LTC3607EMSE
Dual 600mA 15V Monolithic Synchronous Step-Down Regulator Board

DESCRIPTION

Demonstration circuit 1847 is a dual output regulator based on the LTC®3607 monolithic dual channel synchronous buck regulator. The DC1847 has an input voltage range of 4.5V to 15V, with each regulator capable of delivering up to 600mA of output current. The DC1847 can operate in either Burst Mode® or pulse-skipping mode. In shutdown, the DC1847 can run off of less than 1µA total. The DC1847 is a very efficient circuit: up to 90%. The DC1847 uses the 16 Pin MSOP LTC3607 package, which has an exposed pad on the bottom-side of the IC for good thermal performance. These features, plus a set operating frequency of 2.25MHz, make the DC1847 demo board an ideal circuit for use in industrial, automotive, or distributed power applications.

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

PERFORMANCE SUMMARY

Specifications are at $T_A = 25°C$

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

QUICK START PROCEDURE

Demonstration circuit 1847A The DC1847 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 PV_{IN1}/PV_{IN2} and GND terminals (V_{IN1} and V_{IN2} are separate nodes but are connected.). Connect the loads between the V_{OUT} 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 V_{OUT1} voltage options of choice of header JP4: 1.2V, 1.5V, or 1.8V, and shunt xJP5 into the V_{OUT2} voltage options of choice of header JP5: 2.5V, 3.3V, or 5V.

2. Apply 5.5V at PV_{IN1} or PV_{IN2} turret. Measure both V_{OUT}s; they should read 0V. If desired, one can measure the shutdown supply current at this point. The supply current will be less than 1µA in shutdown.

3. Turn on V_{OUT1} and V_{OUT2} by shifting shunts xJP1 and xJP2 from the OFF positions to the ON positions. Both output voltages should be within a tolerance of ±2%.

4. Vary the input voltages from 5.8V (the min. V_{IN} is dependent on V_{OUT}) to 15V, and the load currents from 0 to 600 mA. Both output voltages should be within ±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 20 mVAC. 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 frequency should be about 2.25MHz ±20% (period between 370ns and 555ns). Both switch node waveforms should be rectangular in shape, and 180° out-of-phase with each other.

6. For Burst Mode operation, change the shunt position of header JP3 to Burst Mode.

7. Regulators 1 (PV_{IN1}) and 2 (PV_{IN2}) 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, SV_{IN}. However, SV_{IN} must powered for either regulator to function (SV_{IN} is connected to PV_{IN1} through a filter on the demo board.).

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.

