DC Brush Motor Drivers (30V Max)

BD62222HFP

General Description

BD62222HFP is a full bridge driver for brush motor applications. This IC can operate at a wide range of power-supply voltages (from 6V to 27V) with output currents of up to 2.5A. MOS transistors in the output stage allow PWM speed control. The BD62222HFP is pin compatible with the BD623xHFP series.

Key Specifications

- Supply Voltage Range: 30V(Max)
- Maximum Output Current: 2.5A
- Output ON-Resistance: 1.0Ω
- PWM Input Frequency Range: 20kHz to 100kHz
- Standby Current: 0μA (Typ)
- Operating Temperature Range: -40°C to +85°C

Features

- Built-in One Channel Driver
- Cross-Conduction Prevention Circuit
- Four Protection Circuits Provided: OCP, OVP, TSD and UVLO

Package

	W(Typ) x D(Typ) x H(Max)
HRP7	9.395mm x 10.540mm x 2.005mm

HRP7 (Pd=1.60W)

(Note) Pd : Mounted on a 70mm x 70mm x 1.6mm glass-epoxy board.

Applications

VTR; CD/DVD players; audio-visual equipment; optical disc drives; PC peripherals; OA equipments

Ordering Information

B D 6 2 2 2 2 H F P - T R

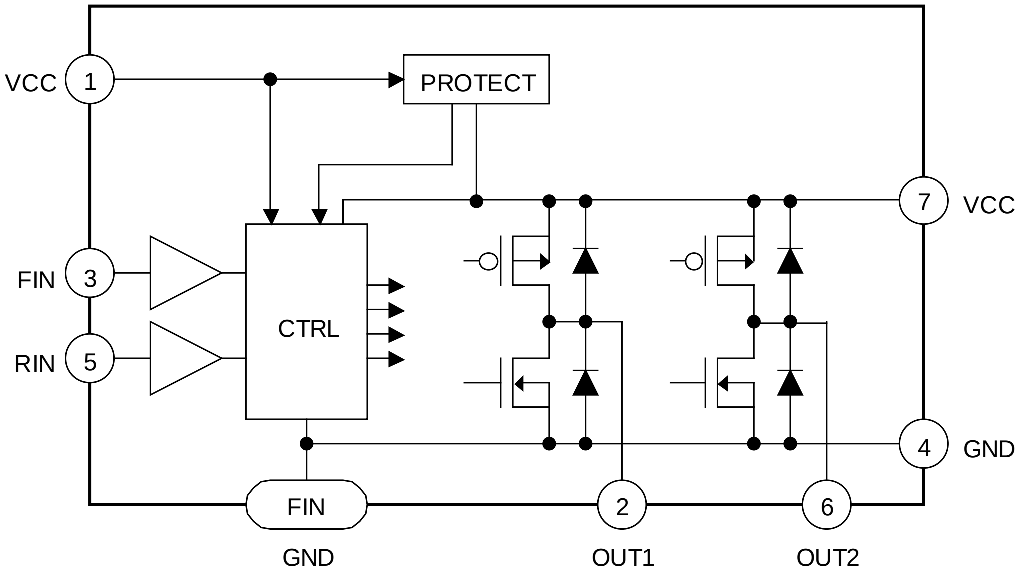
- Part Number
- Package
  HFP : HRP7
- Packaging and forming specification
  TR: Embossed tape and reel
  (HRP7)

Lineup

Voltage Rating (Max)	Channels	Output Current (Max)	Package		Ordering Part Number
30V	1ch	2.5A	HRP7	Reel of 2000	BD62222HFP -TR

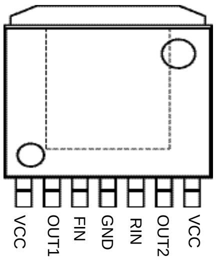
○Product structure : Silicon monolithic integrated circuit ○This product has no designed protection against radioactive rays

Block Diagram



Pin Configuration

(TOP VIEW)



Pin Descriptions

Pin No.	Pin Name	Function
1	VCC	Power supply
2	OUT1	Driver output
3	FIN	Control input (forward)
4	GND	Ground
5	RIN	Control input (reverse)
6	OUT2	Driver output
7	VCC	Power supply
FIN	GND	Ground

(Note) Use all VCC pin by the same voltage.

Absolute Maximum Ratings (Ta=25°C, All voltages are with respect to ground)

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{CC}	30	V
Output Current	I_{OMAX}	2.5 (Note 1)	A
All Other Input Pins	V_{IN}	-0.3 to V_{CC}	V
Operating Temperature	Topr	-40 to +85	°C
Storage Temperature	Tstg	-55 to +150	°C
Power Dissipation	Pd	1.6 (Note 2)	W
Junction Temperature	Tjmax	150	°C

(Note 1) Do not exceed Pd or ASO.
(Note 2) HRP7 package. Mounted on a 70mm x 70mm x 1.6mm glass-epoxy board. Derate by 12.8mW/°C for Ta above 25°C.
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.

