

LTC3892-2EUH Dual Output SEPIC and Buck Converter

DESCRIPTION

Demonstration circuit 2727A is a high input voltage, high efficiency dual output DC/DC converter. It features the [LTC®3892-2](#), a low I_Q , dual output, 2-phase synchronous step-down DC/DC controller. This demo board operates over a 6V to 40V input voltage range and produces a 3.3V at 10A and a 12V at 3A output.

The 12V output is designed using a SEPIC converter which allows a stable output voltage from an input voltage that can be above, below or equal to the output voltage. The 3.3V is provided using a synchronous step-down converter. These output voltages can easily be changed with certain modifications.

The gate drive voltage can be adjusted from 5V to 10V allowing the use of logic or standard level MOSFETs. The DC2727A supports three operation modes: forced continuous mode, pulse-skipping and Burst Mode® operation during light loads. Forced continuous mode reduces output voltage ripple and yields a low noise switching spectrum. The pulse-skipping and burst modes increased efficiency at light loads.

Both outputs of the DC2727A switch out of phase to reduce input filtering. The DC2727A supports selectable current limit and provides very low dropout operation with its 99% duty cycle capability. The DC2727A has a standard operating frequency of 250kHz, but can be adjusted in a range between 75kHz and as high as 850kHz. In addition, the LTC3892-2 integrates the bootstrap diodes which simplifies the design.

The DC2727A was designed to support multiple footprints of input/output capacitors and inductors to accommodate variety of applications. The data sheet of LTC3892-2 gives a complete description and application information, and must be read in conjunction with this demo board manual for DC2727A.

Design files for this circuit board are available at <http://www.analog.com/DC2727A>

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PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

| PARAMETER | CONDITIONS/NOTES | VALUE |
|--------------------------------------|---|----------------------|
| Minimum Input Voltage | | 6V |
| Maximum Input Voltage | | 40V |
| Output Voltage V_{OUT1} Regulation | $V_{IN} = 6V - 40V$ | $3.3V \pm 2\%$ |
| Output Voltage V_{OUT2} Regulation | $V_{IN} = 6V - 40V$ | $12V \pm 2\%$ |
| Maximum Continuous Output Current | V_{OUT1} | 10A |
| Maximum Continuous Output Current | V_{OUT2} | 3A |
| Preset Operating Frequency | | 250kHz |
| External Clock Sync. Frequency Range | | 75kHz – 850kHz |
| Efficiency | $V_{IN} = 14V, V_{OUT2} = 12V, I_{OUT} = 3A$ $V_{OUT1} = 3.3V, I_{OUT} = 10A$ See Figures 3 and 4 for Efficiency Curves | 92% 94% |
| Typical Output Ripple V_{OUT} | $V_{IN} = 14V, V_{OUT2} = 12V, I_{OUT} = 3A$ (20MHz BW) | <45mV _{P-P} |
| Quiescent Current at Shutdown | $V_{IN} = 6V - 40V$ | <50 μ A |

QUICK START PROCEDURE

Demonstration circuit 2727A is easy to set up to evaluate the performance of the LTC3892-2. For proper measurement equipment configuration, set up the circuit according to the diagram in Figure 1. Before proceeding to test, insert shunts into JP1, JP2 (RUN1, 2) into OFF position, which connects the RUN pins to ground (GND), and thus shuts down the outputs.

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 2 for proper scope probe technique.

1. With the DC2727A set up according to the proper measurement and equipment in Figure 1, apply 14V at V_{IN} . Measure V_{OUT1} and V_{OUT2} , both should read 0V.

2. Turn on V_{OUT1} of the circuit by inserting the shunt in header JP1 (RUN1) into the ON position. Voltage should be regulating. Measure V_{OUT1} , it should measure $3.3V \pm 2\%$ (do not apply more than the rated maximum voltage of 40V to the board or the part may be damaged). Vary the V_{OUT1} load, which should not exceed 10A. Vary the input voltage from 6V to 40V. V_{OUT1} should measure $3.3V \pm 2\%$.
3. Turn on V_{OUT2} of the circuit by inserting the shunt in header JP2 (RUN2) into the ON position. The output voltage should be regulating. Measure V_{OUT2} , it should measure $12V \pm 2\%$ (do not apply more than the rated maximum voltage of 40V to the board or the part may be damaged). Vary the V_{OUT2} load, which should not exceed 3A. Vary the input voltage from 6V to 40V. V_{OUT2} should measure $12V \pm 2\%$.

