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

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS/NOTES	VALUE
Minimum Input Voltage		6V
Maximum Input Voltage		40V
Output Voltage V_{OUT1} Regulation	V_{IN} = 6V – 40V	3.3V ± 2%
Output Voltage V_{OUT2} Regulation	V_{IN} = 6V – 40V	12V ± 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	<50µA

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 ±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 ±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 ±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 ±2%.

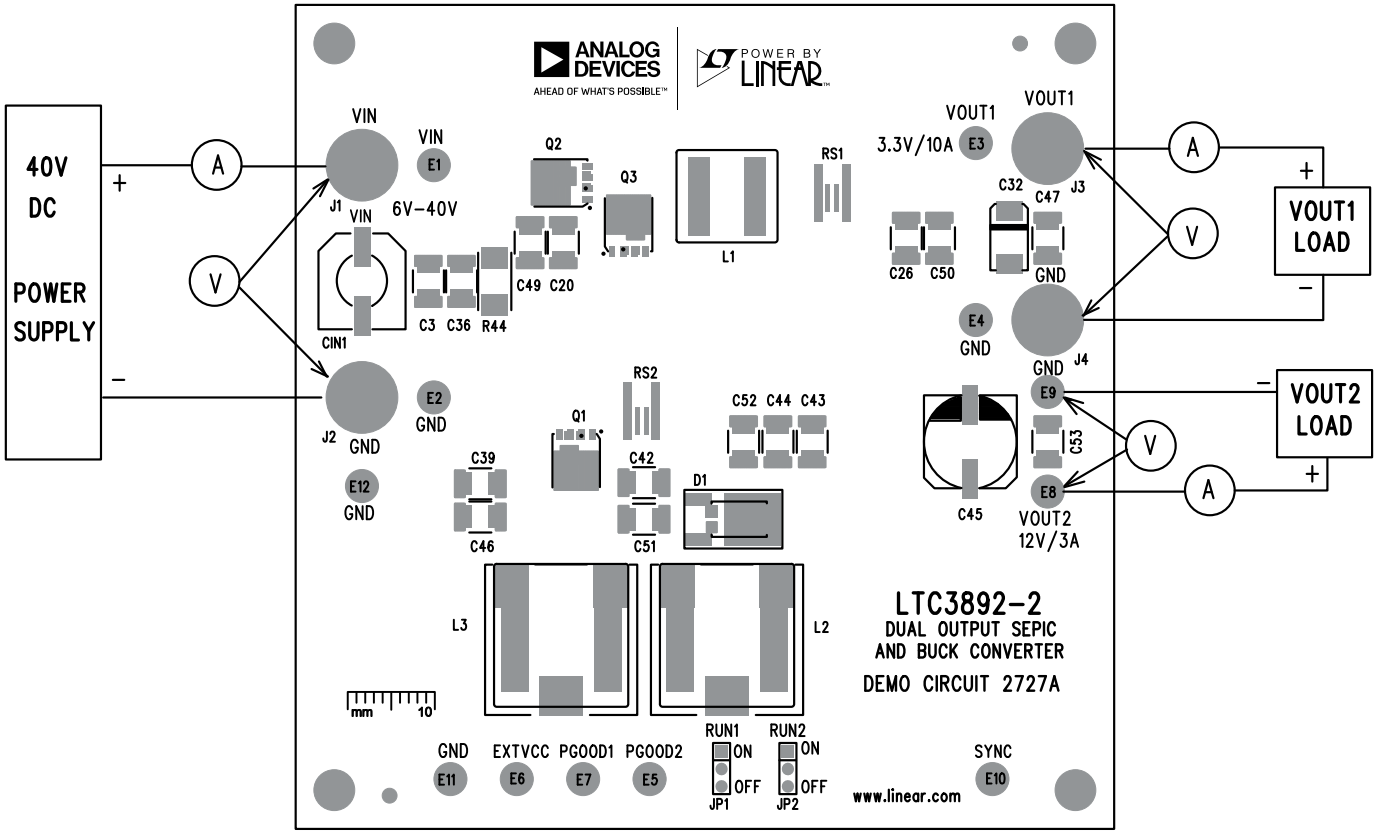


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

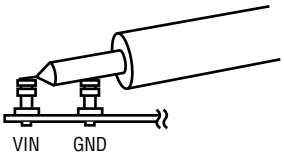


Figure 2. Measuring Input or Output Ripple

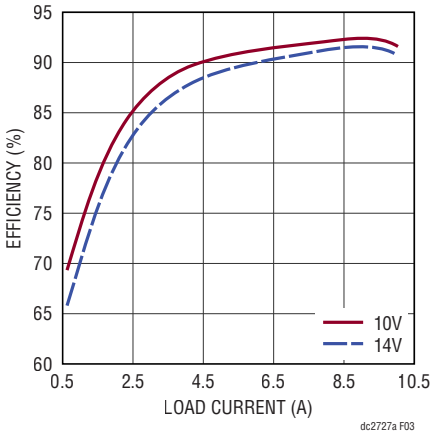


Figure 3. Efficiency vs Input Voltage and Load Current, V_{OUT} 3.3V for V_{IN} 10V and 14V

