LT8648S
42V, 15A Synchronous Step-Down Silent Switcher 2

DESCRIPTION

Demonstration Circuit 2841A is a 42V, 15A synchronous step-down Silent Switcher 2 with spread spectrum frequency modulation featuring the LT8648S. The demo board is designed for 5V output from a 5.7V to 42V input. The wide input range allows a variety of input sources, such as automotive batteries and industrial supplies. The LT8648S is a compact, ultralow emission, high efficiency, and high speed synchronous monolithic step-down switching regulator. The integrated bypass capacitors optimize the fast current loops and make it easier to minimize EMI emissions by reducing layout sensitivity. Selectable spread spectrum mode further improves EMI performance, making it perfect solution to the noise sensitive applications.

Peak current mode control with minimum on-time of as small as 25ns allows high step-down conversion even at high frequency. The LT8648S switching frequency can be programmed either via oscillator resistor or external clock over a 200kHz to 2.2MHz range. The default frequency of demo circuit 2841A is 400kHz.

The SYNC/MODE pin on the demo board DC2841A is grounded (JP1 at BURST position) by default for low ripple Burst Mode® operation. It can be configured into different operation modes through JP1 and SYNC terminal (Table 1).

Figure 1 shows the efficiency of the circuit at 12V input and 24V input in force continuous mode without spread spectrum. To get accurate efficiency measurement, measure the input voltage at the VIN SENSE terminal and measure the output voltage at the VO SENSE terminal.

Figure 2 shows the LT8648S temperature rising on DC2841A demo board under different load conditions. The LT8648S is assembled in a 7mm × 4mm LQFN package with exposed pads for low thermal resistance. The rated maximum load current is 15A, while derating is necessary for certain input voltage and thermal conditions.

Table 1. Operation Mode Configuration

JP1 Position	SYNC (E5) Input	Operation Mode
SPREAD-SPECTRUM	N/A	Forced Continuous Mode w/ Spread-Spectrum
BURST	N/A	Low Ripple Burst Mode®
FCM/SYNC	Floating	Forced Continuous Mode w/o Spread-Spectrum
FCM/SYNC	External Clock	Forced Continuous Mode w/ Synchronization

The demo board has an EMI filter installed. The EMI performance of the board is shown on Figure 3. The red line in 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 performance as shown in Figure 3, the input EMI filter is required and the input voltage should be applied at VIN_EMI terminal, and the test setup can be referred to the CISPR25 standards. If the input is applied to VIN terminal, the EMI filter is bypassed.

The LT8648S 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 DC2841A. 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. Contact ADI applications engineer for support.

Design files for this circuit board are available.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		5.7		42	V
V_{OUT}	Output Voltage	V_{IN} = 12V	4.85	4.98	5.11	V
I_{OUT}	Maximum Output Current		15			A
f_{SW}	Switching Frequency		370	400	430	kHz
EFF	Efficiency	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 9A		96.5		%