QUICK START PROCEDURE

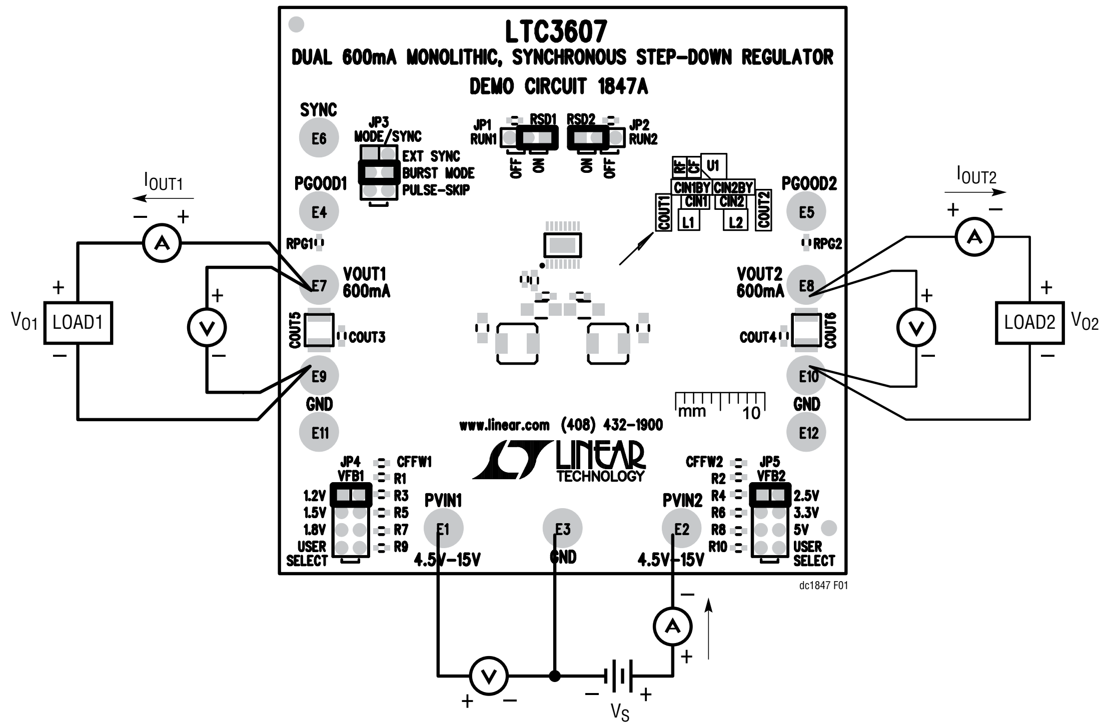


Figure 1. Proper Measurement Equipment Setup

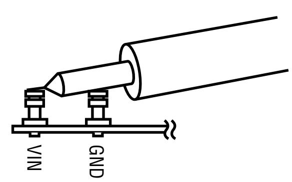
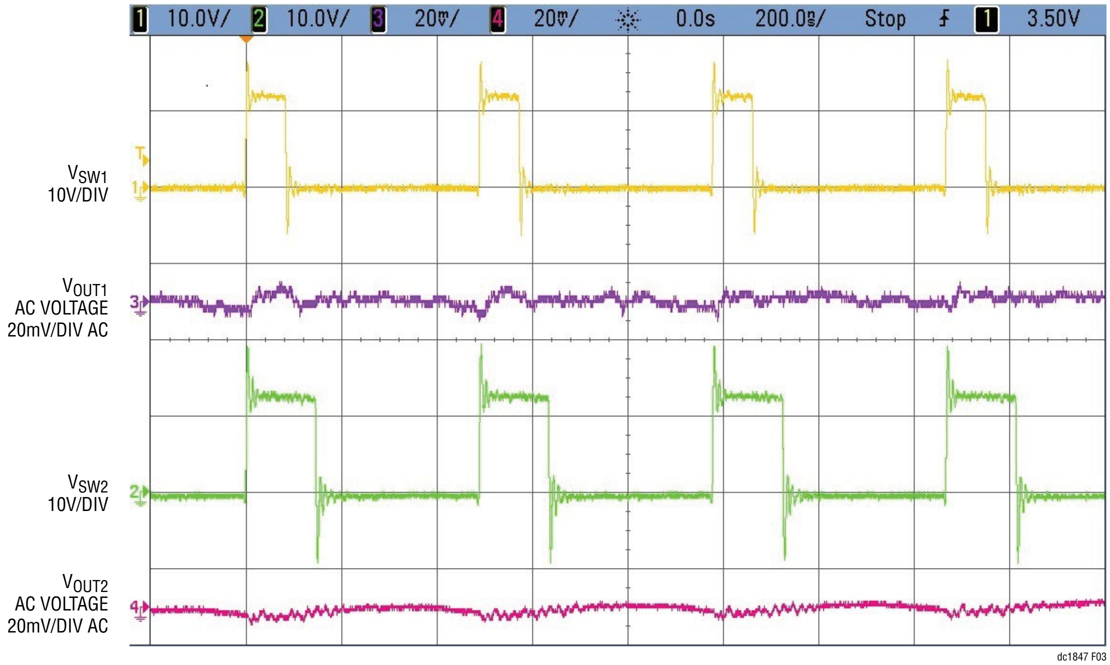


