

## 3A, 18V, Synchronous Step-Down Converter

### *Purpose*

The RT6251BH is a current mode step-down converter with the input voltage range from 4.5V to 18V and provides 3A outputcurrent. This document explains the function and use of the RT6251BH evaluation board (EVB), and provides information to enable operation, modification of the evaluation board and circuit to suit individual requirements.

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## Introduction

### General Product Information

The RT6251BH is a high efficiency, monolithic synchronous step-down DC/DC converter that can deliver up to 3A output current from a 4.5V to 18V input supply. The RT6251BH current-mode architecture with external compensation allows the transient response to be optimized over a wide range of loads and output capacitors. Cycle-by-cycle current limit provides protection against shorted outputs and soft-start eliminates input current surge during start-up. Fault condition protections include output under-voltage protection, output over-voltage protection, and over-temperature protection. The low current shutdown mode provides output disconnection, enabling easy power management in battery-powered systems.

### Product Feature

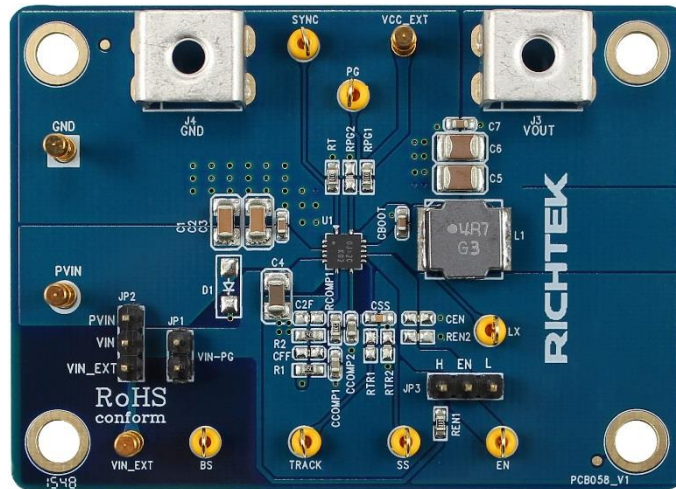
- Low  $R_{DS(ON)}$  Power MOSFET Switches 46m $\Omega$ /36m $\Omega$
- Input Voltage Range : 4.5V to 18V
- Adjustable Switching Frequency : 200kHz to 1.2MHz
- Current-Mode Control
- Synchronous to External Clock : 200kHz to 1.2MHz
- Accurate Voltage Reference 0.8V $\pm$ 1%
- Monotonic Start-Up into Pre-biased Outputs
- Adjustable Soft-Start
- Power Good Indicator
- Under-Voltage and Over-Voltage Protection
- Input Under-Voltage Lockout

### Key Performance Summary Table

Key Features	Evaluation Board Number : PCB058_V1
Default Input Voltage	12V
Max Output Current	3A
Default Output Voltage	3.3V
Default Marking & Package Type	RT6251BHGQW, WQFN-14AL 3.5x3.5
Operation Frequency	Steady 200kHz to 1.2MHz

**Bench Test Setup Conditions**

**Headers Description and Placement**



Please carefully inspect the EVB IC and external components, comparing them to the following Bill of Materials, to ensure that all components are installed and undamaged. If any components are missing or damaged during transportation, please contact the distributor or send e-mail to [evb\\_service@richtek.com](mailto: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	Comment (expected waveforms or voltage levels on test points)
<b>RT/SYNC</b>	Oscillator Resistor and External Frequency Synchronization Input	Oscillator Resistor and External Frequency Synchronization Input. Connecting a resistor from this pin to GND sets the switching frequency or connecting an external clock to this pin changes the switching frequency.
<b>GND</b>	System Ground	System Ground. Provide the ground return path for the control circuitry and low-side power MOSFET. The exposed pad must be soldered to a large PCB and connected to GND for minimum power dissipation.
<b>PVIN</b>	Power Input	Power Input. Supplies the power switches of the device.
<b>VIN</b>	Supply Voltage Input	Supply Voltage Input. Supplies the control circuitry and internal reference of the device.
<b>FB</b>	Feedback Voltage Input	Feedback Voltage Input. This pin is used to set the desired output voltage via an external resistive divider. The feedback reference voltage is 0.8V typically.
<b>COMP</b>	Compensation Node	Compensation Node. The current comparator threshold increases with this control voltage. Connect external compensation elements to this pin to stabilize the control loop. capacitor between the BOOT and LX pins.
<b>SS/TR</b>	Soft-Start and Tracking Control Input	Soft-Start and Tracking Control Input. Connect a capacitor from SS to GND to set the soft-start period. The soft-start period can be used to track and sequence when the external voltage on this pin overrides the internal reference.

