Omnipolar Detection Hall IC

(Dual Outputs for both S and N Pole Polarity Detection)

BU52273NUZ

General Description

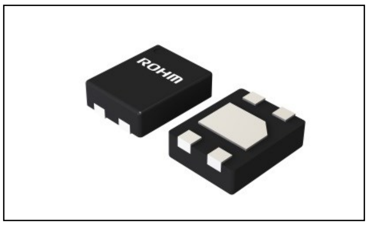
The BU52273NUZ is omnipolar Hall IC incorporating a polarity determination circuit that enables separate operation (output) of both the South and North poles.
This Hall IC product can be in tablets, smart phones, and other applications in order to detect open and close of the cover.
And this Hall IC product can be in digital video cameras and other applications involving display panels in order to detect the front/back location or determine the rotational direction of the panel.

Key Specifications

- V_{DD} Voltage Range: 1.65V to 3.6V
- Operate Point: ±4.1mT(Typ)
- Hysteresis: 0.8mT(Typ)
- Period: 50ms(Typ)
- Supply Current (AVG): 4.4µA (Typ)
- Output Type: CMOS
- Operating Temperature Range: -40°C to +85°C

Package

Package	W(Typ) x D(Typ) x H(Max)
VSON04Z1114A	1.10mm x 1.40mm x 0.40mm



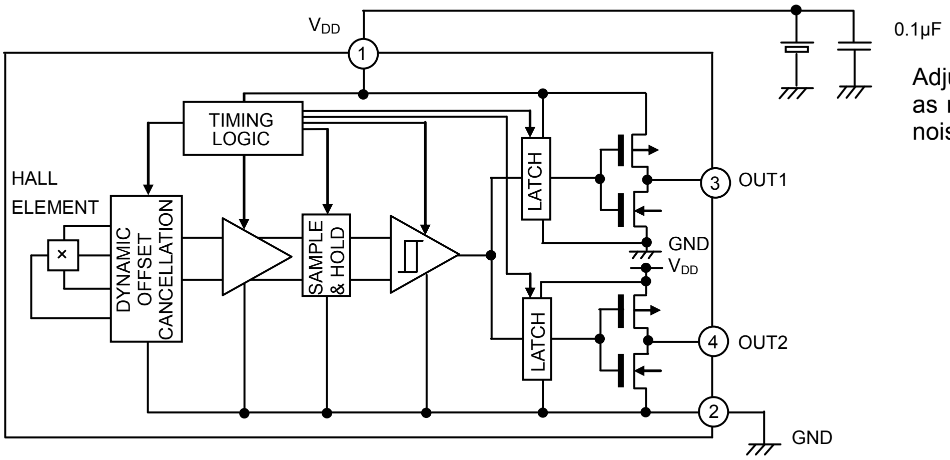
Features

- Omnipolar Detection (Polarity Detection for both S and N Poles with Separate, Dual Outputs)
- Micro Power Operation (Small Current Using Intermittent Operation Method)
- Ultra-small Outline Package
- Polarity Judgment and Separate Output on both Poles
  (OUT1=S-pole Output; OUT2=N-pole Output)

Applications

- Tablets, Smart Phones, Notebook Computers, Digital Video Cameras, Digital Still Cameras, etc.

Typical Application Circuit, and Block Diagram

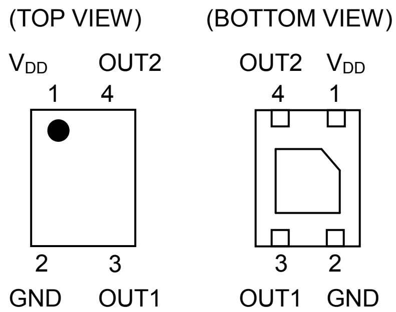


Adjust the bypass capacitor value as necessary, according to voltage noise conditions, etc.

Pin Descriptions

Pin No.	Pin Name	Function
1	V_{DD}	Power supply
2	GND	Ground
3	OUT1	Output (Detect the south pole)
4	OUT2	Output (Detect the north pole)

Pin Configurations



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

Contents

Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	Rating	Unit
Power Supply Voltage	V_{DD}	4.5	V
Output Current	I_{OUT}	±0.5	mA
Operating Temperature Range	T_{opr}	-40 to +85	°C
Storage Temperature Range	T_{stg}	-40 to +125	°C
Maximum Junction Temperature	T_{jmax}	125	°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.

Thermal Resistance*(Note 1)*

Parameter	Symbol	Thermal Resistance (Typ)		Unit
		1s*(Note 3)*	2s2p*(Note 4)*	
VSON04Z1114A				
Junction to Ambient	θ_{JA}	512.5	206.1	°C/W
Junction to Top Characterization Parameter*(Note 2)*	Ψ_{JT}	281	101	°C/W

*(Note 1)*Based on JESD51-2A(Still-Air)
*(Note 2)*The thermal characterization parameter to report the difference between junction temperature and the temperature at the top center of the outside surface of the component package.
*(Note 3)*Using a PCB board based on JESD51-3.

Layer Number of Measurement Board	Material	Board Size
Single	FR-4	114.3mm x 76.2mm x 1.57mmt

Top	
Copper Pattern	Thickness
Footprints and Traces	70μm

*(Note 4)*Using a PCB board based on JESD51-7.

