

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

DESCRIPTION

Demonstration circuit 1757A 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 $\pm 10\%$ regulation window.

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

LT, LT, LTC, LTM, Linear Technology and the Linear logo are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

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 $\pm 2\%$
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 1757A 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 $\pm 2\%$.
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. On DC1757 board, two Coilcraft XAL1010 inductors are used in series instead of one larger inductor, for optimal size and performance. You may use a single inductor, such as Coilcraft SER2915L-332KL, if that is preferred.
2. Usually, the worst case efficiency at full load is at $6V_{IN}$. The board can deliver more output power at higher V_{IN} .
3. R2 is needed for additional/constant output current limit only.

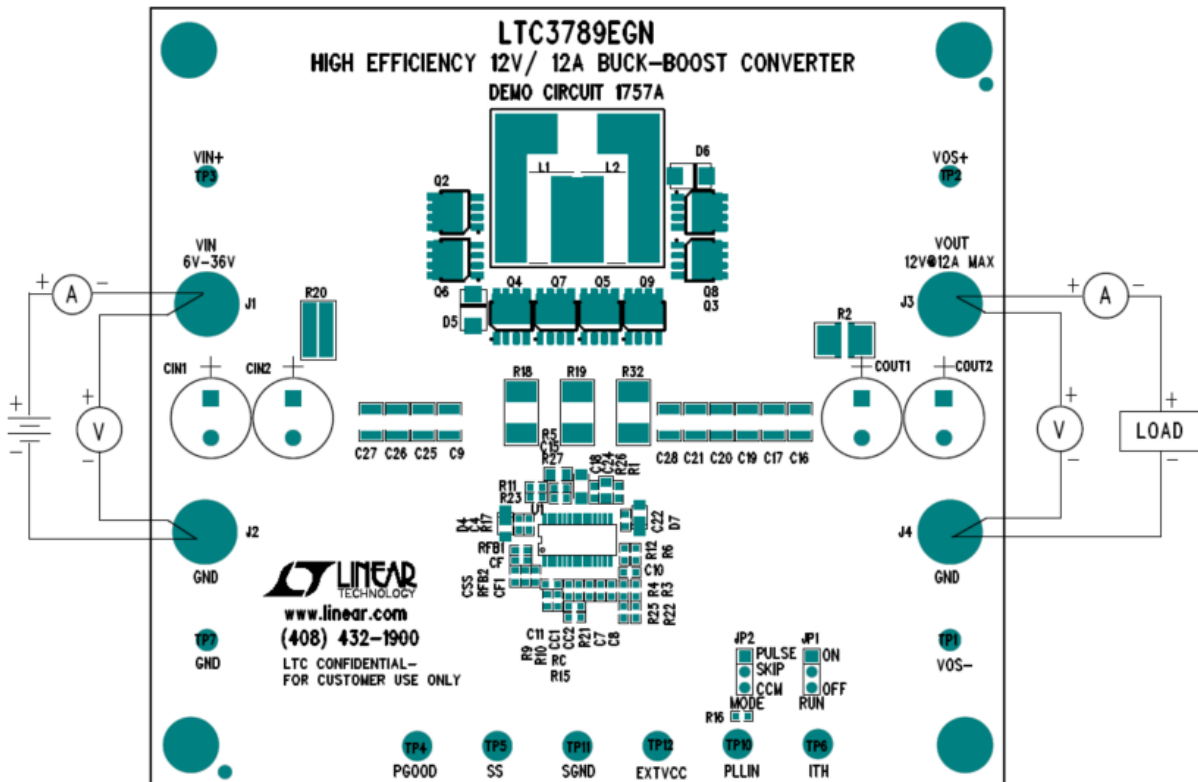


Figure 1. Proper Measurement Equipment Setup

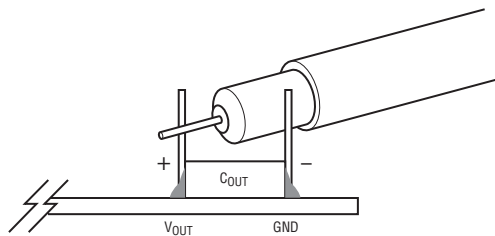


Figure 2. Measuring Output Voltage Ripple

QUICK START PROCEDURE

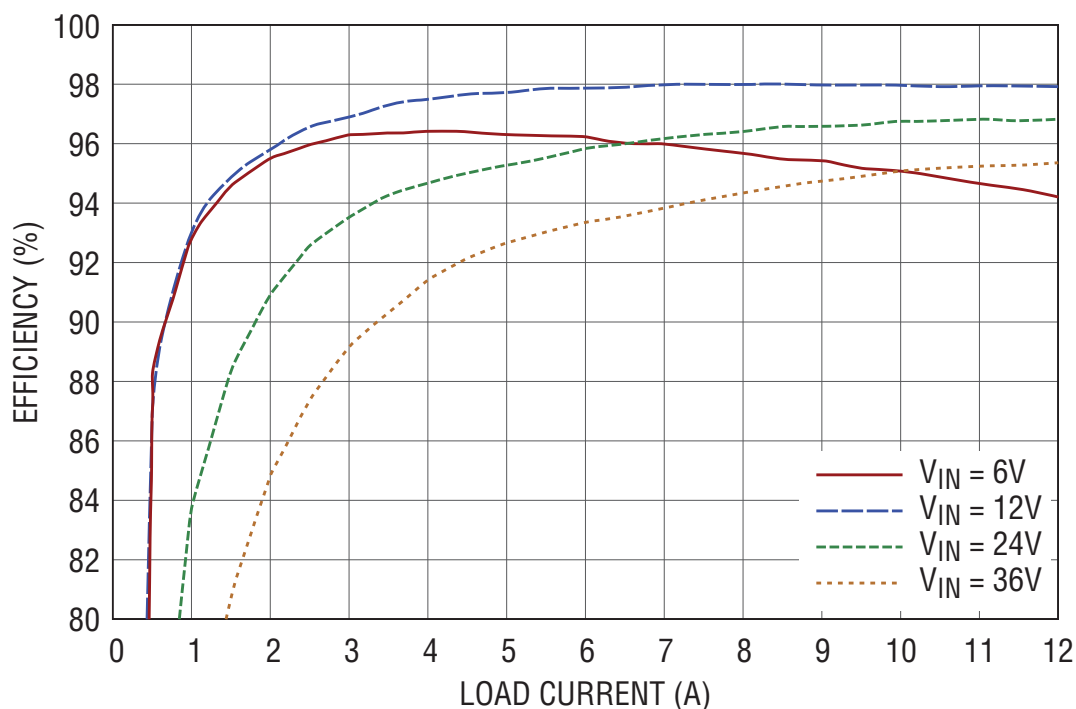


Figure 3. Efficiency vs load current ($V_0 = 12V$, CCM)

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	G4, 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., DFSL160-7
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

DEMO MANUAL DC1757A

PARTS LIST

16	2	L1, L2	Inductor, 1.5μH	COILCRAFT, XAL1010-152ME
17	3	Q2, Q4, Q6	Mosfet N-channel	INFINEON, BSC027N04LS G
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)



DEMO MANUAL DC1757A

DEMONSTRATION BOARD IMPORTANT NOTICE

Linear Technology Corporation (LTC) provides the enclosed product(s) under the following **AS IS** conditions:

This demonstration board (DEMO BOARD) kit being sold or provided by Linear Technology is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not provided by LTC for commercial use. As such, the DEMO BOARD herein may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including but not limited to product safety measures typically found in finished commercial goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may or may not meet the technical requirements of the directive, or other regulations.

If this evaluation kit does not meet the specifications recited in the DEMO BOARD manual the kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY THE SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THIS INDEMNITY, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user releases LTC from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. Also be aware that the products herein may not be regulatory compliant or agency certified (FCC, UL, CE, etc.).

No License is granted under any patent right or other intellectual property whatsoever. **LTC assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind.**

LTC currently services a variety of customers for products around the world, and therefore this transaction **is not exclusive**.

Please read the DEMO BOARD manual prior to handling the product. Persons handling this product must have electronics training and observe good laboratory practice standards. **Common sense is encouraged.**

This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

Copyright © 2004, Linear Technology Corporation

dc1757af