12A, 17V Synchronous Step-Down Converter

General Description

This document explains the function and use of the RTQ2822A evaluation board (EVB), the RTQ2822A is a high-performance, synchronous step-down converter that can deliver up to 12A output currentvwith an input supply voltage range of 4.5V to 17V. The device integrates low $R_{DS(ON)}$ power MOSFETs, accurate 0.6V reference and an integrated diode for bootstrap circuit to offer a very compact solution. This document explains the function and use of the RTQ2822A evaluation board (EVB), and provides information to enable operation, modification of the evaluation board and circuit to meet individual requirements.

Table of Contents

Performance Specification Summary

Summary of the RTQ2822AGQVF Evaluation Board performance specificiaiton is provided in Table 1. The ambient temperature is 25°C.

Table 1. RTQ2822AGQVF Evaluation Board Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Default Input Voltage	Default = 12V	4.5	12	17	V
Output Voltage	Default = 1.2V	0.6	--	5.5	V
Maximum Output Current		--	--	12	A
Operation Frequency	Default = 800kHz	400	800	1200	kHz
Soft-Start Time	C_{SS} = 47nF	--	4.7	--	ms

Power-up Procedure

Suggestion Required Equipments

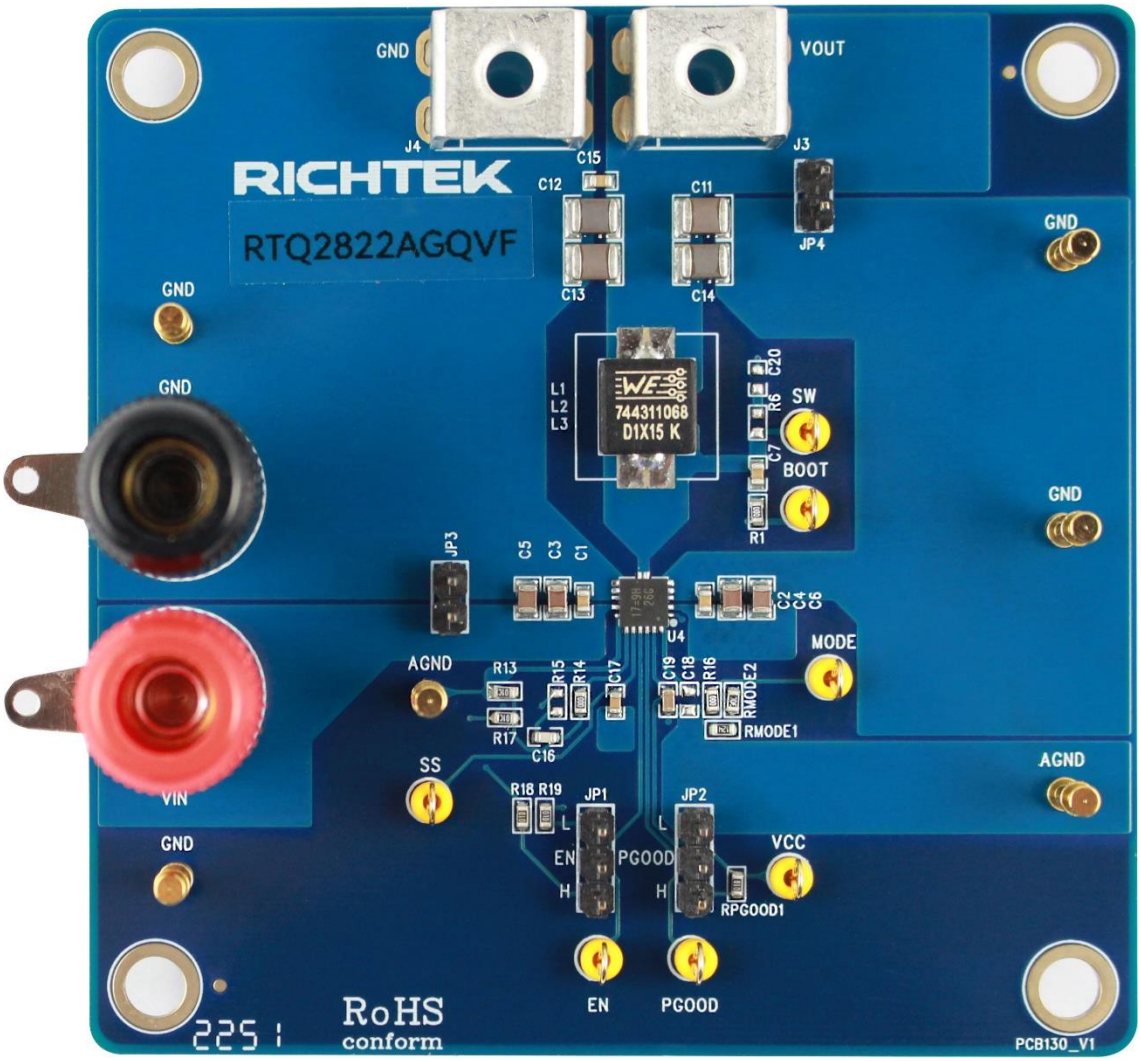
- DC Power Supply (Chroma, 62006P-100-25)
- Electronic load capable of 30A
- Four Channels Digital Real-Time Oscilloscope
- Display Multi-meter (34405A)

