Step-down DC/DC Converters(Non-isolated)

BP5220A / BP5221A / BP5222A

● Description

The BP5220A, BP5221A, BP5222A, 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-tuning 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 input voltage range
2) High power conversion efficiency.
3) Built-in output ON / OFF switch.
4) Adjustable output voltage ensures wide compatibility
5) Few external components required.
6) Heat sink unnecessary.
7) Compact package.
   BP5220A / BP5221A / BP5222A

● Dimensions (Unit : mm)

SIP9

Note : Dimensions without tolerance is typical.

● Lineup

	BP5220A	BP5221A	BP5222A	Unit
Input voltage	8 to 38	8 to 38	15 to 38	V
Output voltage	5	5	12	V
Output current	1	0.5	0.5	A
Power conversion efficiency	85 (Vi=15V)	84 (Vi=15V)	90 (Vi=20V)	%
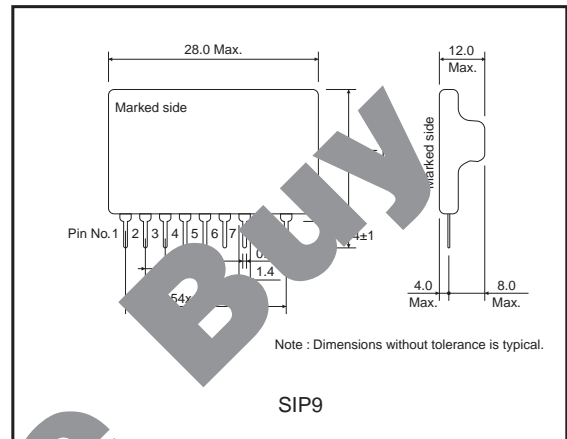
● Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits			Unit
		BP5220A	BP5221A	BP5222A	
Input voltage	Vi	8 to 38	8 to 38	15 to 38	V
Output current	Io	1	0.5	0.5	A
Operating temperature range	Topr	−20 to +70			°C
Storage temperature range	Tstg	−25 to +80			°C

● **Block diagram**
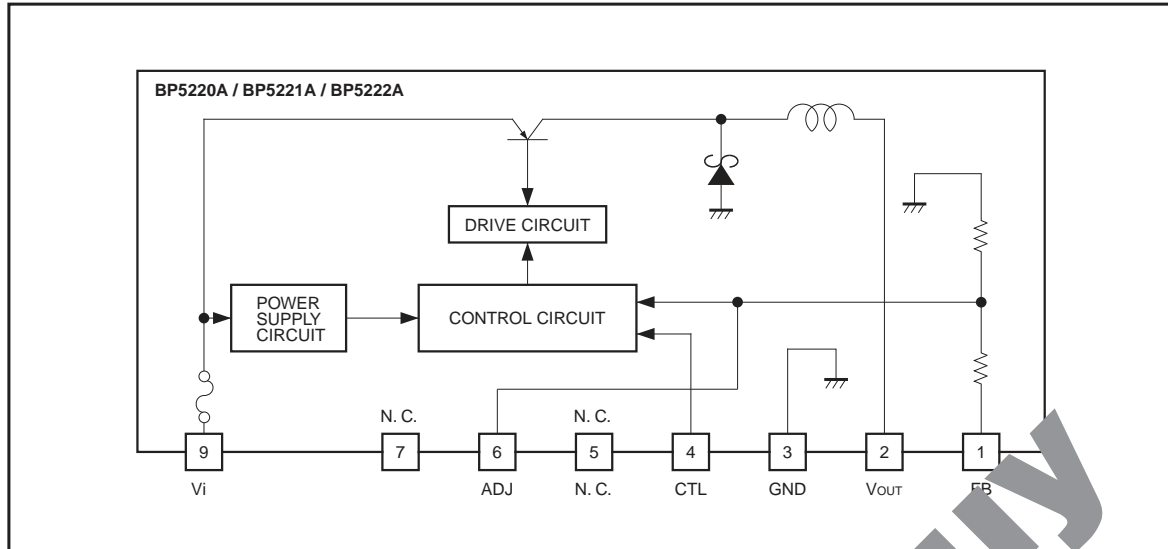
● **Electrical characteristics**

