36V_{IN}, 3A, High Efficiency, 2.1MHz, Synchronous Step-Down Converter Evaluation Board

General Description

The RTQ2104GSP-QA evaluation board showcases the regulator's performance, delivering 3A output from a 4V to 36V input at 2.1MHz. Suitable for industrial and communication systems, it offers protection against shorted outputs, input undervoltage, overcurrent, and thermal shutdown. The documentation includes a BOM, typical application, board overview, power-up procedure, performance summary, and hardware description to provide information on the board's components, capabilities, and usage.

Table of Contents

Performance Specification Summary

Summary of the RTQ2104GSP Evaluation Board performance specificiaiton is provided in Table 1. The ambient temperature is 25°C.

Table 1. RTQ2104GSP Evaluation Board Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	Soft-start is finished	3	--	36	V
Output Current		0	--	3	A
Default Output Voltage		0.8	--	V_{IN}	V
Operation Frequency		1.89	2.1	2.31	MHz
Output Ripple Voltage	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 3A	--	10	--	mVp-p
Line Regulation	V_{OUT} = 5V, I_{OUT} = 3A, V_{IN} = 7V to 25V	--	±1	--	%
Load Regulation	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 0.5A to 3A	--	±1	--	%
Load Transient Response	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 1.5A to 3A	--	±10	--	%
Maximum Efficiency	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 1.5A	--	90	--	%

Power-up Procedure

Suggestion Required Equipments

- RTQ2104GSP Evaluation Board
- DC power supply capable of at least 36V and 3A
- Electronic load capable of 3A
- Function Generator
- Oscilloscope

Quick Start Procedures

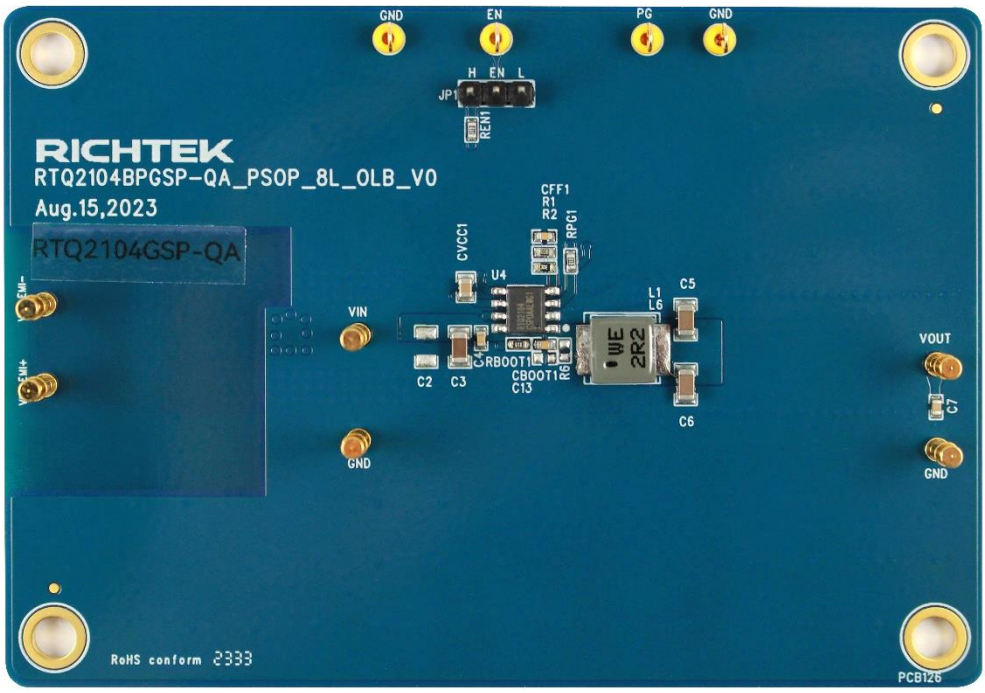
The Evaluation Board is fully assembled and tested. Follow the steps below to verify board operation. Do not turn on supplies until all connections are made. When measuring the output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage ripple by touching the probe tip and ground ring directly across the last output capacitor.