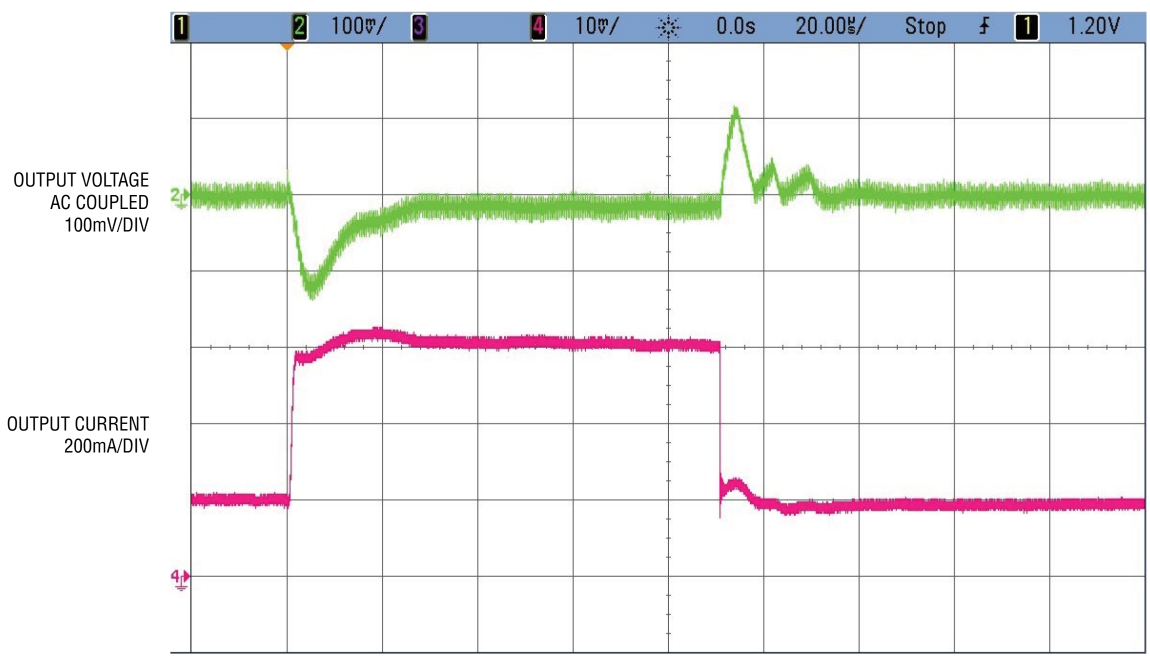
Figure 2. Measuring Input or Output Ripple

