6V Input, 1A, ACOT® Buck Converter in Thin SOT-563 (FC)

General Description

The RT5760A is a full featured 6V, 1A, Advanced Constant-On-Time (ACOT®) synchronous step-down converter with two integrated MOSFETs. This document explains the function and use of the RT5760A evaluation board (EVB) and provides information for the evaluation board layout, schematic, bill of materials (BOM) and measurement results to suit individual requirements.

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Performance Specification Summary

Summary of the RT5760AHGH6F Evaluation Board performance specificiaiton is provided in Table 1. The ambient temperature is 25°C.

Table 1. RT5760AHGH6F Evaluation Board Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range		2.5	--	6	V
Output Current		0	--	1	A
Default Output Voltage		--	1	--	V
Operation Frequency		--	2.2	--	MHz
Output Ripple Voltage	I_{OUT} = 1A	--	10	--	mVp-p
Line Regulation	I_{OUT} = 1A, V_{IN} = 2.5V to 6V	--	±1	--	%
Load Regulation	V_{IN} = 5V, I_{OUT} = 0.001A to 1A	--	±1	--	%
Load Transient Response	I_{OUT} = 0A to 1A	--	±5	--	%
Efficiency	V_{IN} = 5V, V_{OUT} = 1V, I_{OUT} = 0.4A	--	85.8	--	%

Power-up Procedure

Suggestion Required Equipments

- RT5760AHGH6F Evaluation Board
- DC power supply capable of at least 6V and 1A
- Electronic load capable of 1A
- Function Generator
- Oscilloscope

Quick Start Procedures

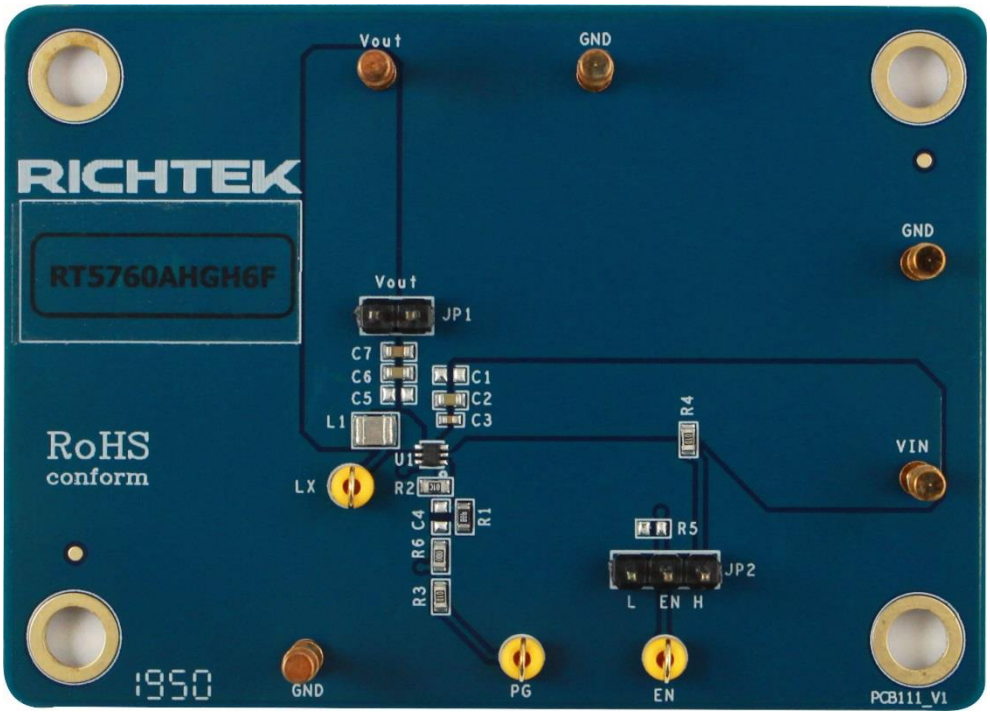
The Evaluation Board is fully assembled and tested. Follow the steps below to verify board operation. Do not turn on supplies until all connections are made. When measuring the output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage 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 60V 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	Signal	Comment (expected waveforms or voltage levels on test points)
VIN	Input Voltage	Positive input voltage from the power supply to the EVB.
VOUT	Output Voltage	Positive output voltage from the EVB to the loads.
JP1	Output Voltage Test Point	Output voltage measurement point.
GND	Ground	Reference voltage for input voltage, output voltage and other test points.
LX	Switch Node Test Point	Frequency measurement point. 2.2MHz (Typ.) in CCM mode.
PG	Power Good Test Point	Power good indicator. Pull low for fault condition.
EN	Enable Test Point	Enable control input. Connect this pin to logic high to enable the device.
JP2	EN Pin Jumper	Place the jumper across on EN and H to enable the device. Place the jumper across on EN and L to disable the device.

