Signal Chain Power Series LT8609S Synchronous Step-Down Regulator

DESCRIPTION

Demonstration circuit SCP-LT8609S-BEVALZ is a 42V, 2A/3A peak micropower synchronous step-down regulator featuring the LT8609S. The demo board is configured for a 5V output from a 5.5V to 42V input.

Like all boards in the Signal Chain Power series, this board is designed to be easily plugged into other SCP boards to form a complete signal chain power system, enabling fast evaluation of low power signal chains. To evaluate this board, some universal SCP hardware is required, namely:

SCP-INPUT-EVALZ
SCP-OUTPUT-EVALZ
SCP-FILTER-EVALZ
SCP-THRUBRD-EVALZ
SCP-1X2BKOUT-EVALZ
SCP-1X5BKOUT-EVALZ
SCP-5X1-EVALZ

To properly evaluate SCP series demo boards, you will need the SCP Configurator companion software. SCP Configurator can help you choose the right board and topology for your design.

Note that this Demo Manual does not cover details important to the operation and configuration regarding the LT8609S. Please refer to the LT8609S datasheet for a complete description of the part.

Design files for this circuit board are available.

Table 1. Performance Summary

SYMBOL	PARAMETER	NOTES	MIN	TYP	MAX	UNITS
$V_{IN(MAX)}$	Max Input Voltage				42	V
$V_{OUT(MAX)}$	Max Output Voltage				24	V
$I_{OUT(MAX)}$	Max Output Current				2	A

BOARD IMAGE

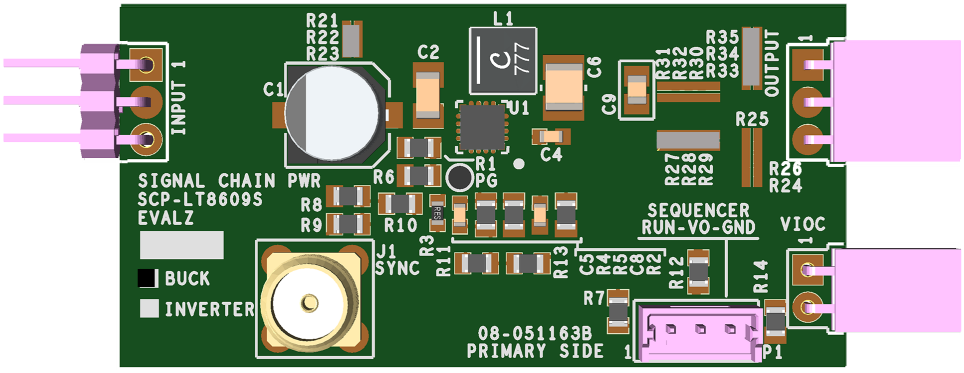


Figure 1. SCP-LT8609S-BEVALZ Evaluation Board

QUICK START PROCEDURE

Demonstration circuit SCP-LT8609S-BEVALZ is easy to set up to evaluate the performance of any SCP hardware configuration.

1. The SCP-LT8609S-BEVALZ ships with a default output voltage of 5V. To change the output voltage, see "Configuration Settings" section, and modify the board accordingly. Be sure to check for open connections or solder shorts after making any modifications.
2. Connect the SCP-INPUT-EVALZ and SCP-OUTPUT-EVALZ boards to the SCP-LT8609S-BEVALZ (refer to Figure 2) and connect the input board to a voltage source, V_{SOURCE}. Connect the output board to a voltmeter or dynamic load. Slowly raise the input voltage until the SCP-LT8609S-BEVALZ powers up into regulation and sweep V_{SOURCE} through the desired range of operation.

   NOTE: Make sure that the input voltage is always within spec. If using a dynamic load to measure output voltage, make sure the load is initially set to zero.
3. Check for proper output voltage. The output should be regulated at the programmed value (±5%).
4. Once the proper output voltage is established, power off V_{SOURCE} and similarly test other boards in the SCP system until all elements have been individually verified prior to assembling into the final circuit configuration.

   NOTE: When measuring the input or output voltage ripple, use the optional SMA connector locations available on the input, output, 1 × 5, 1 × 2, and 5 × 1 breakout boards. Avoid using the test point connections with long scope leads.

