

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.linear.com/demo/DC2727A>

All registered trademarks and trademarks are the property of their respective owners.

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	$V_{IN} = 6V - 40V$	$<50\mu A$

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 $12V \pm 2\%$.

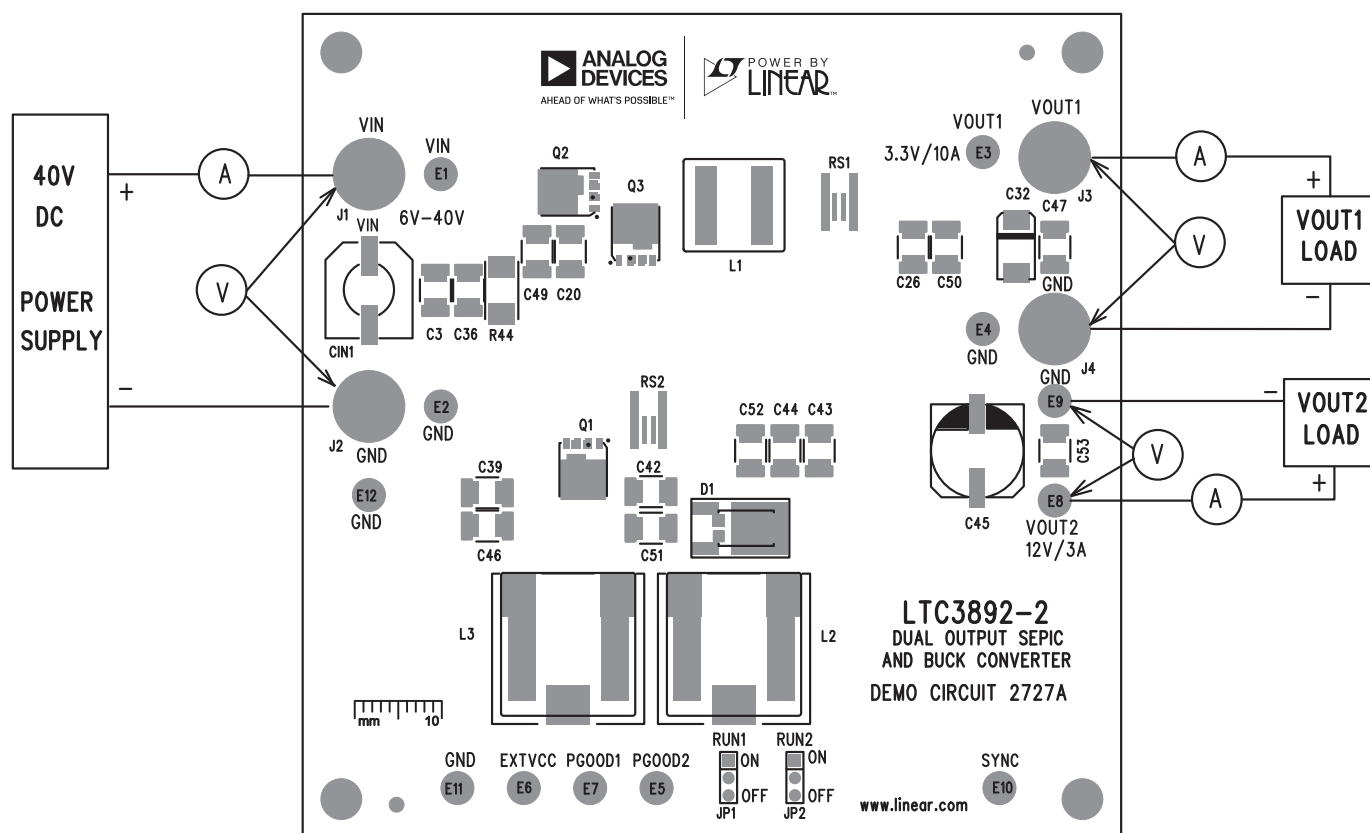


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

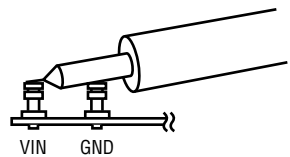


Figure 2. Measuring Input or Output Ripple

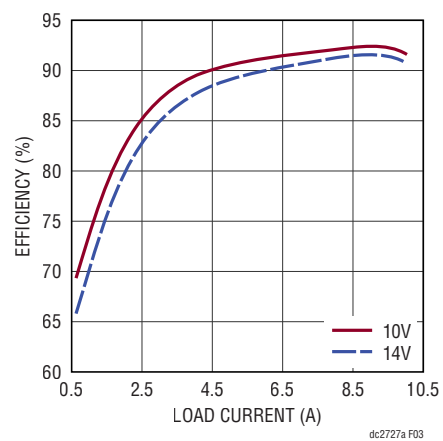


Figure 3. Efficiency vs Input Voltage and Load Current, V_{OUT} 3.3V for V_{IN} 10V and 14V

