
RT5717 Ultra-Low IQ 60nA Buck Converter Evaluation Board

General Description

The RT5717 is a high efficiency synchronous buck converter with typical 60nA ultra-low quiescent current. It provides high efficiency at light loads down to 1 μ A. Its input voltage range is from 1.8V to 5.5V. The RT5717 provides 16 selectable output voltage levels by connecting a resistor between the RSEL pin and GND while delivering the output current up to 0.75A/1.2A/1.5A. This document explains the function and use of the RT5717P series evaluation board (EVB) and provides information to relate the setting of the evaluation board.

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Performance Specification Summary

[Table 1](#) shows the summary of the RT5717P series Evaluation Board performance specification. The ambient temperature is 25°C.

Table 1. RT5717P Series Evaluation Board Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Input Voltage		1.8	--	5.5	V
Output Voltage		0.5		4	V
Output Current	OCP Select 3	--	--	1.5	A
Operation Frequency		--	1.5	--	MHz
Quiescent Current into VIN (Switching)	VOUT = 1.8V, EN = VIN = 3.6V, RSEL = GND	--	60		nA
Shutdown Current	EN = GND	--	20		nA

Power-Up Procedure

Suggestion Required Equipment

- RT5717P series Evaluation Board
- DC power supply capable of at least 5.5V and 3A
- Electronic load capable of 3A
- Function Generator
- Oscilloscope

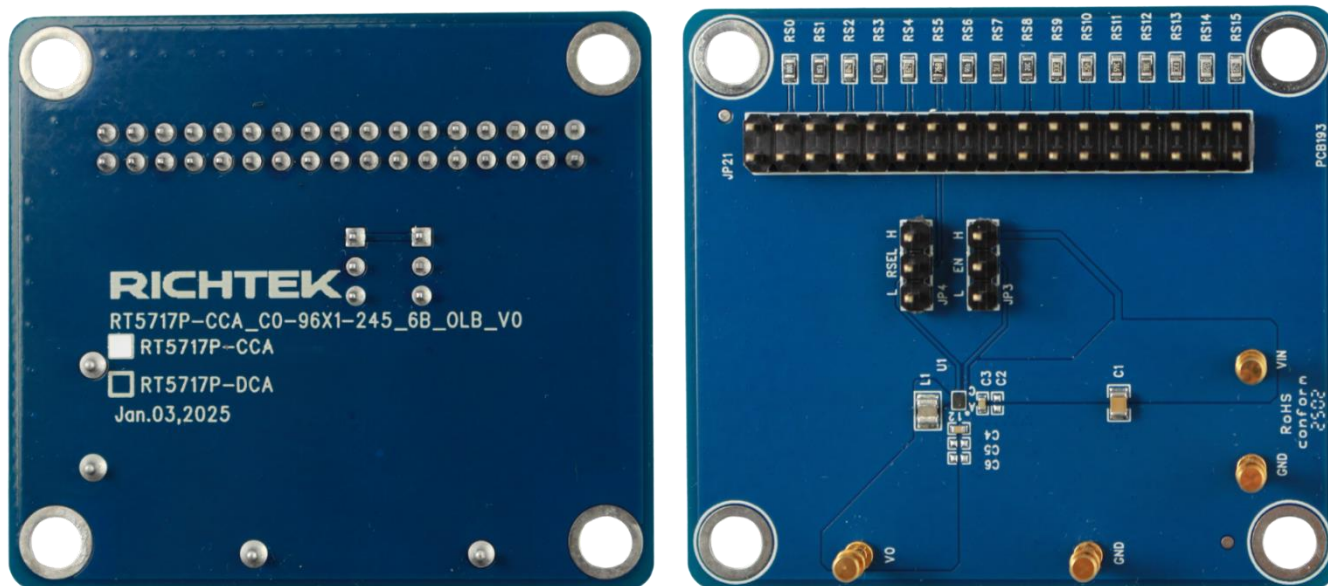
Quick Start Procedures

The Evaluation Board is fully assembled and tested. Follow the steps below to verify board operation. Do not turn on supplies until all connections are made. When measuring the 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 and ground ring directly across the last output capacitor.