BP5220A (Unless otherwise noted : Vi=15V, Io=0.5A, SW=1, Ta=25˚C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	
Input voltage	Vi	8	–	38	V		
Output voltage	Vo	4.75	5	5.25			
Output current	Io	–	–	1	A	Vi<30V	*1
Line regulation	ΔV_{O1}	–	27		mV	Vi=8V to 38V	
Load regulation	ΔV_{O2}	–	3	30	mV	Io=0.1A to 1A	
Output ripple voltage	υ_r	–	22		mVPP		*2
Power conversion efficiency	η	–	85	–	%	Io=1A	
Switching frequency	fSW	–	190	–	kHz		
CTL pin ON resistance	RON	–	–	4.7	kΩ	Vo>4.75V	
CTL pin OFF resistance	ROFF	200	–	–	kΩ	Vo<0.1V, SW=2	

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

BP5221A (Unless otherwise noted : Vi=15V, Io=0.25A, SW=1, Ta=25˚C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	
Input voltage	Vi	8	–	38	V		
Output voltage	Vo	4.75	5	5.25	V		
Output current	Io	–	–	0.5	A		*1
Line regulation	ΔV_{O1}	–	13	50	mV	Vi=8V to 38V	
Load regulation	ΔV_{O2}	–	3	50	mV	Io=0.05A to 0.5A	
Output ripple voltage	υ_r	–	25	70	mVPP		*2
Power conversion efficiency	η	70	84	–	%	Io=1A	
Switching frequency	fSW	–	190	–	kHz		
CTL pin ON resistance	RON	–	–	4.7	kΩ	Vo>4.75V	
CTL pin OFF resistance	ROFF	200	–	–	kΩ	Vo<0.1V, SW=2	

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

BP5222A (Unless otherwise noted : Vi=20V, Io=0.25A, SW=1, Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	
Input voltage	Vi	15	–	38	V		
Output voltage	Vo	11.2	12	12.8	V		
Output current	Io	–	–	0.5	A		*1
Line regulation	ΔVo1	–	22	50	mV	Vi=15V to 38V	
Load regulation	ΔVo2	–	18	50	mV	Io=0.05A to 0.5A	
Output ripple voltage	υr	–	29	70	mVPP		*2
Power conversion efficiency	η	75	90	–	%	Io=0.5A	
Switching frequency	fSW	–	190	–	kHz		*2
CTL pin ON resistance	RON	–	–	4.7	kΩ	Vo>11.2V	
CTL pin OFF resistance	ROFF	200	–	–	kΩ	Vo<0.1V, SW=2	

∗1 Derating required according to the input voltage and ambient temperature.

∗2 Pulse noise not included.