Recommended Operating Condition (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{CC}	6 to 27	V

Electrical Characteristics (Unless otherwise specified, Ta=25°C and V_{CC}=24V)

Parameter	Symbol	Limit			Unit	Conditions
		Min	Typ	Max		
Supply Current	I_{CC}	0.9	1.4	2.7	mA	Forward / Reverse / Brake
Stand-by Current	I_{STBY}	-	0	10	µA	Stand-by
Input High Voltage	V_{IH}	2.0	-	-	V	
Input Low Voltage	V_{IL}	-	-	0.8	V	
Input Bias Current	I_{IH}	30	50	100	µA	V_{IN}=5.0V
Output ON-Resistance	R_{ON}	0.5	1.0	1.5	Ω	I_{OUT}=1.0A, vertically total
Input Frequency Range	f_{MAX}	20	-	100	kHz	FIN / RIN

Typical Performance Curves (Reference Data)

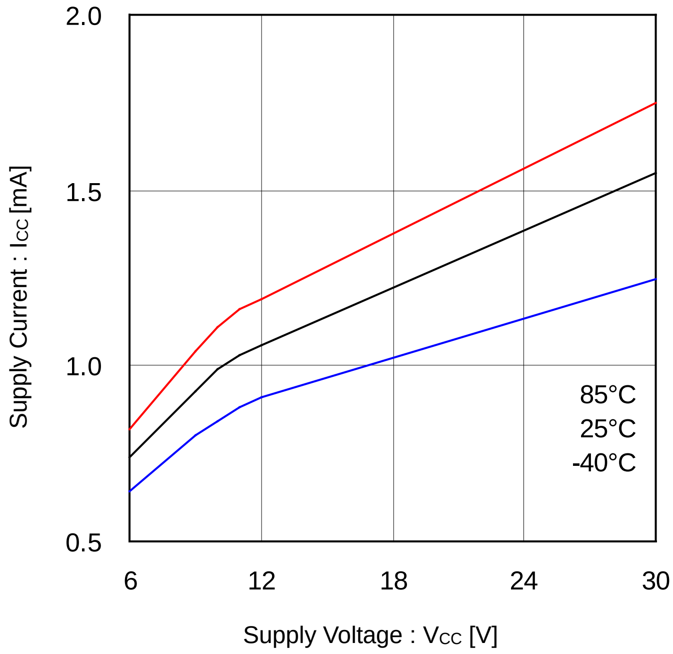


Figure 1. Supply Current vs Supply Voltage

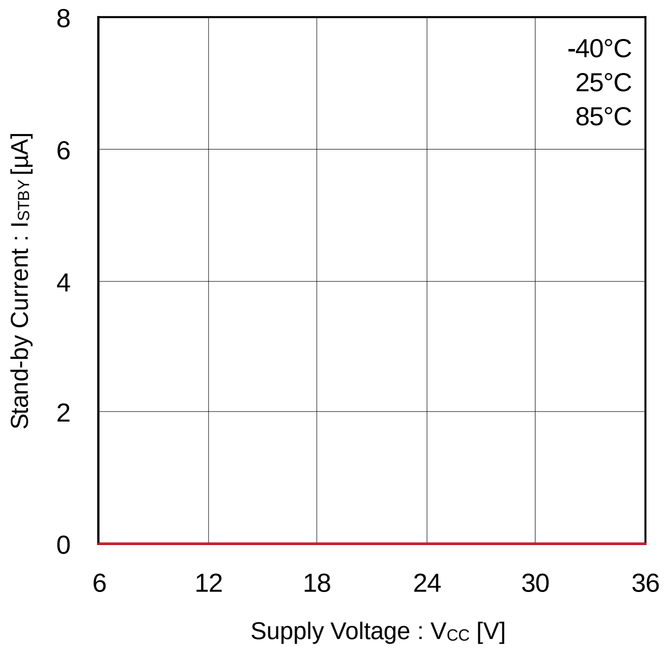


Figure 2. Stand-by Current vs Supply Voltage

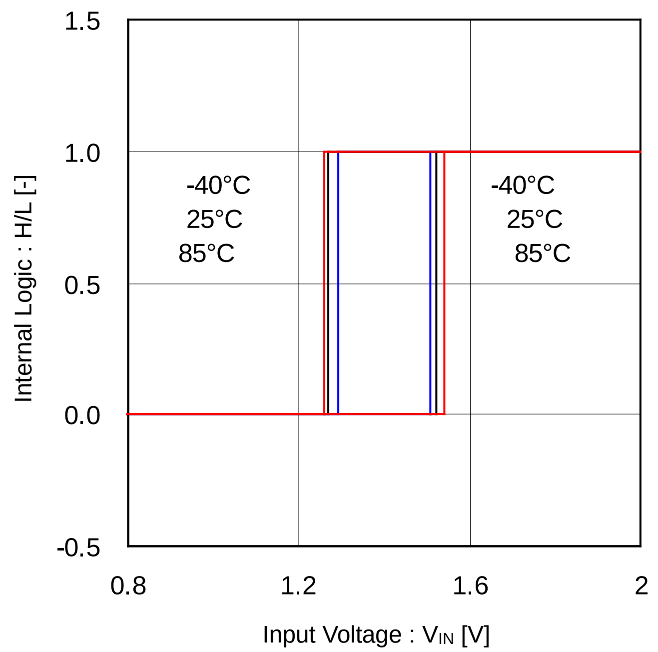


Figure 3. Internal Logic vs Input Voltage
(Input Threshold Voltage)