Power-up & Measurement Procedure

1. Connect a input power supply to the VIN and GND terminals and an electrical load to the VOUT and GND terminals.
2. Set the jumper at JP2 to tie “EN” test pin to “H” pin for enabling the chip.
3. Apply a 5V nominal input power supply (2.5V < V_{IN} < 6V) to the VIN and GND terminals respectively.
4. Set the electrical load up to 1A to Verify the output voltage (approximately 1V) at JP1. Check LX frequency is around 2.2MHz in CCM mode.

Output Voltage Setting

Set the output voltage with the resistive divider (R1, R2) between VOUT and GND with the midpoint connected to FB. The output is set by the following formula :

$$VOUT = 0.6 \times (1+ \frac{R1}{R2})$$

The placement of the resistive divider should be within 5mm of the FB pin. The resistance of R2 is suggested to 10kΩ for noise pick-up at the FB pin. The resistance of R1 can then be obtained as below :

$$R1 = \frac{R2 \times (V_{OUT} - 0.6)}{0.6}$$

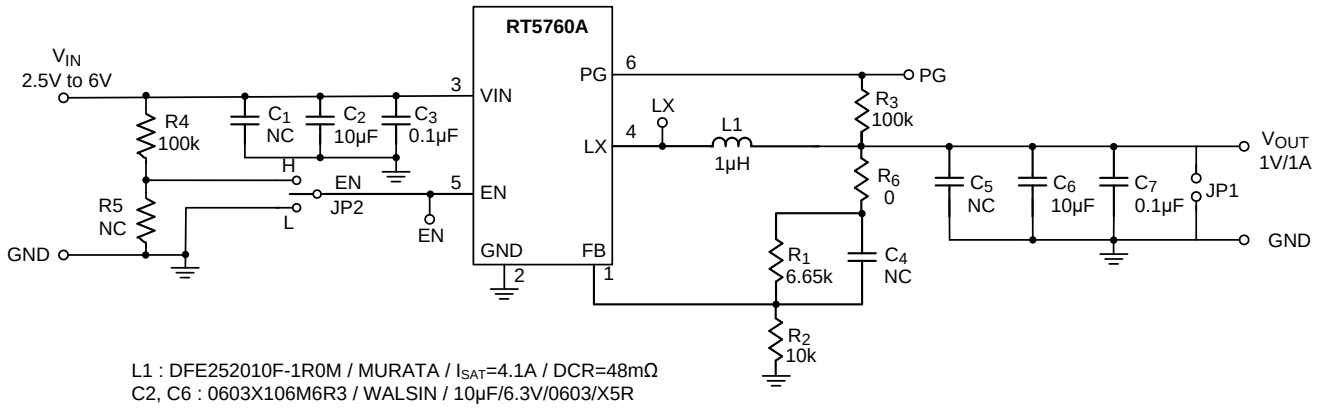
For better output voltage accuracy, divider resistors (R1 and R2) should have tolerance of ±1% tolerance or better.

Bill of Materials

Reference	Qty	Part Number	Description	Package	Manufacturer
U1	1	RT5760AHGH6F	Step-Down DC-DC Converter	SOT-563	WALSIN
C1, C4, C5	3		NC	C-0603	
C2, C6	2	0603X106M6R3CT	10μF/6.3V/X5R/0603	C-0603	WALSIN
C3	1	C1005X7R1C104K050BC	100nF/16V/X7R/0402	C-0402	TDK
C7	1	C1608X7R1H104K080AA	100nF/50V/X7R/0603	C-0603	TDK
L1	1	DFE252010F-1R0M	1μH	L-2520	Murata
R1	1	WR06X6651FTL	6.65K/0603	R-0603	WALSIN
R2	1	WR06X1002FTL	10K/0603	R-0603	WALSIN
R3, R4	2	WR06X1003FTL	100K/0603	R-0603	WALSIN
R5	1		NC	R-0603	
R6	1	WR06X000 PTL	0/0603	R-0603	WALSIN

