LTC3864
55V Low I_Q Step-Down DC/DC Converter with 100% Duty Cycle Capability

DESCRIPTION

Demonstration circuit 1722A is a high voltage, current mode DC/DC step-down converter featuring the LTC®3864.

The board operates from an input range of 3.5V to 55V, and provides a 5V, 2A output when the input exceeds 5V. 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 3.5V_{IN}. It operates at 350kHz 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. The demonstration board has options for larger MOSFET and diode packages on the back of the board for higher output current requirements.

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/DC1722A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		3.5		55	V
V_{OUT}	Output Voltage			5.0		V
I_{OUT}	Output Current Range, Continuous		0		2	A
f_{SW}	Switching (Clock) Frequency			350		kHz
$V_{OUT(P-P)}$	Output Ripple	V_{IN} = 14V, I_{OUT} = 2A (20MHz BW)		15		mV_{P-P}
V_{REG}	Output Regulation	Line and Load (5.5V_{IN} to 55V_{IN}, 0A_{OUT} to 2A_{OUT})		0.23		%
P_{OUT}/P_{IN}	Efficiency (See Figure 3)	V_{IN} =14V, I_{OUT} = 2A		84		%
	Approximate Size	Component Area x Top Component Height		0.6 × 0.6 × 0.14		Inches

QUICK START PROCEDURE

Demonstration circuit 1722 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 3.5V to 55V to 6V. 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 3.5V 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 $2A_{DC}$ or a resistor shunt can be put in series with the input supply in order to measure the DC1722A's input current.
   c. A voltmeter with a capability of measuring at least 55V 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 55V.

4. Check for the proper output voltage of 5V. Turn off the power at the input.
5. Once the proper output voltage is established, connect a variable load capable of sinking 2A at 5V 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 $2A_{DC}$ can be put in series with the output load in order to measure the DC1722A's output current.
   b. A voltmeter with a capability of measuring at least 5V 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

