DC / DC converter

BP5220 / BP5221 / BP5222 / BP5220X / BP5221X / BP5222X

The BP5220, BP5221, BP5222, BP5220X, BP5221X, and BP5222X are DC / DC converters that use a pulse width modulation (PWM) system. They contain control circuits, switching devices, rectifiers, and coils, and operate by only connecting an I / O smoothing capacitor. With a high efficiency of power conversion, the modules are available in stand-alone 9-pin SIP packages with no heat sink required. They can be applied to various purposes by fine-adjusting the output voltage and switching on and off. With a wide range of input voltage, the modules are best suited for obtaining a stable local power supply from a main power supply with a large voltage variation.

● Applications

Power supplies for copiers, personal computers, facsimiles, AV equipment, measuring instruments, vending machines, security device, registers, industrial equipment, and maintenance tools

● Features

1) Wide range of input voltage.
2) High power conversion efficiency.
3) Built-in output ON / OFF switch.
4) Applicable to various purposes by fine-adjusting the output voltage.
5) Small number of external components required.
6) Heat sink unnecessary.
7) Compact package.
   BP5220 / BP5221 / BP5222 : SIP9
   BP5220X / BP5221X / BP5222X : SIP9(L-shaped lead type)

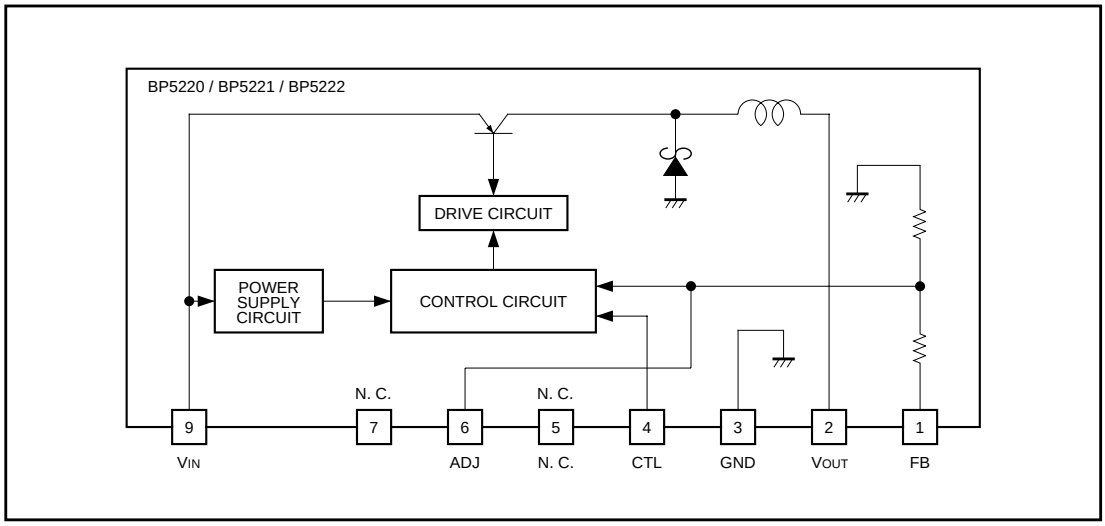
● List of the series

	BP5220 / BP5220X	BP5221 / BP5221X	BP5222 / BP5222X	Unit
Input voltage	8~38	8~38	15~38	V
Output voltage	5	5	12	V
Output current	1	0.5	0.5	A
Power conversion effciency	85 (V_{IN}=15V)	84 (V_{IN}=15V)	90 (V_{IN}=20V)	%

● Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits			Unit
		BP5220 / BP5220X	BP5221 / BP5221X	BP5222 / BP5222X	
Input voltage	V_{IN}	8~38	8~38	15~38	V
Output current	I_O	1	0.5	0.5	A
Operating temperature range	Topr	−20~+70			°C
Storage temperature range	Tstg	−25~+80			°C

● Block diagram



● Electrical characteristics BP5220 / BP5220X (Unless otherwise noted: V_{IN}=15V, I_O=0.5A, SW=1, Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input voltage	V_{IN}	8	–	38	V	
Output voltage	V_O	4.75	5	5.25	V	
Output current	I_O	–	–	1	A	V_{IN} < 30V ∗1
Line regulation	ΔV_{O1}	–	35	80	mV	V_{IN}=8V~38V
Load regulation	ΔV_{O2}	–	20	80	mV	I_O=0.1A~1A
Output ripple voltage	ν_r	–	30	70	mV_{PP}	∗2
Power conversion efficiency	η	75	85	–	%	I_O=1A
Switching frequency	f_{SW}	–	190	–	kHz	
CTL pin ON resistance	R_{ON}	–	–	4.7	kΩ	V_O > 4.75V
CTL pin OFF resistance	R_{OFF}	200	–	–	kΩ	V_O < 0.1V, SW=2 select

∗1 Derating required according to the input voltage and ambient temperature.
∗2 Pulse noise not included.

