

6A, 6V, Synchronous Step-Down Converter with REFIN

Purpose

The RT2660L is a current mode COT step-down converter with the input voltage range from 1V to 6V and provides 6A output current. This document explains the function and use of the RT2660L evaluation board (EVB), and provides information to enable operation, modification of the evaluation board and circuit to suit individual requirements.

Table of Contents

Purpose.....	1
Introduction.....	2
Key Performance Summary Table.....	2
Bench Test Setup Conditions.....	3
Schematic, Bill of Materials & Board Layout.....	5
More Information.....	9
Important Notice for Richtek Evaluation Board.....	9

Introduction

General Product Information

The RT2660L in thermally enhanced VQFN-20L 3.5x4 package is a full featured 6V, 6A synchronous step-down DC-DC converter designed specifically for Double Data Rate (DDR) memory termination, which provides a continuous 6A sink and source current and fixed 1/2 DDQ at output. The current mode COT architecture with external compensation allows the transient response to be optimized over a wide range of loads and achieves nearly constant switching frequency over line, load, and output voltage range. The multiple sets of over-current limit and switching frequency offer an optimized power chain for application design. Efficiency is maximized through the integrated 20mΩ/10mΩ MOSFETs, and cycle-by-cycle current limit provides protection against shorted output. Output external tracking function, output soft discharge, power good indicating, output droop support are all featured in the RT2660L. In addition, the device is specified from 0°C to 85°C to perform an excellent regulation with an accurate 1% reference voltage over-temperature.

Product Feature

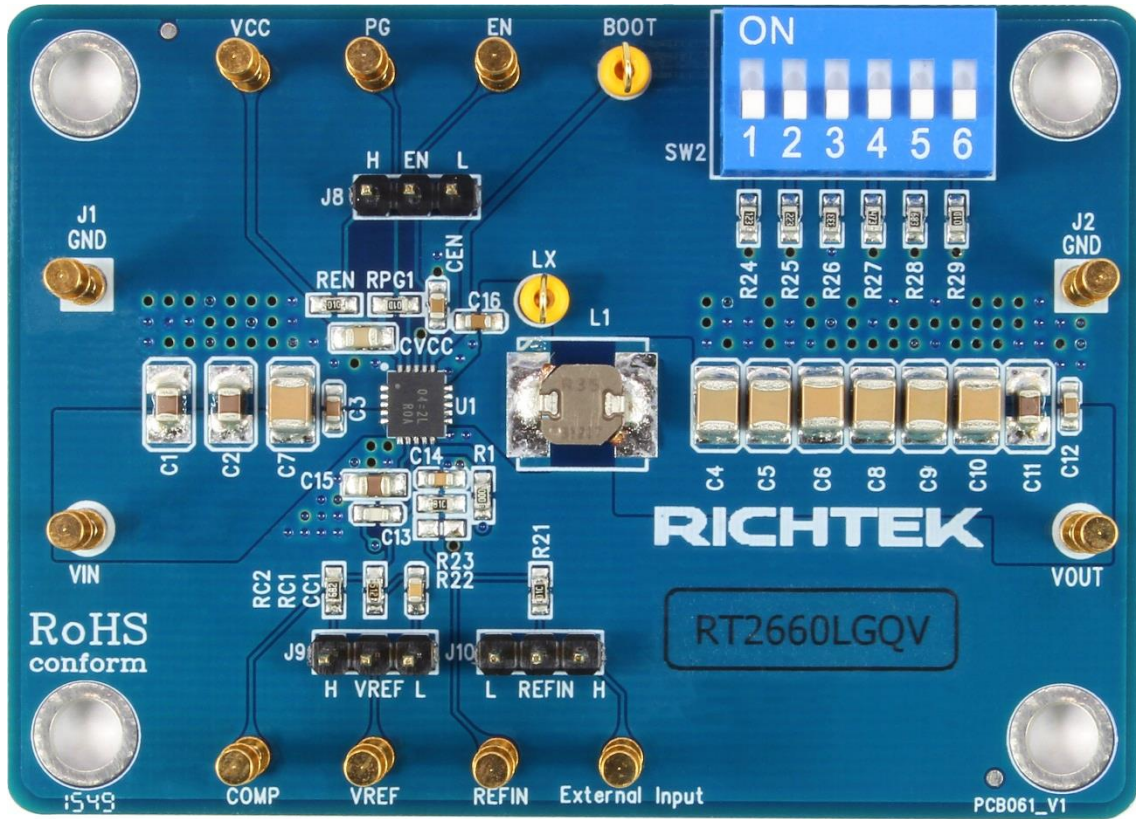
- **Continuous 6A Sink or Source Output Current ability and Droop Design for DDR Memory Termination Applications**
- **Low $R_{DS(ON)}$ Power N-MOSFET Switches 20mΩ/10mΩ**
- **Input voltage Range : 1V to 6V**
- **Output Adjustable from 0.6V to 2V**
- **Current-Mode Constant On-Time Control Design Enables Fast Transient Response**
- **Supports All MLCC Output Capacitor and SP/POSCAP with Robust Loop Stabilization**
- **Selectable 600kHz or 1MHz Switching Frequency**
- **Supports Pre-Biased Start-Up**
- **Selectable Over-Current Protection**
- **Various operation mode Selection for Different Application Requirements**
- **External tracking Start-Up Application**
- **Enable Input Control and Power Good Indicator**
- **Under-Voltage and Over-Voltage Protection**

