

# 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

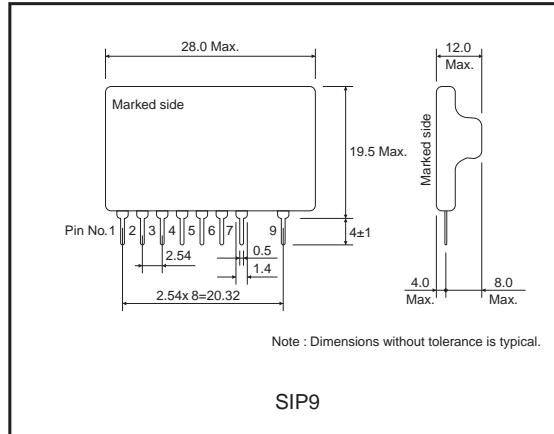
Power supplies for copiers, personal computers, facsimiles, AV equipment, measuring instruments, vending machines, security device, registers, industrial equipment, and maintenance tools

## ● 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 : SIP9

## ● Dimensions (Unit : mm)



SIP9

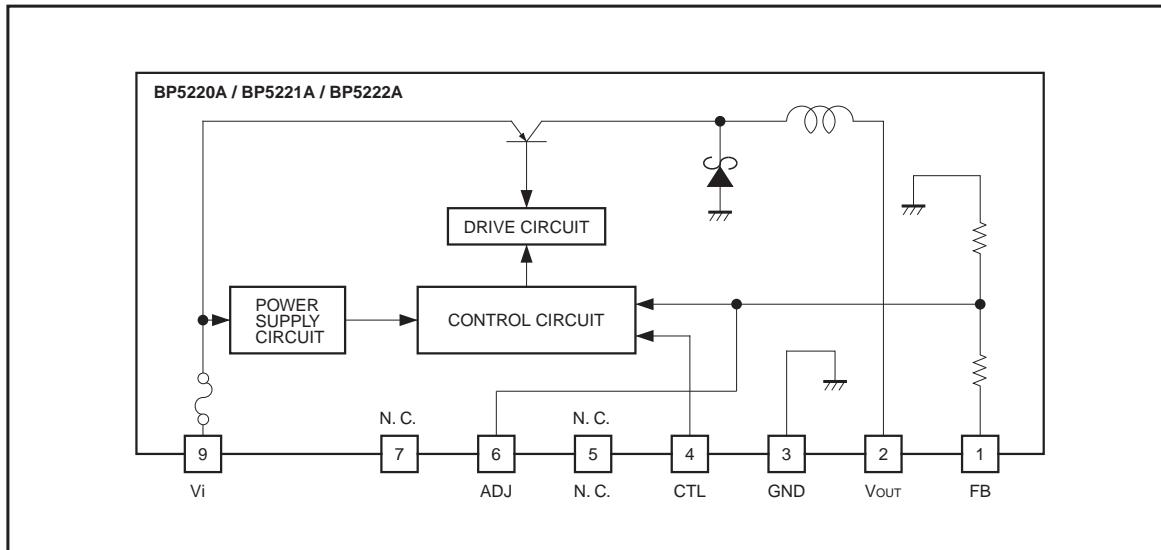
## ● Lineup

	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 :  $Vi=15V$ ,  $Io=0.5A$ ,  $SW=1$ ,  $Ta=25^{\circ}C$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input voltage	$Vi$	8	—	38	V	
Output voltage	$Vo$	4.75	5	5.25	V	
Output current	$Io$	—	—	1	A	$Vi<30V$ *1
Line regulation	$\Delta Vo_1$	—	27	80	mV	$Vi=8V$ to $38V$
Load regulation	$\Delta Vo_2$	—	13	80	mV	$Io=0.1A$ to $1A$
Output ripple voltage	$v_r$	—	22	70	$mV_{PP}$	*2
Power conversion efficiency	$\eta$	75	85	—	%	$Io=1A$
Switching frequency	$f_{sw}$	—	190	—	kHz	
CTL pin ON resistance	$R_{ON}$	—	—	4.7	$k\Omega$	$Vo>4.75V$
CTL pin OFF resistance	$R_{OFF}$	200	—	—	$k\Omega$	$Vo<0.1V$ , $SW=2$

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

\*2 Pulse noise not included.