Typical Applications

EVB Schematic Diagram

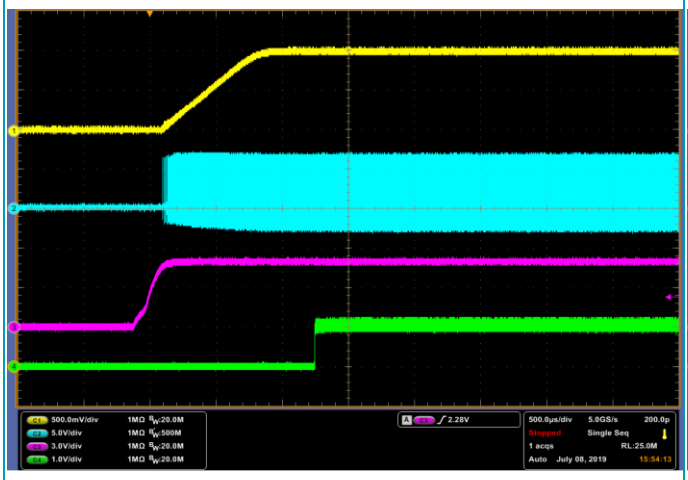
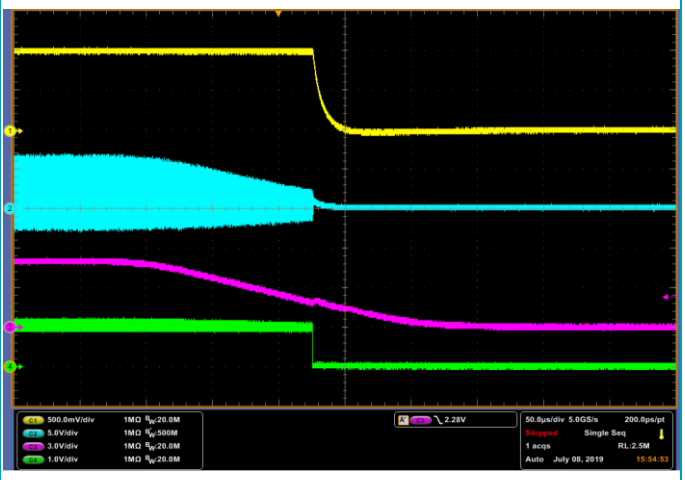


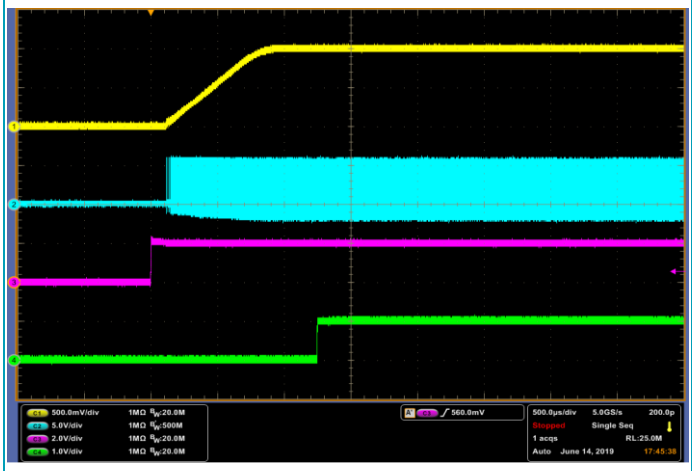
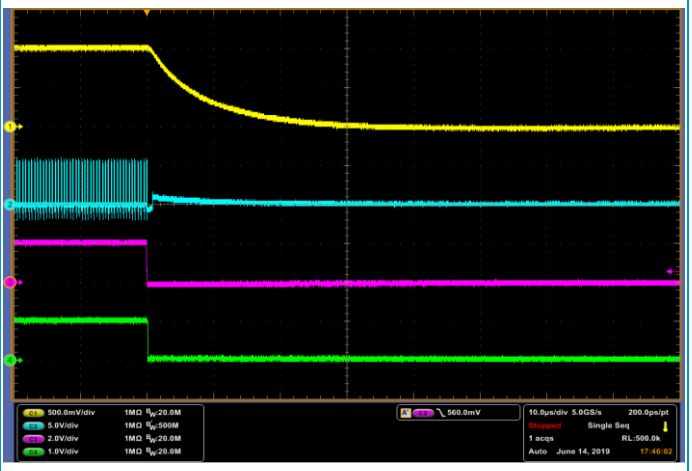
L1 : DFE252010F-1R0M / MURATA / I_{SAT}=4.1A / DCR=48mΩ
C2, C6 : 0603X106M6R3 / WALSIN / 10µF/6.3V/0603/X5R

