EVAL-LT8646SA-AZ

65V, 8A Synchronous Step-Down Silent Switcher 2

General Description

The evaluation circuit EVAL-LT8646SA-AZ is a 65V, 8A synchronous step-down second generation Silent Switcher® with spread spectrum frequency modulation featuring the LT8646SA. The evaluation board is designed for 5V output from a 5.6V to 65V input. The wide input range allows a variety of input sources, such as automotive batteries and industrial supplies. The LT8646SA is a compact, ultralow 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. Fast minimum on-time of 40ns enables high V_{IN} to low V_{OUT} conversion at high frequency.

The LT8646SA switching frequency can be programmed either through oscillator resistor or external clock over a 200kHz to 2.2MHz range. The default frequency of EVAL-LT8646SA-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 the JP1 shunt. *Figure 1* shows the efficiency of the circuit at 12V input and 24V input in Burst Mode operation (input from V_{IN} terminal to bypass the EMI filter). *Figure 2* shows the LT8646SA temperature rising on EVAL-LT8646SA-AZ board under different load conditions. The rated maximum load current is 8A, while derating is necessary for certain input voltage and thermal conditions. Low switching frequency can extend the output load capability by reducing the power dissipation. *Figure 3* shows the temperature rising at 400kHz switching frequency.

The evaluation board has an EMI filter installed. *Figure 4* shows the EMI performance of the board (with EMI filter). The red line in conducted and radiated EMI performance is CISPR25 class 5 peak limit. The figure shows that the circuit passes the test with a wide margin. To achieve EMI/EMC performance, as shown in *Figure 4*, the input EMI filter is required, and the input voltage should be applied at VEMI terminal. An inductor can be added in the EMI filter to further reduce the conducted emission. The EMI filter can be bypassed by applying the input voltage at V_{IN} terminal.

The LT8646SA data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this user guide for EVAL-LT8646SA-AZ. The LT8646SA is assembled in a 6mm x 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.

Performance Summary

Specifications are at T_A = 25°C

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Power Supply with EMI Filter	V_{IN_EMI}		5.6*		65	V
Output Voltage	V_{OUT}		4.85	5	5.15	V
Maximum Output Current	I_{OUT}	Derating is necessary for certain V_{IN} and thermal conditions	8			A
Switching Frequency	f_{SW}		1.85	2	2.15	MHz
Efficiency	EFF	V_{IN} = 12V, I_{OUT} = 4A		92.8		%

**The minimum input voltage of the evaluation board guarantees 5V output regulation. The minimum input voltage of the LT8646SA is 3V. Refer to the LT8646SA data sheet for more details.*

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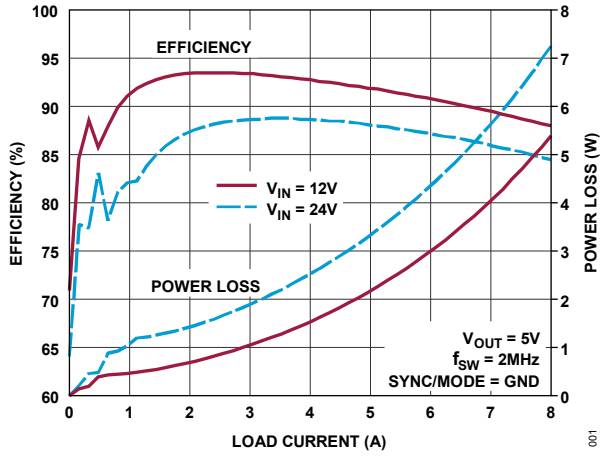


Figure 1. EVAL-LT8646SA-AZ Efficiency vs. Load Current (Input from V_{IN} Terminal)

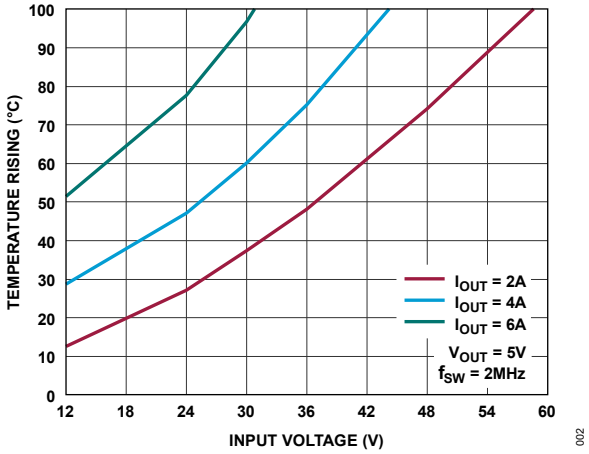


Figure 2. EVAL-LT8646SA-AZ Temperature Rising vs. Input Voltage (2MHz)