BP5221A (Unless otherwise noted :  $Vi=15V$ ,  $Io=0.25A$ ,  $SW=1$ ,  $Ta=25^{\circ}C$ )

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	$\Delta Vo_1$	—	13	50	mV	$Vi=8V$ to $38V$
Load regulation	$\Delta Vo_2$	—	3	50	mV	$Io=0.05A$ to $0.5A$
Output ripple voltage	$v_r$	—	25	70	$mV_{PP}$	*2
Power conversion efficiency	$\eta$	70	84	—	%	$Io=1A$
Switching frequency	$f_{sw}$	—	190	—	kHz	
CTL pin ON resistance	$R_{ON}$	—	—	4.7	$k\Omega$	$Vo>4.75V$
CTL pin OFF resistance	$R_{OFF}$	200	—	—	$k\Omega$	$Vo<0.1V$ , $SW=2$

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

\*2 Pulse noise not included.

BP5222A (Unless otherwise noted :  $V_i=20V$ ,  $I_o=0.25A$ ,  $SW=1$ ,  $T_a=25^\circ C$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input voltage	$V_i$	15	—	38	V	
Output voltage	$V_o$	11.2	12	12.8	V	
Output current	$I_o$	—	—	0.5	A	
Line regulation	$\Delta V_{o1}$	—	22	50	mV	$V_i=15V$ to $38V$
Load regulation	$\Delta V_{o2}$	—	18	50	mV	$I_o=0.05A$ to $0.5A$
Output ripple voltage	$V_r$	—	29	70	$mV_{PP}$	
Power conversion efficiency	$\eta$	75	90	—	%	$I_o=0.5A$
Switching frequency	$f_{sw}$	—	190	—	kHz	
CTL pin ON resistance	$R_{ON}$	—	—	4.7	k $\Omega$	$V_o>11.2V$
CTL pin OFF resistance	$R_{OFF}$	200	—	—	k $\Omega$	$V_o<0.1V$ , $SW=2$

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

\*2 Pulse noise not included.

### ● Measurement circuit

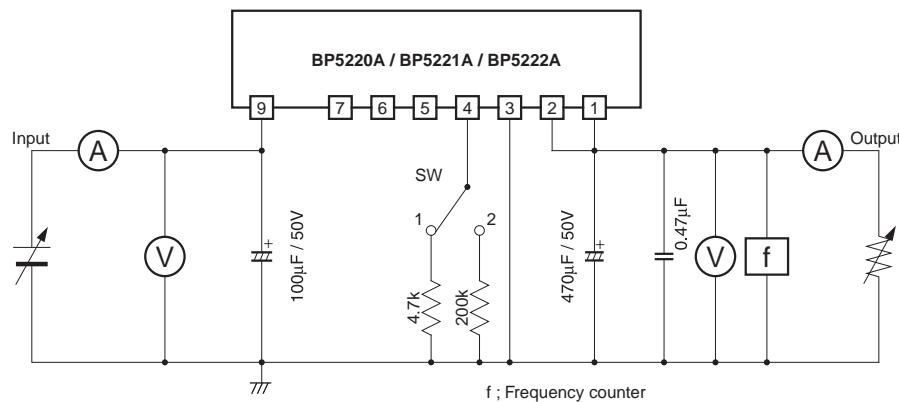
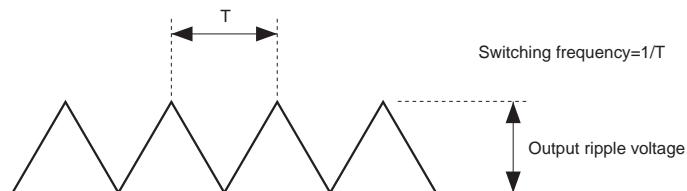
100 $\mu$ F/50V, 470 $\mu$ F/50 ; PL series / NICHIKON (Low-impedance type)

Fig.1



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)