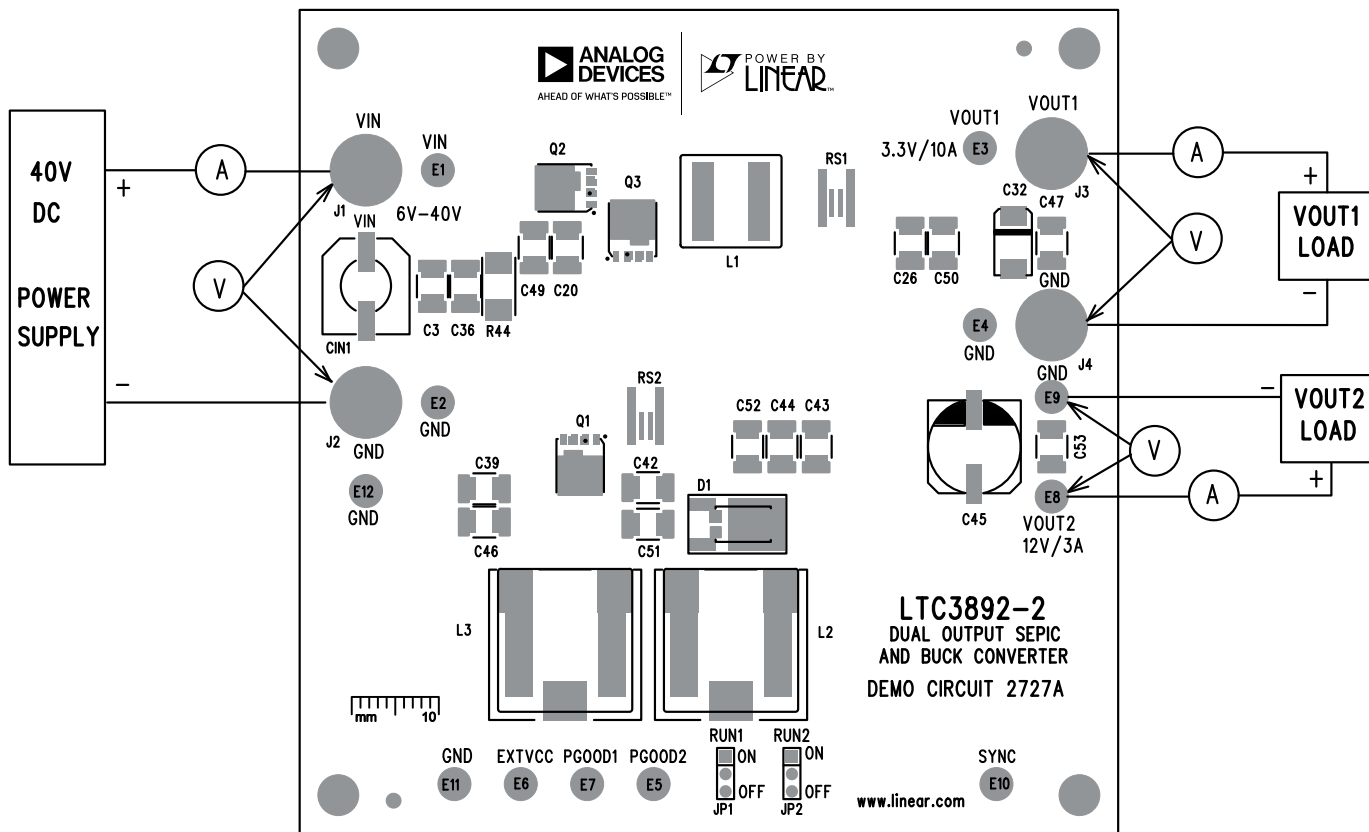


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

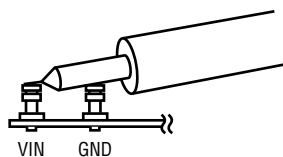


Figure 2. Measuring Input or Output Ripple

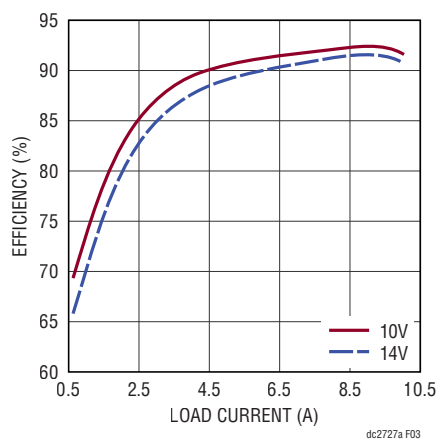


Figure 3. Efficiency vs Input Voltage and Load Current, V_{OUT} 3.3V for V_{IN} 10V and 14V

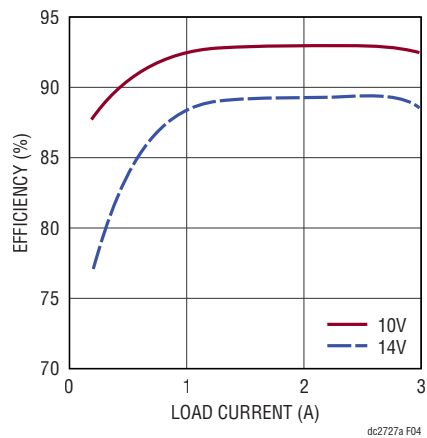


