Evaluation Board User Guide

EVAL-LT8647-AZ

LT8647
65V, 7A (8A Peak) Synchronous Step-Down
Silent Switcher with 2.5µA Quiescent Current

General Description

Demonstration circuit EVAL-LT8647-AZ is a 65V, 7A micropower synchronous step-down Silent Switcher® with spread spectrum frequency modulation featuring the LT8647. The demo board is designed for a 5V output from a 5.6V to 65V input. The wide input range allows a variety of input sources, such as industrial supplies. The LT8647 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 Electromagnetic interference (EMI) /Electromagnetic compatibility (EMC) emissions. Selectable spread spectrum mode can further improve EMI/EMC performance. Ultralow 2.5µA quiescent current in Burst Mode® operation achieves high efficiency at very light loads. A fast minimum on-time of 40ns enables high V_{IN} to low V_{OUT} conversion at high frequency.

The LT8647 switching frequency can be programmed via an oscillator resistor or external clock over a 200kHz to 2.2MHz range. The default frequency of the demo circuit EVAL-LT8647-AZ is 2MHz. The SYNC pin on the demo board is grounded (JP1 at BURST position) by default for low ripple Burst Mode operation. Spread spectrum mode and pulse-skipping mode can be selected, respectively, by moving the JP1 shunt. To synchronize to an external clock, move JP1 to SYNC and apply the external clock to the SYNC terminal.

The LT8647 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 the demo circuit EVAL-LT8647-AZ. The LT8647 is assembled in a 3mm × 6mm, Flip chip 2 quad flat no-lead (FC2QFN) package with exposed pads for low thermal resistance. The layout recommendations for low EMI operation and maximum thermal performance are available in the data sheet section Low EMI Printed circuit board (PCB) Layout and Thermal Considerations.

Design files for this circuit board are available at Product Evaluation Boards and Kits | Design Center | Analog Devices.

***Ordering Information* appears at end of data sheet.**

Performance Summary

Specifications are at T_A = 25°C.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN_EMI}	Input Supply Range		5.6		65	V
V_{OUT}	Output Voltage		4.85	5	5.15	V
I_{OUT}	Maximum Output Current	Derating is necessary for certain V_{IN} and thermal conditions	7			A
f_{SW}	Switching Frequency		1.85	2	2.15	MHz
EFF	Efficiency	V_{IN} = 12V, I_{OUT} = 3A		94.3		%

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EVAL-LT8647-AZ Evaluation Board Photo

