
600 mA 6 MHz Synchronous Step-down DC/DC Converter Evaluation Board

NO. EEV-318-K181B-230403

RP508K181B-EV is the evaluation board for RP508 which has the below features, benefits and specifications.

OUTLINE

The RP508K is a low supply current PWM/VFM step-down DC/DC converter with synchronous rectifier featuring 600 mA⁽¹⁾ output current. Internally, a single converter consists of an oscillator, a reference voltage unit, an error amplifier, a switching control circuit, a mode control circuit, a soft-start circuit, an under-voltage lockout (UVLO) circuit, an over current protection circuit, a thermal shutdown circuit and switching transistors. By the adoption of the synchronous rectification circuit with built-in switching transistors, the RP508K works as efficient step-down DC/DC converter, without connecting external diodes. Using synchronous rectification not only increases circuit performance but also allows a design to reduce parts count.

Power controlling method can be selected from forced PWM control type or PWM/VFM auto switching control type by inputting a signal to the MODE pin. In low output current, forced PWM control switches at fixed frequency rate in order to reduce noise. Likewise, in low output current, PWM/VFM auto switching control automatically switches from PWM mode to VFM mode in order to achieve high efficiency.

Output voltage is internally fixed type which allows output voltages that range from 0.8 V to 3.3 V in 0.1 V step. The output voltage accuracy is as high as $\pm 1.5\%$ or ± 18 mV.

Protection circuits included in the RP508K are over current protection circuit and thermal shutdown circuit. Over current protection circuit supervises the inductor peak current in each switching cycle, and if the current exceeds the I_{LXLIM} , it turns off P-channel Tr. Thermal shutdown circuit detects overheating of the converter if the output pin is shorted to the ground pin (GND) etc. and stops the converter operation to protect it from damage if the junction temperature exceeds the specified temperature.

FEATURES

- Input Voltage Range (V_{IN}) 2.3 V to 5.5 V (Absolute Maximum Ratings: 6.5 V)
- Output Voltage Range (V_{OUT}) 0.8 V to 3.3 V (Adjustable in 0.1 V steps)
- Supply Current (I_{DD2}) Typ. 15 μ A (VFM Mode with No-load)
- Standby Current ($I_{standby}$) Typ. 0 μ A
- Output Voltage Temperature Coefficient ($\Delta V_{OUT}/T_a$) Typ. ± 100 ppm/ $^{\circ}$ C
- Oscillator Frequency (f_{osc}) Typ. 6.0 MHz
- Maximum Duty Cycle (Maxduty) 100%
- Built-in Driver ON Resistance (R_{ONP} , R_{ONN}) Typ. Pch. 0.33 Ω , Nch. 0.24 Ω ($V_{IN} = 3.6$ V)
- UVLO Detector Threshold (V_{UVLO01}) Typ. 2.0 V

⁽¹⁾ This is an approximate value. The output current is dependent on conditions and external components.

- Soft-start Time (tstart) Typ. 90 μ s
- L_x Current Limit Circuit (I_{LXLIM}) Typ. 1.1 A
- Output Voltage Accuracy $\pm 1.5\%$ (V_{OUT} \geq 1.2 V) or ± 18 mV (V_{OUT} < 1.2 V)
- Package DFN(PL)1212-6F
- For more details on RP508 IC, please refer to
<https://www.nisshinbo-microdevices.co.jp/en/products/dc-dc-switching-regulator/spec/?product=rp508>

Part Number Information

Product Name	Package
RP508Kxx1\$-TR	DFN(PL)1212-6F

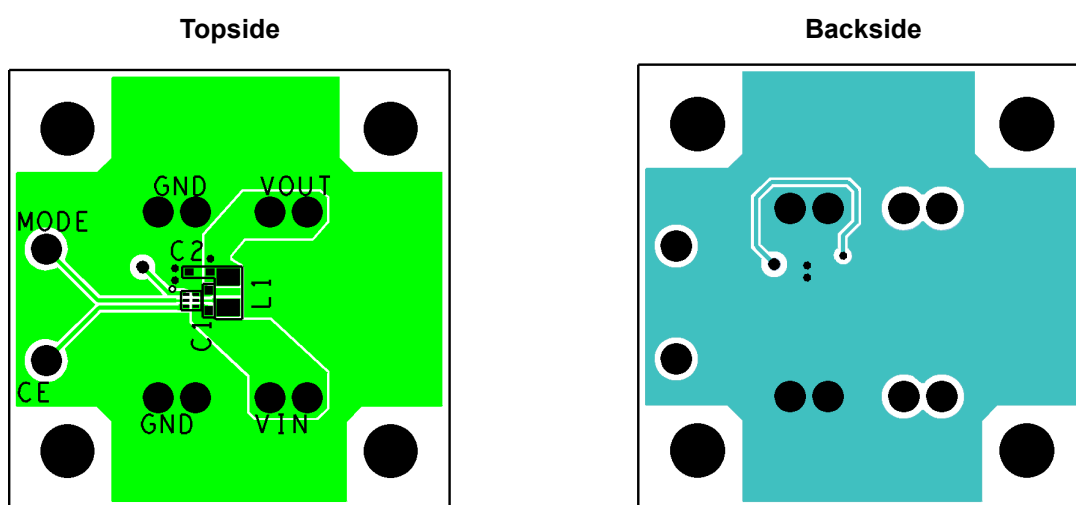
xx: Specify the set output voltage (V_{SET}).

xx: Fixed Output Voltage Type, 18: V_{SET}= 1.8 V

\$: Specify the auto-discharge option.