Layer Number of Measurement Board	Material	Board Size
4 Layers	FR-4	114.3mm x 76.2mm x 1.6mmt

Top		2 Internal Layers		Bottom	
Copper Pattern	Thickness	Copper Pattern	Thickness	Copper Pattern	Thickness
Footprints and Traces	70μm	74.2mm x 74.2mm	35μm	74.2mm x 74.2mm	70μm

Recommended Operating Conditions (Ta= -40°C to +85°C)

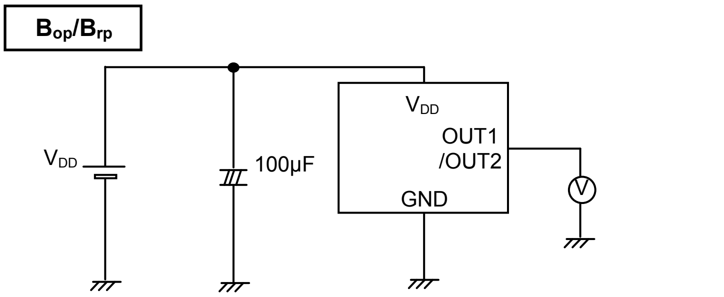
Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	V_{DD}	1.65	1.80	3.60	V

Magnetic, Electrical Characteristics (Unless otherwise specified V_{DD}=1.8V Ta=25°C)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Operate Point	B_{opS}	-	4.1	5.1	mT	Output: OUT1 (Detect the south pole)
	B_{opN}	-5.1	-4.1	-		Output: OUT2 (Detect the north pole)
Release Point	B_{rpS}	2.3	3.3	-	mT	Output: OUT1 (Detect the south pole)
	B_{rpN}	-	-3.3	-2.3		Output: OUT2 (Detect the north pole)
Hysteresis	B_{hysS}	-	0.8	-	mT	
	B_{hysN}	-	0.8	-		
Period	T_p	-	50	100	ms	
Output High Voltage	V_{OH}	V_{DD} -0.2	-	-	V	I_{OUT}=-0.5mA
Output Low Voltage	V_{OL}	-	-	0.2	V	I_{OUT}=+0.5mA
Supply Current	I_{DD}	-	4.4	8	μA	Average

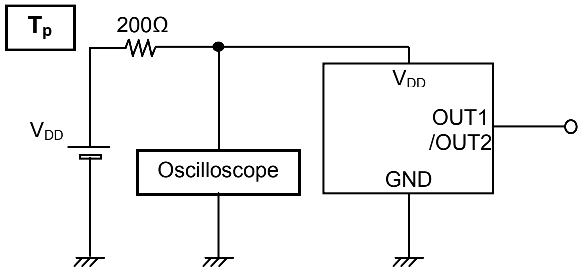
1mT=10Gauss
Positive (“+”) polarity flux is defined as the magnetic flux from south pole which is direct toward to the branded face of the sensor.
After applying power supply, it takes one cycle of period (T_P) to become definite output.

