LT8640A
42V, 5A (8A Peak) Synchronous Step-Down Silent Switcher with 2.5µA Quiescent Current

DESCRIPTION

Demonstration circuit 3099A is a 42V, 5A synchronous step-down Silent Switcher® with spread spectrum frequency modulation featuring the LT®8640A. The demo board is designed for 5V output from a 5.7V to 42V input. Meanwhile the LT8640A can operate down to 3.4V inputs. The wide input range allows a variety of input sources, such as automotive batteries and industrial supplies. The LT8640A is a compact, ultralow emission, high efficiency, and high speed synchronous monolithic step-down switching regulator. The integrated power switches and inclusion of all necessary circuitry reduce the components count and solution size. Special Silent Switcher architecture minimizes EMI emissions. Selectable spread spectrum mode can further improve EMI performance. Ultralow 2.5µA quiescent current in Burst Mode® operation achieves high efficiency at very light loads. Fast minimum on-time of 30ns enables high V_{IN} to low V_{OUT} conversion at high frequency.

The LT8640A switching frequency can be programmed either via oscillator resistor or external clock over a 200kHz to 3MHz range. The default frequency of demo circuit 3099A is 2MHz. The LT8640A SYNC/MODE pin on the demo board is grounded (JP1 at BURST position) by default for low ripple Burst Mode operation. Spread spectrum mode and forced continuous mode can be selected respectively by moving JP1 shunt. To synchronize to an external clock, move JP1 to FCM/SYNC and apply the external clock to the SYNC terminal.

The LT8640A 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 3099A. The LT8640A is assembled in a 3mm × 4mm plastic QFN package with exposed pad for low thermal resistance. The layout recommendations for low EMI operation and maximum thermal performance are available in the data sheet section Low EMI PCB Layout and Thermal Considerations and Peak Output Current.

Design files for this circuit board are available.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		5.7		42	V
V_{OUT}	Output Voltage	R4 = 1MΩ, R5 = 243kΩ	4.85	5	5.15	V
I_{OUT}	Maximum Continuous Output Current	Derating Is Necessary for Certain V_{IN} and Thermal Conditions	5			A
f_{SW}	Switching Frequency	R2 = 17.8kΩ, JP1 = FCM/SYNC	1.85	2	2.15	MHz
EFF	Efficiency at DC	V_{IN} = 12V , I_{OUT} = 3A		94		%

QUICK START PROCEDURE

Demonstration circuit 3099A is easy to set up to evaluate the performance of the LT8640A. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Place JP1 on BURST position.
2. With power off, connect the input power supply to VEMI and GND. If the EMI performance is not important, the input EMI filter can be bypassed by connecting the input power supply to VIN and GND.
3. With power off, connect the load from VOUT to GND.
4. To read the input voltage and output voltage accurately, the voltage meters should be connected to VIN_SENSE and VOUT_SENSE turret pins.
5. Turn on the power at the input.

   NOTE: Make sure that the input voltage does not exceed 42V.
6. Check for the proper output voltage (V_{OUT} = 5V).

   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.

   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 output voltage ripple by touching the probe tip directly across the output capacitor. See Figure 2 for the proper scope technique.
8. JP1 can also set LT8640A in spread spectrum mode (JP1 on the SPREAD-SPECTRUM position) or forced continuous mode (JP1 on the FCM/SYNC position). An external clock can be added to the SYNC terminal when SYNC function is used (JP1 on the FCM/SYNC position). Please make sure that R2 should be chosen to set the LT8640A switching frequency equal to or below the lowest SYNC frequency.

