Evaluation Board User Guide

EVAL-LT8624S-AZ-IBB

LT8624S 18V, 4A Synchronous Step-Down Silent Switcher with Ultra-Low Noise Reference Used as an IBB Converter

General Description

The EVAL-LT8624S-AZ-IBB demonstration board is the inverting buck-boost topology version of the LT8624S, an 18V, 4A synchronous Silent Switcher®3 step-down regulator with ultra-low noise, high efficiency, and power density. The input voltage range of the EVAL-LT8624S-AZ-IBB is 2.7V to (18V - $|V_{OUT}|$). The default demo board setting is -5V for a 2A maximum DC output current with a 5V input, or a 4A maximum DC output current with a 12V input. The LT8624S is a compact, ultra-low noise, ultra-low emission, high efficiency, and high-speed synchronous monolithic step-down switching regulator used as an inverting buck-boost converter. The uniquely designed combination of the ultra-low noise reference and third-generation Silent Switcher architecture enables the LT8624S to achieve both high efficiency and excellent wideband noise performance. A minimum on-time of 12ns allows high V_{IN} to low V_{OUT} conversion at high frequency.

The LT8624S switching frequency can be programmed either through an external resistor RT, or an external clock over a 300kHz to 6MHz range. The default frequency of EVAL-LT8624S-AZ-IBB demo board is 2MHz. The SYNC pin on the demo board is connected to $-V_{OUT}$ for pulse-skip mode operation. To synchronize to an external clock, move JP1 to SYNC and apply the external clock to the SYNC terminal. Select the forced continuous mode (FCM) by moving the JP1 shunt respectively. *Figure 1* shows the efficiency of the circuit at 5V input and 12V input in the FCM operation (input from VIN terminal). *Figure 2* shows the LT8624S temperature rising on the EVAL-LT8624S-AZ-IBB demo board under 1A, 2A, and 3A load conditions, for the full input voltage range. The case temperature rise was measured with the following reference points: The peak IC case temperature and a point on the board, marked with a red 'X' as shown in the thermal picture in *Figure 7*.

The demo board has an electromagnetic interference (EMI) filter installed by default between V_{IN} terminal and the IC. The EMI performance of the board is shown in *Figure 3*. The red line in Radiated EMI Performance is the CISPR32 Class B limit. In addition to the excellent EMI performance, the regulator also features ultra-low noise over a wide frequency range, as is shown in *Figure 4*.

The LT8622S/LT8624S data sheet gives a complete description of the LT8624S part, including operation and application information. Read the data sheet in conjunction with this demo manual for LT8624S-AZ-IBB demo board. The LT8624S is assembled in a 4mm x 3mm LQFN package with exposed ground pads for low thermal resistance. The layout recommendations for low EMI operation and maximum thermal performance are available in the LT8622S/LT8624S data sheet section 'PCB Layout Recommendations.'

Design files for this circuit board are available in the Design Center at *www.analog.com*.

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Performance Summary (T_A = 25°C)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range V_{IN}		2.7		18 - $\|V_{OUT}\|$	V
Output Voltage		-4.96	-5	-5.04	V
Default Switching Frequency			2		MHz
Maximum Output Current	Derating Necessary for Certain V_{IN}, V_{OUT}, and Thermal Conditions	2 (V_{IN} = 5V)		4 (V_{IN} = 12V)	A
Efficiency	V_{IN} = 5V F_{SW} = 2MHz V_{OUT} = -5V at I_{OUT} = 2A		85		%

Typical Performance Characteristics

(Standard Demo Board at F_{SW} = 2MHz, MODE = FCM, T_A = +25°C, unless otherwise noted.)

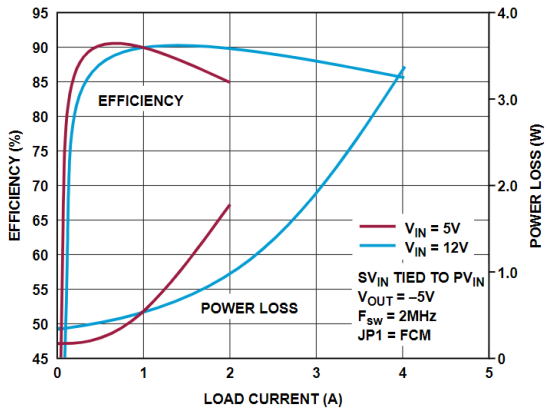


Figure 1. Efficiency vs. Load Current (Input from V_{IN} Terminal)