Key Performance Summary Table

Key Features	Evaluation Board Number : PCB061_V1
Default Input Voltage	2.5V
Max Output Current	6A
Default Output Voltage	0.6V
Default Marking & Package Type	RT2660LGQV, VQFN-20L 3.5x4
Operation Frequency	Selectable 600kHz or 1MHz Switching Frequency

Bench Test Setup Conditions

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	Signal Name	Description
VIN	Input Voltage	Power input. Supplies the power switches of the device.
PGND	Ground	Power ground. Provide the ground return path for the low-side power MOSFET and positive input of an internal amplifier for current sensing circuit. The exposed pad must be soldered to a large PCB and connected to PGND for minimum power dissipation.
GND	Ground	Signal ground. Provides the return path for control circuitry and internal reference.
VREF	Reference Voltage	Reference output. A specified 2V reference output is supplied by internal linear regulator. Decouple with a 0.22μF capacitor between this pin and GND.

Test Point/ Pin Name	Signal Name	Description
COMP	Compensation Node	The current comparator threshold increases with this control voltage. Connect external compensation elements between this pin and VREF pin to stabilize the control loop.
REFIN	Input Reference Voltage	Reference input. The output voltage is targeted by reference input, which is applied from 0.6V to 2V.
VOUT	Output Voltage	Output voltage monitor node. A negative input of the gm error amplifier and it is allowed to be a discharge path if any protection is triggered.
LX	Switch Node	LX is the switching node that supplies power to the output and connect the output LC filter from SW to the output load.
BOOT	Bootstrap Supply	Bootstrap supply for high-side gate driver. Connect a 100nF or greater capacitor from SW to BOOT to power the high-side switch.
EN	Enable	Enable control input. Floating this pin or connecting this pin to logic high can enable the device and connecting this pin to GND can disable the device.
MODE	Mode	Mode selection node. There are 8 modes in RT2660. Connect the specified resistance to GND for selecting different modes of switching frequencies, OC limit thresholds, and light-load operations.
PGOOD	PGOOD	Power good indicator output. This pin is an open-drain logic output that is pulled to ground when the output voltage is lower or higher than its specified threshold under the conditions of OVP, OTP, dropout, EN shutdown, or during slow start.
VCC	Input Voltage	Fixed 5V supply voltage input. Supplies the control circuitry and internal reference of the device.

Power-Up & Measurement Procedure

1. Set the jumper at J8 to connect terminals 1 and 2, connecting EN to VCC through resistor REN, to enable operation.
2. Set the jumper at J9 to connect terminals 2 and 3, connecting VREF to COMP through resistor CC1 and RC1, to stabilize the control loop.
3. Set the jumper at J10 to connect terminals 2 and 3, connecting External Input to VREFIN through resistor R21, to Output Voltage Setting.
4. Apply a 5V nominal input power supply to the VCC and GND terminals.
5. Apply a 2.5V nominal input power supply (1V to 6V) to the VIN and GND terminals.
6. Apply a 1.2V nominal input power supply (1.2V to 4V) to the External Input and GND terminals.
7. Connect an external load up to 6A to the VOUT and GND terminals and verify the output voltage and current.