Power-up & Measurement Procedure

1. Apply a 12V nominal input power supply (4.5V < V_{IN} < 17V) to the VIN and GND terminals.
2. Set the jumper at JP1 to connect terminals H and EN, connecting EN to VIN through resistor R18 (100kΩ). The Enable pin can connected to VIN directly as well to enable operation.
3. Set the jumper at JP2 to connect terminals H and PGOOD, Connenting VCC to H through resistor RPGOOD (100kΩ).
4. Verify the output voltage (approximately 1.2V) between VOUT and GND.
5. Connect an external load up to 12A to the VOUT and GND terminals and verify the output voltage and current.

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
EN	Enable control input
MODE	Current limit, switching frequency, and light load operation mode selection pin.
BOOT	Bootstrap
SW	Switch node
PGND	Power ground
VIN	Input voltage
VCC	4.7V internal LDO output
AGND	Analog GND
PGOOD	Power good indicator output
SS	Soft-start time control pin

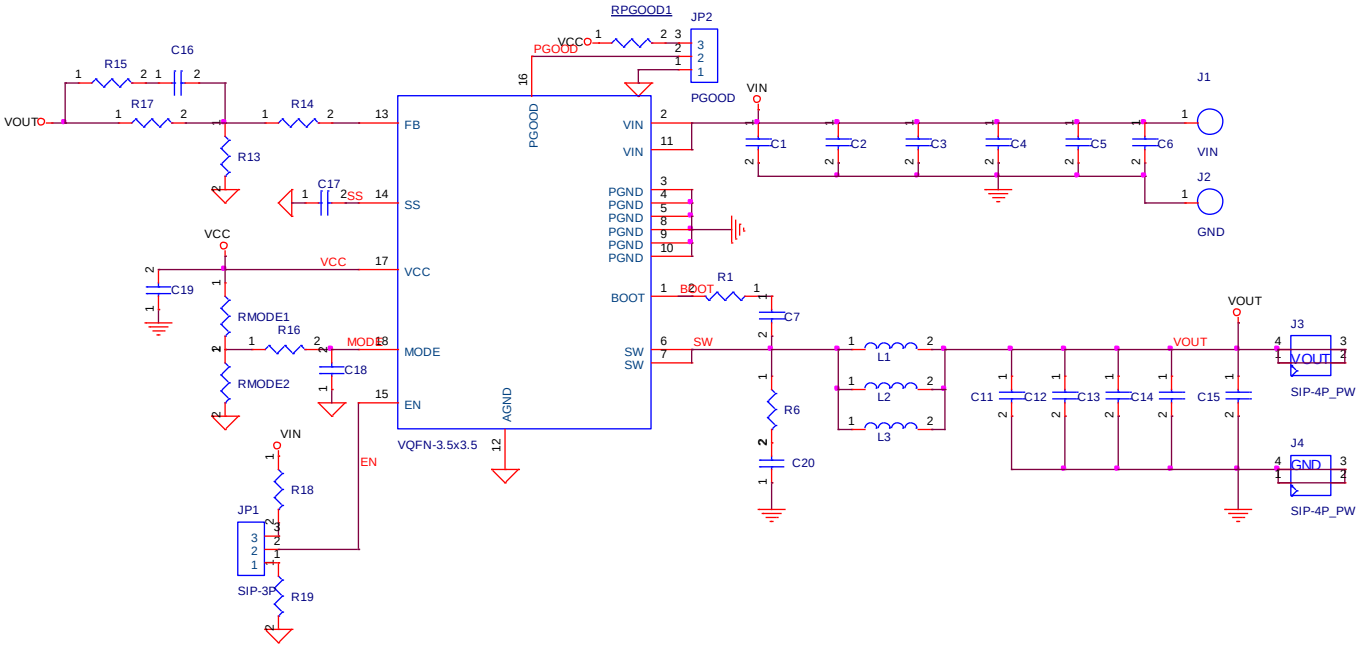
Bill of Materials

Reference	Qty	Part Number	Description	Package	Manufacturer
U4	1	RTQ2822AGQVF	Step-Down DC-DC Converter	VQFN-18L 3.5x3.5 (FC)	RICHTEK
C1, C2, C7, C15	4	0603B104K500CT	0.1µF, 50V, X7R	0603	WALSIN
C3, C4, C5, C6	4	GRM21BR61E226ME44L	22µF, 25V, X5R	0805	MURATA
C11, C12, C13, C14	4	GRM32ER61C476KE15L	47µF, 16V, ±20%, X5R,	1210	MURATA
C16	1	0603N101J500CT	100pF, 50V, NPO	0603	MURATA
C17	1	GRM188R71C473KA01	0.047µF, 16V, ±10%, X7R	0603	MURATA
C19	1	GRM185R61A475KE11	4.7µF, 10V, ±20%, X5R	0603	TDK
L1	1	744311068	0.68µH, R_{DC} = 3.1mΩ	7.0x7.0x4.0	WURTH ELEKTRONIK
R1, R14 R16	3	WR06X000 PTL	RES, 0, 1%, 0.1W	0603	WALSIN
R13, R17	2	WR06X1002FTL	RES, 10k, 1%, 0.1W	0603	WALSIN
R18, R19 RPGOOD1	3	WR06X1003FTL	RES, 100k, 1%, 0.1W	0603	WALSIN
RMODE1	1	WR06X1203FTL	RES, 120k, 1%, 0.1W	0603	WALSIN
RMODE2	1	WR06X2002FTL	RES, 20k, 1%, 0.1W	0603	WALSIN

