

LTC3607EUD Dual 600mA 15V Monolithic Synchronous Step-Down Regulator

DESCRIPTION

Demonstration circuit DC1596 is a dual output regulator consisting of two constant-frequency step-down converters, based on the LTC[®]3607 monolithic dual channel synchronous buck regulator. The DC1596 has an input voltage range of 4.5V to 15V, with each regulator capable of delivering up to 600mA of output current. The DC1596 can operate in either Burst Mode[®] operation or pulse-skipping mode. In shutdown, the DC1596 quiescent current is less than 1µA. The DC1596 is a very efficient circuit attaining up to 90%. The DC1596 uses the LTC3607's16-lead QFN

package, which has an exposed pad on the bottom side of the IC for better thermal performance. These features, plus a set operating frequency range of 2.25MHz, make the DC1596 demo board an ideal circuit for industrial or distributed power applications.

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

⊥7, LT, LTC, LTM, Linear Technology, the Linear logo and Burst Mode are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

PERFORMANCE SUMMARY Specifications are at T_A = 25°C

PARAMETER CONDITIONS VALUE 4.5V Minimum Input Voltage 15V Maximum Input Voltage RUN Pin = GND Run Shutdown RUN Pin = V_{IN} Operating 1.2V ±4% (1.152V-1.148V) Output Voltage VOUT1 Regulation V_{IN1} = 4.5V to 15V, I_{OUT1} = 0A to 600mA 1.5V ±4% (1.44V-1.56V) 1.8V ±4% (1.728V-1.872V) Typical Output Ripple VOUT1 VIN1 = 12V, IOUT1 = 600mA (20MHz BW) <20mV_{P-P} Output Voltage VOUT2 Regulation V_{IN2} = 4.5V to 15V, I_{OUT2} = 0A to 600mA 2.5V ±4% (2.425V-2.6V) 3.3V ±4% (3.168V-3.432V) 5V ±4% (4.8V-5.2V) Typical Output Ripple VOLIT2 V_{IN2} = 12V, I_{OUT2} = 600mA (20MHz BW) $<20 \text{mV}_{P-P}$ Mode Setting Mode Pin Floating **Burst Mode Operation** Mode Pin Grounded Pulse-Skipping Burst Mode Operation Output Current Thresholds Channel 1: PVIN1 = 12V, VOUT1 = 1.8V $I_{0UT1} < 480 mA$ Channel 2: PV_{IN2} = 12V, V_{OUT2} = 3.3V I_{0UT2} < 360mA Channel 1: PV_{IN1} = 12V, V_{OUT1} = 1.8V Pulse-Skipping Operation Output Current I_{OUT1} < 330mA Channel 2: PV_{IN2} = 12V, V_{OUT2} = 3.3V Thresholds I_{0UT2} < 240mA 2.25MHz ±20% Switching Frequency



The DC1596 is easy to set up to evaluate the performance of the LTC3607. For a proper measurement equipment configuration, set up the circuit according to the diagram in Figure 1.

Note: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the V_{IN} or V_{OUT} and GND terminals. See the proper scope probe technique in Figure 2.

Please follow the procedure outlined below for proper operation.

1. Connect the input power supply to the PVIN1/PVIN2 and GND terminals (V_{IN1} and V_{IN2} are separate nodes but are connected). Connect the loads between the VOUT and GND terminals. Refer to Figure 1 for the proper measurement equipment setup.

Before proceeding to operation, insert jumper shunts XJP1 and XJP2 into the OFF positions of headers JP1 and JP2, shunt XJP3 into the pulse-skip position of MODE header JP3, and shunt XJP4 into the VOUT1 voltage options of choice of header JP4: 1.2V, 1.5V, or 1.8V, and shunt XJP5 into the VOUT2 voltage options of choice of header JP5: 2.5V, 3.3V, or 5V.

- 2. Apply 5.5V at PVINs 1, 2. Measure both VOUTs; they should read OV. If desired, one can measure the shutdown supply current at this point. The supply current will be less than 1μ A in shutdown.
- 3. Turn on VOUT1 and VOUT2 by shifting shunts XJP1 and XJP2 from the OFF positions to the ON positions. Both output voltages should be within a tolerance of $\pm 2\%$.
- 4. Vary the input voltages from 5.8V (the minimum V_{IN} is dependent on V_{OUT}) to 15V, and the load currents from 0A to 600mA. Both output voltages should be within $\pm 4\%$ tolerance.

- 5. Set the load current of both outputs to 600mA and the input voltages to 12V, and then measure each output ripple voltage (refer to Figure 2 for proper measurement technique); they should each measure less than 20mVAC. Also, observe the voltage waveform at either switch node (Pin 5 for reg.1 and Pin 8 for reg.2) of each regulator. The switching frequencies should be about 2.25MHz ±20% (T = 555ns and 370ns). Both switch node waveforms should be rectangular in shape, and 180° out-of-phase with each other.
- 6. To operate the ckt.s in Burst Mode operation, change the shunt position of header JP3 to BURST MODE.
- 7. Regulators 1 (PVIN1) and 2 (PVIN2) are completely separated from each other; thus, they can be powered from different individual input supplies (if R11 is removed), as can the signal input supply, SVIN. However, SVIN must powered for either regulator to function (SVIN is connected to PVIN1 through a filter on the demo board.).
- 8. When finished, insert shunts XJP1 and XJP2 to the OFF position(s) and disconnect the power.

