LTC1625
High Efficiency Synchronous Buck Converter

DESCRIPTION

Demonstration circuit DC2008 is DC/DC buck converter featuring the LTC®1625 constant frequency current mode buck controller. The DC2008A operates over a 4.5V to 28V input and provides 15A of output current as shown in Figure 3. The 225kHz constant frequency operation results in a small and efficient circuit. The converter provides high output voltage accuracy (typically ±3%) over a wide load range with no minimum load requirement. The demonstration circuit can be easily modified to generate different output voltages.

The DC2008 has small circuit footprint. It is a high performance and cost effective solution for telecom, automotive and industrial applications.

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

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PERFORMANCE SUMMARY   Specifications are at $T_A = 25°C$

PARAMETER	CONDITIONS	UNITS
Minimum Input Voltage	I_{OUT} = 0A to 15A	4.5V
Maximum Input Voltage	I_{OUT} = 0A to 15A	28V
V_{OUT}	V_{IN} = 4.5V to 28V, I_{OUT} = 0A to 15A	3.3V ±3%
Typical Output Ripple V_{OUT}	V_{IN} = 4.5V to 28V, I_{OUT} = 15A	$50mV_{P-P}$
Nominal Switching Frequency		225kHz

QUICK START PROCEDURE

Demonstration circuit DC2008 is easy to set up to evaluate the performance of the LTC1625. For proper measurement equipment setup refer to Figure 1 and follow the procedure below:

Note: When measuring the input or output voltage ripple, care must be taken to minimize the length of oscilloscope probe ground lead. Measure the input or output voltage ripple by connecting the probe tip directly across the VIN or VOUT and GND terminals as shown in Figure 2.

1. With power off, connect the input power supply to VIN and GND.

2. Check the EXTVCC bias voltage-setting jumper JP1. Remove it for internal VCC bias if required.

3. Turn the input power source on and slowly increase the input voltage. Be careful not to exceed 28V.

Note: Make sure that the input voltage V_{IN} does not exceed 28V. If higher operating voltage is required, power components with higher voltage ratings should be used.

4. Set the input voltage to 6V and check for the proper output voltage of 3.3V. If there is no output, temporarily disconnect the load to make sure that the load is not set too high.

5. Once the proper output voltage is established, adjust the load and observe the output voltage regulation, ripple voltage, efficiency and other parameters.
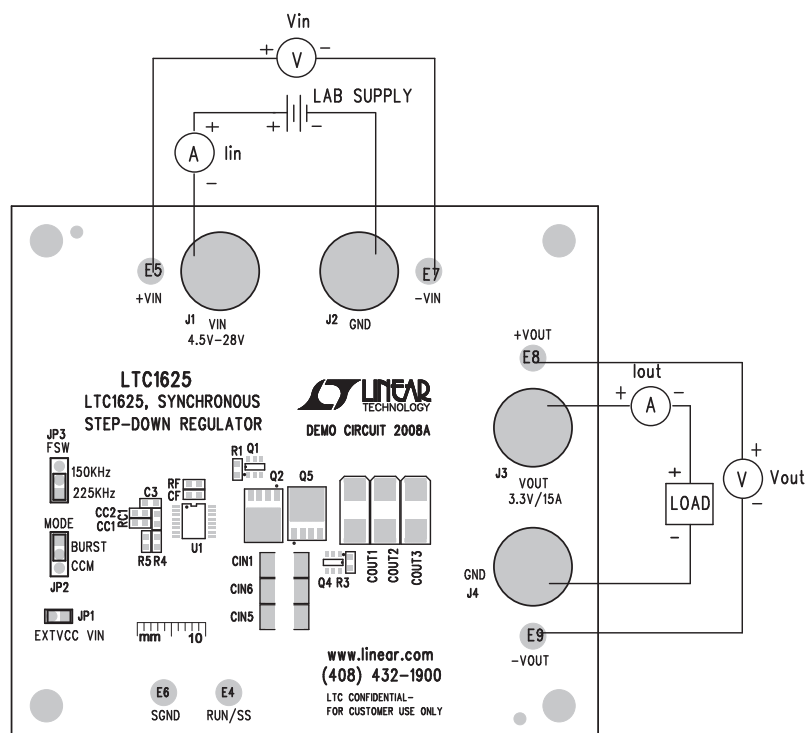
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QUICK START PROCEDURE

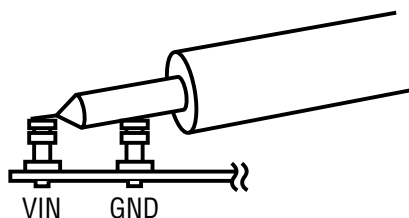**Figure 1. Proper Measurement Equipment Setup**

Figure 2. Measuring Input or Output Ripple

Changing The Output Voltage

To change the output voltage change the bottom voltage divider resistors connected to LTC1625 FB pin (see the Schematic Diagram). Please refer to data sheet for details.