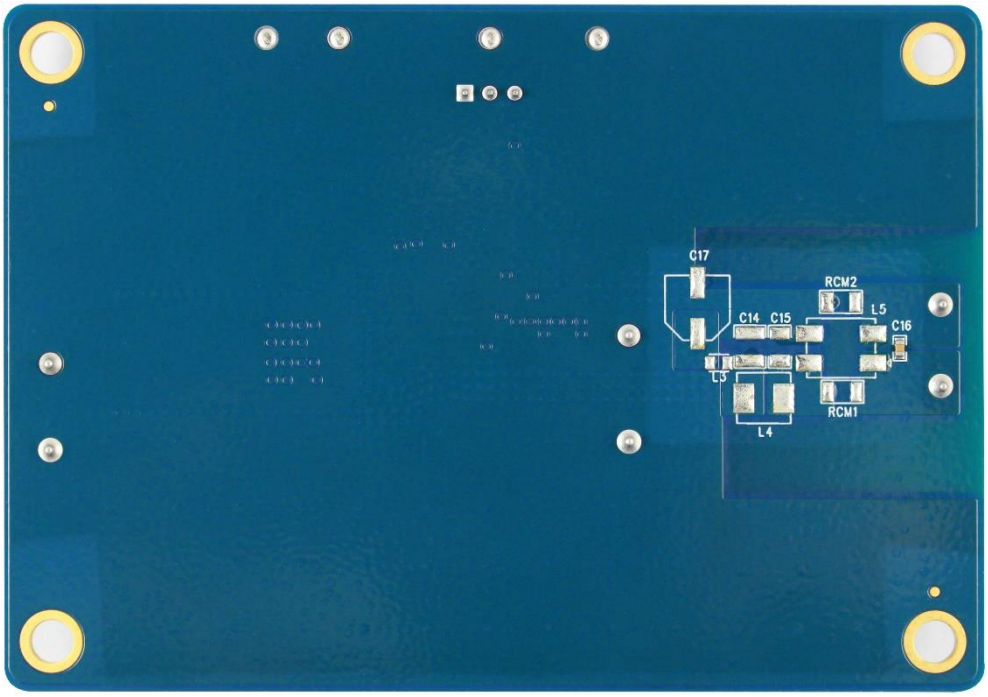
Proper measurement equipment setup and follow the procedure below.

1) With power off, connect the input power supply to VIN and GND pins.
2) With power off, connect the electronic load between the VOUT and nearest GND pins.
3) Turn on the power supply at the input. Make sure that the input voltage does not exceeds 36V on the Evaluation Board.
4) Check for the proper output voltage using a voltmeter.
5) 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 performance.

Detailed Description of Hardware

Headers Description and Placement





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.