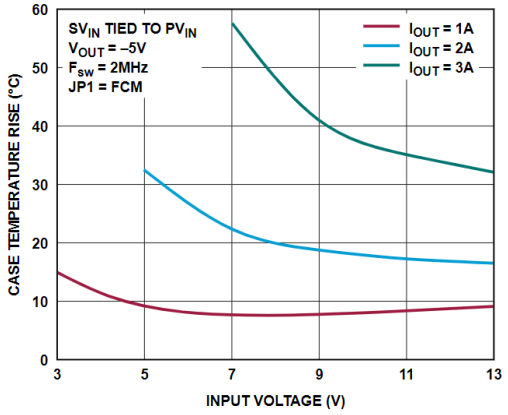


Figure 2. Case Temperature Rise vs. V_{IN}

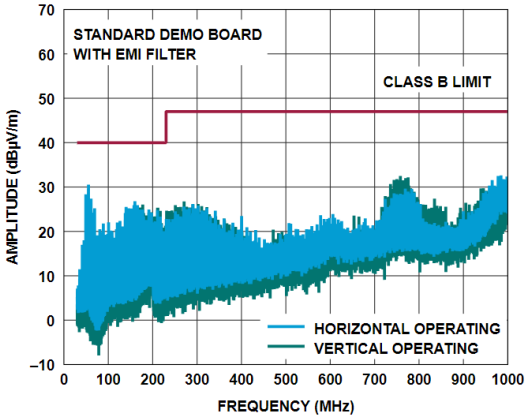


Figure 3. CISPR32 Radiated EMI Performance

(V_{IN} = 12V, V_{OUT} = -5V, I_{OUT} = 2A)

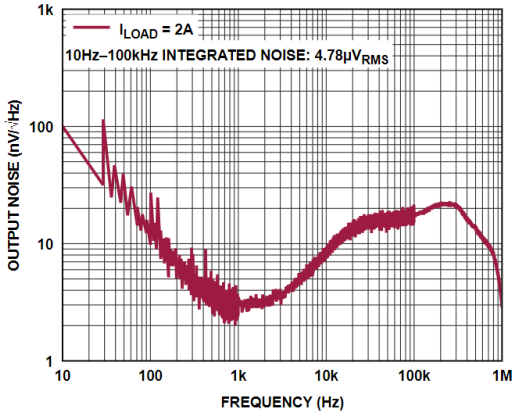


Figure 4. Noise Spectral Density

(V_{IN} = 5V, V_{OUT} = -5V, I_{OUT} = 2A)

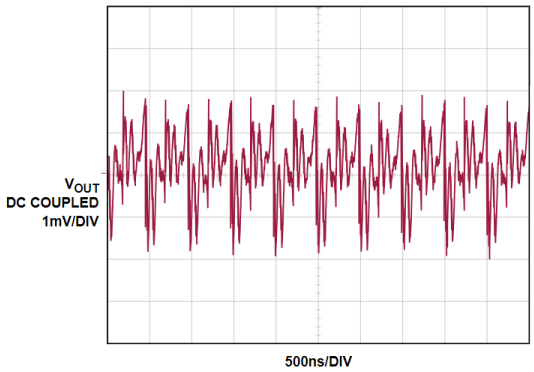


Figure 5. Output Voltage Ripple Measured Through J3. V_{IN} = 5V, V_{OUT} = -5V, I_{OUT} = 2A, Remote Sense Enabled with a 200MHz BWL

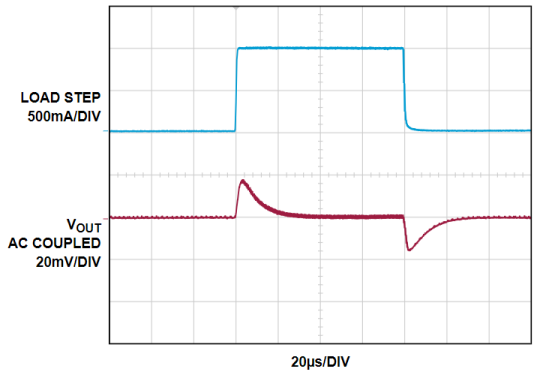


Figure 6. Load Transient Response from 0A to 1A to 0A with a 1A/µs Slew Rate, V_{IN} = 5V, V_{OUT} = -5V. V_{OUT} Measured Through J3