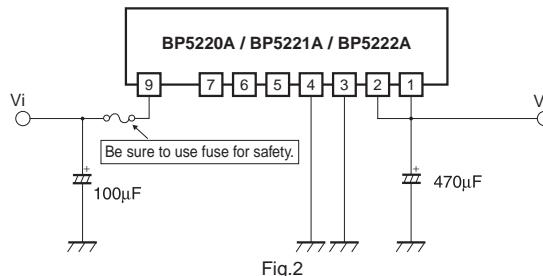


Fig.2

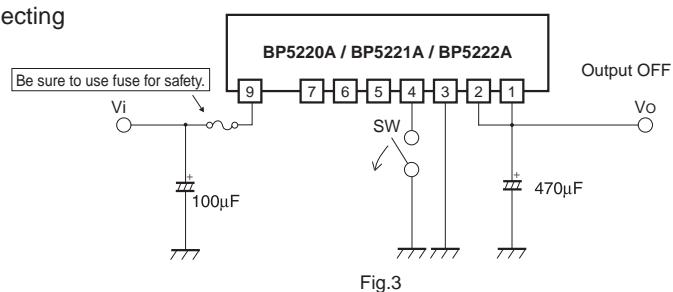


Fig.3

### ●Application Examples

Application Example 1 : DC / DC converter with protection circuit

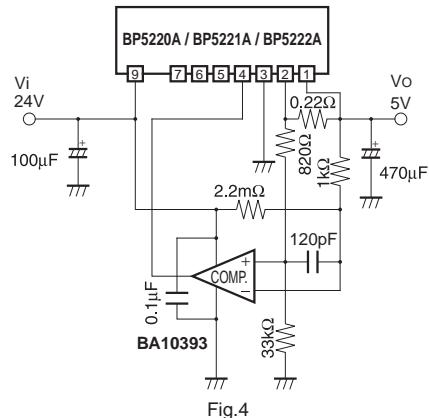


Fig.4

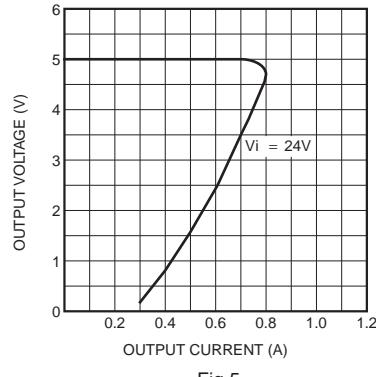


Fig.5

\* 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 by adding a sufficient margin to the normal current level.

Application Example 2 : Output ON / OFF control

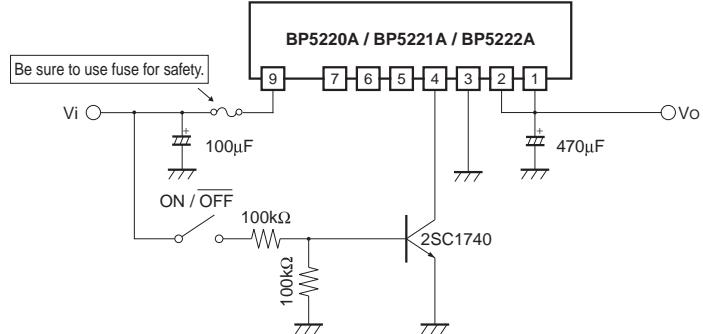


Fig.6

## Application Example 3 : Output voltage adjustment

## (1) When reducing the output voltage

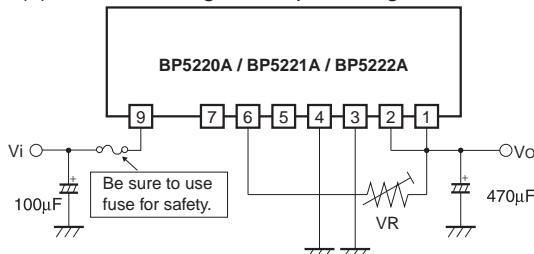


Fig.7

## (2) When increasing the output voltage

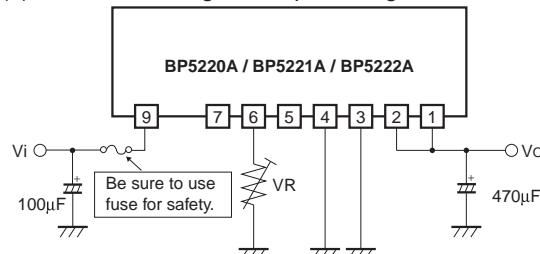


Fig.8

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

## (1) When reducing the output voltage

$$\text{BP5220A / BP5221A} \quad R = (V_o - 1.281) / (0.0278 - 0.00556V_o) \text{ (k}\Omega\text{)}$$