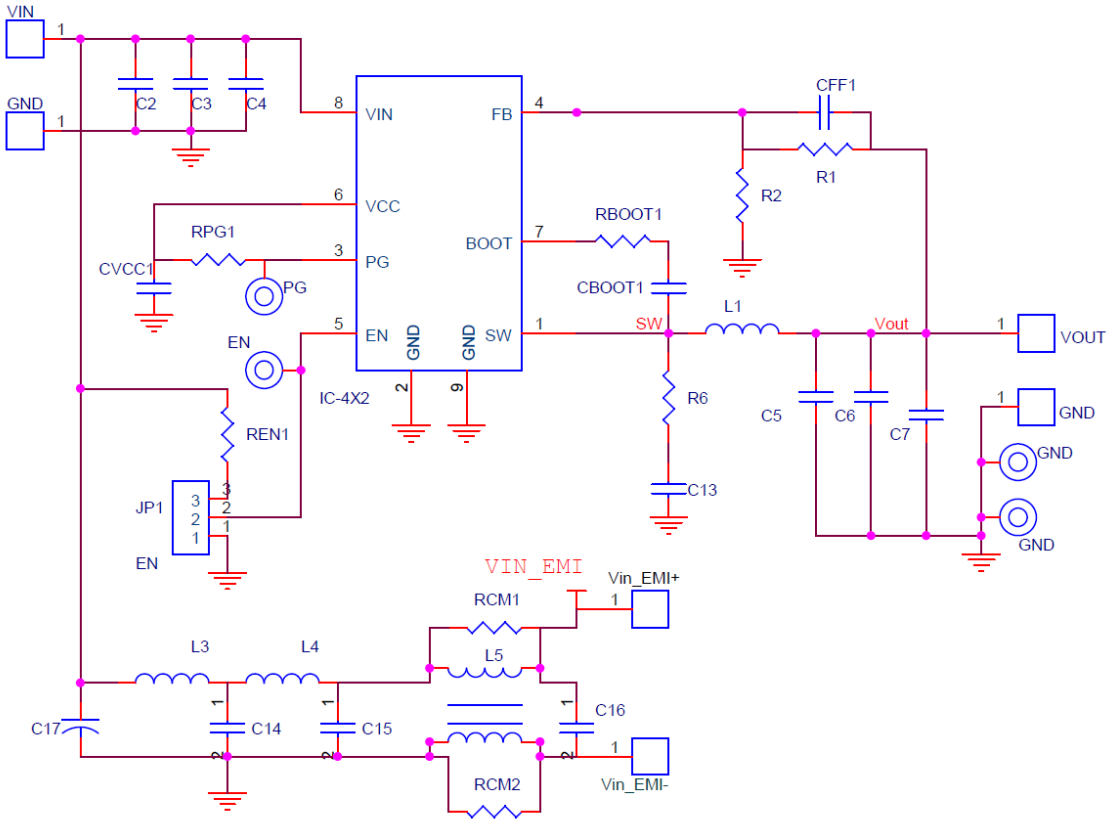
Test Point/ Pin Name	Function
VIN	DC power supply positive input terminal. The input voltage range is from 3V to 36V after soft-start is finished.
VOUT	Electronic load positive output terminal. Draw maximum output current up to 3A.
GND	Reference ground for power supply or electronic load. Provide the ground return path for the control circuitry and low-side power MOSFET.
VIN_EMI+	Positive input terminal of EMI filter circuit.
VIN_EMI-	Negative input terminal of EMI filter circuit.
PG	Power-good indication test point. The test point can be used to measure the power-good singal.
EN	Enable control input. A logic-high enables the converter; a logic-low forces the device into shutdown mode.
JP1	EN jumper. Connect EN to logic-low to disable, connect logic-high to enable.

Bill of Materials

V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 3A, f_{SW} = 2100kHz						
Reference	Count	Part Number	Value	Description	Package	Manufacturer
U4	1	RTQ2104GSP-QA	RTQ2104GSP-QA	Step-Down Converter	SOP-8 (Exposed Pad)	RICHTEK
CFF1	1	0603B121K500CT	120pF	Capacitor, Ceramic, 50V, X7R	0603	WALSIN
CVCC1	1	GRM21BR71A106KE51L	10µF	Capacitor, Ceramic, 10V, X7R	0805	MURATA
C3	1	UMK316AB7475KL-T	4.7µF	Capacitor, Ceramic, 50V, X7R	1206	TAIYO YUDEN
C4, C7, C16, CBOOT1	4	0603B104K500CT	0.1µF	Capacitor, Ceramic, 50V, X7R	0603	WALSIN
C5, C6	2	LMK316AB7226KL-TR	22µF	Capacitor, Ceramic, 10V, X7R	1206	TAIYO YUDEN
R1	1	WR06X1053FTL	105k	Resistor, Chip, 1/10W, 1%	0603	WALSIN
R2	1	WR06X2002FTL	20k	Resistor, Chip, 1/10W, 1%	0603	WALSIN
RBOOT1	1	WR06X10R0FTL	10	Resistor, Chip, 1/10W, 1%	0603	WALSIN
RPG1, REN1	2	WR06X1003FTL	100k	Resistor, Chip, 1/10W, 1%	0603	WALSIN
L1	1	78439344022	2.2µH	Inductor, Isat = 7.5A, 10.5mΩ	6.65x6.45x3mm	Würth Elektronik

