LT3840
60V Current Mode Step-Down DC/DC Converter with Accurate Current Limit

DESCRIPTION

Demonstration circuit 1909A is a 150kHz, 60V current-mode DC/DC step-down converter with accurate current limit featuring the LT®3840.

The circuit operates from a V_{IN} range of 4.5V to 60V, survives an 80V transient, and outputs 3.3V at 20A (66W). An integrated buck-boost switching regulator generates a 7.5V bias supply voltage for MOSFET gate drive and IC power to increase the overall efficiency by reducing the power loss. A soft-start feature controls the output voltage slew rate at start-up, reducing current surges and voltage overshoots. The modes of operation (Burst Mode®, discontinuous current mode and continuous current mode) are jumper selectable. Both Burst Mode operation and discontinuous current mode increase the efficiency at light loads. Continuous current mode will maintain a constant switching frequency regardless of the load current.

The average current control loop regulates the maximum output current of the switching regulator. An Optional LDO circuit is provided on the bottom side of the board for programming the LT3840 current limit set point.

This board is suitable for a wide range of automotive, telecom, industrial, and other applications.

The LT3840 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this demo manual for DC1909A.

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

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Voltage Range		4.5		60	V
V_{OUT}	Output Voltage	I_{OUT} = 0A to 20A	3.168	3.3	3.432	V
I_{OUT}	Maximum Output Current		18.8	20	21.2	A
f_{SW}	Switching Frequency			150		kHz
$V_{OUT(P-P)}$	Output Ripple			50		mV
V_{REG}	Output Regulation	Line and Load (4.5V_{IN} to 60V_{IN}, 0A$_{OUT}$ to 20A$_{OUT}$)		0.15		%
P_{OUT}/P_{IN}	Efficiency (See Figure 3)	V_{IN} = 12V, I_{OUT} = 20A V_{IN} = 24V, I_{OUT} = 20A		91.3 90.5		% %

QUICK START PROCEDURE

DC1909A is easy to set up to evaluate the performance of the LT3840. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

NOTE: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. See Figure 2 for the proper scope technique.

1. Set an input power supply that is capable of 60V/20A. Then turn off the supply.
2. With power off, connect the supply to the input terminals V_{IN} and GND.
   a. Make the ENABLE jumper is in the EN position.
   b. Input voltages lower than 4.5V can keep the converter from turning on due to the undervoltage lockout feature of the LTC3840.
   c. If efficiency measurements are desired, an ammeter capable of measuring 20A DC or a resistor shunt can be put in series with the input supply in order to measure the DC1909A's input current.
   d. A voltmeter with a capability of measuring at least 60V can be placed across the input terminals in order to get an accurate input voltage measurement.
3. Turn on the power at the input.

NOTE: Make sure that the input voltage never exceeds 80V.

4. Check for the proper output voltage of 3.3V. Turn off the power at the input.
5. Once the proper output voltage is established, connect a variable load capable of sinking 20A at 3.3V to the output terminals V_{OUT} and GND. Set the current for 0A.
   a. If efficiency measurements are desired, an ammeter or a resistor shunt that is capable of handling 20ADC can be put in series with the output load in order to measure the DC1909A's output current.
   b. A voltmeter with a capability of measuring at least 3.3V can be placed across the output terminals in order to get an accurate output voltage measurement.
6. Turn on the power at the input.

NOTE: If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

7. Once the proper output voltage is again established, adjust the load and/or input within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other desired parameters.