Typical Applications

EVB Schematic Diagram

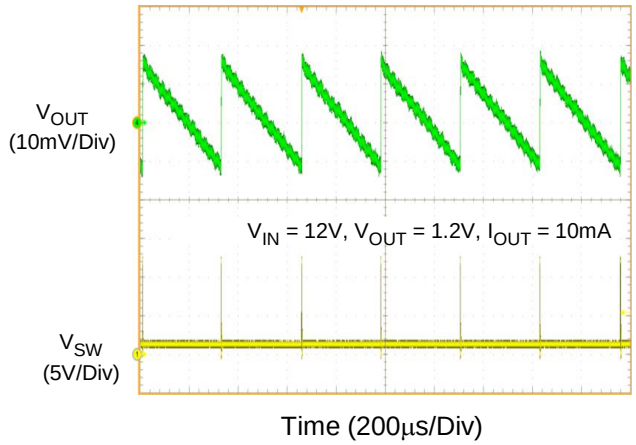
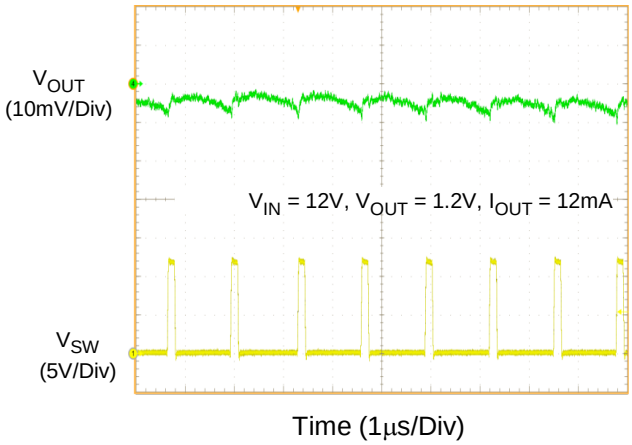
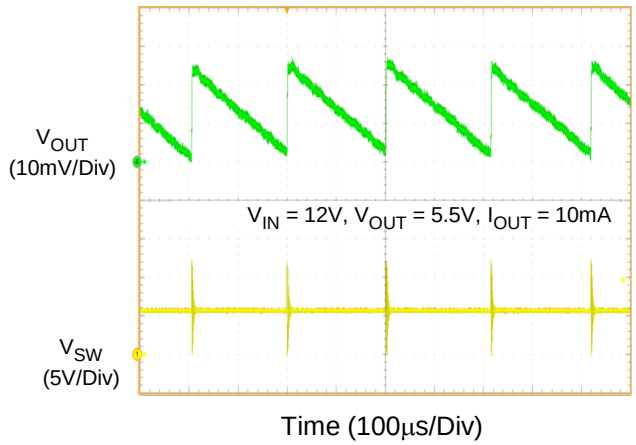