Measurement Circuit



Bop and Brp are measured by applying an external magnetic field

Figure 1. B_{op},B_{rp} Measurement Circuit



The period is monitored by an oscilloscope

Figure 2. T_p Measurement Circuit

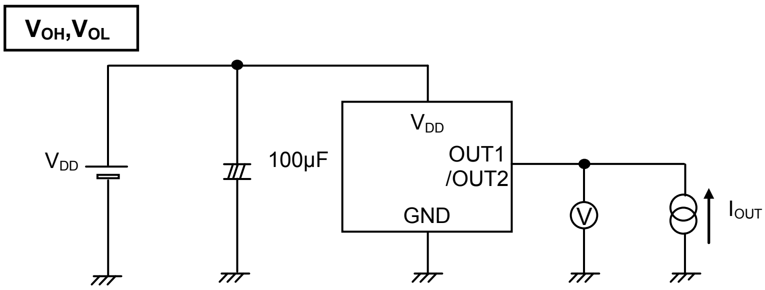


Figure 3. V_{OH} ,V_{OL} Measurement Circuit

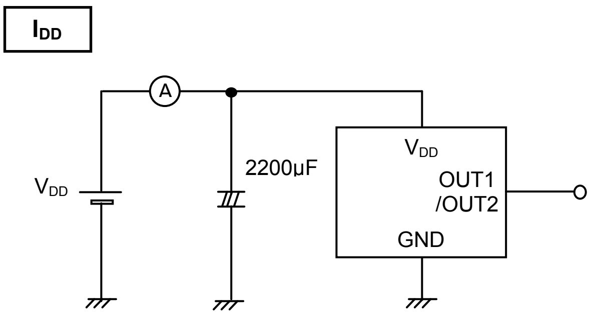


Figure 4. I_{DD} Measurement Circuit

Typical Performance Curves

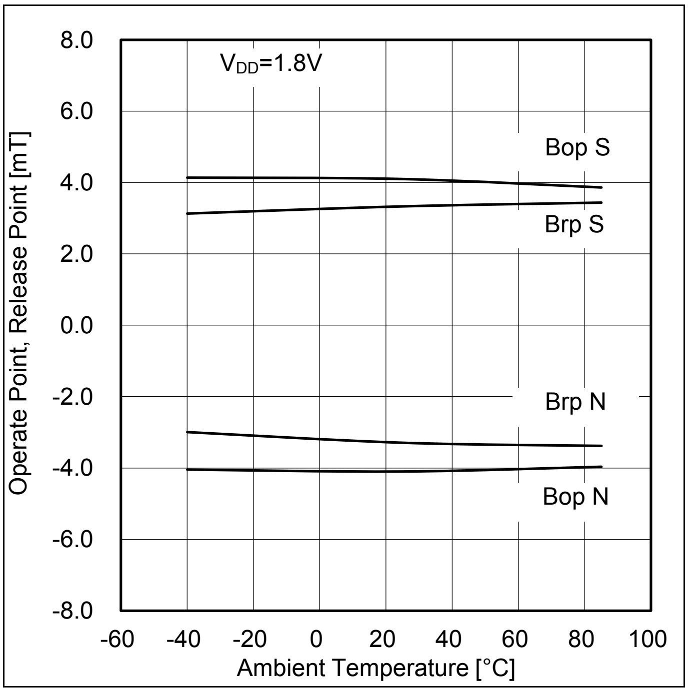


Figure 5. Operate Point, Release Point vs Ambient Temperature

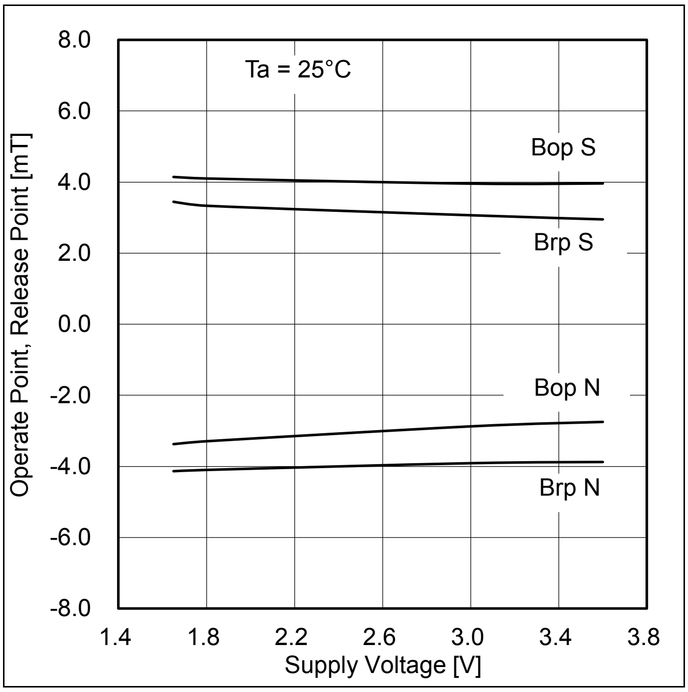


Figure 6. Operate Point, Release Point vs Supply Voltage

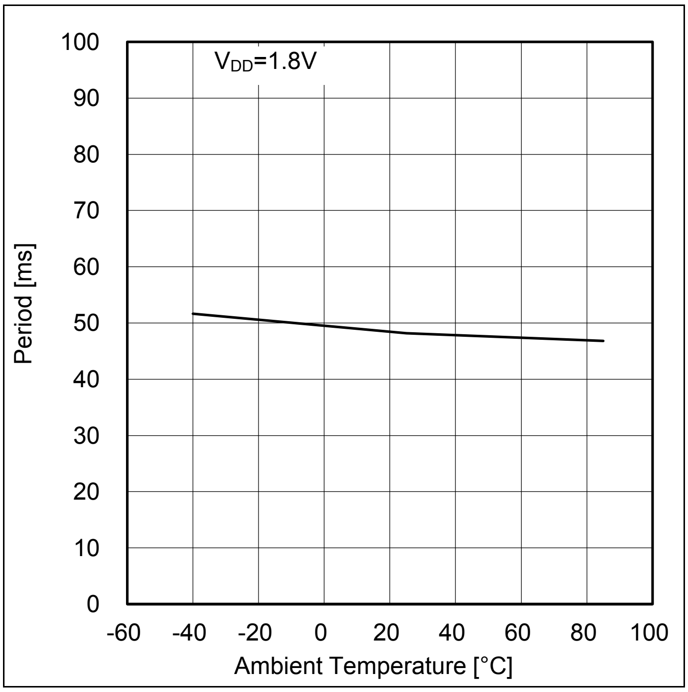


Figure 7. Period vs Ambient Temperature

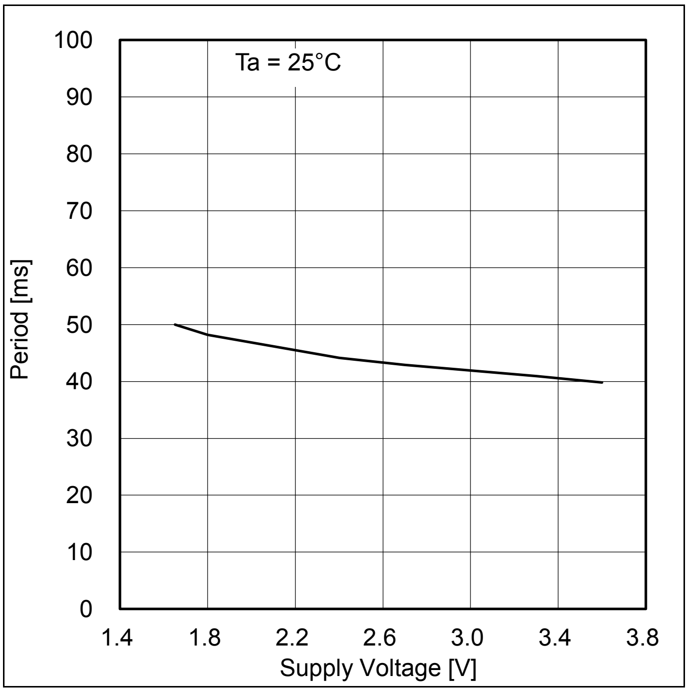


Figure 8. Period vs Supply Voltage

Typical Performance Curves - continued

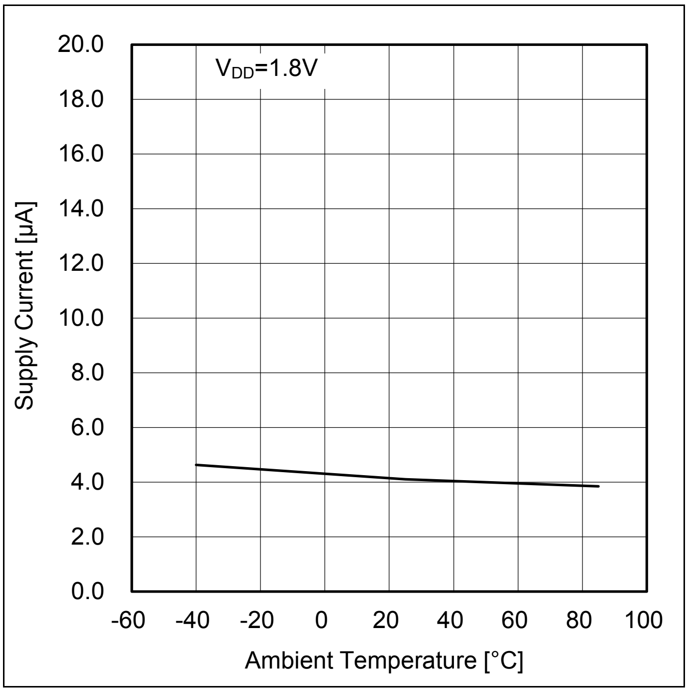


Figure 9. Supply Current vs Ambient Temperature

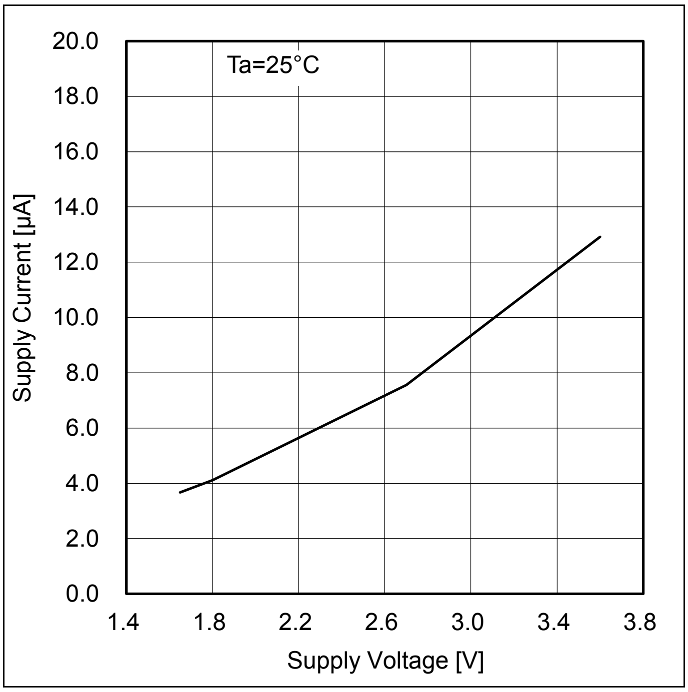


Figure 10. Supply Current vs Supply Voltage

