DC Brushless Motor Drivers for Fans

Standard Single-phase Full wave Fan Motor Driver

BD6982FVM

Description

This is the summary of application for BD6982FVM. BD6982FVM can drive FAN motor silently by BTL soft switching.

Features

- Small package (MSOP8)
- BTL soft switching drive
- Constant voltage output for hall element
- Lock protection and auto restart (without external capacitor)
- Lock alarm signal (AL) output

Package

	W(Typ) x D(Typ) x H(Max)
MSOP8	2.90mm x 4.00mm x 0.90mm

MSOP8

Applications

- PC, PC peripheral component (Power supply, VGA card, case FAN etc.)
- BD player, Projector etc.

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{CC}	18	V
Power Dissipation	Pd	0.58 (Note 1)	W
Operating Temperature	Topr	-40 to +105	°C
Storage Temperature	Tstg	-55 to +150	°C
Junction Temperature	Tjmax	150	°C
Output Voltage	V_{OMAX}	18	V
Output Current	I_{OMAX}	800 (Note 2)	mA
Hall Input Voltage	V_H	7	V
AL Signal Output Voltage	V_{AL}	18	V
AL Signal Output Current	I_{AL}	10	mA
HB Output Current	I_{HB}	10	mA

(Note 1) Reduce by 4.68mW/°C over 25°C. (On 70.0mm×70.0mm×1.6mm glass epoxy board)
(Note 2) This value is not to exceed Pd.

Caution: Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

○Product structure：Silicon monolithic integrated circuit ○This product has no designed protection against radioactive rays

Recommended Operating Conditions

Parameter	Symbol	Limit	Unit
Operating Supply Voltage Range	V_{CC}	2.8 to 16	V
Hall Input Voltage Range	V_H	0.4 to Vcc/4	V

Electrical Characteristics (Unless otherwise specified Ta=25°C, Vcc=12V)

Parameter	Symbol	Limit			Unit	Conditions	Characteristics
		Min.	Typ.	Max.			
Circuit Current	I_{CC}	1.5	4	8	mA		Figure 1
Hall Bias Voltage	V_{HB}	1.1	1.2	1.3	V	I_{HB}=-3mA	Figure 2,3
Hall Input Offset	V_{OFS}	0	-	±6	mV		-
Input-output Gain	G_{IO}	53	55	57	dB		-
Output Voltage	V_O	0.20	0.45	0.70	V	Io=200mA Upper and Lower total	Figure 4 to 7
AL Low Voltage	V_{ALL}	-	0.2	0.4	V	I_{AL}=5mA	Figure 8,9
AL Leak Current	I_{ALL}	0	-	5	µA	V_{AL}=18V	-
Lock Detection ON Time	t_{ON}	0.35	0.50	0.65	s		Figure 10
Lock Detection OFF Time	t_{OFF}	2.0	3.0	4.0	s		Figure 10
Lock Detection Time Ratio	r_{LD}	-	6	-	-	$r_{LD} = t_{OFF} / t_{ON}$	-

Truth Table

H+	H-	OUT1	OUT2
H	L	H	L
L	H	L	H

AL normal operation :L(output is ON)
lock detection :H(output is OFF)

Reference Data

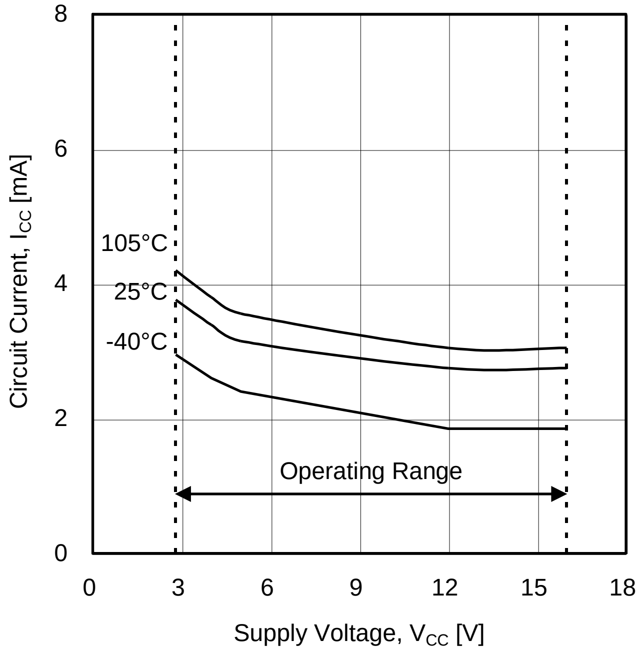


Figure 1. Circuit Current

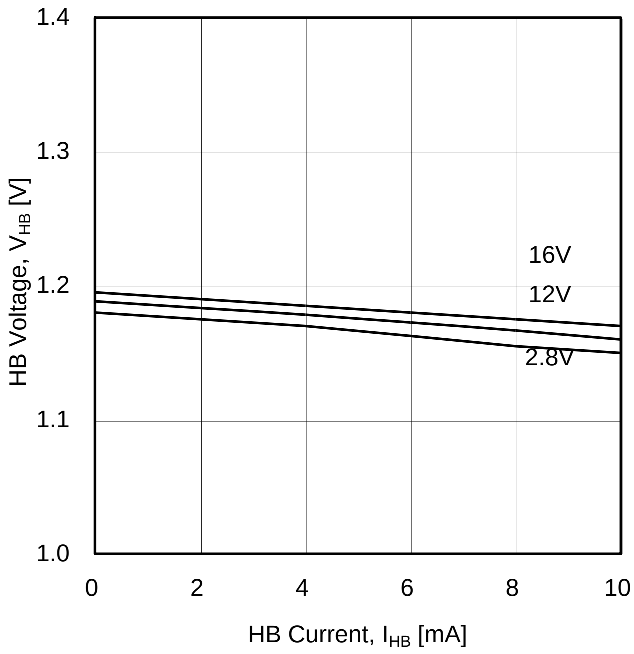


Figure 2. Hall Bias Voltage
(Voltage Characteristics)