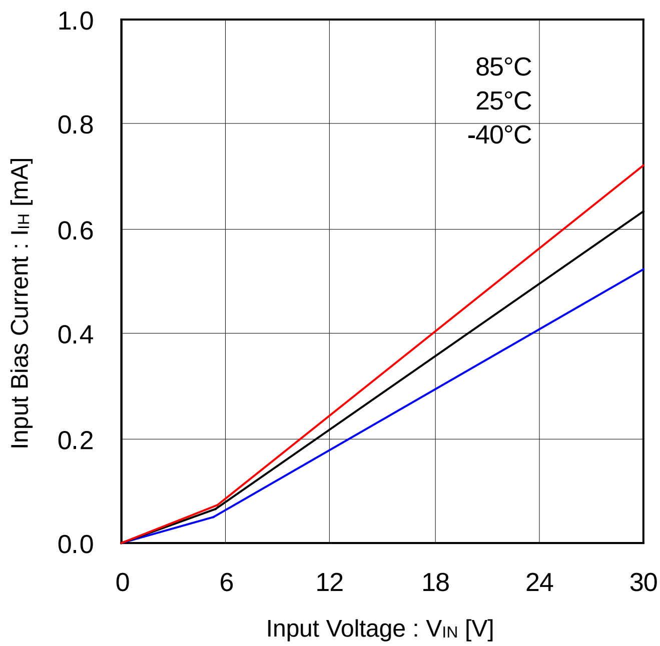


Figure 4. Input Bias Current vs Input Voltage

Typical Performance Curves (Reference Data) **- continued**

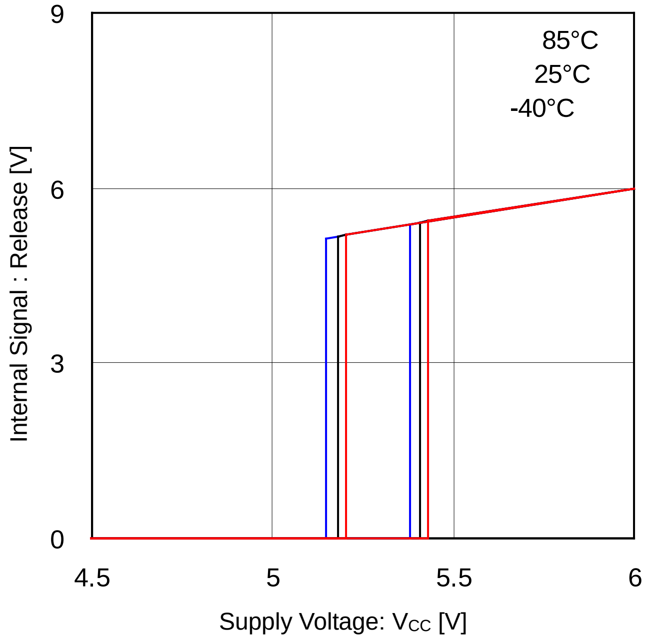


Figure 5. Internal Signal vs Supply Voltage
(Under Voltage Lock Out)

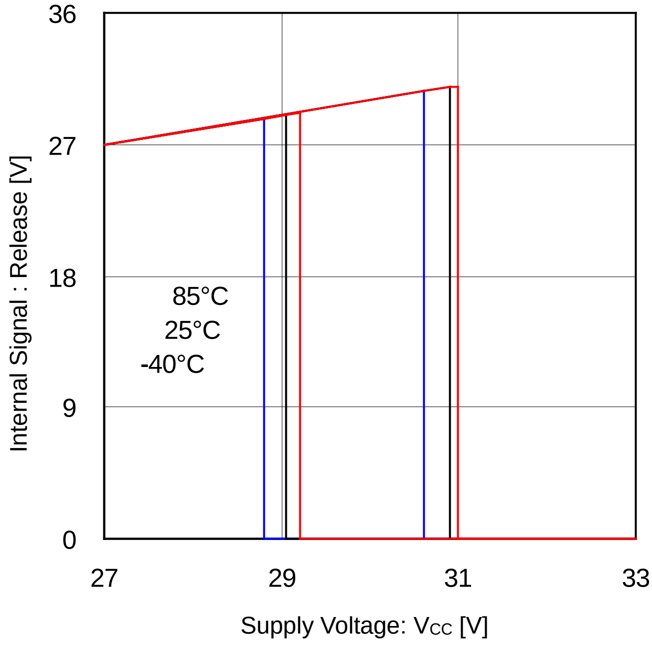


Figure 6. Internal Signal vs Supply Voltage
(Over Voltage Protection)