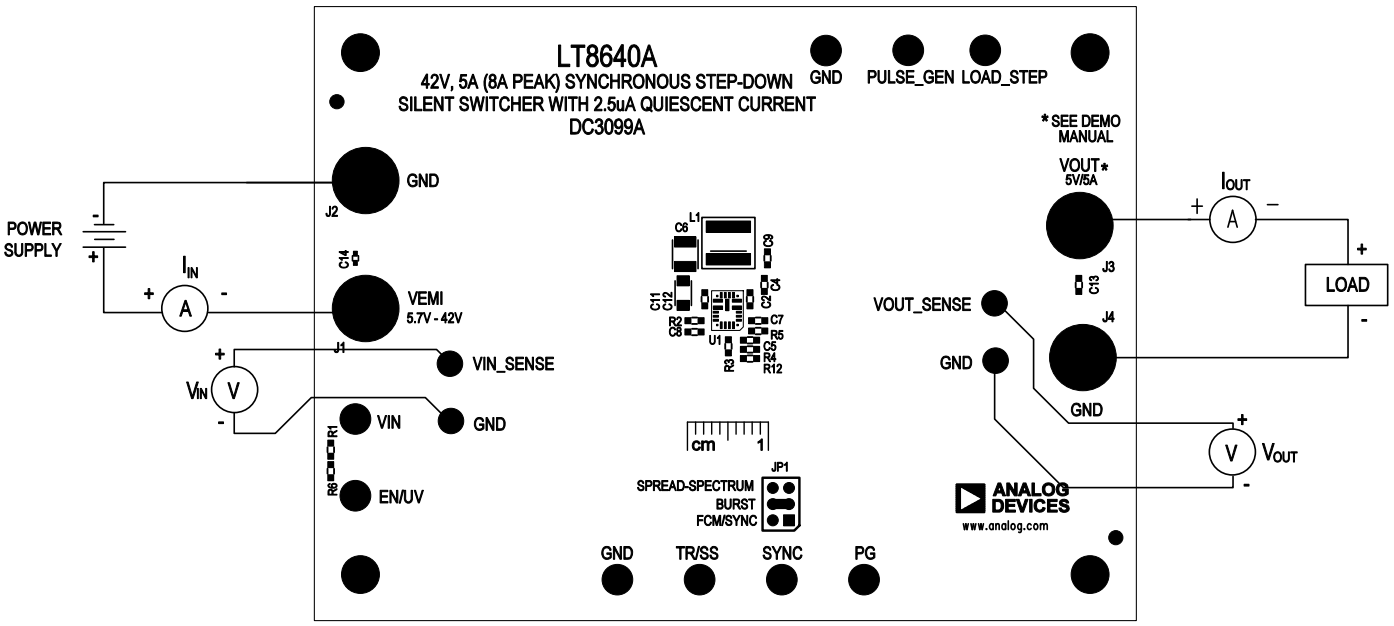


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

Figure 3 shows the efficiency of demo circuit 3099A at 12V input and 24V input in Burse Mode Operation (input from VIN terminal, JP1 = BURST).

The demo board has an EMI filter installed. The EMI performance of the board (with EMI filter) is shown on Figure 4. The red line in Figure 4 is CISPR25 Class 5 peak limit. The figure shows that the circuit passes the test with a wide margin. To achieve EMI performance as shown in Figure 4, the input EMI filter is required, and the input voltage should be applied at VEMI.

