

LT8685S 42V Quad, Gangable, Synchronous, Monolithic Step-Down Regulator

DESCRIPTION

Demonstration circuit EVAL-LT8685S-AZ is a 4-rail power supply featuring the [LT[®]8685S](#), a 42V quad monolithic synchronous step-down silent switcher. The demo circuit is designed for 5V, 3.3V, 1.8V, and 1.2V outputs from a nominal 12V input. The 5V and 3.3V rails are powered from the 12V input, while the 1.8V and 1.2V rails are powered from one of the high voltage buck regulators of 5V or 3.3V. The current capability is 2.5A for the channels 1 and 2. The current ratings for the low voltage channels are 4A.

The two 42V regulators may be combined to provide up to 5A of output current using a single inductor. Similarly, the two 8V regulators may be combined to provide up to 8A of output current using a single inductor.

Individual track/soft-start, current limit, independent enable and power good for each channel simplify the

complex design of quad-output power converters. All regulators can be synchronized to a common external clock input or internal oscillator that can be programmed with a single resistor for switching frequency from 350kHz to 3MHz, allowing for optimal system design per specific applications.

The table below summarizes the performance of the demo board at room temperature. The circuit can be easily modified for different applications.

The LT8685S data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit EVAL-LT8685S-AZ.

[Design files for this circuit board are available.](#)

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PERFORMANCE SUMMARY Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage		5.6	12	42	V
Output Voltage V _{OUT1}	V _{IN} = 12V, I _{OUT1} = 2.5A	4.80	5	5.20	V
Output Voltage V _{OUT2}	V _{IN} = 12V, I _{OUT2} = 2.5A	3.17	3.3	3.43	V
Output Voltage V _{OUT3}	I _{OUT3} = 4A	1.73	1.8	1.87	V
Output Voltage V _{OUT4}	I _{OUT4} = 4A	1.15	1.2	1.25	V
Maximum Output Current I _{OUT1}		2.5			A
Maximum Output Current I _{OUT2}		2.5			A
Maximum Output Current I _{OUT3}		4			A
Maximum Output Current I _{OUT4}		4			A
Switching Frequency		1.8	2	2.2	MHz

QUICK START PROCEDURE

Demo circuit EVAL-LT8685S-AZ is easy to set up to evaluate the performance of the LT8685S. Refer to Figure 1 for proper equipment setup and follow the procedure below.

1. With power off, connect the input power supply to the board through VEMI+ and VEMI– terminals on the top layer. Connect a DMM to VIN (E3), GND (E4) to measure the input voltage after the EMI filter, or to VEMI+ and VEMI– to measure the board input voltage. Do not power the board through E3 and E4.
2. Connect the loads to the terminals VOUT1 and GND, VOUT2 and GND, VOUT3 and GND, VOUT4 and GND on the board, respectively.
3. The default positions of the Headers are given in Table 1.

Table 1. Default Positions of the Headers

NAME		POSITION
EN1	JP1	ON
EN2	JP2	ON
EN3	JP4	ON
EN4	JP5	ON
BIAS	JP3	VOUT1
SYNC/MOD	JP7	BURST

4. Turn on the power at the input (VEMI+, VEMI–). Increase the input voltage to 12V. Make sure that the input voltage is always within spec. Refer to data sheet on the burst mode operation in light load and high V_{IN} condition.
5. Check for the proper output voltages. The output should be regulated at 5V ($\pm 4\%$), 3.3V ($\pm 4\%$), 1.8V ($\pm 4\%$), 1.2V ($\pm 4\%$). Do not overload unless proper thermal cooling method such as air flow or heat sink is applied.