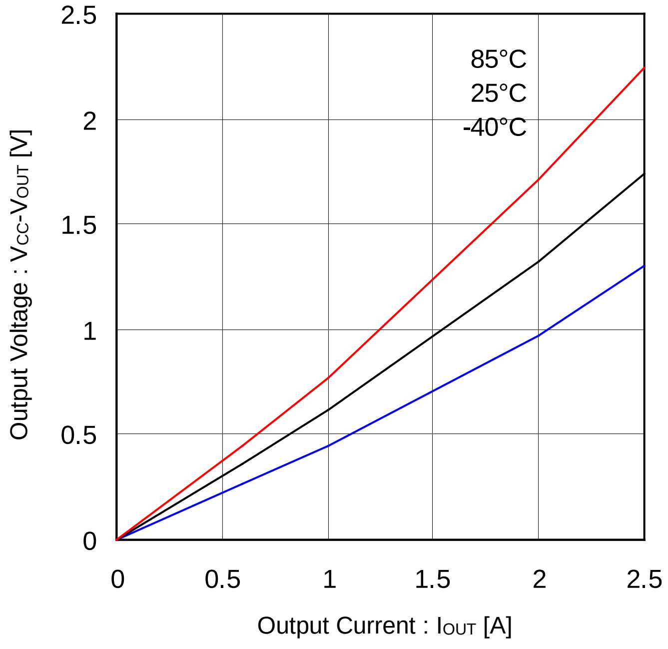


Figure 7. Output Voltage vs Output Current
(Output High Voltage)

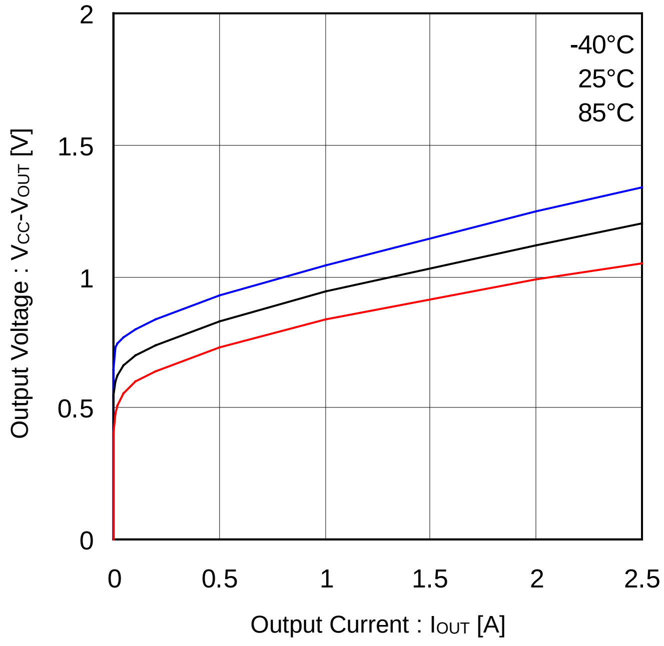


Figure 8. Output Voltage vs Output Current
(High Side Body Diode)

Typical Performance Curves (Reference Data) **- Continued**

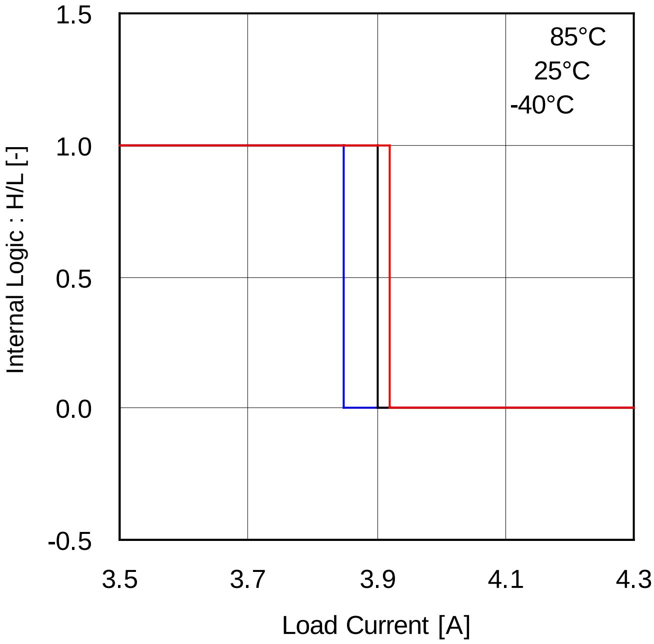


Figure 9. Internal Logic vs Load Current
(Over Current Protection, H Side)

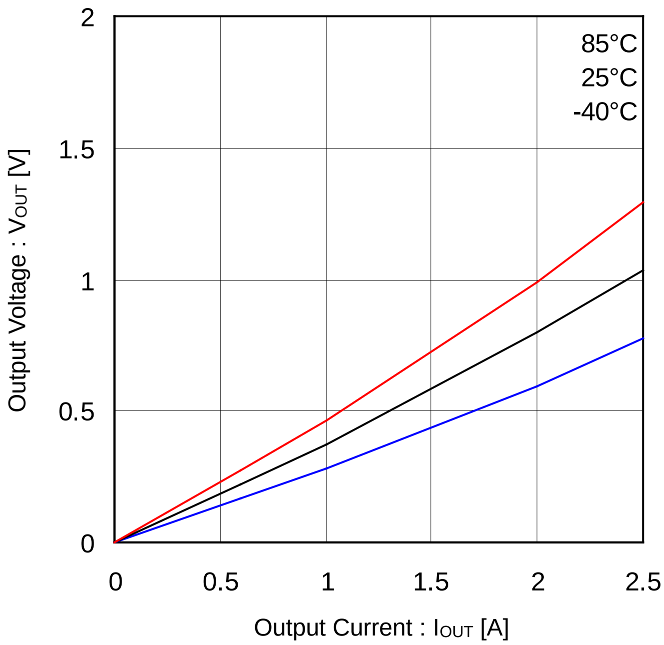


Figure 10. Output Voltage vs Output Current
(Output Low Voltage)

