

DESCRIPTION

Demonstration circuit 1677A is a dual 60V monolithic 1A step-down regulator featuring the LT[®]3988. The demo board operates from inputs up to 60V. The outputs are 5V, 1A and 3.3V, 1A. The wide input range of the LT3988 allows a variety of input sources, such as commercial vehicle batteries and industrial supplies. The switching frequency can be programmed either via oscillator resistor or external clock over a 250kHz to 2.5MHz range. When the circuit is synchronized to an external clock connected to the SYNC terminal, the R_T resistor (R2) should be chosen to set the LT3988 internal switching frequency within $\pm 25\%$ of the final SYNC frequency.

The LT3988 internal boost diodes and loop compensation reduce the components count and solution size. The current mode control scheme creates fast transient response and good loop stability. The EN/UVLO pin can be used to set the part in micropower shutdown mode, reducing the

supply current to less than $2\mu\text{A}$. Users can populate R1 and R3 to provide a programmable undervoltage lockout. Both channels have cycle-by-cycle current limit and diode current sense, providing protection against shorted outputs.

The LT3988 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this demo manual for demo circuit 1677A. The LT3988 is assembled in a 16-lead plastic MSOP package with an exposed pad for low thermal resistance. Proper board layout is essential for both proper operation and maximum thermal performance. See the data sheet section PCB Layout and Thermal Considerations.

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

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PERFORMANCE SUMMARY ($T_A = 25^\circ\text{C}$)

PARAMETER	CONDITIONS	VALUE
Minimum Input Voltage		7V
Maximum Input Voltage		60V
Output Voltage V_{OUT1}	$V_{IN} = 7V \sim 60V$	$5V \pm 3\%$
Output Voltage V_{OUT2}	$V_{IN} = 7V \sim 60V$	$3.3V \pm 3\%$
Switching Frequency	$R_T = 200k$	$250kHz \pm 10\%$
Maximum Output Current I_{OUT1}	$V_{IN} = 7V \sim 60V$	1A
Maximum Output Current I_{OUT2}	$V_{IN} = 7V \sim 60V$	1A
Voltage Ripple V_{OUT1}	$V_{IN} = 12V, I_{OUT1} = 1A$	$< 30mV$
Voltage Ripple V_{OUT2}	$V_{IN} = 12V, I_{OUT2} = 1A$	$< 30mV$

QUICK START PROCEDURE

Demonstration circuit 1677A is easy to set up to evaluate the performance of the LT3988. Refer to Figure 2 for proper measurement equipment setup and follow the procedure below:

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 Figure 3 for the proper scope technique.

1. Place JP1 on the ON position and JP2 on the RT position.
2. With power off, connect the input power supply to V_{IN1} and GND. Also connect the same or another input power supply to V_{IN2} and GND.
3. With power off, connect loads from V_{OUT1} to GND and V_{OUT2} to GND.

4. Turn on the power at the inputs.

NOTE: Make sure that the input voltages do not exceed 60V.

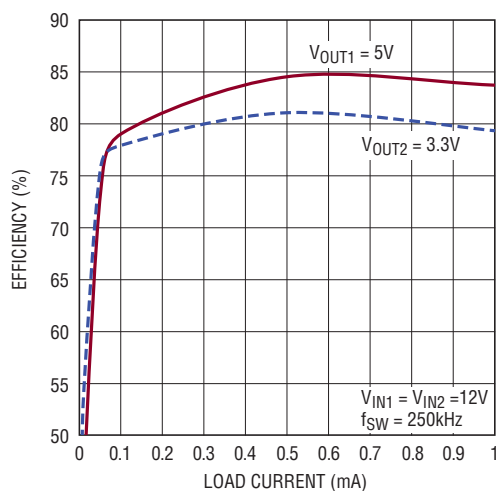
5. Check for the proper output voltages:

$$V_{OUT1} = 5V, V_{OUT2} = 3.3V.$$

NOTE: If there is no output, temporarily disconnect the load to make sure that the load is not set too high or is shorted.