Note that the output voltage will start following the input voltage when input voltage is lower than the voltage set by the voltage divider. In this mode the top synchronous MOSFET is turned continuously ON. The only losses in this mode are due to the DCR of inductor and top MOSFET DC resistance. In this mode the LTC1625 has a repetitive short pulses that are used to refresh the top MOSFET drive circuit.

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QUICK START PROCEDURE

Converter Efficiency And Output Current

The DC2008 output current capability depends on the components used. Typical performance of DC2008A is shown in Figure 3.

The Schematic Diagram can be modified for lower or higher currents and output voltages. Please contact LTC factory for details.

Output Load Step Response

The load step response of DC2008A is very good even though relatively small amount of output capacitance is present at the output.

If higher load steps need to be handled or lower transients are required, more output capacitance can be added in order to keep the voltage transients at the desired level.

The load step transients are shown in Figure 4. Also, note that the load step response even from 0% load is excellent thanks to synchronous operation.

Beware that the load steps on the output will demand current steps on the input. The DC2008A demo board responds fast to load transients, which demands fast response from the input power source. Monitor the input voltage at the DC2008A input terminals to ensure that the input power source is capable of supplying such fast load current demands.

Input And Output Filtering

The DC2008 is equipped with adequate amount of input and output filtering. The input and output voltage ripples with a 10A load are shown in Figure 5. Also, the switch node waveform is shown for reference.

The output ripple voltage will stay constant regardless of the load. Some of the output capacitors could be removed at the expense of output ripple voltage and load transient response.

The input ripple voltage is dependent on the output load current. The input capacitors were selected based on the amount of RMS ripple current that needs to be handled.

Beware that adding high ESR electrolytic capacitors at the input may result in high power dissipation in the capacitors.

If bulk input capacitors are required use sufficient numbers of low ESR type of capacitors like aluminum polymer.
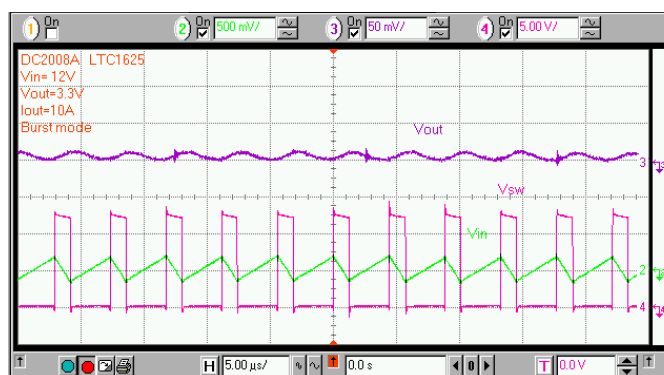
Please consult LTC factory for details on selecting proper input and output capacitors.
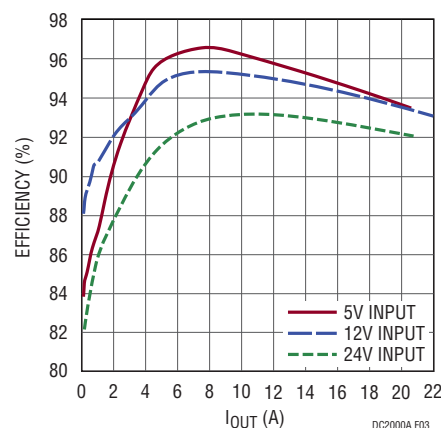
Figure 3. High Efficiency of DC2008 Allows the Board to be Used in Thermally Critical Applications with Outputs Over 15A
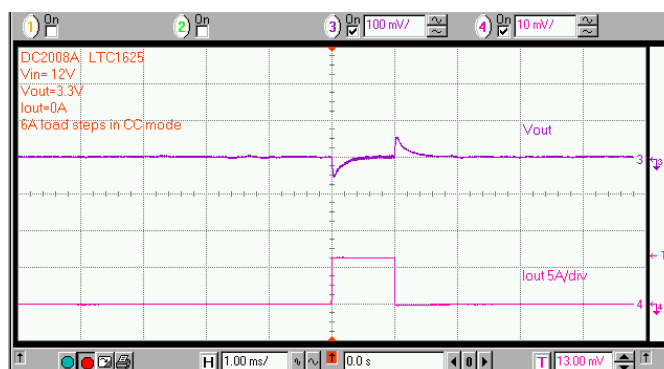
Figure 4. Fast Transient Response of the DC2008 Is Achieved with a Relatively Small Amount of Output Capacitance