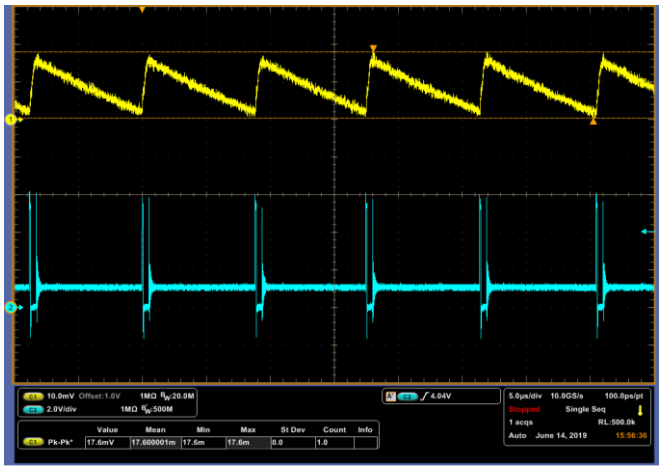
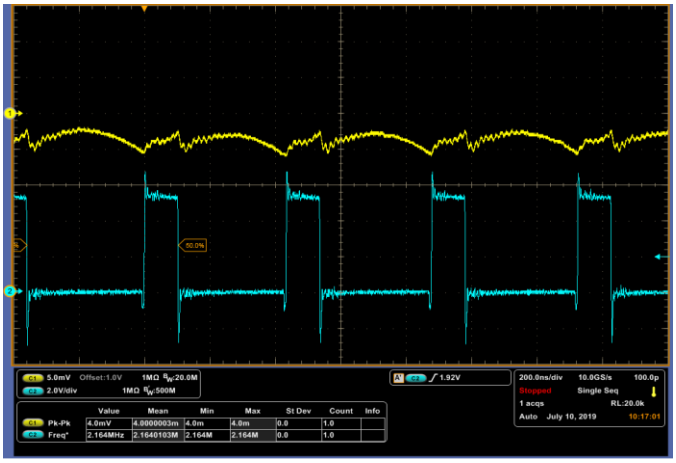
Note:

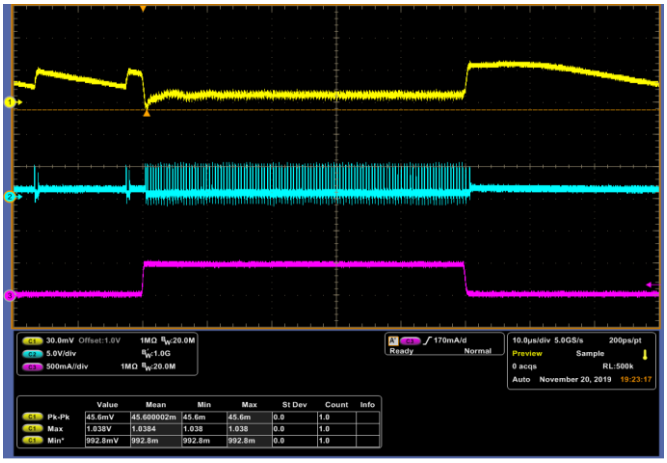
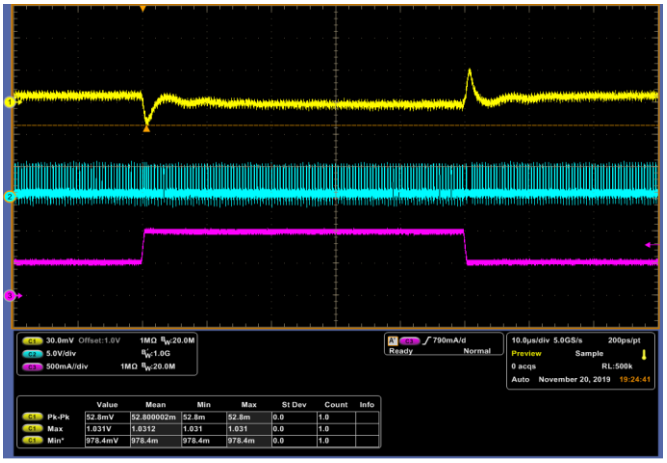
1. Do not hot-plug a live 5V supply to the board. If hot-plugging is required, add ~ 100µF electrolytic capacitor at the input.