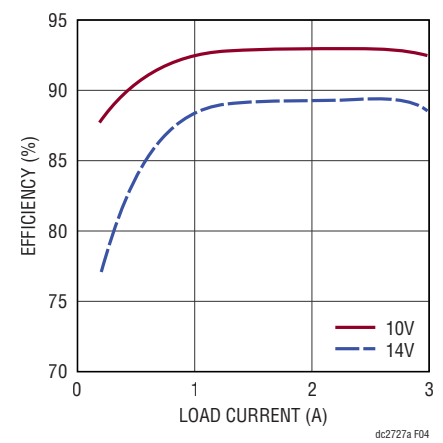


Figure 4. Efficiency vs Input Voltage and Load Current, V_{OUT} 12V for V_{IN} 10V and 14V

QUICK START PROCEDURE

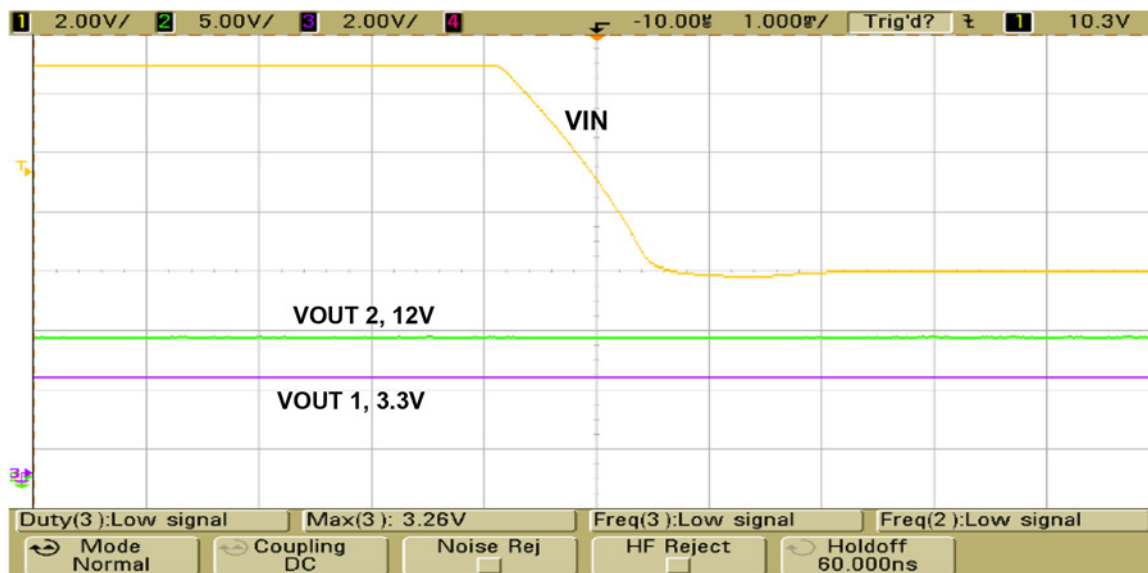


Figure 5. Model of the Cold Cranking. The Rail Voltage Drops from 14V to 7V, However, both V_{OUT1} and V_{OUT2} Stay in Regulation. CH1 V_{IN} , 2V/DIV; CH2 V_{OUT2} , 5V/DIV; CH3 V_{OUT1} , 2V/DIV; 1ms/DIV.