Test point/ Pin name	Signal	Comment (expected waveforms or voltage levels on test points)
<b>EN</b>	Enable Control Input	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.
<b>LX</b>	Switch node test point	Switch Node. LX is the switching node that supplies power to the output and connect the output LC filter from LX to the output load.
<b>BOOT</b>	Bootstrap Supply for High-Side Gate Driver	Bootstrap Supply for High-Side Gate Driver. Connect a 100nF or greater capacitor from LX to BOOT to power the high-side switch.
<b>PGOOD</b>	Power Good Indicator Output	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.

### ***Power-up & Measurement Procedure***

1. Apply a 12V nominal input power supply ( $4.5V < V_{IN} < 18V$ ) to the VIN and GND terminals.
2. Set the jumper at J9 to connect terminals 1 and 2, connecting EN to VIN through resistor REN1, to enable operation.
3. Verify the output voltage (approximately 3.3V) between VOUT and GND.
4. Connect an external load up to 3A to the VOUT and GND terminals and verify the output voltage and current.

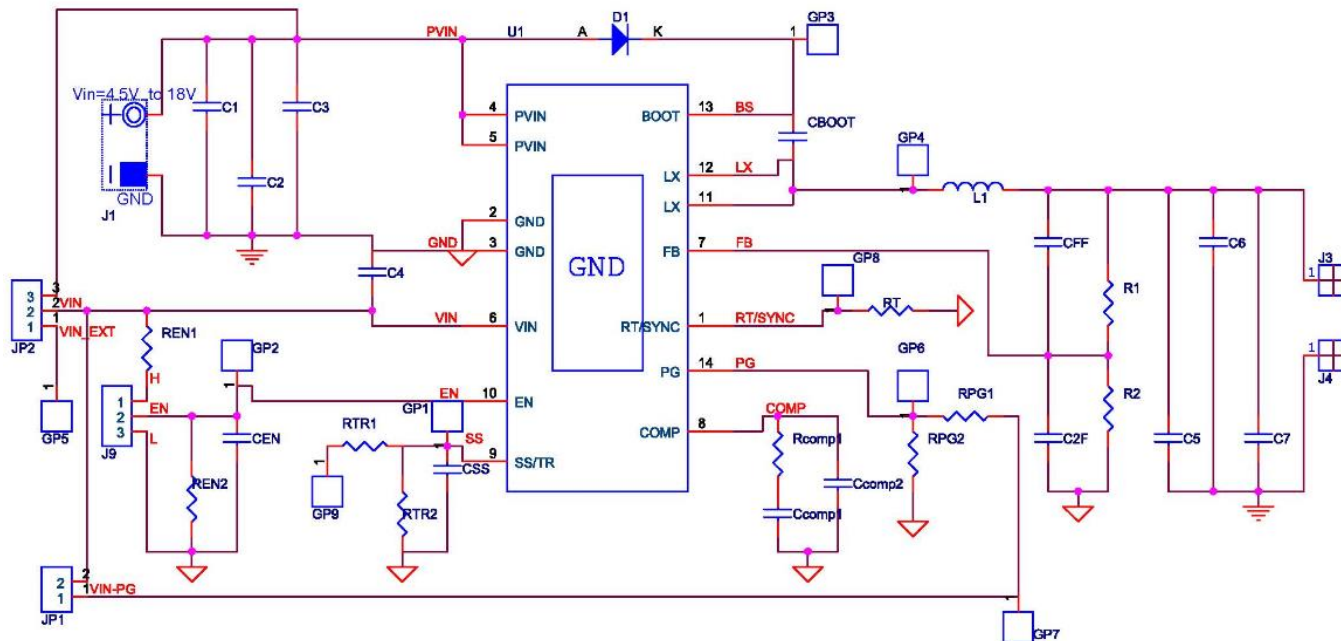
### ***Output Voltage Setting***

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 :