Warning: If the power for the demo board is carried in long leads, the input voltage at the part could "ring", which could affect the operation of the circuit or even exceed the maximum voltage rating of the IC. To eliminate the ringing, a small tantalum capacitor (for instance, AVX part # TPSY226M035R0200) is inserted on the pads between the input power and return terminals on the bottom of the demo board. The (greater) ESR of the tantalum capacitor will dampen the (possible) ringing voltage caused by the long input leads. On a normal, typical PCB, with short traces, this capacitor is not needed.



dc1596afa



Figure 1. Proper Measurement Equipment Setup



Figure 2. Measuring Input or Output Ripple









Figure 4. Load Step Response



Figure 6. Load Step Response



Figure 5. Load Step Response





4



Figure 7. Load Step Response



Figure 9. Load Step Response



Figure 8. Load Step Response



Figure 10. Efficiency

dc1596afa



PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required	d Circuit	Components	·	
1	2	CFFW1, CFFW2	CAP., NPO, 22pF, 25V, 5%, 0402	AVX, 04025A220JAT2A
2	2	CIN1BYP, CIN2BYP	CAP., X7R, 0.1µF, 16V, 10%, 0603	AVX, 0603YC104KAT2A
3	2	COUT1, COUT2	CAP., X5R, 10µF, 6.3V, 10%, 0805	AVX, 08056D106KAT2A
4	2	CIN1, CIN2	CAP., X5R, 10µF, 16V, 10%, 1206	AVX, 1206YD106KAT2A
5	1	L1	Inductor, 2.2µH	VISHAY, IHLP1616BZER2R2M11
6	1	L2	Inductor, 4.7µH	VISHAY, IHLP1616BZER4R7M11
7	1	R1	RES., CHIP, 210k, 1%, 0402	VISHAY, CRCW0402210KFKED
8	1	R2	RES., CHIP, 887k, 1%, 0402	VISHAY, CRCW0402887KFKED
9	1	R6	RES., CHIP, 196k, 1%, 0402	VISHAY, CRCW0402196KFKED
10	1	R7	RES., CHIP, 105k, 1%, 0402	VISHAY, CRCW0402105KFKED
11	1	U1	IC., LTC3607EUD, 16-PIN QFN 3X3	LINEAR TECH., LTC3607EUD
Additiona	al Demo	Board Circuit Components	·	·
1	3	COUT3, COUT4, CF	CAP., X7R, 0.1µF, 16V, 10%, 0603	AVX, 0603YC104KAT2A
2	2	CIN3, CIN4	CAP., TANT, 22µF, 35V, 20%, CASE Y	AVX, TPSY226M035R0200
3	0	COUT5, COUT6 (OPT.)	CAP., X5R, 47µF, 6.3V, 10%, 1210	AVX, 12106D476KAQ2A
4	0	CIN5, CIN6 (OPT.)	CAP., X5R, 47µF, 20V, 10%, 1812	
5	1	RF	RES., CHIP, 100Ω, 1/16W, 5%, 0402	VISHAY, CRCW0402100RJNED
6	1	R3	RES., CHIP, 210k, 1%, 0402	VISHAY, CRCW0402210KFKED
7	1	R4	RES., CHIP, 280k, 1%, 0402	VISHAY, CRCW0402280KFKED
8	1	R5	RES., CHIP, 140k, 1%, 0402	VISHAY, CRCW0402140KFKED
9	1	R8	RES., CHIP, 121k, 1%, 0402	VISHAY, CRCW0402105KFKED
10	0	R9, R10 (OPT.)	RES., 0402	
11	1	R11	RES., CHIP, 0Ω, 1%, 0805	VISHAY, CRCW08050000Z0ED
12	2	RSD1, RSD2	RES., CHIP, 5.1M, 5%, 0402	VISHAY, CRCW04025M10JNED
13	2	RPG1, RPG2	RES., CHIP, 100k, 1%, 0402	VISHAY, CRCW0402100KFKED
Hardware	9	1		
1	12	E1-E12	Testpoint, TURRET, 0.094"	MILL-MAX-2501-2-00-80-00-00-07-0
2	2	JP1,JP2	0.079 SINGLE ROW HEADER, 3-PIN	SAMTEC, TMM103-02-L-S
3	2	JP4,JP5	0.079, 2X4 HEADER	SAMTEC, TMM104-02-L-D
4	1	JP3	0.079, 2X3 HEADER	SAMTEC, TMM103-02-L-D
5	5	JP1-JP5	SHUNT, FOR JP1-JP5	SAMTEC, 2SN-BK-G





SCHEMATIC DIAGRAM



TECHNOLOGY

Information furnished by Linear Technology Corporation is believed to be accurate and reliable. However, no responsibility is assumed for its use. Linear Technology Corporation makes no representation that the interconnection of its circuits as described herein will not infringe on existing patent rights.

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

dc1596afa

8