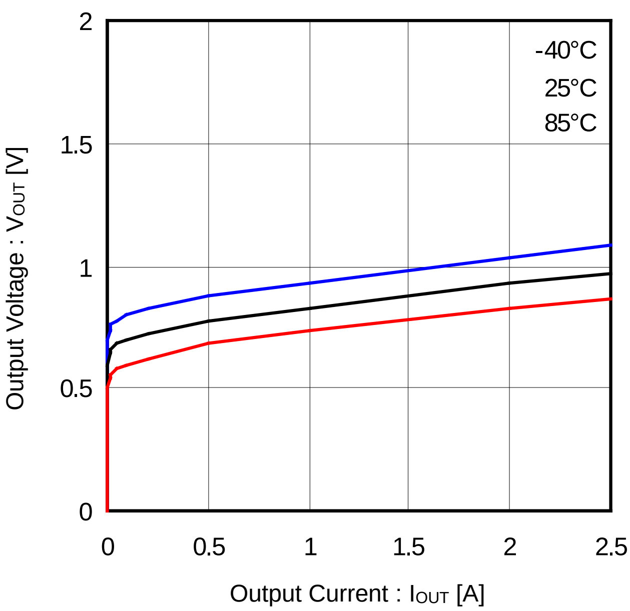


Figure 11. Output Voltage vs Output Current
(Low Side Body Diode)

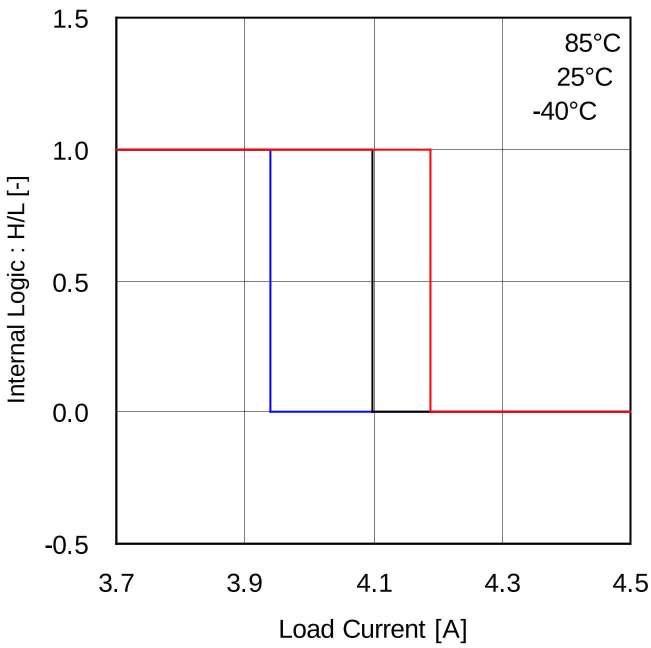


Figure 12. Internal Logic vs Load Current
(Over Current Protection, L side)

Application Information

1. Description of Functions

(1) Operation Modes

Table 1 Logic Table

Mode	FIN	RIN	OUT1	OUT2	Operation
a	L	L	Hi-Z (Note)	Hi-Z (Note)	Stand-by (idling)
b	H	L	H	L	Forward (OUT1 > OUT2)
c	L	H	L	H	Reverse (OUT1 < OUT2)
d	H	H	L	L	Brake (stop)
e	PWM	L	H	$\overline{\text{PWM}}$	Forward (PWM control)
f	L	PWM	$\overline{\text{PWM}}$	H	Reverse (PWM control)

(Note) Hi-Z : all output transistors are off.
Please note that this is the state of the connected diodes, which differs from that of the mechanical relay.

Mode (a) Stand-by Mode

During stand-by mode, all internal circuits are turned off, including the output power transistors. Motor output goes to high impedance. When the system is switched to stand-by mode while the motor is running, the system enters an idling state because of the body diodes. However, when the system switches to stand-by from any other mode (except the brake mode), the control logic remains in the high state for at least 50µs before shutting down all circuits.

Mode (b) Forward Mode

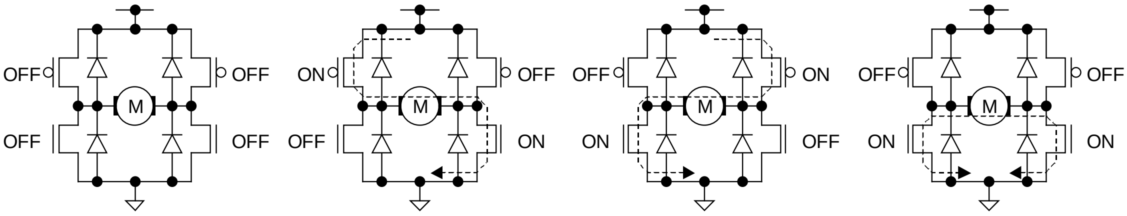
This operating mode is defined as the forward rotation of the motor when the OUT1 pin is high and OUT2 pin is low. If the motor is connected between the OUT1 and OUT2 pins, the current flows from OUT1 to OUT2.