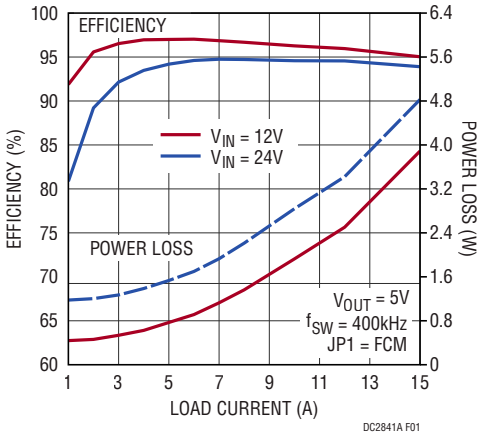


Figure 1. LT8648S Demo Circuit DC2841A Efficiency vs Load Current

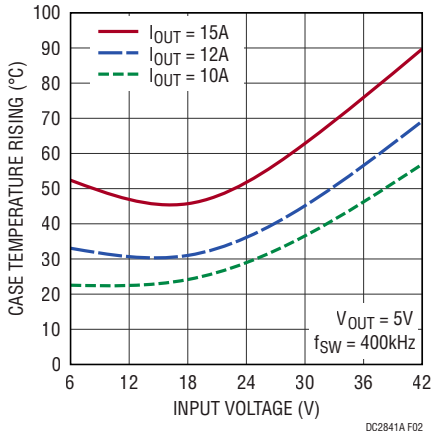
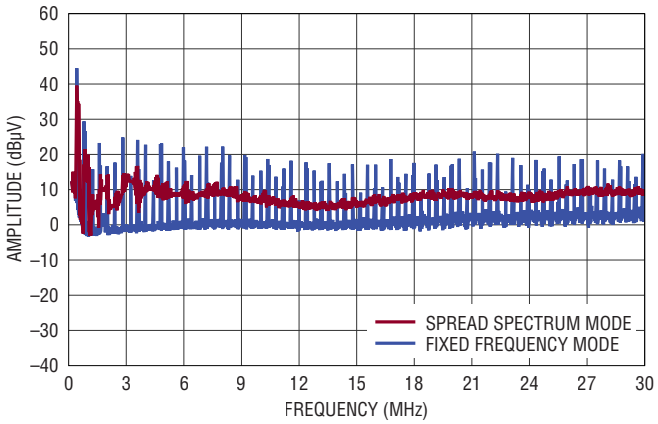


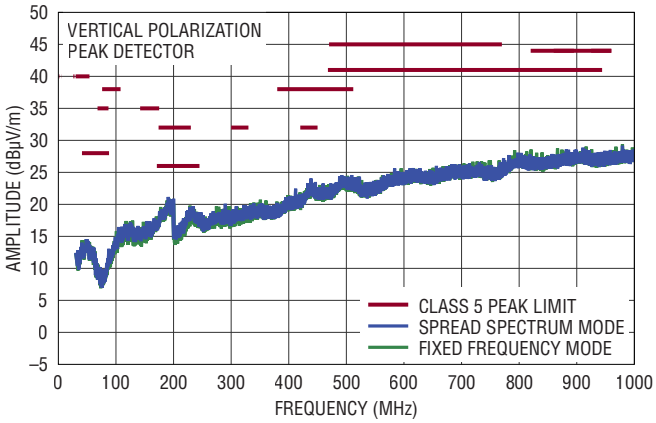
Figure 2. LT8648S Demo Circuit DC2841A Case Temperature Rising vs Input Voltage

PERFORMANCE SUMMARY

Conducted EMI Performance



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



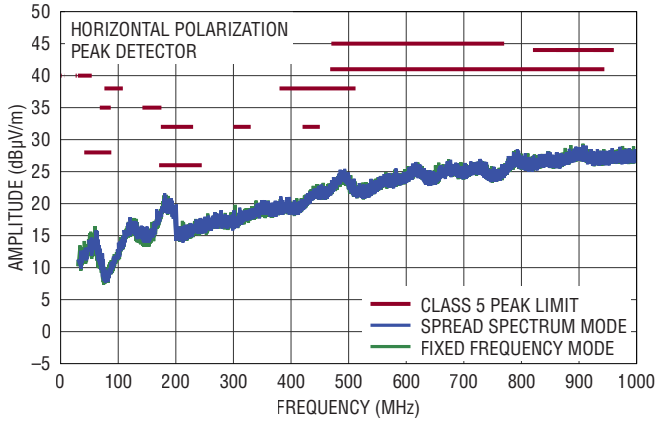


Figure 3. LT8648S Demo Circuit DC2841A EMI Performance (14V input to 5V output at 15A, with EMI filter, f_{SW} = 400kHz)

QUICK START PROCEDURE

Demonstration circuit 2841A is easy to set up to evaluate the performance of the LT8648S. Refer to Figure 4 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 5 for the proper scope technique.