Typical Applications

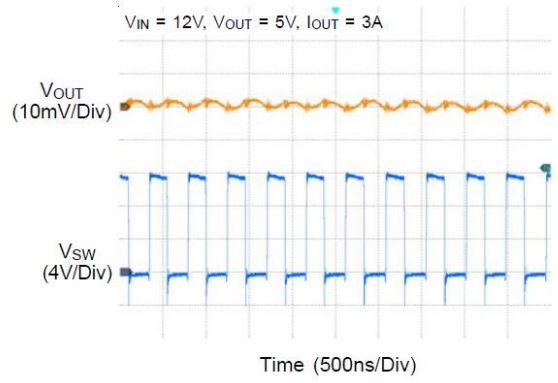
EVB Schematic Diagram



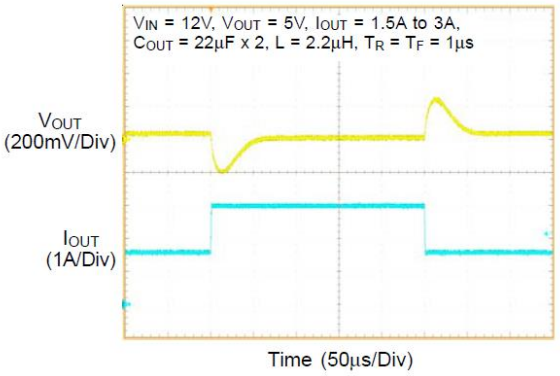
1. The capacitance values of the input and output capacitors will influence the input and output voltage ripple.
2. MLCC capacitors have degrading capacitance at DC bias voltage, and especially smaller size MLCC capacitors will have much lower capacitance.

