Signal Chain Power
LT3094 Negative, Ultrahigh PSRR, LDO Linear Regulator

DESCRIPTION

Demonstration circuit SCP-LT3094-EVALZ features the LT3094, an ultralow noise, ultrahigh power supply rejection ratio (PSRR) negative low dropout (LDO) regulator. The board operates over an input range of –3.8V to –20V, and can deliver up to 500mA output current.

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-1X5BKOUT-EVALZ
SCP-THRUBRD-EVALZ
SCP-FILTER-EVALZ
SCP-1X2BKOUT-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 LT3094. Please refer to the LT3094 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				–20	V
$V_{OUT(MAX)}$	Max Output Voltage				–19.5	V
$I_{OUT(MAX)}$	Max Output Current				500	mA

BOARD IMAGE

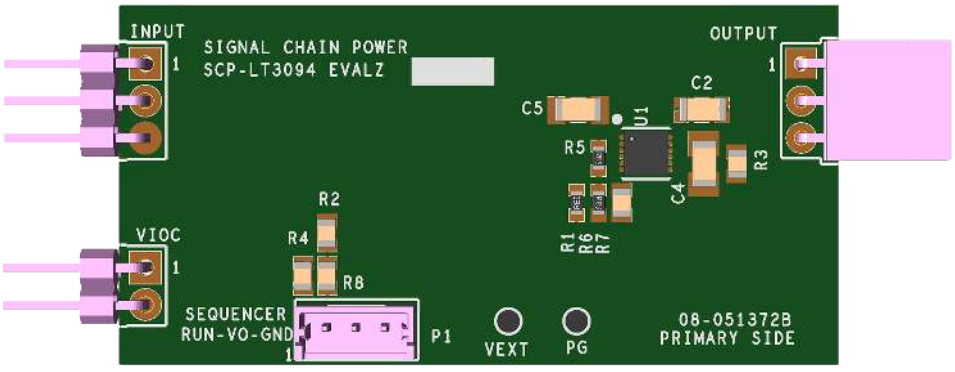


Figure 1. SCP-LT3094-EVALZ Board

QUICK START PROCEDURE

Demonstration circuit SCP-LT3094-EVALZ is easy to set up to evaluate the performance of any SCP hardware configuration.

1. The SCP-LT3094-EVALZ ships with a default output voltage of –3.3V. 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-LT3094-EVALZ (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-LT3094-EVALZ 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.

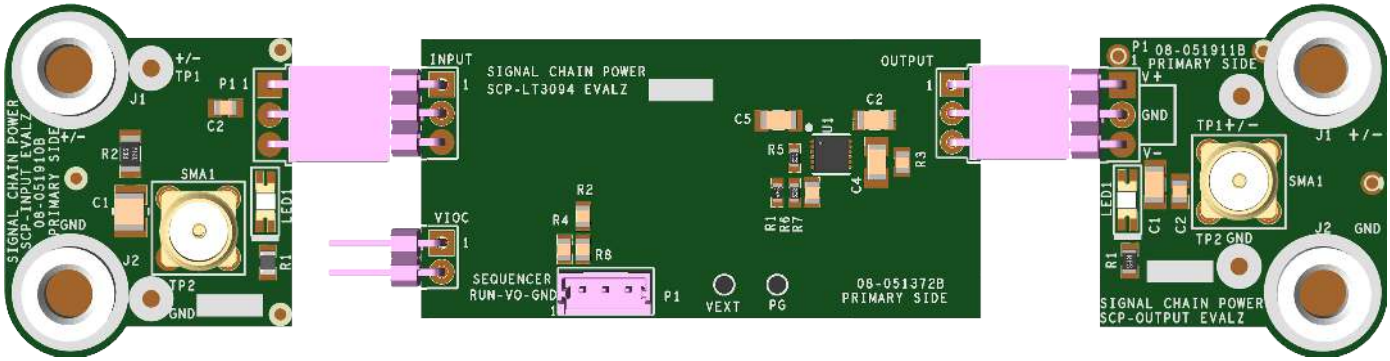


Figure 2. Proper Measurement Equipment Setup (Use SMA connectors for Measuring Input or Output Ripple)

CONFIGURATION SETTINGS

Demonstration circuit SCP-LT3094-EVALZ features the LT3094, an ultralow noise, ultrahigh power supply rejection ratio (PSRR) negative low dropout (LDO) regulator. The board operates over an input range of –3.8V to –20V, and can deliver up to 500mA output current.