QUICK START PROCEDURE



V_{IN} = 12V, V_{OUT} = 1.8V AT I_{OUT1} = 600mA, V_{OUT2} = 3.3V AT I_{OUT2} = 600mA

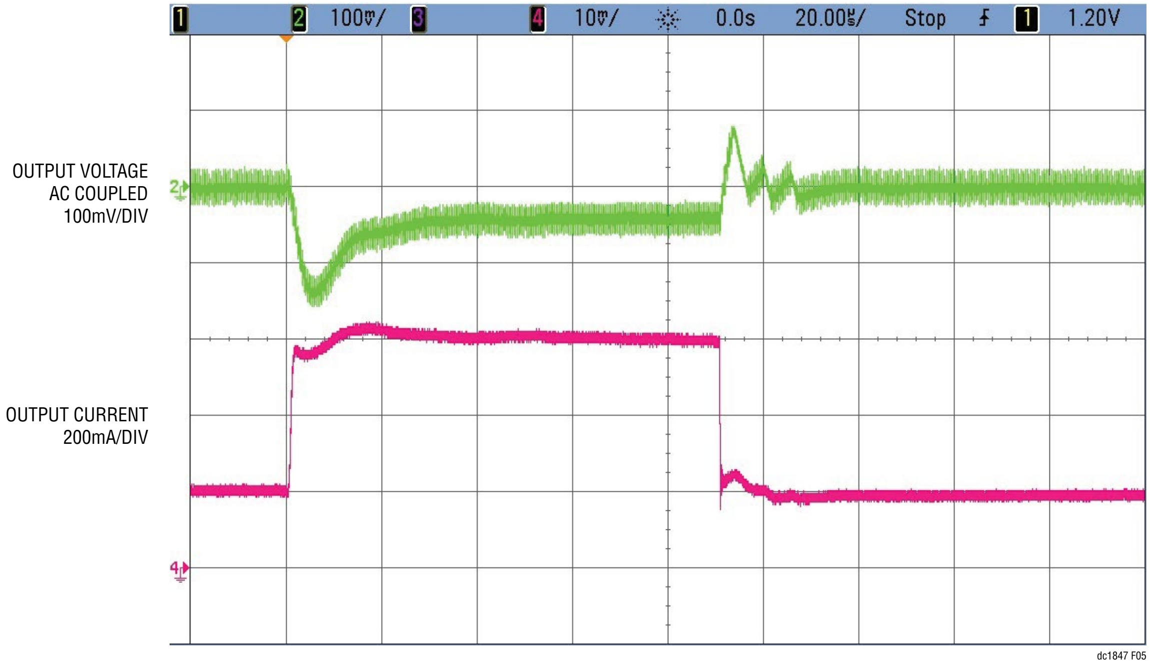
Figure 3. Switch Operation



V_{IN} = 10V, V_{OUT1} = 1.2V, 400mA Load Step (200mA <-> 600mA)
Pulse-Skipping Mode, f_{SW} = 2.25MHz

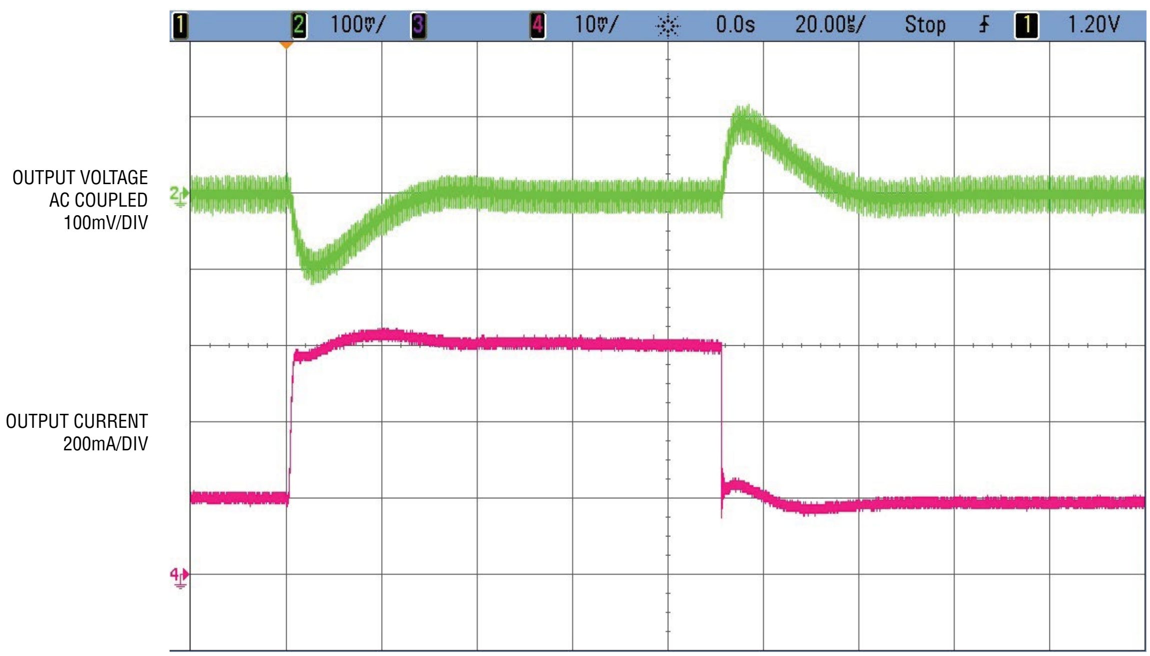
Figure 4. Load Step Response

QUICK START PROCEDURE



V_{IN} = 12V, V_{OUT1} = 1.5V, 400mA Load Step (200mA <-> 600mA)
Pulse-Skipping Mode, f_{SW} = 2.25MHz