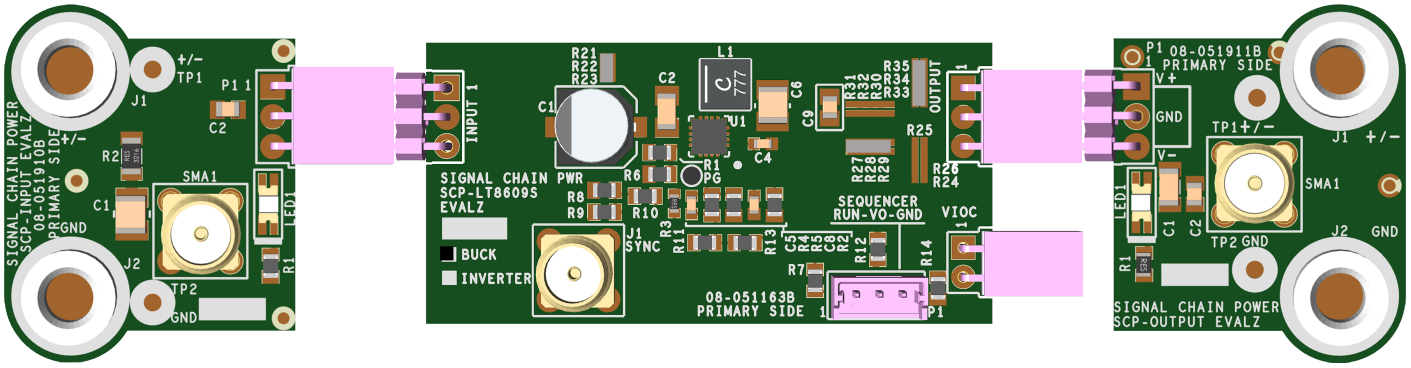


Figure 2. Proper Measurement Equipment Setup (Use SMA connectors for Measuring Input or Output Ripple)

CONFIGURATION SETTINGS

Demonstration circuit SCP-LT8609S-BEVALZ is a 42V, 2A/3A peak micropower synchronous step-down regulator featuring the LT8609S. The demo board is designed for 5V output from a 5.5V to 42V input.

The output of the SCP-LT8609S-BEVALZ is resistor-programmable from 0.8V to 24V. The board can be also configured to drive VIOC-capable LDO regulators.

OUTPUT VOLTAGE PROGRAMMING

$$V_{OUT} = 0.774V_{FB}\left(1+\frac{R_4}{R_5}\right)$$

Table 2. Resistor Selection Guide for Common Output Voltages

V_{OUT} (V)	R4 (Ω)	R5 (Ω)
0.8	3.57k	107k
0.9	17.4k	107k
1.0	102k	348k
1.1	29.4k	69.8k
1.2	73.2k	133k
1.25	115k	187k
1.5	187k	200k
1.8	215k	162k
2.0	187k	118k
2.5	255k	115k
3.0	348k	121k
3.3	332k	102k
3.5	357k	102k
4.0	442k	102k
4.5	511k	107k
5.0	549k	100k
5.5	698k	115k
6.0	931k	137k
6.5	787k	107k
7.0	909k	113k
7.5	887k	102k
8.0	953k	102k
8.5	1.00M	100k
9.0	1.00M	93.1k
9.5	1.00M	88.7k
10.0	1.00M	84.5k
12.0	1.00M	68.1k
16.0	1.00M	51.1k
20.0	1.00M	20.2k
24.0	1.00M	33.2k

EN/UVLO PIN CONFIGURATION

The EN/UVLO pin is tied to the optional SCP Run/Sequence header P1. To create a harness for this function, use Molex part # 0510650300 with crimp pin # 50212-8000.

To use an active run signal, use a 1.00M for either pull-up or pull-down resistors R1 and R6, short R7 with 0Ω, and use the drive signal from connector P1.

If precision UVLO operation is desired, program enable divider R5 and R6 such that:

R6 is 10k to 100k, nominal

$$R5 = R6\left(\frac{V_{IN}-1.05V_{TH}}{1.05V_{TH}}\right)$$

The LT8330 has an accurate 1.60V threshold which places the part into under voltage lockout. The hysteresis threshold on the rising edge is typically 80mV and scales by the factor:

$$V_{HYST} = 50mV\frac{R5+R6}{R6}$$

VOLTAGE INPUT-TO-OUTPUT CONTROL (VIOC) IMPLEMENTATION

To implement the VIOC function for this regulator, set R13 and R14 to 0Ω, respectively. Refer to the "Configuration Settings" section in the Demo Manual for the LDO board and use the following configuration for this board.

