LTC3789EUFD
High Efficiency Compact Buck-Boost Converter

DESCRIPTION

Demonstration circuit 1881A is a high efficiency synchronous buck-boost DC/DC converter with 6V to 36V input range. It can supply 2.5A maximum load current at 12V output. The demo board features the LTC®3789EUFD 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. This board has a compact solution size with dual SO-8 MOSFETs, small inductor and capacitor footprints. The package of LTC3789EUFD is a small, low thermal impedance 4mm × 5mm 28-Lead QFN.

The light load operation mode of the converter is determined with the MODE/PLLIN pin. Use the JP2 jumper to select pulse skipping mode or forced continuous mode (CCM) operation. Switching frequency is preset at about 400kHz. The converter can also be externally synchronized through the MODE/PLLIN pin (PLLIN terminal on the board). To shut down the converter, one simple way is to 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

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITION	VALUE
Input Voltage Range		6V to 36V
Output Voltage, V_{OUT}	V_{IN} = 6V to 36V, I_{OUT} = 0A to 2.5A	12V ±2%
Maximum Output Current, I_{OUT}	V_{IN} = 6V to 36V, V_{OUT} = 12V	2.5A
Typical Output Ripple	V_{IN} = 36V, I_{OUT} = 12A (20MHz BW)	44mV_{P-P}
Typical Efficiency	V_{IN} = 12V, V_{OUT} = 12V, I_{OUT} = 2.5A	97.2%
Typical Switching Frequency		400kHz

QUICK START PROCEDURE

Demonstration circuit 1881A 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.

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.