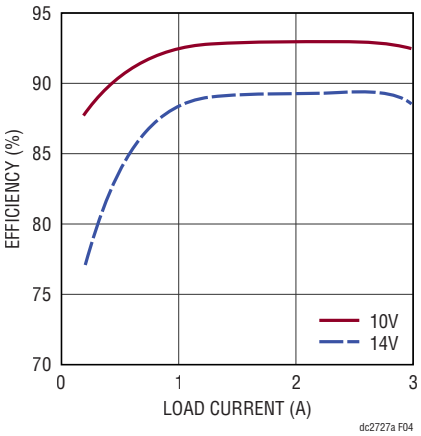


Figure 4. Efficiency vs Input Voltage and Load Current, V_{OUT} 12V for V_{IN} 10V and 14V

QUICK START PROCEDURE

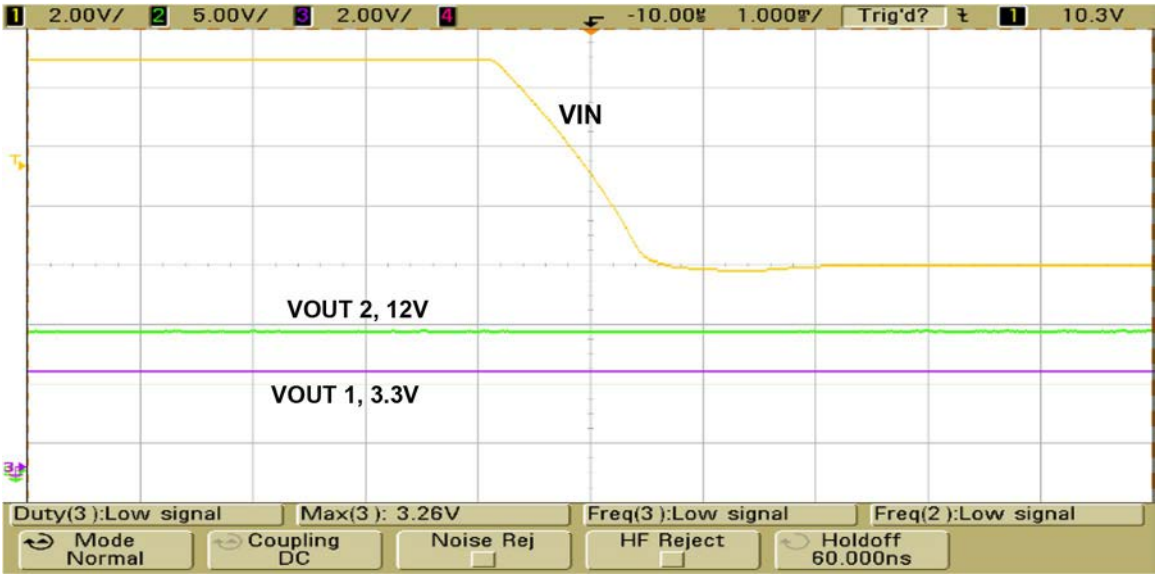


Figure 5. Model of the Cold Cranking. The Rail Voltage Drops from 14V to 7V, However, both V_{OUT1} and V_{OUT2} Stay in Regulation. CH1 V_{IN}, 2V/DIV; CH2 V_{OUT2}, 5V/DIV; CH3 V_{OUT1}, 2V/DIV; 1ms/DIV.