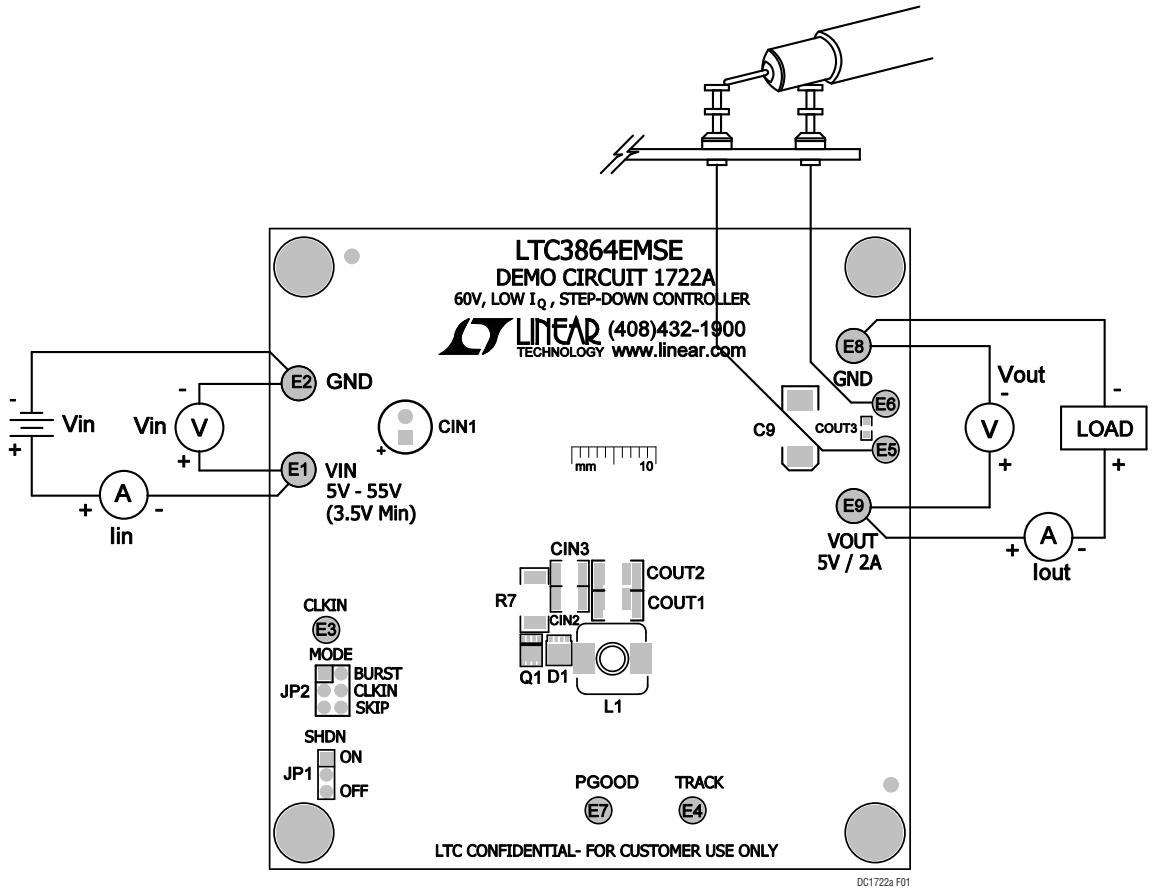


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

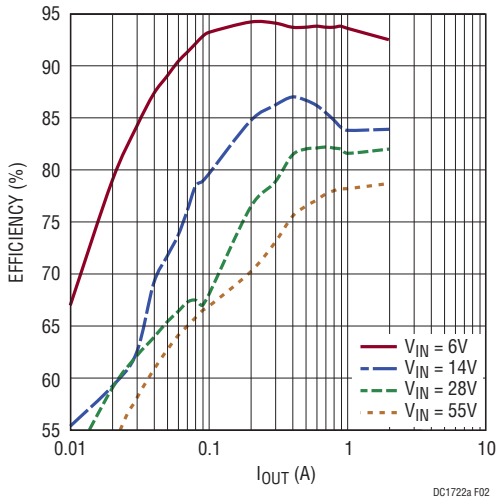


Figure 2. Efficiency with Burst Mode Operation at Light Loads

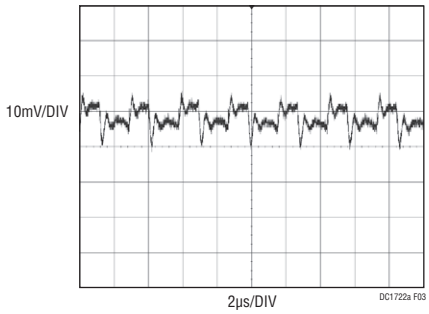


Figure 3. Output Ripple at $14V_{IN}$ and $2A_{OUT}$ (10mV, 2µs/DIV, 20MHz)

