ANALOG DEVICES LT8640A Synchronous Step Down Silent Switcher User Manual

Contents

ANALOG DEVICES

ANALOG DEVICES LT8640A Synchronous Step Down Silent Switcher

Product Information

Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
VIN	Input Supply Range		5.7		42	V
VOUT	Output Voltage	R4 = 1M, R5 = 243k	4.85	5	5.15	V
ABOUT	Maximum Continuous Output Current	Derating Is Necessary for Certain VIN and Thermal Conditions			5	A
fSW	Switching Frequency	R2 = 17.8k, JP1 = FCM/SYNC	1.85	2	2.15	MHz
EFF	Efficiency at DC	VIN = 12V, IOUT = 3A	94			%

Product Usage Instructions

Quick Start Procedure

1. Place JP1 on the BURST position.
2. With power off, connect the input power supply to VEMI and GND. If EMI performance is not important, bypass the input EMI filter by connecting the input power supply to VIN and GND. With power off, connect the load from VOUT to GND.
3. To read the input voltage and output voltage accurately, connect the voltage meters to VIN_SENSE and VOUT_SENSE turret pins.
4. Turn on the power at the input. Note: Ensure that the input voltage does not exceed 42V.
5. Check for the proper output voltage (VOUT = 5V). Note: If there is no output, temporarily disconnect the load to

check if it is set too high or shorted.

6. 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.
    1. JP1 can also be used to set LT8640A in spread spectrum mode
    2. (JP1 on the SPREAD-SPECTRUM position) or forced continuous mode
    3. (JP1 on the FCM/SYNC position). An external clock can be added to the SYNC terminal when the SYNC function is used (JP1 on the FCM/SYNC position). Ensure that R2 is chosen to set the LT8640A switching frequency equal to or below the lowest SYNC frequency.

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 component 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 VIN to low VOUT conversion at high frequency. The LT8640A switching frequency can be programmed either via an 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 the 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 an exposed pad for low thermal resistance. The layout recommendations for low EMI operation and maximum thermal performance are available in the datasheet 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 TA = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
VIN	Input Supply Range		5.7		42	V
VOUT	Output Voltage	R4 = 1MΩ, R5 = 243kΩ	4.85	5	5.15	V
ABOUT	Maximum Continuous Output Current	Derating Is Necessary for Certain VIN and Thermal Conditions	5			A
fSW	Switching Frequency	R2 = 17.8kΩ, JP1 = FCM/SYNC	1.85	2	2.15	MHz
EFF	Efficiency at DC	VIN = 12V , IOUT = 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 (VOUT = 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 the 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.