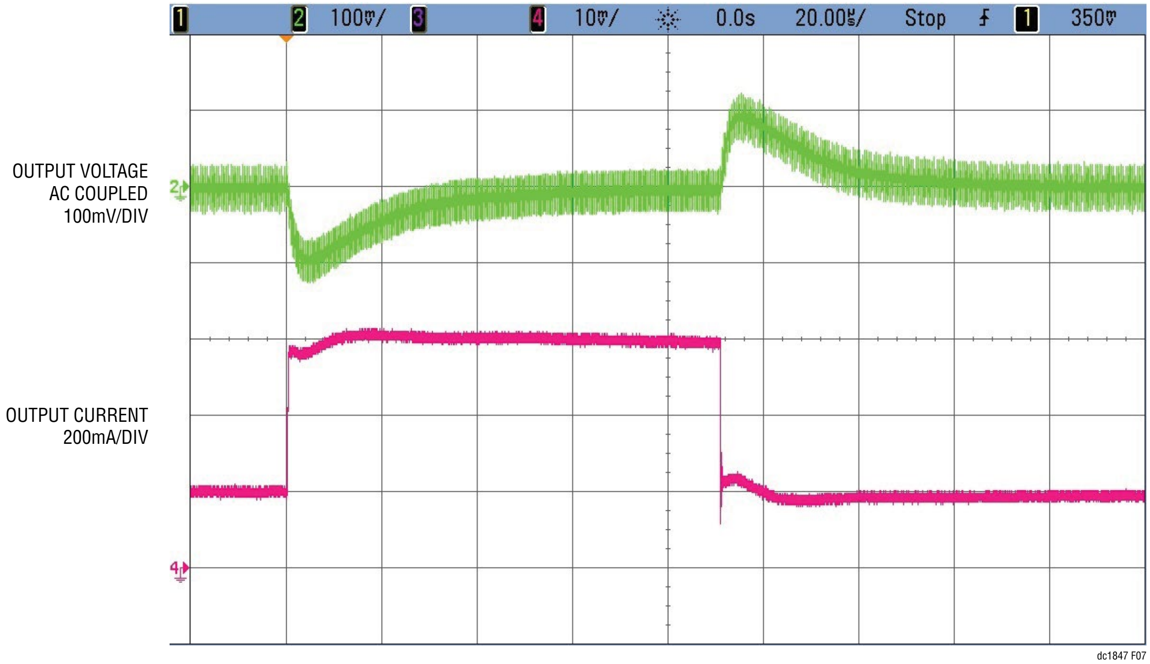
Figure 5. Load Step Response



V_{IN} = 12V, V_{OUT1} = 1.8V, 400mA Load Step (200mA <-> 600mA)
Pulse-Skipping Mode, f_{SW} = 2.25MHz

