LT3976

40V, 5A, 2MHz Step-Down Switching Regulator with 3.3µA Quiescent Current

DESCRIPTION

Demonstration circuit 1848A is a monolithic step-down DC/DC switching regulator featuring the LT3976. The LT3976 is a compact, high efficiency, high speed monolithic step-down switching regulator that consumes only 3.3µA of quiescent current. The demo circuit is designed for 3.3V, 5A output from a 4.3V to 40V input. The switching frequency can be programmed either via oscillator resistor or external clock up to 2MHz. To synchronize to an external clock, move JP2 to SYNC and apply the external clock to the SYNC turret. The R_T resistor (R5) should be chosen to set the LT3976 internal switching frequency at least 20% below the lowest synchronization input frequency.

Low ripple Burst Mode® operation increases the efficiency at the light load while keeping the output ripple below 15mV. The SYNC pin on the demo board is grounded by default for low ripple burst mode operation.

The LT3976 is in shutdown when the EN pin is low and active when the pin is high. The threshold of the EN pin is accurate at 1.02V with 60mV of hysteresis. Users can populate R7 and R8 to provide a programmable under voltage lockout. A low dropout voltage of 500mV is maintained when the input voltage drops below the programmed output voltage. During a short circuit fault, the LT3976 has current limit foldback to limit the power dissipation.

The demo board has an EMI filter installed. The EMI performance of the demo board is shown on Figure 2. The limit in Figure 2 is EN55022 Class B. The figure shows the circuit passes the test with a wide margin. To use the EMI filter, the input should be tied to V_{EMI}, not V_{IN}. V_{EMI} pad is on the back of the demo board.

The LT3976 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 1848A. The LT3976 is assembled in a 16-lead plastic MSOP and 24-lead 5mm × 3mm QFN packages 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 sections for details.

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 Voltage		4.3V
Maximum Input Voltage		40V
Output Voltage V_{OUT}	V_{IN} = 4.3V ~ 40V	3.3V ± 3%
Switching Frequency	R_T = 130k	400kHz ± 20%
Guaranteed Maximum Output Current I_{OUT}	V_{IN} = 4.3V ~ 40V	5A
Typical Efficiency	V_{IN} = 12V, I_{OUT} = 5A	82.1%
Typical Output Voltage Ripple	V_{IN} = 12V, I_{OUT} = 5A	20mV

PERFORMANCE SUMMARY

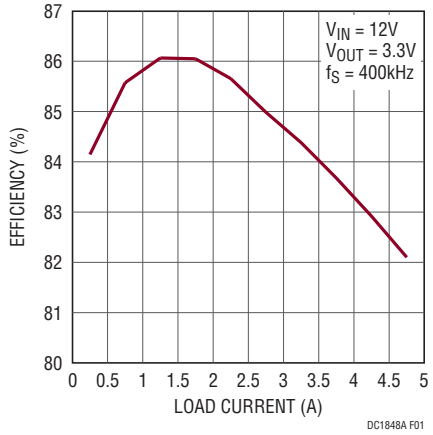


Figure 1. LT3976 Efficiency vs Load Current

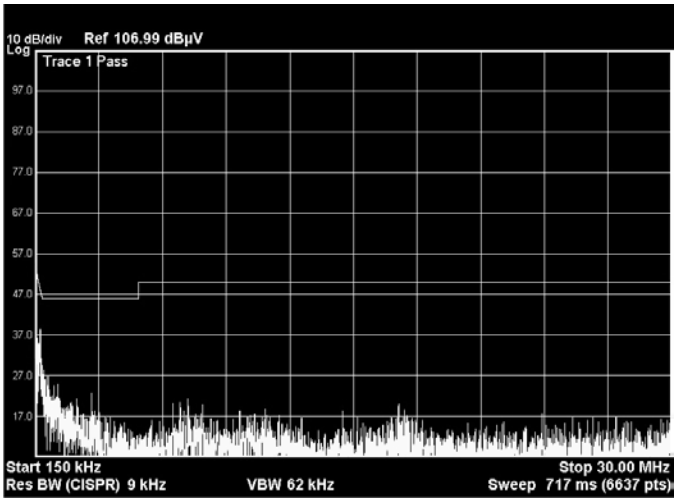


Figure 2. LT3976 Demo Board EMI Performance, Switching Frequency 400kHz

QUICK START PROCEDURE

Demonstration circuit 1848A is easy to set up to evaluate the performance of the LT3976. Refer to Figure 3 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 4 for the proper scope technique.