● **Measurement circuit**
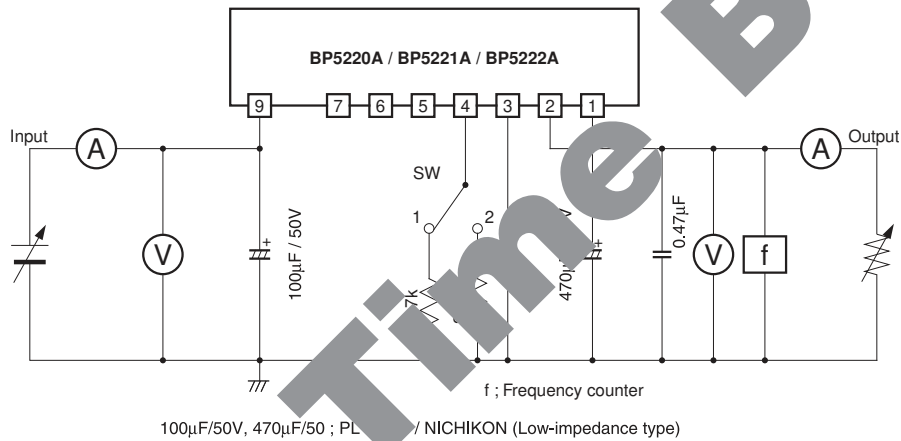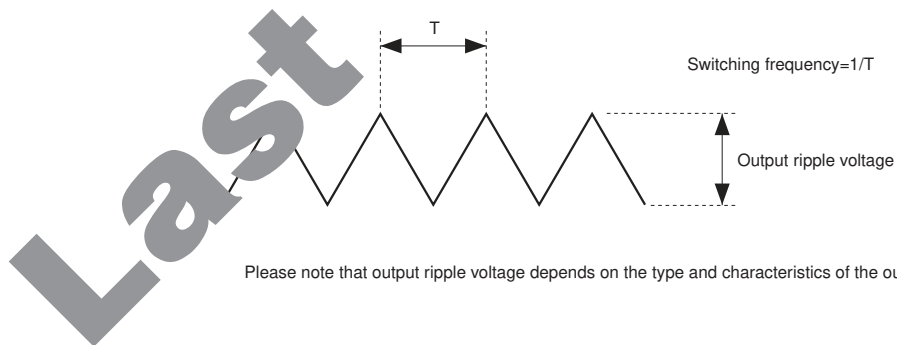

f ; Frequency counter

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

Fig.1

Switching frequency=1/T

Output ripple voltage

Please 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 only external parts required are 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
    open (high impedance). (See Fig.3)

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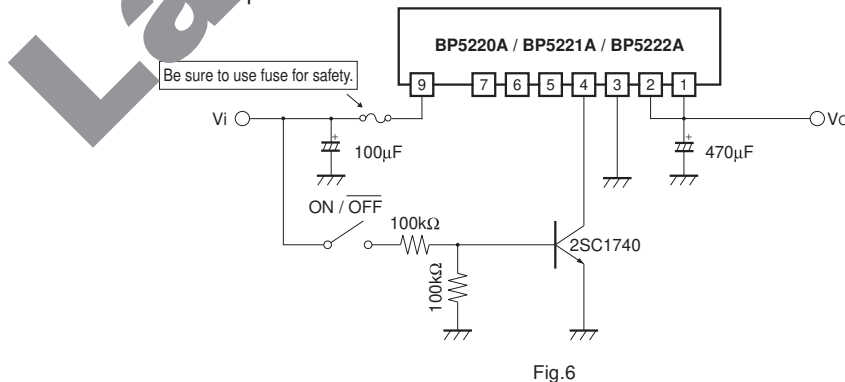   application example 3)

Fig.2

Fig.3
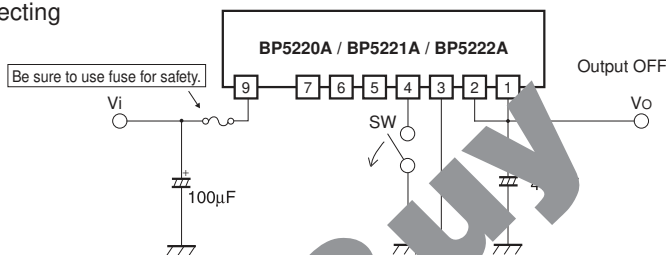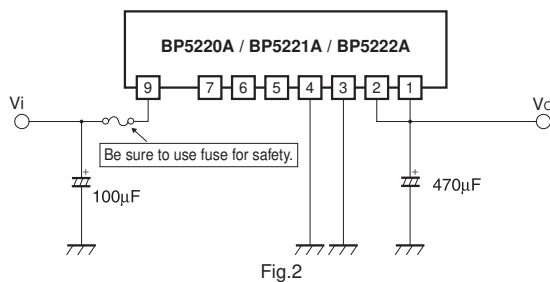
● **Application Examples**

