 10kΩ 5% 0.1W	VISHAY CRCW060310K0JNEA
37	1	R9	RES, 0603 5kΩ 5% 0.1W	VISHAY CRCW06035K00JNED
38	3	R11, R12, R13	RES, 0603 1kΩ 5% 0.1W	VISHAY CRCW06031K00JNEA
39	6	R14, R20, R135, R143, R144, R157	RES, 0603 715Ω 1% 0.1W	VISHAY CRCW0603715RFKEA
40	1	R16	RES, 0603 10Ω 1% 1/10W	VISHAY CRCW060310R0FKEA
41	2	R29, R34	RES, 0603 10kΩ 5% 0.1W	VISHAY CRCW060310K0JNEA
42	2	R49, R50	RES, 0603 2Ω 1% 0.1W	VISHAY CRCW06032R00FNEA
43	2	R55, R58	RES, 0603 100kΩ 5% 0.1W	VISHAY CRCW0603100KJNEA
44	5	R59, R95, R96, R107, R158	RES, 0603 20kΩ 5% 0.1W	VISHAY CRCW060320K0JNEA
45	1	R70	RES, 0603 10Ω 5% 0.1W	VISHAY CRCW060310R0JNEA
46	2	R79, R130	RES, 0603 200Ω 5% 0.1W	VISHAY CRCW0603200RJNEA
47	1	R81	RES, 0603 127Ω 1% 0.1W	VISHAY CRCW0603127RFKEA