Description of Operations

Micropower Operation (Small Current Consumption Using Intermittent Sensing)

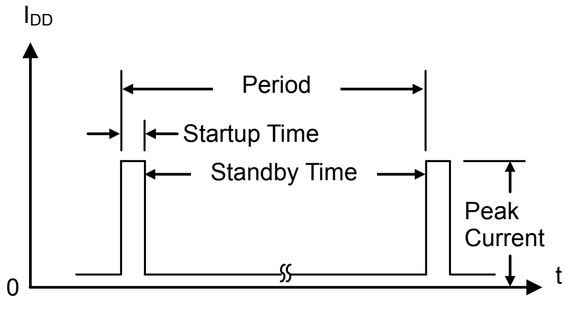


Figure 11

The dual output omnipolar detection Hall IC uses intermittent sensing save energy. At startup the Hall elements, amplifier, comparator, and other detection circuits power on and magnetic detection begins. During standby, the detection circuits power off, thereby reducing current consumption. The detection results are held while standby is active, and then output.

Period: T_p

Startup Time: T_p /4096x4 clk

Peak Current: 8mA

(Reference data, this is not thing guaranteeing.)

(Offset Cancellation)

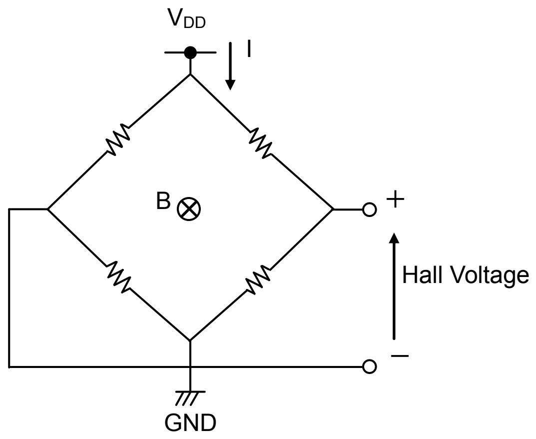


Figure 12

The Hall elements form an equivalent Wheatstone (resistor) bridge circuit. Offset voltage may be generated by a differential in this bridge resistance, or can arise from changes in resistance due to package or bonding stress. A dynamic offset cancellation circuit is employed to cancel this offset voltage.