Application Example 1 : DC / DC converter with protection circuit

Fig.4

Fig.5
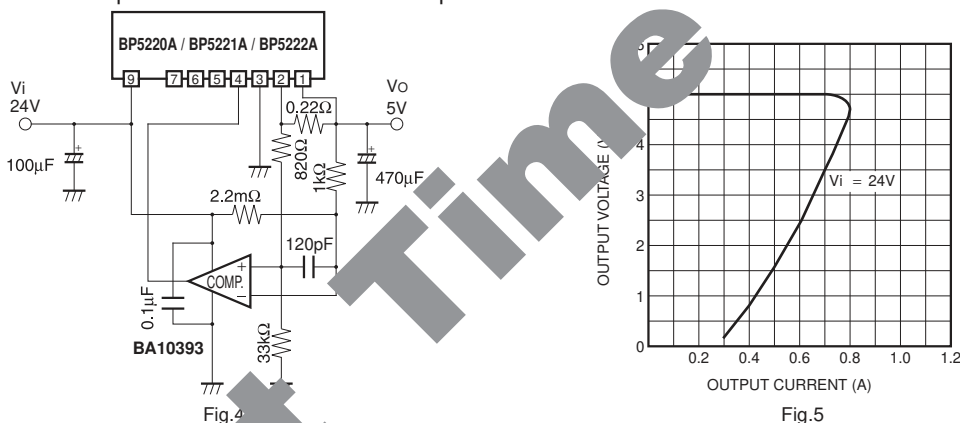
∗ A resistor is used to limit the rise of output at power on. The resistance depends on the input voltage.
  This is a standard application. Because the control current fluctuates with variations in circuits and components,
  set the control current adding a sufficient margin to the normal current level.

Application Example 2 : Output ON / OFF control

Fig.6

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Application Example 3 : Output voltage adjustment

(1) When reducing the output voltage

BP5220A / BP5221A / BP5222A

Vi — 100μF — Be sure to use fuse for safety. — VR — 470μF — Vo

Fig.7

(2) When increasing the output voltage

BP5220A / BP5221A / BP5222A
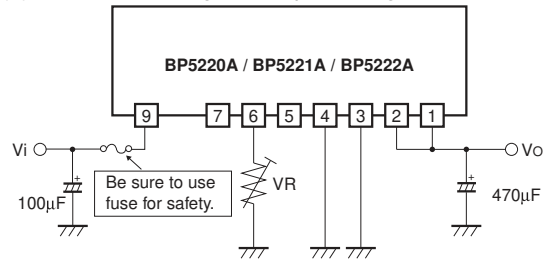
Vi — 100μF — Be sure to use fuse for safety. — VR — 470μF — Vo
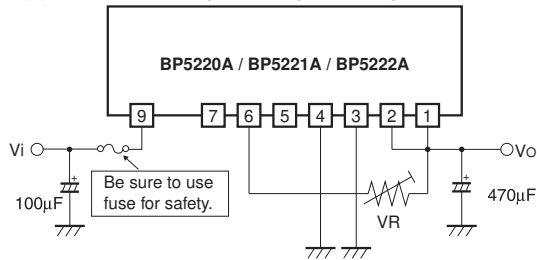
Fig.8

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

(1) When reducing the output voltage

BP5220A / BP5221A $R = (V_O - 1.281) / (0.0278 - 0.00556V_O)$ (kΩ)

BP5222A $R = (V_O - 1.281) / (0.1196 - 0.01V_O)$ (kΩ)

(2) When increasing the output voltage

BP5220A / BP5221A $R = 11160 / (48.4V_O - 242)$ (kΩ)

BP5222A $R = 1200 / (9.368V_O - 112)$ (kΩ)