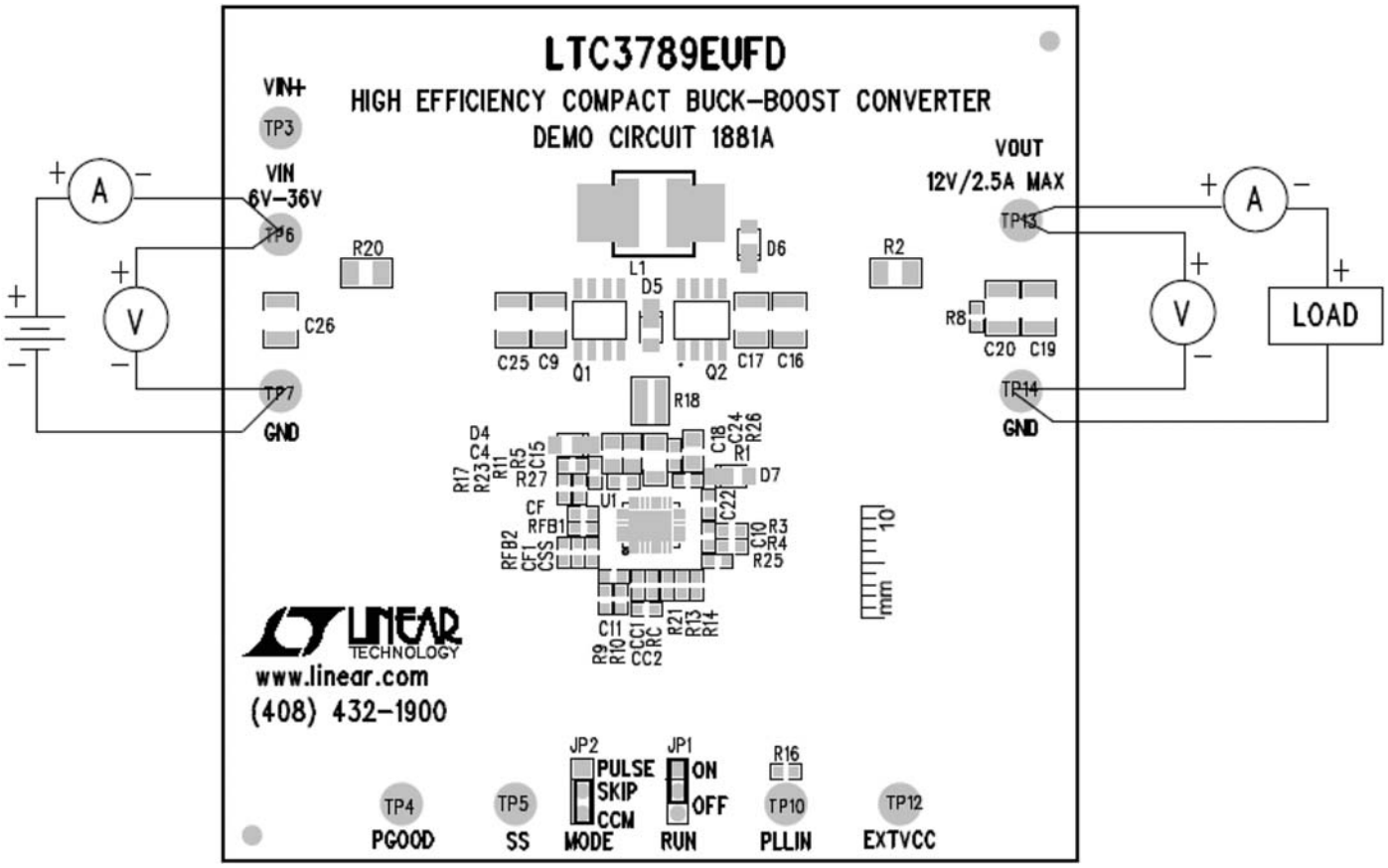


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

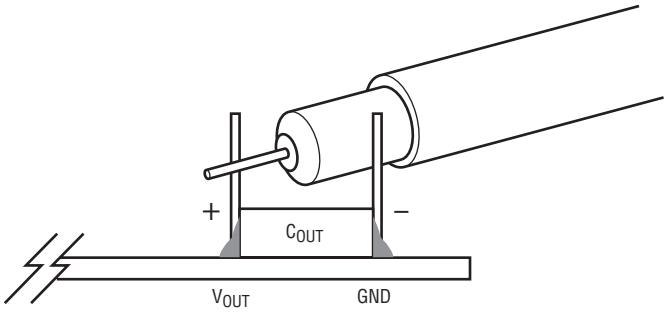


Figure 2. Measuring Output Voltage Ripple

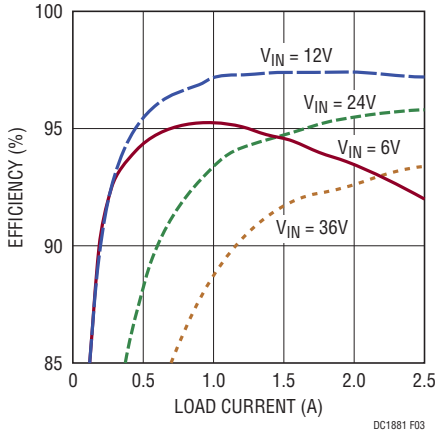


Figure 3. Efficiency vs Load Current (V_O = 12V, CCM)