Table 3. VIOC Cross-Reference Designators

VIOC SETTING REFERENCES	R_{BOT}	R_{TOP}	R_{MAX}
V_{OUT} Reference Designators	R4	R5	R13

$$V_{LDOIN} - V_{LDOOUT} = V_{VIOC} = 0.774V_{FB}\left(\frac{R_{BOT}+R_{TOP}}{R_{BOT}}\right)$$

$$V_{(MAX)LDOIN} = 0.774V_{FB}\left(\frac{R_{BOT}+R_{TOP}+R_{MAX}}{R_{BOT}}\right)+I_{SINK}R_{MAX}$$

I_{SINK} is the current through R_{MAX}, typically 15µA, so R_{BOT} should be sized such that the divider current runs a minimum of 100µA to minimize the I_{SINK} error term.

SYNC PIN CONFIGURATION

The table below shows the various configurations possible with the SYNC pin.

If clock synchronization option is desired, the SCP-LT8609S-BEVALZ can be driven from an external source via the optional SMA connector.

Table 4. SYNC Pin Configuration

MODE	R8	R9	R10
Burst Mode (default)	0Ω	Open	Open
External Clock Synchronized	Open	0Ω	Open
Pulse Skip/Spread Spectrum	Open	Open	0Ω
Pulse Skip	Open	Open	Open

FREQUENCY (RT) PIN CONFIGURATION

The LT8609S allows the user to program the switching frequency (f_{SW}) by a single resistor (R2). The default operating frequency is 2.0MHz. Note that changing the switching frequency may affect other parameters and likely will necessitate a change in inductor and compensation component values. Contact the SCP team for support if shifting the switching frequency greater than ±10%.

Table 5. Switching Frequency f_{SW} vs Resistor R_2 Value

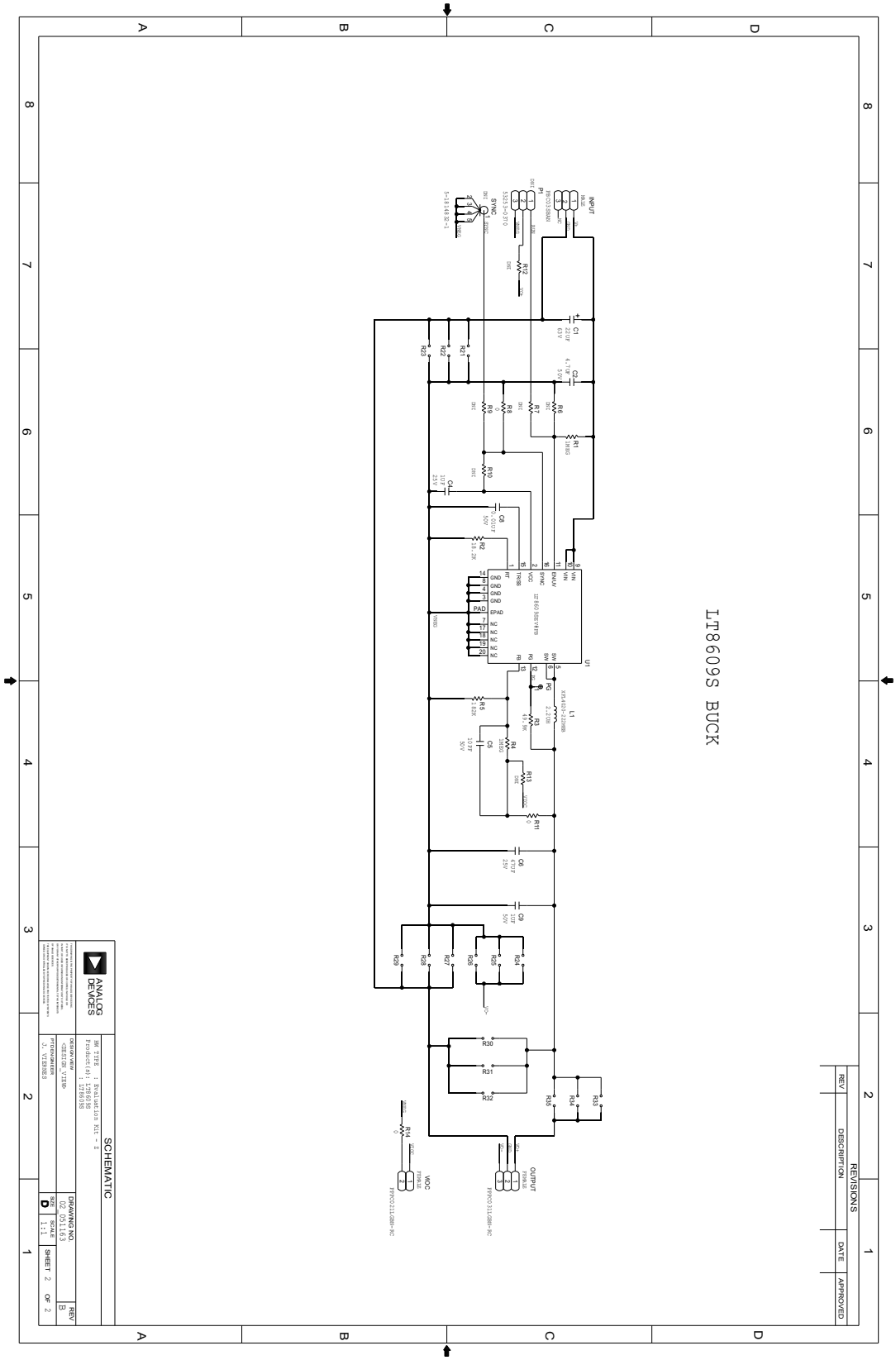
f_{SW}	R2 (Ω)	f_{SW}	R2 (Ω)
200kHz	221K	1.30MHz	30.1K
300kHz	143K	1.40MHz	27.4K
400kHz	110K	1.50MHz	25.5K
500kHz	86.6K	1.60MHz	23.7K
600kHz	71.5K	1.70MHz	22.1K
700kHz	60.4K	1.80MHz	20.5K
800kHz	52.3K	1.90MHz	19.1K
900kHz	46.4K	2.00MHz	18.2K
1.00MHz	40.2K	2.10MHz	16.9K
1.10MHz	36.5K	2.20MHz	16.2K
1.20MHz	33.2K		