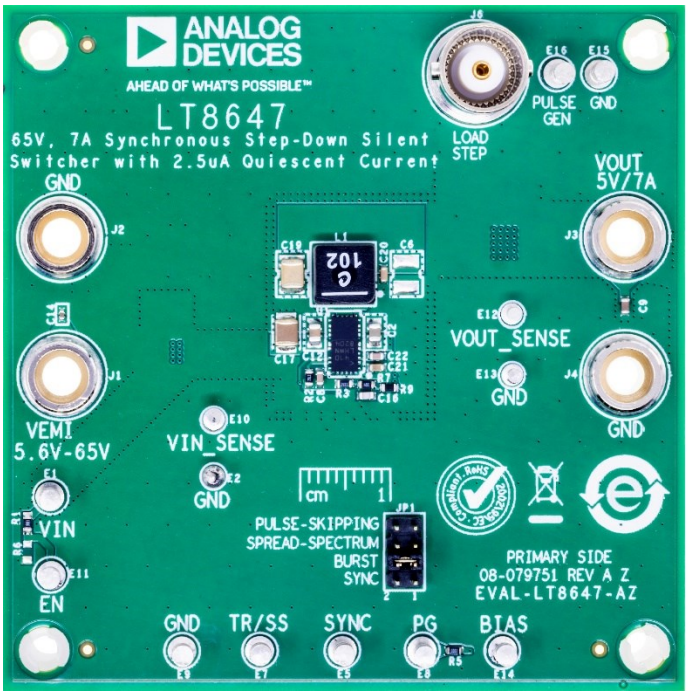


Figure 1. EVAL-LT8647-AZ Board Photo Front View

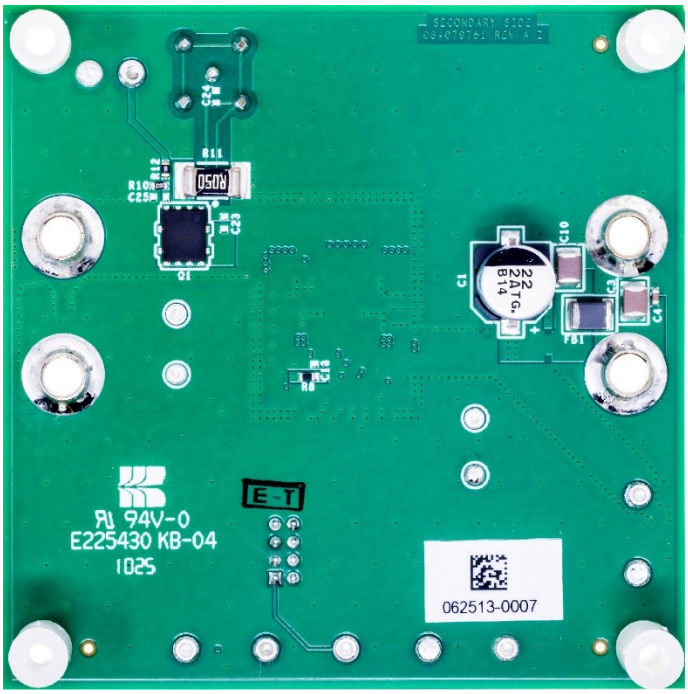


Figure 2. EVAL-LT8647-AZ Board Photo Back View

Quick Start Procedure

Demonstration circuit EVAL-LT8647-AZ is easy to set up to evaluate the performance of the LT8647. See *Figure 3* for proper measurement equipment setup and use the following procedure:

Note: Care must be taken to avoid a long ground lead on the oscilloscope probe when measuring the input or output voltage ripple. Measure the output voltage ripple by touching the probe tip directly across the output capacitor. See *Figure 4* for the proper scope technique.

1. Place JP1 on the Burst position.
2. When the power is off, connect the input power supply to VEMI and GND. If the input EMI filter is not desired, connect the input power supply to VIN and GND.
3. When the power is 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: Ensure that the input voltage does not exceed 65V.
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.
8. An external clock can be added to the SYNC terminal when the SYNC function is used (JP1 on the SYNC position). Please make sure that R2 should be chosen to set the LT8647 switching frequency equal to or below the lowest SYNC frequency. JP1 can also set LT8647 in spread-spectrum mode (JP1 on the spread-spectrum position) or pulse-skipping mode (JP1 on the pulse-skipping position).