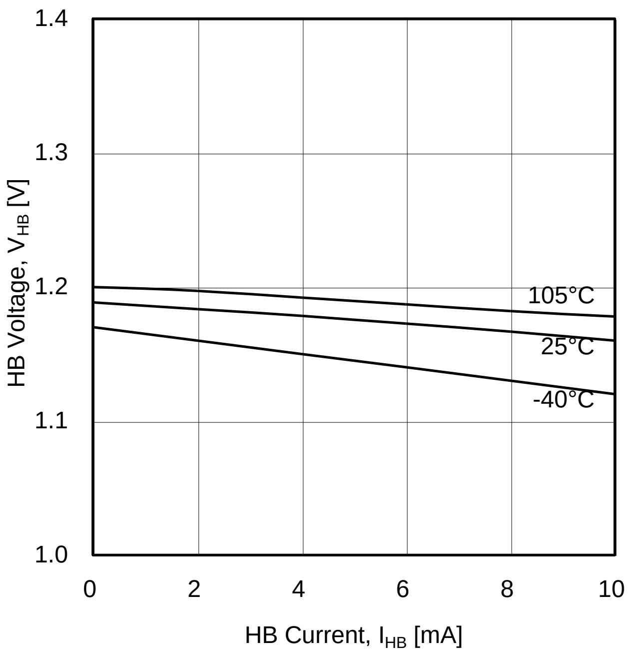


Figure 3. Hall Bias Voltage
(Temperature Characteristics)

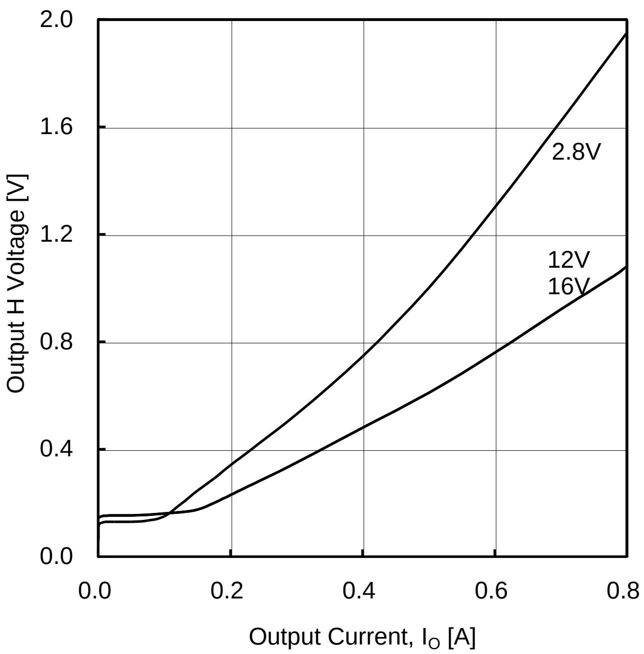


Figure 4. Output H Voltage
(Voltage Characteristics)

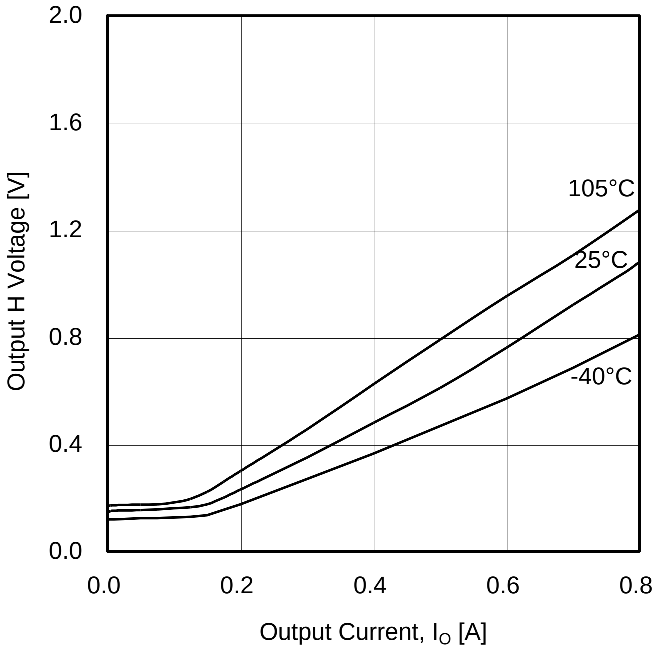


Figure 5. Output H Voltage
(Temperature Characteristics)