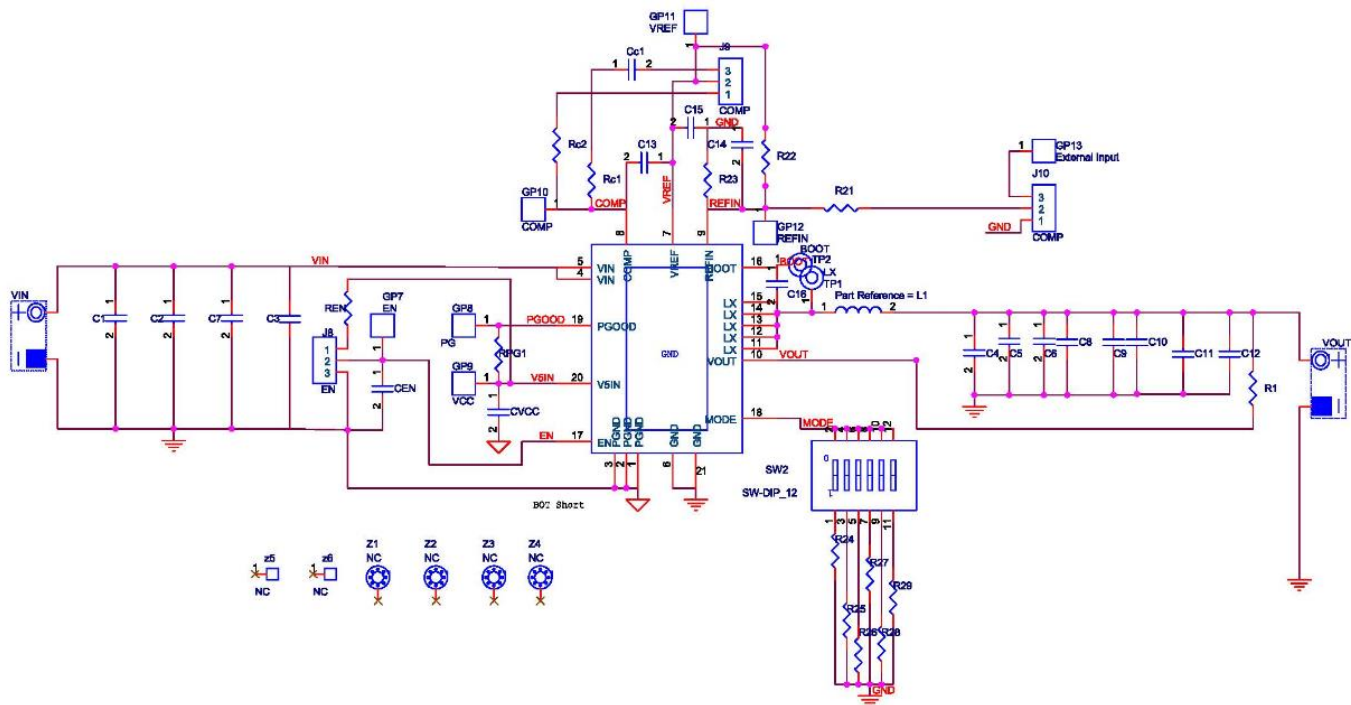
Output Voltage Setting

Set the output voltage must set the jumper at J10 to connect terminals 2 and 3, Use external power to External Input Pin, the resistive divider (R21, R23) between External Input and GND with the midpoint connected to VREFIN. The output is set by the following formula :