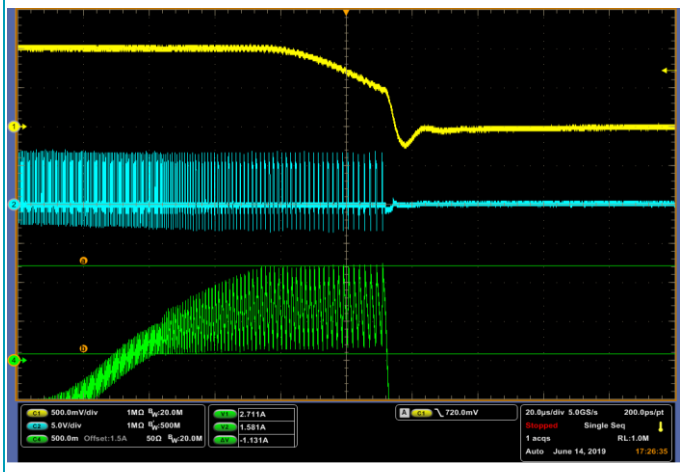
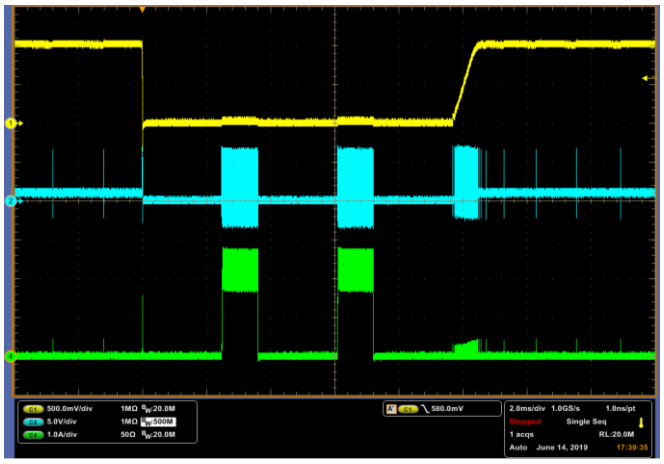
Measurement Results

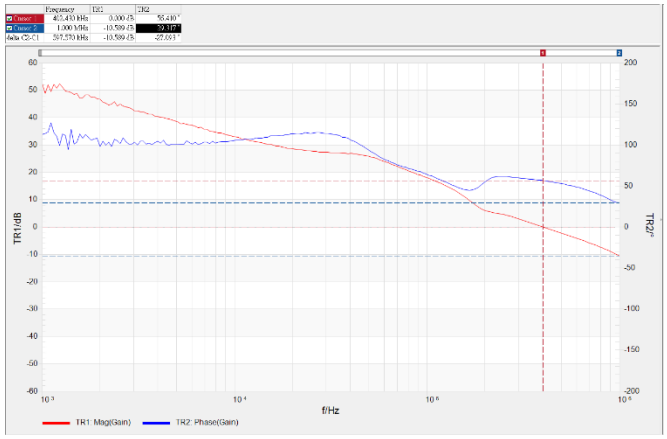
Power-On from VIN Yellow: VOUT; Cyan: LX; Pink: VIN; Green: PG	Power-Off from VIN Yellow: VOUT; Cyan: LX; Pink: VIN Green: PG
	
V_{IN} = 5V, V_{OUT} = 1V, I_{OUT} = 1A	V_{IN} = 5V, V_{OUT} = 1V, I_{OUT} = 1A

Power-On from EN Yellow: VOUT; Cyan: LX; Pink: EN; Green: PG	Power-Off from EN Yellow: VOUT; Cyan: LX; Pink: EN; Green: PG
	