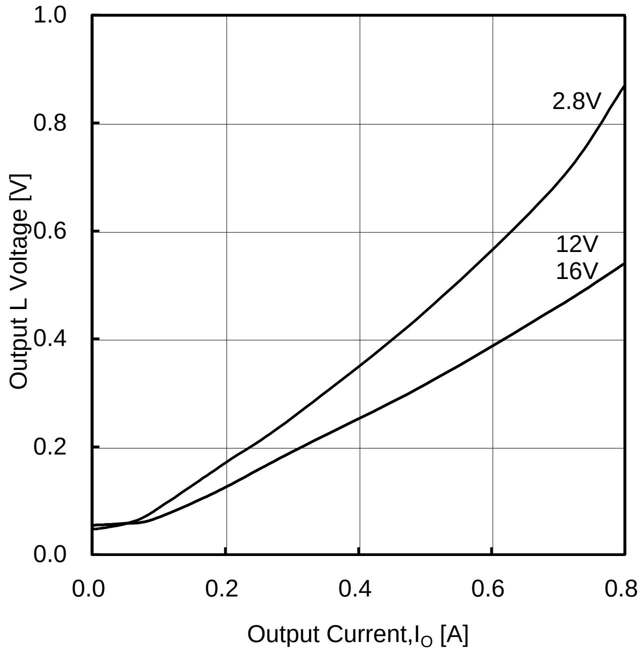


Figure 6. Output L Voltage
(Voltage Characteristics)

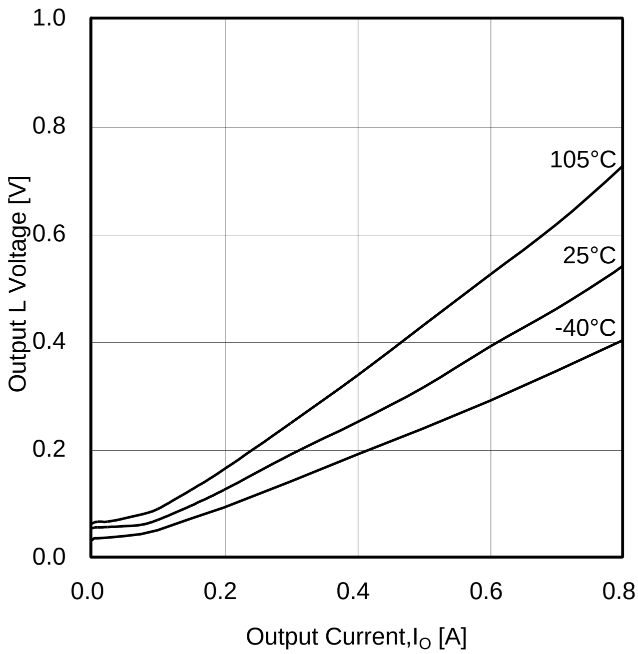


Figure 7. Output L Voltage
(Temperature Characteristics)

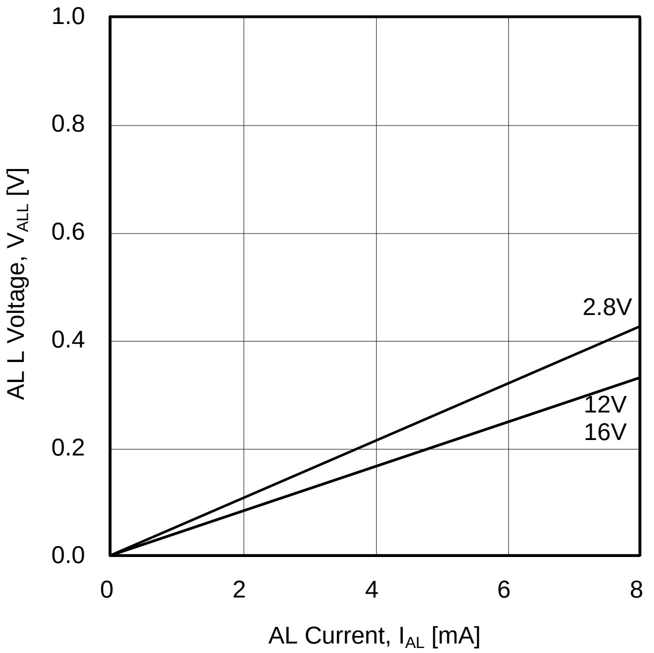


Fig.8 AL Output Voltage
(Voltage Characteristics)

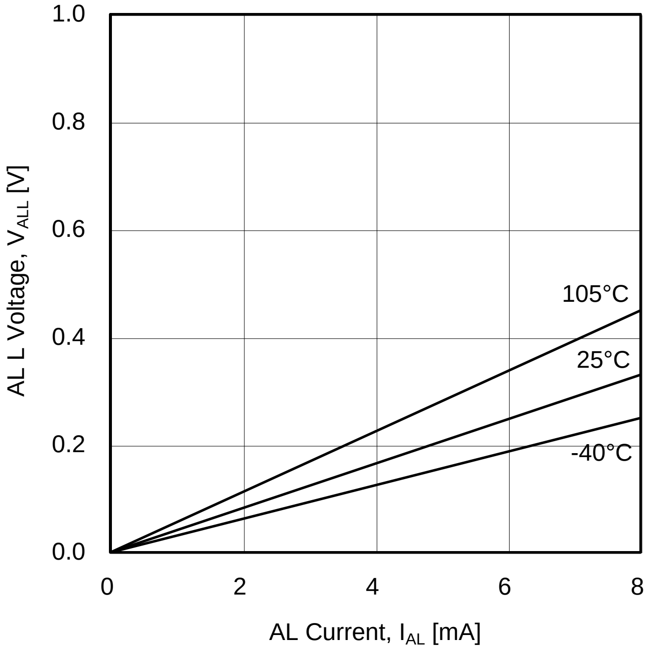


Figure 9. AL Output voltage
(Temperature Characteristics)