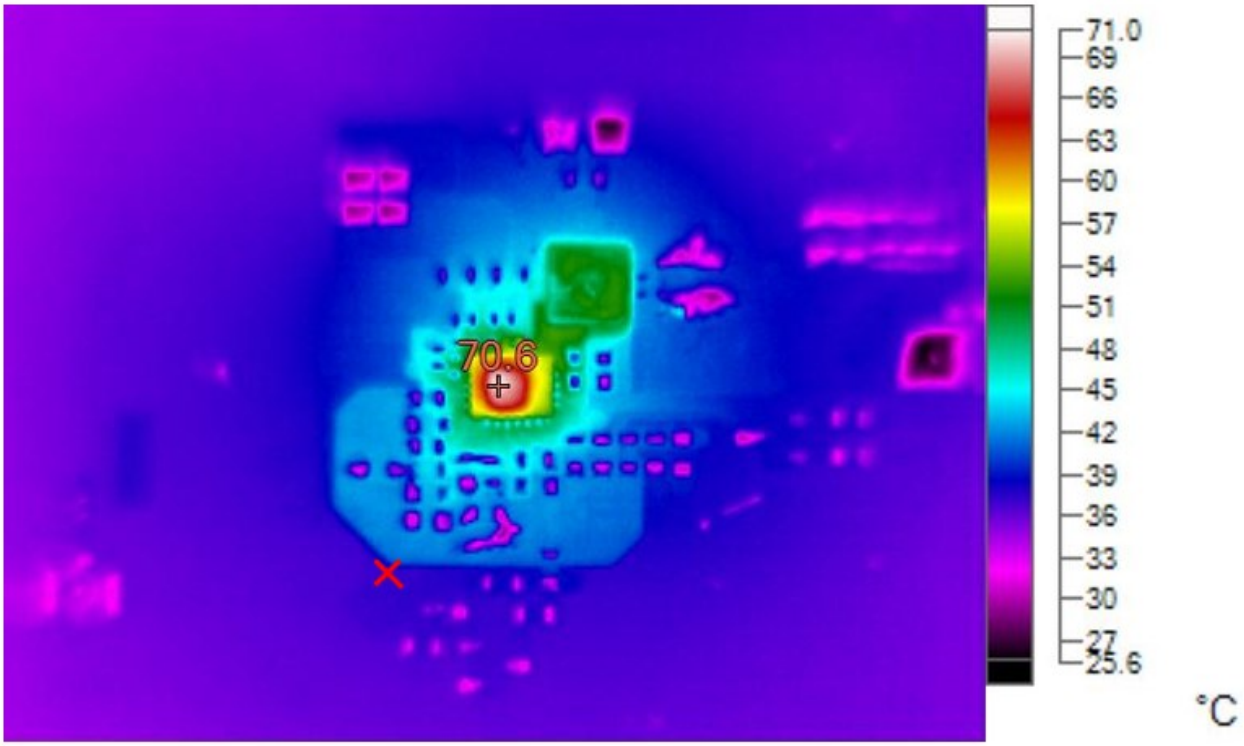


Figure 7. Thermal Performance at V_{IN} = 5V, SV_{IN} tied to PV_{IN}, V_{OUT} = -5V, I_{OUT} = 2A, T_A = 25°C

Quick Start Procedure

The EVAL-LT8624S-AZ-IBB demo board is easy to set up to evaluate the performance of LT8624S operating as an inverting buck-boost converter. See *Figure 8* for a proper test setup and follow this test procedure.

NOTE: When measuring the input or output voltage ripple, be careful to avoid a long ground lead on the oscilloscope probe. For the input and output voltage ripple, measure them through the U.FL connectors—"V_{IN}" (J2), and "-V_{OUT}" (J3), respectively. *Figure 5* shows the output voltage ripple measured at the output capacitor C9 through the "-V_{OUT}" U.FL connector.