Measure Result

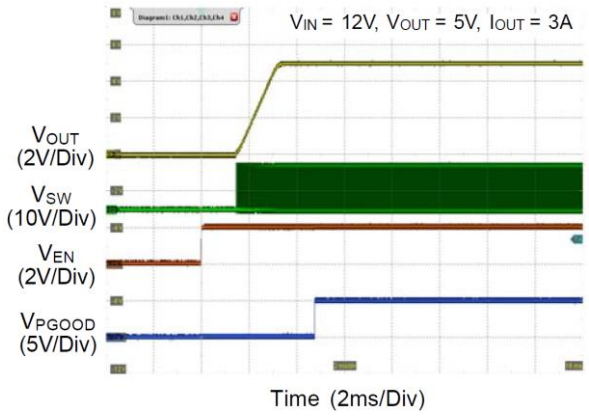
Output Ripple Measurement



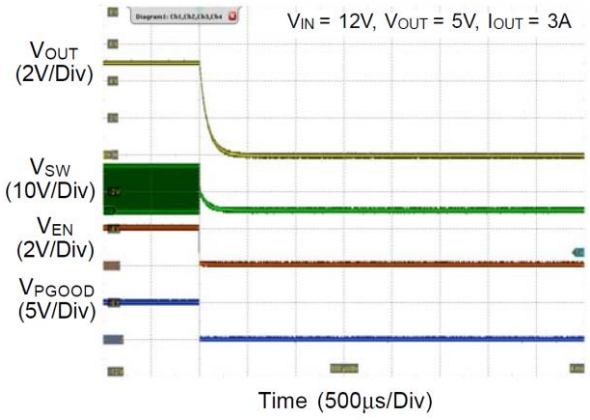
Load Transient Response



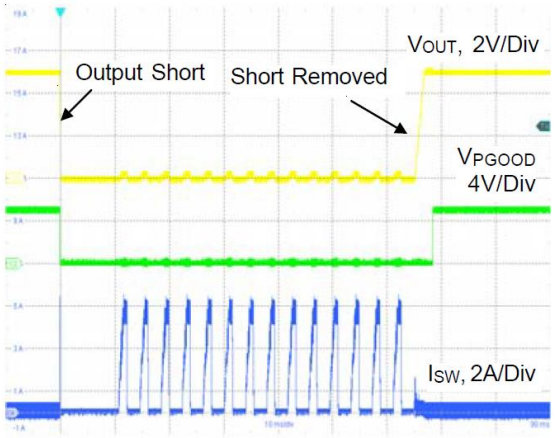
Power On from EN



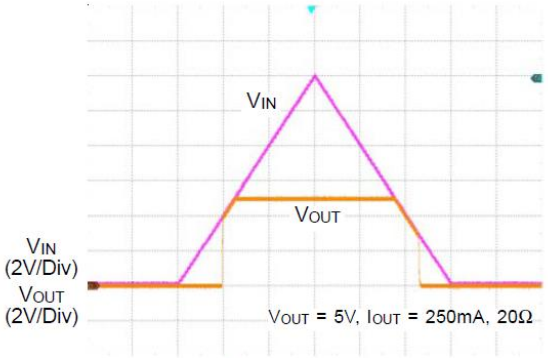
Power Off from EN



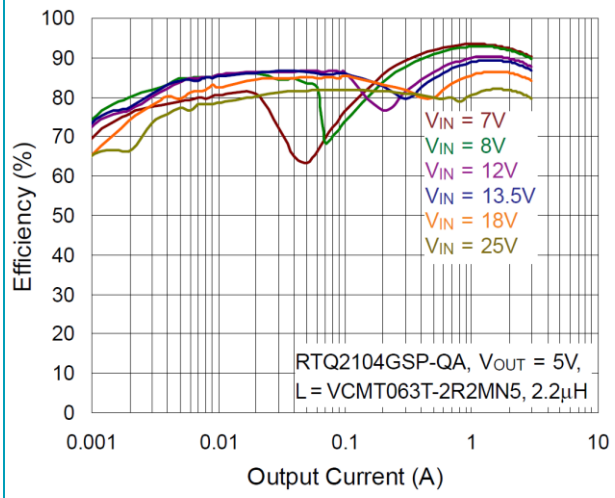
Short Circuit Response – Short and Recovery



