

## LT8643SA

### 42V, 6A Synchronous Step-Down Silent Switcher 2

## General Description

The demonstration circuit EVAL-LT8643SA-AZ is a 42V, 6A micropower synchronous step-down second generation Silent Switcher® with spread spectrum frequency modulation featuring the LT8643SA. The demo board is designed for 5V output from a 5.8V to 42V input. The wide input range allows a variety of input sources, such as automotive batteries and industrial supplies. The LT8643SA is a compact, ultra-low emission, high efficiency, and high speed synchronous monolithic step-down switching regulator. The integrated bypass capacitors optimize all the fast current loops and make it easier to minimize EMI/EMC emissions by reducing layout sensitivity. Selectable spread spectrum mode can further improve EMI/EMC performance. Ultra-low 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.

Program the LT8643SA switching frequency either through oscillator resistor or external clock over a 200kHz to 3MHz range. The default frequency of demo circuit EVAL-LT8643SA-AZ is 2MHz. The SYNC pin on the demo board is grounded (JP1 at BURST position) by default for low ripple Burst Mode operation. To synchronize to an external clock, move JP1 to SYNC and apply the external clock to the SYNC terminal. Select the spread spectrum mode and forced continuous mode (FCM) respectively by

moving JP1 shunt. [Figure 3](#) shows the efficiency of the circuit at 12V input and 24V input in Burst Mode Operation. [Figure 4](#) shows the LT8643SA temperature rising on EVAL-LT8643SA-AZ demo board under different load conditions. The rated maximum load current is 6A, while derating is necessary for certain input voltage and thermal conditions.

The demo board doesn't have an EMI filter installed, but it leaves footprints for the filter components. [Figure 5](#) shows the EMI performance of the board (without EMI filter). The red line in Radiated EMI Performance is CISPR32 Class B limit. The figure shows that the circuit passes the test with a wide margin. An inductor and input capacitors can be added in the EMI filter footprint to further reduce the EMI emission.

The LT8643SA data sheet gives a complete description of the part, operation and application information. Read the data sheet in conjunction with this demo manual for EVAL-LT8643SA-AZ. The LT8643SA is assembled in a 4mm × 4mm LQFN 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 PCB Layout and Thermal Considerations and Peak Output Current'.

**Design files for this circuit board are available.**

## Performance Summary

Specifications are at  $T_A = 25^\circ\text{C}$

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Input Supply Range	$V_{IN}$		5.8		42	V
Output Voltage	$V_{OUT}$		4.85	5	5.15	V
Maximum Output Current	$I_{OUT}$		6			A
Switching Frequency	$f_{SW}$	Derating is Necessary for Certain $V_{IN}$ and Thermal Conditions	1.85	2	2.15	MHz
Efficiency	EFF	$V_{IN} = 12\text{V}$ , $I_{OUT} = 3\text{A}$	94.3			%

## Quick Start Procedure

The demonstration circuit EVAL-LT8643SA-AZ is easy to set up to evaluate the performance of the LT8643SA. See [Figure 1](#) for proper measurement equipment setup and follow the procedures below:

NOTE: When measuring the input or output voltage ripple, be careful to avoid a long ground lead on the oscilloscope probe. See [Figure 2](#) for the proper scope technique.

1. Place JP1 on the BURST position.
2. With power off, connect the input power supply to  $V_{IN}$  and GND.
3. With power off, connect the load from  $V_{OUT}$  to GND.
4. Turn on the power supply at the input.

NOTE: Make sure that the input voltage does not exceed 42V.

5. 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.

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.
7. Add an external clock to the SYNC terminal when using SYNC function (JP1 on the SYNC position). Choose the R2 to set the LT8643SA switching frequency equal to or below the lowest SYNC frequency. JP1 can also set LT8643SA in spread spectrum mode (JP1 on the SPREAD-SPECTRUM position) or forced continuous mode (JP1 on the FCM position).