V_{IN} = 5V, V_{OUT} = 1V, I_{OUT} = 1A	V_{IN} = 5V, V_{OUT} = 1V, I_{OUT} = 1A

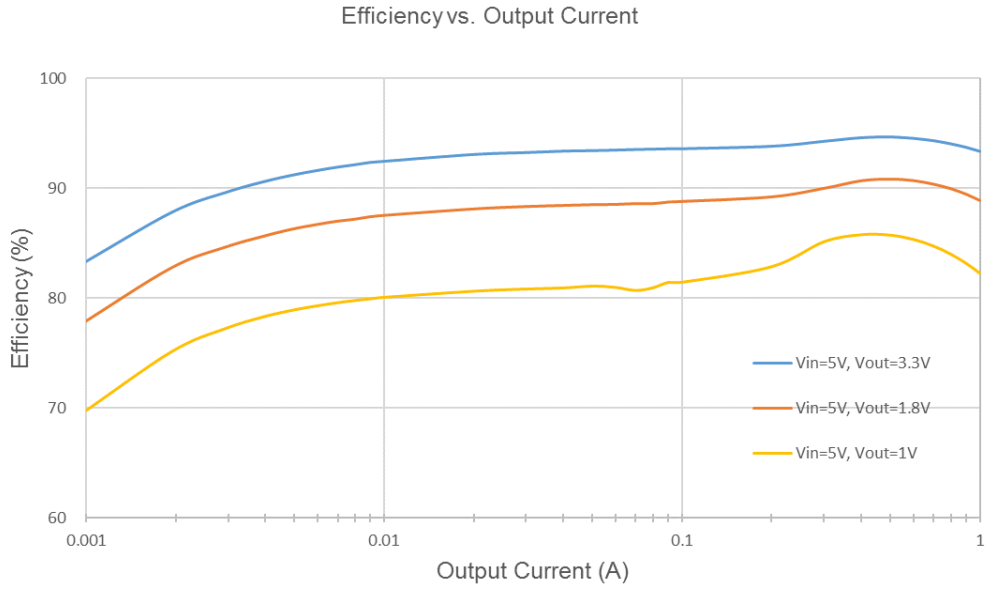
Output Ripple Measurement Yellow: VOUT; Cyan: LX	Output Ripple Measurement Yellow: VOUT; Cyan: LX
	
V_{IN} = 5V, V_{OUT} = 1V, I_{OUT} = 0.01A Output ripple: 17.6mVpp (PSM)	V_{IN} = 5V, V_{OUT} = 1V, I_{OUT} = 1A Output ripple: 4mVpp, Frequency: 2.164MHz (CCM)

Fast Dynamic Load Yellow: VOUT; Cyan: LX; Pink: IOUT	Fast Dynamic Load Yellow: VOUT; Cyan: LX; Pink: IOUT
	
V_{IN} = 5V, V_{OUT} = 1V, I_{OUT} = 0.01A to 0.5A (SR = 1A/μs) Output ripple: 45.6mVpp	V_{IN} = 5V, V_{OUT} = 1V, I_{OUT} = 0.5A to 1A (SR = 1A/μs) Output ripple: 52.8mVpp

OCP Function Yellow: VOUT; Cyan: LX; Green: Inductor current	UVP Function Yellow: VOUT; Cyan: LX; Green: Inductor current
	
VIN = 5V, VOUT = 1V, IOUT = 0A to OCP (Gradually increase load) Low-side current limit is 1.581A High-side current limit is 2.711A	VIN = 5V, VOUT = 1V, IOUT = 0A (Output short and recovery)

