LTC3789EGN High Efficiency 12V/12A Buck-Boost Converter

DESCRIPTION

Demonstration circuit 1757B is a high efficiency synchronous buck-boost DC/DC converter with a 6V to 36V input voltage range. It can supply a 12A maximum load current with a 12V output. The demo board features the LTC®3789EGN controller. The constant frequency current mode architecture allows a phase-lockable frequency of up to 600kHz, while an optional output current feedback loop provides support for applications such as battery charging. With a wide input range, wide output range and seamless transfers between operation modes, the LTC3789 is ideal for automotive, telecom, distributed DC power systems and battery-powered applications.

The light load operation mode of the converter is determined with the MODE/PLLIN pin. Use JP2 jumper to select pulse-skipping mode or forced continuous mode (CCM) operation. The switching frequency is pre-set at about 200kHz. The converter can also be externally synchronized to an external clock through the MODE/PLLIN pin (PLLIN terminal on the board). To shut down the converter, force the RUN pin below 1.2V (JP1: OFF). The power good output (PGOOD terminal) is low when the output voltage is outside of the ±10% regulation window.

Design files for this circuit board are available at http://www.linear.com/demo/DC1757B

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PERFORMANCE SUMMARY (T_A = 25°C)

PARAMETER	CONDITIONS	VALUE
Input Voltage Range		6V to 36V
Output Voltage, V_{OUT}	V_{IN} = 6V to 36V, I_{OUT} = 0A to 12A	12V ±2%
Maximum Output Current, I_{OUT}	V_{IN} = 6V to 36V, V_{OUT} = 12V	12A
Typical Output Ripple	V_{IN} = 36V, I_{OUT} = 12A (20MHz BW)	109mV_{P-P}
Typical Efficiency	V_{IN} = 12V, V_{OUT} = 12V, I_{OUT} = 12A	97.9%
Typical Switching Frequency		200kHz

QUICK START PROCEDURE

Demonstration circuit 1757B is easy to set up to evaluate the performance of the LTC3789. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below:

1. With power off, connect the input power supply to V_{IN} (6V to 36V) and GND (input return).
2. Connect the 12V output load between V_{OUT} and GND (Initial load: no load).
3. Connect the DVMs to the input and outputs.
4. Turn on the input power supply and check for the proper output voltages. V_{OUT} should be 12V ±2%.
5. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage and other parameters.

QUICK START PROCEDURE

Note: When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. See Figure 2 for the proper scope probe technique. Short, stiff leads need to be soldered to the (+) and (–) terminals of an output capacitor. The probe's ground ring needs to touch the (–) lead and the probe tip needs to touch the (+) lead.

Additional Notes:

1. Usually, the worst case efficiency at full load is at $6V_{IN}$. The board can deliver more output power at higher V_{IN}.
2. R2 is needed for additional/constant output current limit only.