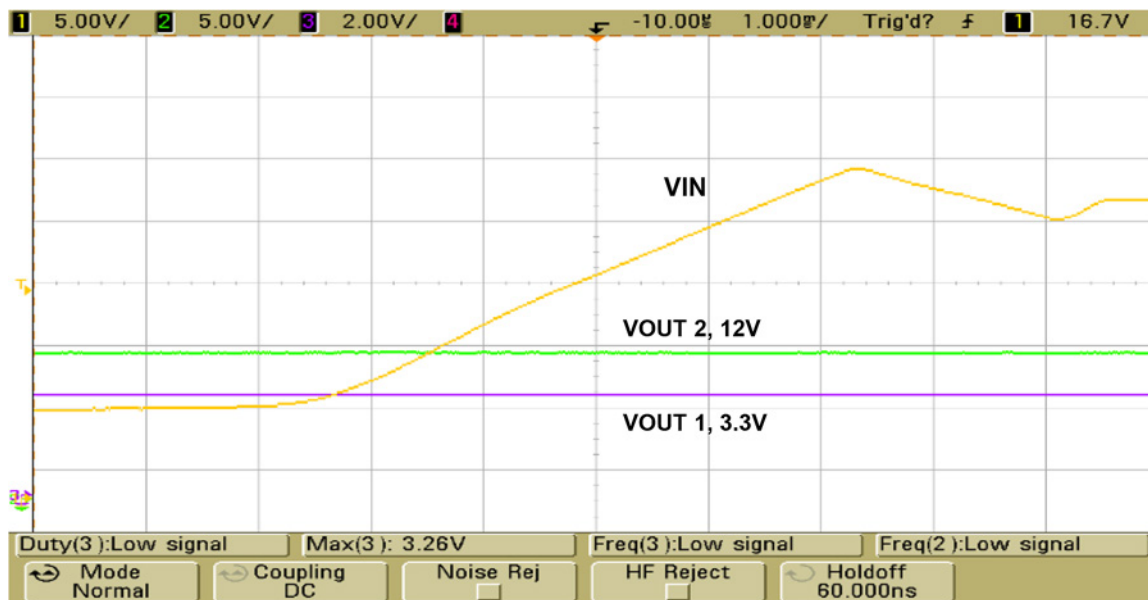


Figure 6. Model of the Load Dump. The Rail Voltage Rises from 14V to 24V, However, Both V_{OUT1} and V_{OUT2} Stay in Regulation. CH1 V_{IN} , 5V/DIV; CH2 V_{OUT2} , 5V/DIV; CH3 V_{OUT1} , 2V/DIV; 1ms/DIV.

QUICK START PROCEDURE

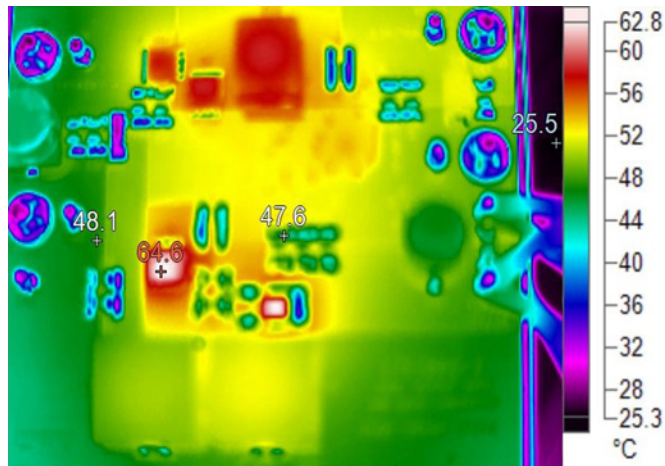


Figure 7. Thermal Map, V_{IN} 14V, V_{OUT1} 3.3V at 10A, V_{OUT2} 12V at 3.0A. No Airflow.

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., 63HVV47M
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, TDSO-8	INFINEON, BSC028N06LS3 G
18	1	Q2	XSTR., MOSFET, N-CH, 60V, 50A, TDSO-8	INFINEON, BSC100N06LS3 G
19	1	RS1	RES. SENSE., 0.002 Ω , 1W, 1%, 2010	SUSUMU, KRL3216-C-R002-F-T1
20	1	RS2	RES. SENSE., 0.004 Ω , 1W, 1%, 2010	SUSUMU, KRL3216-C-R004-F-T1
21	1	R1	RES., 0 Ω , 1/18W, 0805	VISHAY, CRCW08050000Z0EA
22	14	R2, R10, R12, R13, R16, R18, R19, R23, R30, R33, R34, R35, R48, R50	RES., 0 Ω , 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., 1M Ω , 1/10W, 1%, 0805	VISHAY, CRCW08051M00FKEA
30	2	R38, R39	RES., 237k, 1/10W, 1%, 0603	VISHAY, CRCW0603237KFKEA
31	1	R44	RES., 0 Ω , R-S1911	HARWIN, S1911-46R
32	1	R47	RES, 0603 150 Ω 1% 0.1W	VISHAY, CRCW0603150RFKEA
33	1	R48	RES., 51.1 Ω , 1/10W, 1%, 0603	VISHAY, CRCW060351R1FKEA
34	1	U1	I.C., LTC3892EUH-2#PBF, QFN32UH-5X5	ANALOG DEVICES, LTC3892EUH-2#PBF