QUICK START PROCEDURE

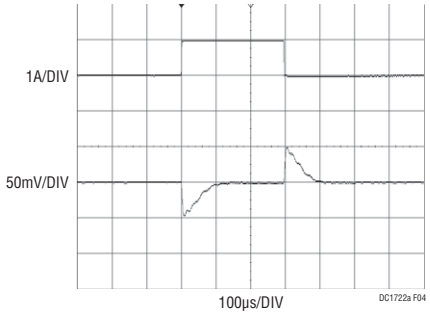
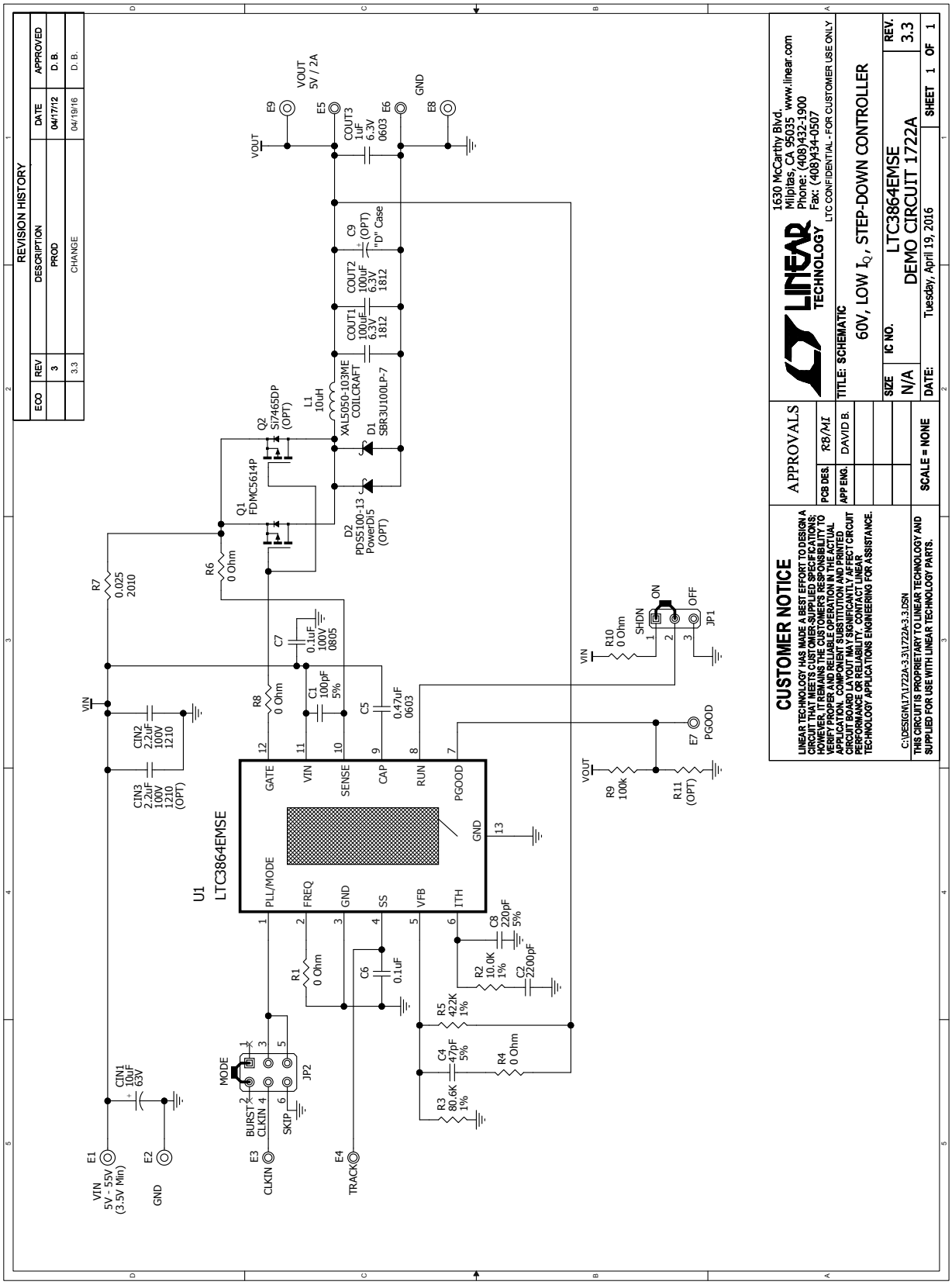


Figure 4. Transient Response Waveform at $14V_{IN}$ and 1A - 2A - $1A_{OUT}$ (1A, 50mV,100µs/DIV)