Figure 4. Efficiency vs Input Voltage and Load Current, V_{OUT} 12V for V_{IN} 10V and 14V

QUICK START PROCEDURE

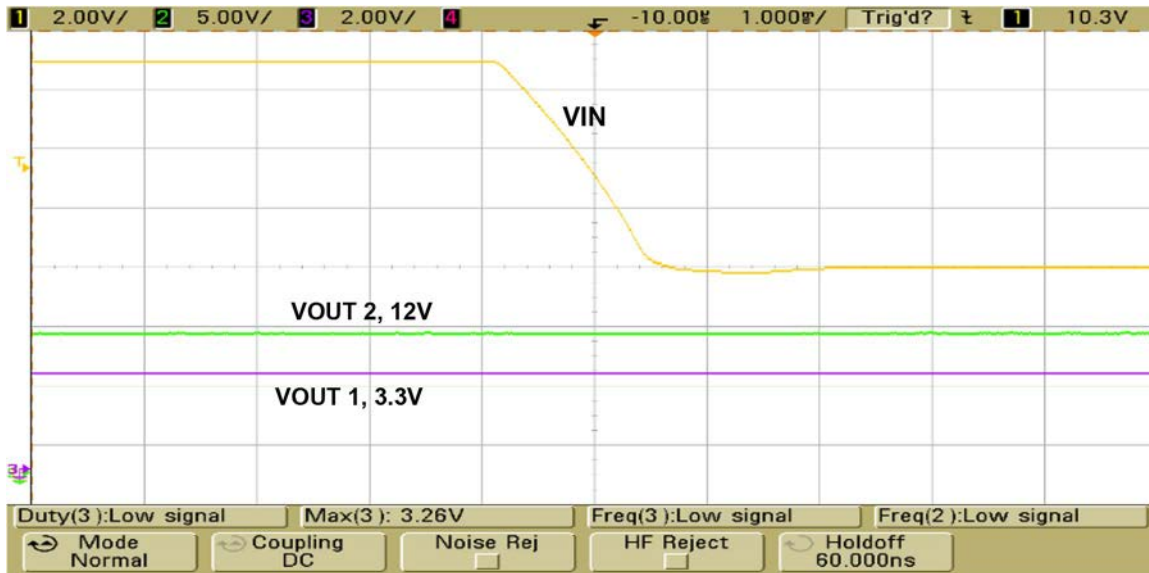


Figure 5. Model of the Cold Cranking. The Rail Voltage Drops from 14V to 7V, However, both V_{OUT1} and V_{OUT2} Stay in Regulation. CH1 V_{IN} , 2V/DIV; CH2 V_{OUT2} , 5V/DIV; CH3 V_{OUT1} , 2V/DIV; 1ms/DIV.