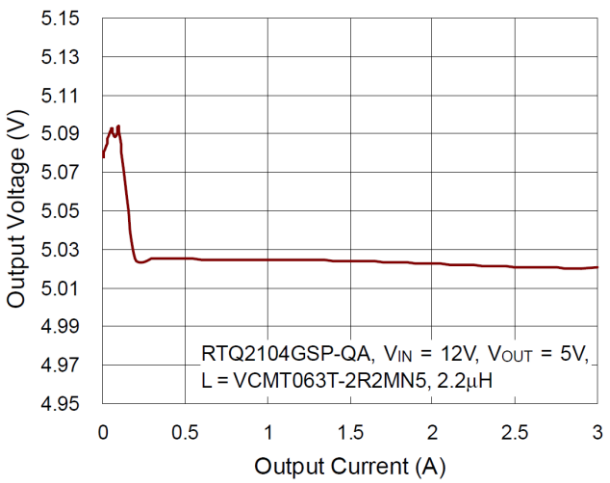
Start-Up Dropout Performance



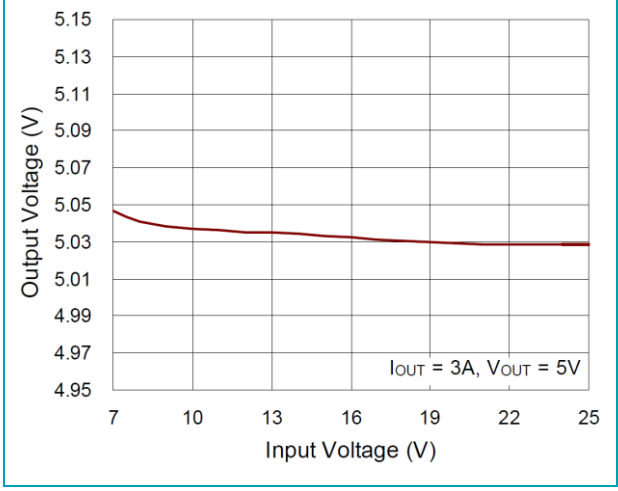
Efficiency vs. Output Current



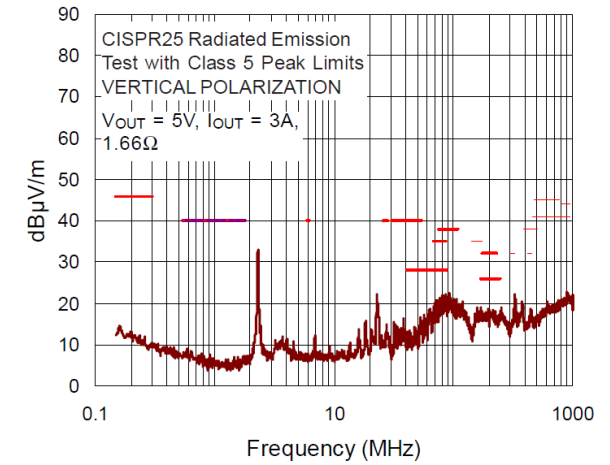
Output Voltage vs. Output Current



Output Voltage vs. Input Voltage



Radiated EMI Performance



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.

Evaluation Board Layout

Figure 1 to Figure 4 are RTQ2104GSP Evaluation Board layout. This board size is 100mm x 70mm and is constructed on four-layer PCB, outer layers with 2 oz. Cu and inner layers with 1 oz. Cu.