$$V_{OUT} = V_{FB} \times \left(1 + \frac{R1}{R2}\right)$$

**Schematic, Bill of Materials & Board Layout**

**EVB Schematic Diagram**

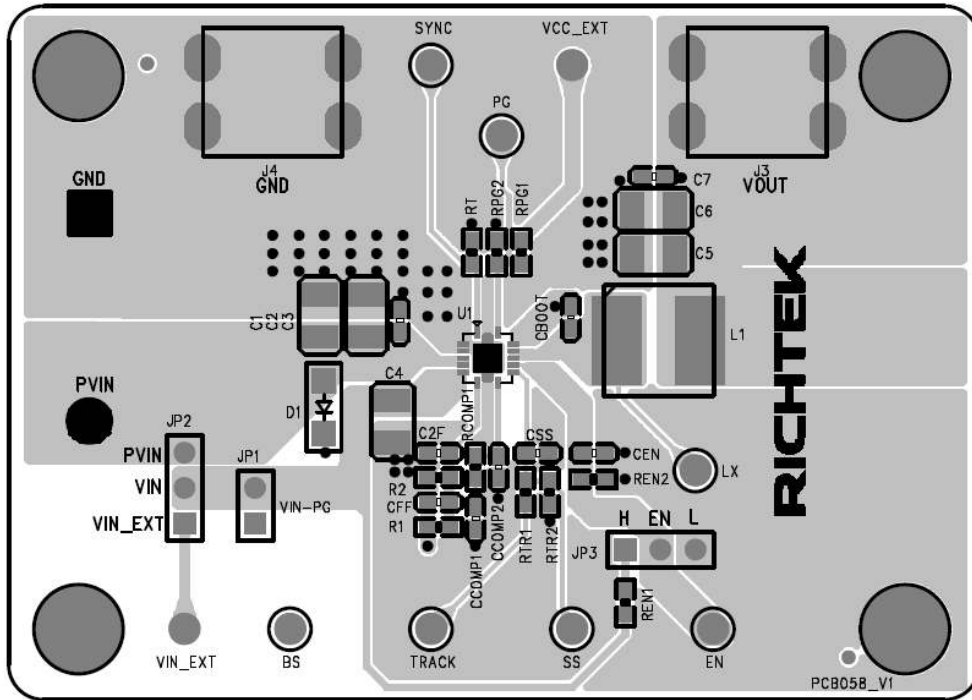


**Bill of Materials**

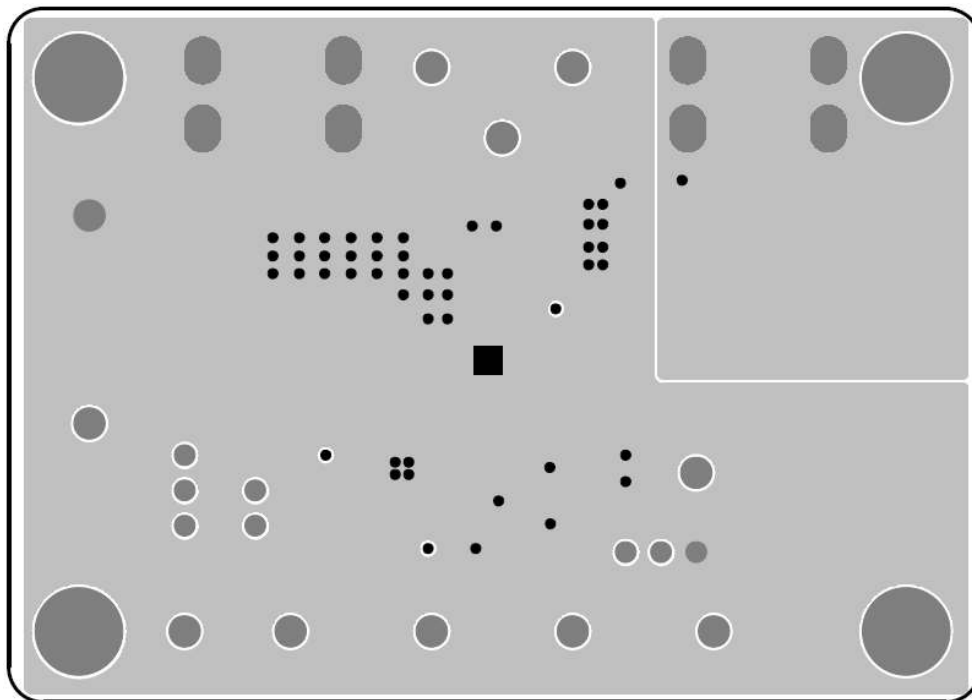
Reference	Qty	Part Number	Description	Package	Manufacture
C3, C7, CBOOT	3	C1608X7R1H104KT000N	0.1μF/50V/X7R/0603	C-0603	TDK
RTR1, RTR2, RPG2, REN2, C2F, CFF, CEN	7		NC		
CSS	1	0603B103K500	10nF/50V/X7R/0603	C-0603	WALSIN
Ccomp1	1	0603B153K500CT	15nF/50V/X7R/0603	C-0603	WALSIN
Ccomp2	1	0603B181K500	180pF/50V/X7R/0603	C-0603	WALSIN
C1, C2	2	UMK325BJ106MM-T	10μF/50V/X5R/1210	C-1210	TAIYO YUDEN
C4	1	GRM31CR71H475KA12L	4.7μF/50V/X7R/1206	C-1210	muRata