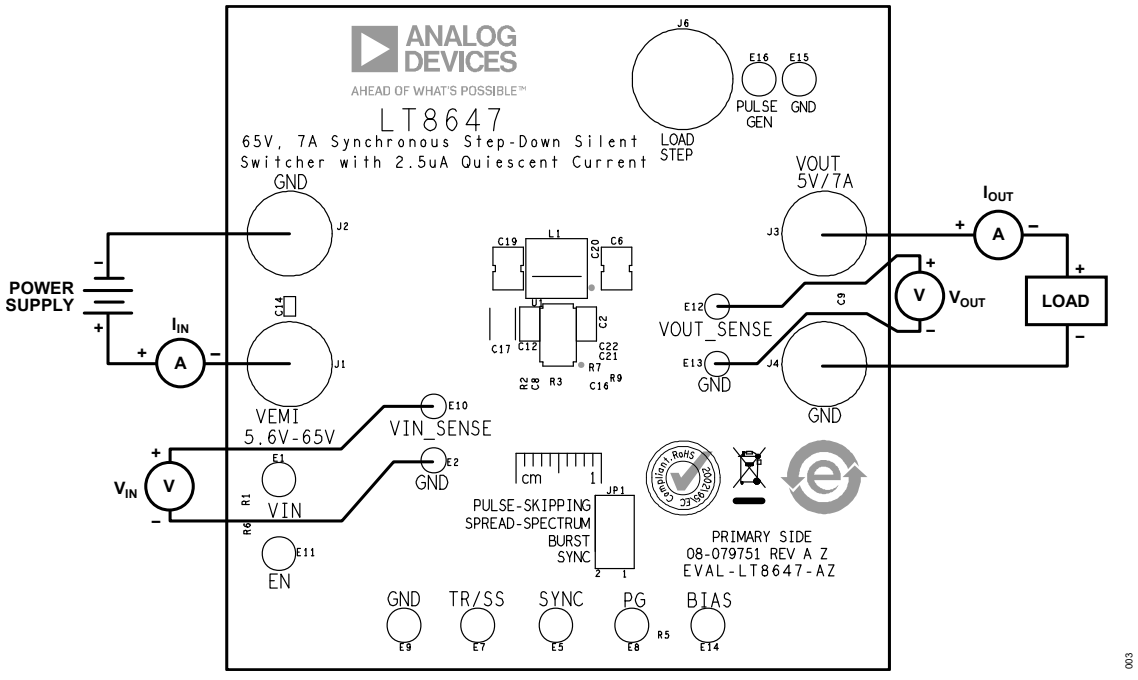


Figure 3. Test Procedure Setup Drawing for EVAL-LT8647-AZ

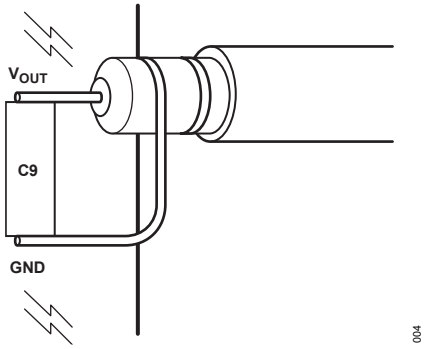


Figure 4. Measuring Output Ripple at Output Capacitor C9

Figure 5 shows the efficiency of the circuit at 12V input and 24V input in Burst Mode operation (input from VIN terminal).

The demo board has an EMI filter installed. This EMI filter can be included by applying the input voltage at the VEMI terminal. The conducted EMI performance of the board is shown in *Figure 6*. The red line in Radiated EMI Performance is the CISPR32 Class B limit. *Figure 7* shows that the LT8647 circuit passes the test with and without the EMI filter.

Test Results

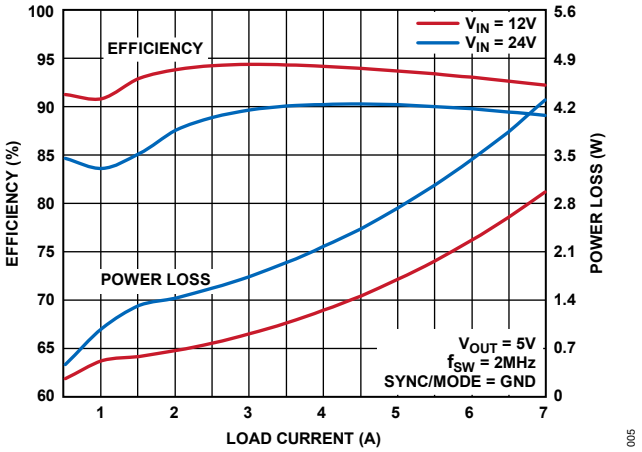


Figure 5. EVAL-LT8647-AZ Efficiency vs Load Current (Input from VIN Terminal)

