

# AC-DC converter unit

## BP5030

The BP5030 is an AC-DC converter that provides a direct current (5V) from commercial power supply (100V, AC), with a small number of external components required. Using this IC, a compact microcontroller-based device can be configured without a transformer.

### ●Applications

Power supplies for vacuum cleaners, rice cookers, electric pots, steam irons, telephones, electric heaters, lighting equipment, gas leakage alarms, and sensors

### ●Features

- 1) Smaller and lighter than transformers.
- 2) Wide range of input voltage (80 ~ 120V, AC).
- 3) Few external components required.
- 4) Power supply board is resistant to impacts because a transformer is not used.
- 5) The hybrid IC allows easy assemblage of components.

### ●Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	$V_i$	170	V
Operating temperature	$T_{opr}$	-25~80	°C
Storage temperature	$T_{stg}$	-25~105	°C

### ●Electrical characteristics (Unless otherwise noted, Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input voltage	$V_i$	113	141	170	V	DC
Output voltage	$V_o$	4.7	5	5.3	V	$I_o=50\text{mA}$ , $V_i=141\text{V}$
Output current	$I_o$	0	—	100	mA	$V_i=141\text{V}$ *1
Line regulation	$V_r$	—	0.03	0.1	V	$I_o=50\text{mA}$ , $V_i=113\sim 170\text{V}$
Load regulation	$V_l$	—	0.05	0.15	V	$I_o=0\sim 50\text{mA}$ , $V_i=141\text{V}$
Output ripple voltage	$V_p$	—	0.05	0.15	$V_{pp}$	$I_o=50\text{mA}$ , $V_i=141\text{V}$ *2
Power conversion efficiency	$\eta$	35	46	—	%	$I_o=100\text{mA}$ , $V_i=141\text{V}$

\*1 Based on the derating curve.

\*2 Output ripple voltage does not include spike noise.

● Measurement circuit

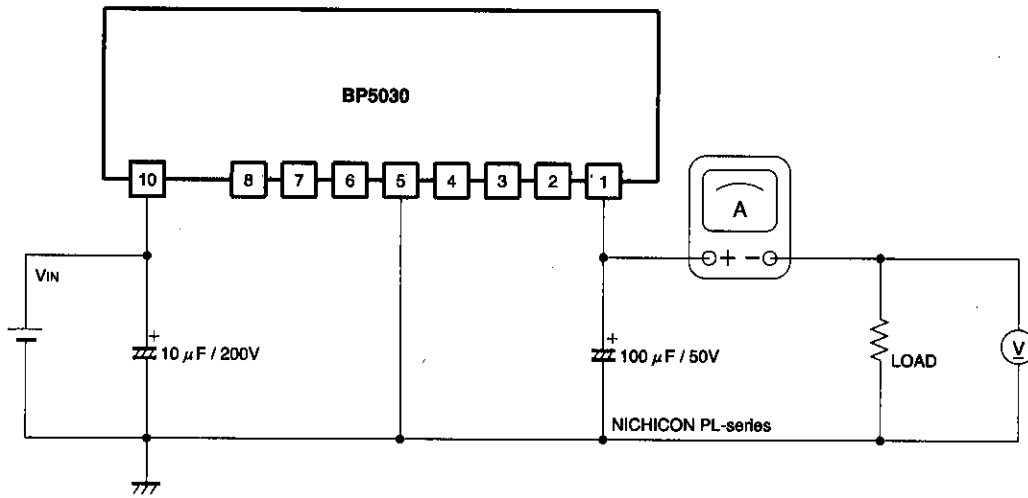
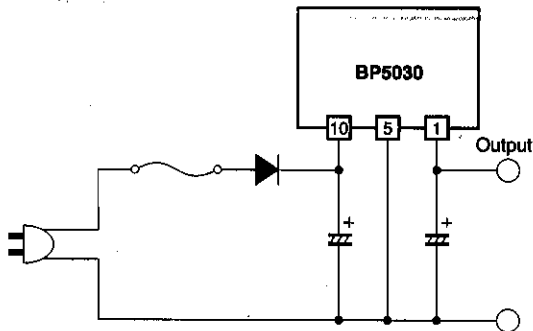


Fig.1

Pin No.	Pin name
1	V <sub>OUT</sub>
2	NC
3	Internally connected pin
4	NC
5	COMMON
6	NC
7	Internally connected pin
8	NC
9	Not used
10	V <sub>IN</sub>