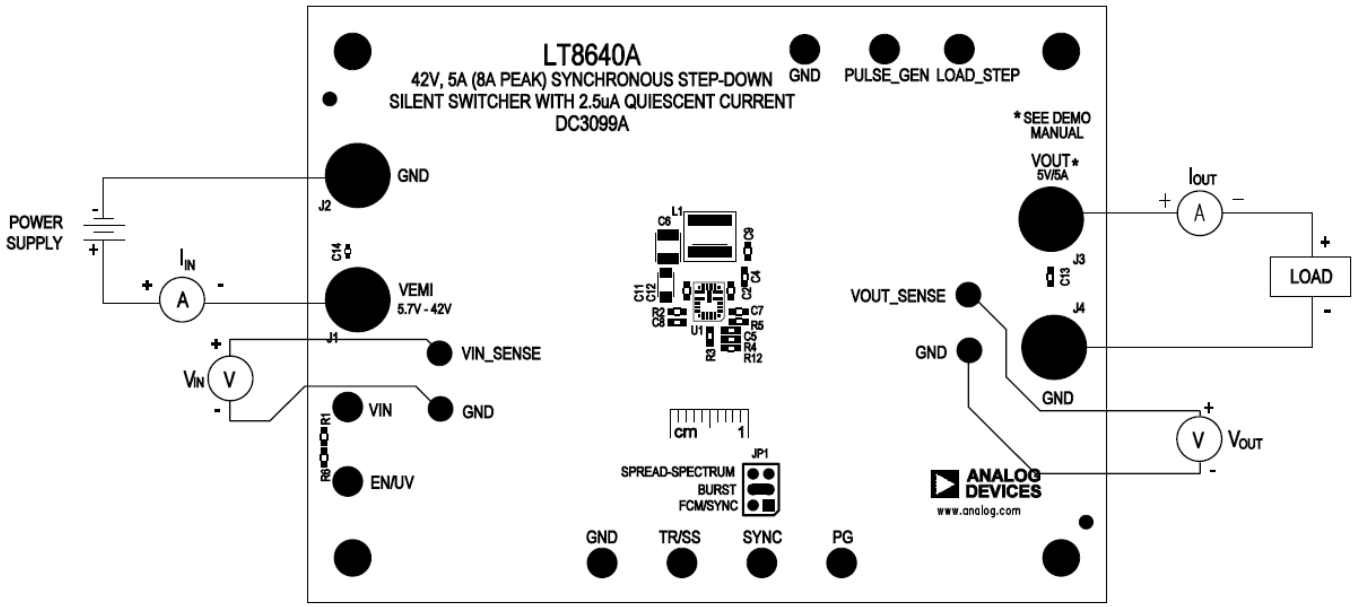


Figure 1. Proper Measurement Equipment Setup

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.

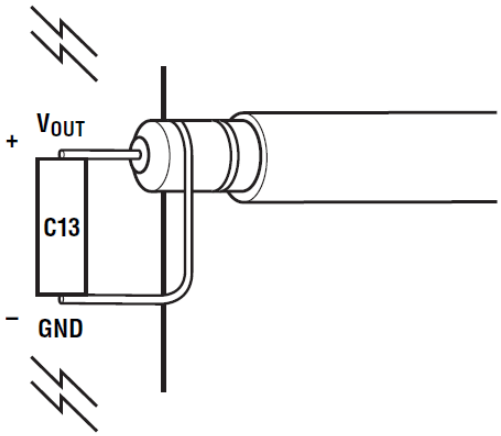


Figure 2. Measuring Output Ripple at Output Capacitor C13

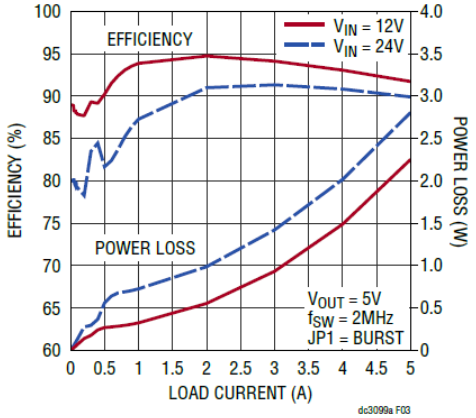
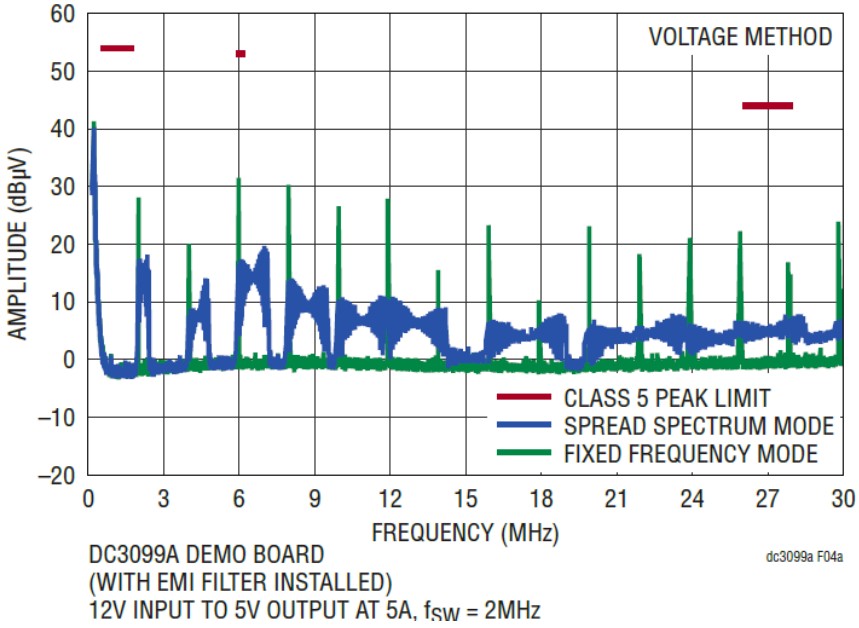