48	1	R89	RES, 0603 2Ω 5% 0.1W	VISHAY CRCW06032R00JNED
49	1	R92	RES, 0603 3.3Ω 1% 0.1W	VISHAY CRCW06033R30FNEA
50	1	R93	RES, 0603 154kΩ 5% 0.1W	VISHAY CRCW0603154KJNEA
51	1	R94	RES, 0603 1MΩ 5% 0.1W	VISHAY CRCW06031M00JNEA
52	1	R97	RES, 0603 681kΩ 1% 0.1W	VISHAY CRCW0603681KFEA
53	1	R99	RES, 0603 301Ω 1% 0.1W	VISHAY CRCW0603301RFKEA
54	1	R100	RES, 0603 82.5Ω 5% 0.1W	VISHAY CRCW060382R5FKEA
55	2	R101, R102	RES, 2512 0.01Ω 1% 1W	VISHAY WSL2512R0100FEA
56	1	R103	RES, VARIABLE 5K	BOURNS 3386P-1-502-LF
57	1	R104	RES, 0603 1.21kΩ 1% 0.1W	VISHAY CRCW06031K21FKEA
58	1	R105	RES, 0603 118kΩ 1% 0.1W	VISHAY CRCW0603118KFKEA
59	1	R106	RES, 0603 80.6kΩ 1% 0.1W	VISHAY CRCW060380K6FKEA