BP5221 / BP5221X (Unless otherwise noted: V_{IN}=15V, I_O=0.25A, SW=1, Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input voltage	V_{IN}	8	–	38	V	
Output voltage	V_O	4.75	5	5.25	V	
Output current	I_O	–	–	0.5	A	∗1
Line regulation	ΔV_{O1}	–	35	80	mV	V_{IN}=8V~38V
Load regulation	ΔV_{O2}	–	20	80	mV	I_O =0.05A~0.5A
Output ripple voltage	ν_r	–	30	70	mV_{PP}	∗2
Power conversion efficiency	η	70	84	–	%	I_O=0.5A
Switching frequency	f_{SW}	–	190	–	kHz	
CTL pin ON resistance	R_{ON}	–	–	4.7	kΩ	V_O > 4.75V
CTL pin OFF resistance	R_{OFF}	200	–	–	kΩ	V_O < 0.1V, SW=2 select

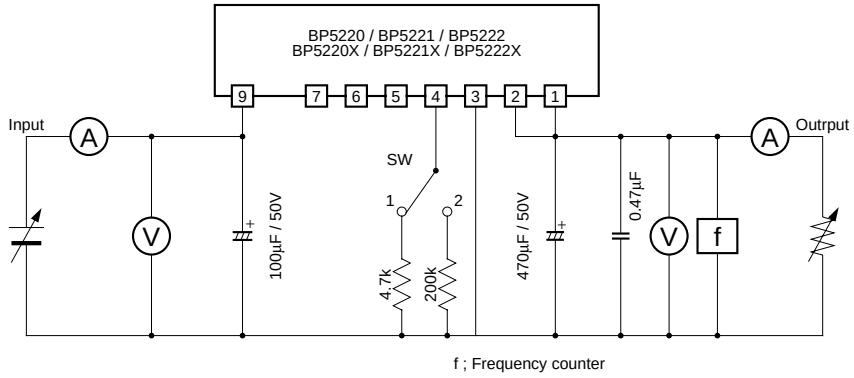
∗1 Derating required according to the input voltage and ambient temperature.
∗2 Pulse noise not included.

BP5222 / BP5222X (Unless otherwise noted ; V_{IN}=20V, IO=0.25A, SW=1, Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input voltage	V_{IN}	15	–	38	V	
Output voltage	V_O	11.2	12	12.8	V	
Output current	I_O	–	–	0.5	A	∗1
Line regulation	ΔV_{O1}	–	22	80	mV	V_{IN}=15V~38V
Load regulation	ΔV_{O2}	–	45	80	mV	I_O=0.05A~0.5A
Output ripple voltage	ν_r	–	35	70	mV_{PP}	∗2
Power conversion efficiency	η	75	90	–	%	I_O=0.5A
Switching frequency	f_{SW}	–	190	–	kHz	∗2
CTL pin ON resistance	R_{ON}	–	–	4.7	kΩ	V_O > 11.2V
CTL pin OFF resistance	R_{OFF}	200	–	–	kΩ	V_O < 0.1V, SW=2 select

∗1 Derating required according to the input voltage and ambient temperature.
∗2 Pulse noise not included.

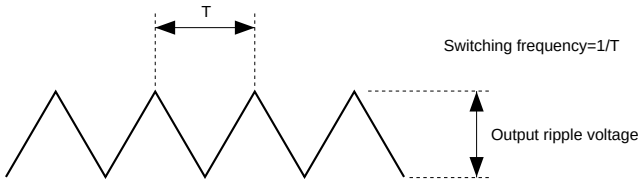
● Measurement circuit



f ; Frequency counter

100µF/50V, 470µF/50V ; PL series / NICHIKON(Low-impedance type)

Fig.1



Note that output ripple voltage depends on the type and characteristics of the output capacitor.

● Circuit operation

(1) The basic application examples are shown in Fig.2. The externally installed parts are only the input and output smoothing capacitors.