Ensure proper measurement equipment setup, then follow the procedure below:

1. Connect JP21 so that the resistor is connected between the RSEL pin and GND to set the output voltage value.
2. With power off, connect the input power supply to the VIN and GND pins.
3. With power off, connect the electronic load between the VOUT and the nearest GND pins.
4. Turn on the power supply at the input. Make sure that the input voltage does not exceed 5.5V on the Evaluation Board.
5. Enabled the RT5717 by the EN pin. When the EN pin is higher than the logic-high threshold, the IC goes to normal operation; When the EN pin transitions from high to low, the device enters shutdown mode. In this state, the converter stops switching, the internal control circuitry is turned off, and the discharge function is triggered.
6. Use a voltmeter to check that the output voltage is correct.
7. Once the correct output voltage is established, adjust the load within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency, and other performance.

Detailed Description of Hardware



Carefully inspect all the components used in the EVB according to the following Bill of Materials table, and then make sure all the components are undamaged and correctly installed. If there is any missing or damaged component, which may occur during transportation, please contact our distributors or e-mail us at evb_service@richtek.com.

Test Points

The EVB is provided with the test points and pin names listed in the table below.

Test Point/ Pin Name	Function
VIN	Input voltage. (Note VIN on EVB)
VOUT	Output voltage. (Note VOUT on EVB)
GND	Ground. (Note GND on EVB)
EN	Device Enable. (Note EN on EVB)
SW	Switching Signal. (Note SW on EVB)
RSEL	Output Voltage Select. (Note RSEL on EVB)

Output Voltage Selection

The RT5717 provides 16 selectable output voltages that can be set with a single external resistor connected between the RSEL pin and GND. The VOUT select circuit starts to detect the value of the resistor when the converter is enabled, and the control circuit is powered up.

Table 2. Output Voltage Setting

Type	Output-1	Output-2	Output-3	Output-4	Output-5	RSEL (Ω)		
Level	0.5V to 4V	0.8V to 1.55V	1.8V to 3.3V	1.8V to 3.6V	0.54V to 3.7V	Min	Typ	Max
0	0.50	0.80	1.8	1.8	--	0	GND	0.01k
1	0.58	0.85	1.9	2.0	0.54	0.87k	0.909k	0.95k
2	0.60	0.90	2.0	2.2	0.56	1.67k	1.74k	1.81k
3	0.70	0.95	2.1	2.4	0.65	2.76k	2.87k	2.98k
4	0.75	1.00	2.2	2.5	0.70	4.15k	4.32k	4.49k
5	0.80	1.05	2.3	2.6	0.74	5.80k	6.04k	6.28k
6	1.10	1.10	2.4	2.7	1.00	8.11k	8.45k	8.79k
7	1.20	1.15	2.5	2.8	1.10	11.04k	11.5k	11.96k
8	1.50	1.20	2.6	2.9	1.40	15.17k	15.8k	16.43k
9	1.60	1.25	2.7	3.0	1.50	20.64k	21.5k	22.36k
10	1.80	1.30	2.8	3.1	1.65	27.55k	28.7k	29.85k
11	1.90	1.35	2.9	3.2	1.75	36.77k	38.3k	39.83k
12	2.10	1.40	3.0	3.3	1.95	50.21k	52.3k	54.39k
13	3.00	1.45	3.1	3.4	2.80	68.64k	71.5k	74.36k
14	3.30	1.50	3.2	3.5	3.05	97.92k	102k	106.08k
15	4.00	1.55	3.3	3.6	3.70	256.32k	267k	277.68k