6. Once the proper output voltage is established, adjust the input voltage and load currents within the operating range and observe the output voltage regulation, transient, ripple voltage, efficiency and other parameters. When measuring the input or output voltage ripples, care must be taken to avoid a long ground lead on the oscilloscope probe.
7. Measure the input or output voltage ripple by touching the probe tip directly across the VIN, GND or VOUT capacitor terminals. Refer to the LT8685S data sheet for high input voltage and/or high ambient temperature operations.
8. When combining channels, refer to the data sheet for the proper setup. The lowest numbered channel assumes control of the combined regulators. For example, with channel 1 and channel 2 combined, channel 1 assumes control (controller) and channel 2 becomes dependent (subordinate). A feedback network is connected only to the master channel to program the combined regulator output voltage. The slave channel's feedback pin must be connected to INTVCC (R27 for channel 4, R28 for channel 2). Combined channels must have a low impedance connection between their respective VIN pins, SW pins, and BST pins. Only a single inductor is connected to the combined SW pins. Though combined channels' BST pins are connected together, each channel should retain their individual boost capacitors.

QUICK START PROCEDURE

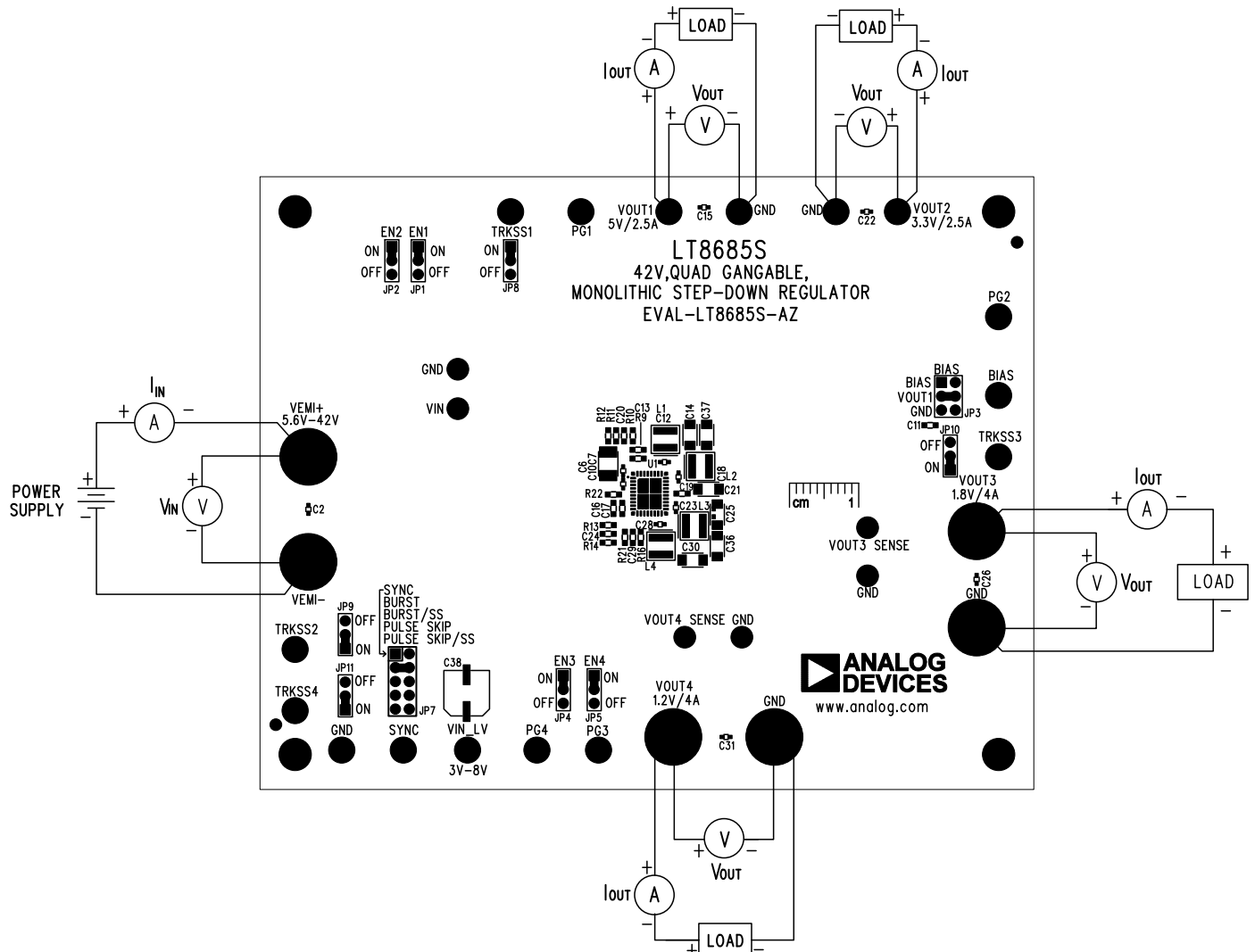


Figure 1. Proper Measurement Equipment Setup

DEMO MANUAL

EVAL-LT8685S-AZ

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	4	C1, C2, C7, C10	CAP., 0.1 μ F, X7R, 50V, 10%, 0402	AVX, 04025C104KAT2A