Mode (c) Reverse Mode

This operating mode is defined as the reverse rotation of the motor when the OUT1 pin is low and OUT2 pin is high. If the motor is connected between the OUT1 and OUT2 pins, the current flows from OUT2 to OUT1.

Mode (d) Brake Mode

This operating mode is used to quickly stop the motor (short circuit brake). It differs from the stand-by mode because the internal control circuit is operating in the brake mode. Please switch to stand-by mode (rather than the brake mode) to save power and reduce consumption.



(a) Stand-by Mode (b) Forward Mode (c) Reverse Mode (d) Brake Mode

Figure 13. Four Basic Operations (Output Stage)

Mode (e),(f) PWM Control Mode

The rotational speed of the motor can be controlled by the duty cycle of the PWM signal fed to the FIN pin or the RIN pin. In this mode, the high side output is fixed and the low side output is switching, corresponding to the input signal. The state of the output toggles between LOW and high impedance.

The frequency of the input PWM signal can be between 20kHz and 100kHz. The circuit may not operate properly for PWM frequencies below 20kHz and above 100kHz. Note that control may not be attained by switching ON duty at frequencies lower than 20kHz, since the operation functions via the stand-by mode. To operate in this mode, connect the VREF pin to the VCC pin. In addition, establish a current path for the recovery current from the motor, by connecting a bypass capacitor (10µF or higher is recommended) between VCC and ground.

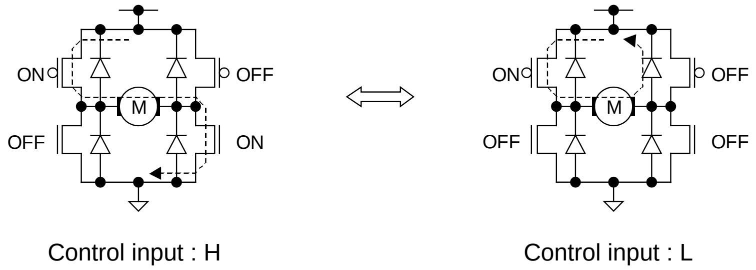


Figure 14. PWM control operation (output stage)

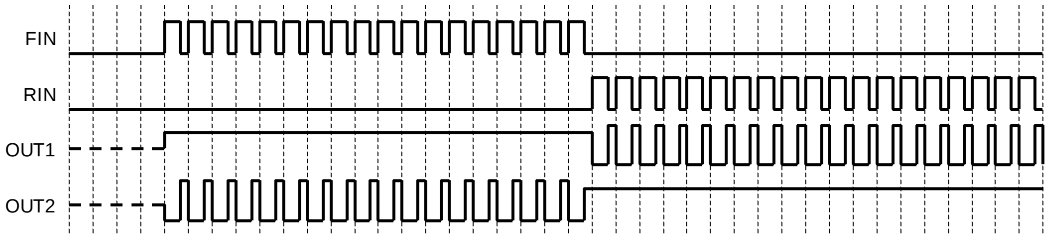


Figure 15. PWM Control Operation (Timing Chart)

(2) Cross-Conduction Protection Circuit

In the full bridge output stage, when the upper and lower transistors are turned on at the same time during high to low or low to high transition, an inrush current flows from the power supply to ground, resulting to a loss. This circuit eliminates the inrush current by providing a dead time (about 400ns, nominal) during the transition.

(3) Output Protection Circuits

(a) Under Voltage Lock-out (UVLO) Circuit

To ensure the lowest power supply voltage necessary to operate the controller, and to prevent under voltage malfunctions, a UVLO circuit has been built into this driver. When the power supply voltage falls to 5.3V (nominal) or below, the controller forces all driver outputs to high impedance. When the voltage rises to 5.5V (nominal) or above, the UVLO circuit ends the lockout operation and returns the chip to normal operation.

(b) Over Voltage Protection (OVP) Circuit

When the power supply voltage exceeds 31V (nominal), the controller forces all driver outputs to high impedance. The OVP circuit is released and its operation ends when the voltage drops back to 29V (nominal) or below. This protection circuit does not work in the stand-by mode. Also, note that this circuit is supplementary, and thus if it is asserted, the absolute maximum rating will have been exceeded. Therefore, do not continue to use the IC after this circuit is activated, and do not operate the IC in an environment where activation of the circuit is assumed.

(c) Thermal Shutdown (TSD) Circuit

The TSD circuit operates when the junction temperature of the driver exceeds the preset temperature (175°C nominal). At this time, the controller forces all driver outputs to high impedance. Since thermal hysteresis is provided in the TSD circuit, the chip returns to normal operation when the junction temperature falls below the preset temperature (150°C nominal). Thus, it is a self-resetting circuit.

The TSD circuit is designed only to shut the IC off to prevent thermal runaway. It is not designed to protect the IC or guarantee its operation in the presence of extreme heat. Do not continue to use the IC after the TSD circuit is activated, and do not operate the IC in an environment where activation of the circuit is assumed.