$$V_{REFIN} = \text{External Input } R23 / (R21 + R23)$$

Schematic, Bill of Materials & Board Layout

EVB Schematic Diagram

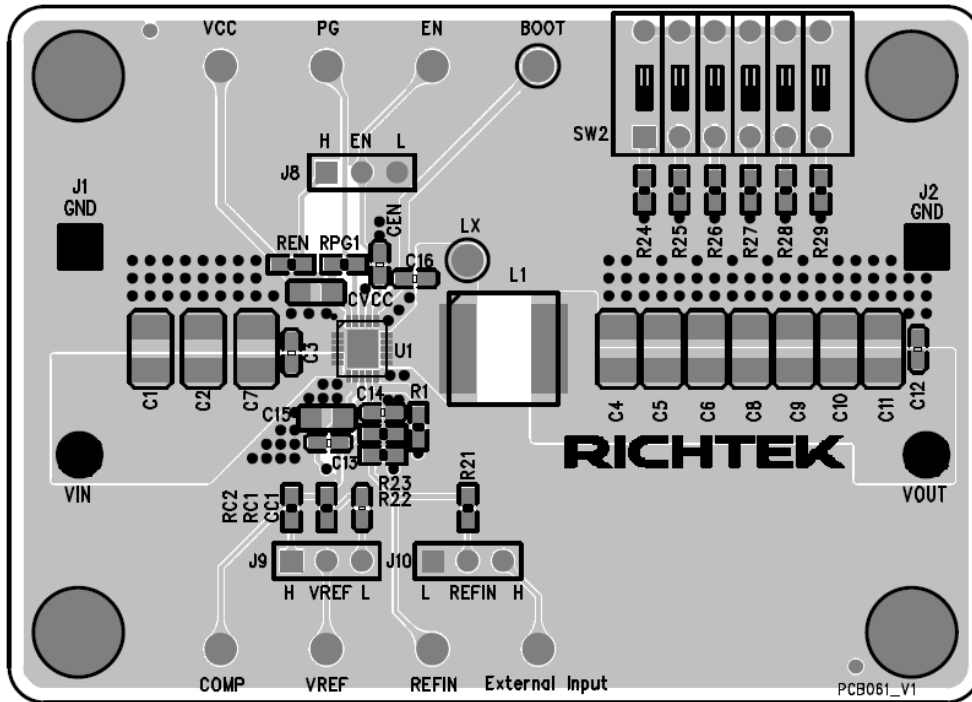


Bill of Materials

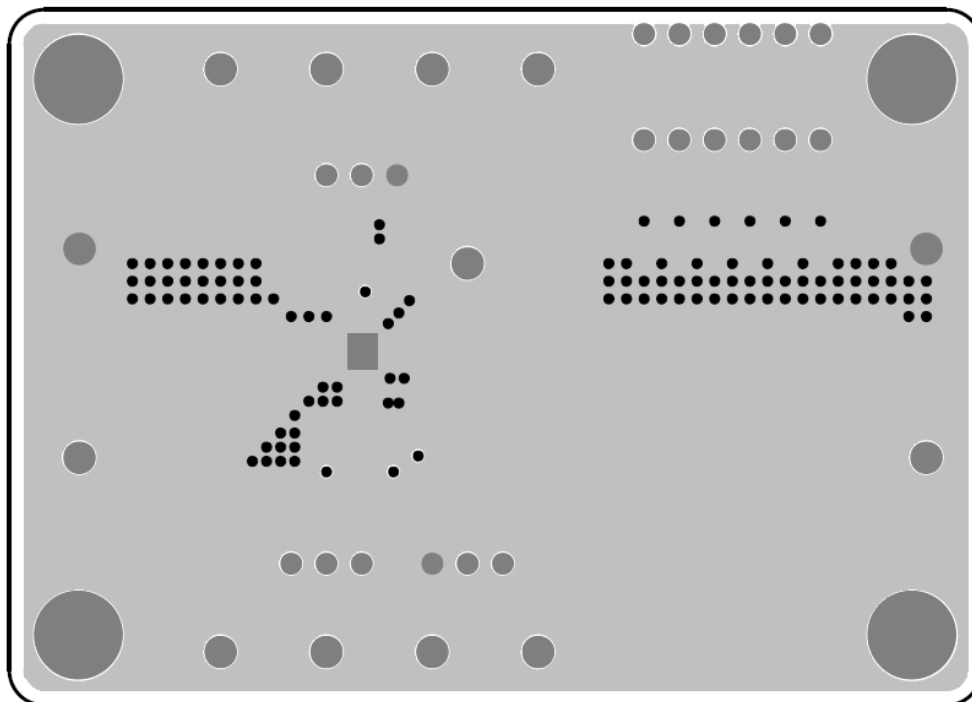
Reference	Qty	Part Number	Description	Package	Manufacturer
U1	1	RT2660LGQV	DC-DC Converter	VQFN-20L 3.5x4	RICHTEK
C3, C12, C16, CEN	4	C1608X7R1H104K080AA	0.1μF/±10%/50V/X7R	C-0603	TDK
CVCC	1	C2012X7R1E105KT	1μF/25V/X7R	C-0805	TDK
CC1	1	0603B332K500	3.3nF/50V/X7R	C-0603	WALSIN
C1, C2, C11	3	GRM219R60J226ME47D	22μF/6.3V/X5R	C-0805	muRata
C4, C5, C6, C7, C8, C9, C10	7	GRM32ER61C47476KE15L	47μF/16V/X5R	C-1210	muRata
C13	1	0603N330J500	33pF/50V/npo	C-0603	WALSIN
C14	1	0603B103K500	10nF/50V/X7R	C-0603	WALSIN
C15	1	C2012X7R1H105KT	1μF/50V/X7R	C-0805	TDK
GP7	1		EN		
GP8	1		PGOOD		
GP9	1		VCC		
GP10	1		COMP		
GP11	1		VREF		