When the Hall elements are connected as shown in Figure 12 and a magnetic field is applied perpendicular to the Hall elements, a voltage is generated at the mid-point terminal of the bridge. This is known as Hall voltage.

Dynamic cancellation switches the wiring (shown in the figure) to redirect the current flow to a 90° angle from its original path, and thereby cancels the Hall voltage.

The magnetic signal (only) is maintained in the sample/hold circuit during the offset cancellation process and then released.

(Magnetic Field Detection Mechanism)

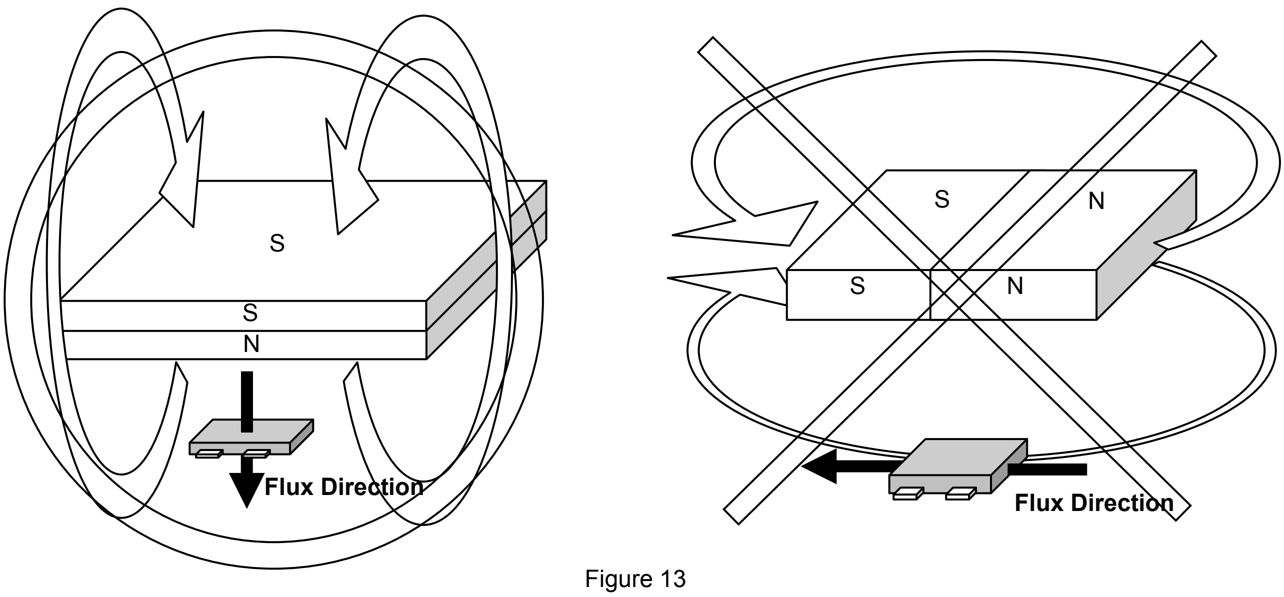


Figure 13

The Hall IC cannot detect magnetic fields that run horizontal to the package top layer.
Be certain to configure the Hall IC so that the magnetic field is perpendicular to the top layer.