● Basic circuits

Half wave rectifier circuit



Full wave rectifier circuit

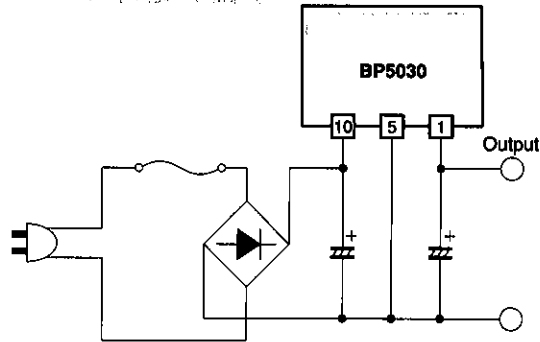


Fig.2

●Application example

Example of a vacuum cleaner application

The diode bridge, which draws out a zero-cross signal, is not required if a zero-cross signal is not used.

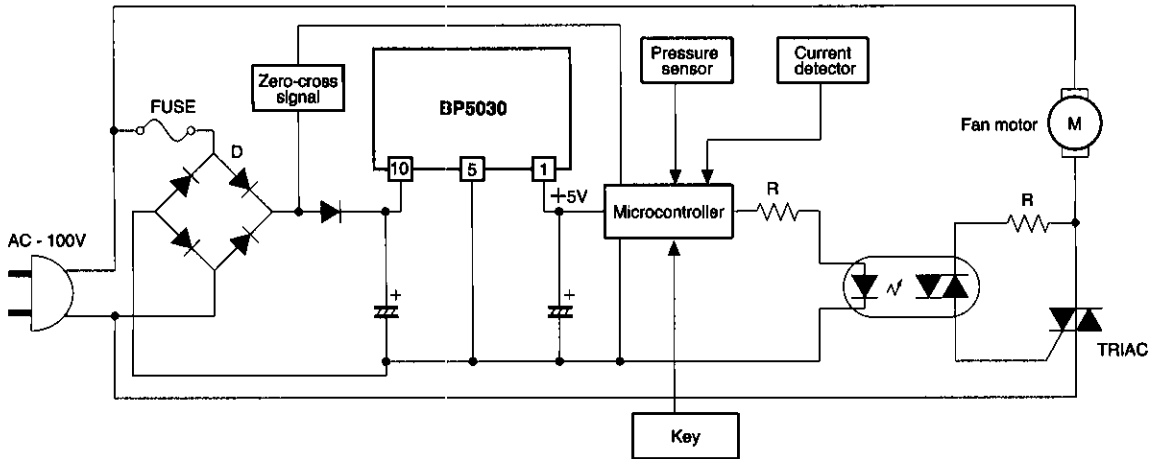


Fig. 3

Example of a rice cooker application

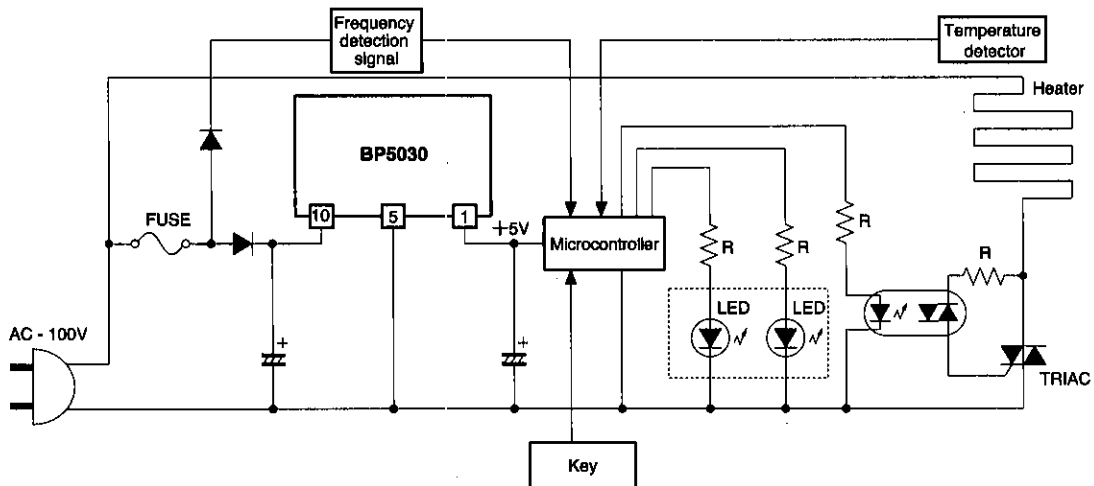


Fig.4

● External component setting

1. Diodes

Use rectifier diodes with the following absolute maximum ratings : minimum peak reverse voltage is 400V, the mean rectifying current is more than 0.5V, and minimum peak forward surge current is 20A. For example, 1SR35-400A is recommended.

