LT8392
3V Minimum V_{IN}, 12V_{OUT} High Power Synchronous 4-Switch Buck-Boost Regulator

DESCRIPTION

Demonstration circuit 2626A is a 4-switch synchronous buck-boost regulator that demonstrates the high power capability of the LT®8392. The output is 12V and the maximum output current is 12A for up to 144W power delivery. The switching frequency is 200kHz and efficiency can exceed 97%.

The steady-state operating input voltage range of DC2626A in which the temperature of the components is less than 90°C is from 9V to 18V. The transient operating input voltage range of DC2626A is from 3V to 36V. The output voltage and EN/UVLO are all programmed by resistor dividers. EN/UVLO is set so the circuit will turn off when the input voltage falls below 3V and will turn on when the input voltage rises above 4V. The PCB has large copper planes and extensive vias for excellent high power thermal performance.

DC2626A features MOSFETs that complement the 5V gate drive of the LT8392 to achieve high efficiency. 40V AEC-Q101 MOSFETs are used on the input and output side of the four-switch topology. Ceramic capacitors are used at both the circuit input and output because of their small size and high ripple current capability. In addition to ceramic capacitors, there are bulk aluminum polymer capacitors on the input and output to make input and output stable during transient period.

The CTRL input is pulled up to the VREF pin through a 0Ω resistor to set the output current limit to its maximum, and an external voltage on CTRL can be used to lower the current limit if the resistor is removed. A capacitor at the SS pin programs soft-start.

To improve the EMI performance, the LT8392 has spread spectrum frequency modulation. With the SYNC/SPRD pin tied to INTVCC, LT8392 spreads its switching frequency ±15% around the programmed oscillator frequency.

The $\overline{\text{PGOOD}}$ status flag indicates when output voltage is within ±10% of the final regulation voltage.

The LT8392's proprietary peak current mode buck-boost architecture ensures DC2626A runs either in discontinuous conduction mode (DCM) or pulse-skipping mode (PSM) without reverse inductor current. Both modes enhance the light load efficiency.

The demo circuit is designed to be easily reconfigured to suit other applications, including the example schematics in the data sheet. Consult the factory for assistance.

High power operation, 3V input voltage operation, 4-switch buck-boost topology, proprietary peak current mode architecture, fault protection and output current monitoring make the LT8392 attractive for high power voltage regulator circuits and also circuits whose input voltage drops to 3V such as cold crank of car battery. It is also suitable for output current regulation such as battery chargers. The LT8392JFE is available in a thermally enhanced 28 lead TSSOP package. The LT8392 data sheet must be read in conjunction with this demo manual to properly use or modify demo circuit DC2626A.

Design files for this circuit board are available.

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PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range (V_{IN})	V_{OUT} = 12V	3		36	V
Full Load (12A) Input Voltage Range (V_{IN})	Component Temperature <90°C with no airflow	9		18	V
Output Voltage (V_{OUT})	R7 = 110k, R8 = 10k	11.5	12.0	12.5	V
Output Voltage Ripple	V_{IN} = 12V, V_{OUT} = 12V, I_{OUT} = 10A		70		mV_{P-P}
Maximum Output Current	9V ≤ V_{IN} ≤ 18V, V_{OUT} = 12V	12			
Switching Frequency	R5 = 226k		200		kHz
Efficiency	V_{IN} = 12V, V_{OUT} = 12V, I_{OUT} = 12A, SSFM On		95.5		%
Input EN Voltage	R9 = 121k, R10 = 100k, $EXTV_{CC}$ = V_{OUT}, I_{OUT} = 6A		4		V
Input UVLO Voltage	R9 = 121k, R10 = 100k, $EXTV_{CC}$ = V_{OUT}, I_{OUT} = 6A		3		V
Output Current Limit (I_{OUT})	R3 = 3mΩ		16.6		A
Peak Switch Current Limit	R1 = 1mΩ	35	50	65	A
V_{ISMON}	V_{OUT} = 12V, I_{OUT} = 12A		0.97		V

QUICK START PROCEDURE

The DC2626A is easy to set up to evaluate the performance of the LT8392JFE. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below.

NOTE: Make sure that the voltage applied to VIN does not exceed 40V, which is the voltage rating for input side MOSFETs.

1. Set JP1 at NO SSFM/SYNC to disable SSFM, at SSFM ON to enable SSFM, or at EXT SYNC and connect an external oscillator to EXT SYNC.
2. Connect the EN/UVLO terminal to ground with a clip-on lead. Connect the power supply (with power off), load, and meters as shown.
3. After all connections are made, turn on the input power and verify that the input voltage is between 9V and 18V.
4. Remove the clip-on lead from EN/UVLO. Verify that the output voltage is 12V.