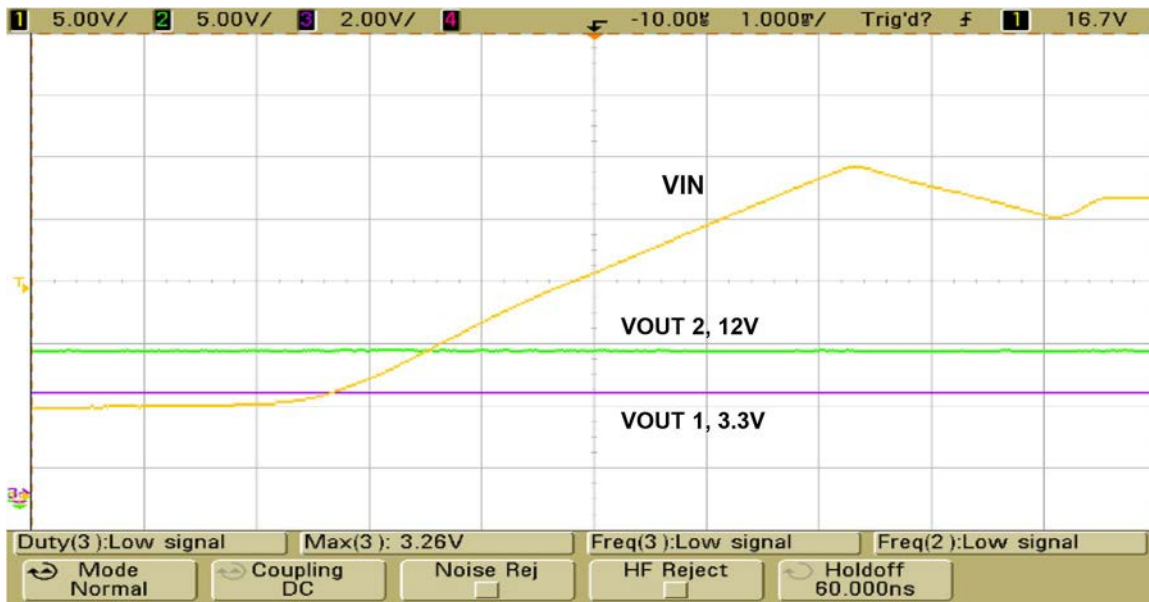


Figure 6. Model of the Load Dump. The Rail Voltage Rises from 14V to 24V, However, Both V_{OUT1} and V_{OUT2} Stay in Regulation. CH1 V_{IN} , 5V/DIV; CH2 V_{OUT2} , 5V/DIV; CH3 V_{OUT1} , 2V/DIV; 1ms/DIV.

QUICK START PROCEDURE

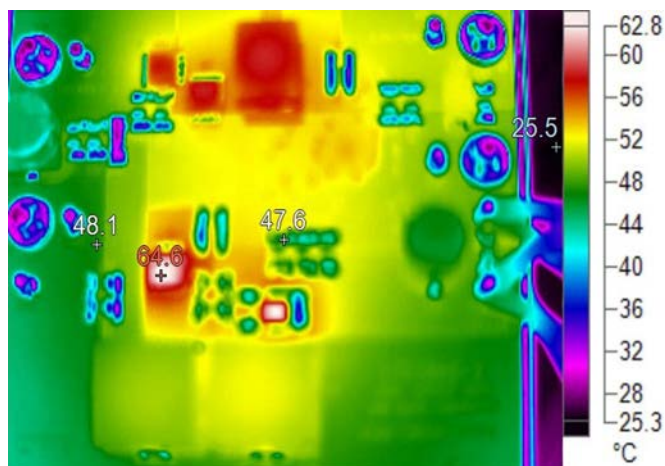


Figure 7. Thermal Map, V_{IN} 14V, V_{OUT1} 3.3V at 10A, V_{OUT2} 12V at 3.0A. No Airflow.