2. Input voltage smoothing capacitor

When the capacitance of this capacitor is increased, the output voltage is stabilized but the start-up rush current is increased. The waveforms of rush currents for capacitance values of  $3.3 \mu F$  (Fig. 5) and  $10 \mu F$  (Fig. 7) are shown in Figs. 6 and 8, respectively. The recommended capacitance is plotted against the output current in Fig. 9. The capacitor must have a withstand voltage of at least 200V.

3. Output voltage smoothing capacitor

Use a capacitor with a small ESR. Specifically, a low-impedance capacitor for power supply switching is recommended. The capacitor's ESR affects the output ripple voltage. Capacitor products are listed below for reference.

Manufacturer	Product
NICHIKON	PJ series
Matsushita Electronic Components	A type FA series

Application circuit 1 ( $C_{IN}=3.3 \mu F$ )

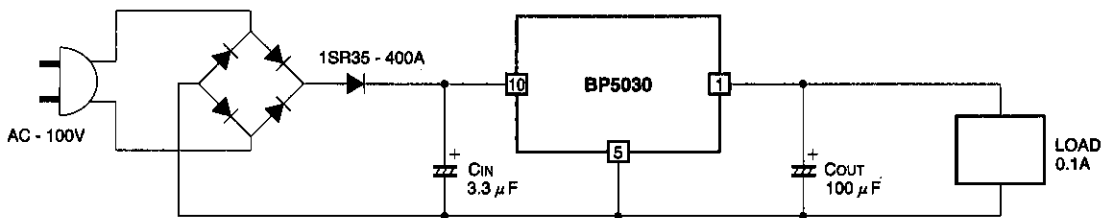


Fig.5

Rush current waveform

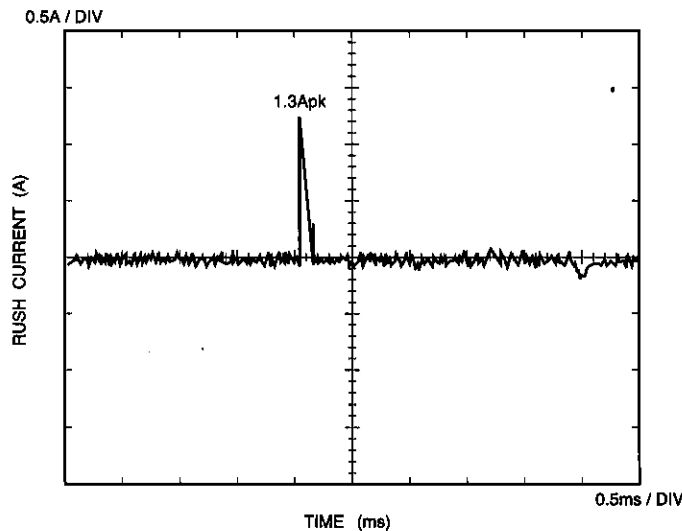


Fig.6

Application circuit 2 ( $C_{IN}=10\ \mu F$ )