1. Place JP1 on the ON position.
2. Place JP2 on the RT FREQ position.
3. With power off, connect the input power supply to V_{IN} and GND. Make sure that the input voltage does not exceed 40V.
4. With power off, connect load from V_{OUT} to GND.
5. Turn on the power at the input.
6. Check for the proper output voltage (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.
7. Once the proper output voltage is established, adjust the load within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency and other parameters.
8. An external clock can be added to the SYNC terminal when SYNC function is used (JP2 on the SYNC position). Please make sure that the SYNC frequency is at least 20% higher than the set switching frequency. See the data sheet section Synchronization.

QUICK START PROCEDURE

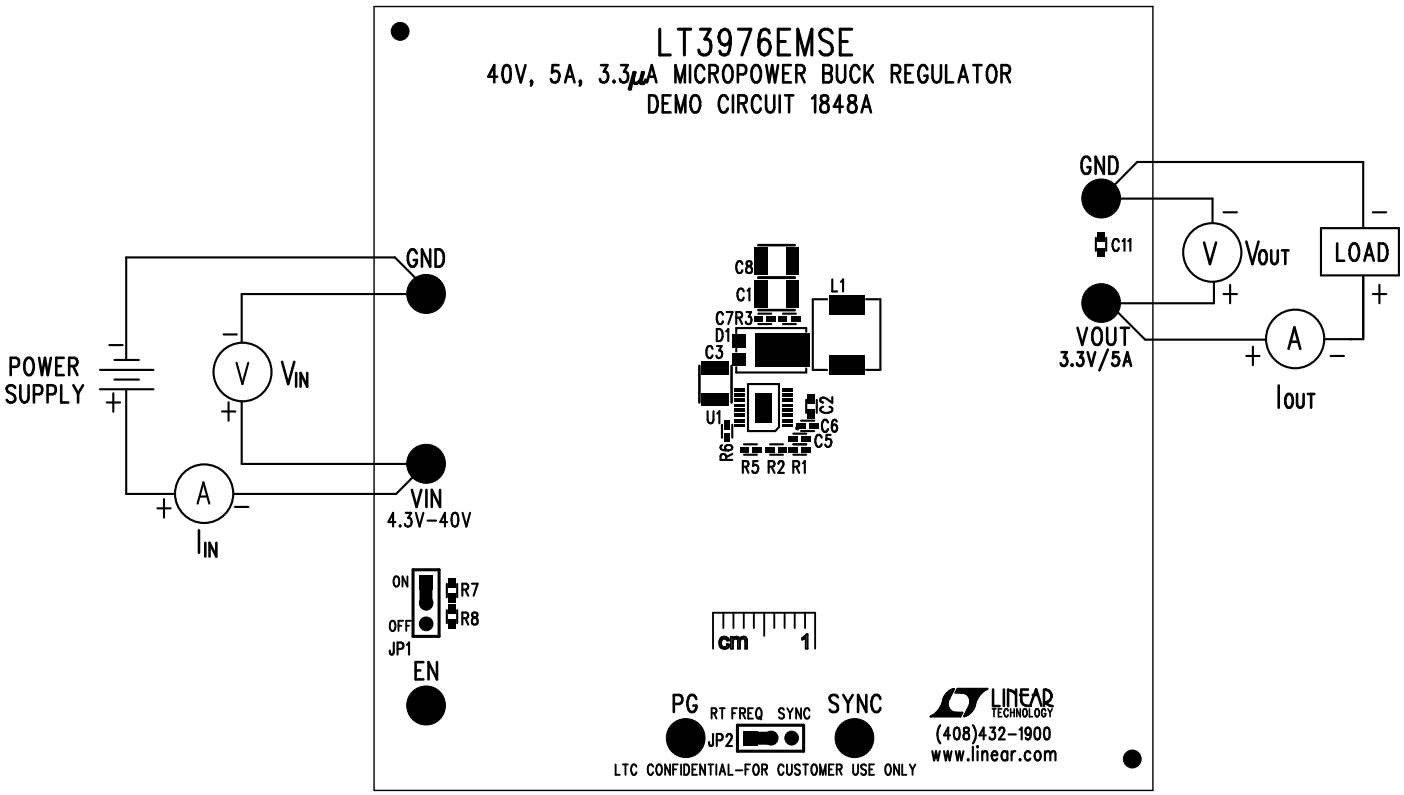


Figure 3. Proper Measurement Equipment Setup

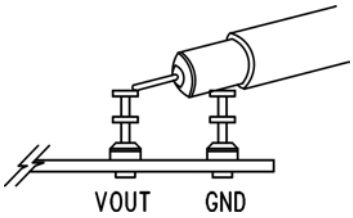
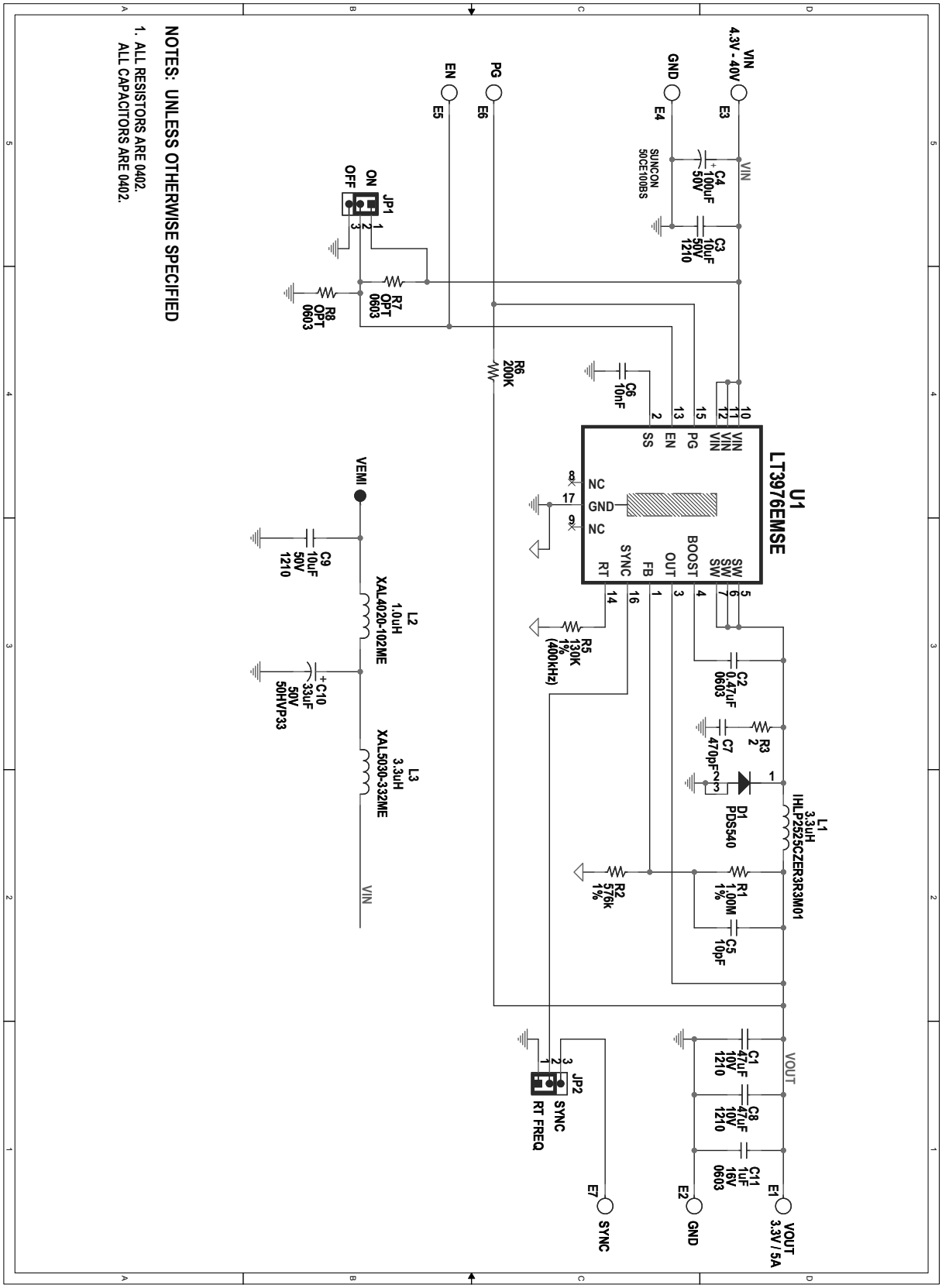