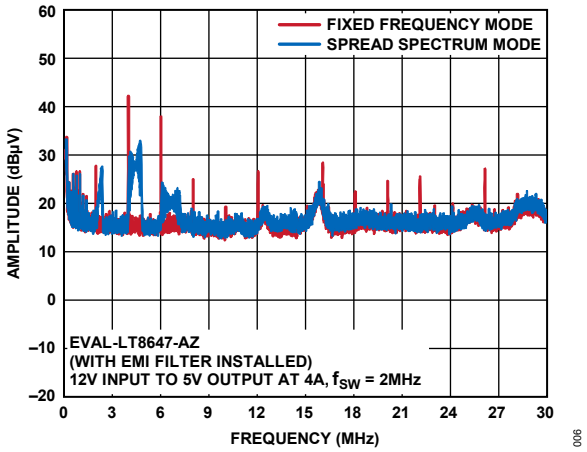
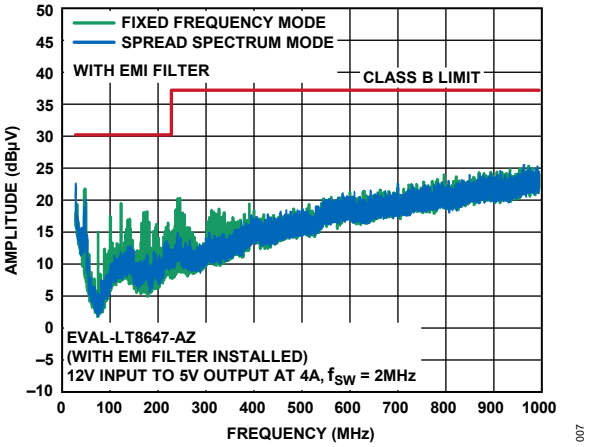
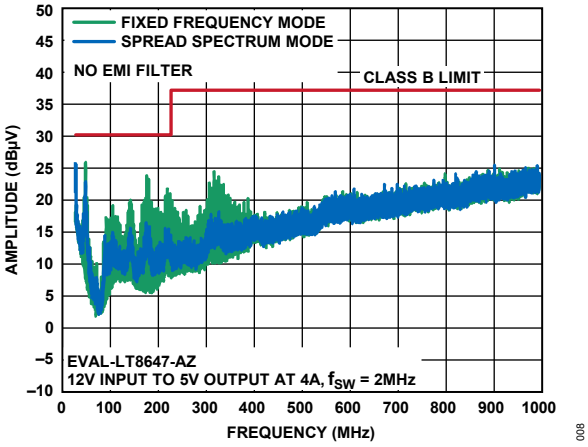


Figure 6. EVAL-LT8647-AZ CISPR32 Conducted EMI Performance with $12V_{IN}$ to $5V_{OUT}$ at 4A, f_{SW} = 2MHz



a) CISPR32 with EMI Filter



b) CISPR32 without EMI Filter

Figure 7. EVAL-LT8647-AZ CISPR32 Radiated EMI Performance with $12V_{IN}$ to $5V_{OUT}$ at 4A, f_{SW} = 2MHz