(d) Over-Current Protection (OCP) Circuit

To protect this driver IC from ground faults, power supply line faults and load short circuits, the OCP circuit monitors the output current for the circuit's monitoring time (10µs, nominal). When the protection circuit detects an over current, the controller forces all driver outputs to high impedance during the off time (290µs, nominal). The IC returns to normal operation after the off time period has elapsed (self-returning type). At the two channels type, this circuit works independently for each channel.

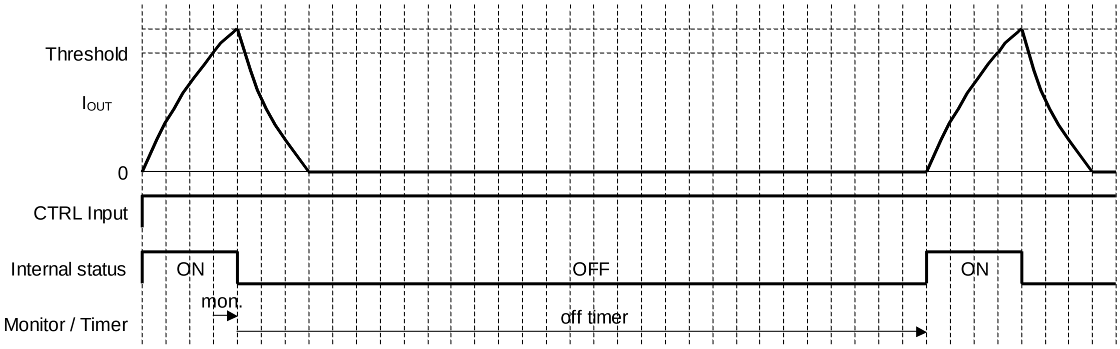


Figure 16. Over-Current Protection (Timing Chart)

I/O Equivalent Circuits

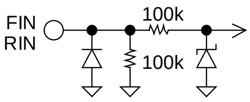


Figure 17. FIN / RIN

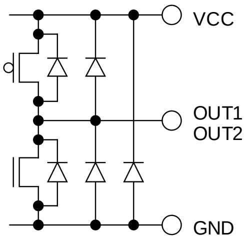


Figure 18. OUT1 / OUT2

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. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. 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.

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.

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.

Operational Notes – continued

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.

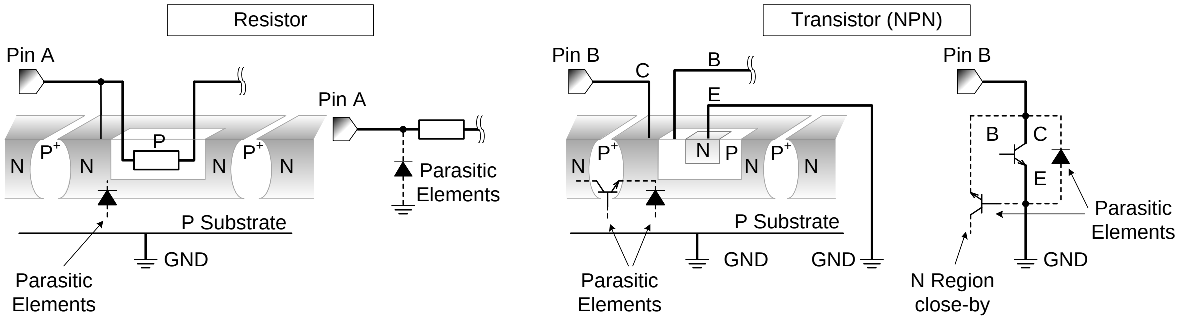


Figure 19. Example of monolithic IC structure

13. Area of Safe Operation (ASO)

Operate the IC such that the output voltage, output current, and power dissipation are all within the Area of Safe Operation (ASO).

14. Power supply lines2

Return current generated by the motor's Back-EMF requires countermeasures, such as providing a return current path by inserting capacitors across the power supply and GND (10µF, ceramic capacitor is recommended). In this case, it is important to conclusively confirm that none of the negative effects sometimes seen with electrolytic capacitors – including a capacitance drop at low temperatures - occurs. Also, the connected power supply must have sufficient current absorbing capability. Otherwise, the regenerated current will increase voltage on the power supply line, which may in turn cause problems with the product, including peripheral circuits exceeding the absolute maximum rating. To help protect against damage or degradation, physical safety measures should be taken, such as providing a voltage clamping diode across the power supply and GND.

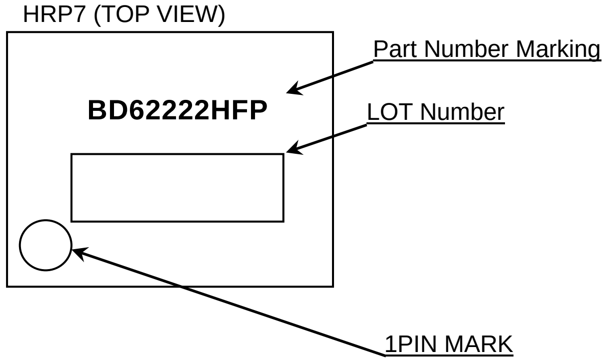
15. Capacitor Between Output and Ground

If a large capacitor is connected between the output pin and ground pin, current from the charged capacitor can flow into the output pin and may destroy the IC when the VCC or VIN pin is shorted to ground or pulled down to 0V. Use a capacitor smaller than 10µF between output and ground.

