LTC3864
60V Low IQ Step-Down DC/DC Converter with 100% Duty Cycle Capability

DESCRIPTION

Demonstration circuit 2434A is a high voltage, current-mode DC/DC step-down converter featuring the LTC®3864.

The board operates from an input range of 6V to 60V and provides a 12V, 5A output when the input exceeds 12V. The PMOSFET architecture allows it to operate seamlessly up to 100% duty cycle and function as a saturated switch below the regulation threshold, down to $6V_{IN}$. It operates at 200kHz and may be synchronized to an external clock. A soft-start feature controls output voltage slew rate at start-up, reducing current surge and voltage overshoot. Burst Mode® operation that improves efficiency at light loads can be enabled with a jumper. A power good output signal is provided.

This board is suitable for a wide range of automotive, telecom, industrial and other applications. The LTC3864 is available in small 12-pin thermally enhanced MSOP and DFN packages. For other output requirements, see the LTC3864 data sheet or contact the LTC factory.

Design files for this circuit board are available at http://www.linear.com/demo/DC2434A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		6		60	V
V_{OUT}	Output Voltage			12		V
I_{OUT}	Output Current Range, Continuous	Free Air	0		5	A
f_{SW}	Switching (Clock) Frequency			200		kHz
$V_{OUT(P-P)}$	Output Ripple	V_{IN} = 14V, I_{OUT} = 5A (20MHz BW)		45		mV_{P-P}
I_{REG}	Output Regulation	Line and Load (13V_{IN} to 60V_{IN}, 0.1A_{OUT} to 5A_{OUT})		±0.4		%
P_{OUT}/P_{IN}	Efficiency (see Figure 3)	V_{IN} =14V, I_{OUT} = 5A		97.0		%
	Approximate Size	Component Area x Top Component Height		1.3 × 1.0 × 0.39		Inches

QUICK START PROCEDURE

Demonstration circuit 2434 is easy to set up to evaluate the performance of the LTC3864. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

NOTE. When measuring the output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip and ground ring directly across the last output capacitor as shown in Figure 1.

1. Set an input power supply that is capable of 6V to 60V to 13V. Then turn off the supply.
2. With power off, connect the supply to the input terminals $+V_{IN}$ and GND.
   a. Input voltages lower than 6V can keep the converter from turning on due to the undervoltage lockout feature of the LTC3864.
   b. If efficiency measurements are desired, an ammeter capable of measuring $5A_{DC}$ or a resistor shunt can be put in series with the input supply in order to measure the DC2434A's input current.
   c. 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 60V.

4. Check for the proper output voltage of 12V. Turn off the power at the input.
5. Once the proper output voltage is established, connect a variable load capable of sinking 5A at 12V 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 $5A_{DC}$ can be put in series with the output load in order to measure the DC2434A's output current.
   b. A voltmeter with a capability of measuring at least 12V 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.