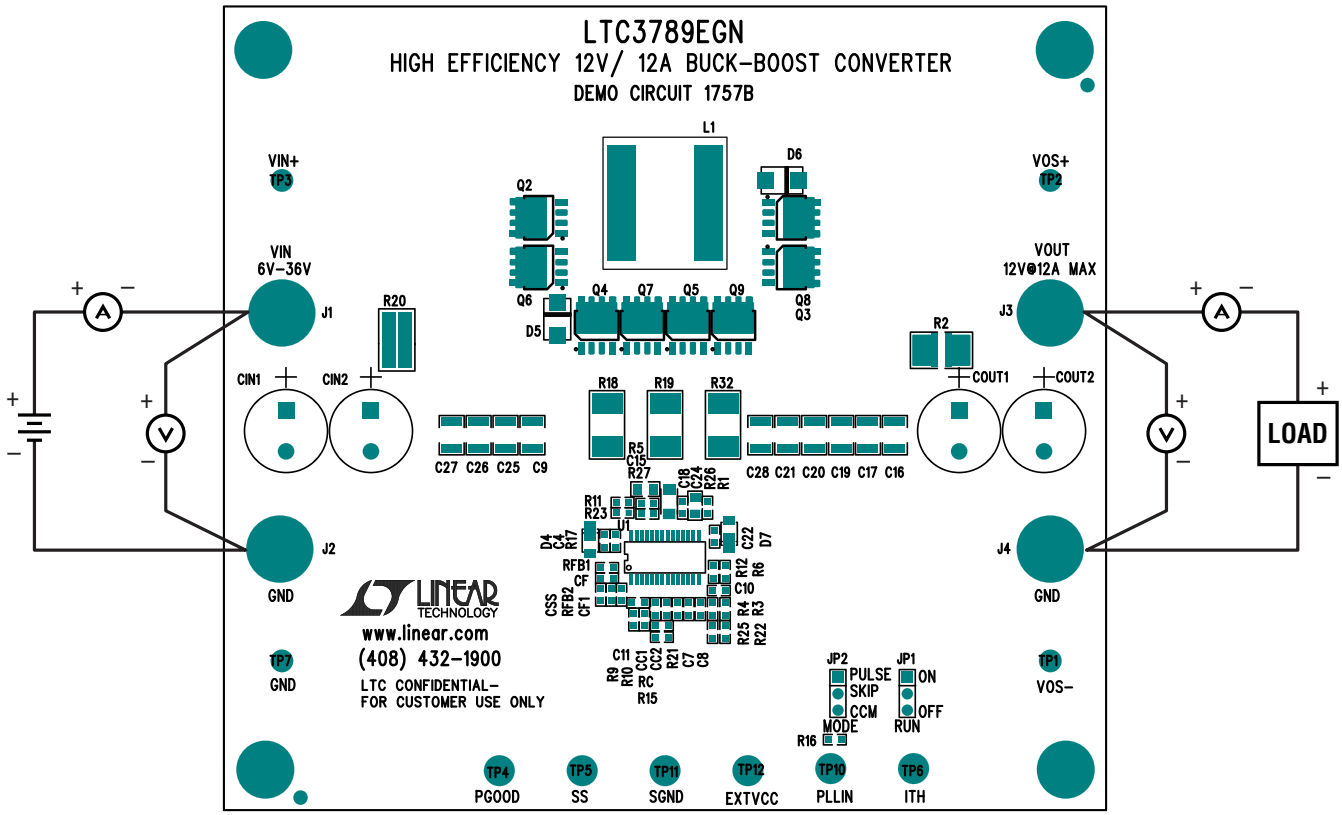


Figure 1. Proper Measurement Equipment Setup

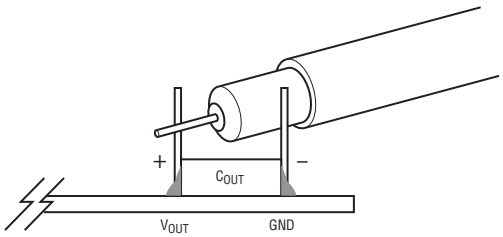


Figure 2. Measuring Output Voltage Ripple

QUICK START PROCEDURE

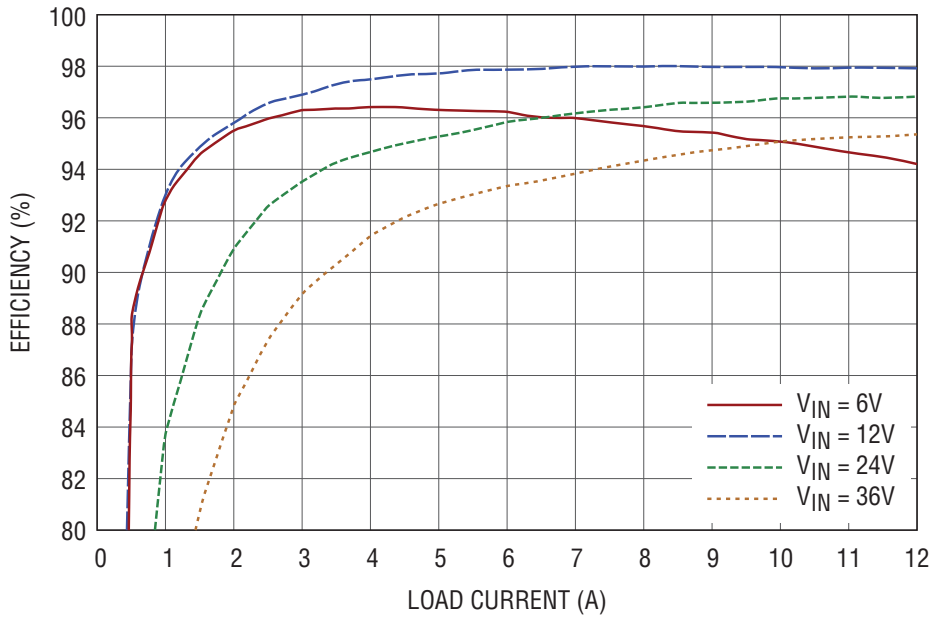


Figure 3. Efficiency vs Load Current (V_O = 12V, CCM)