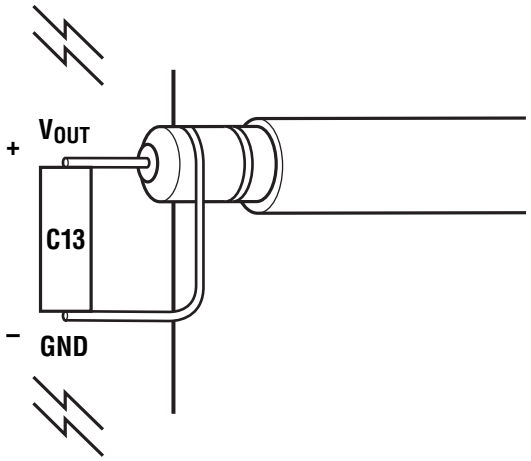


Figure 2. Measuring Output Ripple at Output Capacitor C13

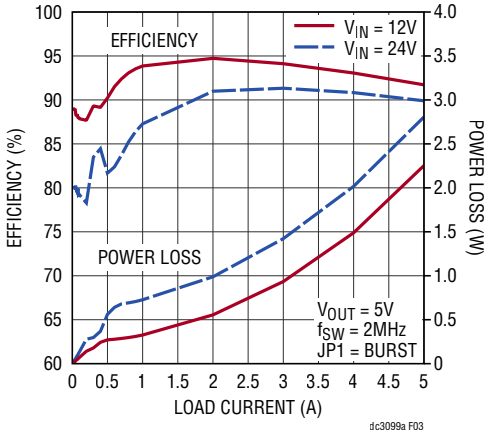
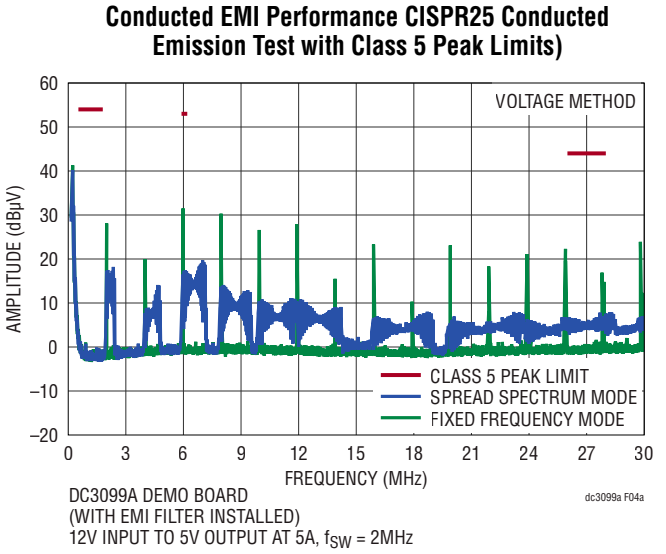


Figure 3. LT8640A Demo Circuit 3099A Efficiency vs Load Current (Input from V_{IN} Terminal)

QUICK START PROCEDURE



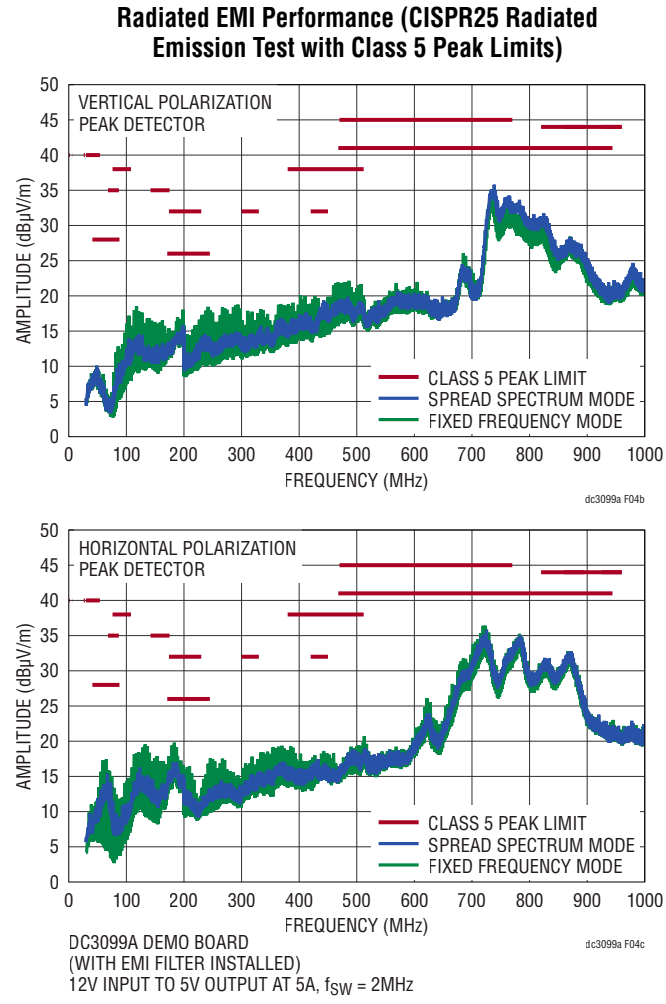


Figure 4. LT8640A Demo Circuit 3099A EMI Performance (12V Input from VEMI, with EMI filter, I_{OUT} = 5A)