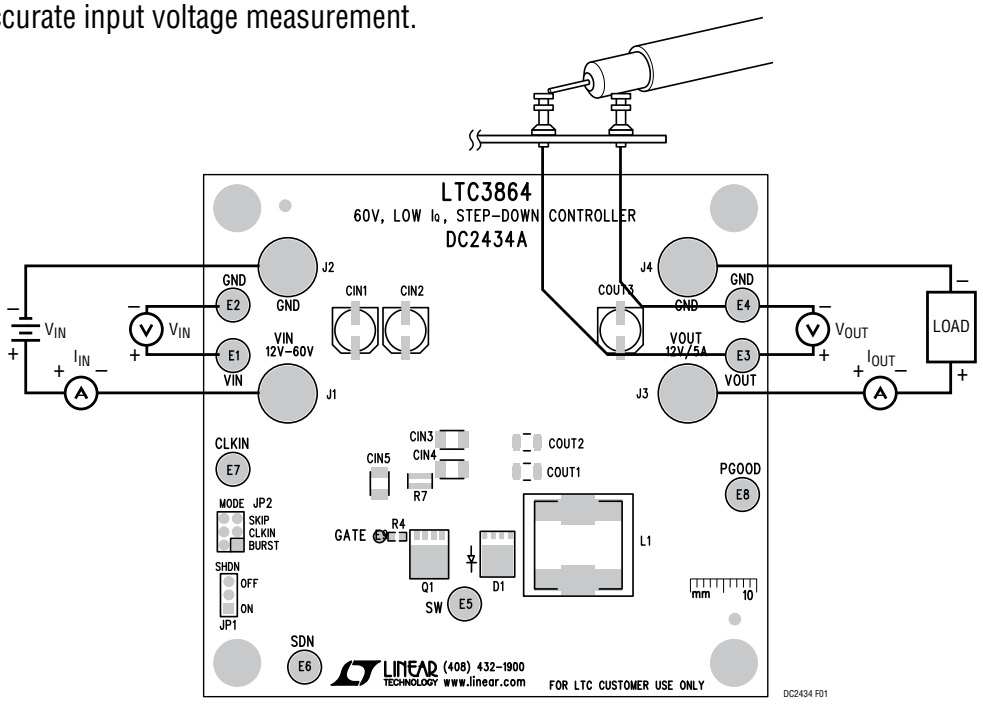


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

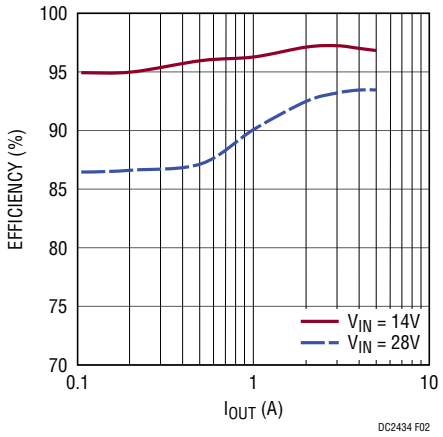


Figure 2. Efficiency with Burst Mode Operation at Light Loads

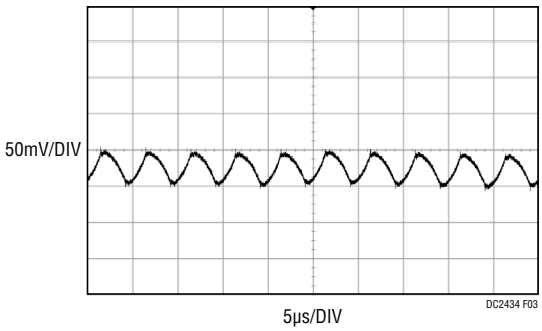


Figure 3. Output Ripple at $28V_{IN}$ and $5A_{OUT}$ (50mV, 5µs/Div, 20MHz)