To maximize performance we recommended the output voltage be adjusted within ±20% of the output voltage rating. When the output voltage 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 BP5220A, the minimum input voltage is charged 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 increases the output voltage gradually by starting the switching operation slowly.
This application is useful for preventing malfunction of the external protection circuit due to rush current, and can serve as a countermeasure against operation outside the safe operation range.
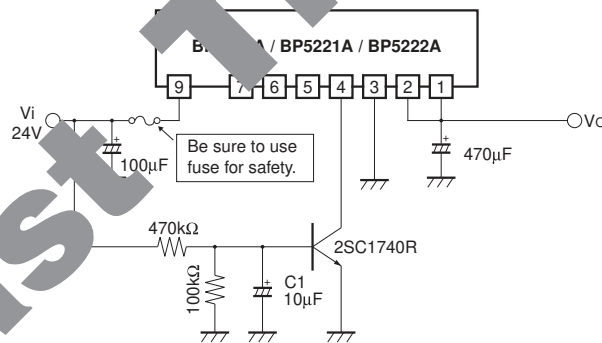
BP5220A / BP5221A / BP5222A

Vi 24V — 100μF — Be sure to use fuse for safety. — 470μF — Vo

470kΩ — 2SC1740R — 100kΩ — C1 10μF

Fig.9

C1 is a slow start capacitor for mitigating excessive rush current that flows into the module when the switch is turned on.

●**Operation notes**

(1) No circuit is installed in the modules to protect against excessive output currents. Therefore, take physical safety measures such as using a fuse if short-circuit loading is probable.
(2) 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.
(3) 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 Fig.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 in application 1 or the slow start circuit in application 4.
(4) Pins 5 and 7 are not connected.
(5) A smoothing electrolytic capacitor is necessary for I/O external components. Please use a capacitor equivalent to the recommended one.
(6) Please put an I/O smoothing capacitor near the module. Output ripple voltage may be larger or output voltage may not be stable.

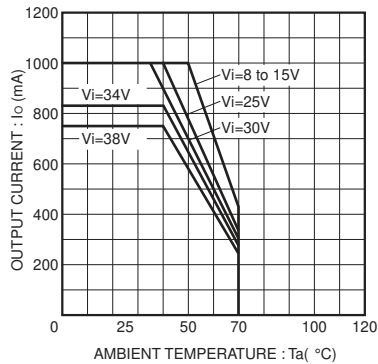●**Electrical Characteristics Curves**

BP5220A
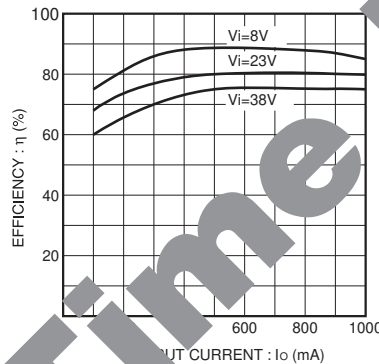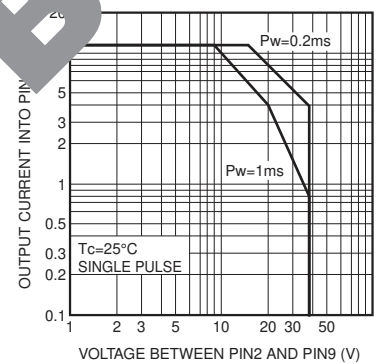