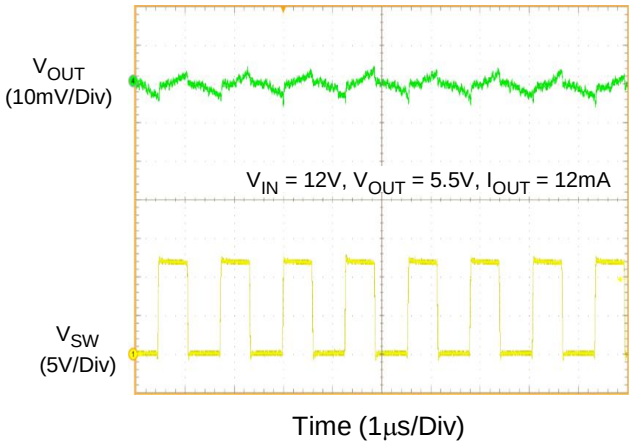
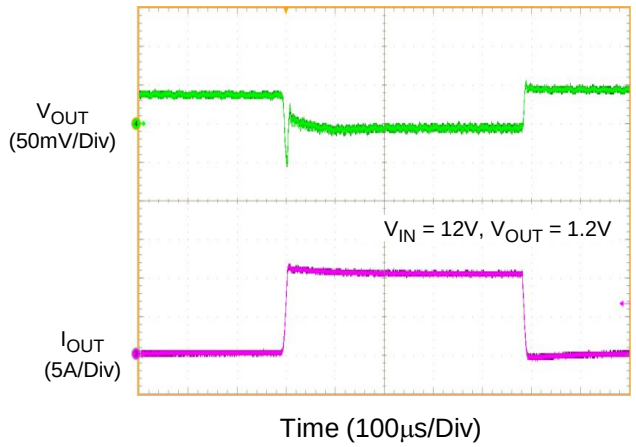
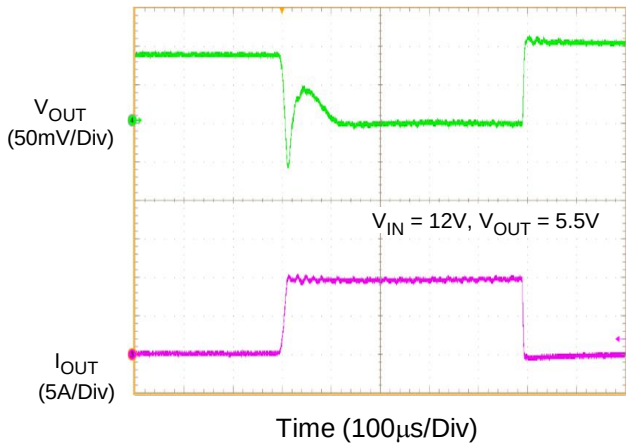
RTQ2822A demo board: V_{IN} = 12V, V_{OUT} 1.2V / 12A