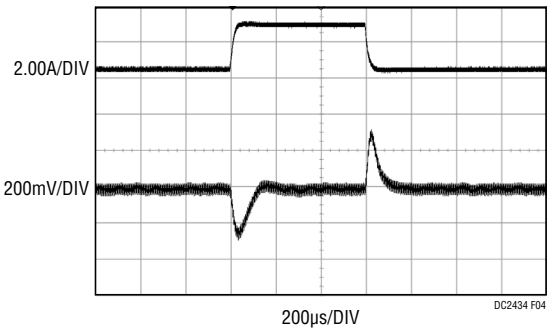
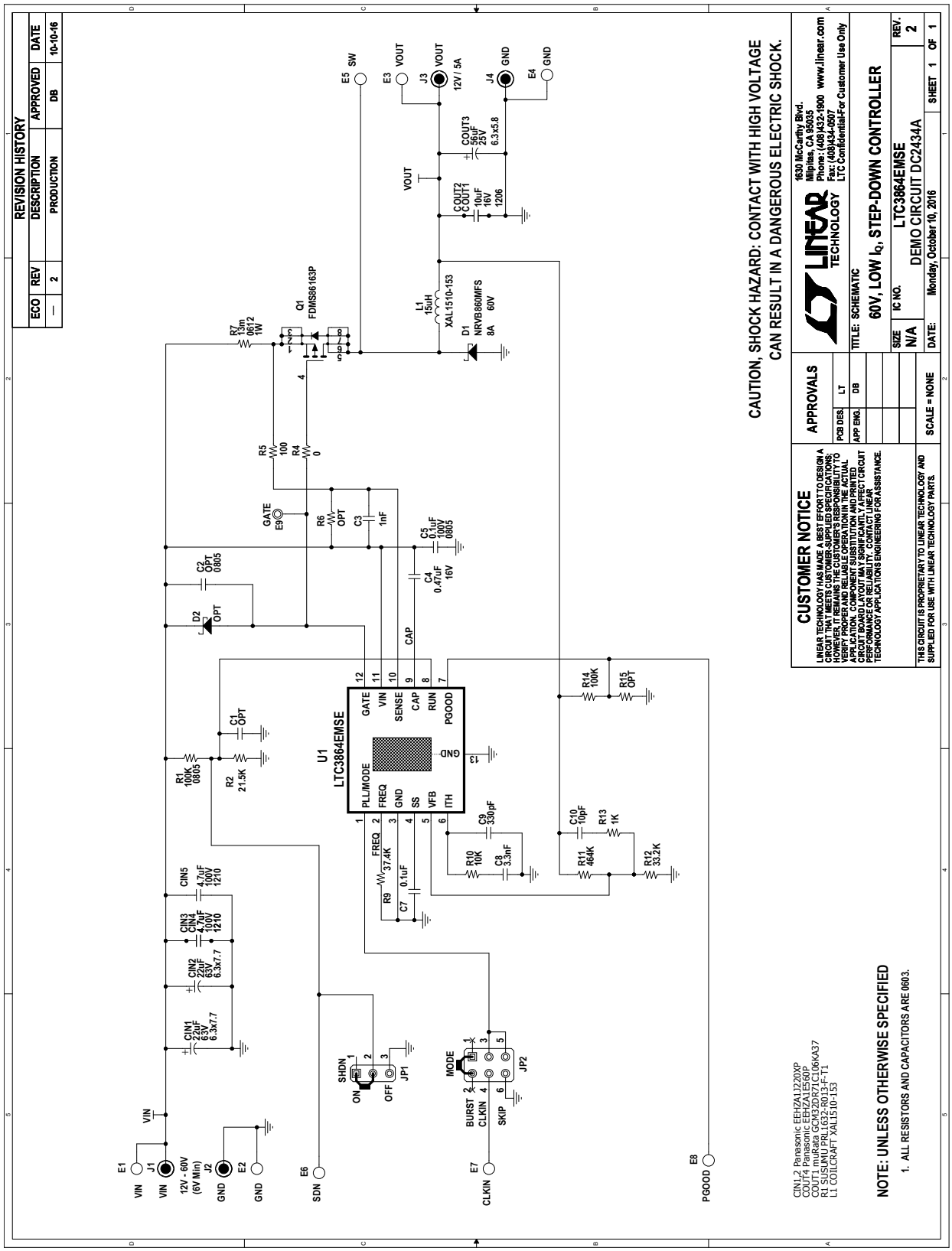


Figure 4. Transient Response Waveform at $14V_{IN}$ and $2.5A–5A–2.5A_{OUT}$ (2A, 200mV, 200µs/Div)