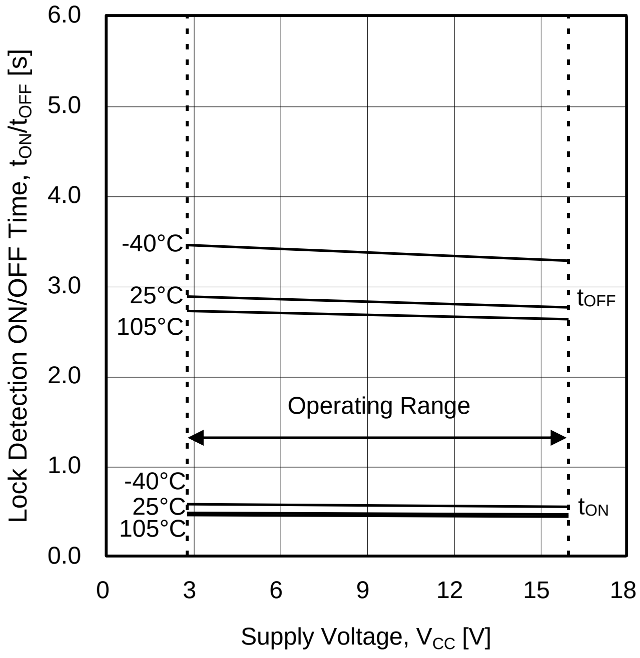
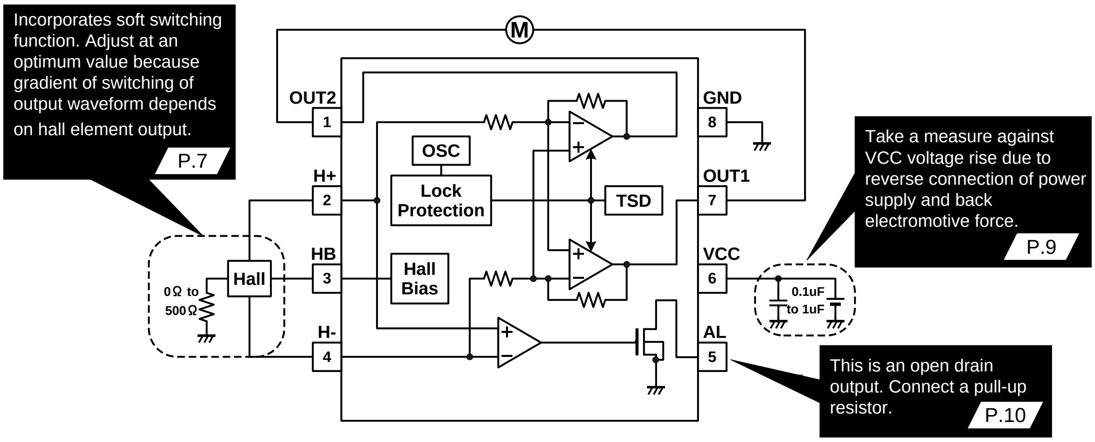


Figure 10. Lock Detection Time

Block Diagram, Application Circuit and Pin Assignment



OSC : Internal reference oscillation circuit
TSD : Thermal shut down(heat rejection circuit)

Pin Description

Pin No.	Pin Name	Function
1	OUT2	Motor output 2
2	H+	Hall input +
3	HB	Constant voltage output for hall element
4	H-	Hall input -
5	AL	Lock alarm signal output
6	VCC	Power supply pin
7	OUT1	Motor output 1
8	GND	GND

Description of Operations

1) Lock Protection and Automatic Restart

Motor rotation is detected by hall signal. Lock detection ON time (t_{ON}) and lock detection OFF time (t_{OFF}) are set by the digital counter based on internal oscillator. Therefore the ratio of ON/OFF time is always constant. Timing chart is shown in Figure 11.

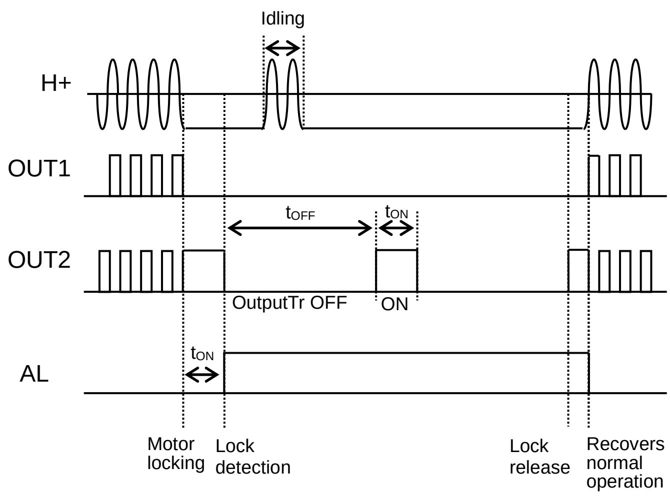


Figure 11. Lock Protection Timing Chart

2) Soft Switching (silent drive setting)

Input signal to hall amplifier is amplified to produce an output signal.

When the hall element output signal is small, the gradient of switching of output waveform is gentle. When it is large, the gradient of switching of output waveform is steep. Gain of 55dB (560 times) is provided between input and output, therefore enter an appropriate hall element output to IC where output waveform swings sufficiently.