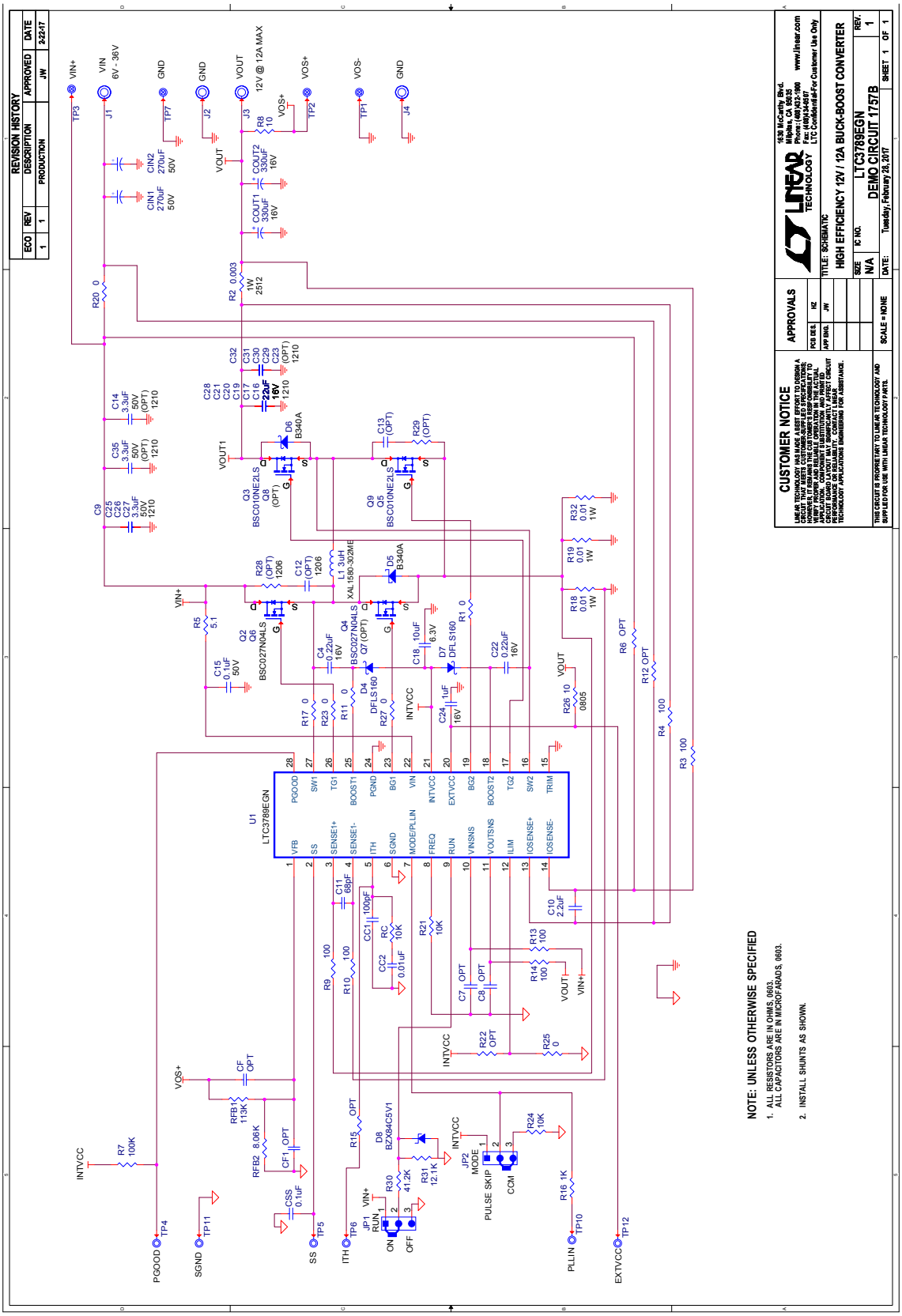
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CC1	CAP., C0G, 100pF, 50V, 10% 0603	AVX, 06035A101KAT2A
2	1	CC2	CAP., X7R, 0.01µF, 50V, 10% 0603	AVX, 06035C103KAT2A
3	2	CSS, C15	CAP., X7R, 0.1µF, 50V, 10% 0603	AVX, 06035C104KAT2A
4	1	C11	CAP., NPO, 68pF, 50V, 10% 0603	AVX, 06035A680KAT2A
5	1	C10	CAP., X5R, 2.2µF, 10V, 10% 0603	AVX, 0603ZD225KAT2A
6	1	C24	CAP., X7R, 1µF, 16V, 20% 0603	AVX, 0603YC105MAT2A
7	2	CIN1, CIN2	CAP., ALUM, 270µF, 50V, 20%	SUN ELECTRONICS, 50ME270WX+T
8	2	COUT1, COUT2	CAP., OS-CON, 330µF, 16V, 20%	SANYO, 16SEP330M+T
9	6	C16, C17, C19-C21, C28	CAP., X7R, 22µF, 16V, 20% 1210	AVX, 1210YC226MAT2A
10	2	C4, C22	CAP., X7R, 0.22µF, 16V, 20% 0603	AVX, 0603YC224MAT2A
11	5	C9, C14, C25-C27	CAP., X7R, 3.3µF, 50V, 20% 1210	AVX, 12105C335MAT2A
12	1	C18	CAP., X5R, 10µF, 6.3V, 20% 1206	AVX, 12066D106MAT2A
13	2	D4, D7	DIODE, SCHOTTKY 1A, 60V POWERDI123	DIODE INC., DFLS160-7
14	2	D5, D6	DIODE, SCHOTTKY 3A, 40V SMA	DIODE INC., B340A-13-F
15	1	D8	DIODE, ZENER 5.1V 350MW SOT23-3	DIODE INC., BZX84C5V1-7-F
16	2	L1	INDUCTOR, 3µH	COILCRAFT, XAL1580-302ME
17	3	Q2, Q4, Q6	MOSFET N-CHANNEL	INFINEON, BSC027N04LS G