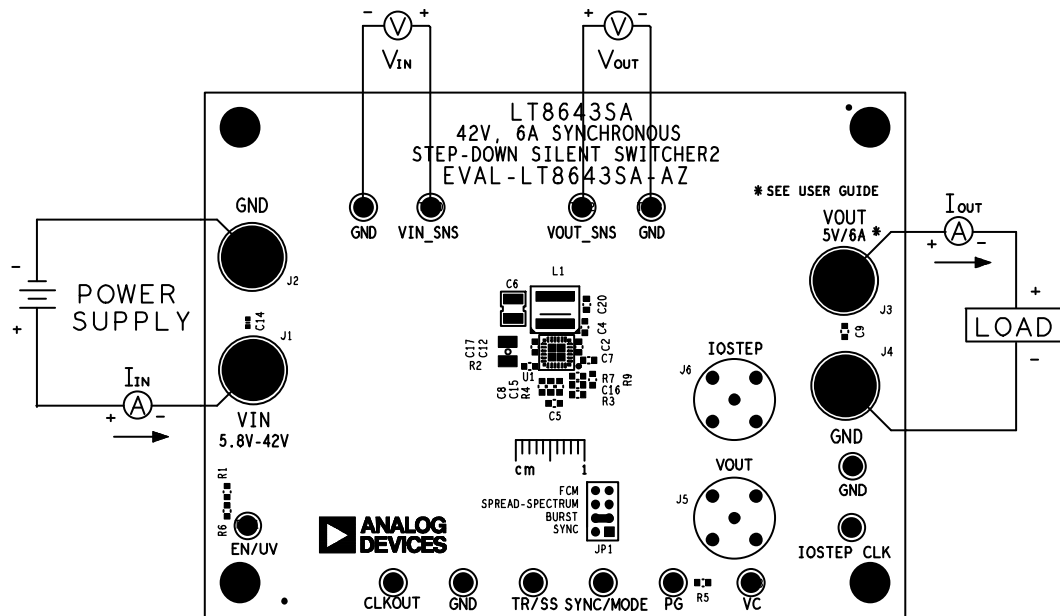


Figure 1. Proper Measurement Setup

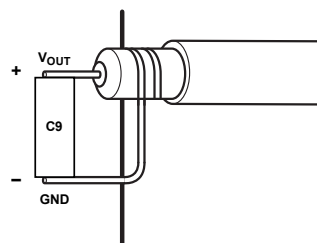


Figure 2. Scope Placement for Measuring Input or Output Voltage Ripple

## Typical Performance Characteristics

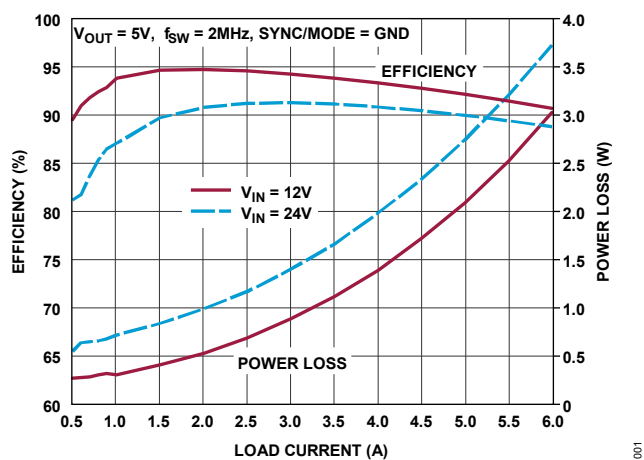