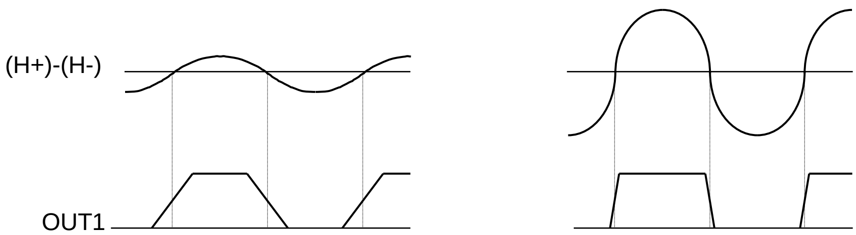


Figure 12. Relation between Hall Element Output Amplitude and Output Waveform

3) Hall Input Setting

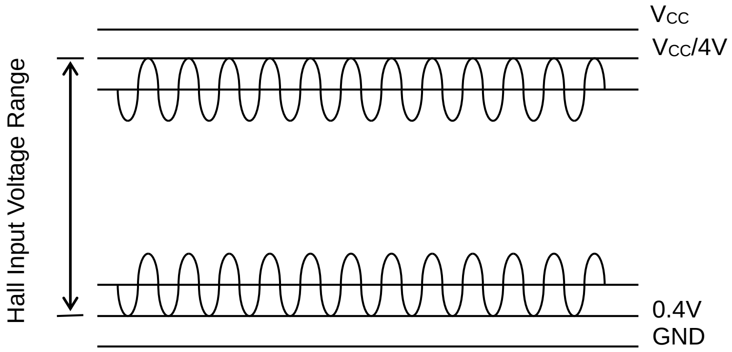


Figure 13. Hall Input Voltage Range

Adjust the value of R1 in Figure 14 so that the input voltage of a hall signal is input in "Hall Input Voltage Range" including signal amplitude.

In order to detect rotation of a motor, the amplitude of hall signal is required more than 30mVpp.

○Reducing the Noise of Hall Signal

Hall element may be affected by Vcc noise or the like depending on the wiring pattern of board. In this case, place a capacitor like C1 in Figure 14. In addition, when wiring from the hall element output to IC hall input is long, noise may be loaded on wiring. In this case, place a capacitor like C2 in Figure 14.

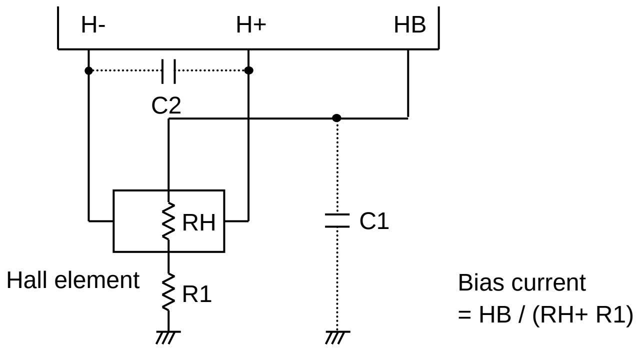
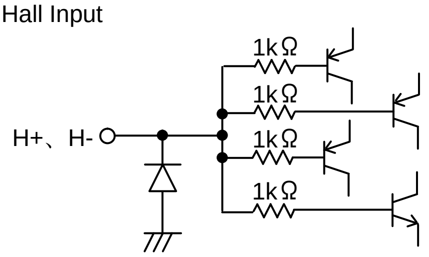


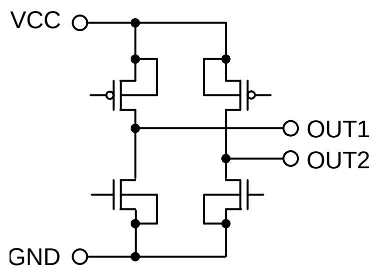
Figure 14. Application near of Hall Signal

Equivalent Circuit

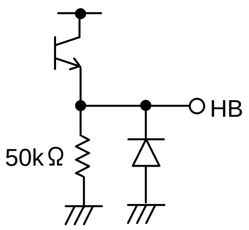
1) Hall Input



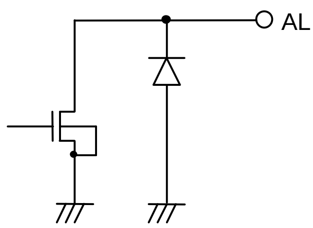
2) Motor Output



3) HB Output



4) AL Output



Safety Measure

1) Reverse Connection Protection Diode

Reverse connection of power results in IC destruction as shown in Figure 15. When reverse connection is possible, reverse connection protection diode must be added between power supply and VCC.

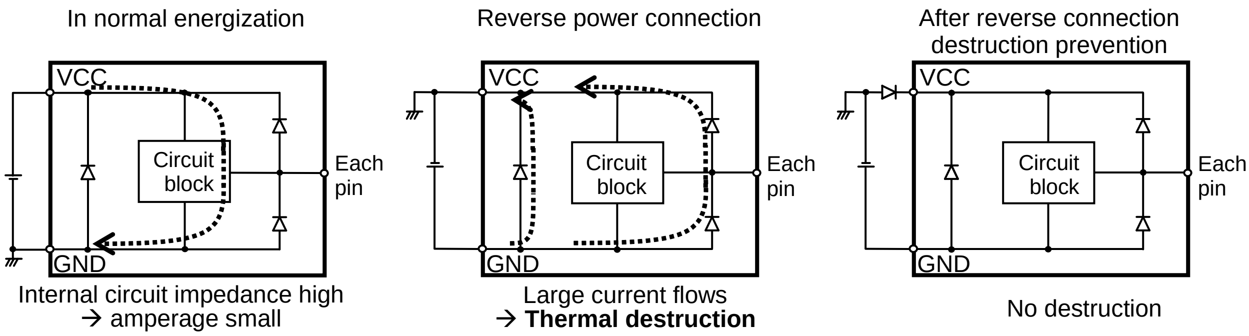


Figure 15. Flow of Current when Power is Connected Reversely

2) Measure against VCC Voltage Rise by Back Electromotive Force

Back electromotive force (Back EMF) generates regenerative current to power supply. However, when reverse connection protection diode is connected, VCC voltage rises because the diode prevents current flow to power supply.