Figure 4. Measuring Input or Output Ripple

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Demo Board Circuit Components				
1	2	C1, C8	Cap., X5R, 47µF, 10V, 20% 1210	TDK, C325X5R1A476MT
2	1	C2	Cap., X5R, 0.47µF, 25V, 10% 0603	TDK, C1608X5R1E474K
3	2	C3	Cap., X5R, 10µF, 50V, 10%,1210	TDK, C3225X5R1H106K
4	1	C5	Cap., C0G, 10pF, 50V, 10% 0402	TDK, C1005C0G1H100D
5	1	C6	Cap., X7R, 10nF, 25V, 10%, 0402	TDK, C1005X7R1E103K
6	1	C7	Cap., C0G, 470pF, 50V, 10%, 0402	AVX, 04025A471KAT2A
7	1	D1	DIODE, Schottky, PowerDi5	DIODE INC., PDS540-13
8	1	L1	IND., 3.3µH	VISHAY, IHLP2525CZER3R3M01
9	1	R1	Res., Chip, 1.00M, 1/16W, 1% 0402	NIC, NRC04F1004TRF
10	1	R2	Res., Chip, 576K, 1/16W, 1% 0402	VISHAY, CRCW0402576KFKED
11	1	R3	Res., Chip, 2, 1/16W, 1% 0402	VISHAY, CRCW04022R00FKED
12	1	R5	Res., Chip, 130k, 1/16W, 1% 0402	VISHAY, CRCW0402130KFKED
13	1	R6	Res., Chip, 200k, 1/16W, 1% 0402	VISHAY,CRCW0402200KFKED
14	1	U1	I.C., MSE16	LINEAR TECH., LT3976EMSE
Additional Demo Board Circuit Components				
15	1	C11	Cap., X5R, 1µF 16V 20%, 0603	AVX, 0603YD105MAT
16	1	C4	Cap., Elect.,100µF, 50V, 10%	SUN ELECT, 50CE100BS
17	1	C9	Cap., X5R, 10µF, 50V, 10%,1210	TDK, C3225X5R1H106K
18	1	C10	Cap., Alum. Electro., 33µF, 50V	SUNCON, 50HVP33M
19	1	L2	Ind., 1.0µH XAL4020	COILCRAFT, XAL4020-102MEC
20	1	L3	Ind., 3.3µH XAL5030	COILCRAFT, XAL5030-332MEC
21	0	R7, R8	Res., 0402	OPT
Hardware/Components (for Demo Board Only)				
22	7	E1, E2, E3, E4, E5, E6, E7	Turret, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
23	2	JP1, JP2	JMP, 1X3-079	SAMTEC, TMM-103-02-L-S
24	2	XJP1, XJP2		SAMTEC, 2SN-BK-G

SCHEMATIC DIAGRAM



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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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