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
1	1	PCB	PCB	ANALOG DEVICES 08_051163b
2	1	C1	CAP ALUM 22UF 63V 20% 6X6MM	UNITED CHEMI CON EMVE630ADA220MF80G
3	1	C2	CAP CER 4.7UF 50V 10% X7R 1206	SAMSUNG CL31B475KBHNNNE
4	1	C4	CAP CER X7R, AUTOMOTIVE GRADE	TDK CGA3E1X7R1E105K080AD
5	1	C5	CAP CER 10PF 50V 5% C0G 0603	SAMSUNG CL10C100JB8NNNC
6	1	C6	CAP CER 47UF 25V 20% X5R 1210	TAIYO YUDEN TMK325ABJ476MM-P
7	1	C8	CAP CER X7R	YAGEO CC0603KRX7R9BB103
8	1	C9	CAP CER X7R	SAMSUNG CL21B105KBFNNNE
9	1	INPUT	CONN-PCB MALE HEADER 3POS 2.54MM PITCH R/A GOLD	SULLINS PBC03SBAN
10	1	L1	IND SHIELDED POWER	COILCRAFT XFL4020-222MEB
11	1	OUTPUT	CONN FEMALE 3POS 2.54MM PITCH R/A GOLD	SULLINS PPPC031LGBN-RC
12	1	P1	CONN-PCB 3POS HEADER WIRE TO BRD WAFER ASSY STRAIGHT 2MM PITCH (Note 1)	MOLEX 53253-0370
13	1	R1	RES THICK FILM CHIP, GENERAL PURPOSE	YAGEO RC0805JR-071ML
14	1	R2	RES PRECISION THICK FILM CHIP	PANASONIC ERJ-6ENF1822V
15	1	R3	RES PRECISION THICK FILM CHIP	PANASONIC ERJ-3EKF4992V
16	1	R4	RES PRECISION THICK FILM CHIP	PANASONIC ERJ-6ENF1004V
17	1	R5	RES THICK FILM CHIP	VISHAY CRCW0805182KFKEA
18	6	R6, R7, R9, R10, R12, R13	RES THICK FILM 0805 (Note 1)	N/A
19	3	R8, R11, R14	RES STANDARD THICK FILM CHIP JUMPER, FOR AUTOMOTIVE	VISHAY CRCW08050000Z0EA
20	1	SYNC	CONN-PCB STRAIGHT SMA PCB DIE CAST (Note 1)	TE CONNECTIVITY LTD 5-1814832-1
21	1	U1	IC-LIN 42V, 2A/3A PEAK SYNCHRONOUS STEP-DOWN REGULATOR WITH 2.5UA QUIESCENT CURRENT	LINEAR TECHNOLOGY LT8609SEV#PBF
22	1	VIOC	CONN FEMALE 2POS 2.54MM PITCH R/A GOLD	SULLINS PPPC021LGBN-RC

Note 1. These items are not stuffed (DNI).

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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