C5, C6	2	C3225X5R1E226MT	22μF/25V/X5R/1210	C-1210	TDK
D1	1		NC		
GP1	1		SS	SIP-1P-GP	
GP2	1		EN	SIP-1P-GP	
GP3	1		BS	SIP-1P-GP	
GP4	1		LX	SIP-1P-GP	
GP5	1		VIN_EXT	SIP-1P-GP	
GP6	1		PG	SIP-1P-GP	

Reference	Qty	Part Number	Description	Package	Manufacture
GP7	1		VCC_EXT	SIP-1P-GP	
GP8	1		SYNC	SIP-1P-GP	
GP9	1		TRACK	SIP-1P-GP	
JP1	1		SIP-2P	SIP-2P	
JP2,J9	2		SIP-3P	SIP-2P	
J1	1		PVIN\GND	SIP-2P-PWR_1	
J3	1		VOUT	sip-4p_pw_l	
J4	1		GND	sip-4p_pw_l	
L1	1		4.7 $\mu$ H	L-GSTB135	TAIYO YUDEN
RPG1, REN1, RT	3		100k/0603	R0603	
Rcomp1	1		3.48k/0603	R0603	
R1	1		75k/0603	R0603	
R2	1		24k/0603	R0603	
U1	1	RT6251BHGQW	DC/DC Converter	WQFN-14AL 3.5 x 3.5	RICHTEK
Z1, Z2, Z3, Z4	4		SIP-1P-M	PAD6	
Z5, Z6	2		SIP-1P-TP	FK_1	