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|------------------------------------|-----|--|--|-------------------------------|
| Required Circuit Components | | | | |
| 1 | 1 | CIN1 | CAP, ALUM., 47 μ F, 63V, 20%, 10 \times 10.5 | SUN ELECT., 63HVH47M |
| 2 | 19 | C2, C3, C4, C20, C26, C36, C37, C38, C39, C42, C43, C44, C46, C47, C49, C50, C51, C52, C53 | CAP, 10 μ F, X7R, 50V, 10%, 1210 | AVX, 12105C106KAT2A |
| 3 | 1 | C5 | CAP, 0.1 μ F, X7R, 100V, 10%, 0805 | AVX, 08051C104KAT2A |
| 4 | 1 | C6 | CAP, 4.7 μ F, X5R, 50V, 10%, 0805 | MURATA, GRM21BR61E475KA12L |
| 5 | 5 | C8, C15, C16, C21, C22 | CAP, 0.1 μ F, X7R, 100V, 10%, 0603 | MURATA, GRM188R72A104KA35D |
| 6 | 1 | C9 | CAP, 1 μ F, X5R, 35V, 10%, 0603 | TAIYO YUDEN, GMK107BJ105KA-T |
| 7 | 1 | C11 | CAP, 47nF, X7R, 50V, 10%, 0603 | MURATA, GCM188R71H473KA55D |
| 8 | 1 | C12 | CAP, 0.01 μ F, X7R, 50V, 10%, 0603 | KEMET, C0603C103K5RACTU |
| 9 | 1 | C13 | CAP, 330pF, C0G, 50V, 5%, 0603 | MURATA, GRM1885C1H331JA01D |
| 10 | 1 | C14 | CAP, 100pF, NPO, 100V, 10%, 0603 | AVX, 06031A101KAT2A |
| 11 | 2 | C17, C18 | CAP, 1000pF, NPO, 50V, 10%, 0603 | AVX, 06035A102KAT2A |
| 12 | 1 | C32 | CAP, POSCAP, 470 μ F, 6.3V, 7343, D4 CASE | PANASONIC, 6TPE470MI |
| 13 | 1 | C45 | CAP, ALUM POLY., 330 μ F, 16V, 20%, 10 \times 12.5 | PANASONIC, 16SVP330M |
| 14 | 1 | D1 | DIODE, SBR 60V 8A, POWERDI5 | DIODES, SBR8U60P5-13 |
| 15 | 1 | L1 | IND., PWR., 2.2 μ H, IND-744393 | WURTH ELEKTRONIK, 74439369022 |
| 16 | 2 | L2, L3 | IND., 18 μ H, 9.8A, 13.8 M Ω | PULSE ELECT., PG0936.183NL |