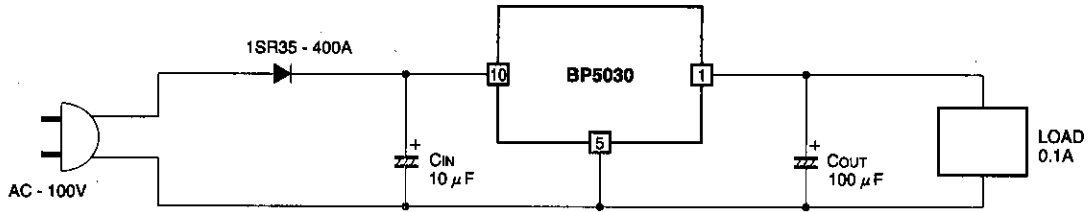


Fig.7

Rush current waveform

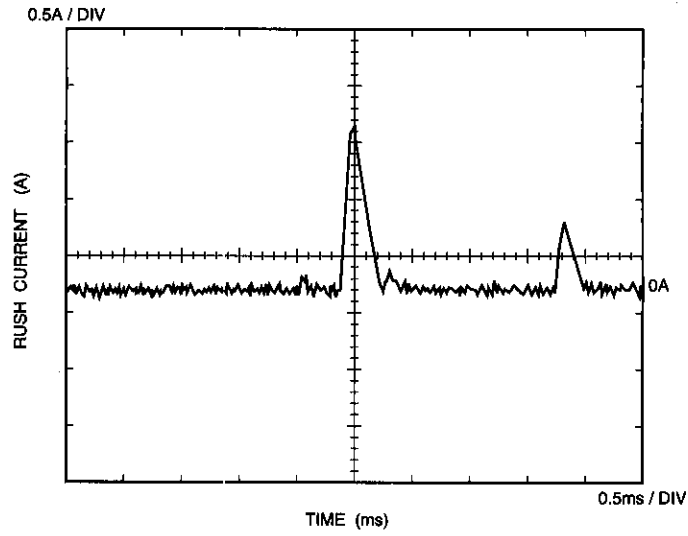


Fig.8

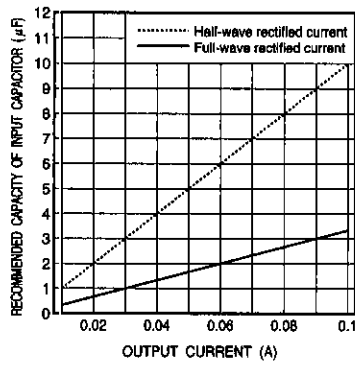


Fig.9

● Operation notes

1. Output current should be reduced with increasing ambient temperature.
2. Pins 3 and 7 are internally connected. Use the IC with these pins OPEN.
3. Overcurrent and short-circuit load

The overcurrent protection circuit limits the current to about 160mA with a curve shape of "inverted -L" in the voltage-current graph. The IC may be damaged if the duration of intermittent overcurrent flows of more than 100mA exceeds 1 minute in total at 25°C. Be sure to take safety measures such as fusing if short-circuit

loads or overcurrent is probable. Though a 0.5A continuous break fuse is recommended, careful selection should be made according to the loading condition.

4. Regulations on Electrical Appliances

A single IC (BP5030) unit is not subject to the Regulations on Electrical Appliances. An application for approval should be based on an assembled unit.

5. Surge tolerance

Results of electrostatic breakdown tests are shown in Fig. 10. The test methods are based on EIAJ ED-4071 and C-111.

Conditions A R2=0 (Ω), C=200pF

-2kV	-1kV	Pin no.	1kV	2kV
		1		
		2		
		3		
		4		
		5		
		6		
		7		
		8		
		10		

Conditions B R2=1.5 (kΩ), C=100pF

-2kV	-1kV	Pin no.	1kV	2kV
		1		
		2		
		3		
		4		
		5		
		6		
		7		
		8		
		10		

Measurement circuit

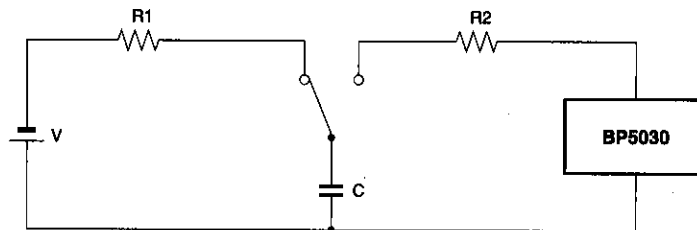


Fig.10

6. Pin noise voltage

Results obtained by using the Measurement circuit of Fig. 12 are shown in Fig. 11.