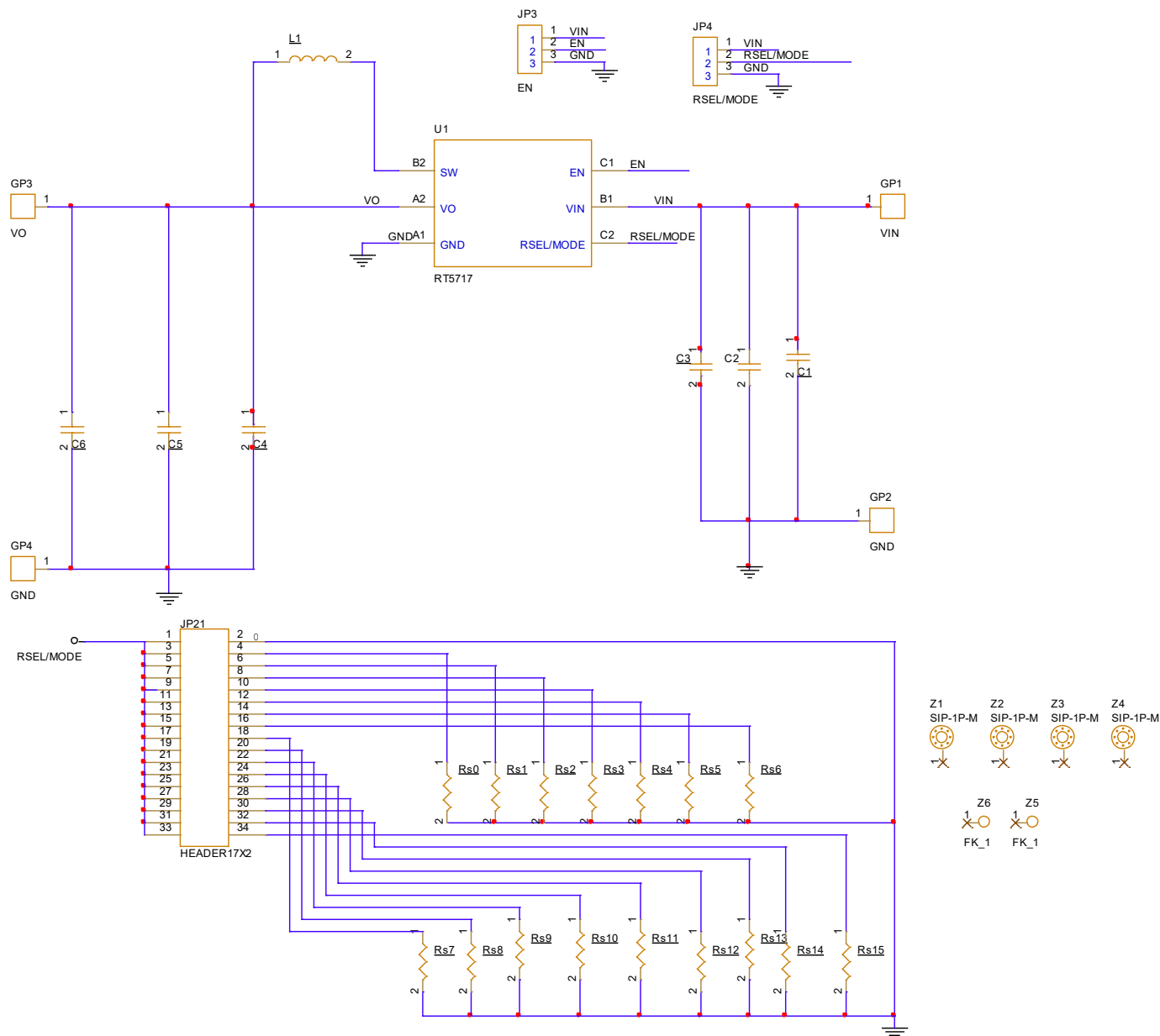
Note 1: E96 resistor series, 1% accuracy, temperature coefficient better or equal than ± 200 ppm/ $^{\circ}\text{C}$.

Bill of Materials

Reference	Count	Part Number	Value	Description	Package	Manufacturer
U1	1	RT5717P series	RT5717P	Buck Converter	XWL-CSP-6B 0.96X1.245(m m ²)	RICHTEK
C1	1	GRM21BR61A476ME15L	47μF	47μF/6.3V/X5R	0805(inch)	Murata
C3	1	GRM155R60J475ME47D	4.7μF	4.7μF/6.3V/X5R	0402(inch)	Murata
C4	1	GRM155R60J106ME15	10μF	10μF/6.3V/X5R	0402(inch)	Murata
L1	1	DFE201610E-1R0M	1uH	1uH	0805(inch)	Murata
R3	1	Resistor E96 series	See Table 2	1%, TC ±200ppm	0201(inch)	