DEMO MANUAL DC2727A

PARTS LIST

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER/PART NUMBER |
|------|-----|---|---|----------------------------------|
| 17 | 2 | Q1, Q3 | XSTR., MOSFET, N-CH, 60V, 100A, TDSON-8 | INFINEON, BSC028N06LS3 G |
| 18 | 1 | Q2 | XSTR., MOSFET, N-CH, 60V, 50A, TDSON-8 | INFINEON, BSC100N06LS3 G |
| 19 | 1 | RS1 | RES. SENSE., 0.002Ω, 1W, 1%, 2010 | SUSUMU, KRL3216-C-R002-F-T1 |
| 20 | 1 | RS2 | RES. SENSE., 0.004Ω, 1W, 1%, 2010 | SUSUMU, KRL3216-C-R004-F-T1 |
| 21 | 1 | R1 | RES., 0Ω, 1/18W, 0805 | VISHAY, CRCW08050000Z0EA |
| 22 | 14 | R2, R10, R12, R13, R16, R18, R19, R23, R30, R33, R34, R35, R48, R50 | RES., 0Ω, 1/10W, 0603 | VISHAY, CRCW06030000Z0EA |
| 23 | 2 | R8, R24 | RES., 100k, 1/10W, 1%, 0603 | VISHAY, CRCW0603100KFKEA |
| 24 | 2 | R9, R15 | RES., 1M, 1/10W, 1%, 0603 | VISHAY, CRCW06031M00FKEA |
| 25 | 1 | R14 | RES., 43.2k, 1/10W, 1%, 0603 | VISHAY, CRCW060343K2FKEA |
| 26 | 1 | R21 | RES., 7.5k, 1/10W, 1%, 0603 | VISHAY, CRCW06037K5FKEA |
| 27 | 1 | R22 | RES., 4.75k, 1/10W, 1%, 0603 | VISHAY, CRCW06034K75FKEA |
| 28 | 1 | R25 | RES., 7.15k, 1/10W, 1%, 0603 | VISHAY, CRCW06037K15FKEA |
| 29 | 2 | R36, R37 | RES., 1MΩ, 1/10W, 1%, 0805 | VISHAY, CRCW08051M00FKEA |
| 30 | 2 | R38, R39 | RES., 237k, 1/10W, 1%, 0603 | VISHAY, CRCW0603237KFKEA |
| 31 | 1 | R44 | RES., 0Ω, R-S1911 | HARWIN, S1911-46R |
| 32 | 1 | R47 | RES, 0603 150Ω 1% 0.1W | VISHAY, CRCW0603150RFKEA |
| 33 | 1 | R48 | RES., 51.1Ω, 1/10W, 1%, 0603 | VISHAY, CRCW060351R1FKEA |
| 34 | 1 | U1 | I.C., LTC3892EUH-2#PBF, QFN32UH-5X5 | ANALOG DEVICES, LTC3892EUH-2#PBF |

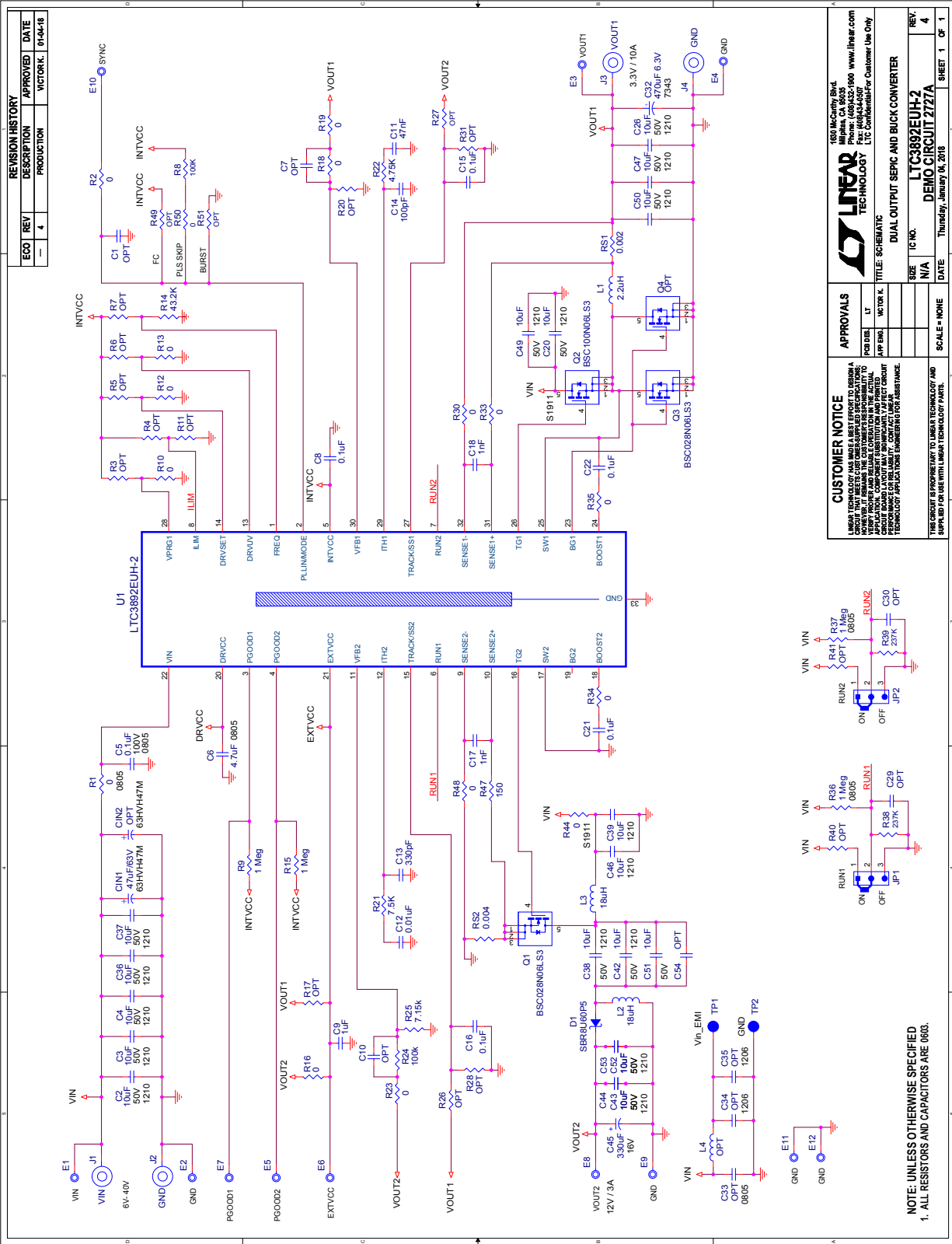
Additional Demo Board Circuit Components

