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

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NO. EEV-318-K331B-230403

**RP508K331B-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<sup>(1)</sup> 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  $\pm 18$  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  $\mu$ A (VFM Mode with No-load)
- Standby Current ( $I_{standby}$ ) ..... Typ. 0  $\mu$ A
- Output Voltage Temperature Coefficient ( $\Delta V_{OUT}/T_a$ ) ..... Typ.  $\pm 100$  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  $\Omega$ , Nch. 0.24  $\Omega$  ( $V_{IN} = 3.6$  V)
- UVLO Detector Threshold ( $V_{UVLO01}$ ) ..... Typ. 2.0 V

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

- Soft-start Time (tstart) ..... Typ. 90  $\mu$ s
- L<sub>x</sub> Current Limit Circuit (I<sub>LXLIM</sub>) ..... Typ. 1.1 A
- Output Voltage Accuracy .....  $\pm 1.5\%$  (V<sub>OUT</sub>  $\geq$  1.2 V) or  $\pm 18$  mV (V<sub>OUT</sub> < 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

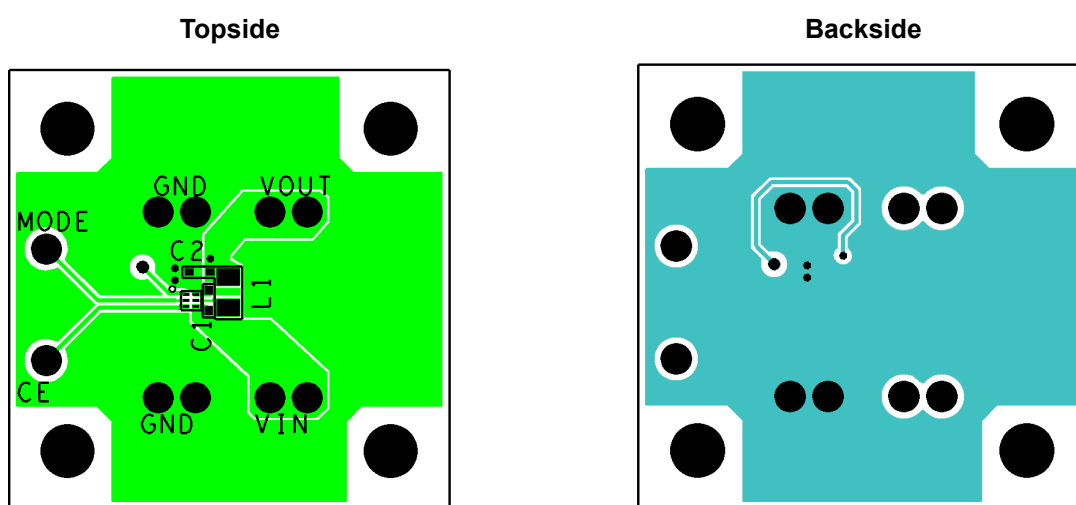
xx: Specify the set output voltage (V<sub>SET</sub>).

xx: Fixed Output Voltage Type, 33: V<sub>SET</sub>= 3.3 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 <sup>(1)</sup> (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

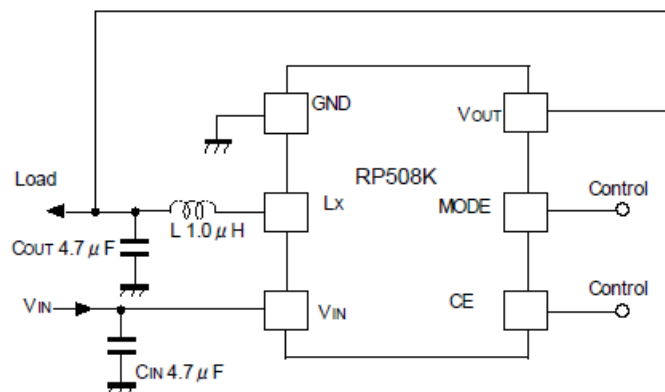
### RECOMMENDED OPERATING CONDITIONS

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.

<sup>(1)</sup> Refer to *POWER DISSIPATION* for detailed information.

## APPLICATION INFORMATION

### Typical Application



RP508K Typical Application

### Recommended Components\*1

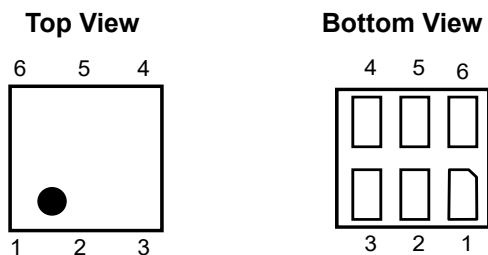
Symbol	Size
C <sub>IN</sub>	4.7 μF
C <sub>OUT</sub>	4.7 μF
L	1.0 μH

\*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	L = 0.47 μH	L = 1.0 μH
2.7 to 3.3	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.
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  - Fire Alarms / Intruder Detectors
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  - Various Safety Devices
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  - 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.
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