Ordering Information

PART	TYPE
EVAL-LT8647-AZ	Evaluation Board

EVAL-LT8647-AZ Bill of Materials

ITEM	PART	QTY	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	C2, C12	2	CAP., X7R, 0.47µF, 100V, 10%, 0805	MURATA, GRM21BR72A474KA73L
2	C19	1	CAP., X5R, 100µF, 10V, 20%, 1210	MURATA, GRM32ER61A107ME20L
3	C8, C22	2	CAP., X8R, 0.1µF, 25V, 10%, 0603	TDK, C1608X8R1E104K080AA
4	C9	1	CAP., X5R, 10µF, 25V, 20%, 0603	MURATA, GRM188R61E106MA73D
5	C16	1	CAP., C0G, 4.7pF, 50V, ±0.25pF, 0603	TDK, CGA3E2C0G1H4R7C080AA
6	C17	1	CAP., X7S, 4.7µF, 100V, 10%, 1210	MURATA, GCM32DC72A475KE02L
7	C20, C21	2	CAP., X7R, 1µF, 16V, 10%, 0603	MURATA, GCM188R71C105KA64D
8	L1	1	INDUCTOR, 1.0µH, XGL6030	COILCRAFT, XGL6030-102MEC
9	R1, R5	2	RES., CHIP, 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
10	R2	1	RES., CHIP, 17.8k, 1/10W, 1%, 0603	VISHAY, CRCW060317K8FKEA
11	R3	1	RES., CHIP, 243k, 1/10W, 1%, 0603	VISHAY, CRCW0603243KFKEA
12	R7	1	RES., CHIP, 1M, 1/10W, 1%, 0603	VISHAY, CRCW06031M00FKEA
13	U1	1	I.C., STEP-DOWN SWITCHER, 3mm x 6mm QFN	ANALOG DEVICES, LT8647RCPZ-RL
Additional Demo Board Circuit Components				
1	C1	1	CAP., ALUM 22µF, 100V, 10%	PANASONIC, EEE-TG2A220UP
2	C3, C10	2	CAP., X7R, 2.2µF, 100V, 10%, 1210	TDK, CGA6N3X7R2A225K230AB
3	C4	1	CAP., X7R, 0.1µF, 100V, 10%, 0603	TDK, CGA3E3X7S2A104K080AB
4	C14	1	CAP., X5R, 0.1µF, 100V, 10%, 0402	MURATA, GRM155R62A104KE14D
5	C18, C23-C25 (OPT)	0	CAP., 0603	
6	C6 (OPT)	0	CAP., 1210	
7	FB1	1	FERRITE BEAD 100Ω 8A SMD 1812	WÜRTH ELEKTRONIK, 74279226101
8	Q1	1	MOSFET, N-CH, 80V, 10A, POWERDI5060-8	DIODES, DMTH8012LPSQ-13
9	R6 (OPT)	0	RES., OPTION, 0603	
10	R8, R9	2	RES., CHIP, 0Ω, 1/10W, 1%, 0603	VISHAY, CRCW06030000Z0EA
11	R10	1	RES., CHIP, 10k, 1/10W, 1%, 0603	VISHAY, CRCW060310K0FKECC
12	R11	1	RES., CHIP, 0.05Ω, 3W, 0.5%, 2512	MULTICOMP, MCLRP12DTDRR050
13	R12	1	RES., CHIP, 10Ω, 1/10W, 1%, 0603	VISHAY, CRCW060310R0FKEA
Hardware: For Demo Board Only				
1	E1, E5, E7-E9, E11, E14-E16	9	TESTPOINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	E2, E10, E12, E13	4	TESTPOINT, TURRET, 0.061"	MILL-MAX, 2308-2-00-80-00-00-07-0
3	JP1	1	2X4, 0.079" DOUBLE ROW HEADER	WURTH ELEKTRONIK, 62000821121
4	XJP1	1	SHUNT, 0.079" CENTER	WURTH ELEKTRONIK, 60800213421
5	J1-J4	4	JACK BANANA	KEYSTONE, 575-4
6	J6	1	JACK BNC	AMPHENOL, 112404
7	MH1-MH4	4	STAND-OFF, NYLON 0.50" TALL	WÜRTH ELEKTRONIK, 702935000