Typical Applications

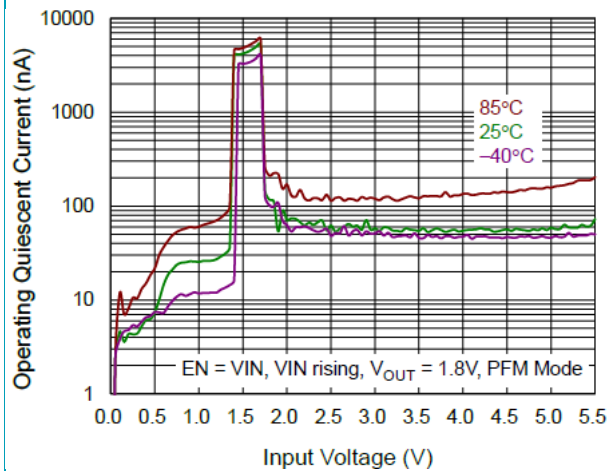
EVB Schematic Diagram



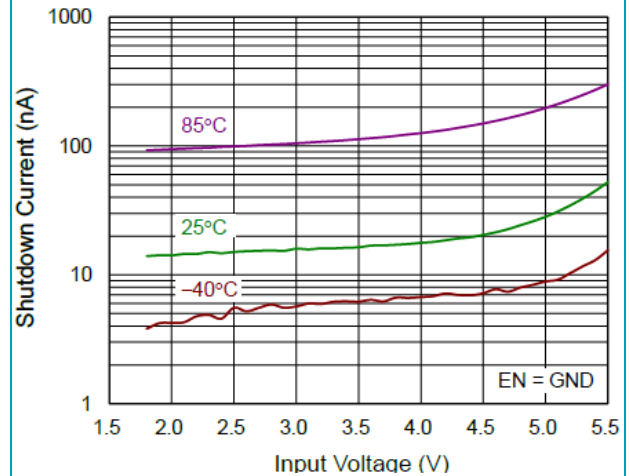
1. The capacitance values of the input and output capacitors will influence the input and output voltage ripple.
2. MLCC capacitors have degrading capacitance at DC bias voltage, and especially smaller size MLCC capacitors will have much lower capacitance.

Measure Result

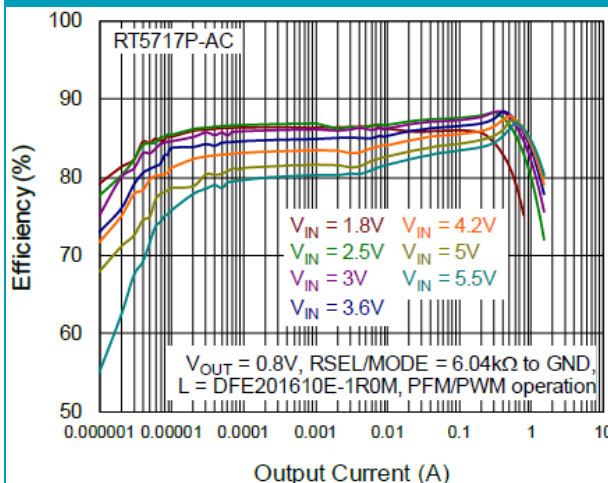
No Load Operating Quiescent Current
vs. Input Voltage