1. Make sure the Jump JP1 is on the BURST position. Refer to the schematic.
2. With power off, connect the input power supply to VIN_EMI 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. Connect the voltage meter across the VIN SENSE and GND for V_{IN} measurement, and VOUT SENSE and GND for V_{OUT} measurement.
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 (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. For efficiency measurement, use the VIN SENSE and VOUT SENSE accordingly.
8. An external clock can be added to the SYNC terminal when SYNC function is used (JP1 on the FCM/SYNC position). Please make sure that R2 should be chose to set the LT8648S switching frequency equal to or below the lowest SYNC frequency. When JP1 is in FCM/SYNC position, and no external clock is connected to the SYNC terminal of the board, the SYNC/MODE pin is floating, and the LT8648S runs in forced continuous mode. JP1 can also set LT8648S in spread spectrum mode (JP1 on the SPREAD-SPECTRUM position).

QUICK START PROCEDURE

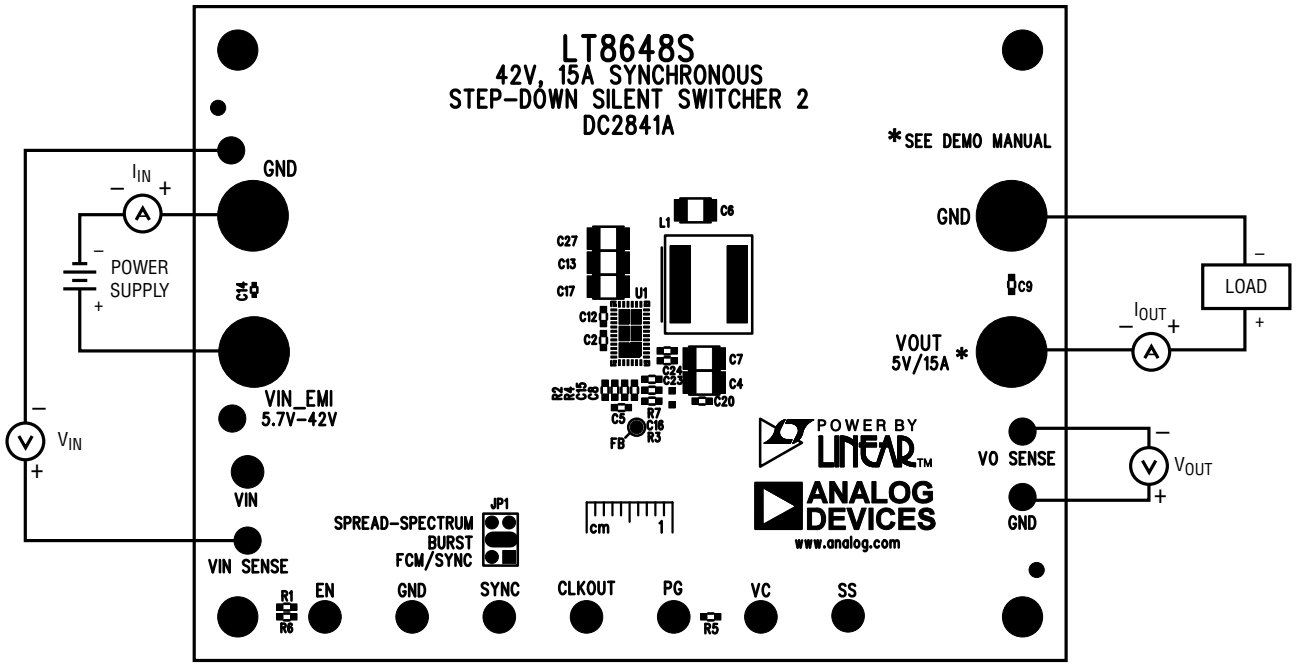


Figure 4. Proper Measurement Equipment Setup

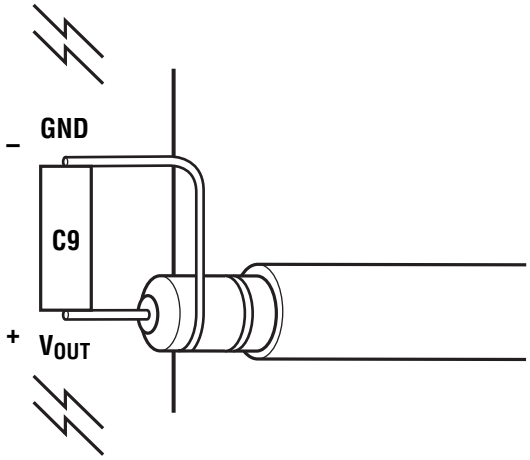
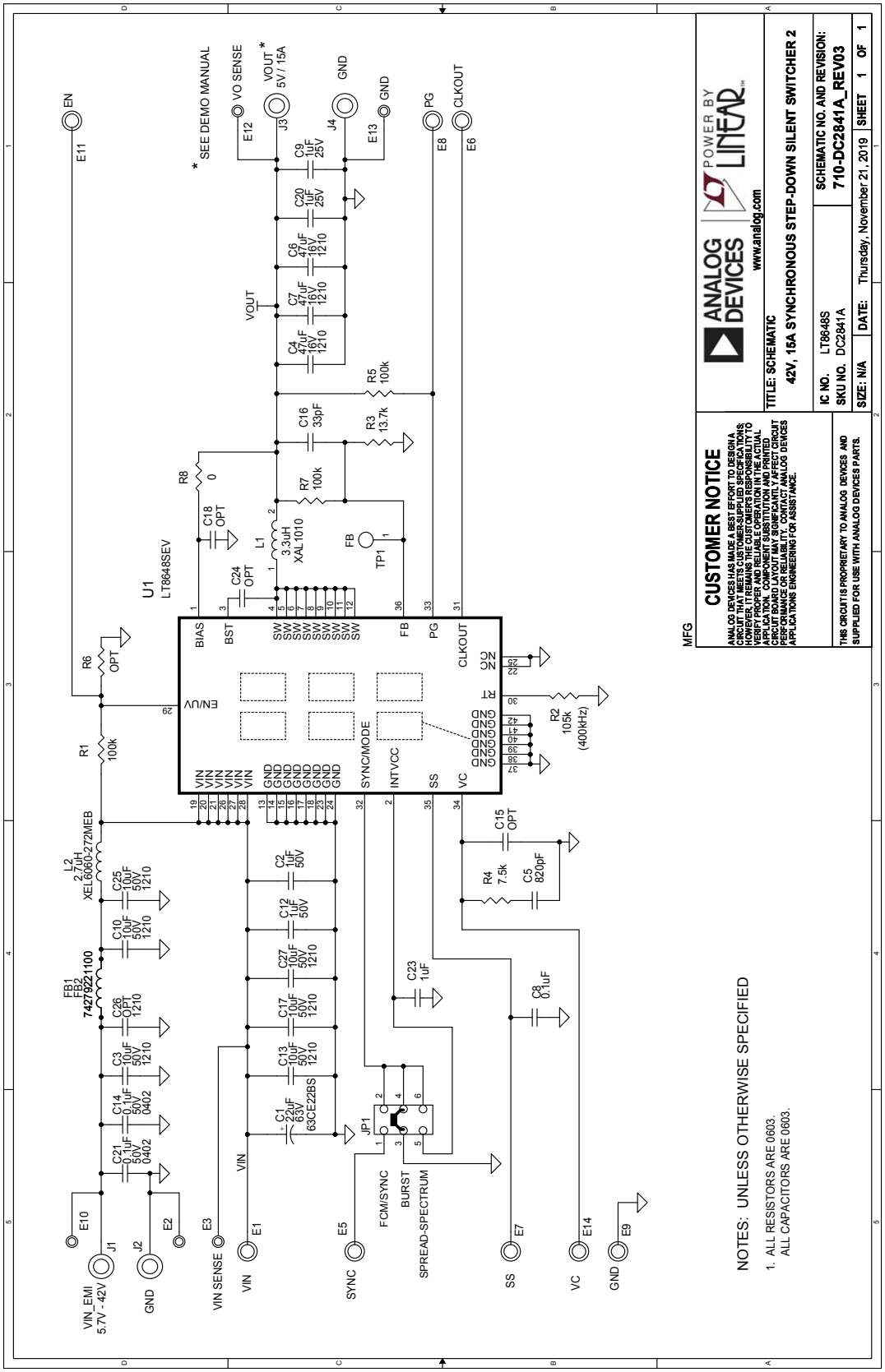