EVAL-LT8647-AZ Schematic Diagram

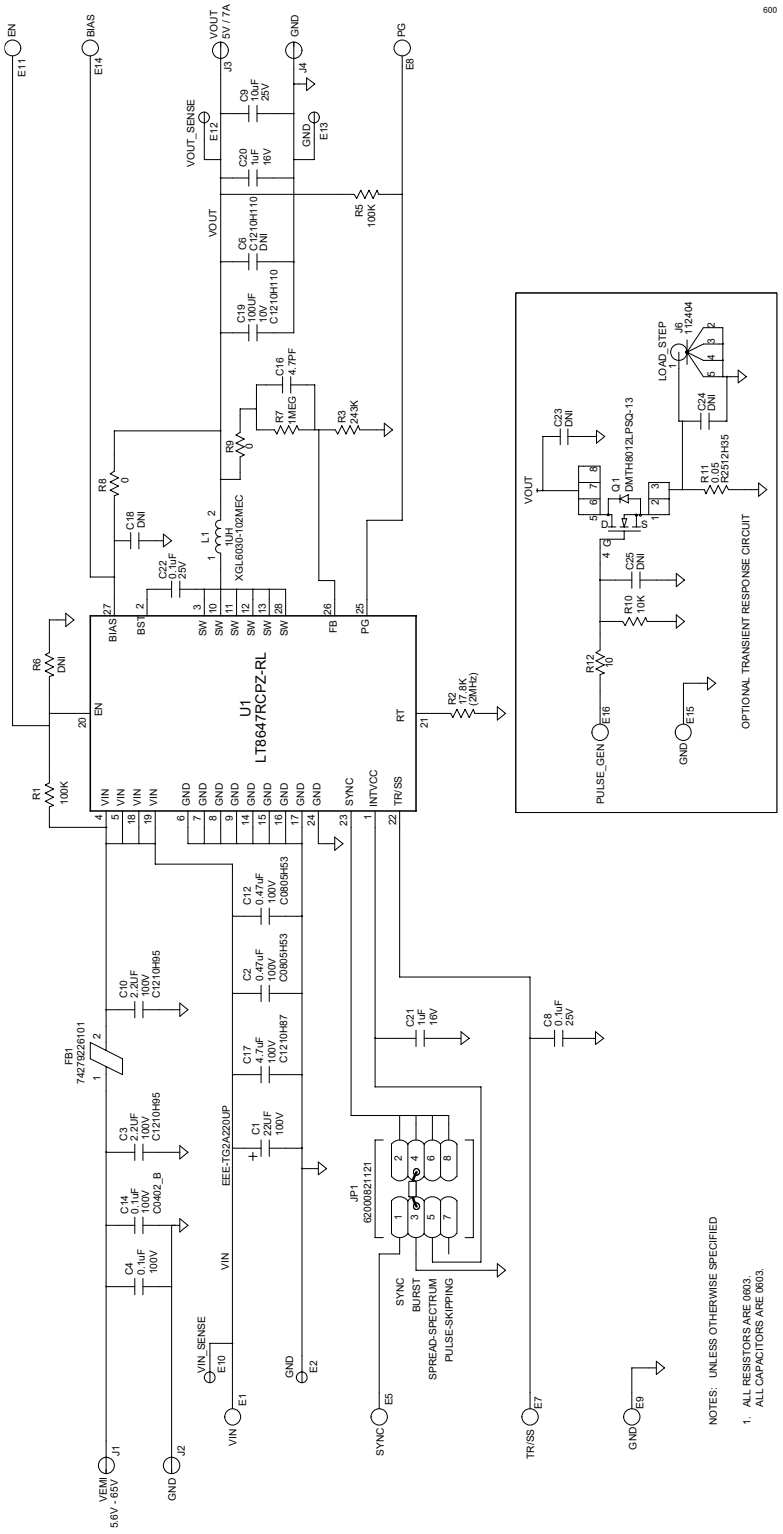