Figure 3. EVAL-LT8643SA-AZ Efficiency vs Load Current

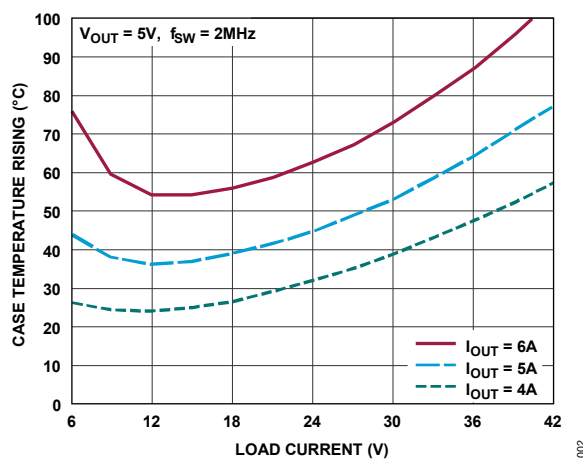


Figure 4. EVAL-LT8643SA-AZ Temperature Rising vs Input Voltage

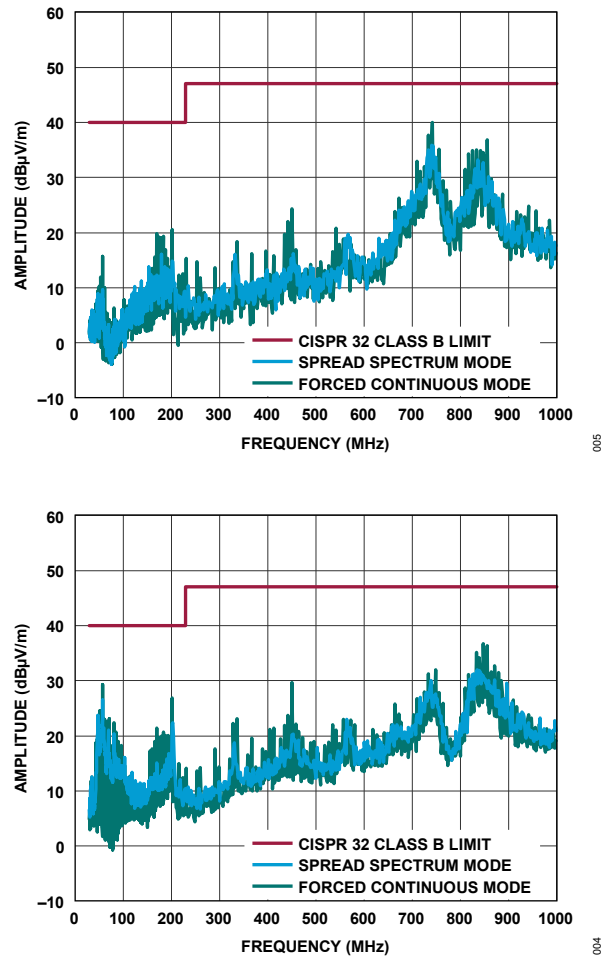
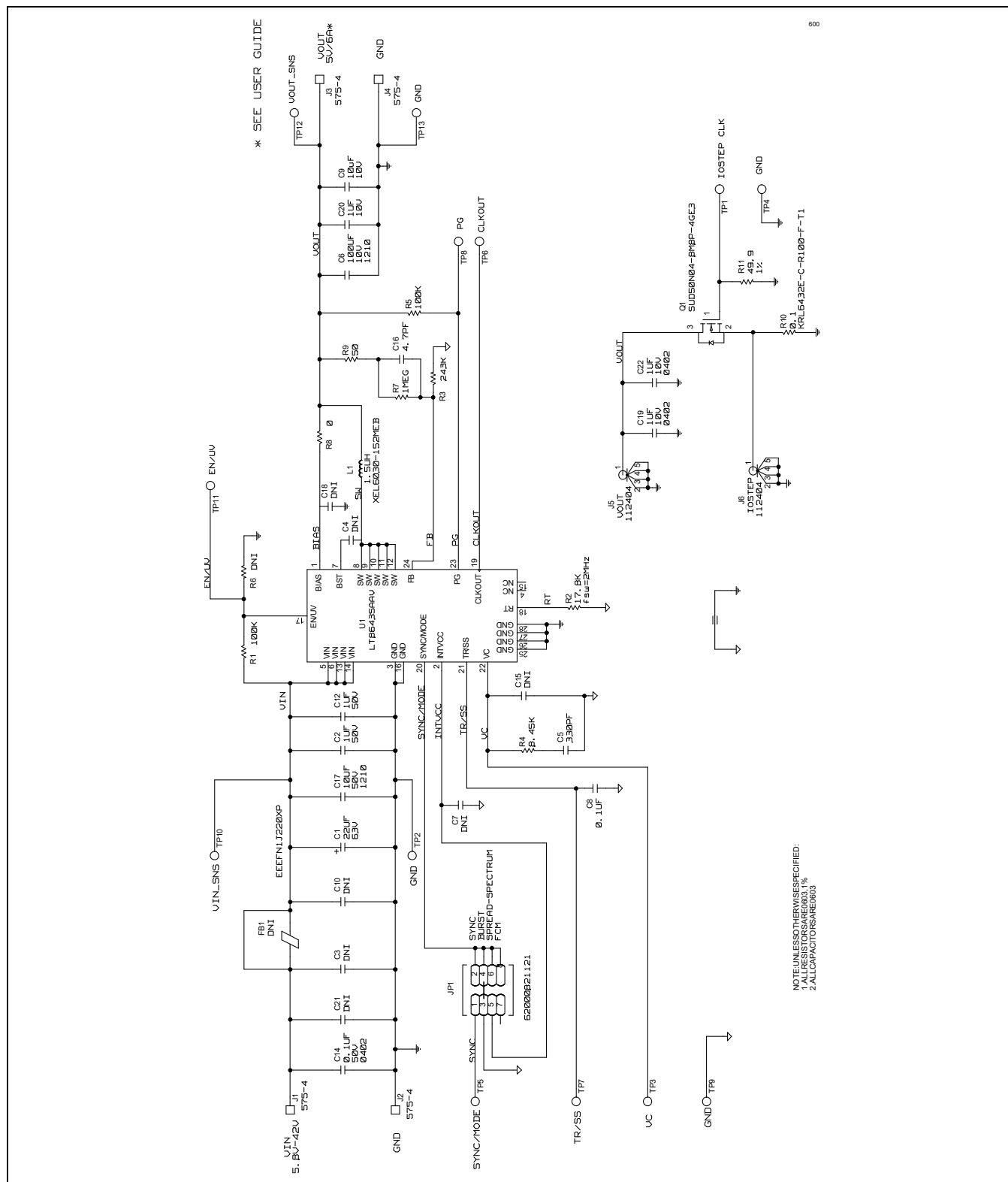