The output of the SCP-LT3094-EVALZ is resistor-programmable from –0.8V to –19.5V.

OUTPUT VOLTAGE PROGRAMMING

$$-V_{OUT} = 100\mu A \bullet R3$$

Table 2. Resistor Selection Guide for Common Output Voltages

$\lvert V_{OUT}\rvert$ (V)	R3 (Ω)	V_{OUT} (V)	R3 (Ω)
0.8	8.06k	9.5	95.3k
0.9	9.09k	10.0	100k
1.0	10.0k	10.5	105k
1.2	12.1k	11.0	110k
1.5	15.0k	11.5	115k
1.8	18.2k	12.0	121k
2.0	20.0k	12.5	124k
2.5	24.9k	13.0	130k
3.0	30.1k	13.5	133k
3.5	34.8k	14.0	140k
4.0	40.2k	14.5	143k
4.5	45.3k	15.0	150k
5.0	49.9k	15.5	154k
5.5	54.9k	16.0	158k
6.0	60.4k	16.5	165k
6.5	64.9k	17.0	169k
7.0	69.8k	17.5	174k
7.5	75.0k	18.0	182k
8.0	80.6k	18.5	187k
8.5	84.5k	19.0	19.1k
9.0	90.9k	19.5	196k

EN/UV PIN CONFIGURATION

The EN/UV 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 100k resistor for either pull-up or pull-down resistors R2 and R4, short R8 with 0Ω, and use the drive signal from connector P1.

If precision undervoltage lockout (UVLO) operation is desired, program enable divider R2 and R4 such that:

$$R4 = 10k – 100k, \text{ nominal}$$

$$R2 = R4 \bullet \left(\frac{V_{IN} - 1.26V_{TH}}{1.26V_{TH}} \right)$$

The hysteresis threshold on the falling edge is typically 200mV above GND, 215mV below GND, and scales by the factor:

$$V_{HYST} = 130(mV)\frac{R4 + R2}{R2}$$

ILIM PIN CONFIGURATION

Resistor R7 programs a current limit according to the scale factor:

$$I_{LIM} = \frac{150mA(k\Omega)}{R7(k\Omega)}$$

Table 3. ILIM Pin Configuration

I_{LIMIT} (mA)	R7 (Ω)	I_{LIMIT} (mA)	R7 (Ω)
10	15.0k	90	1.65k
20	7.50k	100	1.50k
25	6.04k	150	1.00k
30	4.99k	200	750
40	3.74k	250	604
50	3.01k	300	499
60	2.49k	350	432
70	2.15k	400	374
75	2.00k	450	453
80	1.87k	500	300

PGFB PIN CONFIGURATION

To achieve a very low 1/f corner, C4 may need to be sized as high as 22µF, which dramatically increases the startup time. To counter this, the set pin current is increased from 100µA to 2mA whenever PGFB voltage is less than 300mV.

If fast startup is not desired, set R5 to 0Ω.

If fast startup is desired, program enable divider R5 and R6 such that PGFB is guaranteed to be above 300mV when the set pin is at its desired voltage. A good rule of thumb is to choose a transition voltage from 2mA to 100µA of set pin current roughly 10% lower than the desired output voltage to account for resistor and reference tolerance variation.

Use the following table to program the PGFB if fast startup is desired, setting R6 to 10kΩ for the closest 1% resistor value.