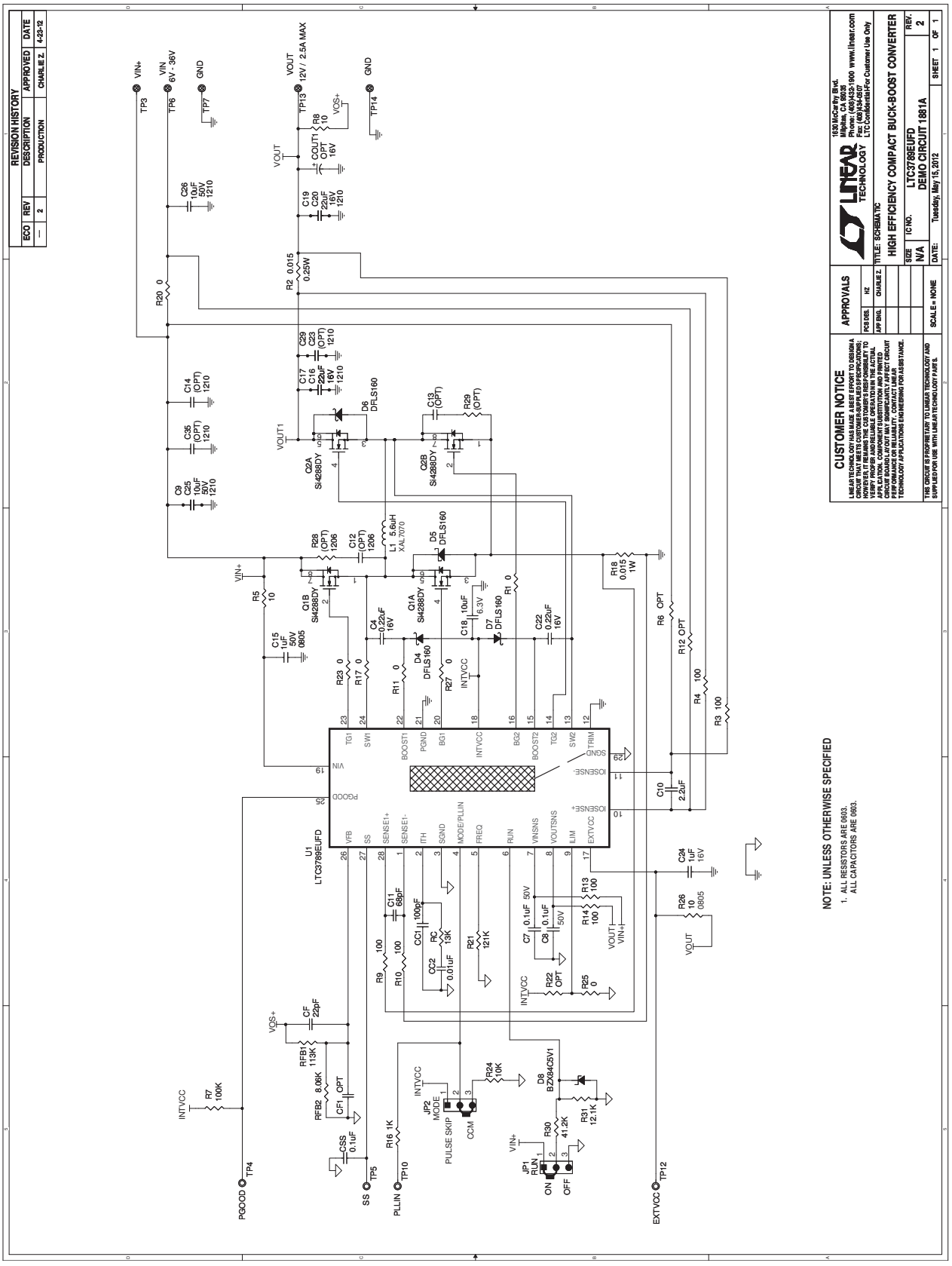
PARTS LIST

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	1	CSS	CAP., X7R, 0.1µF, 50V, 10% 0603	AVX, 06035C104KAT2A
4	1	C15	CAP., X7R, 1µF, 50V, 10% 0805	AVX, 08055C105K
5	2	C7, C8	CAP., X7R, 0.1µF, 50V, 10% 0603	AVX, 06035C104K
6	1	CF	CAP., X7R, 22pF, 50V, 10% 0603	AVX, 06035C220K
7	1	C11	CAP., NPO, 68pF, 50V, 10% 0603	AVX, 06035A680KAT2A
8	1	C10	CAP., X5R, 2.2µF, 16V, 10% 0603	TDK, C1608X5R1C225K
9	1	C24	CAP., X5R, 1µF, 16V, 10% 0603	AVX, 0603YD105KAT2A
10	4	C16, C17, C19, C20	CAP., X7R, 22µF, 16V, 20% 1210	AVX, 1210YC226MAT2A
11	2	C4, C22	CAP., X7R, 0.22µF, 16V, 20% 0603	AVX, 0603YC224MAT2A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
12	3	C9, C25, C26	CAP., X7R, 10µF, 50V, 20% 1210	TDK, C3225X7S1H106M
13	1	C18	CAP., X5R, 10µF, 6.3V, 20% 1206	AVX, 12066D106MAT2A
14	4	D4-D7	SCHOTTKY REC., DFLS160, POWER DI-123	DIODE INC., DFLS160
15	1	D8	ZENER DIODE, 5.1V, BZX84C5V1, SOT23	DIODES INC., BZX84C5V1-7-F
16	1	L1	INDUCTOR, 5.6µH	COILCRAFT, XAL7070-562ME
17	2	Q1, Q2	DUAL N-CHANNEL MOSFET, SO-8	VISHAY, Si4288DY-T1-E3
18	1	RC	RES., CHIP, 13k, 1/10W, 1% 0603	VISHAY, CRCW060313K0FKEA
19	1	RFB1	RES., CHIP, 113k, 1/10W, 1% 0603	YAGEO, RC0603FR-07113KL
20	1	RFB2	RES., CHIP, 8.06k, 1/10W, 1% 0603	YAGEO, RC0603FR-078K06L
21	1	R18	SENSOR RES., 0.015Ω, 1W, 1%, 2512	THIN FILM TECH., RL3720WT-R015-F
22	1	R2	SENSOR RES., 0.015Ω, .25W, 1%, 1206	VISHAY, WSL1206R0150FEA
23	6	R3, R4, R9, R10, R13, R14	RES., CHIP, 100Ω, 1/10W, 1% 0603	YAGEO, RC0603FR-07100RL