1. Place JP1 on the FCM position.
2. With power off, connect the input power supply to V_{IN} (E1) and GND (E2).
3. With power off, connect the load's "-" input to the board's -V_{OUT} (E4), and connect the load's "+" input to the board's GND (E5).
4. Connect the digital multimeter (DMM) between the input test points: "VIN SENSE" (E10) and "GND SENSE" (E12) to monitor the input voltage. Connect another DMM between "-VOUT SENSE" (E6) and "GND SENSE" (E8) to monitor the output voltage.
5. Set the power supply voltage to 5V and enable it.
6. Check for the proper output voltage (V_{OUT} = -5V).
7. Once the input and output voltages are properly established, adjust the load current within the operating range of 0A to 2A maximum. Observe the output voltage regulation, output voltage ripples, switching node waveform, load transient response, and other parameters.
8. Add an external clock to the SYNC terminal when using the SYNC function (JP1 on the SYNC position). Choose the R_T resistor (R23) to set the LT8624S switching frequency at least 20% below the lowest SYNC frequency.

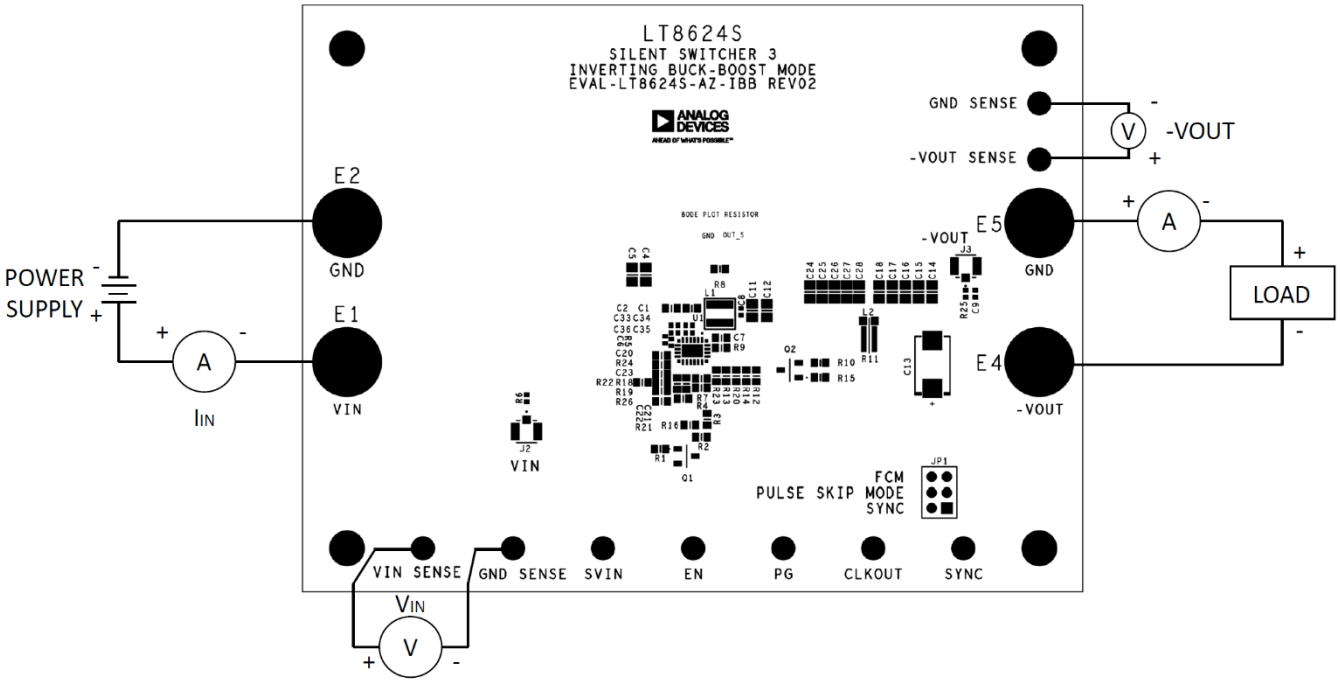


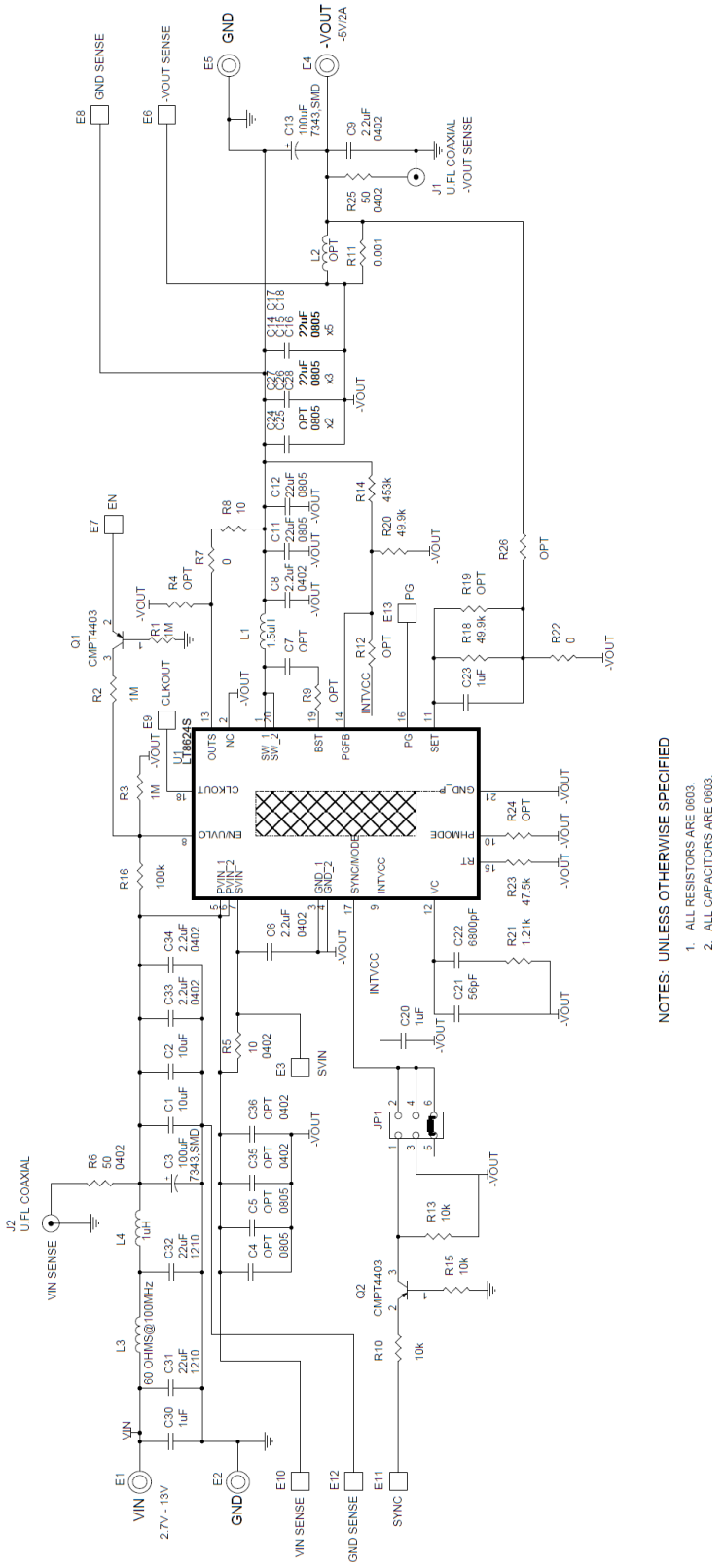
Figure 8. Board Test Setup

Bill of Materials

ITEM	QTY	DESIGNATOR	DESCRIPTION	MANUFACTURER PART NUMBER
REQUIRED CIRCUIT COMPONENTS				
1	2	C1,C2	CAP.,10uF,X5R,25V,20%,0603	MURATA, GRM188R61E106MA73D