Figure 5. The DC2008 Has Very Low Output Ripple Voltage. The Input Ripple Voltage, if Required, Can Be Further Reduced By More Input Capacitance of by Adding a Small LC Filter
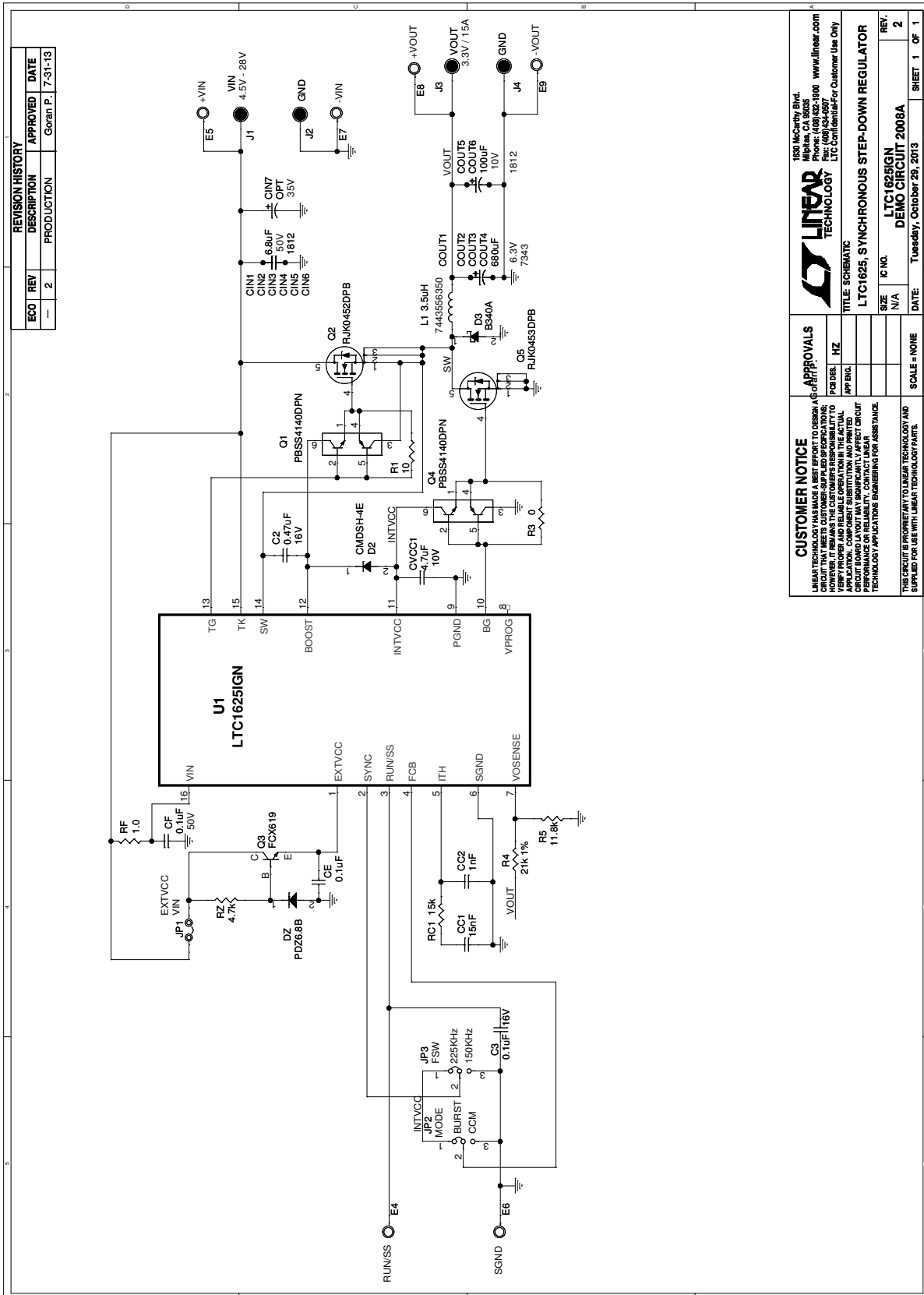
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PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	CC1	CAP., X7R, 15nF, 25V, 10% 0603	KEMET, C0603C153J3GACTU
2	1	CC2	CAP., X7R, 1nF, 50V, 10% 0603	YAGEO., CC0603KRX7R9BB102
3	1	C3	CAP., X5R, 0.1µF, 16V, 10%, 0603	KEMET, C0603C104K4RACTU
4	1	CF	CAP., X5R, 0.1µF, 50V, 10%, 0603	TDK, CGA3E2X5R1H104K080AA
5	6	CIN1-CIN6	CAP., X5R, 6.8µF, 50V, 10%, 1812	TDK, C4532X7R1H685K
6	2	COUT5, COUT6	CAP., X5R, 100µF, 10V, 20%, 1812	TDK, C4532X5R1A107M280KC
7	4	COUT1-COUT4	CAP., TANT, 680µF,6.3V,7343	KEMET, T530X687M006A1E010
8	1	CVCC1	CAP., X5R, 4.7µF, 6.3V, 10%, 0805	TAIYO YUDEN JMK212BJ475KD-T
9	1	C2	CAP., X7R, 0.47µF, 6.3V, 10%, 0805	TDK, CGJ4J2X7R0J474K
10	1	D2	DIODE, SCHOTTKY, SOD-323	CENTRAL, CMDSH4E
11	1	D3	DIODE., SCHOTTKY, SMA,	DIODE, B340A-13-F
12	1	L1	IND., 3.5µH	WÜRTH ELEKTRONIK, 7443556350
13	2	Q1,Q4	NPN/PNP TRANSISTOR., SC-74	NXP SEMI., PBSS4140DPN
14	1	Q5	N-CHANNEL MOSFET, LFPAK	RENESAS, RJK0453DPB-T-E3
15	1	Q2	N-CHANNEL MOSFET, LFPAK	RENESAS, RJK0452DPB-T-E3
16	1	RC1	RES., CHIP, 15k, 1%, 0603	CRCW060315K0FKEA
17	1	RF	RES., CHIP, 1.0Ω, 1%, 0603	VISHAY,CRCW06031R00FKEA
18	1	R1	RES., CHIP, 10Ω, 1%, 0603	VISHAY, CRCW060310R0FKEA