16. Switching Noise

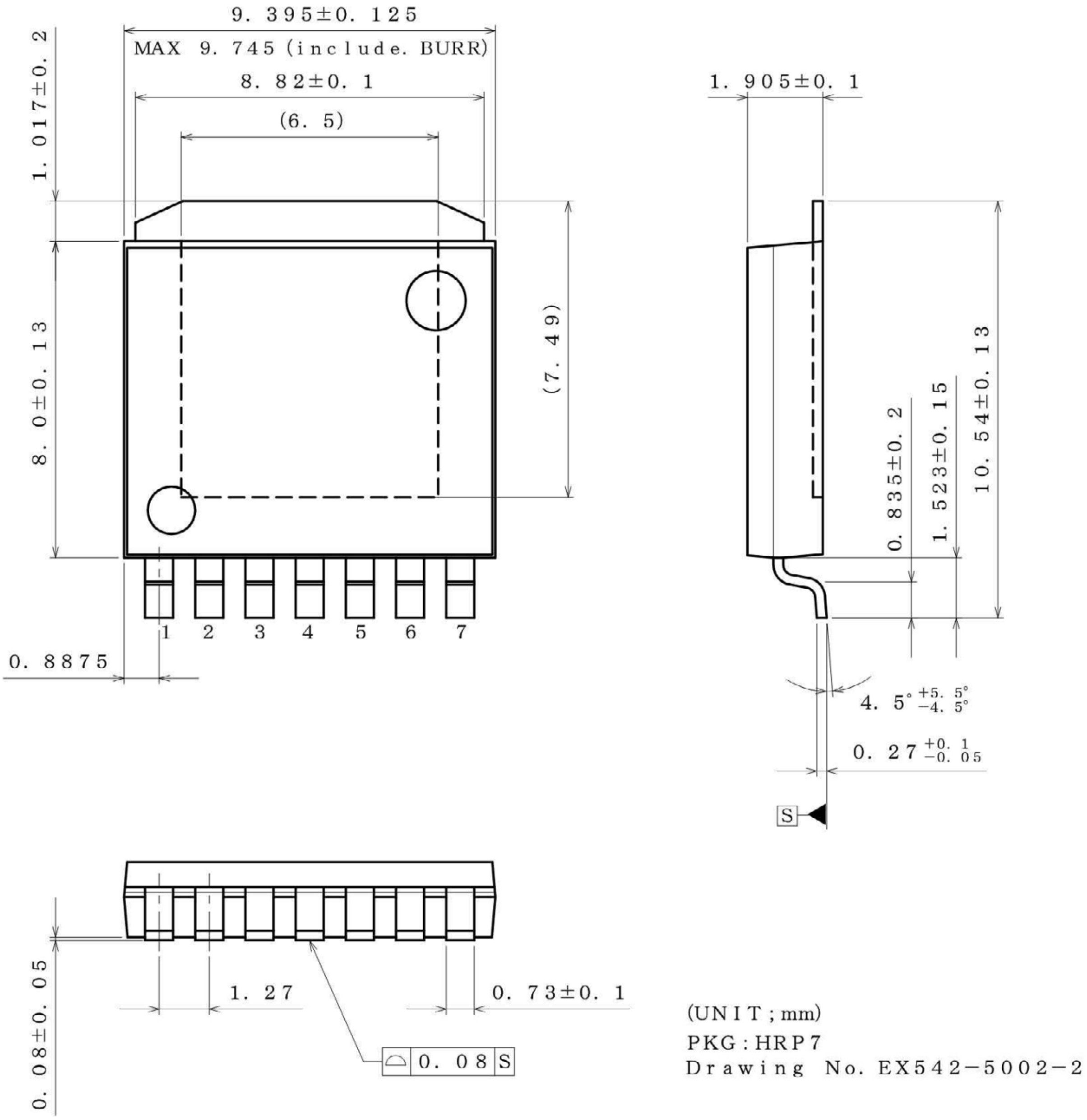
When the operation mode is in PWM control or VREF control, PWM switching noise may affect the control input pins and cause IC malfunctions. In this case, insert a pull down resistor (10kΩ is recommended) between each control input pin and ground.

Marking Diagram



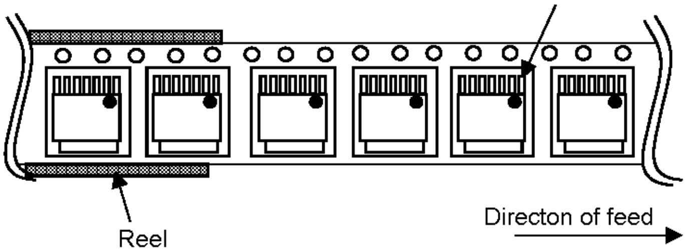
Physical Dimension, Tape and Reel Information

Package Name	HRP7



< Tape and Reel Information >

Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	TR The direction is the pin 1 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



Revision History

Date	Revision	Changes
14.Mar.2012	001	New Release
25.Dec.2012	002	Improved the statement in all pages. Deleted “Status of this document” in page 11.
09.Sep.2014	003	Applied the ROHM Standard Style. Improved Operational Notes.

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; if flow soldering method is preferred, 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 our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

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General Precaution

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