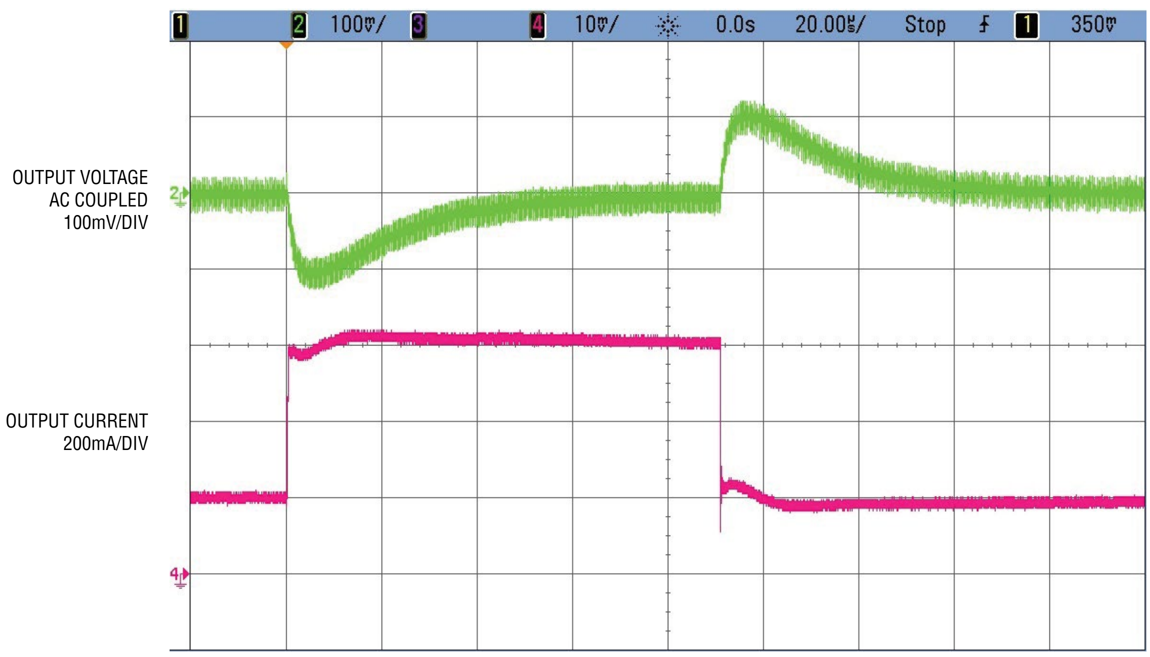
Figure 6. Load Step Response

QUICK START PROCEDURE



V_{IN} = 12V, V_{OUT2} = 2.5V, 400mA Load Step (200mA <-> 600mA)
Pulse-Skipping Mode, f_{SW} = 2.25MHz

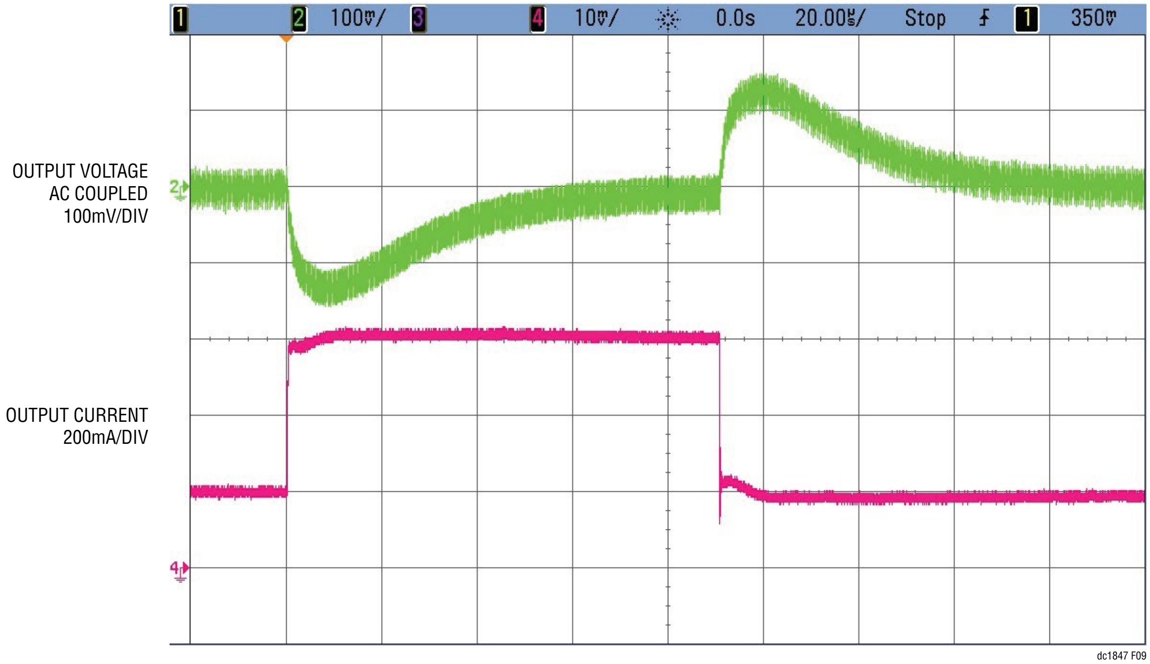
Figure 7. Load Step Response



V_{IN} = 12V, V_{OUT2} = 3.3V, 400mA Load Step (200mA <-> 600mA)
Pulse-Skipping Mode, f_{SW} = 2.25MHz