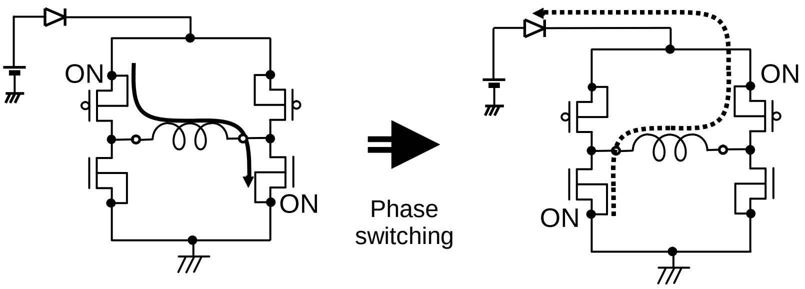


Figure 16. VCC Voltage Rise by Back Electromotive Force

When the absolute maximum rated voltage may be exceeded due to voltage rise by back electromotive force, place (A) Capacitor or (B) Zener diode between VCC and GND. It necessary, add both (C).

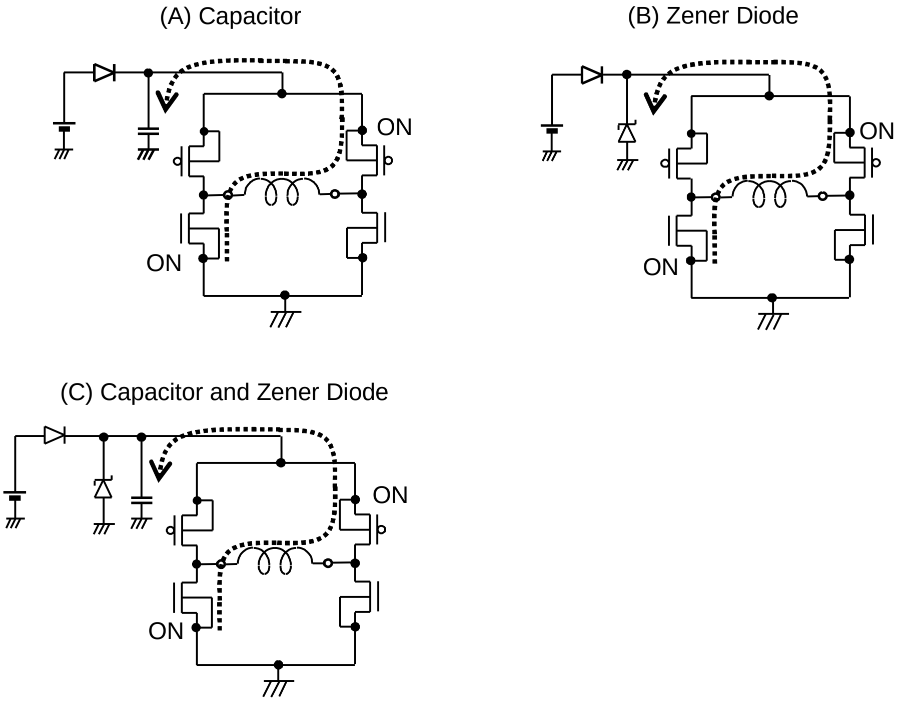


Figure 17. Measure against VCC Voltage Rise

3) Problem of GND Line PWM Switching

Do not perform PWM switching of GND line because GND terminal potential cannot be kept to a minimum.

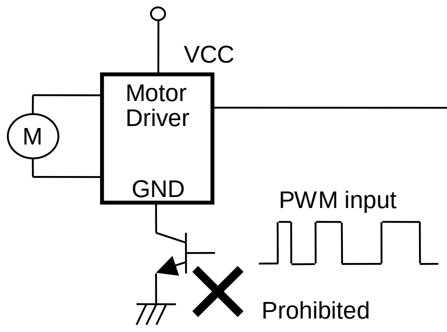


Figure 18. GND Line PWM Switching Prohibited

4) AL Output

AL output is an open drain and requires pull-up resistor. The IC can be protected by adding resistor R1. An excess of absolute maximum rating, when AL output terminal is directly connected to power supply, could damage the IC.