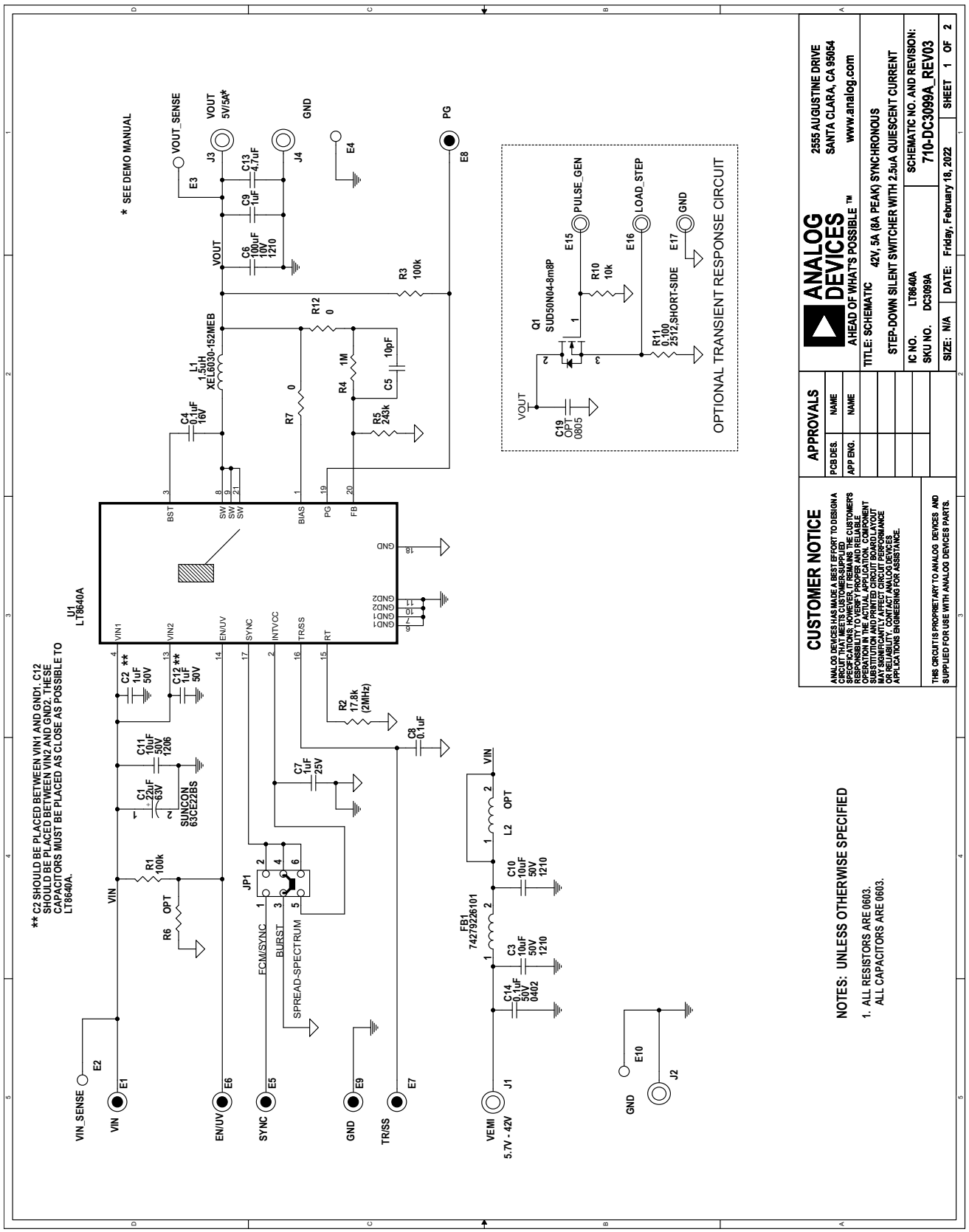
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C2, C12	CAP., X5R, 1µF, 50V, 10%, 0603	MURATA, GRT188R61H105KE13D
2	2	C4, C8	CAP., X7R, 0.1µF, 16V, 10%, 0603	MURATA, GRM188R71C104KA01D
3	1	C5	CAP., C0G, 10pF, 25V, ±0.25pF, 0603	AVX, 06033A100CAT2A
4	1	C6	CAP., X5R, 100µF, 10V, 20% 1210	MURATA, GRM32ER61A107ME20L
5	2	C7, C9	CAP., X7R, 1µF, 25V, 10%, 0603	MURATA, GRM188R71E105KA12D
6	1	C11	CAP., X5R, 10µF, 50V, 10%, 1206	TDK, C3216X5R1H106K160AB
7	1	C13	CAP., X5R, 4.7µF, 25V, 10%, 0603	MURATA, GRM188R61E475KE11D
8	1	L1	INDUCTOR, 1.5µH	COILCRAFT, XEL6030-152ME
9	2	R1, R3	RES., CHIP, 100k, 1/10W, 1% 0603	VISHAY, CRCW0603100KFKEA
10	1	R2	RES., CHIP, 17.8k, 1/10W, 1% 0603	VISHAY, CRCW060317K8FKEA
11	1	R4	RES., CHIP, 1M, 1/10W, 1%, 0603	VISHAY, CRCW06031M00FKEA
12	1	R5	RES., CHIP, 243k, 1/10W, 1%, 0603	VISHAY, CRCW0603243KFKEA
13	1	U1	I.C., STEP-DOWN SILENT SWITCHER, QFN-18	ANALOG DEVICES, LT8640AJUDCM#PBF
Additional Demo Board Circuit Components				
1	1	C1	CAP., ALUM 22µF, 63V	SUN ELECT., 63CE22BS
2	2	C3, C10	CAP., X7R, 10µF, 50V, 10%, 1210	MURATA, GRM32ER71H106KA12L