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
18	3	Q3, Q5, Q9	MOSFET N-CHANNEL	INFINEON, BSC010NE2LS
19	1	RFB1	RES., CHIP., 113k, 0.1W, 1% 0603	YAGEO, RC0603FR-07113KL
20	1	RFB2	RES., CHIP., 8.06k, 0.1W, 1% 0603	YAGEO, RC0603FR-078K06L
21	3	R18, R19, R32	SENSOR RES., 0.01, 1W, 1% 2512	VISHAY, WSL2512R0100FEA
22	1	R2	SENSE RES 0.003Ω, 1W, 1% 2512 SMD	YAGEO, PR2512FKF070R003L
23	6	R3, R4, R9, R10, R13, R14	RES., CHIP., 100, 0.1W, 1% 0603	YAGEO, RC0603FR-07100RL
24	1	R5	RES., CHIP, 5.1, 0.1W, 5% 0805	YAGEO, RC0805JR-075R1L
25	1	R7	RES., CHIP., 100k, 0.1W, 1% 0603	YAGEO, RC0603FR-07100KL
26	1	R8	RES., CHIP., 10, 0.1W, 5% 0603	YAGEO, RC0603JR-0710RL
27	1	R26	RES., CHIP., 10, 0.1W, 5% 0805	YAGEO, RC0805JR-0710RL
28	6	R1, R11, R17, R23, R25, R27	RES., CHIP., 0 1% 0603	YAGEO, RC0603FR-070RL
29	1	R20	RES., CHIP., 0 2512	TEPRO, RN5326
30	1	R16	RES., CHIP., 1k, 0.1W, 1% 0603	YAGEO, RC0603FR-071KL
31	3	RC, R21, R24	RES., CHIP., 10k, 0.1W, 1% 0603	YAGEO, RC0603FR-0710KL
32	1	R30	RES., CHIP., 33.2k, 0.1W, 1% 0603	YAGEO, RC0603FR-0733K2L
33	1	R31	RES., CHIP., 12.1k, 0.1W, 1% 0603	YAGEO, RC0603FR-0712K1L
34	1	U1	I.C., VOLT. REG.	LINEAR TECH., LTC3789EGN#PBF
Additional Demo Board Circuit Components				
1	0	CF1, CF, C7, C8 (OPT)	CAP., 0603	
2	0	C23, C29-C32, C35 (OPT)	CAP., 1210	
3	0	C12, C13 (OPT)	CAP., 1206	
4	0	Q7, Q8 (OPT)	MOSFET	
5	0	R6, R12, R15, R22 (OPT)	RES., 0603	
6	0	R28, R29 (OPT)	RES., CHIP., 1206	
Hardware-For Demo Board Only				
1	2	JP1, JP2	HEADER, 3 PIN, 0.079 SINGLE ROW	SAMTEC, TMM-103-02-L-S
2	2	XJP1, XJP2B	SHUNT, .079" CENTER	SAMTEC, 2SN-BK-G
3	4	J1, J2, J3, J4	CONNECTOR, BANANA JACK	KEYSTONE, 575-4
4	4	TP1, TP2, TP3, TP7	TESTPOINT, TURRET, .061" PBF	MILL-MAX, 2308-2-00-80-00-00-07-0
5	6	TP4, TP5, TP6, TP10-TP12	TESTPOINT, TURRET, .094" PBF	MILL-MAX, 2501-2-00-80-00-00-07-0
6	4	MTGS AT 4 CORNERS	STAND-OFF, NYLON 0.5"	KEYSTONE, 8833 (SNAP ON)

SCHEMATIC DIAGRAM



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