QUICK START PROCEDURE

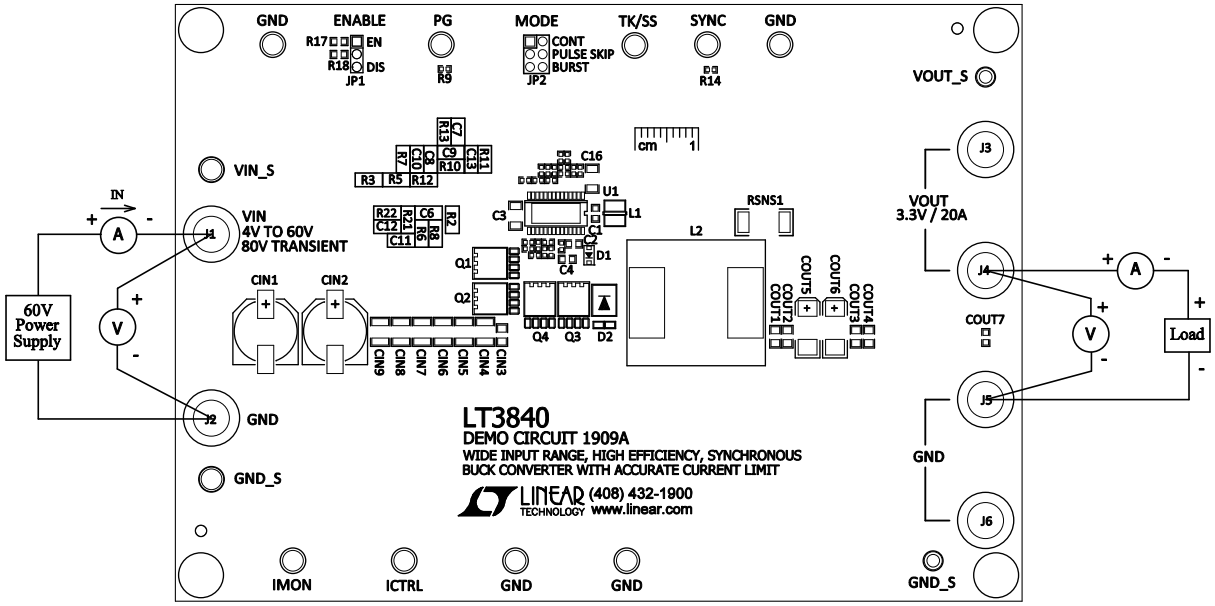


Figure 1. Proper Measurement Equipment Setup

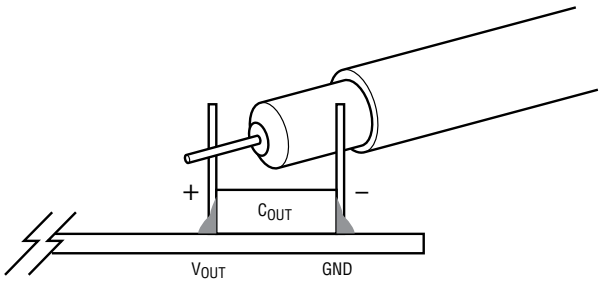


Figure 2. Measuring Output Ripple

QUICK START PROCEDURE

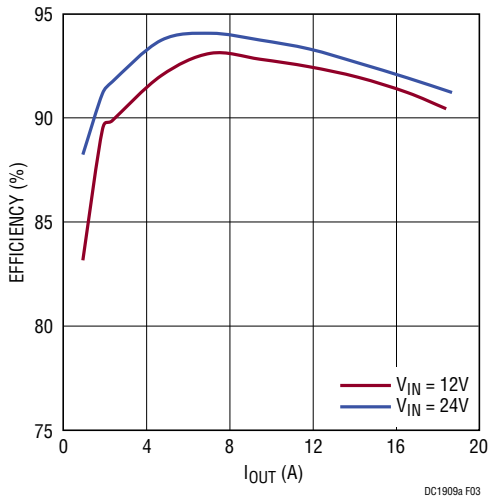


Figure 3. DC1909A Pulse-Skipping Mode Efficiency

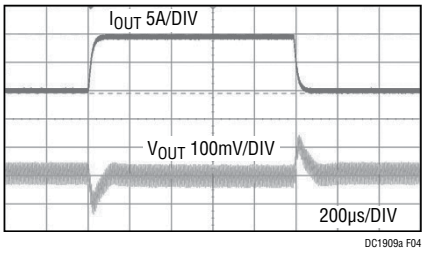


Figure 4. DC1909A 9.5A to 19.5A Load Transient

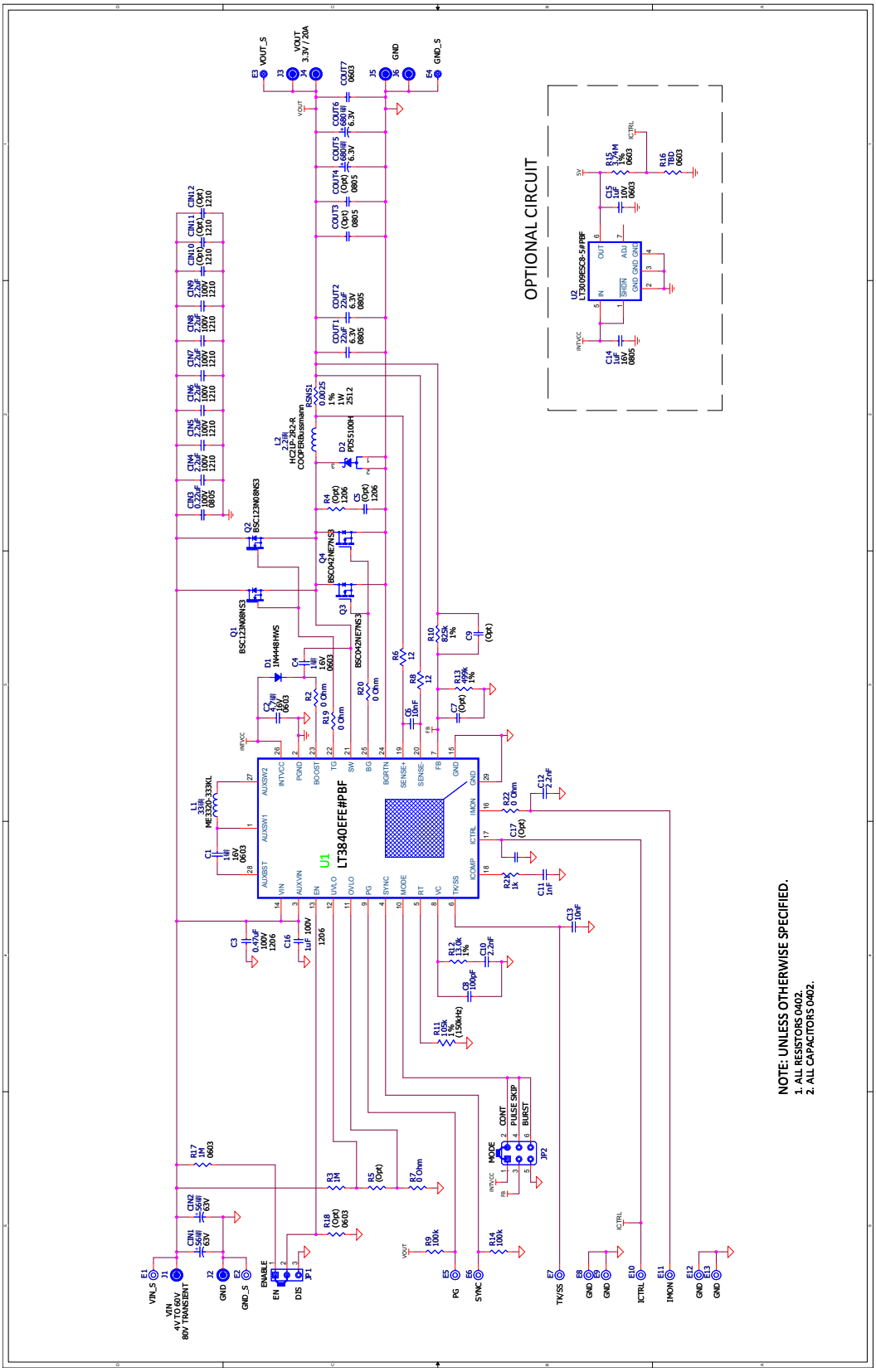
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	CIN1, CIN2	Cap., SMT Alum 56µF 63V 25%	Sun Elect.Ind. 63HVH56M
2	1	CIN3	Cap., X7S 0.22µF 100V 10% 0805	TDK C2012X7S2A224KT
3	6	CIN4 to CIN9	Cap., X7R 2.2µF 100V 20% 1210	Taiyo Yuden HMK325B7225MN-T
4	2	COUT1, COUT2	Cap., X5R 22µF 6.3V 20% 0805	TDK C2012X5R0J226M
5	2	COUT5, COUT6	Cap., POSCAP 680µF 6.3V ±20% D4	Panasonic 6TPE680MI
6	2	C1, C4	Cap., X7R 1µF 16V 10% 0603	TDK C1608X7R1C105K
7	1	C2	Cap., X5R 4.7µF 16V 20% 0603	TDK C1608X5R1C475MT
8	1	C3	Cap., X7R 0.47µF 100V 10% 1206	TDK C3216X7R2A474K
9	2	C6, C13	Cap., X7R 10nF 16V 20% 0402	AVX 0402YC103MAT2A
10	1	C8	Cap., NPO 100pF 25V 10% 0402	AVX 04023A101KAT2A
11	2	C10, C12	Cap., X7R 2.2nF 25V 20% 0402	AVX 04023C222MAT2A
12	1	C11	Cap., NPO 1nF 25V 10% 0402	AVX 04023A102KAT2A
13	1	C16	Cap., X7R 1µF 100V 15% 1206	Murata GRM31CR72A105KA01L
14	1	D1	Fast Switching Diode SOD-323	Diodes Inc. 1N4448HWS
15	1	D2	Schottky Diode 5A PowerDi5	Diodes Inc. PDS5100H