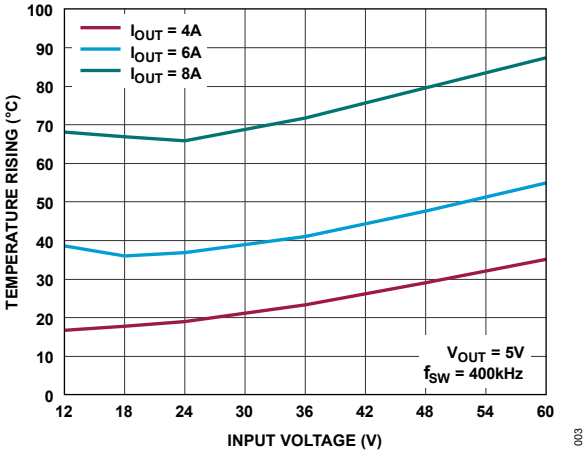
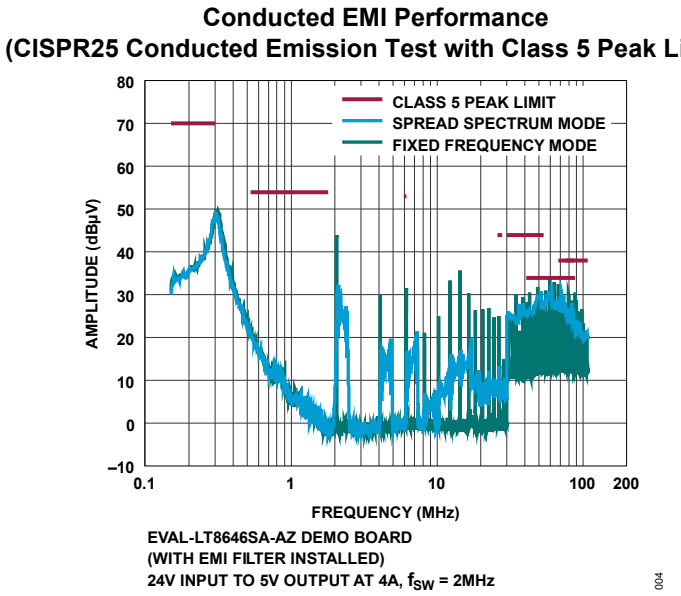


Figure 3. EVAL-LT8646SA-AZ Temperature Rising vs. Input Voltage (400kHz)



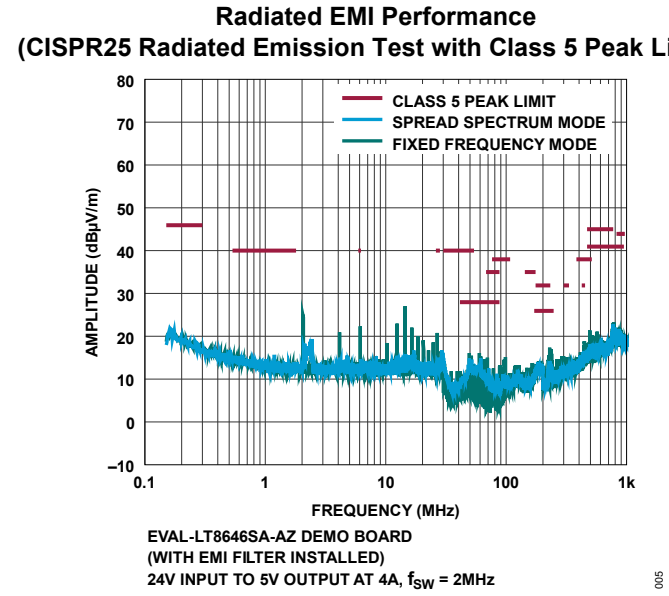


Figure 4. Evaluation Board EVAL-LT8646SA-AZ EMI Performance 24V Input from VEMI, with EMI Filter, I_{OUT} = 4A

Quick Start Procedure

The evaluation circuit EVAL-LT8646SA-AZ is easy to set up to evaluate the performance of the LT8646SA. See *Figure 5* 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 output voltage ripple by touching the probe tip directly across the output capacitor. See *Figure 6* for the proper scope technique. *Figure 7* shows the output voltage ripple measured at the output capacitor C9.