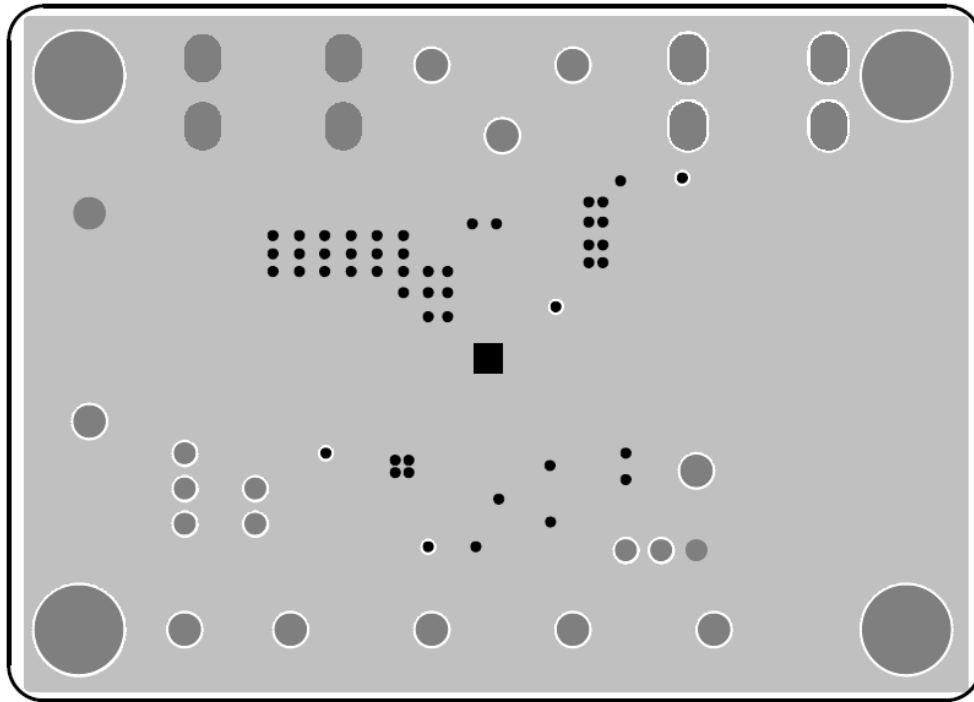
**PCB Layout**



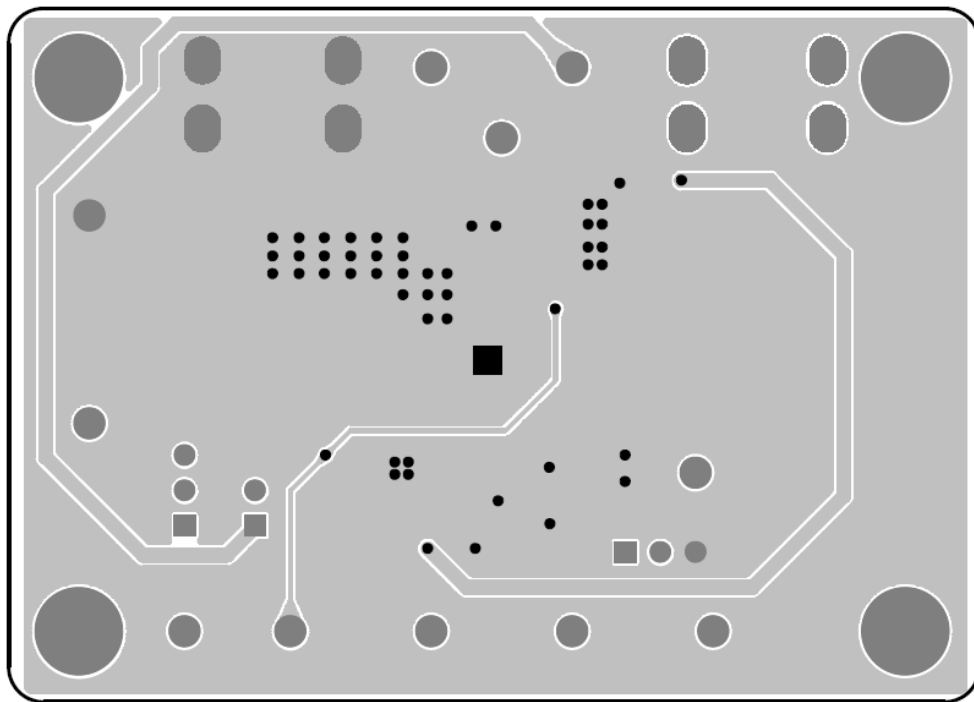
Top View (1<sup>st</sup> layer)



PCB Layout—Inner Side (2<sup>nd</sup> Layer)



PCB Layout—Inner Side (3<sup>rd</sup> Layer)



Bottom View (4<sup>th</sup> 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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