2	2	C3, C13	CAP TANT POLY 100UF 20V 2917	KYOCERA AVX, TCJY107M020R0055
3	5	C6, C8, C9, C33, C34	CAP.,2.2uF,X5R,25V,10%,0402	MURATA, GRM155R61E225KE11D
4	10	C11, C12, C14-C18, C26-C28	CAP.,22uF,X5R,25V,20%,0805	MURATA, GRM21BR61E226ME44L
5	2	C20, C23	CAP.,1uF,X7R,16V,20%,0603	AVX, 0603YC105MAT2A
6	1	C21	CAP.,56pF,C0G,50V,5%,0603	AVX, 06035A560JAT2A
7	1	C22	CAP.,6800pF,X7R,50V,20%,0603	AVX, 06035C682MAT2A
8	1	C30	CAP.,1uF,X7R,25V,10%,0603,AEC-Q200	MURATA, GCM188R71E105KA64D
9	2	C31, C32	CAP.,22uF,X7R,25V,10%,1210	AVX, 12103C226KAT2A
10	1	L1	IND.,1.5uH,PWR,SHIELDED,20%,11.1A,14.3 mOHMS,4.3mmX4.3mm,AEC-Q200	COILCRAFT, XGL4020-152MEC
11	1	L3	IND.,60 OHMS@100MHz,PWR,FERRITE BEAD,25%,5100mA,15mOHMS,0603	WURTH ELEKTRONIK, 74279228600
12	1	L4	IND.,1uH,PWR,SHIELDED,20%,4A,52.5mOH MS,1616AB,IHLP-01 Series	VISHAY, IHLP1616ABER1R0M01
13	2	Q1, Q2	TRANS PNP 40V 0.6A SOT23	CENTRAL SEMI., CMPT4403 TR PBFREE
14	3	R1-R3	RES.,1M OHM,1%,1/10W,0603	VISHAY, CRCW06031M00FKEA
15	0	R4, R9, R12, R19, R24, R26	RES., OPTION, 0603	
16	1	R5	RES.,10 OHMS,1%,1/16W,0402,AEC-Q200	NIC, NRC04F10R0TRF
17	2	R6, R25	RES.,50 OHMS,0.1%,1/20W,0402,HIGH FREQ.	VISHAY, FC0402E50R0BST1
18	2	R7, R22	RES.,0 OHM,1/10W,0603,AEC-Q200	VISHAY, CRCW06030000Z0EA
19	1	R8	RES.,10 OHMS,1%,1/10W,0603	VISHAY, CRCW060310R0FKEA
20	3	R10, R13, R15	RES.,10k OHMS,1%,1/10W,0603	VISHAY, CRCW060310K0FKEC