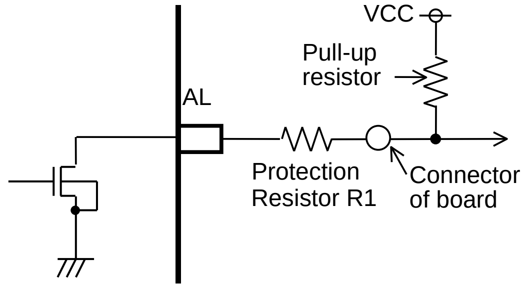
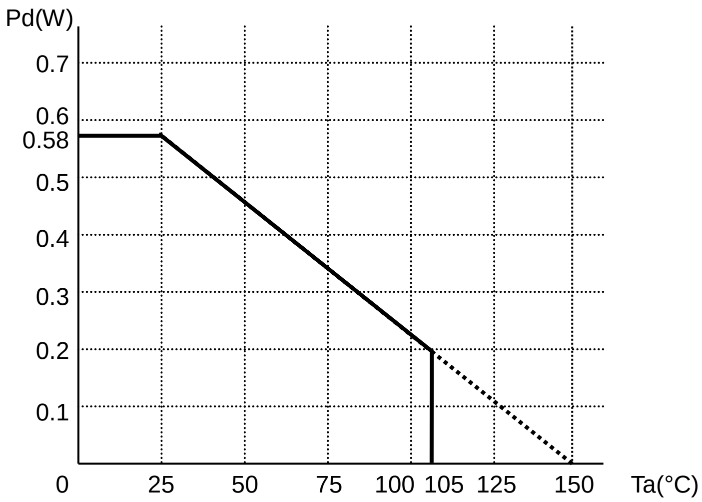


Figure 19. Protection of AL Pin

Thermal Derating Curve

Thermal derating curve indicates power that can be consumed by IC with reference to ambient temperature. Power that can be consumed by IC begins to attenuate at certain ambient temperature. this gradient is determined by thermal resistance θja.
Thermal resistance θja depends on chip size, power consumption, package ambient temperature, packaging condition, wind velocity, etc., even when the same package is used. Thermal derating curve indicates a reference value measured at a specified condition. Fig.20 shows a thermal derating curve.



* Reduce by 4.68 mW/°C over 25°C.
(70.0mm x 70.0mm x 1.6mm glass epoxy board)

Figure 20. Thermal Derating Curve

Operational Notes

1. **Reverse Connection of Power Supply**
   Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. **Power Supply Lines**
   Design the PCB layout pattern to provide low impedance supply lines. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. **Ground Voltage**
   Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition. However, pins that drive inductive loads (e.g. motor driver outputs, DC-DC converter outputs) may inevitably go below ground due to back EMF or electromotive force. In such cases, the user should make sure that such voltages going below ground will not cause the IC and the system to malfunction by examining carefully all relevant factors and conditions such as motor characteristics, supply voltage, operating frequency and PCB wiring to name a few.

4. **Ground Wiring Pattern**
   When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. **Thermal Consideration**
   Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the Pd rating.

6. **Recommended Operating Conditions**
   These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

7. **Inrush Current**
   When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

8. **Operation Under Strong Electromagnetic Field**
   Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

9. **Testing on Application Boards**
   When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

10. **Inter-pin Short and Mounting Errors**
    Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

Operational Notes – continued

11. Unused Input Pins

Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

12. Regarding the Input Pin of the IC

This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.
When GND > Pin B, the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

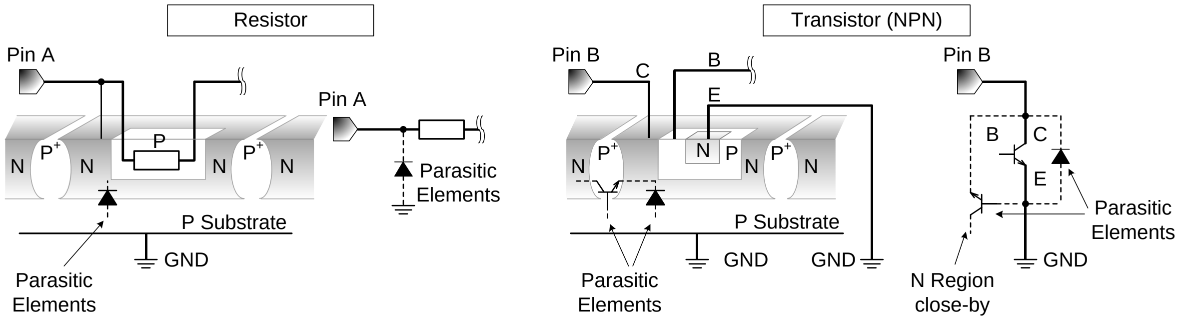


Figure 21. Example of monolithic IC structure

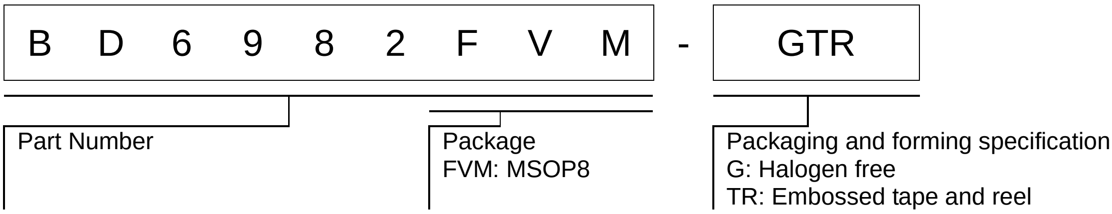
13. Ceramic Capacitor

When using a ceramic capacitor, determine the dielectric constant considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

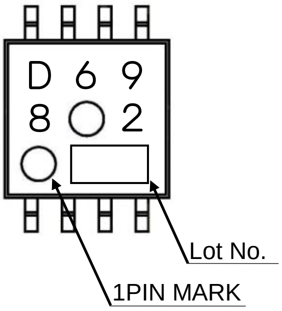
14. Thermal Shutdown Circuit(TSD)

This IC has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's power dissipation rating. If however the rating is exceeded for a continued period, the junction temperature (Tj) will rise which will activate the TSD circuit that will turn OFF all output pins. When the Tj falls below the TSD threshold, the circuits are automatically restored to normal operation.
Note that the TSD circuit operates in a situation that exceeds the absolute maximum ratings and therefore, under no circumstances, should the TSD circuit be used in a set design or for any purpose other than protecting the IC from heat damage.