   NOTE: If the output voltage is low, temporarily disconnect the load to make sure that it is not set too high.
5. Once the proper output voltage is established, adjust the input voltage and load within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

QUICK START PROCEDURE

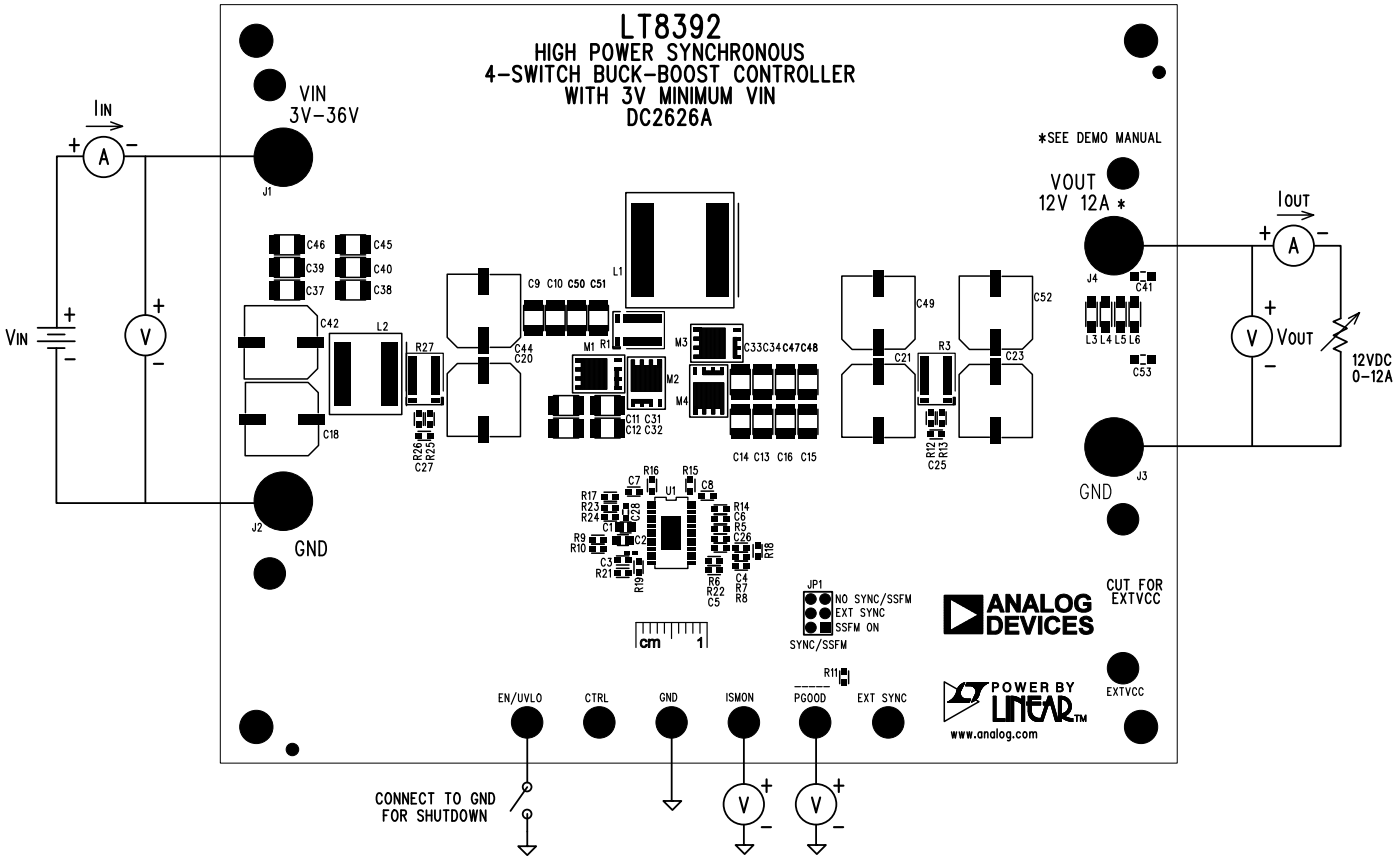


Figure 1. Test Procedure Setup Drawing for DC2626A

TEST RESULTS

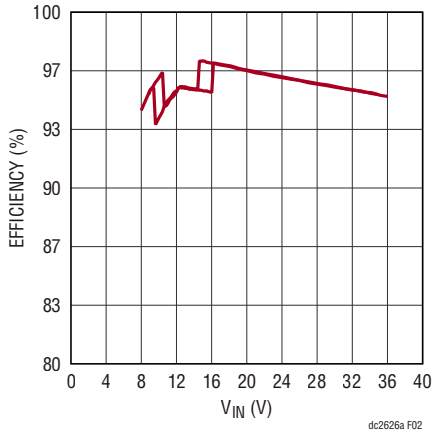
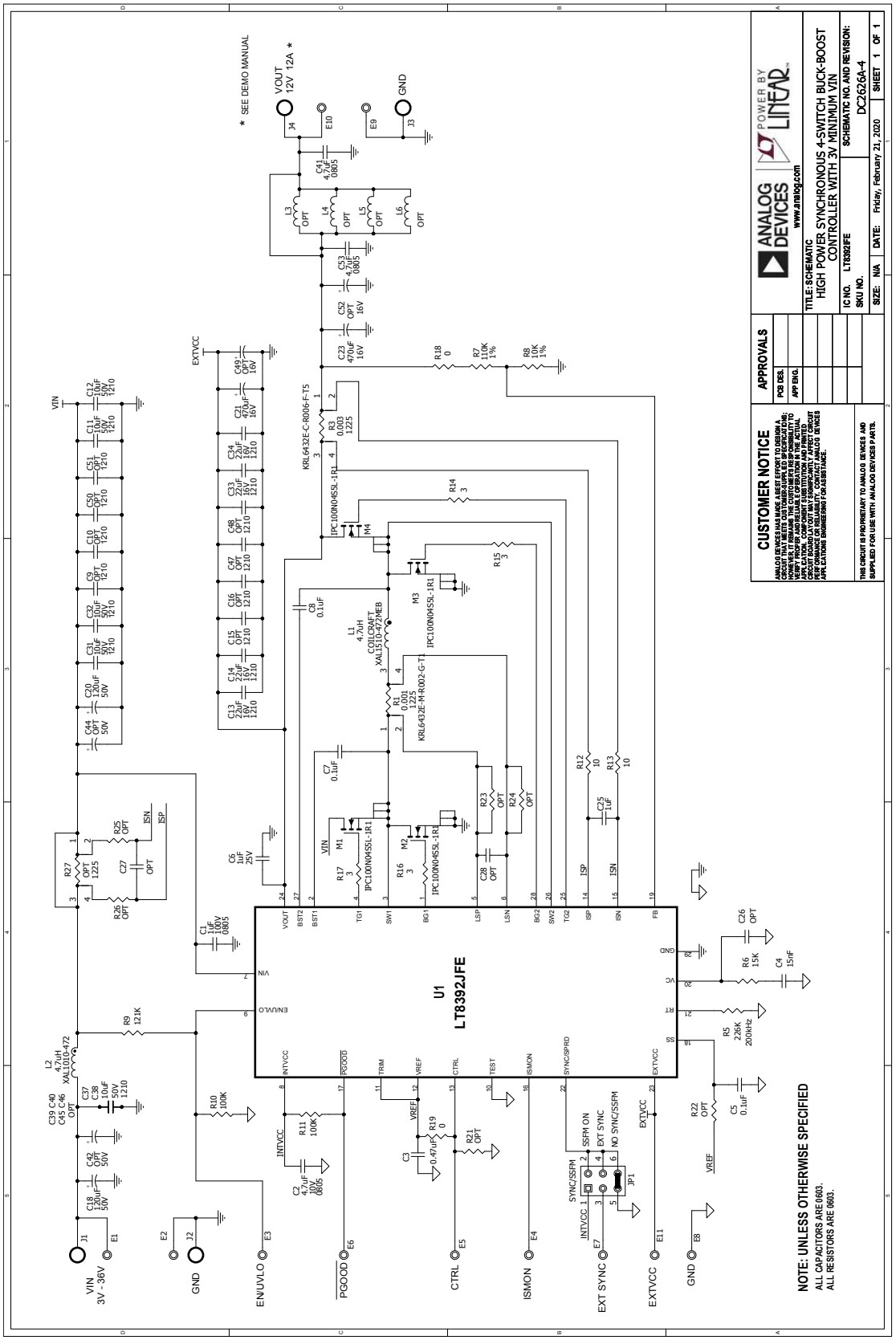