Figure 5. Measuring Output Ripple at Output Capacitor C9

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C2, C12	CAP., 1µF, X5R, 50V, 10%, 0603	AVX, 06035D105KAT2A
2	3	C4, C6, C7	CAP., 47µF, X5R, 16V, 20%, 1210	AVX, 1210YD476MAT2A
3	1	C5	CAP., 820pF, C0G, 50V, 5%, 0603	AVX, 06035A821JAT2A
4	1	C8	CAP., 0.1µF, X7R, 16V, 10%, 0603	AVX, 0603YC104KAT2A
5	2	C9, C20	CAP., 1µF, X7R, 25V, 10%, 0603	TAIYO YUDEN, TMK107B7105KA-T
6	3	C13, C17, C27	CAP., 10µF, X7R, 50V, 10%, 1210	MURATA, GRM32ER71H106KA12L
7	1	C16	CAP., 33pF, X7R, 16V, 5%, 0603	AVX, 0603YC330JAT2A
8	1	C23	CAP., 1µF, X7R, 16V, 10%, 0603	AVX, 0603YC105KAT2A
9	1	C20	CAP., 1µF, X7R, 10V, 10%, 0603	MURATA, GRM188R71A105KA61D
10	1	L1	IND., 3.3µH, PWR, 20%, 25A, 4.10mΩ, 11.8 × 10.5mm	COILCRAFT, XAL1010-332MEB
11	3	R1, R5, R7	RES., 100kΩ, 1%, 1/10W, 0603	VISHAY, CRCW0603100KFKEA
12	1	R2	RES., 105kΩ, 1%, 1/10W, 0603	VISHAY, CRCW0603105KFKEA
13	1	R3	RES., 13.7kΩ, 1%, 1/10W, 0603	VISHAY, CRCW060313K7FKEA
14	1	R4	RES., 7.5kΩ, 1%, 1/10W, 0603	VISHAY, CRCW06037K50FKEA
15	1	U1	IC, STEP-DOWN REG., LQFN-36	ANALOG DEVICES, LT8648SEV#PBF
Additional Demo Board Circuit Components				
1	1	C1	CAP., 22µF, ALUM. ELECT., 63V, 20%, 6.3 × 7.7mm, CE-BS	SUN ELECTRONIC INDUSTRIES CORP, 63CE22BS
2	3	C3, C10, C25	CAP., 10µF, X7R, 50V, 10%, 1210	MURATA, GRM32ER71H106KA12L
3	2	C14, C21	CAP., 0.1µF, X7R, 50V, 10%, 0402	MURATA, GRM155R71H104KE14D
4	0	C15, C18, C24 (OPT)	CAP., OPTION, 0603	
5	0	C26 (OPT)	CAP., OPTION, 1210	
6	2	FB1, FB2	IND., 10Ω at 100MHz, FERRITE BEAD, 25%, 10.5A, 3mΩ, 1206	WURTH ELEKTRONIK, 74279221100
7	1	L2	IND., 2.7µH, PWR, 20%, 17A, 7.63mΩ, 6.56 × 6.36mm	COILCRAFT, XEL6060-272MEB
8	0	R6 (OPT)	RES., OPTION, 0603	
9	1	R8	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
Hardware/Components (For Demo Board Only)				
1	7	E1, E5-E9, E11, E14	TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THICK	MILL-MAX, 2501-2-00-80-00-00-07-0
2	5	E2, E3, E10, E12, E13	TEST POINT, TURRET, 0.064" MTG. HOLE, PCB 0.062" THICK	MILL-MAX, 2308-2-00-80-00-00-07-0
3	1	JP1	CONN., HDR, MALE, 2 × 3, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000621121
4	4	J1-J4	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218"	KEYSTONE, 575-4
5	4	MH1-MH4	STANDOFF, NYLON, SNAP-ON, 0.50"	WURTH ELEKTRONIK, 702935000
6	1	XJP1	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421

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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