Bode Plot	
	
VIN = 5V, VOUT = 1V, IOUT = 1A Bandwidth = 402kHz Phase Margin = 56.4	

Efficiency Measurements



Evaluation Board Layout

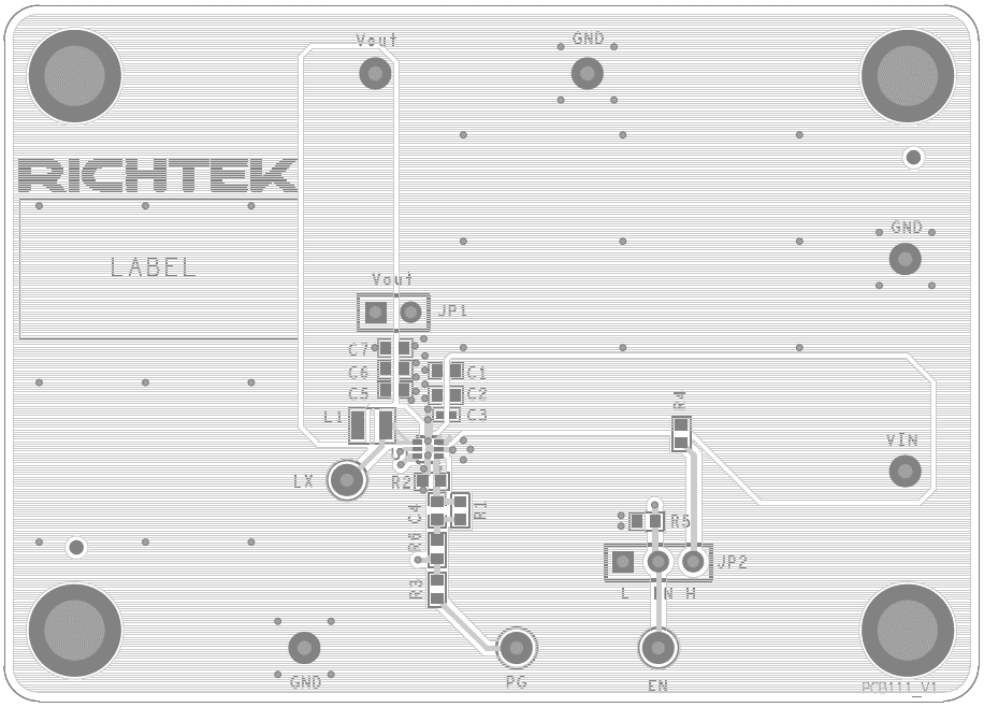


Figure 1. Top View (1st layer)

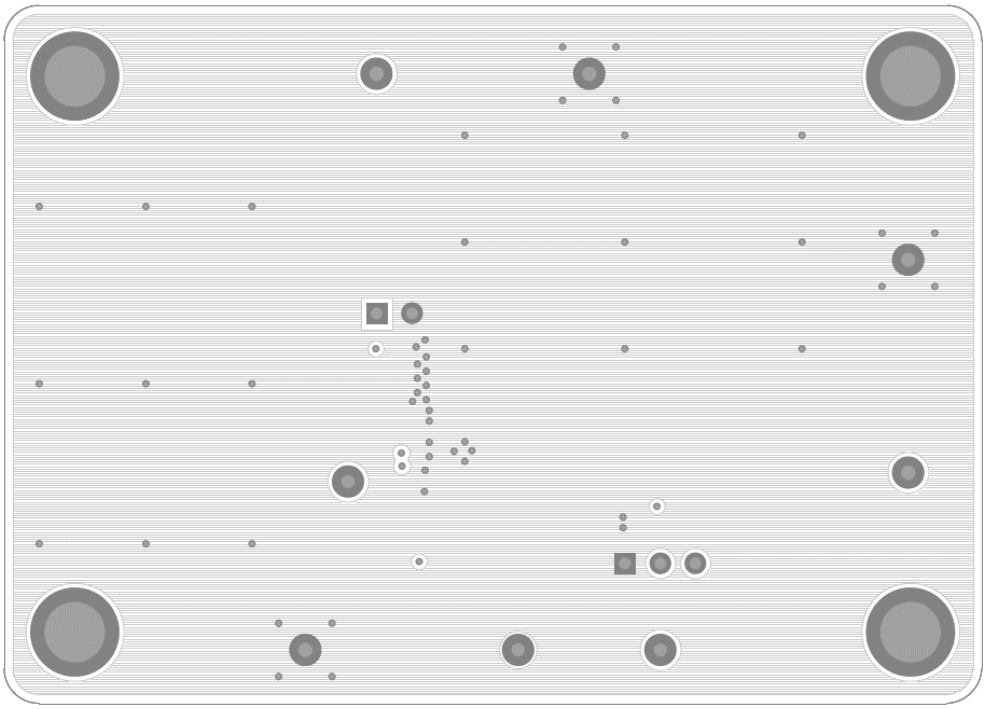


Figure 2. PCB Layout—Inner Side (2nd Layer)