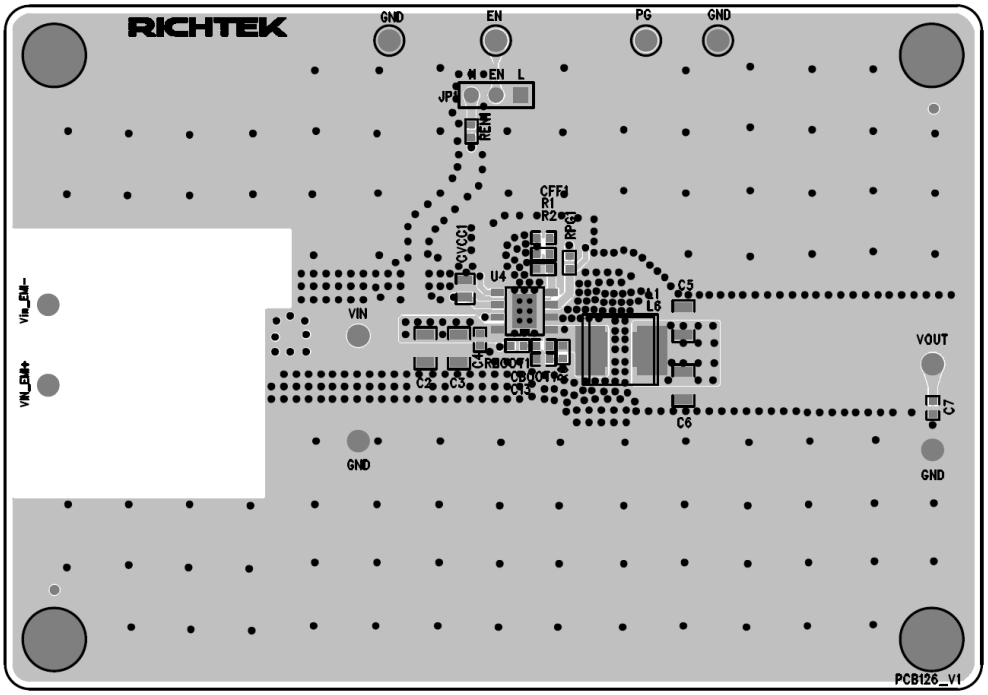


Figure 1. Top View (1st layer)

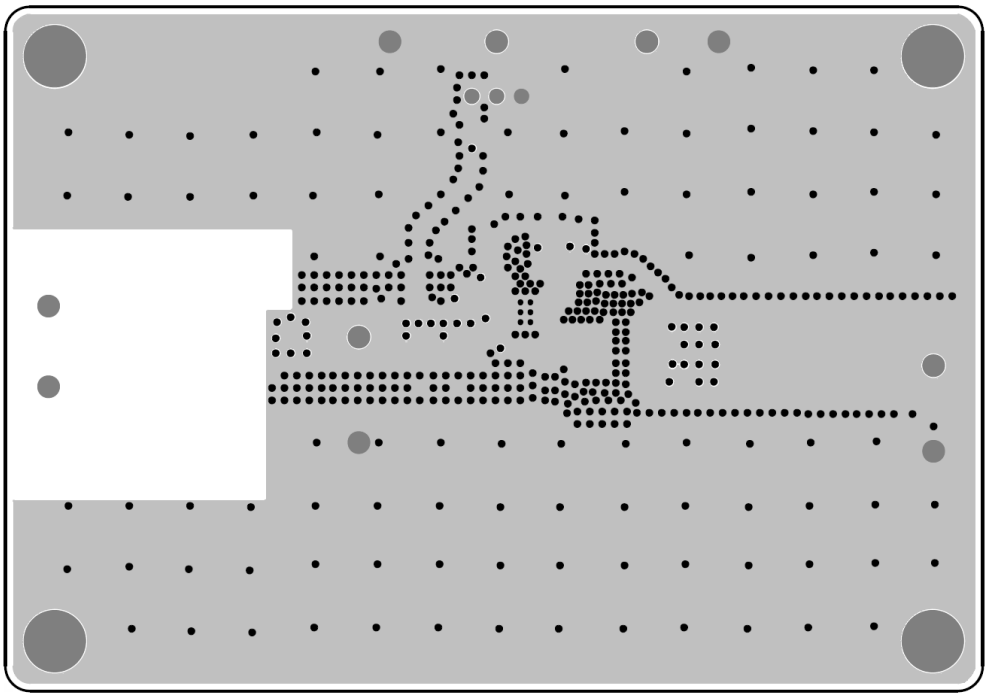


Figure 2. PCB Layout—Inner Side (2nd Layer)