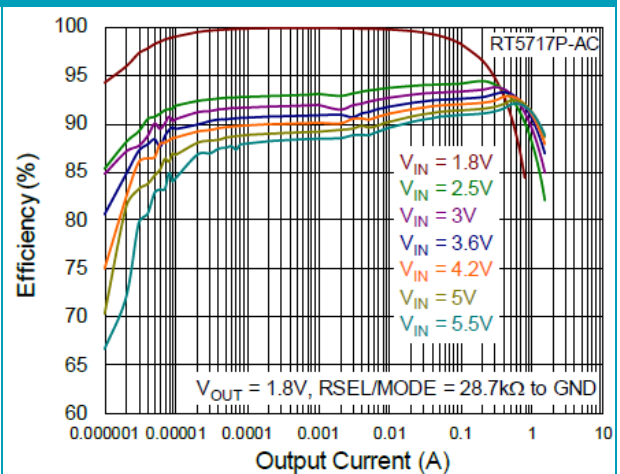
Shutdown Current vs. Input Voltage



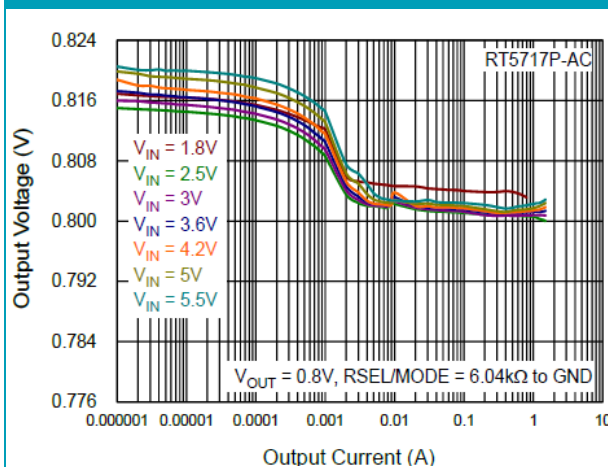
Efficiency, Power Save Mode



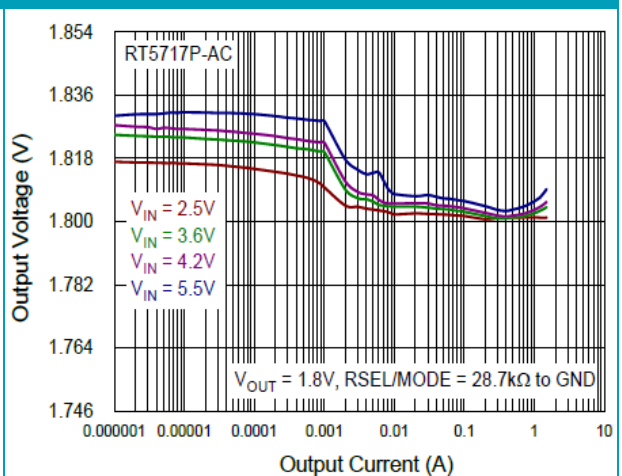
Efficiency, Power Save Mode



Output Voltage vs. Output Current



Output Voltage vs. Output Current





Note 2. When measuring the input or output voltage ripples, 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.

Evaluation Board Layout

Figure 1 to Figure 4 show the layout of the RT5717P series Evaluation Board. This board size is 56mm x 50mm and is constructed on four-layer PCB, outer layers with 1 oz. Cu, and inner layers with 1 oz. Cu.

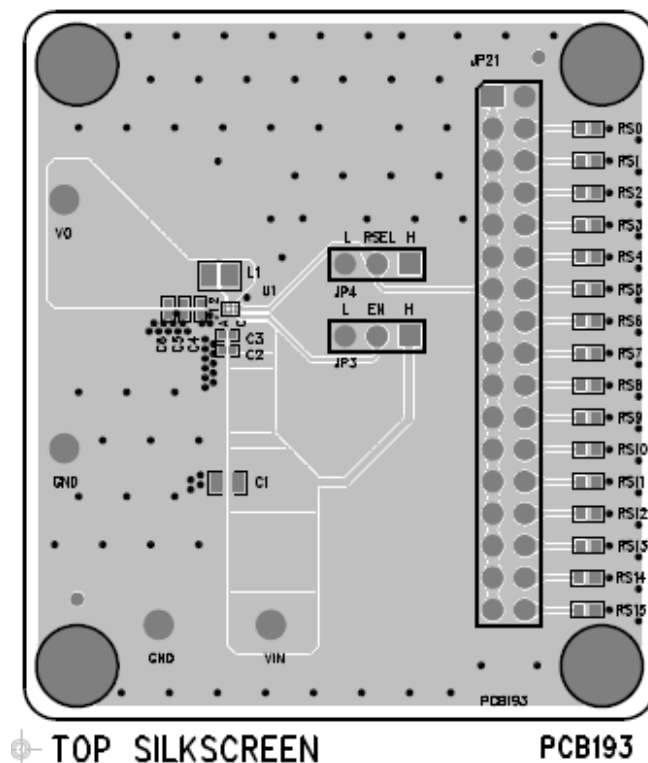


Figure 1. Top View (1st layer)

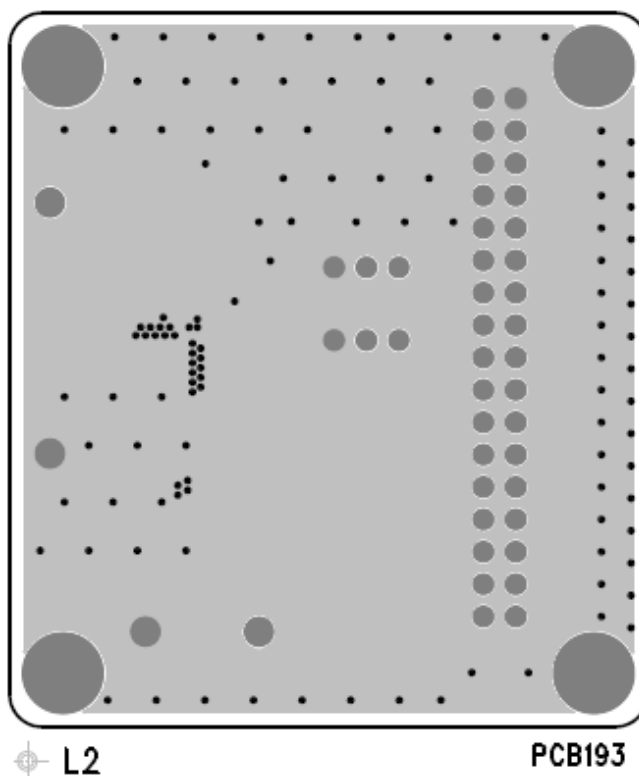


Figure 2. PCB Layout—Inner Side (2nd Layer)