2	3	C3, C4, C6	CAP., 10 μ F, X7R, 50V, 10%, 1210, NO SUBS. ALLOWED	MURATA, GRM32ER71H106KA12L
3	1	C5	CAP., 68 μ F, ALUM ELECT., 50V, 20%, SMD, 8mm \times 10mm, AEC-Q200	NICHICON, UWD1H680MCL1GS
4	1	C11	CAP., 1 μ F, X7R, 10V, 10%, 0603	AVX, 0603ZC105KAT2A
5	5	C12, C15, C18, C23, C28	CAP., 0.1 μ F, X7R, 16V, 10%, 0402	AVX, 0402YC104KAT2A
6	1	C13	CAP., 2.2pF, C0G/NP0, 50V, \pm 0.25pF, 0603	AVX, 06035A2R2CAT2A
7	1	C14	CAP., 47 μ F, X5R, 16V, 20%, 1206	AVX, 1206YD476MAT2A
8	3	C16, C17, C19	CAP., 4.7 μ F, X5R, 10V, 10%, 0603	AVX, 0603ZD475KAT2A
9	1	C20	CAP., 4.7pF, C0G/NP0, 50V, \pm 0.25pF, 0603	AVX, 06035A4R7CAT2A
10	1	C21	CAP., 47 μ F, X5R, 10V, 10%, 1206	MURATA, GRM31CR61A476KE15L
11	1	C22	CAP., 0.1 μ F, X7R, 10V, 10%, 0402	AVX, 0402ZC104KAT2A
12	1	C24	CAP., 3.9pF, C0G, 50V, 5%, 0603	AVX, 06035A3R9JAT2A
13	2	C25, C30	CAP., 100 μ F, X5R, 6.3V, 10%, 1206	MURATA, GRM31CR60J107KE39L
14	2	C26, C31	CAP., 0.1 μ F, X5R, 6.3V, 20%, 0402	AVX, 04026D104MAT2A
15	4	C27, C32-C34	CAP., 2200pF, X7R, 25V, 10%, 0603	AVX, 06033C222KAT2A
16	1	C29	CAP., 10pF, C0G, 50V, 5%, 0603	AVX, 06035A100JAT2A
17	1	FB1	IND., 100 Ω AT 100MHz, FERRITE BEAD, 25%, 8A, 6m Ω , 1812	WURTH ELEKTRONIK, 74279226101
18	1	L1	IND., 1.5 μ H, PWR, 20%, 10.2A, 10.5m Ω , SMD, AEC-Q200	COILCRAFT, XGL4030-152MEB
19	1	L2	IND., 1.2 μ H, PWR, 20%, 12.2A, 9.4m Ω , SMD, AEC-Q200, SHIELDED	COILCRAFT, XGL4030-122MEB
20	1	L3	IND., 0.40 μ H, PWR, 20%, 22.5A, 32.8m Ω , SMD, AEC-Q200	COILCRAFT, XGL4030-401MEB
21	1	L4	IND., 0.3 μ H, PWR, 20%, 21.2A, 3.4m Ω , SMD, AEC-Q200, SHIELDED	COILCRAFT, XGL4030-301MEC
22	1	L5	IND., 1 μ H, PWR, SHIELDED, 20%, 10.7A, 9.78m Ω , 4.3mm \times 4.3mm, XEL4030, AEC-Q200	COILCRAFT, XEL4030-102MEB