Figure 5. EVAL-LT8643SA-AZ CISPR 32 EMI Performance (14V Input, without EMI filter,  $I_{OUT} = 4A$ )

## EVAL-LT8643SA-AZ Kit Schematic

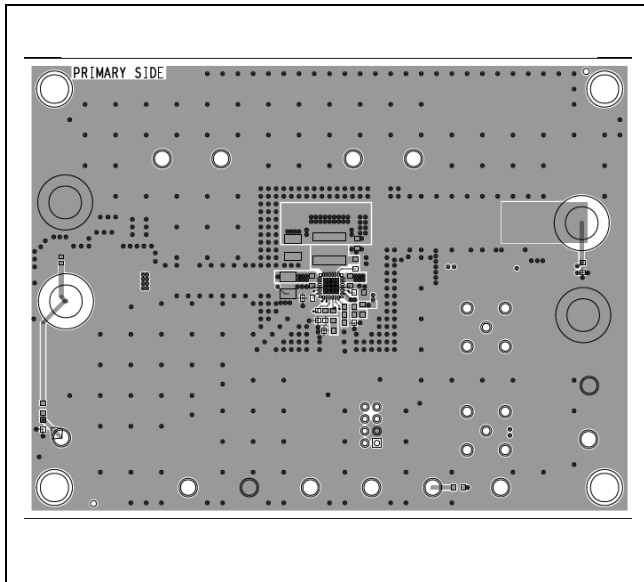


## EVAL-LT8643SA-AZ Kit Bill of Materials

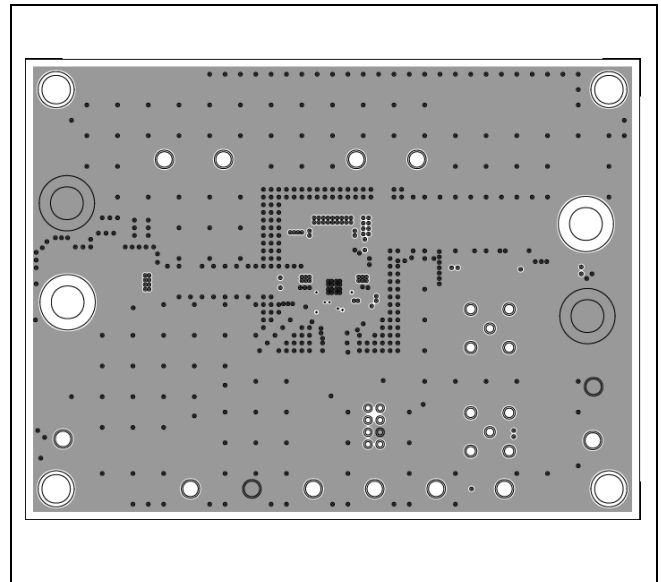
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>REQUIRED CIRCUIT COMPONENTS</b>				
1	1	C1	CAP., ALUM ELECT, 22 $\mu$ F, 63V, 20%, 6.3x7.7MM, AEC-Q200, 1.2 $\Omega$ , 120MA 2000H	EEEFN1J220XP
2	2	C2, C12	CAP., CER 1 $\mu$ F, 50V, 10%, X7R 0603	UMK107AB7105KA-T
3	1	C14	CAP., CER 0.1 $\mu$ F, 50V, 10%, X7R 0402 LOW ESR	C1005X7R1H104K050BB
4	1	C16	CAP., CER 4.7PF, 50V, 0.25PF, C0G 0603, AEC-Q200	CGA3E2C0G1H4R7C080AA
5	1	C17	CAP., CER 10 $\mu$ F, 50V, -20% TO +80% Y5V, 1210	12105G106ZAT2A
6	2	C19, C22	CAP., CER 1 $\mu$ F, 10V, 10%, X7R 0402	GRM155Z71A105KE01D
7	1	C20	CAP., CER 1 $\mu$ F, 10V, 10%, X7R 0603	C0603C105K8RACTU
8	1	C5	CAP., CER 330pF, 50V, 5%, C0G, 0603, EXTREME LOW ESR	C0603C331J5GACTU
9	1	C6	CAP., CER 100 $\mu$ F, 10V, 20%, X5R, 1210	GRM32ER61A107ME20L
10	1	C8	CAP., CER 0.1 $\mu$ F, 16V, 10%, X7R 0603	0603YC104KAT2A
11	1	C9	CAP., CER 10 $\mu$ F, 10V, 10%, X5R 0603 LOW ESR	C1608X5R1A106K080AC
12	1	L1	IND POWER SHIELDED WIREWOUND 1.5 $\mu$ H, 20%, 1MHZ, 14A, 0.01052 $\Omega$ , DCR HIGH CURRENT, AEC-Q200	XEL6030-152MEB
13	1	Q1	TRAN N-CH, MOSFET, 40V, 14A	SUD50N04-8M8P-4GE3
14	2	R1, R5	RES SMD, 100K $\Omega$ , 1%, 1/10W, 0603 AEC-Q200	ERJ-3EKF1003V
15	1	R10	RES SMD 0.1 $\Omega$ , 1%, 3W, 1225 WIDE AEC-Q200	KRL6432E-C-R100-F-T1
16	1	R11	RES SMD 49.9 $\Omega$ , 1%, 1/10W, 0603 AEC-Q200	ERJ-3EKF49R9V
17	1	R2	RES SMD 17.8K $\Omega$ , 1%, 1/10W, 0603 AEC-Q200	ERJ-3EKF1782V
18	1	R3	RES SMD 243K $\Omega$ , 1%, 1/10W, 0603 AEC-Q200	CRCW0603243KFKEA
19	1	R4	RES SMD 8.45K $\Omega$ , 1%, 1/10W, 0603 AEC-Q200	ERJ-3EKF8451V
20	1	R7	RES SMD 1M $\Omega$ , 1%, 1/10W, 0603 AEC-Q200	ERJ-3EKF1004V
21	1	R8	RES SMD 0 $\Omega$ , JUMPER 1/10W, 0603 AEC-Q200	ERJ-3GEY0R00V
22	1	R9	RES SMD 50 $\Omega$ , 1%, 1/10W, 0603 AEC-Q200	CRCW060350R0FKEA
23	1	U1	PRELIM, IC-ADI LT8643SA	LT8643SAAV#PBF