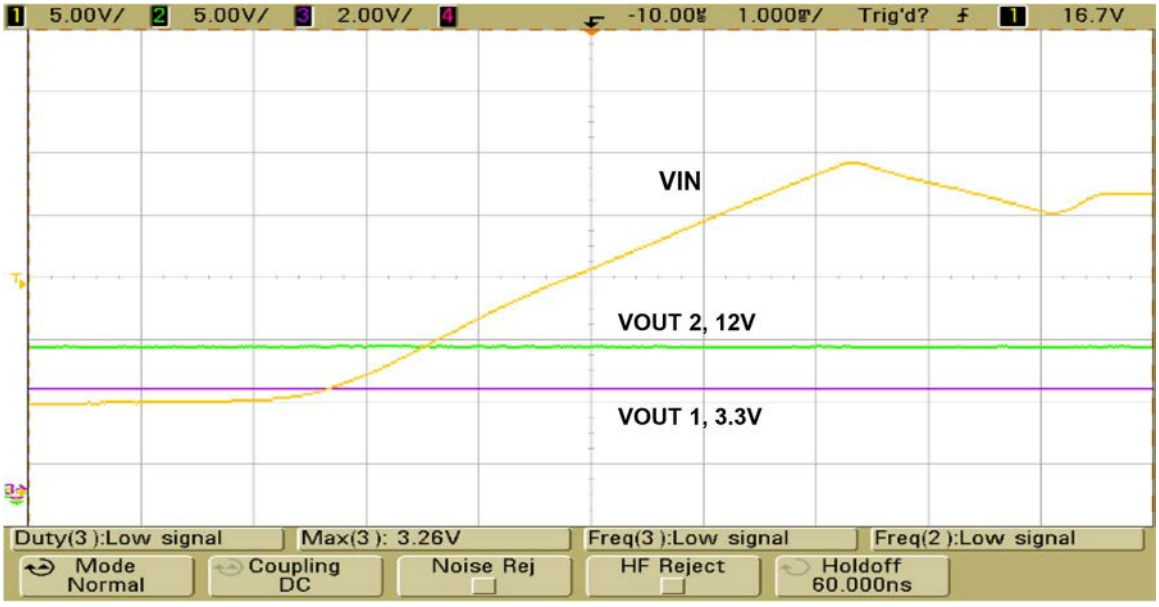


Figure 6. Model of the Load Dump. The Rail Voltage Rises from 14V to 24V, However, Both V_{OUT1} and V_{OUT2} Stay in Regulation. CH1 V_{IN}, 5V/DIV; CH2 V_{OUT2}, 5V/DIV; CH3 V_{OUT1}, 2V/DIV; 1ms/DIV.

QUICK START PROCEDURE

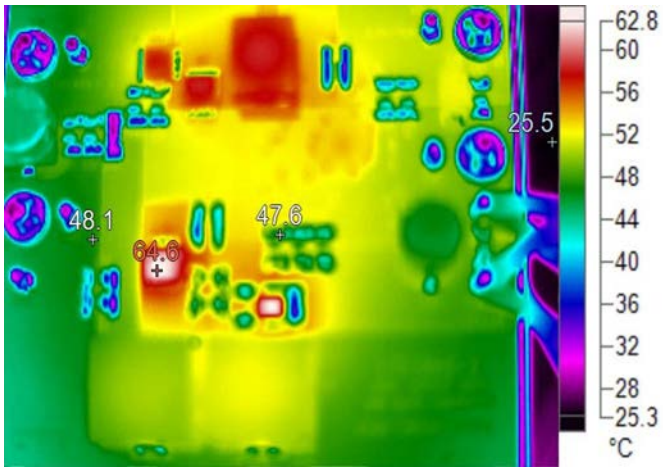


Figure 7. Thermal Map, V_{IN} 14V, V_{OUT1} 3.3V at 10A, V_{OUT2} 12V at 3.0A. No Airflow.

