

220VAC Input/12W Output

# Non-Isolated AC/DC Converter with Built-In Zero Cross Signal Output

**BP5013**

## ● Absolute Maximum Ratings

Parameter	Symbol	Limits	Unit
Input voltage	$V_i$	-170	V
Zero-cross input voltage	$V_1$	120	V <sub>rms</sub>
Operating temperature range	$T_{opr}$	-20 to +85	°C
Storage temperature range	$T_{stg}$	-25 to +105	°C
Maximum surface temperature	$T_{smx}$	105	°C
Maximum output power	$P_o$	12	W

## ● Electrical Characteristics

 (Unless otherwise specified,  $T_a=25^{\circ}\text{C}$ ,  $V_i=-141\text{V}$ ,  $I_o=1000\text{mA}$ ,  $V_2=-5\text{V}$ ,  $R_1=10\text{k}\Omega$ )

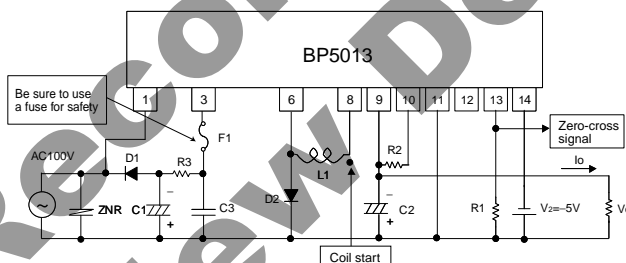
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input voltage range	$V_i$	-113	-141	-170	V	DC
Output voltage	$V_o$	-11	-12	-13	V	—
Output current	$I_o$	—	—	1000	mA	*1
Line regulation	$V_r$	—	0.03	0.2	V	$V_i=-113$ to $-170\text{V}$
Load regulation	$V_l$	—	0.13	0.2	V	$I_o=0$ to $1000\text{mA}$
Output ripple voltage	$V_p$	—	0.22	0.35	V <sub>p-p</sub>	*2
Power conversion efficiency	$\eta$	75	83	—	%	—
Zero-cross signal H	$V_{zH}$	0	—	-0.3	V	$V_1=-141\text{V}$
Zero-cross signal L	$V_{zL}$	-4.6	-5.0	-5.3	V	$V_1=0\text{V}$

\*1 Max output current should be reduced according to the surrounding temperature.

\*2 The output ripple voltage may vary depending on the capacitance, environment, and location of peripheral components.

## ● Application Circuit

Pin No.	Function
1	Zero-cross input 1 (ACin)
2	Skip
3	Input ( $V_i$ )
4	Skip
5	Skip
6	Coil 1 (Coil-1)
7	Skip
8	Coil 2 (Coil-2)
9	Output ( $V_o$ )
10	ADJ ( $V_{oADJ}$ )
11	Common
12	Test
13	Zero-cross signal output (Zc <sub>out</sub> )
14	Zero-cross signal input (-5V) (Zc)


 Please verify operation and characteristics in the customer's circuit before actual usage.  
 Ensure that the load current does not exceed the maximum rating.

### External Component Specifications

**F1: FUSE**

Use a fast-acting fuse of 2.0A.

**C1: Input capacitor**

 Rated voltage : Beyond 250V, capacitance : 47 to 220 $\mu\text{F}$ 
**C2: Output capacitor**

Rated ripple current : 0.22Arms or higher

 Rated voltage : Please ensure a rated voltage (whose value is proportional to the output voltage) with sufficient margin  
 capacitance : 330 to 1000 $\mu\text{F}$ , low impedance type  
 ESR : Less than 0.08 $\Omega$ 

Rated ripple current : Beyond 1.0Arms

Evaluate under actual operating conditions since it affects the output ripple voltage.

 Rated voltage : Beyond 250V, Capacity : 0.1 to 0.22 $\mu\text{F}$ 

Film or ceramic capacitor

 Resistance : 10 to 22 $\Omega$ , Power : More than 1/4W

Peak reverse voltage : More than 400V

Mean rectifying current : More than 1.0A

Peak forward surge current : More than 20A

Full-wave rectification can be used.

Peak reverse voltage : More than 400V

Mean rectifying current : More than 3.0A, Fast recovery diode

Please note that both the switching and efficiency characteristics

of the module are affected by this diode. Recommended

products : RF2001T4S (Rohm), 31DF4 (Nihon Inter), RU30 (Sanken).

 Inductance : 330 $\mu\text{H}$  ( $V_o=-12\text{V}$ )

Rated current : More than 1.3A

Please refer to the Output Voltage Settings table to the right.