| | | | | |
|--|--|---|------------------------|-----|
| | | CIN2 | CAP, OPTION, 10 × 10.5 | OPT |
| | | C1, C7, C10, C29, C30 | CAP, OPTION, 0603 | OPT |
| | | C33 | CAP, OPTION, 0805 | OPT |
| | | C34, C35 | CAP, OPTION, 1206 | OPT |
| | | C54 | CAP, OPTION, 1210 | OPT |
| | | L4 | IND., OPTION | OPT |
| | | Q4 | XSTR., MOSFET, OPTION | OPT |
| | | R3, R4, R5, R6, R7, R11, R17, R20, R26, R27, R28, R31, R40, R41, R49, R51 | RES., OPTION, 0603 | OPT |

Hardware

| | | | | |
|--|----|------------------|--|-----------------------------------|
| | 12 | E1-E12 | TEST POINT, TURRET, 0.094" MTG. HOLE | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| | 2 | JP1, JP2 | CONN., HDR, MALE, 1 × 3, 2mm, THT, STR | WURTH ELEKTRONIK, 62000311121 |
| | 2 | XJP1, XJP2 | CONN., SHUNT, FEMALE, 2 POS, 2mm | WURTH ELEKTRONIK, 60800213421 |
| | 4 | J1, J2, J3, J4 | CONN., BANANA JACK, 0.218" | KEYSTONE, 575-4 |
| | 3 | XJP1, XJP2, XJP3 | SHUNT | SAMTEC 2SN-BK-G |

SCHEMATIC DIAGRAM



| REVISION HISTORY | | | |
|------------------|-----|-------------|--------------------|
| ECO | REV | DESCRIPTION | APPROVED DATE |
| — | 4 | PRODUCTION | VICTOR.K. 01/04/08 |

LINTECH TECHNOLOGY
1850 McCarty Blvd.
Milpitas, CA 95035
Phone: (408) 592-9900 www.linear.com

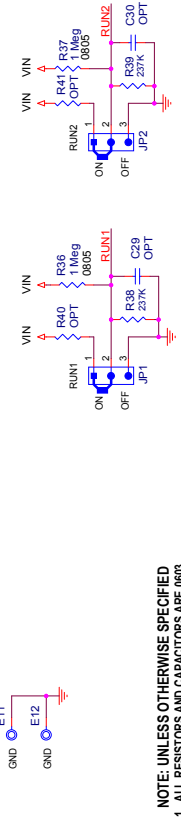
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APPROVALS
 PCB DES: LT
 APP ENG: WYTOR.K.
 TITLE: SCHEMATIC

DUAL OUTPUT SEPIC AND BUCK CONVERTER

IC NO: LTC3892EUH-2
 REV: 4
 DEMO CIRCUIT 2727A

DATE: Thursday, January 09, 2008
 SHEET: 1 OF 1





ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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