Fig.10 Derating curve

Fig.11 Efficiency

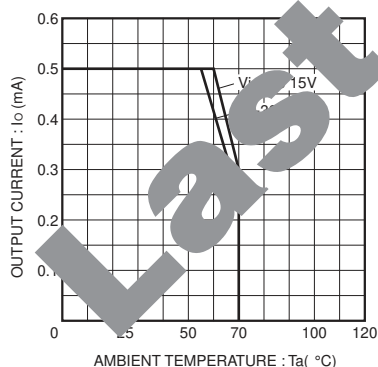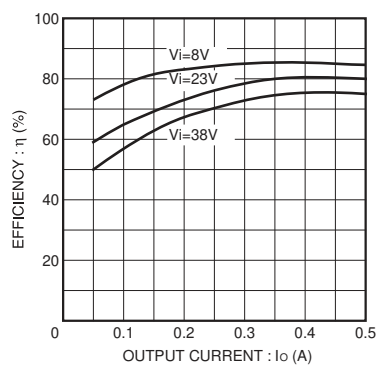Fig.12 Safety operation range

BP5221A

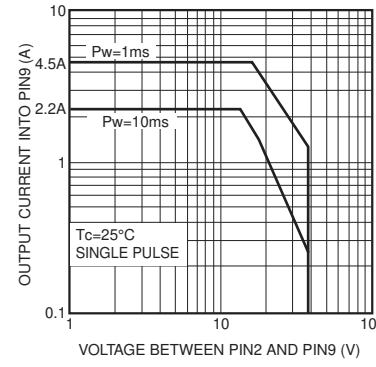Fig.13 Derating curve

Fig.14 Efficiency

Fig.15 Safety operation range

BP5222A

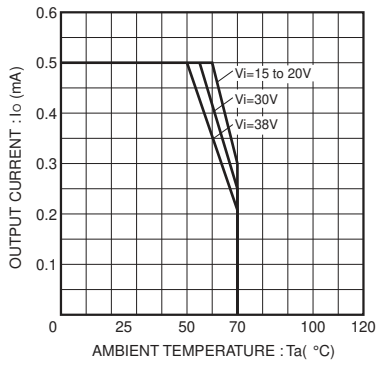Fig.16 Derating curve
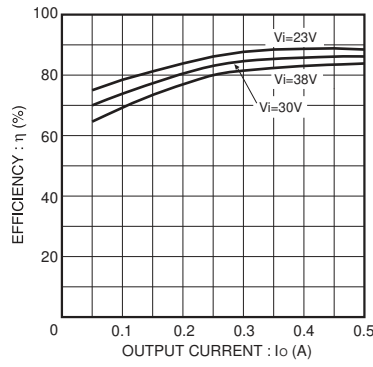
Fig.17 Efficiency

Fig.18 Safety operation range

Pin 9 sink current

BP5220A / BP5221A / BP5222A

9   7 6 5 4 3 2 1

Voltage difference
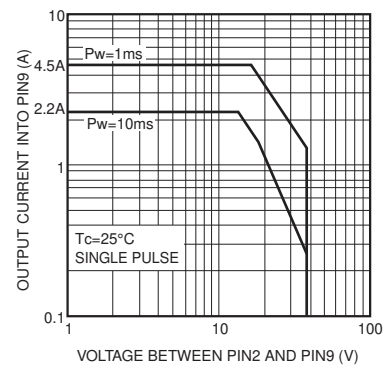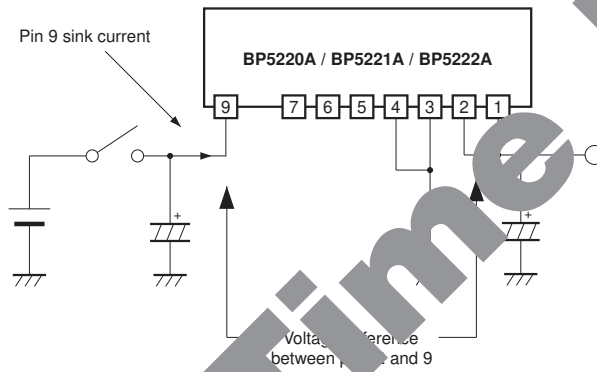between pins 2 and 9

Fig. SO measurement circuit

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:
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   [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':
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   [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. Cl_2, H_2S, NH_3, SO_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.

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