16	1	L1	Inductor, 33µH	Coilcraft ME3320-333KL
17	1	L2	Inductor, 2.2µH	COOPERBussmann HC2LP-2R2-R
18	2	Q1, Q2	MOSFET, N-Channel, 80V PG-TDSON-8	Infineon BSC123N08NS3
19	2	Q3, Q4	MOSFET, N-Channel, 75V/100A SuperSO8	Infineon BSC042NE7NS3
20	1	RSNS1	Res., 0.0025 1W 1% 2512	Vishay WSL25122L500FEA
21	5	R2, R7, R19, R20, R22	Res., Chip 0Ω 1/16W 1A 0402	Vishay CRCW04020000Z0ED
22	1	R3	Res., Chip 1M 0.06W 5% 0402	Vishay CRCW04021M00JNED
23	2	R6, R8	Res., Chip 12 0.06W 5% 0402	Vishay CRCW040212R0JNED
24	2	R9, R14	Res., Chip 100k 0.06W 5% 0402	Vishay CRCW0402100KJNED
25	1	R10	Res., Chip 825k 0.06W 1% 0402	Vishay CRCW0402825KFKED
26	1	R11	Res., Chip 105k 0.06W 1% 0402	Vishay CRCW0402105KFKED
27	1	R12	Res., Chip 13.0k 0.06W 1% 0402	Vishay CRCW040213K0FKED
28	1	R13	Res., Chip 499k 0.06W 1% 0402	Vishay CRCW0402499KFKED
29	1	R17	Res., Chip 1M 0.06W 5% 0603	Vishay CRCW06031M00JNEA
30	1	R21	Res., Chip 1k 0.06W 5% 0402	Vishay CRCW04021K00JNED
31	1	U1	I.C., LT3840EFE TSSOP28	Linear Technology Corporation LT3840EFE#PBF
Additional Circuits				
1	0	CIN10, CIN11, CIN12 (Opt)	Cap., 1210	
2	0	COUT3, COUT4 (Opt)	Cap., 0805	
3	0	COUT7 (Opt)	Cap., 0603	
4	0	C5 (Opt)	Cap., 1206	
5	0	C7, C9, C17 (Opt)	Cap., 0402	
6	0	C14 (Opt)	Cap., X7R 1µF 16V 20% 0805	Taiyo Yuden EMK212BJ105MG
7	0	C15 (Opt)	Cap., X7R 1µF 10V 10% 0603	Taiyo Yuden LMK107BJ105KA
8	0	R4 (Opt)	Res., 1206	
9	0	R5 (Opt)	Res., 0402	