Reference	Qty	Part Number	Description	Package	Manufacturer
GP12	1		REFIN		
GP13	1		External Input		
J1	1		VIN		
J2	1		VOUT		
J8	1		EN		
J9, J10	2		COMP, REFIN		
L1	1	SPM5030T-R35M	0.35 μ H/16.6A	5.20 x 5.00mm	TDK
R21, R23, REN	3	0603 10K 1%	Resistor, 10k Ω , 1%	R-0603	WALSIN
RPG1, R29	2	0603 100K 1%	Resistor, 100k Ω , 1%	R-0603	WALSIN
RC1	1	0603 5K1 1%	Resistor, 5.1k Ω , 1%	R-0603	WALSIN
RC2	1	0603 6K8 1%	Resistor, 6.8k Ω , 1%	R-0603	WALSIN
R1	1	0603 Jump 1%	Resistor, Jump, 1%	R-0603	WALSIN
R22	1		Open		
R24	1	0603 12K0 1%	Resistor, 12k Ω , 1%	R-0603	WALSIN
R25	1	0603 22K0 1%	Resistor, 22k Ω , 1%	R-0603	WALSIN
R26	1	0603 47K0 1%	Resistor, 33k Ω , 1%	R-0603	WALSIN
R27	1	0603 68K0 1%	Resistor, 47k Ω , 1%	R-0603	WALSIN
R28	1	0603 68K0 1%	Resistor, 68k Ω , 1%	R-0603	WALSIN
SW2	1		SW-DIP_12		
TP1	1		LX		
TP2	1		BOOT		
Z1, Z2, Z3, Z4	4		SIP-1P-M		
Z5, Z6	2		FK		