60	2	R128, R150	RES, 0603 4.99kΩ 1% 0.1W	VISHAY CRCW06034K99FKEA
61	1	R147	RES, 0603 15.8kΩ 1% 0.1W	VISHAY CRCW060315K8FKEA
62	1	U1	IC, DUAL OUTPUT STEP-DOWN CONTROLLER	LINEAR TECH. LTC3884EUK#10EV-1PBF-ES
63	2	U2, U7	IC, STEP-DOWN SLAVE CONTROLLER	LINEAR TECH.LTC3874EUFD
64	1	U4	IC, SYNCHRONOUS STEP-DOWN CONVERTER	LINEAR TECH. LTC3630EMSE
65	1	U5	IC, TIMER BLOX: VOLTAGE CONTROLLED (PWM)	LINEAR TECH. LTC6992IS6-1
66	1	U6	IC, OP AMP	LINEAR TECH. LT1803IS5
67	1	U8	IC, SERIAL EEPROM	MICROCHIP 24LC024-I/ST

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	0	C5, C51	CAP, 0603 OPTION	OPTION
2	0	D11	DIODE, SCHOTTKY 30V, 100mA OPTION	CENTRAL SEMI CMDSH-3-TR OPTION
3	0	R17, R22, R23, R24, R25, R26,R27, R28, R31, R32, R35, R36, R37, R38, R87, R122, R134, R136, R141, R142, R145, R146, R151, R156	RES, 0603 OPTION	OPTION
4	0	R85, R159	RES, 2512 OPTION	OPTION
5	0	R139	RES, 1206 OPTION	OPTION
Hardware: For Demo Board Only				
1	16	E1, E2, E3, E4, E7, E8, E21, E22, E23, E24, E25, E26, E28, E34, E36, E37	TURRET	MILL MAX 2501-2-00-80-00-00-07-0
2	5	JP1, JP2, JP3, JP4, JP5	HEADER, SINGLE ROW 3-PIN	SAMTEC TMM-103-02-L-S
3	6	J1, J2, J3, J4, J5, J6	STUD, TEST PIN	PEM KFH-032-10
4	14		NUT, BRASS 10-32	ANY #10-32
5	7		LUG RING, #10	KEYSTONE 8205
6	7		WASHER, #10 TIN PLATED BRASS	ANY #10 EXT BZ TN
7	2	J11, J12	CONN, BNC, 5 PINS	CONNEX 112404
8	1	J13	CONN, SOCKET 14-PIN DUAL ROW R/A	SULLINSINC. NPPN072FJFN-RC