ADDITIONAL EVALUATION BOARD CIRCUIT COMPONENTS				
24	2	C3, C10	CAP., CER 10 $\mu$ F, 50V, -20% TO +80%, Y5V 1210	12105G106ZAT2A
25	4	C4, C7, C15, C18	TBD0603	TBD0603
26	1	C21	CAP., CER 0.1 $\mu$ F, 50V, 10%, X7R 0402 LOW ESR	C1005X7R1H104K050BB
27	1	FB1	IND FERRITE BEAD MULTI LAYER 100 $\Omega$ AT 100MHZ, 25%, 8A 0.006 $\Omega$ 1812 AEC-Q200	74279226101
28	1	R6	TBD0603	TBD0603
HARDWARE: FOR EVALUATION BOARD ONLY				
29	1		SHUNT FEMALE 2POS 2MM	60800213421
30	4		STANDOFF, BRD SPT SNAP FIT 12.7MM LENGTH	8833
31	4	J1, J2, J3, J4	CONN-PCB, BANANA JACK, FEMALE, NON-INSULATED, THT, SWAGE, 0.218 INCHES LENGTH	575-4
32	2	J5, J6	CONN-PCB BNC JACK ST 50 $\Omega$	112404
33	1	JP1	CONN-PCB 8POS MALE HDR UNSHROUDED DUAL ROW ST, 2MM PITCH, 2.80MM, SOLDER TAIL	62000821121
34	13	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13	CONN-PCB SOLDER TERMINAL TEST POINT TURRET 0.094" MTG. HOLE PCB 0.062 INCH THK	2501-2-00-80-00-00-07-0