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
23	5	R1, R2, R5, R7, R9	RES., 1M, 1%, 1/10W, 0603	VISHAY, CRCW06031M00FKEA
24	2	R3, R4	RES., 402k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603402KFKEA
25	2	R6, R8	RES., 806k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603806KFKEA
26	1	R10	RES., 191k, 1%, 1/10W, 0603	VISHAY, CRCW0603191KFKEA
27	1	R11	RES., 1.07M, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06031M07FKEA
28	1	R12	RES., 340k, 1%, 1/10W, 0603	VISHAY, CRCW0603340KFKEA
29	1	R13	RES., 357k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603357KFKEA
30	1	R14	RES., 226k, 1%, 1/10W, 0603	VISHAY, CRCW0603226KFKEA
31	1	R15	RES., 26.1k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060326K1FKEA
32	1	R16	RES., 232k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF2323V
33	4	R17-R20	RES., 100k, 1%, 1/16W, 0402, AEC-Q200	VISHAY, CRCW0402100KFKEA
34	1	R21	RES., 324k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603324KFKEA
35	1	R22	RES., 22.6k, 1%, 1/10W, 0603	NIC, NRC06F2262TRF
36	1	R30	RES., 0.001 Ω , 5%, 1W, 0805, LONG SIDE TERM, METAL, SENSE, AEC-Q200	SUSUMU, KRL2012E-C-R001-J-T5
37	1	U1	IC, MONOLITHIC STEP-DOWN REGULATOR, LQFN-36, 5mm \times 6mm	ANALOG DEVICES, LT8685SRV#PBF

Additional Demo Board Circuit Components

1	0	C36	CAP., 100 μ F, X5R, 6.3V, 10%, 1206	MURATA, GRM31CR60J107KE39L
2	0	C37	CAP., 47 μ F, X5R, 16V, 20%, 1206	AVX, 1206YD476MAT2A
3	0	C38	CAP., 22 μ F, ALUM ELECT, 50V, 20%, 6.3mm \times 5.4mm, RADIAL, SMD, CE-BSS SERIES, AEC-Q200	SUN ELECTRONIC INDUSTRIES CORP, 50CE22BSS
4	0	R27-R29	RES., OPTION, 0603	
5	0	R31, R32	RES., 0.001 Ω , 5%, 1W, 0805, LONG SIDE TERM, METAL, SENSE, AEC-Q200	SUSUMU, KRL2012E-C-R001-J-T5
6	0	R33, R34	RES., OPTION, 0402	