$$\text{BP5222A} \quad R = (V_o - 1.281) / (0.1196 - 0.01V_o) \text{ (k}\Omega\text{)}$$

## (2) When increasing the output voltage

$$\text{BP5220A / BP5221A} \quad R = 11160 / (48.4V_o - 242) \text{ (k}\Omega\text{)}$$

$$\text{BP5222A} \quad R = 1200 / (9.368V_o - 112) \text{ (k}\Omega\text{)}$$

To maximize performance we recommended the output voltage be adjusted within  $\pm 20\%$  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 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 an external protection circuit due to rush current, and can serve as a countermeasure against operation outside the safe operation range.

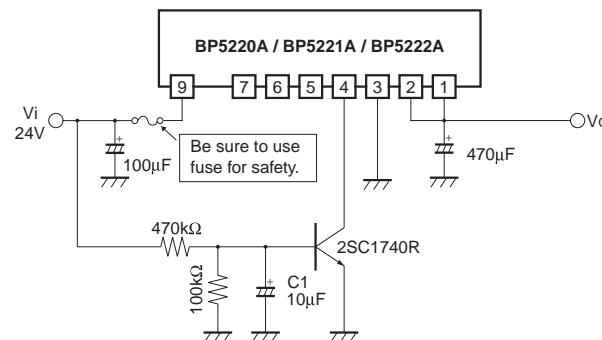


Fig.9

$C_1$  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

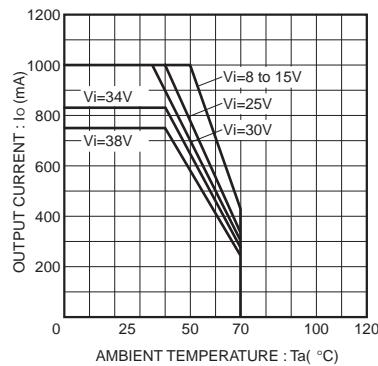


Fig.10 Derating curve

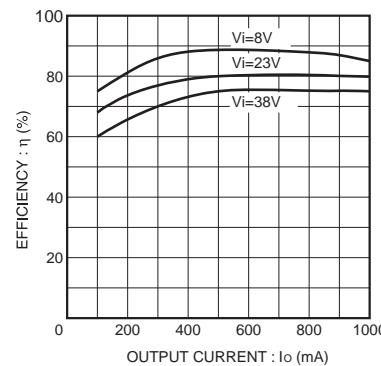


Fig.11 Efficiency

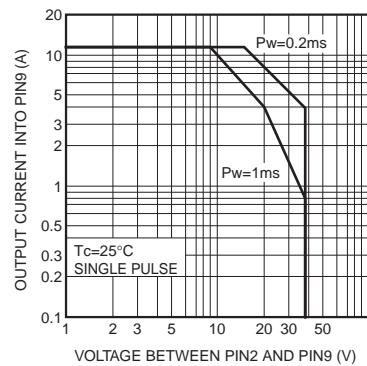


Fig.12 Safety operation range

BP5221A

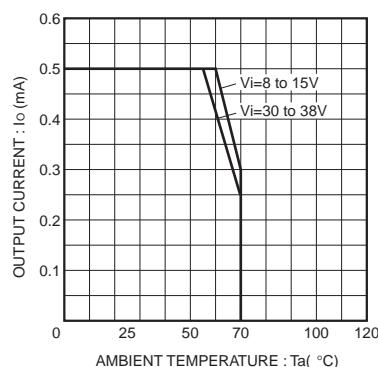


Fig.13 Derating curve

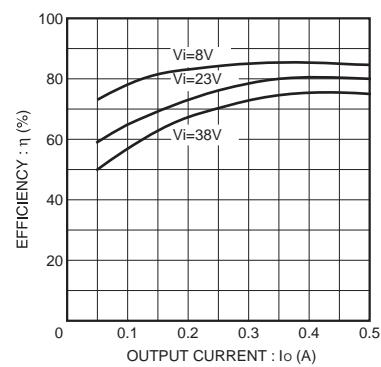


Fig.14 Efficiency

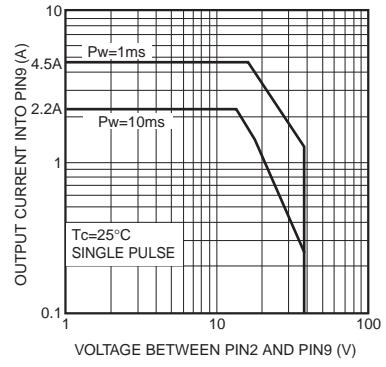


Fig.15 Safety operation range

## BP5222A

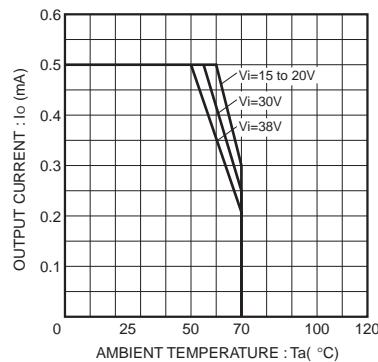


Fig.16 Derating curve

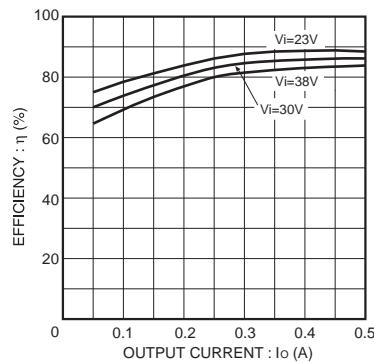


Fig.17 Efficiency

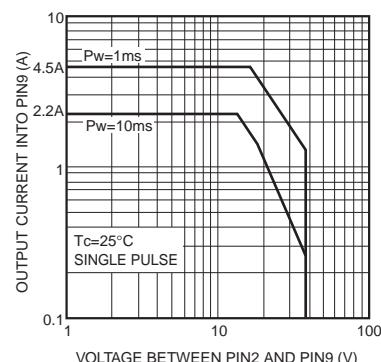