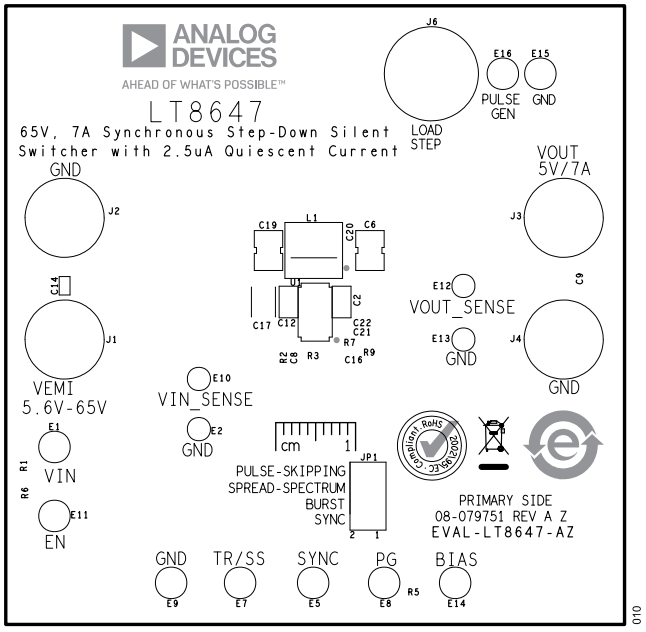
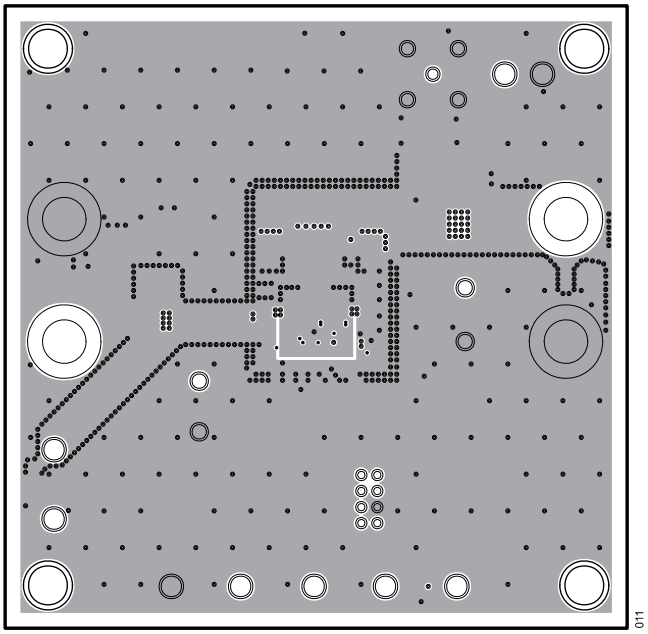