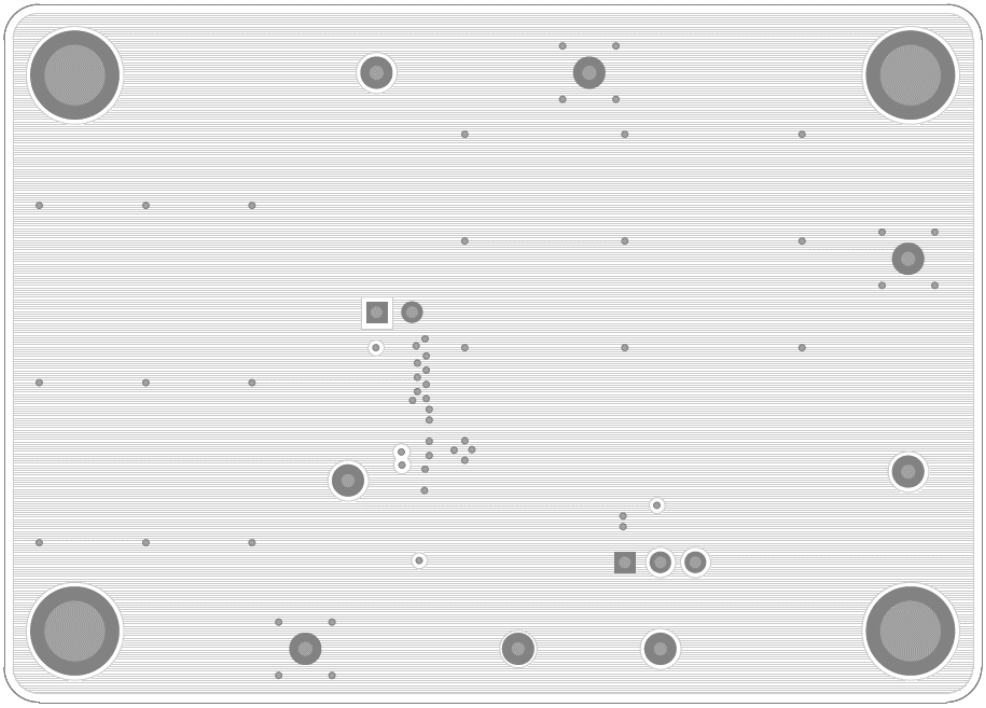


Figure 3. PCB Layout—Inner Side (3rd Layer)

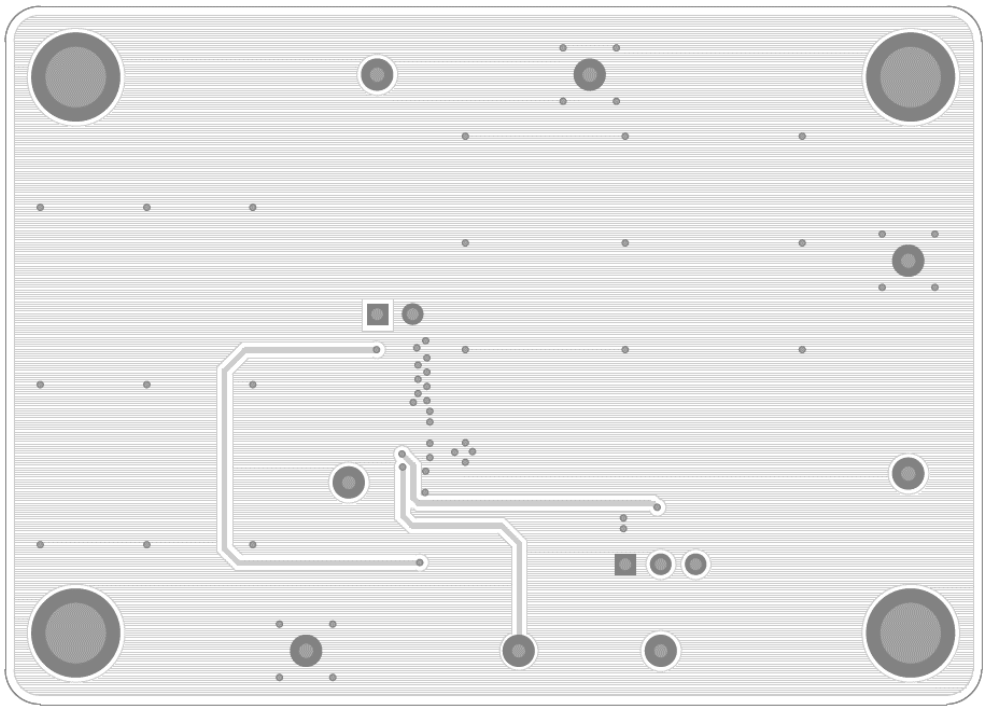


Figure 4. Bottom View (4th Layer)

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