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
10	0	R15 (Opt)	Res., Chip 3.74M 0.06W 1% 0603	Vishay CRCW06033M74FKEA
11	0	R16, R18 (Opt)	Res., 0603	
12	0	U2 (Opt)	I.C., LDO Linear Reg. SC70-SC8	Linear Technology Corporation LT3009ESC8-5#PBF
Hardware, For Demo Board Only:				
1	11	E1, E2, E5, E6, E7, E8, E9, E10, E11, E12, E13	Turret, Testpoint	Mill Max 2501-2-00-80-00-00-07-0
2	2	E3, E4	Turret, Testpoint	Mill Max 2308-2-00-80-00-00-07-0
3	1	JP1	Headers, 3 Pins 2mm Ctrs.	Sullins NRPN031PAEN-RC
4	1	JP2	Headers, Dbl. Row 2 × 3 2mm Ctrs.	Sullins NRPN032PAEN-RC
5	6	J1, J2, J3, J4, J5, J6	Connector, Banana Jack	Keystone 575-4
6	2	XJP1, XJP2	Shunt, 2mm Ctrs.	Samtec 2SN-BK-G
7	4	MH1 to MH4	STANDOFF, NYLON, 0.5"	KEYSTONE, 8833 (SNAP ON)

SCHEMATIC DIAGRAM



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