Figure 2. Efficiency vs V_{IN} at Full Load (12A), SSFM On

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C1	CAP., 1µF, X7S, 100V, 10%, 0805	MURATA, GCM21BC72A105KE36L
2	1	C2	CAP., 4.7µF, X7S, 10V, 10%, 0805	MURATA, GCM21BCA475KA73L
3	1	C3	CAP., 0.47µF, X7R, 16V, 10%, 0603	MURATA, GCM188R71C474KA55D
4	1	C4	CAP., 0.015µF, X7R, 25V, 10%, 0603	MURATA, GCJ188R71E153KA01
5	3	C5, C7, C8	CAP., 0.1µF, X7R, 16V, 10%, 0603	MURATA, GCJ188R71E104KA12
6	2	C6, C25	CAP., 1µF, X7R, 25V, 10%, 0603	MURATA, GCM188R71E105KA64D
7	4	C11, C12, C31, C32	CAP., 10µF, X7S, 50V, 10%, 1210	MURATA, GCM32EC71H106KA03L
8	4	C13, C14, C33, C34	CAP., 22µF, X7R, 16V, 20%, 1210	MURATA, GCM32ER71C226ME19L
9	2	C18, C20	CAP., ALUM, 120µF, 50V 20% 10x10.5mm	PANASONIC, EEHZC1H121P
10	2	C21, C23	CAP., ALUM, 470µF, 16V, 20%, 10x10.3mm	CHEMI-CON, HHXA160ARA471MJA0G
11	4	C33, C34, C50, C51	CAP., 10µF, X7R, 16V, 10%, 1206	MURATA, GCM31CR71C106KA64
12	2	C37, C38	CAP., 10µF, X7S, 50V, 10%, 1210	MURATA, GCM32EC71H106KA03L
13	2	C41, C53	CAP., 4.7µF, X7R, 16V, 10%, 0805	MURATA, GCM21BR71C475KA73L
14	1	L1	IND., 4.7µH XAL1510	COILCRAFT, XAL1510-472MEB
15	1	L2	IND., 4.7µH, XAL1010	COILCRAFT, XAL1010-472MEB
16	4	M1, M2, M3, M4	XSTR., MOSFET, N-CH, 40V, TDSON-8	INFINEON, IPC100N04S5L-1R1
17	2	R1	SENSE RES., 0.001Ω, 3W 2% 1225	SUSUMU, KRL6432E-M-R001-G-T1
18	2	R3	RES., SENSE, 0.003Ω 3W 1% 1225	SUSUMU, KRL6432E-C-R003-F-T1
19	1	R5	RES., 226k, 1/10W, 1%, 0603	VISHAY, CRCW0603226KFKEA
20	1	R6	RES., 15k, 1/10W, 1%, 0603	VISHAY, CRCW060315K0FKEA
21	1	R7	RES., 110k, 1/10W, 1%, 0603	VISHAY, CRCW0603110KFKEA
22	1	R8	RES., 10k, 1/10W, 1%, 0603	VISHAY, CRCW060310K0FKEA
23	1	R9	RES., 121k, 1/10W, 1%, 0603	VISHAY, CRCW0603121KFKEA
24	2	R10, R11	RES., 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
25	2	R12, R13	RES., 10Ω, 1/10W, 5%, 0603	VISHAY, CRCW060310R0JNEA
26	6	R14, R15, R16, R17, R18, R19	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
27	4	R14, R15, R16, R17	RES., 3Ω, 1/10W, 1%, 0603	VISHAY, CRCW06033R00FKEA
28	1	U1	I.C., VOLTAGE REGULATOR, 28-TSSOP	ANALOG DEVICES, INC., LT8392JFE#PBF
Additional Demo Board Circuit Components				
29	0	C26, C27, C28	CAP., OPTION, 0603	
30	0	C9, C10, C15, C16, C39, C40, C45, C46, C47, C48, C50, C51	CAP., OPTION, 1210	
31	0	C42, C44	CAP., OPTION, ALUM., 10x10.5mm	
32	0	C49, C52	CAP., OPTION, ALUM, 10x10.3mm	
33	0	R21, R22, R23, R24, R25, R26	RES., OPTION, 0603	
34	0	R27	RES., OPTION, 1225	
Hardware: For Demo Board Only				
35	11	E1-E11	TESTPOINT, TURRET, 0.094" pbf	MILL-MAX, 2501-2-00-80-00-00-07-0
36	4	J1, J2, J3, J4	CONN., JACK, BANANA, 0.218"	KEYSTONE, 575-4
37	1	JP1	CONN., HEADER, 2X3, 2mm	WURTH ELEKTRONIK, 62000621121
38	1	XJP1	SHUNT, 2mm	WURTH ELEKTRONIK, 60800213421
39	4	MH1-MH4	STAND-OFF, NYLON 0.375"	WURTH ELEKTRONIK, 702933000

SCHEMATIC DIAGRAM



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