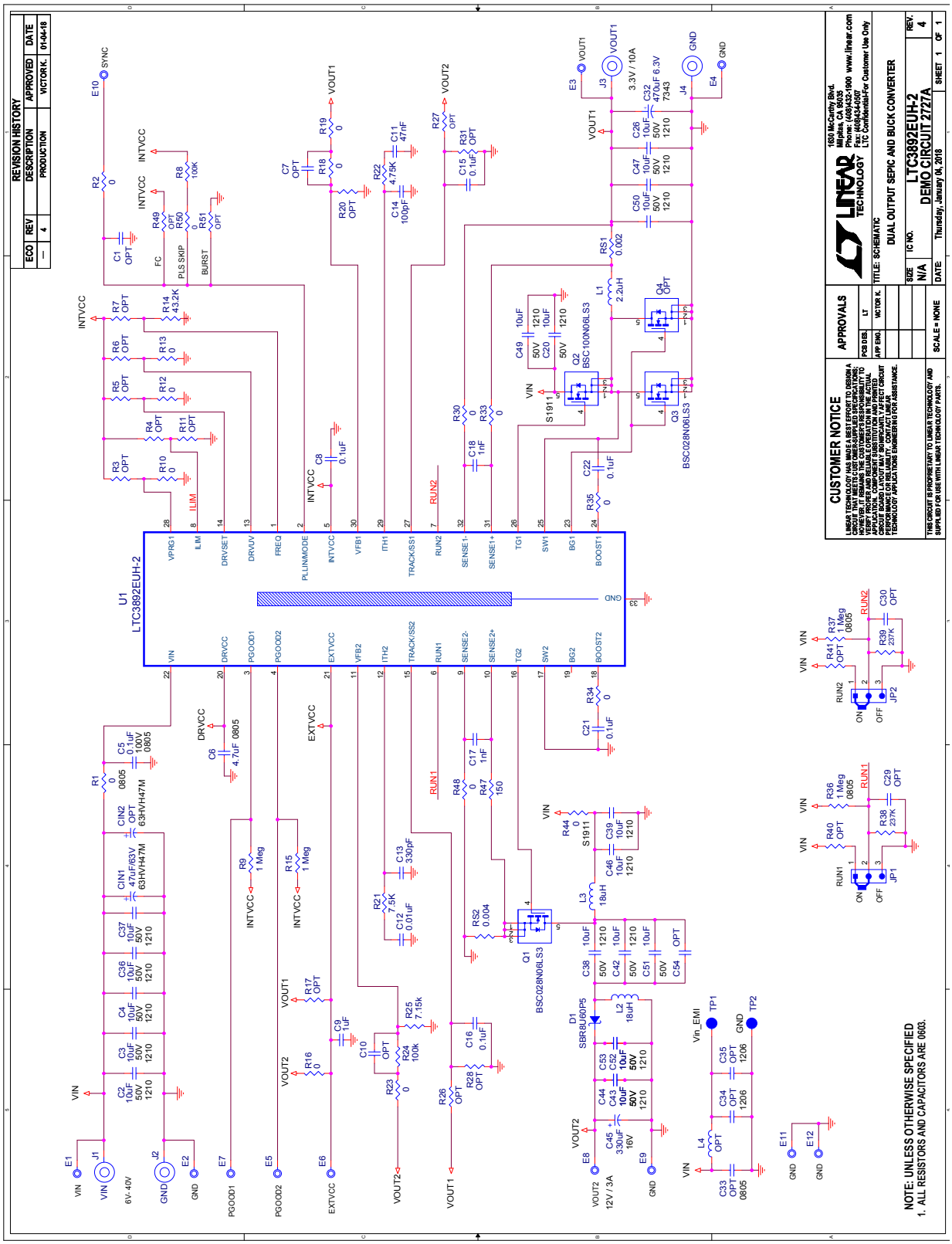
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CIN1	CAP., ALUM., 47µF, 63V, 20%, 10 × 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., 10µF, X7R, 50V, 10%, 1210	AVX, 12105C106KAT2A
3	1	C5	CAP., 0.1µF, X7R, 100V, 10%, 0805	AVX, 08051C104KAT2A
4	1	C6	CAP., 4.7µF, X5R, 50V, 10%, 0805	MURATA, GRM21BR61E475KA12L
5	5	C8, C15, C16, C21, C22	CAP., 0.1µF, X7R, 100V, 10%, 0603	MURATA, GRM188R72A104KA35D
6	1	C9	CAP., 1µF, X5R, 35V, 10%, 0603	TAIYO YUDEN, GMK107BJ105KA-T
7	1	C11	CAP., 47nF, X7R, 50V, 10%, 0603	MURATA, GCM188R71H473KA55D
8	1	C12	CAP., 0.01µF, X7R, 50V, 10%, 0603	KEMET, C0603C103K5RACTU
9	1	C13	CAP., 330pF, C0G, 50V, 5%, 0603	MURATA, GRM1885C1H331JA01D
10	1	C14	CAP., 100pF, NP0, 100V, 10%, 0603	AVX, 06031A101KAT2A
11	2	C17, C18	CAP., 1000pF, NP0, 50V, 10%, 0603	AVX, 06035A102KAT2A
12	1	C32	CAP., POSCAP, 470µF, 6.3V, 7343, D4 CASE	PANASONIC, 6TPE470MI
13	1	C45	CAP., ALUM POLY., 330µF, 16V, 20%, 10 × 12.5	PANASONIC, 16SVP330M
14	1	D1	DIODE, SBR 60V 8A, POWERDI5	DIODES, SBR8U60P5-13
15	1	L1	IND., PWR., 2.2µH, IND-744393	WURTH ELEKTRONIK, 74439369022
16	2	L2, L3	IND., 18µH, 9.8A, 13.8 MΩ	PULSE ELECT., PG0936.183NL

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



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.