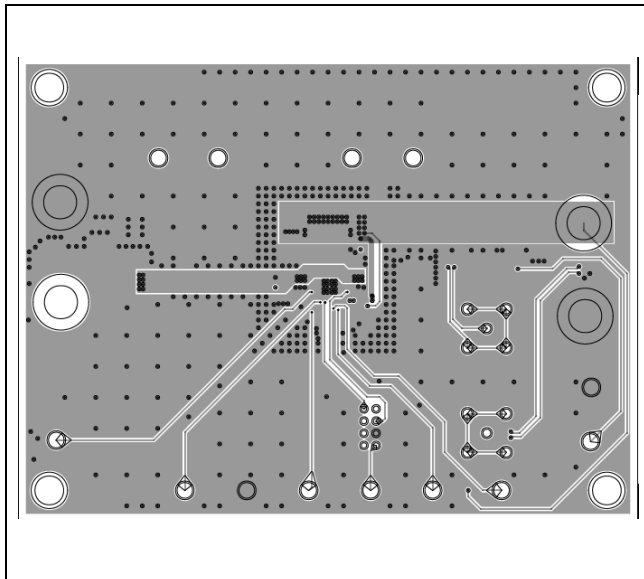
## EVAL-LT8643SA-AZ Kit PCB Layout



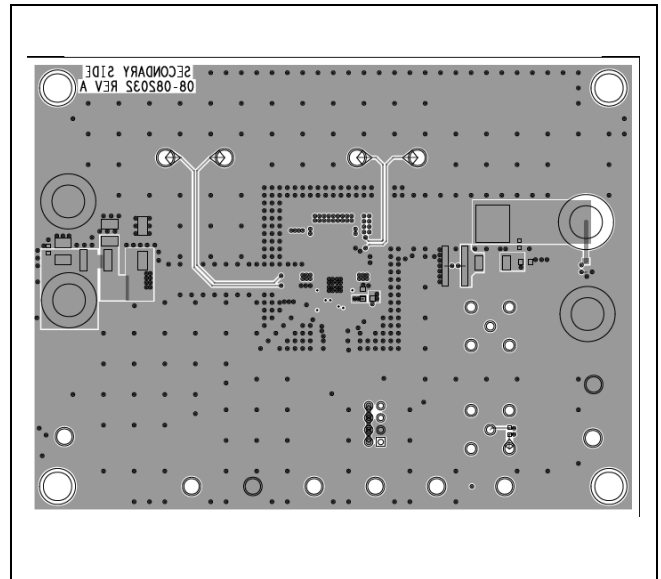
LT8643SA EV Kit PCB Layout—Layer 1



LT8643SA EV Kit PCB Layout—Layer 2



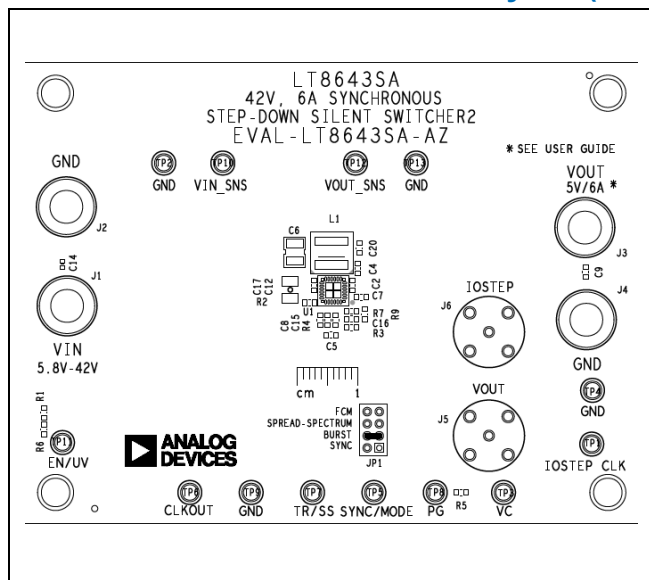
LT8643SA EV Kit PCB Layout—Layer 3



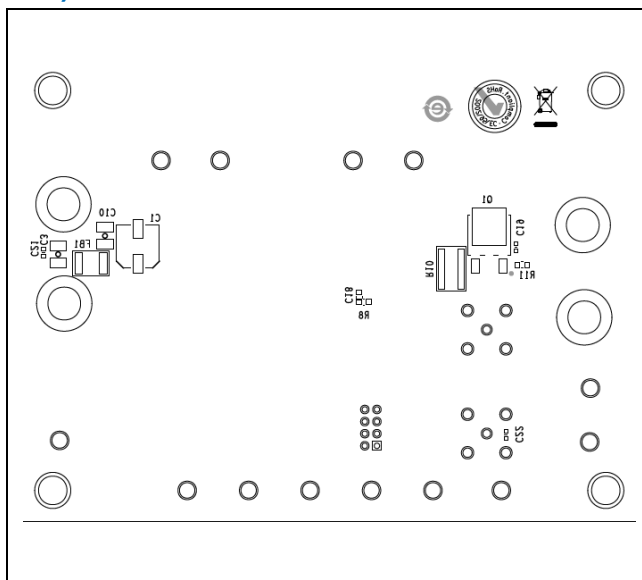
LT8643SA EV Kit PCB Layout—Bottom



## EVAL-LT8643SA-AZ Kit PCB Layout (continued)



LT8643SA EV Kit Component Placement Guide—Top  
Silkscreen



LT8643SA EV Kit Component Placement Guide—Bottom  
Silkscreen

## Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	09/24	Initial release	—

## Notes

ALL INFORMATION CONTAINED HEREIN IS PROVIDED “AS IS” WITHOUT REPRESENTATION OR WARRANTY. NO RESPONSIBILITY IS ASSUMED BY ANALOG DEVICES FOR ITS USE, NOR FOR ANY INFRINGEMENTS OF PATENTS OR OTHER RIGHTS OF THIRD PARTIES THAT MAY RESULT FROM ITS USE. SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE. NO LICENSE, EITHER EXPRESSED OR IMPLIED, IS GRANTED UNDER ANY ADI PATENT RIGHT, COPYRIGHT, MASK WORK RIGHT, OR ANY OTHER ADI INTELLECTUAL PROPERTY RIGHT RELATING TO ANY COMBINATION, MACHINE, OR PROCESS, IN WHICH ADI PRODUCTS OR SERVICES ARE USED. TRADEMARKS AND REGISTERED TRADEMARKS ARE THE PROPERTY OF THEIR RESPECTIVE OWNERS. ALL ANALOG DEVICES PRODUCTS CONTAINED HEREIN ARE SUBJECT TO RELEASE AND AVAILABILITY.