3	1	C14	CAP., X7R, 0.1µF, 50V, 10%, 0402	MURATA, GRM155R71H104KE14D
4	0	C19 (OPT)	CAP., OPTION, 0805	
5	1	FB1	BEAD, FERRITE, 100Ω AT 100MHz, 8A, 1812	WURTH ELEKTRONIK, 74279226101
6	0	L2	IND., OPT, XAL60XX	
7	1	Q1	MOSFET, N-CH, 40V, 14A, DPAK (TO-252)	VISHAY, SUD50N04-8M8P-4GE3
8	0	R6 (OPT)	RES., OPTION, 0603	
9	2	R7, R12	RES., CHIP, 0Ω, 1/10W, 1%, 0603	VISHAY, CRCW06030000Z0EA
10	1	R10	RES., CHIP, 10k, 1/10W, 1% 0603	VISHAY, CRCW060310K0FKEA
11	1	R11	RES., 0.1Ω, 1%, 3W, 2512, SHORT-SIDE TEMINAL	SUSUMU, KRL3264E-C-R100-F-T1

PARTS LIST

Hardware: For Demo Board Only				
1	9	E1, E5-E9, E15-E17	TESTPOINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	4	E2, E3, E4, E10	TESTPOINT, TURRET, 0.064"	MILL-MAX, 2308-2-00-80-00-00-07-0
3	4	J1-J4	JACK BANANA	KEYSTONE, 575-4
4	1	JP1	2X3, 0.079 DOUBLE ROW HEADER	WURTH ELEKTRONIK, 62000621121
5	4	MP1-MP4	STANDOFF, NYLON, SNAP-ON, 11.1mm	WURTH ELEKTRONIK, 702934000
6	1	XJP1	SHUNT, 0.079" CENTER	WURTH ELEKTRONIK, 60800213421

SCHEMATIC DIAGRAM



Rev. 0

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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