(2) Switching on and off the output voltage is allowed. The output can be switched off by making pin 4 to be open (high impedance). (See Fig.3)

(3) Fine adjustment of the output voltage is allowed. The fine adjustment of output voltage can be performed from pin 6 via the resistor by connecting the output terminal (pin 2) or GND.(See application example3)

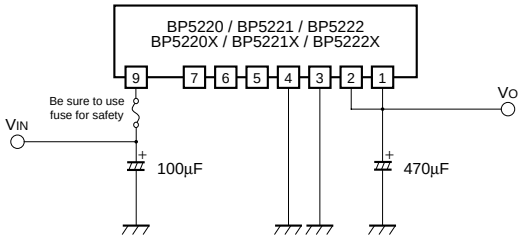


Fig.2

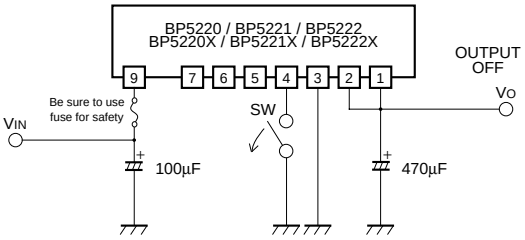


Fig.3

● Application example

Application example 1 : DC / DC converter with a protection circuit

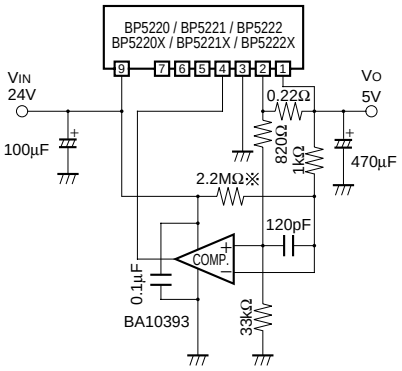


Fig.4

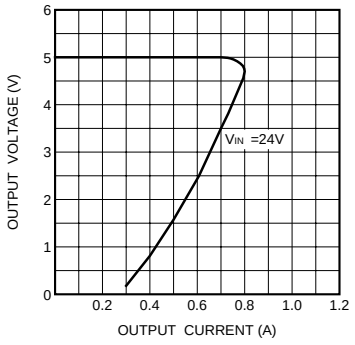


Fig.5

※A resistor to secure the rise of output at power on. The resistance to be selected depends on the input voltage. This is a standard application. Because the control current fluctuates with variations in circuits and components, set the control current by adding a sufficient margin to the normal current level.

Application example 2 : Output ON / OFF control

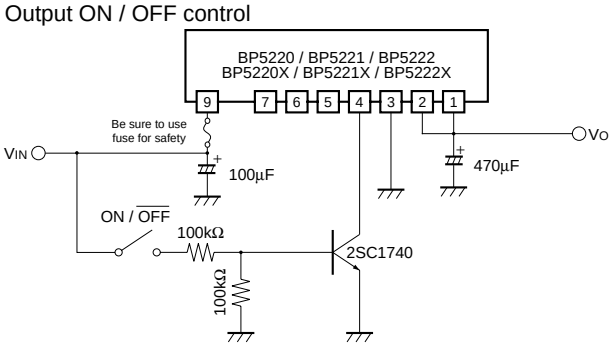


Fig.6

Application example 3 : Output voltage fine adjustment

(1) When reducing the output voltage

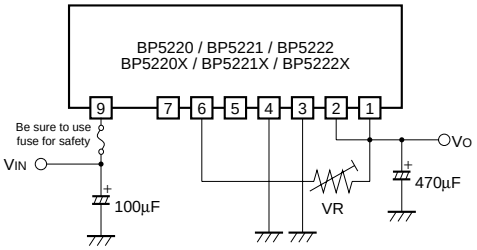


Fig.7

(2) When increasing the output voltage

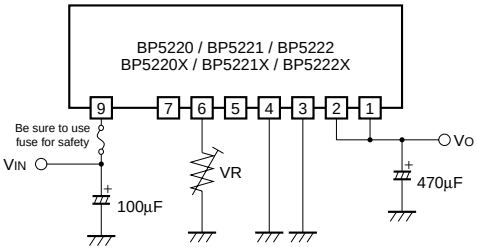


Fig.8

VR value setting equations(The output voltage after adjustment is denoted Vo.)

(1) When reducing the output voltage

BP5220 / BP5221, BP5220X / BP5221X R=(V_O–1.281) / (0.0278–0.00556V_O) (kΩ)

BP5222, BP5222X R=(Vo–1.281) / (0.1196–0.01Vo) (kΩ)

(2) When increasing the output voltage

BP5220 / BP5221, BP5220X / BP5221X R=11160 / (48.4Vo–242) (kΩ)

BP5222, BP5222X R=1200 / (9.368Vo–112) (kΩ)

To make full use of the ability of the the module products, we recommended the output voltage be adjusted within ± 20% of the output voltage rating. When the output voltage is increased by 20%, for instance, the minimum input voltage is also increased by 20%.