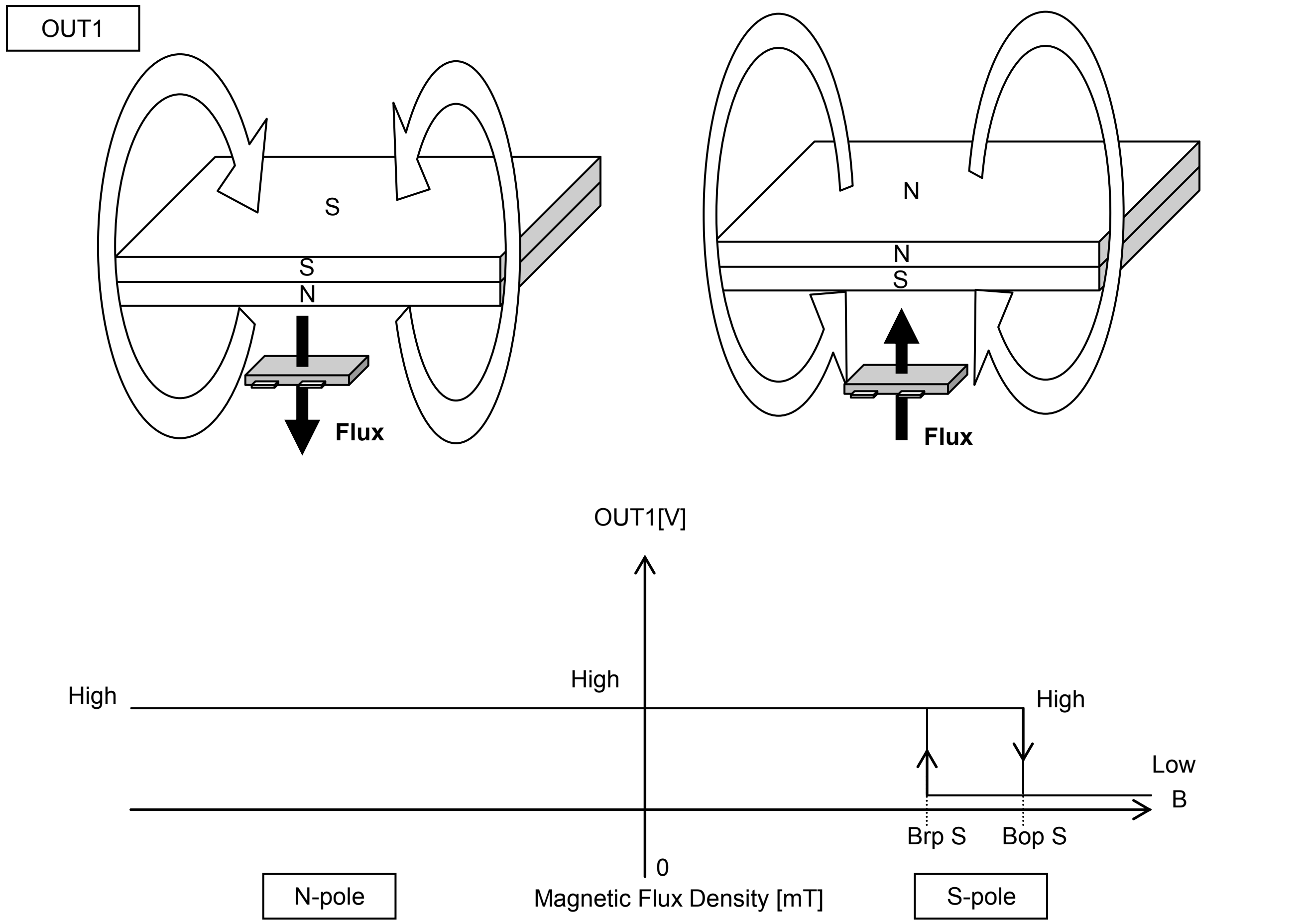


Figure 14. S-pole Detection

The OUT1 pin detects and outputs for the S-pole only. Since the OUT1 pin output is unipolar, the output does not respond to the N-pole.

OUT2

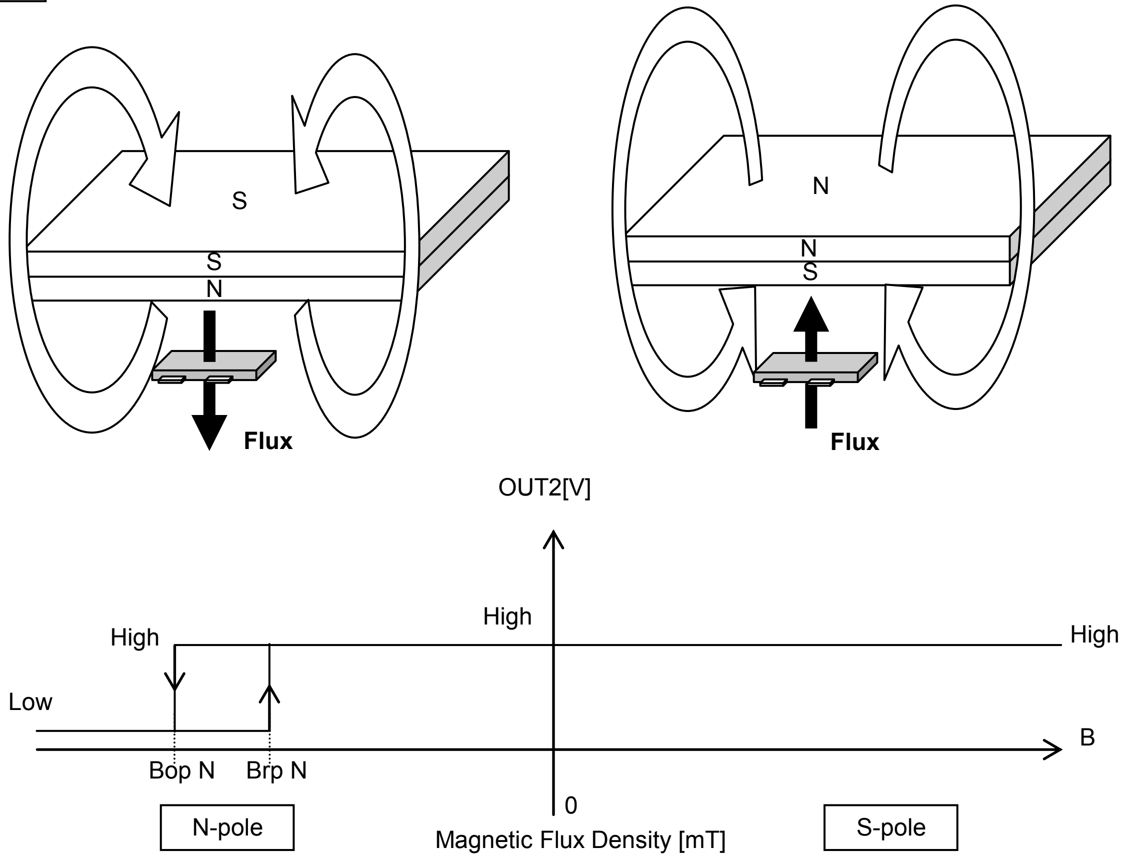


Figure 15. N-pole Detection

The OUT2 pin detects and outputs for the N-pole only. Since the OUT2 pin output is unipolar, the output does not respond to the S-pole.