Table 4. PGFB Configuration

V_{OUT} (V)	R5 (Ω)	V_{OUT} (V)	R5 (Ω)
0.8	14.0k	9.5	274k
0.9	16.9k	10.0	287k
1.0	20.0k	10.5	301k
1.2	26.1k	11.0	316k
1.5	34.8k	11.5	332k
1.8	44.2k	12.0	348k
2.0	53.6k	12.5	365k
2.5	64.9k	13.0	383k
3.0	80.6k	13.5	392k
3.5	107k	14.0	412k
4.0	110k	14.5	422k
4.5	124k	15.0	442k
5.0	140k	15.5	453k
5.5	154k	16.0	475k
6.0	169k	16.5	487k
6.5	187k	17.0	499k
7.0	200k	17.5	511k
7.5	215k	18.0	536k
8.0	232k	18.5	549k
8.5	243k	19.0	562k
9.0	261k	19.5	576k

VOLTAGE INPUT-TO-OUTPUT CONTROL (VIOC) CONFIGURATION

VIOC functionality allows the LT3094 to directly modulate a preceding switching regulator feedback to maintain a constant overhead voltage. For the LT3094, a 1.0V drop provides a good balance between power loss and PSRR figure of merit.

The VIOC pin is tied directly to pin 1 of the VIOC header, and when using a compatible switching regulator, the VIOC line must be connected by populating the series resistor to drive the top of the feedback network. Refer to the corresponding appendix page for details on calculation.

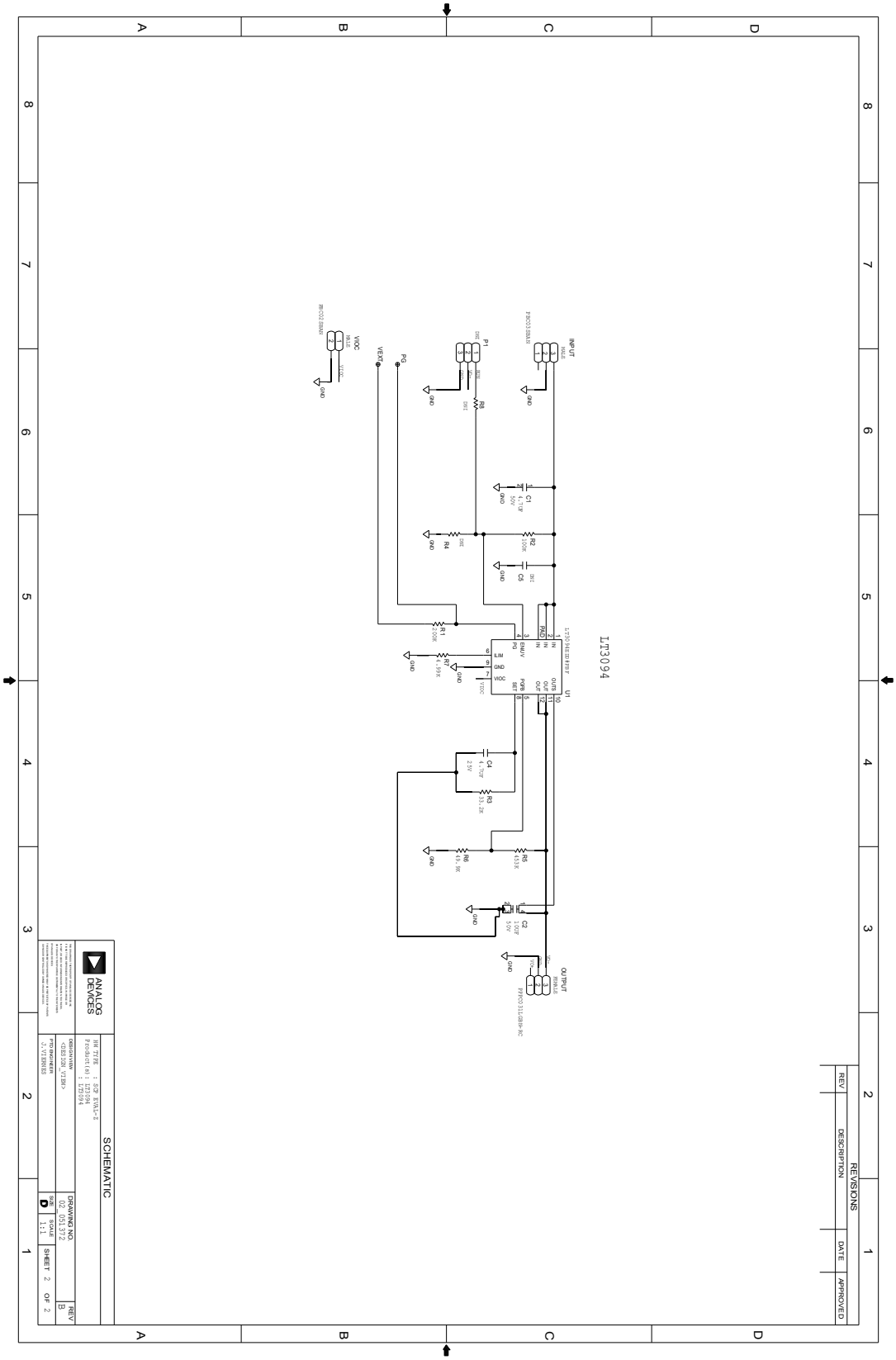
IMPORTANT: The LTC3094 cannot be used to drive buck regulators if configured as inverting buck. Plugging the SCP-LT3094-EVALZ into an inverting buck board will short the regulator.