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	CIN1, CIN2	CAP., ALUM, 22µF, 63V 6.3x7.7	PANASONIC, EEHZA1J220XP
2	3	CIN3, CIN4, CIN5	CAP., X7S, 4.7µF, 100V, 10%, 1210	MURATA, GRM32DC72A475KE01
3	2	COUT1, COUT2	CAP., X7R, 10µF, 16V, 10%, 1206	MURATA, GRM31CR71C106KA12
4	1	COUT3	CAP., ALUM 56µF, 25V 6.3x5.8	PANASONIC, EEHZA1E560P
5	1	C3	CAP., NPO, 1000pF, 50V, 10%, 0603	AVX, 06035A102KAT2A
6	1	C4	CAP., X7R, 0.47µF, 16V, 10%, 0603	MURATA, GCM188R71C474KA55L
7	1	C5	CAP., X7R, 0.1µF, 100V, 10%, 0805	MURATA, GRM21BR72A104KAC4
8	1	C7	CAP., X7R, 0.1µF, 50V, 10%, 0603	MURATA, GCM188R71H104KA57D
9	1	C8	CAP., COG, 3300pF, 50V, 5%, 0603	MURATA, GCM1885C1H332JA16D
10	1	C9	CAP., COG, 330pF, 50V, 5%, 0603	MURATA, GCM1885C1H331JA16D
11	1	C10	CAP., COG, 10pF, 50V, 5%, 0603	MURATA, GCM1885C1H100JA16D
12	1	D1	SCHOTTKY DIODE, 60V, 10A, DFN5-SO-8FL	ON SEMI, NRVB860MFST1G
13	1	L1	INDUCTOR, 15µH	COILCRAFT, XAL1510-153
14	1	Q1	FET, P-CHAN., 100V, PowerPak SO-8	FAIRCHILD, FDMS86163P
15	1	R1	RES., 100kΩ, 1/8W, 1%, 0805	VISHAY, CRCW0805100KFKEA
16	1	R2	RES., 21.5kΩ, 1/10W, 1%, 0603	VISHAY, CRCW060321K5FKEA
17	1	R5	RES., 100Ω, 1/10W, 1%, 0603	VISHAY, CRCW0603100RFKEA
18	1	R7	RES., 13mΩ, 1W, 1%, 0612	PANASONIC, ERJ-B2CFR013V
19	1	R9	RES., 37.4kΩ, 1/10W, 1%, 0603	VISHAY, CRCW060337K4FKEA
20	1	R10	RES., 10kΩ, 1/10W, 1%, 0603	VISHAY, CRCW060310K0FKEA
21	1	R11	RES., 464kΩ, 1/10W, 1%, 0603	VISHAY, CRCW0603464KFKEA
22	1	R12	RES., 33.2kΩ, 1/10W, 1%, 0603	VISHAY, CRCW060333K2FKEA
23	1	R13	RES., 1.0kΩ, 1/10W, 1%, 0603	VISHAY, CRCW06031K00FKEA
24	1	R14	RES., 100kΩ, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
25	1	U1	IC, LTC3864EMSE MSE12	LINEAR TECH.CORP. LTC3864EMSE#PBF
Additional Demo Board Circuit Components				
1	0	C1	CAP., OPT 0603	OPT
2	0	C2	CAP., OPT 0805	OPT
3	0	D2	SCHOTTKY DIODE, OPT, SOD323	OPT
4	0	R6, R15	RES., OPT, 0603	OPT
5	1	R4	RES., 0Ω, 1/16W, 0603	VISHAY, CRCW06030000Z0EA
Hardware: For Demo Board Only				
1	8	E1, E2, E3, E4, E5, E6, E7, E8	TESTPOINT, TURRET, .094"	MILL MAX, 2501-2-00-80-00-00-07-0
2	1	JP1	CONN., HEADER, 1X3, 2mm	WURTH ELEKTRONIK, 62000311121
3	1	JP2	CONN., HEADER, 2X3, 2mm	WURTH ELEKTRONIK, 62000621121
4	2	XJP1, XJP2	SHUNT, 2mm	WURTH ELEKTRONIK, 60800213421
5	4	J1, J2, J3, J4	CONN, BANANA JACK,	KEYSTONE 575-4
6	4	MTGS AT 4 CORNERS	STAND-OFF, SNAP ON NYLON 0.50" tall	KEYSTONE, 8833

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.

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