24	1	R7	RES., CHIP, 100k, 1/10W, 1% 0603	YAGEO, RC0603FR-07100KL
25	1	R8	RES., CHIP, 10Ω, 1/10W, 5% 0603	YAGEO, RC0603JR-0710RL
26	1	R26	RES., CHIP, 10Ω 1/8W, 5% 0805	YAGEO, RC0805JR-0710RL
27	1	R5	RES., CHIP, 10Ω 1/8W, 5% 0805	YAGEO, RC0805JR-0710RL
28	6	R1, R11, R17, R23, R25, R27	RES., CHIP, 0Ω, 1/10W, 1% 0603	YAGEO, RC0603FR-070RL
29	1	R20	0Ω JUMPER, 1/4W, 1206	IRC
30	1	R16	RES., CHIP, 1k, 1/10W, 1% 0603	YAGEO, RC0603FR-071KL
31	1	R24	RES., CHIP, 10k, 1/10W, 1% 0603	YAGEO, RC0603FR-0710KL
32	1	R21	RES., CHIP, 121k, 1/10W, 1% 0603	YAGEO, RC0603FR-07121KL
33	1	R30	RES., CHIP, 41.2k, 1/10W, 1% 0603	YAGEO, RC0603FR-0741K2L
34	1	R31	RES., CHIP, 12.1k, 1/10W, 1% 0603	YAGEO, RC0603FR-0712K1L
35	1	U1	I.C., VOLT. REG.	LINEAR TECH. CORP. LTC3789EUFD
Additional Demo Board Circuit Components				
1	0	CF1 (OPT)	CAP., 0603	
2	0	COUT1 (OPT)	CAP., OS-CON, 330µF, 16V, 20%	SANYO, 16SEP330M+T
3	0	C14, C23, C29 C35 (OPT)	CAP., 1210	
4	0	C12, C13 (OPT)	CAP., 1206	
5	0	R6, R12, R22 (OPT)	RES., 0603	
6	0	R28, R29 (OPT)	RES., CHIP, 1206	
Hardware: For Demo Board Only				
1	2	JP1, JP2	3-PIN 0.079" SINGLE ROW HEADER	SAMTEC, TMM103-02-L-S
2	2	XJP1, XJP2B	SHUNT, 0.079" CENTER	SAMTEC, 2SN-BK-G
3	9	TP3-TP7, TP10-TP14	TESTPOINT, TURRET, 0.094" pbf	MILL-MAX, 2501-2-00-80-00-00-07-0
4	4	(STAND-OFF)	STAND-OFF, NYLON 0.50"	KEYSTONE, 8833 (SNAP ON)

SCHEMATIC DIAGRAM



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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