19	1	R3	RES., CHIP, 0Ω, 0603	VISHAY, CRCW06030R00FKEA
20	1	R4	RES., CHIP, 21k, 1%, 0603	KOA Speer Electronics, RK73H1JTTD2102F
21	1	R5	RES., CHIP, 11.8k, 1%, 0603	VISHAY, CRCW060311K8FKEA
22	1	U1	LTC1625IGN, GN PACKAGE 16-PIN	LINEAR TECH., LTC1625IGN
Additional Demo Board Circuit Components				
1	0	CIN7, OPT	CAP., OPTIONAL	
2	1	CE	CAP., X5R, 0.1µF, 16V, 10%, 0603	KEMET, C0603C104K4RACTU
3	1	DZ	DIODE., 350mW, 5% ,SOD-323	PHILIPS, PDZ6.8B
4	1	Q3	TRANSISTOR., NPN SOT-89	ZETEX, FCX619
5	1	RZ	RES., CHIP, 4.7k, 5%, 0603	VISHAY, CRCW06034K70JNED
Hardware-For Demo Board Only				
1	6	E4-E9	TESTPOINT, TURRET, 0.095"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	4	STAND OFF	STAND OFF	KEYSTONE, 8833
3	1		FAB, PRINTED CIRCUIT BOARD	DEMO CIRCUIT 2008A
4	1		STENCIL TOP AND BOTTOM	STENCIL DC2008A
5	1	JP1	0.079 SINGLE ROW HEADER, 2-PIN	SAMTEC, TMM102-02-LS
6	2	JP2,JP3	0.079 SINGLE ROW HEADER, 3-PIN	SAMTEC, TMM-103-02-L-S
7	3	JP1-JP3	SHUNT	SAMTEC, 2SN-BK-G
8	4	J1-J4	STUD, TEST PIN	PEM KFH-032-10
9	8	J1-J4 (X2)	NUT, BRASS 10-32	ANY #10-32
10	4	J1-J4	RING, LUG #10	KEYSTONE #10
11	4	J1-J4	WASHER, TIN PLATED BRASS	ANY #10

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SCHEMATIC DIAGRAM

DEMONSTRATION BOARD IMPORTANT NOTICE

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

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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.

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