6. Once the proper output voltages are established, adjust the loads within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

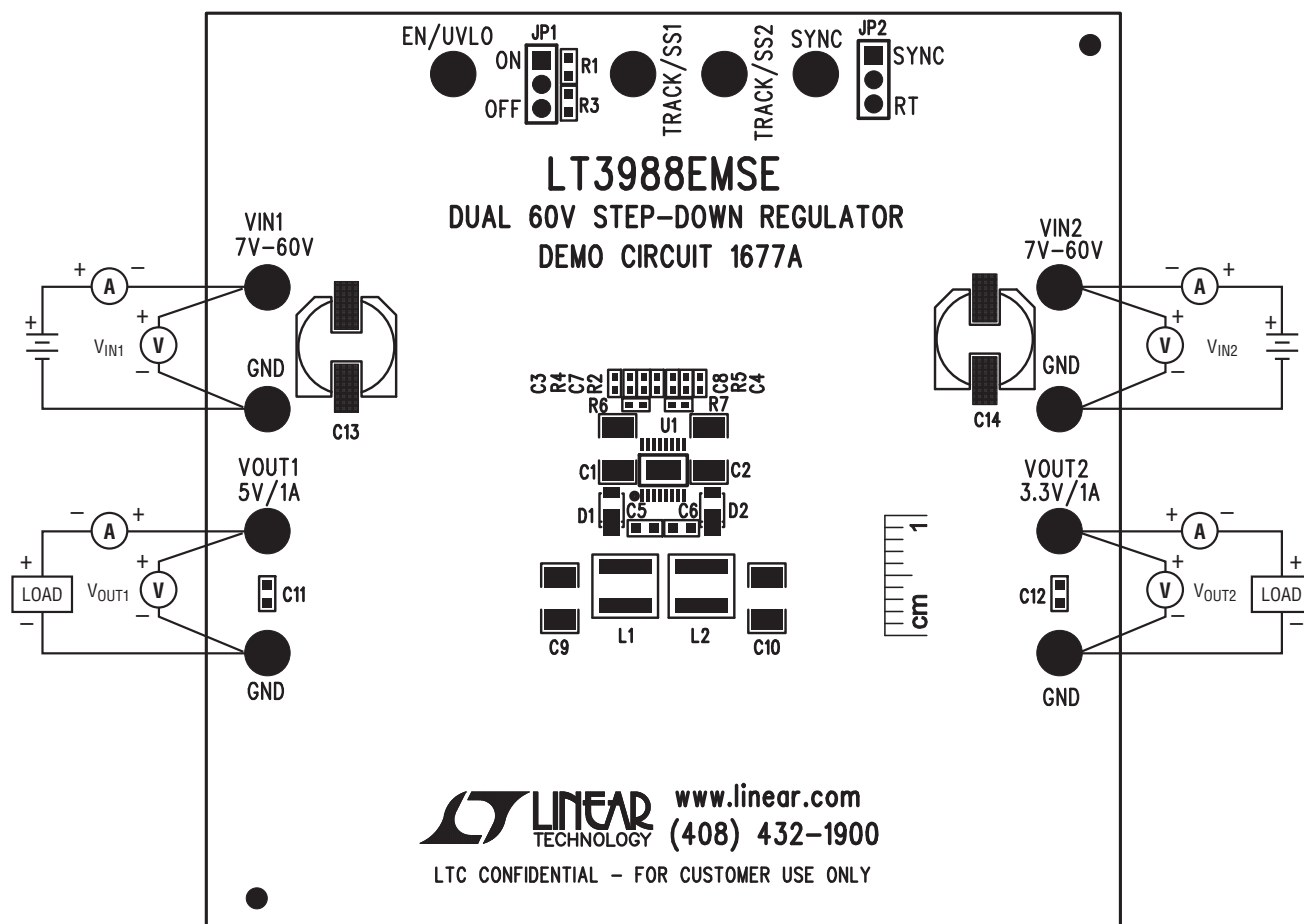
7. An external clock can be added to the SYNC terminal when SYNC function is used (JP2 on the SYNC position). Please make sure that R_T should be set to provide a frequency within $\pm 25\%$ of the final SYNC frequency. See the data sheet section Switching Frequency.