21	1	R11	RES.,0.001 OHM,5%,1.5W,1206,LONG-SIDE TERM,METAL,SENSE,AEC-Q200	SUSUMU, KRL3216D-M-R001-J-T5
22	1	R14	RES.,453k OHMS,1%,1/10W,0603,AEC-Q200	VISHAY, CRCW0603453KFKEA
23	1	R16	RES.,100k OHMS,1%,1/10W,0603,AEC-Q200	PANASONIC, ERJ3EKF1003V
24	2	R18, R20	RES.,49.9k OHMS,0.1%,1/10W,0603,AEC-Q200	VISHAY, TNPU060349K9BZEN00
25	1	R21	RES.,1.21k OHMS,1%,1/10W,0603	PANASONIC, ERJ3EKF1211V
26	1	R23	RES.,47.5k OHMS,1%,1/10W,0603	VISHAY, CRCW060347K5FKEA
27	1	U1	IC,SYN STEP-DOWN SILENT SWITCHER,LQFN-20,PRELIM.	ANALOG DEVICES, LT8624SAV#PBF

OPTIONAL CIRCUIT COMPONENTS				
1	0	C4, C5, C24, C25	CAP., OPTION, 0805	
2	0	C7	CAP., OPTION, 0603	
3	0	C35, C36	CAP., OPTION, 0402	
4	0	L2	IND., OPTION, 0603	
HARDWARE – FOR EVALUTATION CIRCUIT ONLY				
1	4	E1, E2, E4, E5	CONN.,BANANA JACK,FEMALE,THT,NON-INSULATED,SWAGE,0.218"	KEYSTONE, 575-4
2	9	E3, E6-E13	TEST POINT,TURRET,0.064" MTG. HOLE,PCB 0.062" THK	MILL-MAX, 2308-2-00-80-00-00-07-0
3	2	J1, J2	CONN.,UMC,RCPT,STR,50 OHM SMD	SAMTEC, RSP-122811-01
4	1	JP1	CONN.,HDR,MALE,2x3,2mm,VERT,ST,THT	WURTH ELEKTRONIK, 62000621121
5	4	MH1-MH4	STANDOFF, NYLON, SNAP-ON,0.375"	KEYSTONE, 8832
6	2	MP1, MP2	CBL ASSY U.FL-SMA JACK-PLUG 3"	PULSE ELECTRONICS, W9003M
7	1	XJP1	CONN.,SHUNT,FEMALE,2 POS,2.54mm	SAMTEC, SNT-100-BK-G

LT8624S-IBB EV Kit Schematic



Revision History

Revision Number	Revision Date	Nature of Change	Page Number
A	4/24	Initial Release for open market	—

Notes