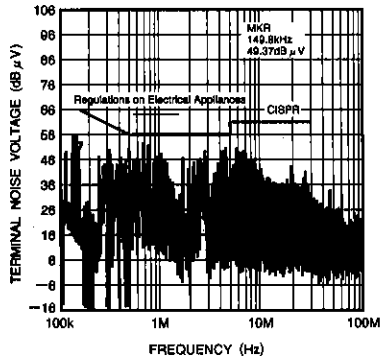


Fig.11

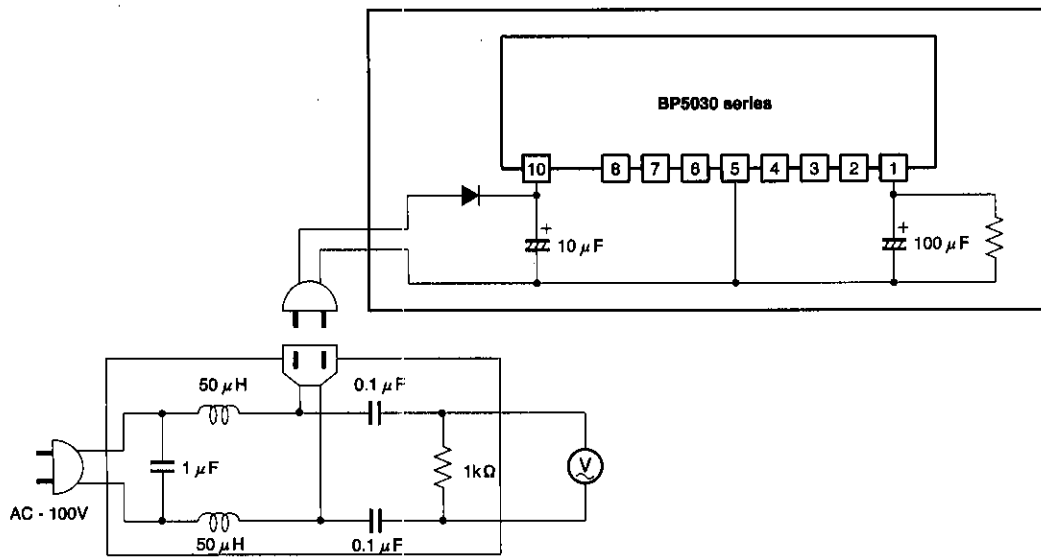


Fig.12

● Measurement data (Measurement circuit is Fig. 7)

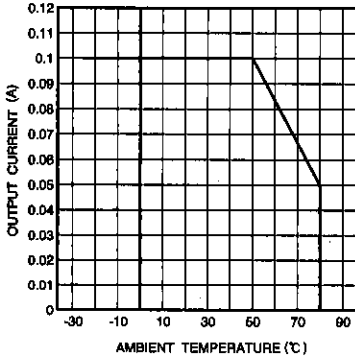


Fig.13 Derating curve

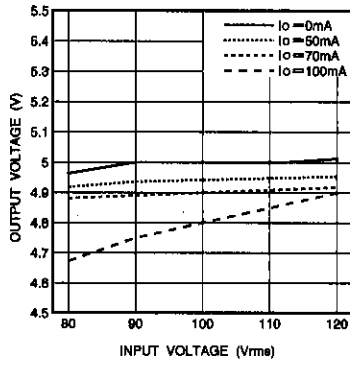


Fig.14 Line regulation

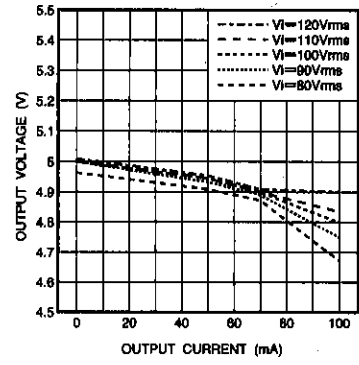


Fig.15 Load regulation

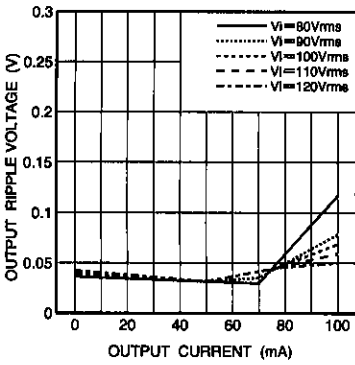


Fig.16 output ripple voltage

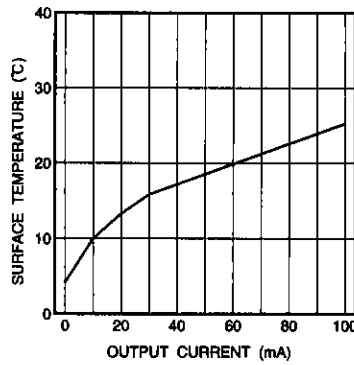
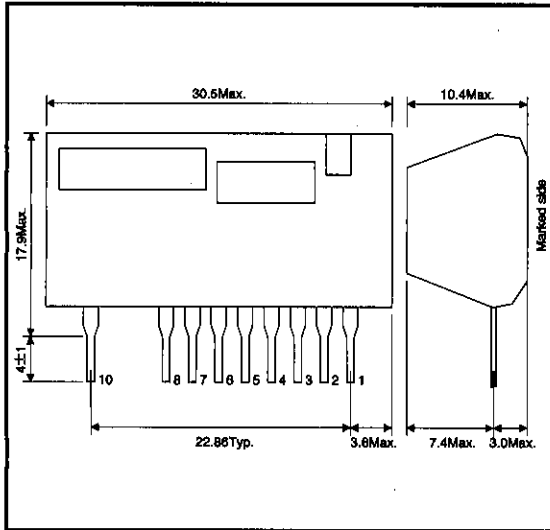


Fig.17 temperature rise

● External dimensions (Units: mm)





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