Figure 8. Load Step Response

QUICK START PROCEDURE



V_{IN} = 12V, V_{OUT2} = 5V, 400mA Load Step (200mA <-> 600mA)
Pulse-Skipping Mode, f_{SW} = 2.25MHz

Figure 9. Load Step Response

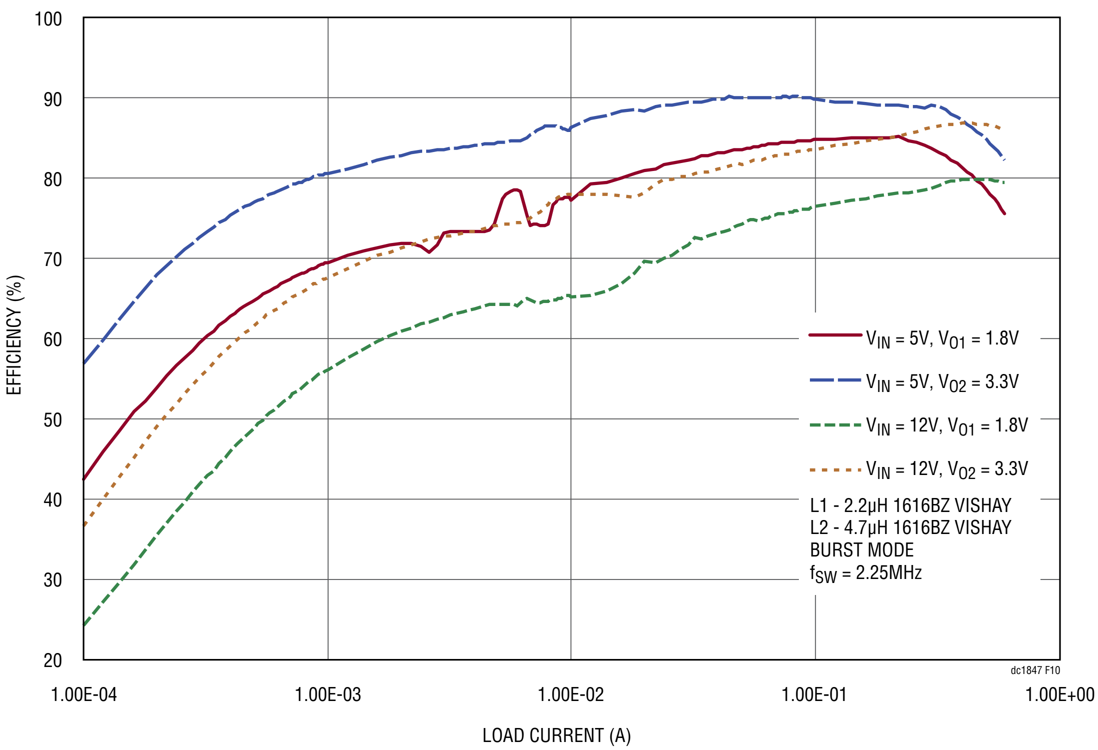
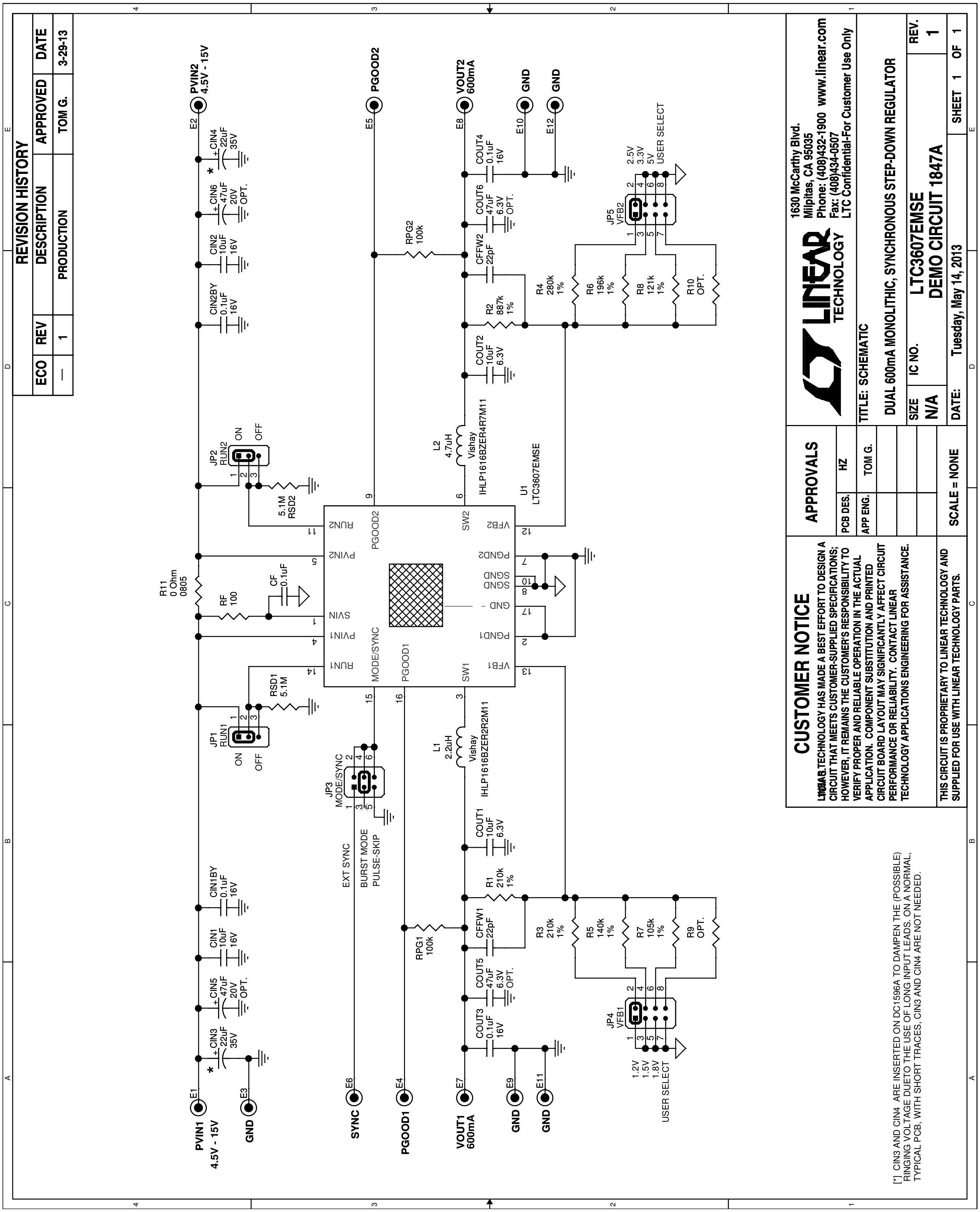


Figure 10. DC1847 Efficiency

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required 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., LTC3607EMSE, 16 Pin QFM 3 × 3	Linear Tech., LTC3607EMSE
Additional 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, 100, 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, 0, 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: For Demo Board Only				
1	12	E1-E12	Testpoint, TURRET, .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, 2 × 4 HEADER	SAMTEC, TMM104-02-L-D
4	1	JP3	0.079, 2 × 3 HEADER	SAMTEC, TMM103-02-L-D
5	5	JP1-JP5	SHUNT, FOR JP1-JP5	SAMTEC, 2SN-BK-G

SCHEMATIC DIAGRAM



dc1847af

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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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