B: Fixed output voltage type, auto-discharge function in shutdown mode

PCB LAYOUT



DFN1212-6 Typical Board Layout

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings

Symbol	Item	Rating	Unit
V_{IN}	V_{IN} Input Voltage	-0.3 to 6.5	V
V_{LX}	L_X Pin Voltage	-0.3 to $V_{IN} + 0.3$	V
V_{CE}	CE Pin Input Voltage	-0.3 to 6.5	V
V_{MODE}	MODE Pin Input Voltage	-0.3 to 6.5	V
V_{OUT}	V_{OUT} Pin Voltage	-0.3 to 6.5	V
I_{LX}	L_X Pin Output Current	1300	mA
P_D	Power Dissipation ⁽¹⁾ (JEDEC STD 51-7 Test Land Pattern)	666	mW
T_j	Junction Temperature Range	-40 to 125	°C
T_{stg}	Storage Temperature Range	-55 to 125	°C

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings are not assured.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	2.3 to 5.5	V
T_a	Operating Temperature Range	-40 to 85	°C

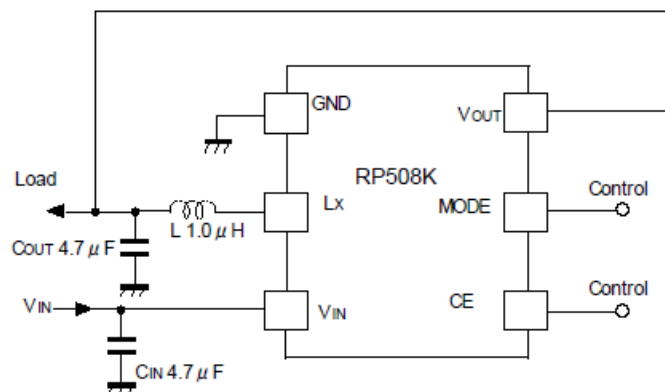
RECOMMENDED OPERATING CONDITIONS

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

⁽¹⁾ Refer to *POWER DISSIPATION* for detailed information.

APPLICATION INFORMATION

Typical Application



RP508K Typical Application

Recommended Components*1

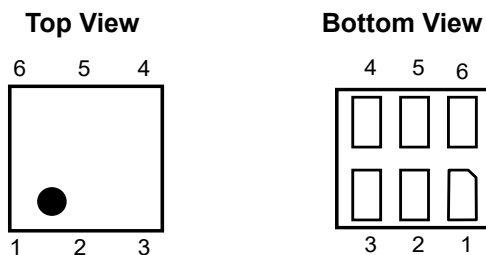
Symbol	Size
C _{IN}	4.7 μF
C _{OUT}	4.7 μF
L	1.0 μH

*1 The bill of materials will be attached on the shipment of each purchased evaluation board.

Set Output Voltage Range vs. Inductance Range

Voltage (V)	Input Voltage (V)	Inductance	
		L = 0.47 μH	L = 1.0 μH
VSET	VIN		
1.6 to 2.6	up to 3.6	Recommended	Acceptable
	up to 4.5	Acceptable	Recommended
	4.5 to 5.5	-	Recommended

PIN DESCRIPTION



DFN(PL)1212-6F Pin Configuration

Pin Description

Pin No.	Symbol	Pin Description
1	VOUT	Output Pin
2	MODE	Mode Control Pin ("H" forced PWM control, "L" PWM/VFM auto switching control)
3	CE	Chip Enable Pin ("H" active)
4	VIN	Input Pin
5	LX	LX Switching Pin
6	GND	Ground Pin

TECHNICAL NOTES

The performance of power source circuits using this IC largely depends on the peripheral circuits. When selecting the peripheral components, consider the conditions of use. Do not allow each component, PCB pattern and the IC to exceed their respected rated values (voltage, current and power) when designing the peripheral circuits.

1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to our sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without the prior written consent of us.
3. This product and any technical information relating thereto are subject to complementary export controls (so-called KNOW controls) under the Foreign Exchange and Foreign Trade Law, and related politics ministerial ordinance of the law. (Note that the complementary export controls are inapplicable to any application-specific products, except rockets and pilotless aircraft, that are insusceptible to design or program changes.) Accordingly, when exporting or carrying abroad this product, follow the Foreign Exchange and Foreign Trade Control Law and its related regulations with respect to the complementary export controls.
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5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death should first contact us.
 - Aerospace Equipment
 - Equipment Used in the Deep Sea
 - Power Generator Control Equipment (nuclear, steam, hydraulic, etc.)
 - Life Maintenance Medical Equipment
 - Fire Alarms / Intruder Detectors
 - Vehicle Control Equipment (automotive, airplane, railroad, ship, etc.)
 - Various Safety Devices
 - Traffic control system
 - Combustion equipment

In case your company desires to use this product for any applications other than general electronic equipment mentioned above, make sure to contact our company in advance. Note that the important requirements mentioned in this section are not applicable to cases where operation requirements such as application conditions are confirmed by our company in writing after consultation with your company.

6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. The products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. We shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products.
8. **Quality Warranty**
 - 8-1. **Quality Warranty Period**

In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
 - 8-2. **Quality Warranty Remedies**

When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.

Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
 - 8-3. **Remedies after Quality Warranty Period**

With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.



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