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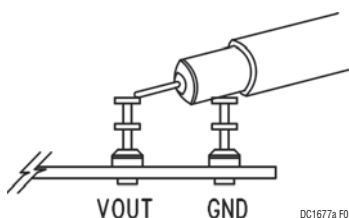
Figure 1. Efficiency vs Load Current

QUICK START PROCEDURE



DC1677a F02

Figure 2. Proper Measurement Equipment Setup



DC1677a F03

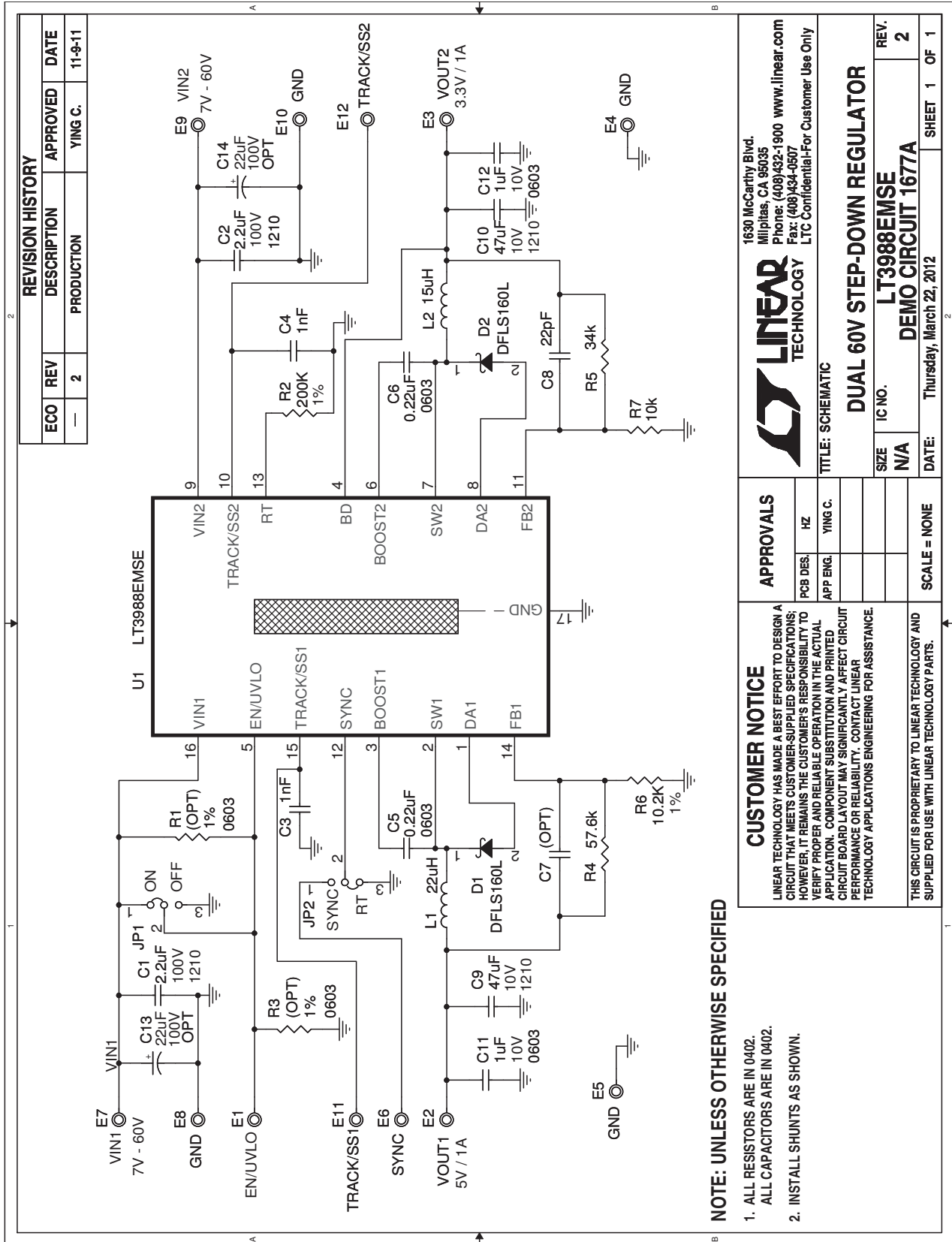
Figure 3. Measuring Input and Output Ripple