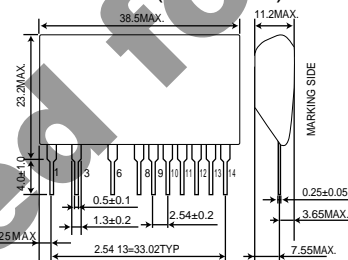
A varistor is required to protect against lightning surges and static electricity.

 10k $\Omega$  1/10W

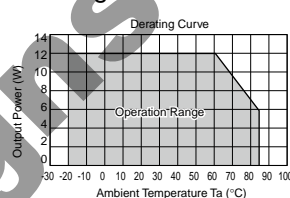
Refer to the Output Voltage Settings table to the right.

**C3: Noise removal capacitor**  
**R3 : Noise removal resistor**  
**D1: Rectifier diode**
**D2: Flywheel Diode**
**L1: Power inductor**
**ZNR: Varistor**
**R1: Pull-up resistor**
**R2: Output voltage setting resistor**

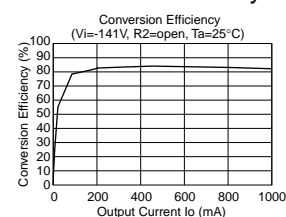
## ● Dimensions (Unit : mm)



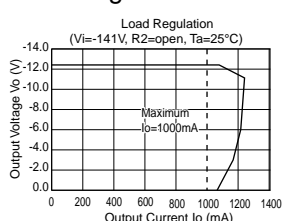
## ● Derating Curve



## ● Conversion Efficiency

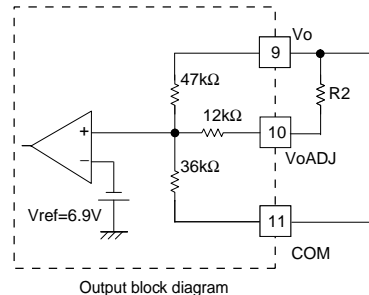


## ● Load Regulation



## ● Output Voltage Settings

$V_o$	$I_o$	$R_2$	$L_1$
-12V	1000mA	open	330 $\mu\text{H}$
-15V	800mA	75k $\Omega$	470 $\mu\text{H}$
-24V	500mA	8.2k $\Omega$	1mH
-30V	400mA	1.8k $\Omega$	1mH



# Power Module Usage Precautions

## Safety Precautions

- 1) The products are designed and manufactured for use in ordinary electronic equipment (i.e. AV/OA/telecommunication/amusement equipment, home appliances). Please consult with the Company's (ROHM) sales staff if intended for use in devices requiring high reliability (e.g. medical/transport/aircraft/spacecraft equipment, nuclear power/fuel controllers, automotive/safety devices) and whose malfunction may result in injury or death. In this case, failsafe measures must be taken, including the following:
  - [a] Installation of protection circuits in order to improve system safety
  - [b] Incorporation of redundant circuits in the case of single-circuit failure
- 2) The products are designed for use under normal conditions. Application in special environments can cause a deterioration in product performance. Therefore, verification and confirmation of product performance, prior to use, is recommended. The following environments are considered to be 'special':
  - [a] Outdoors, exposed to direct sunlight or dust
  - [b] In contact with liquids, such as water, oils, chemicals, or organic solvents
  - [c] In areas where exposure to the sea air or corrosive gases (i.e.  $\text{Cl}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ ,  $\text{SO}_2$ ,  $\text{NO}_2$ ) can occur
  - [d] In places where the products may be in contact with static electricity or electromagnetic waves
  - [e] In proximity to heat-producing items, plastic cords, or flammable materials
  - [f] In contact with sealing or coating products, such as resin
  - [g] In contact with unclean solder or exposed to water or water-soluble cleaning agents used after soldering
  - [h] In areas where dew condensation occurs
- 3) The products are not designed to be radiation resistant
- 4) The Company is not responsible for any problems resulting from use of the products under conditions not recommended herein.
- 5) The Company should be notified of any product safety issues. Moreover, product safety issues should be periodically monitored by the customer.

## Application Notes

- 1) A sufficient margin must be allowed if changes are made to the peripheral circuit due to variations in the inherent tolerances of the external components as well as transient and static characteristics. In addition, please be aware that the Company has not conducted investigations on whether or not particular changes in the example application circuits would result in patent infringement.
- 2) The application examples, their constants, and other types of information contained herein are applicable only when the products are used in accordance with standard methods.  
Therefore, if mass production is intended, sufficient consideration to external conditions must be made.

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