The dual output omnipolar detection Hall IC detects magnetic fields running perpendicular to the top surface of the package. There is an inverse relationship between magnetic flux density and the distance separating the magnet and the Hall IC: when distance increases magnetic density falls. When it drops below the operate point (Bop), output goes HIGH. When the magnet gets closer to the IC and magnetic density rises to the operate point, the output switches LOW. In LOW output mode, the distance from the magnet to the IC increases again until the magnetic density falls to a point just below Bop, and output returns HIGH. The point where magnetic flux density restores a HIGH output is known as the release point, Brp. This detection and adjustment mechanism is designed to prevent noise, oscillation, and other erratic system operation.

Intermittent Operation at Power ON

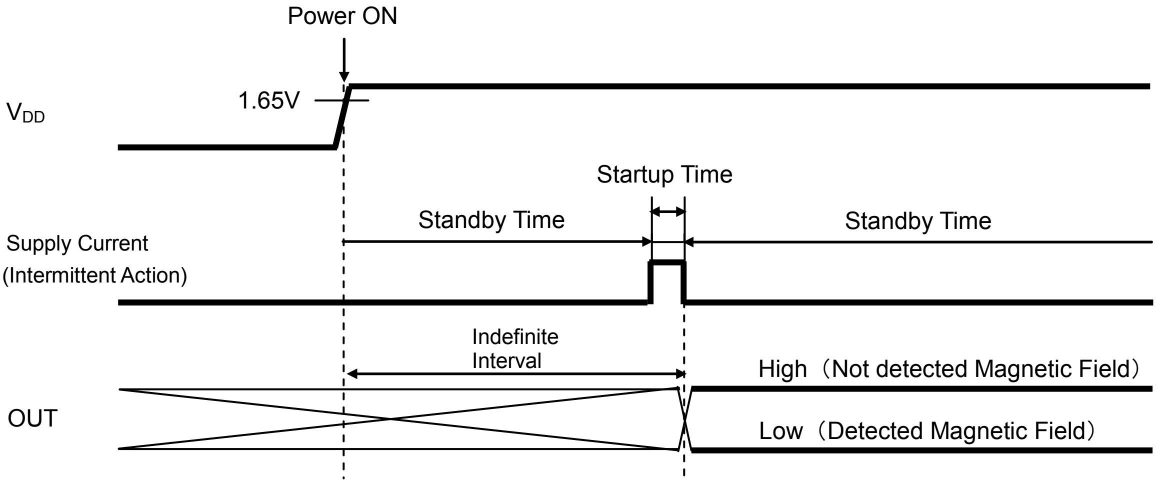


Figure 16

The dual output omnipolar detection Hall IC adopts an intermittent operation method in detecting the magnetic field during startup, as shown in Figure 16. The IC outputs to the appropriate terminal based on the detection result and maintains the output condition during the standby period. The time from power ON until the end of the initial startup period is an indefinite interval, but it cannot exceed the maximum period of 100ms. To accommodate the system design, the Hall IC output read should be programmed within 100ms of power ON, but after the time allowed for the period, ambient temperature, and supply voltage.

Magnet Selection

Neodymium and ferrite are major permanent magnets. Neodymium generally offers greater magnetic power per volume than ferrite, thereby enabling miniaturization of magnet. The larger neodymium magnet is, the stronger magnetic flux density is. And the farther detection distance is, the weaker it is. Therefore the proper size and detection distance of the magnet should be determined according to the sensitivity of Hall IC. To increase the magnet’s detection distance, the magnet which is thicker or larger sectional area is used.

Position of the Hall Element

(Reference)

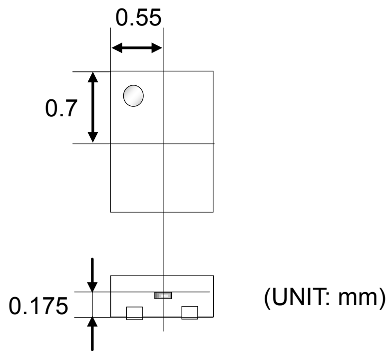


Figure 17

I/O Equivalence Circuit

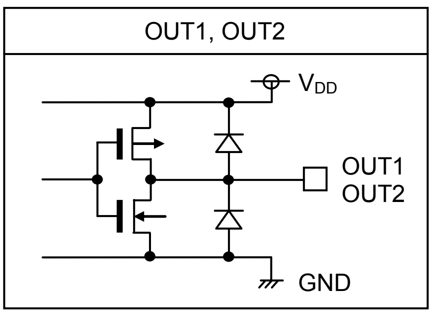


Figure 18

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.

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 maximum junction temperature 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 maximum junction temperature 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**
In the construction of this IC, P-N junctions are inevitably formed creating parasitic diodes or transistors. The operation of these parasitic elements can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions which cause these parasitic elements to operate, such as applying a voltage to an input pin lower than the ground voltage should be avoided. Furthermore, do not apply a voltage to the input pins when no power supply voltage is applied to the IC. Even if the power supply voltage is applied, make sure that the input pins have voltages within the values specified in the electrical characteristics of this IC.

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. **Area of Safe Operation (ASO)**
Operate the IC such that the output voltage, output current, and the maximum junction temperature rating are all within the Area of Safe Operation (ASO).