9	1	J14	HEADER, 12-PIN 2mm STR DL	FCI 98414-G06-12ULF
10	1	J15	HEADER, 14-PIN DUAL ROW R/A	MOLEX 87760-1416
11	1	J16	HEADER, 4-PIN 2mm STR DL	HIROSE DF3A-4P-2DSA
12	4	MH1, MH2, MH3, MH4	STANDOFF, SNAP ON	KEYSTONE 8834
13	1	SW2	SWITCH, SUBMINATURE SLIDE	C&K JS202011CQN
14	5	XJP1, XJP2, XJP3, XJP4, XJP5	SHUNT	SAMTEC 2SN-BK-G

SCHEMATIC DIAGRAM



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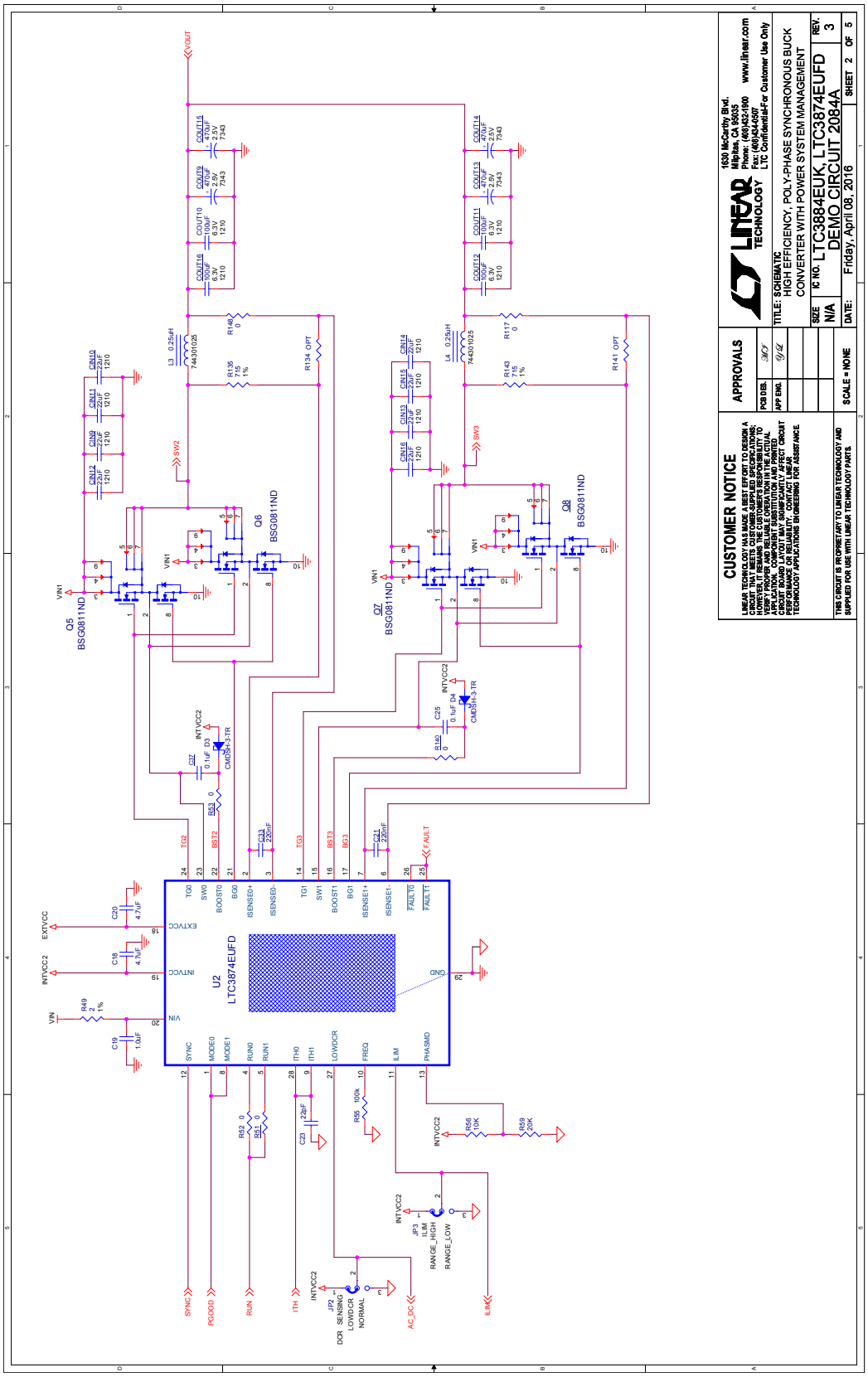
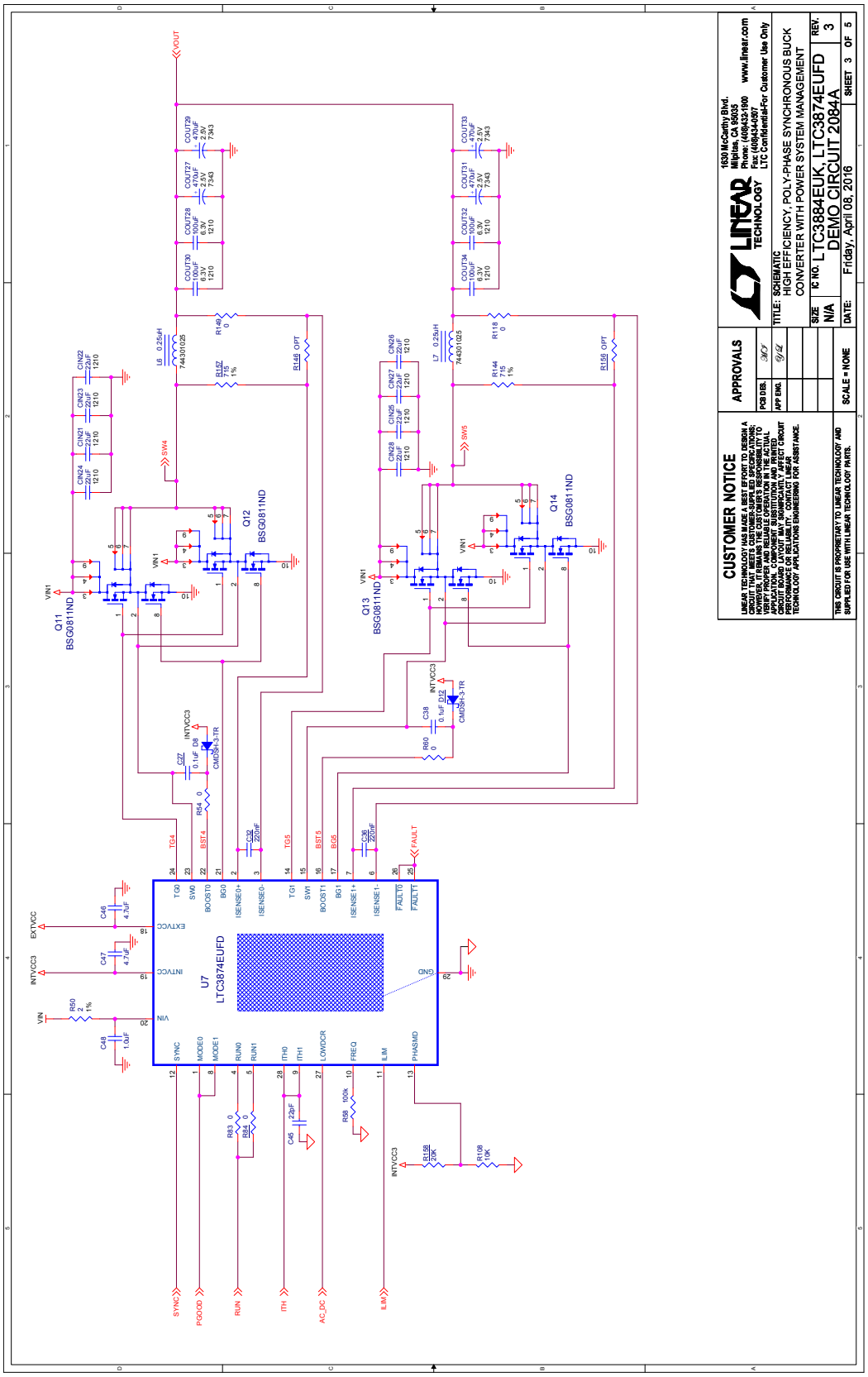
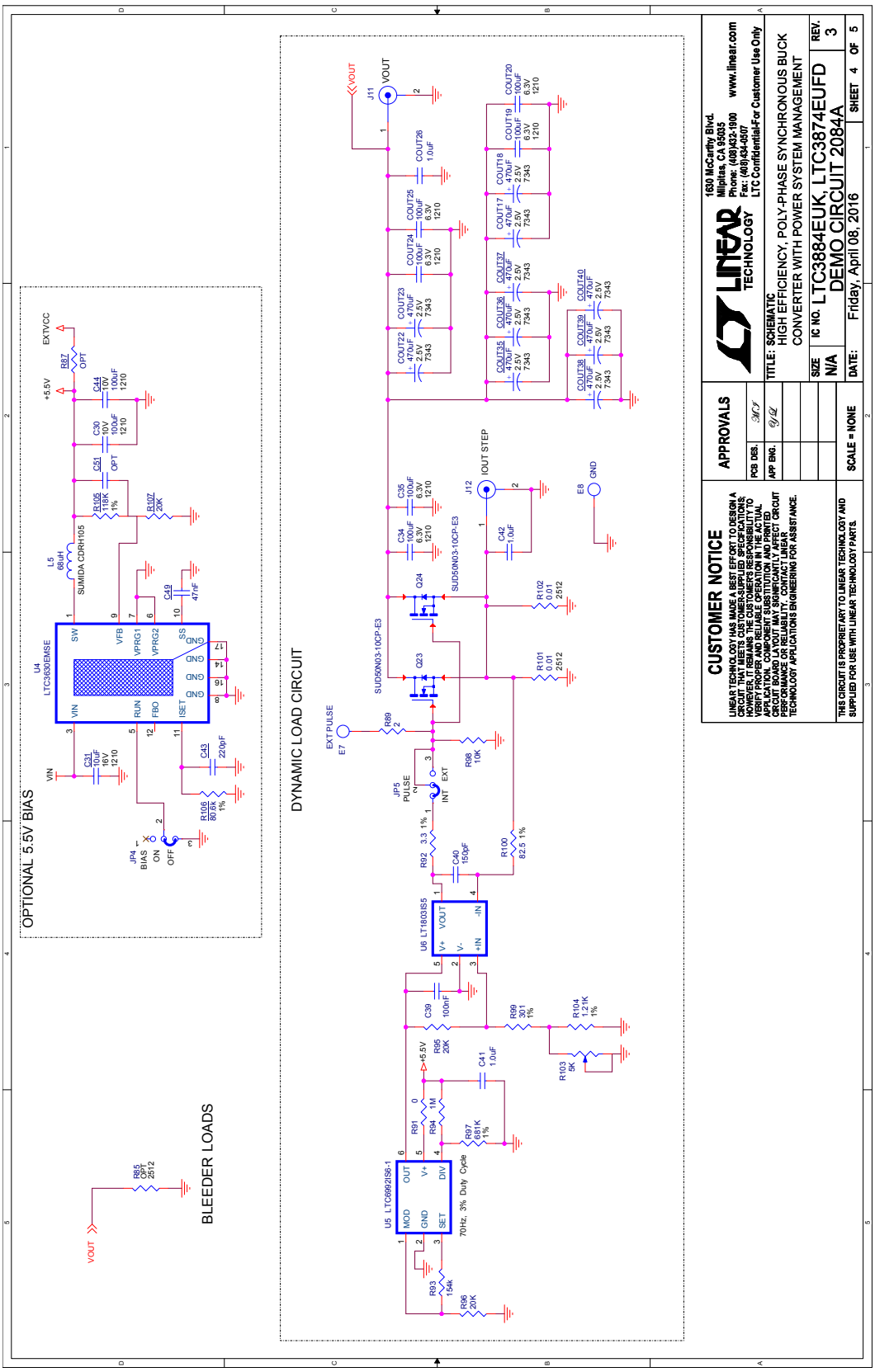


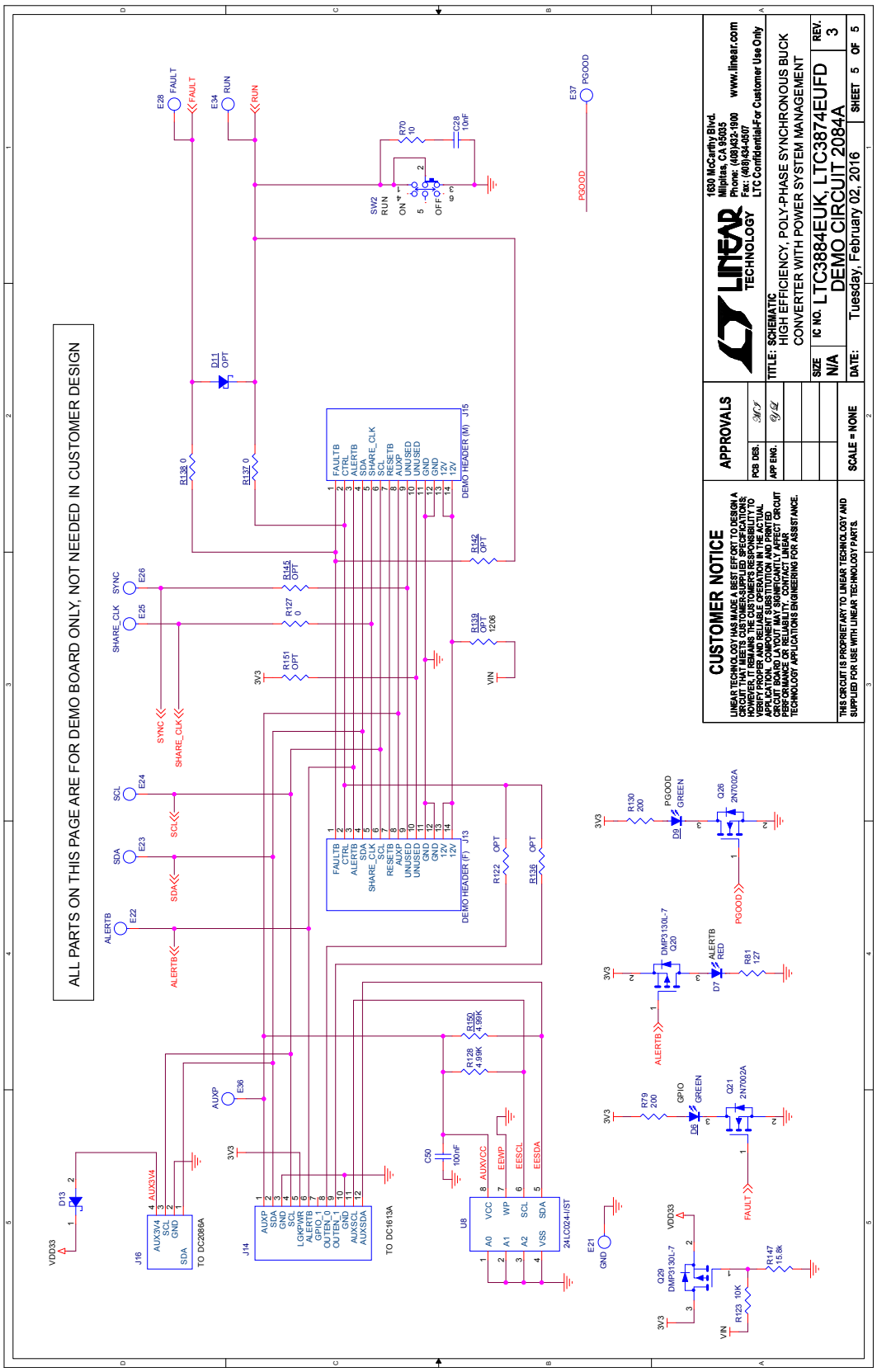
SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



DEMONSTRATION BOARD IMPORTANT NOTICE

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LT 0716 • PRINTED IN USA