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
1	1	PCB	PCB	ANALOG DEVICES SUPPLIED 08_051372b
2	1	C1	CAP CER 4.7UF 50V 10% X7R 1206	SAMSUNG CL31B475KBHNNNE
3	1	C2	CAP CER 10UF 50V X5R 1206	SAMSUNG CL31A106MBHNNNE
4	1	C4	CAP CER X7R	KEMET C1206C475K3RACTU
5	1	C5	CAP MLCC 1206 (Note 1)	N/A
6	1	INPUT	CONN-PCB MALE HEADER 3POS 2.54MM PITCH R/A GOLD	SULLINS PBC03SBAN
7	1	OUTPUT	CONN FEMALE 3POS 2.54MM PITCH R/A GOLD	SULLINS PPPC031LGBN-RC
8	1	P1	CONN-PCB 3POS HEADER WIRE TO BRD WAFER ASSY STRAIGHT 2MM PITCH (Note 1)	MOLEX 53253-0370
9	1	R1	RES PRECISION THICK FILM CHIP	PANASONIC ERJ-3EKF2003V
10	1	R2	RES PRECISION THICK FILM CHIP	PANASONIC ERJ-6ENF1003V
11	1	R3	RES PRECISION THICK FILM CHIP	PANASONIC ERJ-6ENF3322V
12	2	R4, R8	RES THICK FILM 0805 (Note 1)	N/A
13	1	R5	RES STANDARD THICK FILM CHIP, FOR AUTOMOTIVE	VISHAY CRCW0603453KFKEA
14	1	R6	RES PRECISION THICK FILM CHIP	PANASONIC ERJ-3EKF4992V
15	1	R7	RES PRECISION THICK FILM CHIP	PANASONIC ERJ-6ENF4991V
16	1	U1	IC-LIN -20V, 0.5A ULTRALOW NOISE, ULTRA HIGH PSSR NEGATIVE LINEAR REGULATOR	LINEAR TECHNOLOGY LT3094EDD#PBF
17	1	VIOC	CONN-PCB MALE HEADER 2POS 2.54MM PITCH R/A GOLD	SULLINS PBC02SBAN

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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