1. Place JP1 on BURST position.
2. With power off, connect the input power supply to VEMI and GND. If the input EMI filter is not desired, 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 at the input.
   NOTE: Make sure that the input voltage does not exceed 65V.
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 the SYNC function (JP1 on the SYNC position). Choose the R2 to set the LT8646SA switching frequency equal to or below the lowest SYNC frequency. JP1 can also set LT8646SA in spread spectrum mode (JP1 on the spread-spectrum position) or forced continuous mode (JP1 on the FCM position).

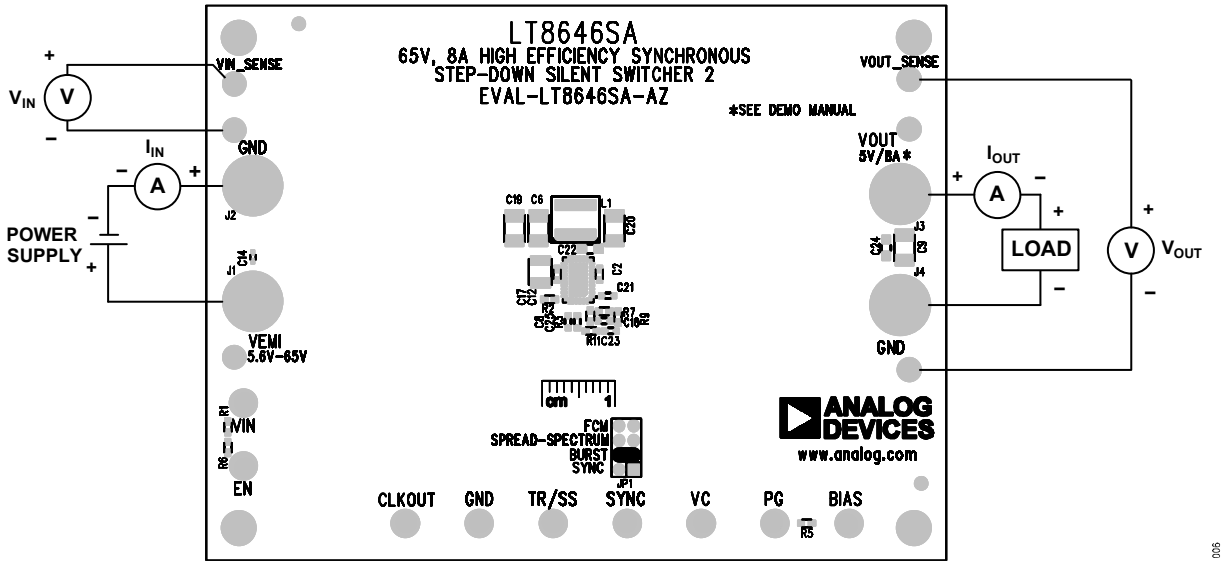


Figure 5. Proper Measurement Equipment Setup

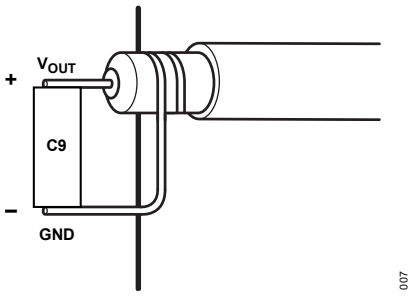


Figure 6. Measuring Output Ripple at Output Capacitor C9

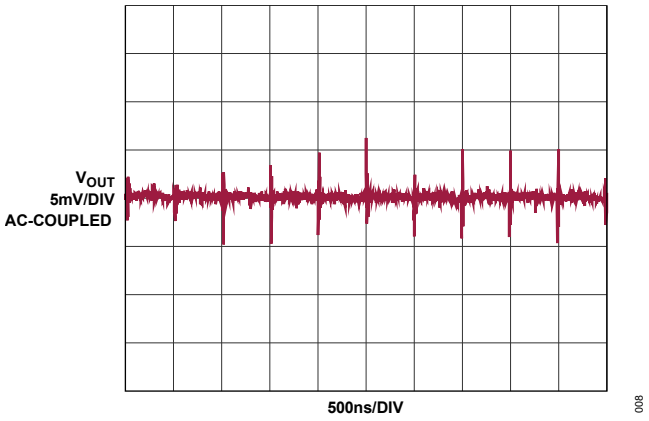
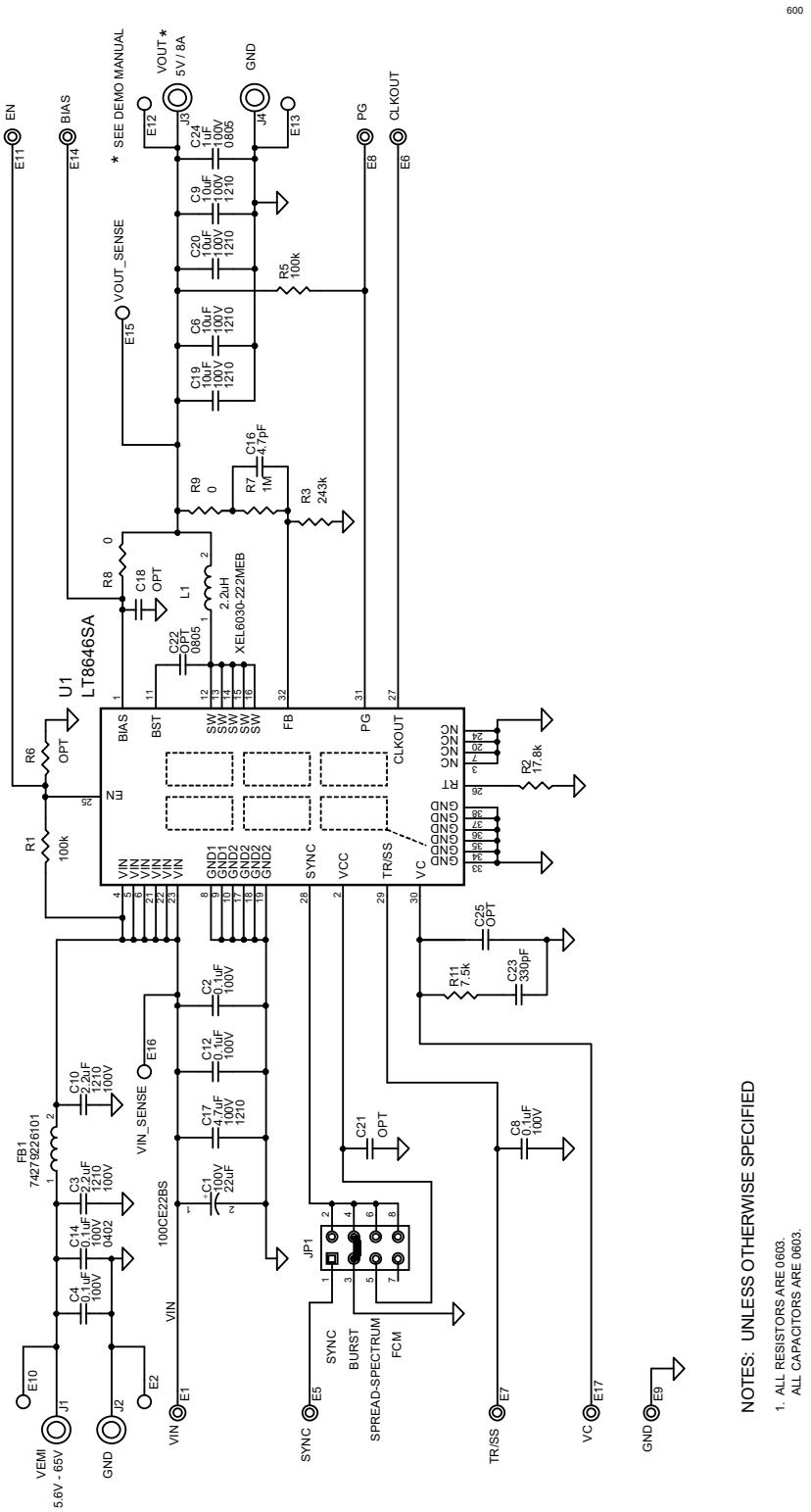