Ordering Information

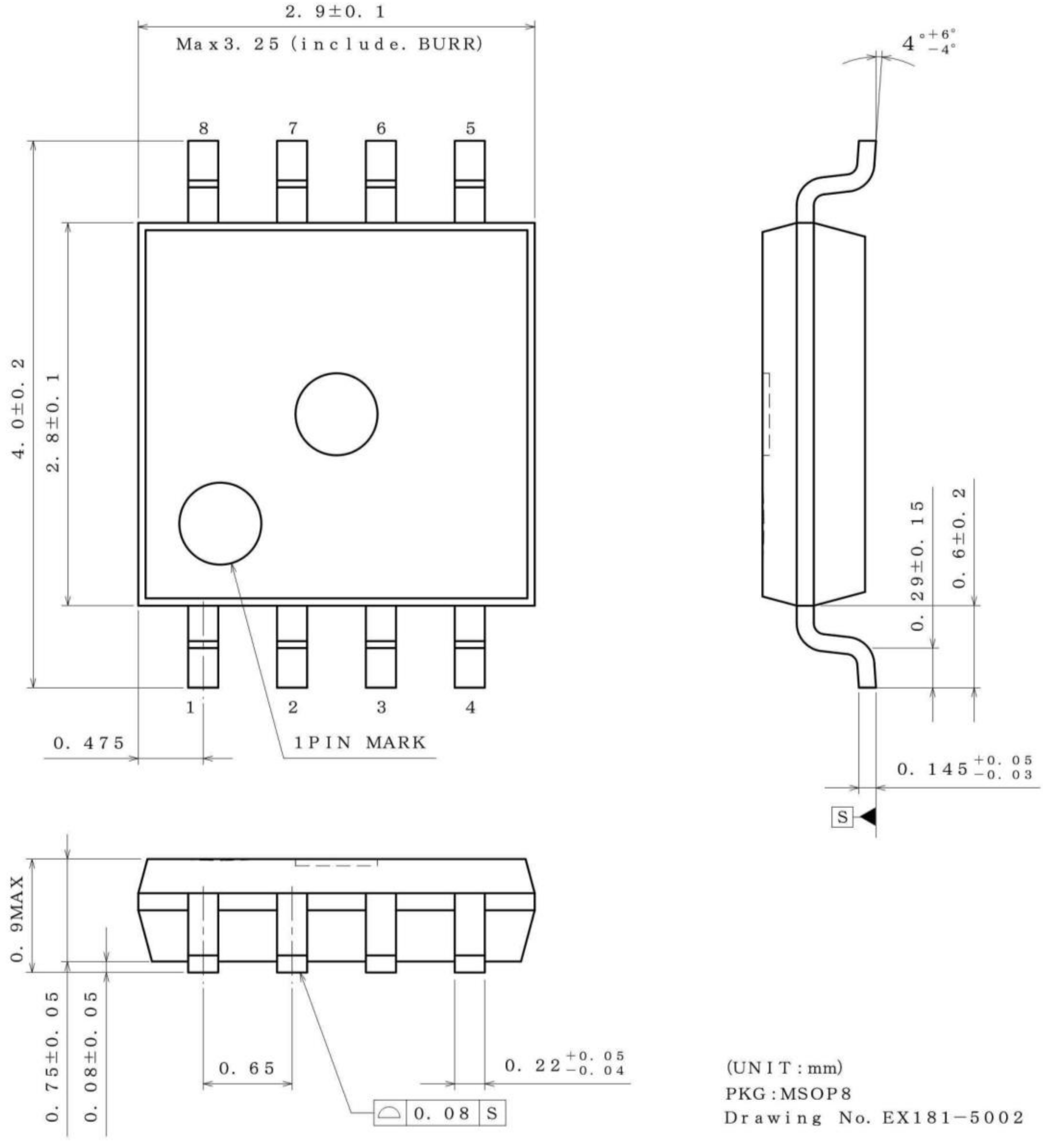


Marking Diagram



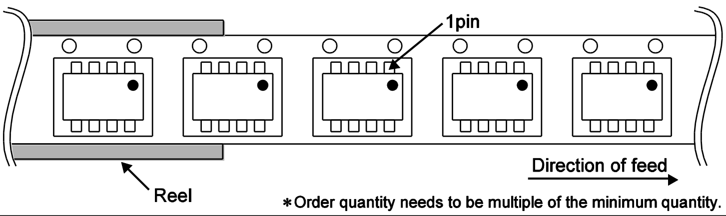
Physical Dimension, Tape and Reel Information

Package Name	MSOP8



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	TR (The direction is the 1pin of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand)



∗Order quantity needs to be multiple of the minimum quantity.

Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   - [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   - [b] the temperature or humidity exceeds those recommended by ROHM
   - [c] the Products are exposed to direct sunshine or condensation
   - [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

Precaution Regarding Intellectual Property Rights

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