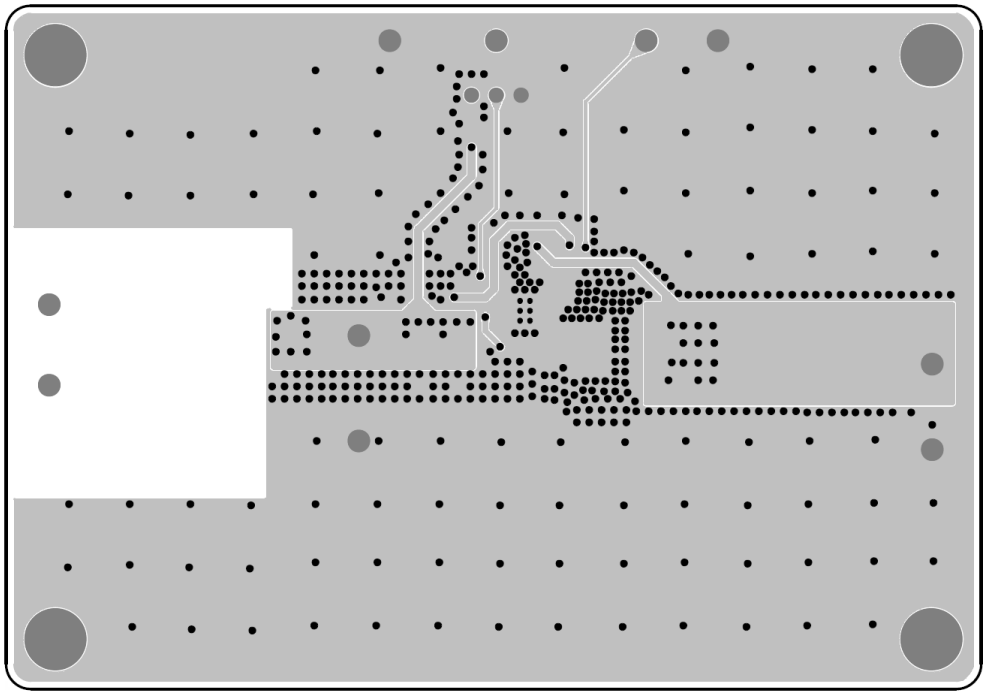


Figure 3. PCB Layout—Inner Side (3rd Layer)

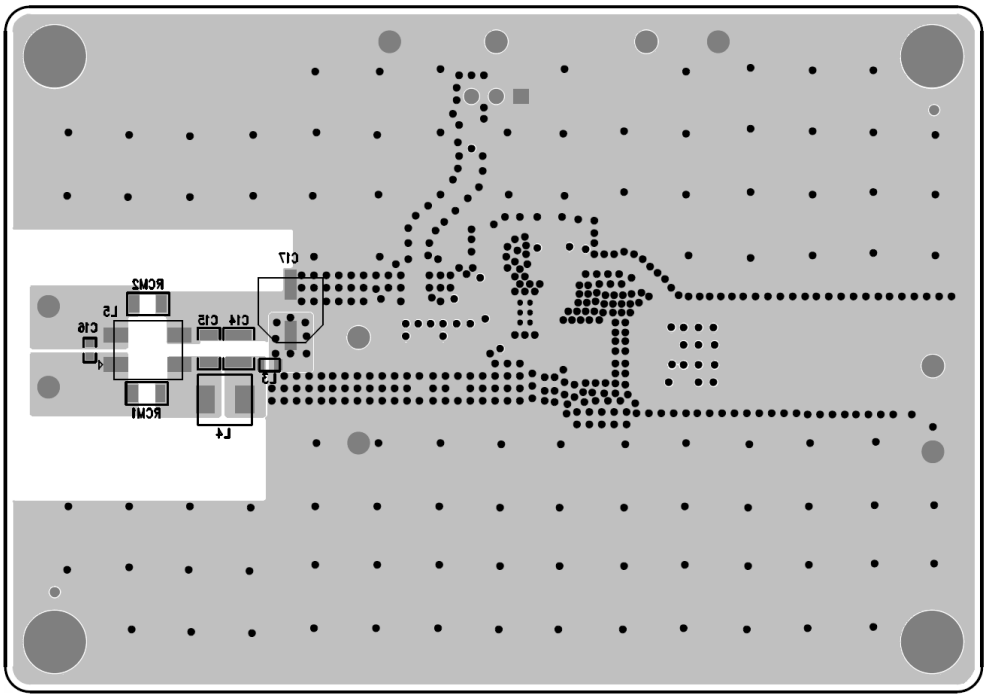


Figure 4. Bottom View (4th Layer)

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