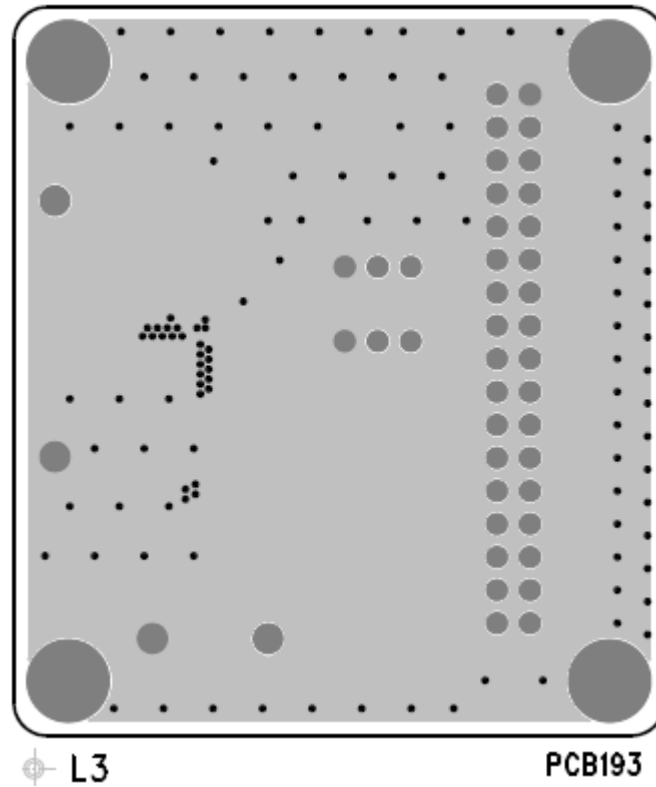


Figure 3. PCB Layout—Inner Side (3rd Layer)

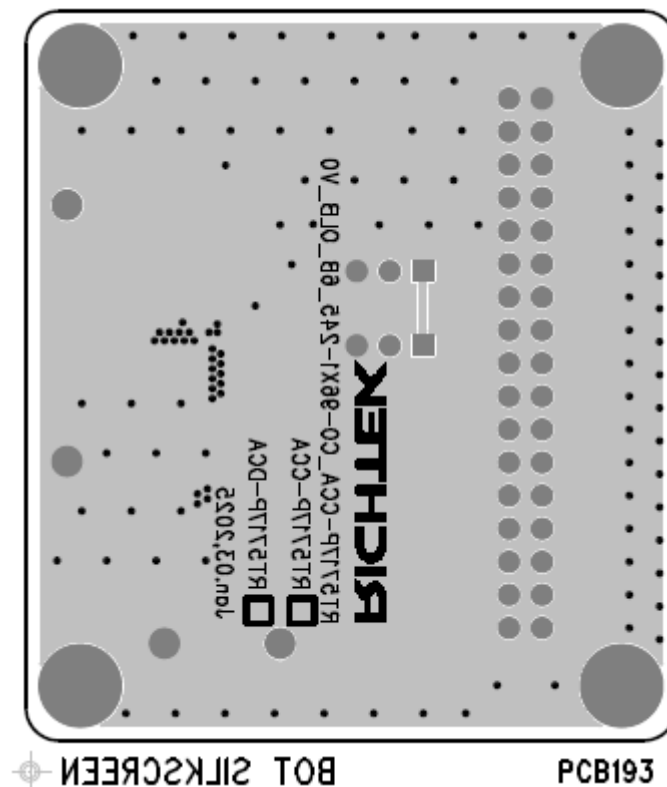


Figure 4. Bottom View (4th Layer)

More Information

For more information, please find the related datasheet or application notes from Richtek website

<http://www.richtek.com>.

Important Notice for Richtek Evaluation Board

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