Figure 3. LT8640A Demo Circuit 3099A Efficiency vs Load Current (Input from V_{IN} Terminal)

- **Conducted EMI Performance CISPR25 Conducted Emission Test with Class 5 Peak Limits)**



DC3099A DEMO BOARD
(WITH EMI FILTER INSTALLED)
12V INPUT TO 5V OUTPUT AT 5A, f_{SW} = 2MHz

- **Radiated EMI Performance (CISPR25 Radiated Emission Test with Class 5 Peak Limits)**

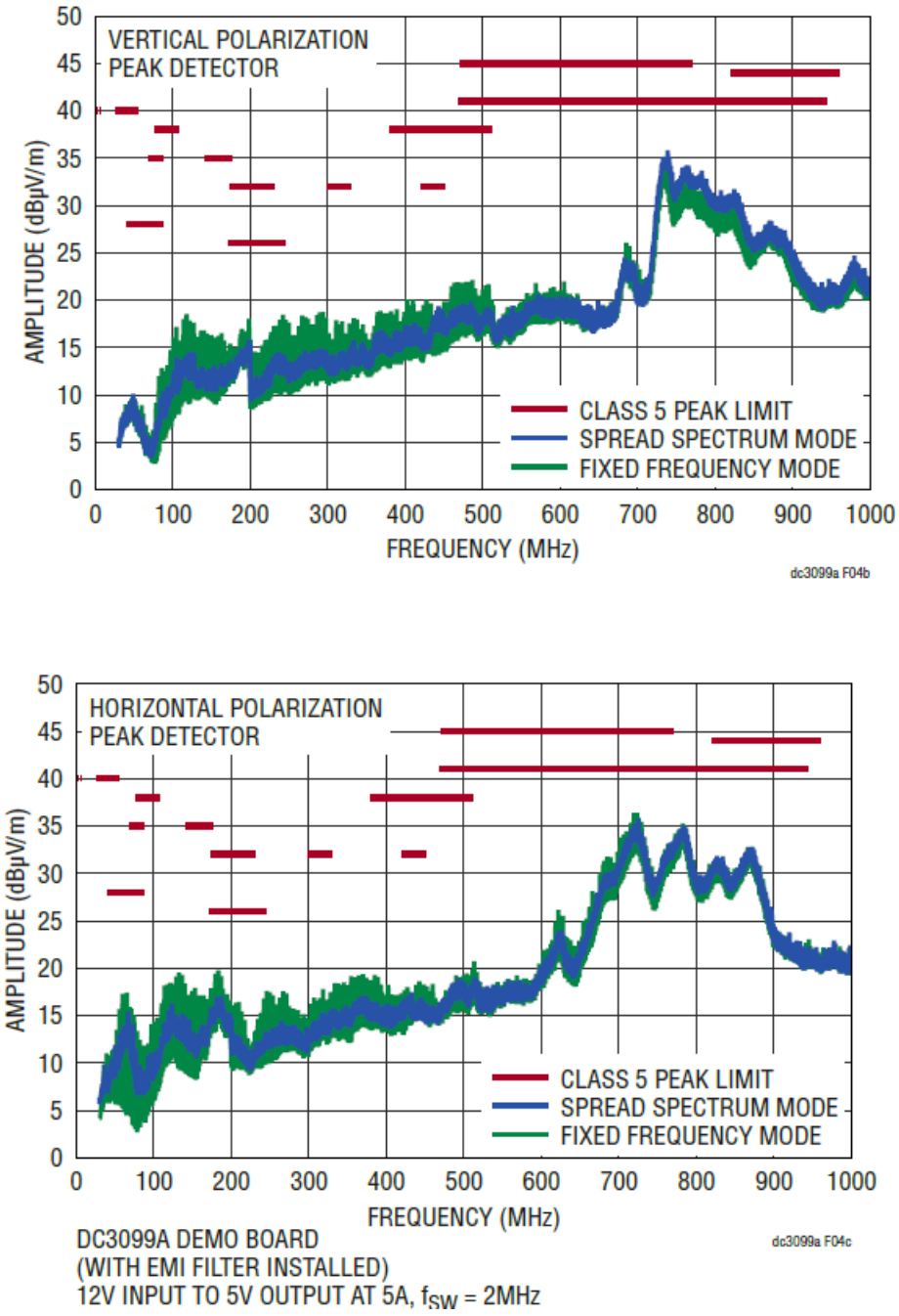


Figure 4. LT8640A Demo Circuit 3099A EMI Performance (12V Input from VEMI, with EMI filter, IOUT = 5A)

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

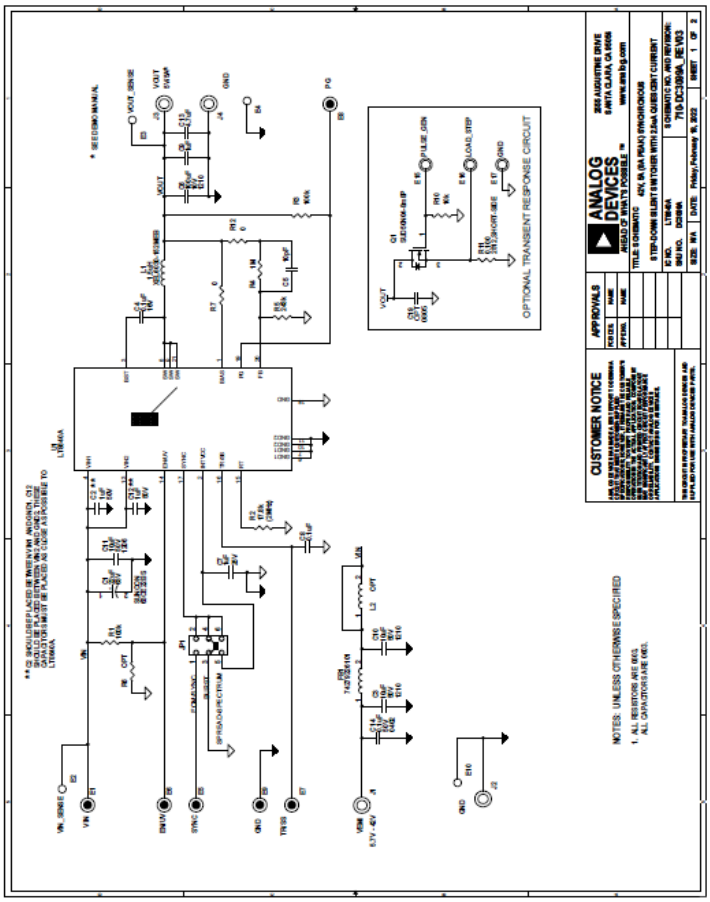
Additional Demo Board Circuit Components

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, 7427 9226101
6	0	L2	IND., OPT, XAL60XX	
7	1	Q1	MOSFET, N-CH, 40V, 14A, DPAK (TO-252)	VISHAY, SUD50N04-8M8P-4 GE3
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 TERMINAL	SUSUMU, KRL3264E-C-R100-F-T1

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, 6200 0621121
5	4	MP1-MP4	STANDOFF, NYLON, SNAP-ON, 11.1mm	WURTH ELEKTRONIK, 7029 34000
6	1	XJP1	SHUNT, 0.079″ CENTER	WURTH ELEKTRONIK, 6080 0213421

SCHEMATIC DIAGRAM



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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CONTACT

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References

- User Manual