Figure 8. EVAL-LT8647-AZ Evaluation Board Schematic Diagram

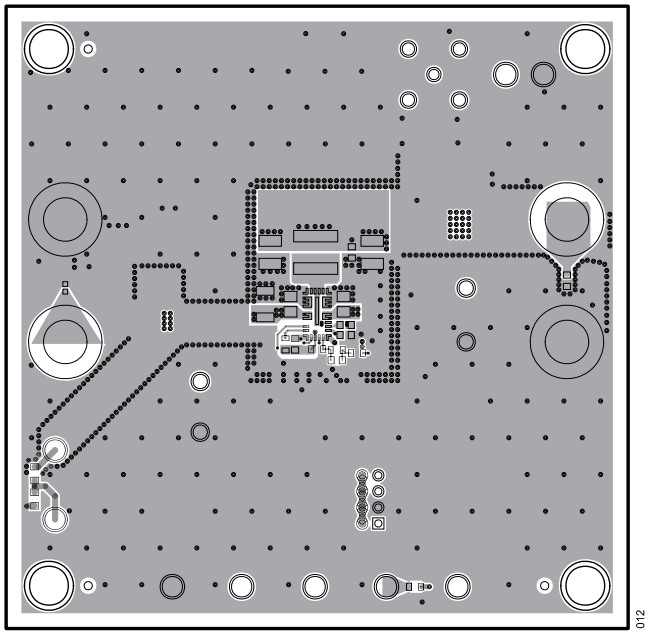
EVAL-LT8647-AZ PCB Layout Diagrams



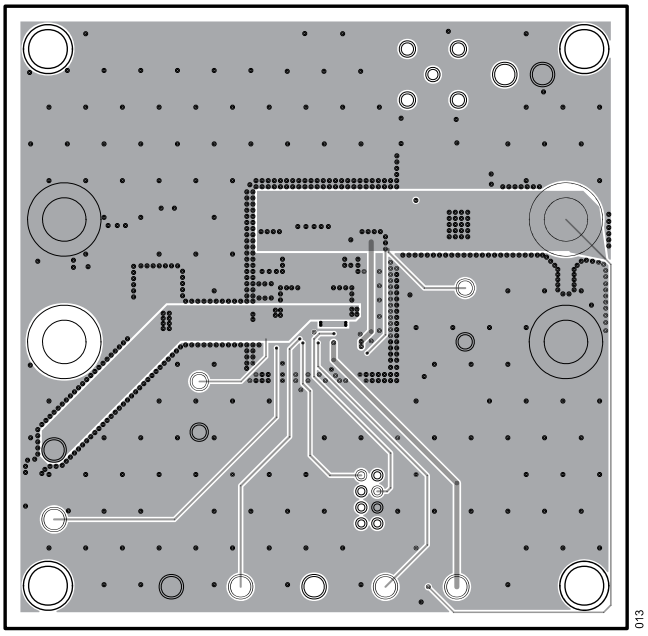
EVAL-LT8647-AZ Component Placement Guide—Top Silkscreen



EVAL-LT8647-AZ PCB Layout Diagram—Layer 2

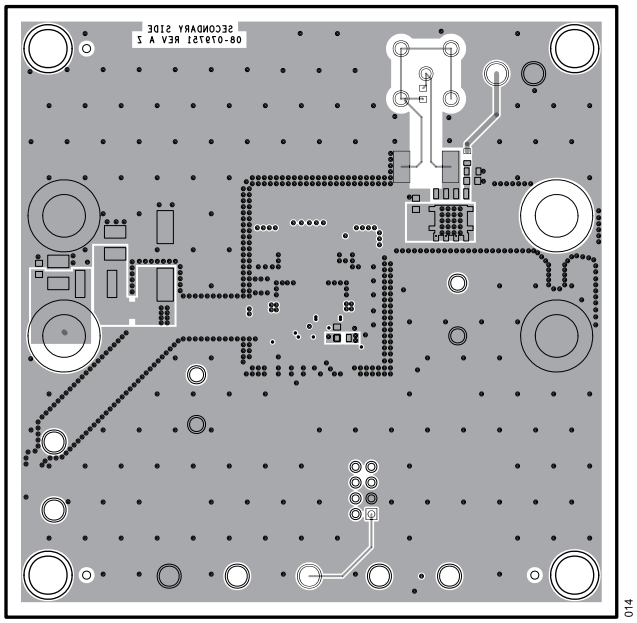


EVAL-LT8647-AZ PCB Layout Diagram—Top View

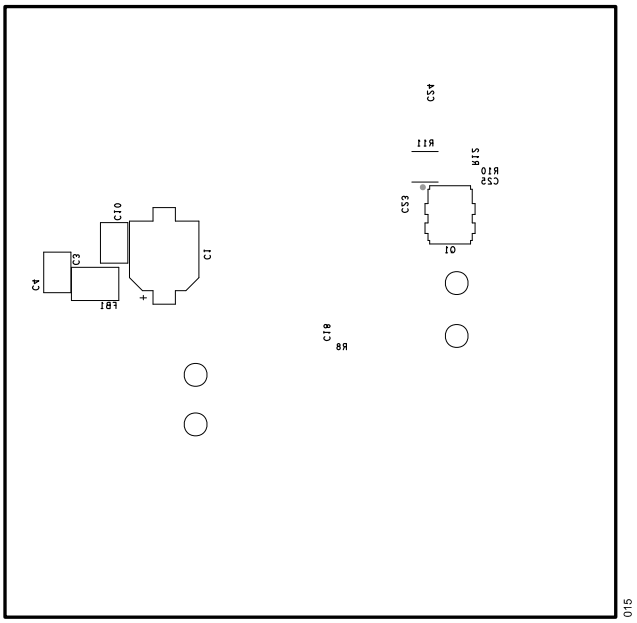


EVAL-LT8647-AZ PCB Layout Diagram—Layer 3

Evaluation Board PCB Layout Diagrams (continued)



EVAL-LT8647-AZ PCB Layout Diagram—Bottom View



EVAL-LT8647-AZ Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	6/25	Initial Release	—

Notes