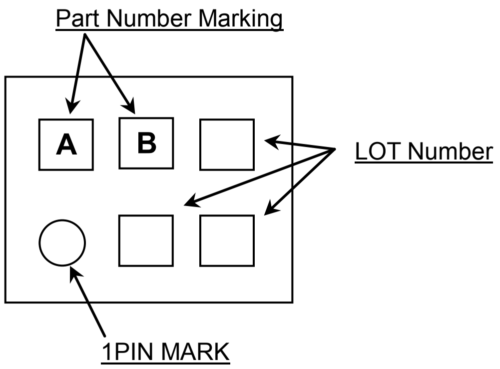
Ordering Information

B U 5 2 2 7 3 N U Z - Z E 2

- Part Number: BU52273
- Package: NUZ:VSON04Z1114A
- Packaging and forming specification: E2: Embossed tape and reel

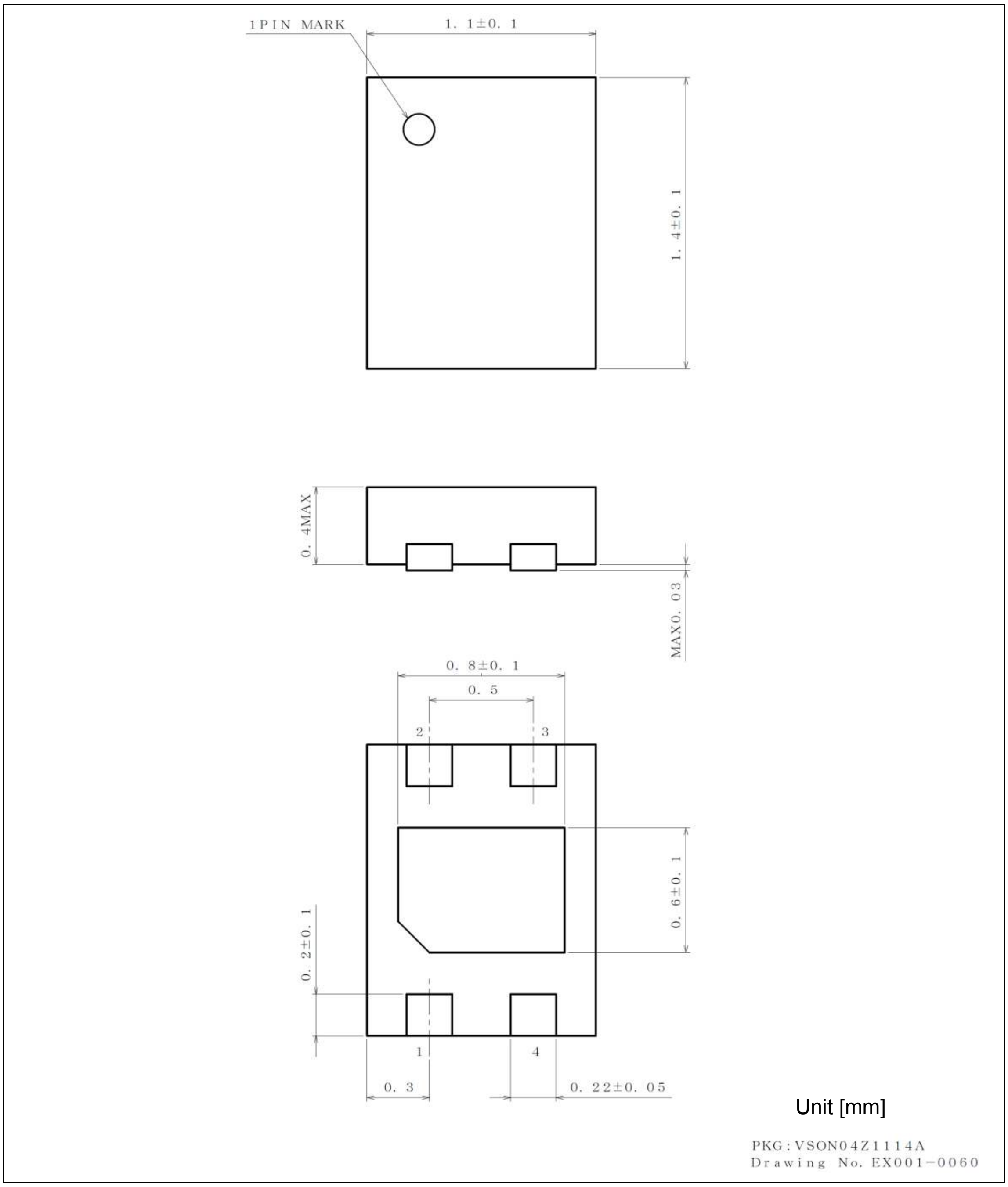
Marking Diagrams

VSON04Z1114A (TOP VIEW)



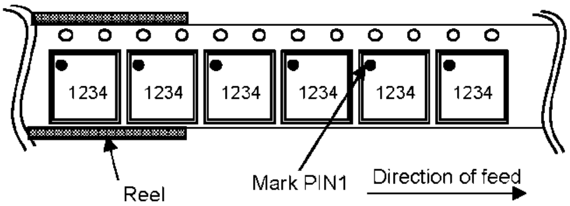
Physical Dimension, Tape and Reel Information

Package Name	VSON04Z1114A



< Tape and Reel Information >

Tape	Embossed carrier tape
Quantity	5000pcs
Direction of feed	E2 The direction is the pin 1 of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand



Revision History

Date	Revision	Changes
1.Mar.2016	001	New Release
24.May.2016	002	P3. Modified Absolute Maximum Ratings and Correction of error in Thermal Resistance

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 depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction 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

A two-dimensional barcode 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.

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