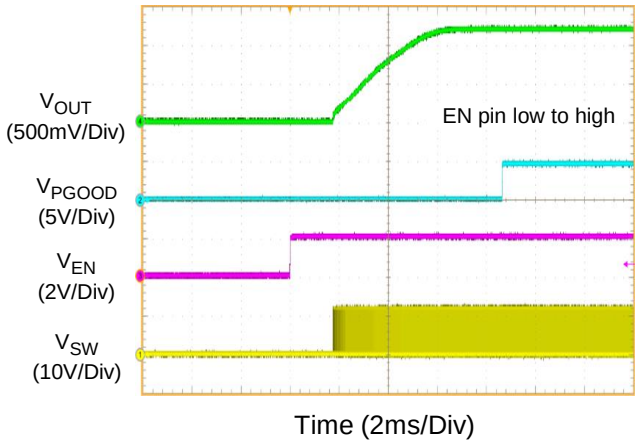
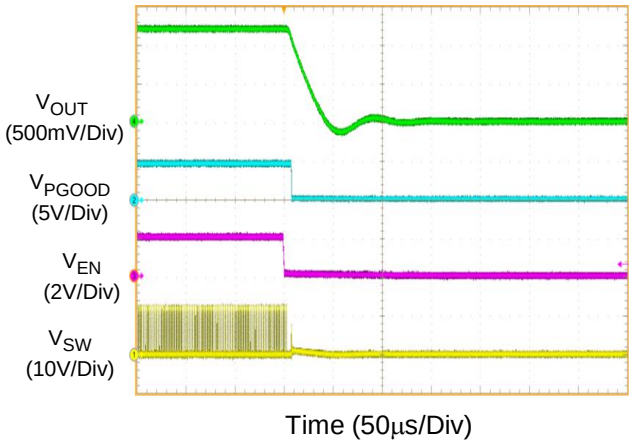
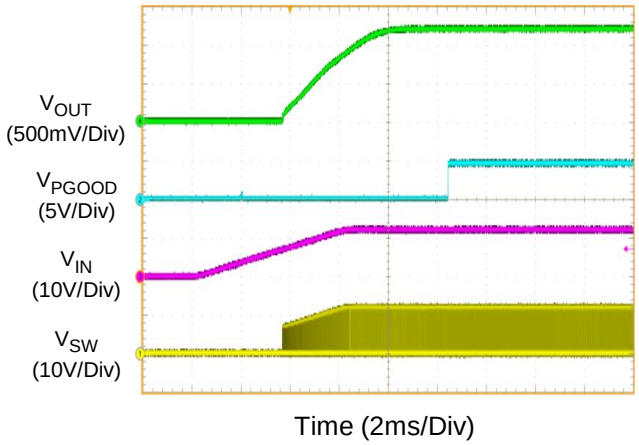
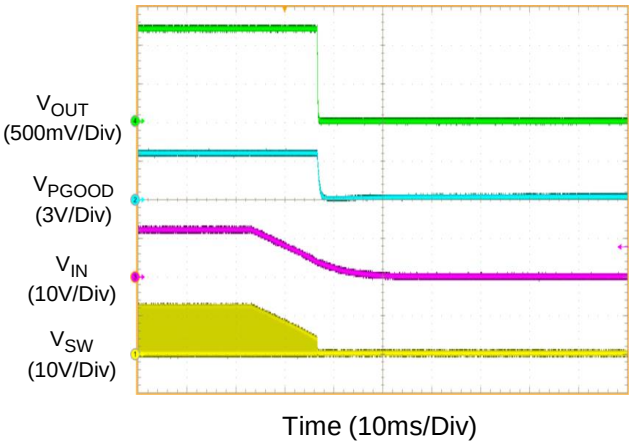


Note:

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 than specified.
3. Set default soft start time 5ms by connecting C17 to 47nF.

Measurement Results

Output Ripple Measurement	Output Ripple Measurement
	
Output ripple at 10mA load: 32mVpp	Output ripple at 12A load: 10mVpp
Output Ripple Measurement	**Output Ripple Measurement**
	
Output ripple at 10mA load: 27mVpp	Output ripple at 12A load: 10mVpp
Dynamic Load 0A to 10A Load Step (DCM Mode)	**Dynamic Load 0A to 10A Load Step (DCM Mode)**
	
VPK-PK: 112mV	VPK-PK: 344mV

Start-Up Measurement from Enable	Power-Off Measurement from Enable
	
Start-up time 5ms. Soft-start 5ms.	VOUT discharge during power-off
Start-Up Measurement from VIN	**Power-Off Measurement from VIN**
	
Start-up time 2.7ms. Soft-start 1.575ms.	VOUT discharge during power-off.