(Example : When the output voltage is changed from 5V to 6V in the BP5220, the minimum input voltage is changed from 8V to 9.6V)

Application example 4 : Slow start

The slow start circuit mitigates the pulse load on the internal switching transistor when input voltage is applied, and rises the output voltage gradually by starting the switching operation slowly.

This application is useful for preventing the malfunction of an external protection circuit due to a rush current, and can serve as a countermeasure against the operation outside the safe operation range.

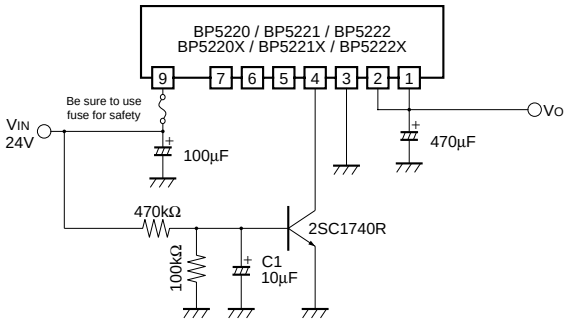


Fig.9

C1 is a slow-start capacitor for mitigating the over rush current that flows into the modules when the switch is turned on.

● Operation notes

(1) The output current should be reduced according to an increase in the input voltage or ambient temperature. Use the modules within the derating curve range.
(2) Pins 5 and 7 are no connected.
(3) No circuit is installed in the modules to protect against over output currents. Take physical safety measures such as fusing if short-circuit loading is probable.
(4) A large rush current may flow in the module when the input voltage is applied or the output ON / OFF is controlled with pin 4 without a capacitor such as C1 in application 4. Operating within the safe operation ranges shown in Figs.12, 15, and 18.
The safe operation range is determined by the safe operation range of the internal switching transistor. The amount of rush current depends on the output impedance of the input power supply and capacitors connected to the module outputs. The pulse load on the internal switching transistor at the start of operation can be reduced by using the protection circuit of application 1 or the slow start circuit of application 4.