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CIN1	CAP, 10µF 20% 63V ALUM	SUN ELEC. 63HEH10M
2	1	CIN2	CAP, 1210 2.2µF 10% 100V X7R	MURATA GRM32ER72A225KA35L
3	2	COUT1, COUT2	CAP, 1812 100µF 20% 6.3V X5R	TDK C4532X5R0J107M
4	1	COUT3	CAP, 0603 1µF 10% 6.3V X5R	TAIYO YUDEN JMK107BJ105KA-T
5	1	C1	CAP, 0402 100pF 5% 25V NPO	AVX 04023A101JAT2A
6	1	C2	CAP, 0402 2200pF 10% 25V X7R	AVX 04023C222KAT2A
7	1	C4	CAP, 0402 47pF 5% 25V NPO	AVX 04023A470JAT2A
8	1	C5	CAP, 0603 0.47µF 20% 16V X7R	AVX 0603YC474MAT2A
9	1	C6	CAP, 0402 0.1µF 20% 16V X5R	AVX 0402YD104MAT2A
10	1	C7	CAP, 0805 0.1µF 20% 100V X5R	TDK C2012X5R2A104M
11	1	C8	CAP, 0402 220pF 5% 25V NPO	AVX 04023A221JAT2A
12	1	D1	DIODE, SUPER BARRIER RECTIFIER 100V DFN3030-8	DIODES INC./ZETEX SBR3U100LP-7
13	1	L1	IND, 10µH	COILCRAFT XAL5050-103ME
14	1	Q1	XSTR, FET P-CHANNEL 60V	FAIRCHILD SEMI FDMC5614P
15	5	R1, R4, R6, R8, R10	RES, 0402 0Ω JUMPER	VISHAY CRCW04020000Z0ED
16	1	R2	RES, 0402 10k 1% 1/16W	VISHAY CRCW040210K0FKED
17	1	R3	RES, 0402 80.6k 1% 1/16W	VISHAY CRCW040280K6FKED
18	1	R5	RES, 0402 422k 1% 1/16W	VISHAY CRW0402422KFKED
19	1	R7	RES, 2010 0.025Ω 1% 1/2W	VISHAY WSL2010R0250FEA
20	1	R9	RES, 0402 100k 5% 1/16W	VISHAY CRCW0402100KJNED
21	1	U1	IC, VOLTAGE REG. MSOP(12)-MSE	LINEAR TECH. LTC3864EMSE
Additional Demo Board Circuit Components				
1	0	CIN3	CAP, 1210 2.2µF 10% 100V X7R OPTION	MURATA GRM32ER72A225KA35L OPTION
2	0	C9	CAP, D CASE OPTION	OPTION
3	0	D2	DIODE, SCHOTTKY, 5A POWERDi5 OPTION	DIODES INC./ZETEXPDS5100-13 OPTION
4	0	L1 – ALTERNATE	IND, 10µH	TOKO B1134AS-100M
5	0	L1 – ALTERNATE	IND, 10µH	WURTH ELECTRONIK 744071100
6	0	Q2	XSTR, MOSFET P-CHANNEL 60V OPTION	VISHAY SILICONIX Si7465DP OPTION
7	0	R11	RES, 0402 OPTION	OPTION
Hardware				
1	4	E1, E2, E8, E9	TURRET	MILL MAX 2501-2-00-80-00-00-07-0
2	5	E3, E4, E5, E6, E7	TURRET	MILL MAX 2308-2-00-80-00-00-07-0
3	1	JP1	HEADER, 3-PIN SINGLE ROW 2mm	SAMTEC TMM-103-02-L-S
4	1	JP2	HEADER, 3-PIN DOUBLE ROW 2mm	SAMTEC TMM-103-02-L-D
5	4	MH1, MH2, MH3, MH4	STANDOFF, SNAP ON	KEYSTONE_8831
6	2	XJP1, XJP2	SHUNT, 2mm	SAMTEC 2SN-BK-G

SCHEMATIC DIAGRAM



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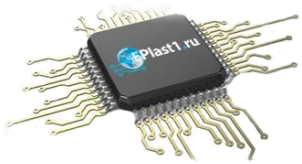

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