Thermal Image: 800kHz, PWM mode

IC Top Temperature = 77.5°C on VIN = 12V, VOUT = 1.2V, IOUT = 12A	IC Top Temperature = 98.2°C on VIN = 12V, VOUT = 2.5V, IOUT = 12A
	

Evaluation Board Layout

Figure 1 to Figure 4 are RTQ2822AGQVF Evaluation Board layout.

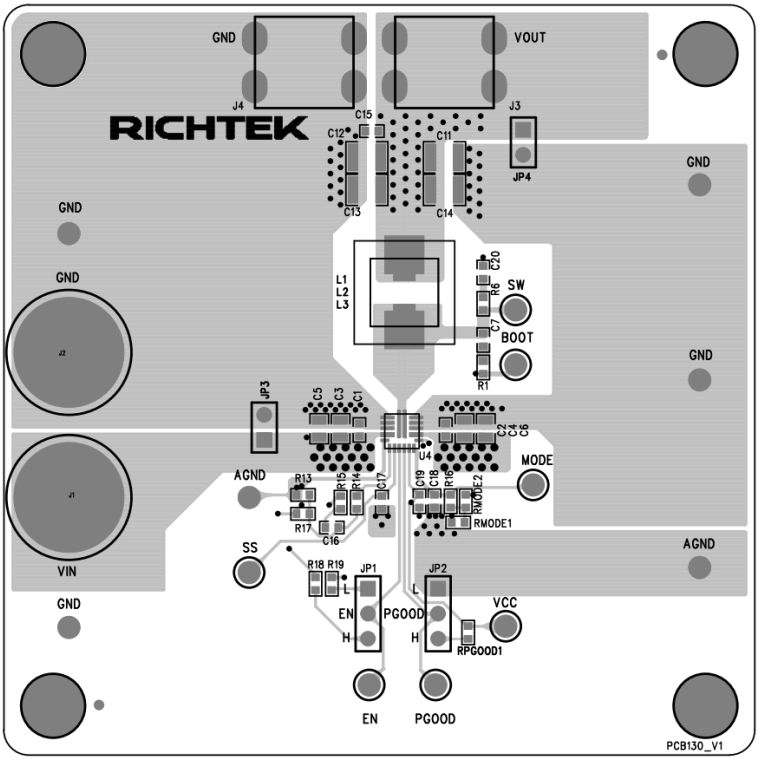


Figure 1. Top View (1st layer)

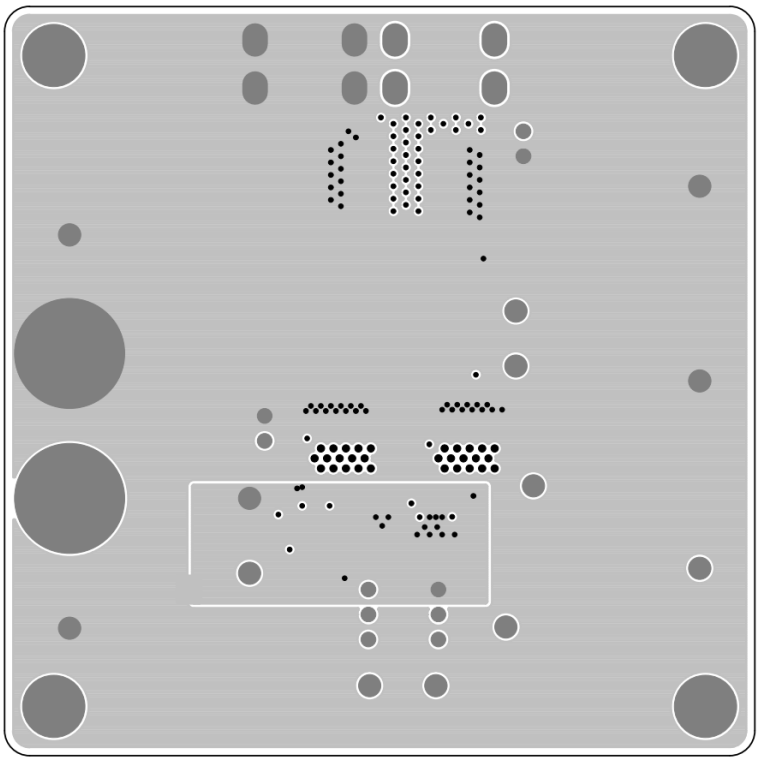


Figure 2. PCB Layout—Inner Side (2nd Layer)