● Electrical characteristic curves

BP5220, BP5220X

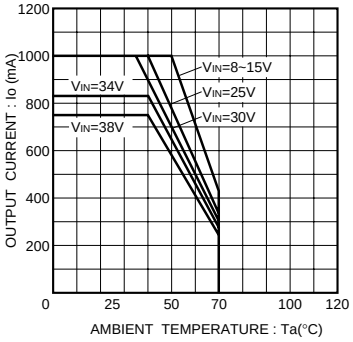


Fig.10 Derating curve

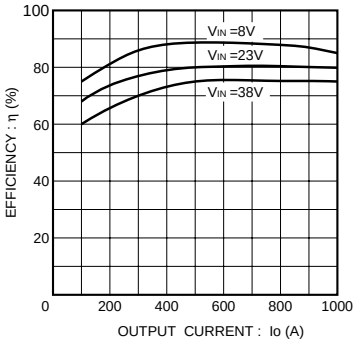


Fig.11 Efficiency

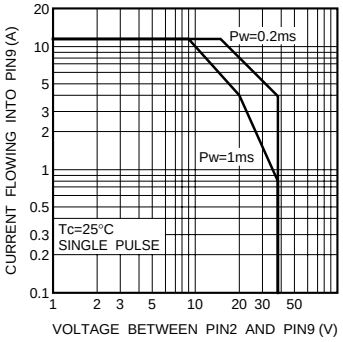


Fig.12 Safety operation range

BP5221, BP5221X

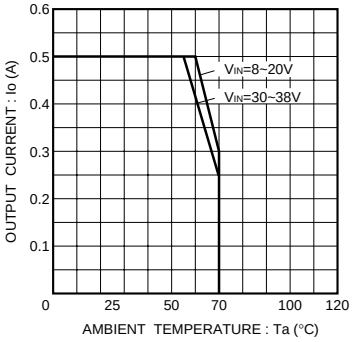


Fig.13 Derating curve

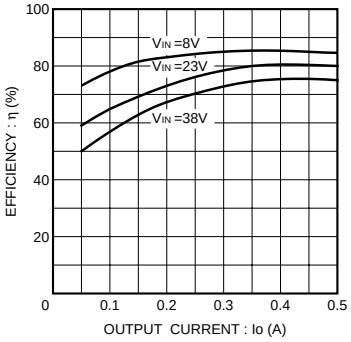


Fig.14 Efficiency

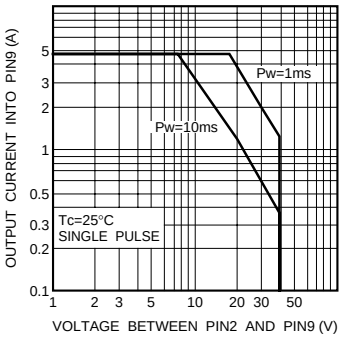


Fig.15 Safety operation range

BP5222, BP5222X

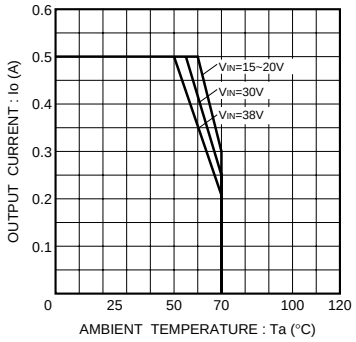


Fig.16 Derating curve

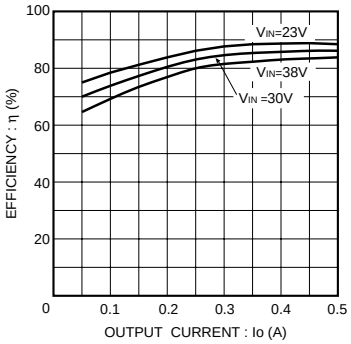


Fig.17 Efficiency

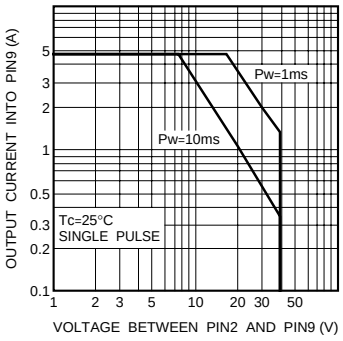


Fig.18 Safety operation range

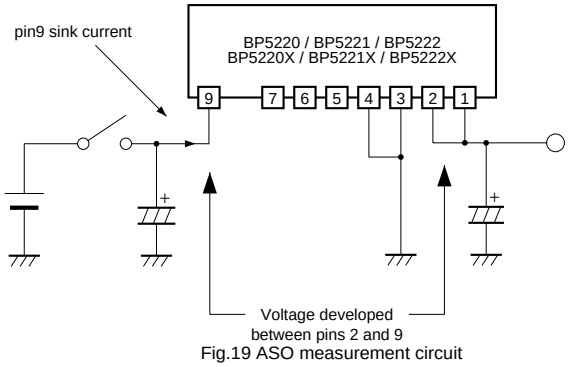
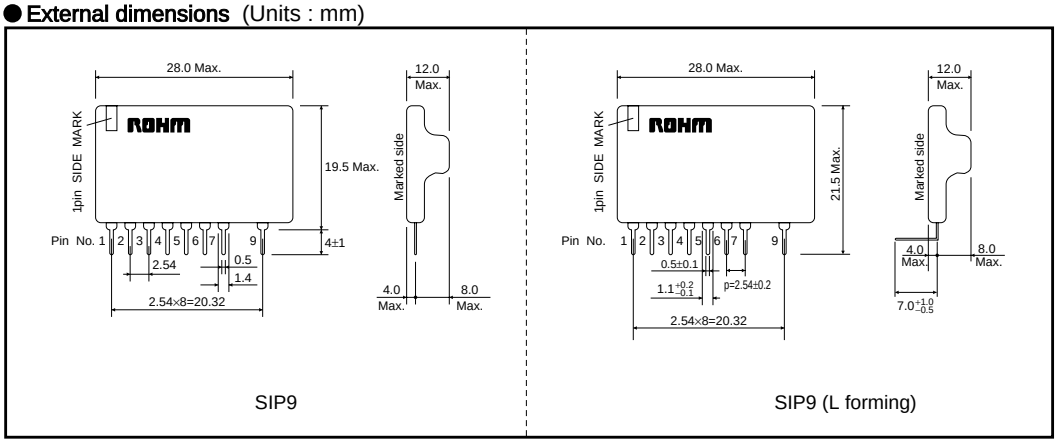


Fig.19 ASO measurement circuit

● **External dimensions** (Units : mm)



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   [c] Use in places where the products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   [d] Use in places where the products are exposed to static electricity or electromagnetic waves
   [e] Use in proximity to heat-producing components, plastic cords, or othe flammable items
   [f] Use involving sealing or coating the products with resin or other coating materials
   [g] Use involving unclean solder or use of water or water-soluble cleaning agents for cleaning after soldering
   [h] Use of the products in places subject to dew condensation
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