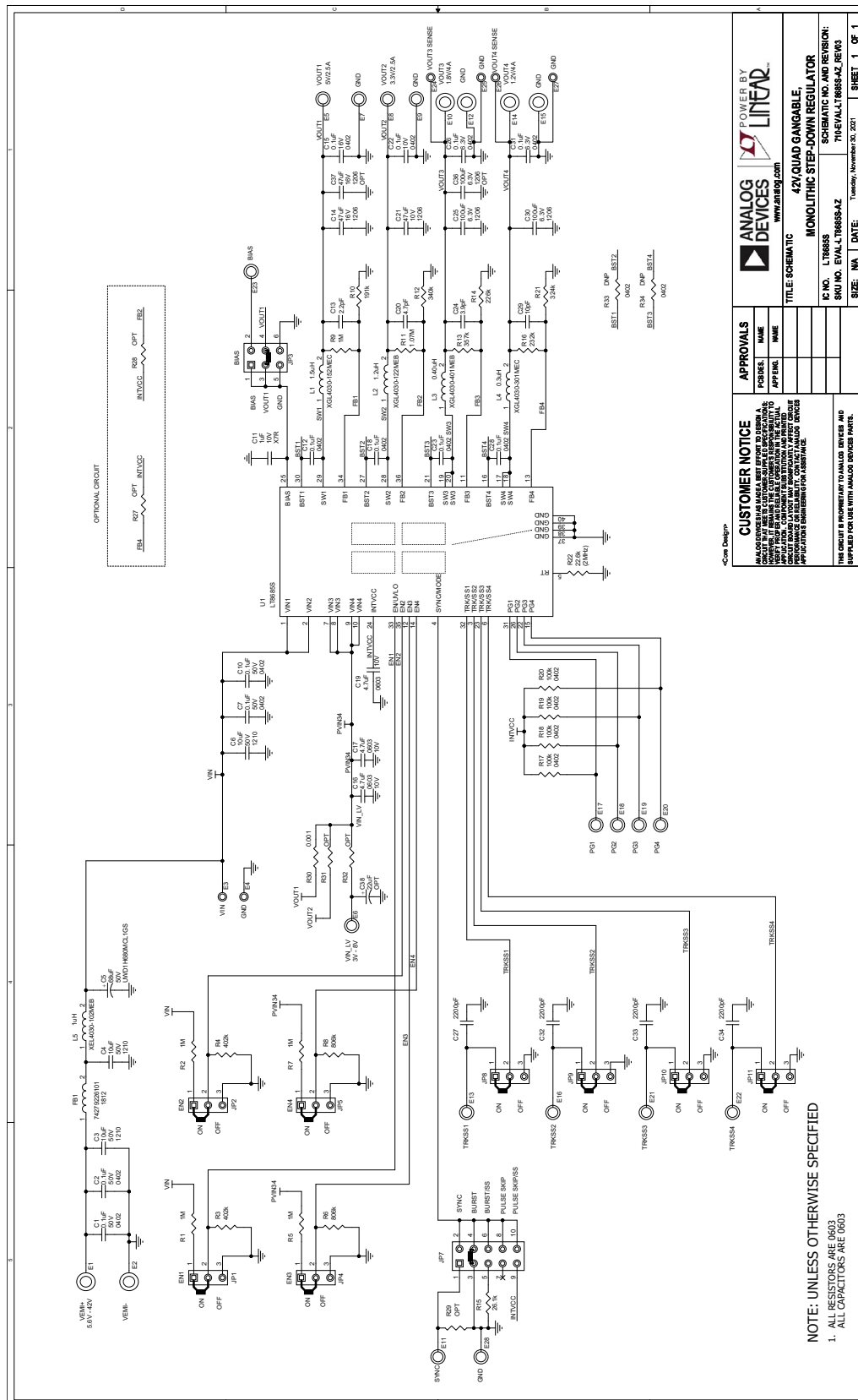
DEMO MANUAL

EVAL-LT8685S-AZ

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Hardware: For Demo Board Only				
1	6	E1, E2, E10, E12, E14, E15	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218"	KEYSTONE, 575-4
2	6	E3, E4, E24-E27	TEST POINT, TURRET, 0.064" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2308-2-00-80-00-00-07-0
3	16	E5-E9, E11, E13, E16-E23, E28	TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2501-2-00-80-00-00-07-0
4	8	JP1, JP2, JP4, JP5, JP8-JP11	CONN., HDR, MALE, 1 × 3, 2mm, VERT, ST, THT, NO SUBS. ALLOWED	WURTH ELEKTRONIK, 62000311121
5	1	JP3	CONN., HDR, MALE, 2 × 3, 2mm, VERT, ST, THT	WURTH ELEKTRONIK, 62000621121
6	1	JP7	CONN., HDR, MALE, 2 × 5, 2mm, VERT, ST, THT	WURTH ELEKTRONIK, 62001021121
7	4	MP1-MP4	STANDOFF, NYLON, SNAP-ON, 0.50"	KEYSTONE, 8833
8	1	PCB1	PCB, EVAL-LT8685S-AZ	ADI APPROVED SUPPLIER, 600-EVAL-LT8685S-AZ
9	10	XJP1-XJP5, XJP7-XJP11	CONN., SHUNT, FEMALE, 2-POS, 2mm	WURTH ELEKTRONIK, 60800213421

SCHEMATIC DIAGRAM



DEMO MANUAL

EVAL-LT8685S-AZ



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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