DEMO MANUAL DC1677A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1, C2	CAP, X7R, 2.2 μ F 100V, 20%, 1210	TDK, C3225X7R2A225M
2	2	C3, C4	CAP, X7R, 1000pF 50V, 5%, 0402	AVX, 04025C102JAT
3	2	C5, C6	CAP, X5R, 0.22 μ F 16V, 10%, 0603	AVX, 0603YD224KAT
4	1	C8	CAP, C0G, 22pF 16V, 0402, 5%	AVX, 0402YA220JAT2A
5	2	C9, C10	CAP, X7R, 47 μ F 10V, 1210	MURATA, GRM32ER71A476KE15L
6	2	C11, C12	CAP, X5R, 1 μ F 10V, 10%, 0603	AVX, 0603ZD105KAT2A
7	2	D1, D2	DIODE, SCHOTTKY 1.0A, POWERDI123	DIODE INC, DFLS160L
8	1	L2	IND, 15 μ H	COILCRAFT, XAL5050-153ME
9	1	L1	IND, 22 μ H	COILCRAFT, XAL5050-223ME
10	1	R2	RES, CHIP 200k 0402	VISHAY, CRCW0402200KFKEA
11	1	R4	RES, CHIP 57.6k 1%, 0402	VISHAY, CRCW040257K6FKEA
12	1	R5	RES, CHIP 34k 1%, 0402	VISHAY, CRCW040234K0FKEA
13	1	R7	RES, CHIP 10k 1%, 0402	VISHAY, CRCW040210K0FKEA
14	1	R6	RES, CHIP 10.2k 1%, 0402	VISHAY, CRCW040210K2FKEA
15	1	U1	IC, LT3988EMSE, MS16	LINEAR TECHNOLOGY, LT3988EMSE#PBF
Additional Circuits				
16	0	C13, C14 (OPT)	CAP, ALUM, 22 μ F 20% 100V, CE-BS	SUNCON, 100CE22BS
17	0	C7 (OPT)	CAP, 0402	
18	0	R1, R3 (OPT)	RES, CHIP 0603	
Hardware (For Demo Board Only)				
19	12	E1 TO E12	TESTPOINT, TURRET, 0.095"	MILL-MAX, 2501-2-00-80-00-00-07-0
20	2	JP1, JP2	2mm SINGLE ROW HEADER, 3 PIN	SAMTEC, TMM-103-02-L-S
21	2	JP1, JP2	SHUNT	SAMTEC, 2SN-BK-G

SCHEMATIC DIAGRAM



REVISION HISTORY				
ECO	REV	DESCRIPTION	APPROVED	DATE
—	2	PRODUCTION	YING C.	11-9-11

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TITLE: SCHEMATIC

DUAL 60V STEP-DOWN REGULATOR

IC NO. **LT3988EMSE** REV. **2**
 SIZE **N/A** DEMO CIRCUIT **1677A**

DATE: **Thursday, March 22, 2012** SHEET **1** OF **1**

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APPROVALS

PCB DES.	HZ	YING C.
APP ENG.		

SCALE = NONE

THIS CIRCUIT IS PROPRIETARY TO LINEAR TECHNOLOGY AND SUPPLIED FOR USE WITH LINEAR TECHNOLOGY PARTS.

NOTE: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE IN 0402.
ALL CAPACITORS ARE IN 0402.
2. INSTALL SHUNTS AS SHOWN.

DEMO MANUAL DC1677A

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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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