Fig.18 Safety operation range

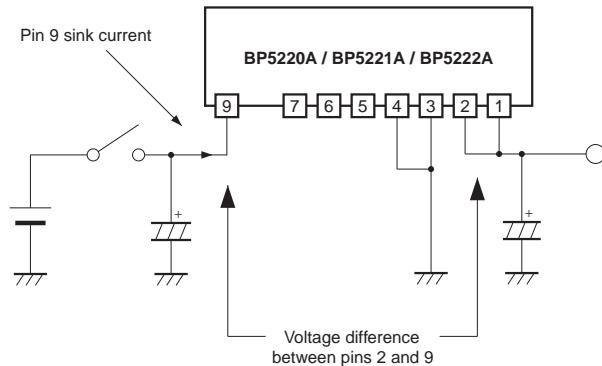


Fig.19 ASO measurement circuit

# 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:
  - [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. Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, NO<sub>2</sub>) 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.

## Notes Regarding Industrial Property

- 1) The specifications included herein contain information related to the Company's industrial property. Their use other than pertaining to the relevant products is forbidden. Duplication and/or disclosure to a third party without express written permission is strictly prohibited.
- 2) Product information and data, including application examples, contained in the specifications are for reference purposes only; the Company does not guarantee the industrial/intellectual property rights or any other rights of a third party. Accordingly, the Company shall not bear responsibility for:
  - [a] Infringement of the intellectual property rights of a third party
  - [b] Problems arising from the use of the products listed herein
- 3) The Company prohibits the purchaser from exercising or using the intellectual/industrial property rights or any rights belonging to or are controlled by the Company, other than the right to use, sell, or dispose of the products.