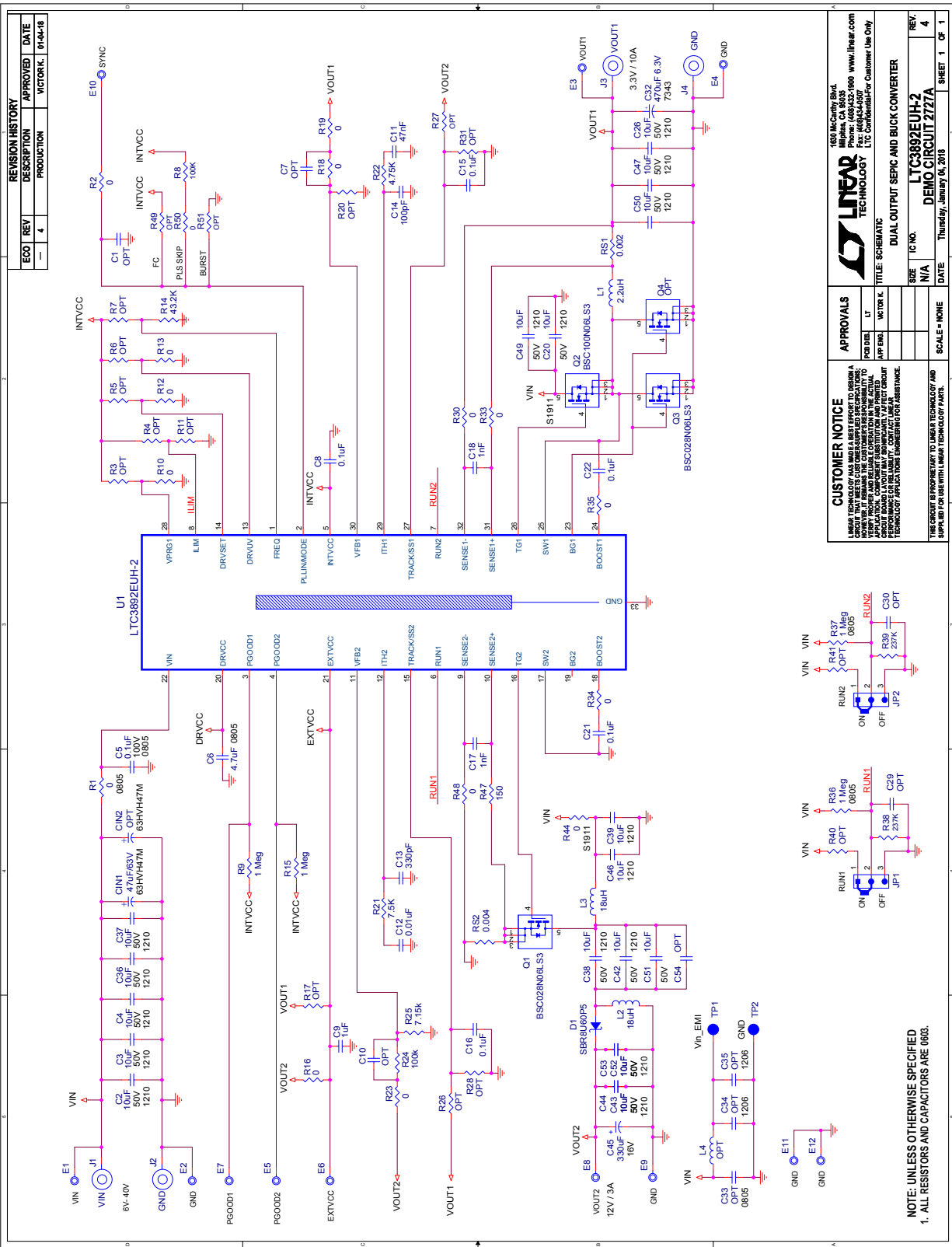
Additional Demo Board Circuit Components

		CIN2	CAP, OPTION, 10 \times 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 \times 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



**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.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. **CONFIDENTIALITY.** This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. **ADDITIONAL RESTRICTIONS.** Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. **TERMINATION.** ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. **LIMITATION OF LIABILITY.** THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). **EXPORT.** Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. **GOVERNING LAW.** This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.