Figure 7. EVAL-LT8646SA-AZ Output Voltage Ripple 12V Input, I_{OUT} = 8A, Full BW

Bill of Materials

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER, PART NUMBER
REQUIRED CIRCUIT COMPONENTS				
1	3	C2, C8, C12	Capacitors, 0.1µF, X7S, 100V, 10%, 0603	TDK, CGA3E3X7S2A104K080AB
2	3	C6, C19, C20	Capacitors, 10µF, X7S, 100V, 10%, 1210	MURATA, GRM32EC72A106KE05L
3	1	C16	Capacitor, 4.7pF, C0G/NP0, 50V, 0603	AVX, 06035A4R7CAT2A
4	1	C17	Capacitor, 4.7µF, X7S, 100V, 10%, 1210	TDK, C3225X7S2A475K200AB
5	1	C23	Capacitor, 330pF, NP0, 50V, 10%, 0603	AVX, 06035A331K4T2A
6	1	L1	Inductor, 2.2µH, 20%, 10A, 13.97mΩ	Coilcraft, XEL6030-222MEB
7	1	R1	Resistor,100kΩ, 5%, 1/10W, 0603	Vishay, CRCW0603100KJNEA
8	1	R2	Resistor, 17.8kΩ, 1%, 1/10W, 0603	Vishay, CRCW060317K8FKEA
9	1	R3	Resistor, 243kΩ, 1%, 1/10W, 0603	Vishay, CRCW0603243KFKEA
10	1	R5	Resistor, 100kΩ, 1%, 1/10W, 0603	Vishay, CRCW0603100KFKEA
11	1	R7	Resistor, 1MΩ, 1%, 1/10W, 0603	Vishay, CRCW06031M00FKEA
12	1	R9	Resistor, 0Ω, 1/10W, 0603	Vishay, CRCW06030000Z0EA
13	1	R11	Resistor, 7.5kΩ, 1%, 1/10W, 0603	Vishay, CRCW06037K50FKEA
14	1	U1	IC., Regulator, 32-LQFN	LT8646SAAV#PBF
ADDITIONAL EVALUATION BOARD COMPONENTS				
1	1	C1	Capacitor, 22µF, Aluminum, 100V, 20%	Suncon, 100CE22BS
2	2	C3, C10	Capacitor, 2.2µF, X7R, 100V, 10%, 1210	AVX, 12101C225KAT2A
3	1	C4	Capacitor, 0.1µF, X7S, 100V, 10%, 0603	TDK, CGA3E3X7S2A104K080AB
4	1	C9	Capacitor, 10µF, X7S, 100V, 10%, 1210	Murata, GRM32EC72A106KE05L
5	1	C14	Capacitor, 0.1µF, X5R, 100V, 10%, 0402	Murata, GRM155R62A104KE14D
6	0	C18, C21, C25	Capacitor, Option, 0603	
7	0	C22	Capacitor, Option, 0805	
8	1	C24	Capacitor,1µF, X7R, 100V, 10%, 0805	AVX, 08051C105K4T2A
9	1	FB1	Ferrite Bead, 8A, 1812	Wurth, 74279226101
10	0	R6	Resistor, Option, 0603	
11	1	R8	Resistor,0Ω, 1/10W, 0603	Murata, CRCW06030000Z0EA
HARDWARE FOR EVALUATION BOARD ONLY				
1	9	E1,E5-9, E11, E14, E17	Test Point, Turret, 0.094"	Mill-Max, 2501-2-00-80-00-00-07-0
2	6	E2, E10, E12, E13, E15, E16	Test Point, Turret, 0.064"	Mill-Max, 2308-2-00-80-00-00-07-0
3	4	J1-J4	Connector, Banana Jack	Keystone, 575-4
4	1	JP1	Connector, 2 x 4, 2mm	Wurth, 62000821121
5	4	MP1-MP4	Standoff, Nylon, 0.50"	Keystone, 8833
6	1	XJP1	Connector, Shunt, 2mm	Wurth, 60800213421

Schematic Diagram



Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	10/25	Initial release	—

Notes