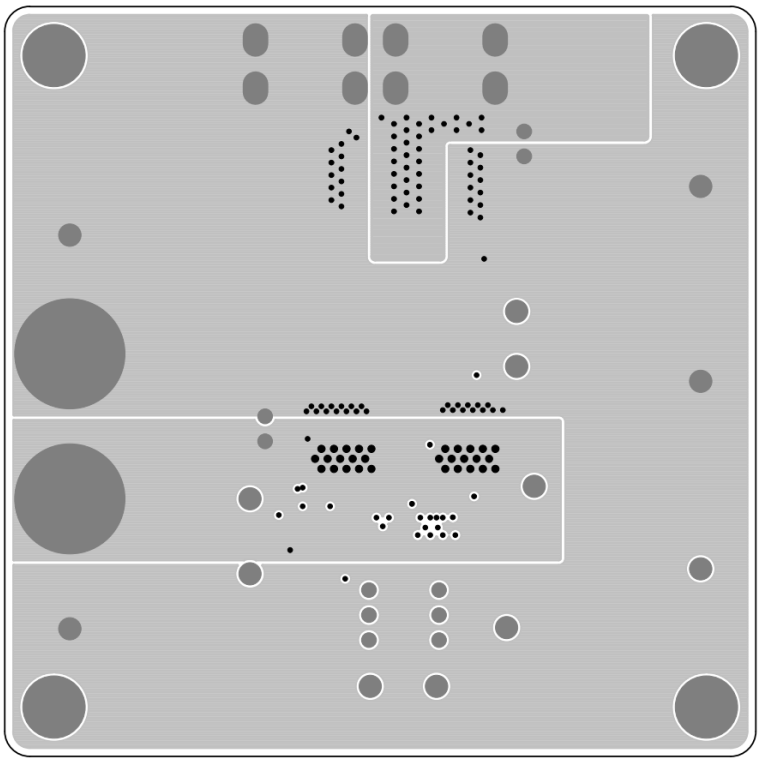


Figure 3. PCB Layout—Inner Side (3rd Layer)

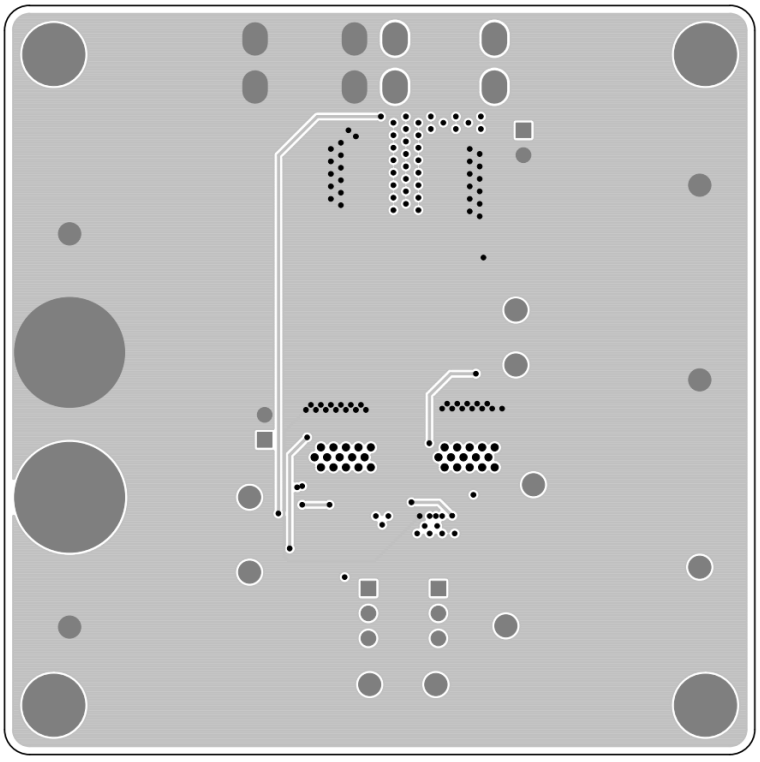


Figure 4. Bottom View (4th Layer)

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