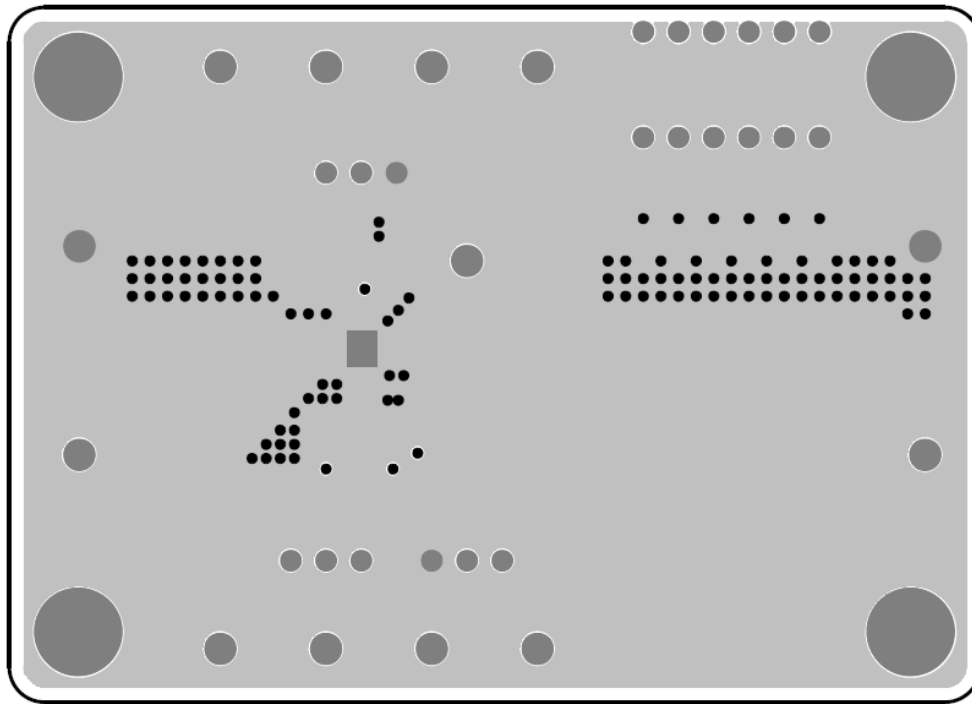
PCB Layout



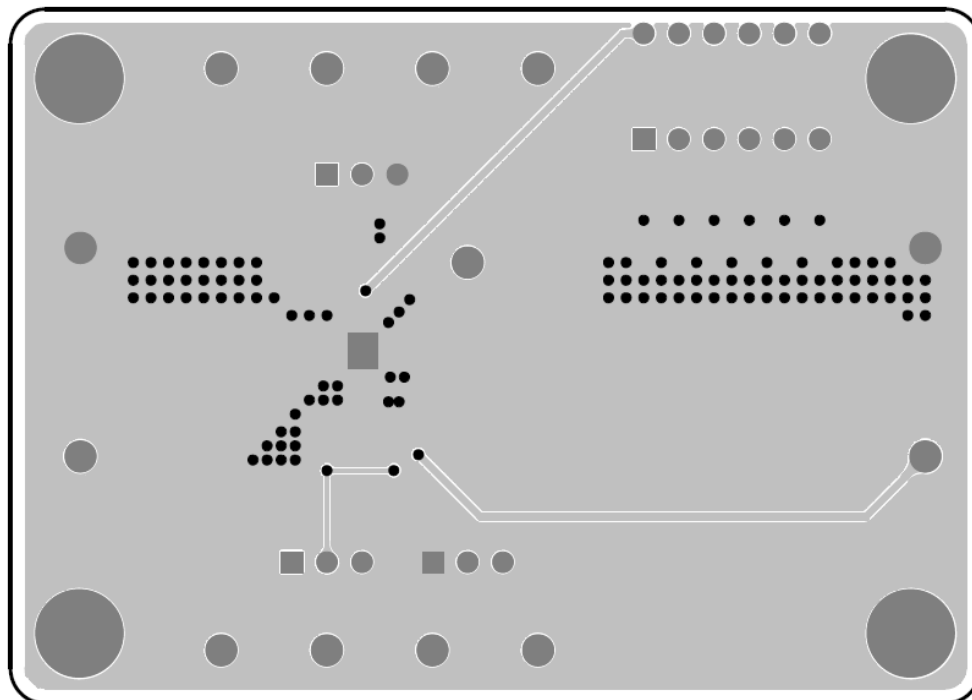
Top View (1st layer)



PCB Layout—Inner Side (2nd Layer)



PCB Layout—Inner Side (3rd Layer)



Bottom View (4th Layer)

More Information

For more information, please refer to the related datasheets or application notes from Richtek website <http://www.richtek.com>.

Important Notice for Richtek Evaluation Board

THIS DOCUMENT IS FOR REFERENCE ONLY, NOTHING CONTAINED IN THIS DOCUMENT SHALL BE CONSTRUED AS RICHTEK'S WARRANTY, EXPRESS OR IMPLIED, UNDER CONTRACT, TORT OR STATUTORY, WITH RESPECT TO THE PRESENTATION HEREIN. IN NO EVENT SHALL RICHTEK BE LIABLE TO BUYER OR USER FOR ANY AND ALL DAMAGES INCLUDING WITHOUT LIMITATION TO DIRECT, INDIRECT, SPECIAL, PUNITIVE OR CONSEQUENTIAL DAMAGES.