Datasheet

EARTH LEAKAGE CURRENT DETECTOR

Earth Leakage Current Detector IC

BD95820F-LB BD95820N-LB

General Description

This is the product guarantees long time support in Industrial market.
BD95820F-LB/BD95820N-LB integrates leakage detector and amplifier. Especially, it is suitable for high sensitivity and a high-speed operation use, and since the operating temperature range is wide, it can be used for various uses.

Key Specifications

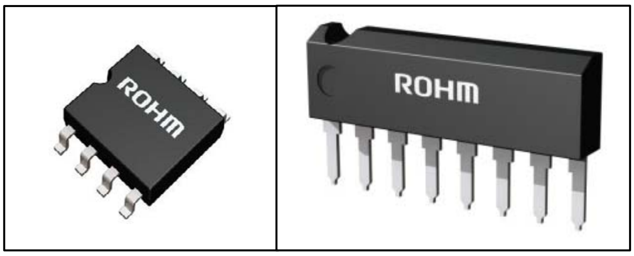
- Operating Supply Voltage Range : 12V to 22V
- Operating Temperature Range : -20°C to +95°C
- Supply Current : 330µA (typ)
- Trip Voltage : 4.92mV to 11.06mV
- Output Current(Ta=-20℃) : -200µA (min)

Features

- Long Time Support a Product for Industrial Applications
- Small Temperature Fluctuation and High Input Sensitivity
- Wide Operating Temperature Range

Packages

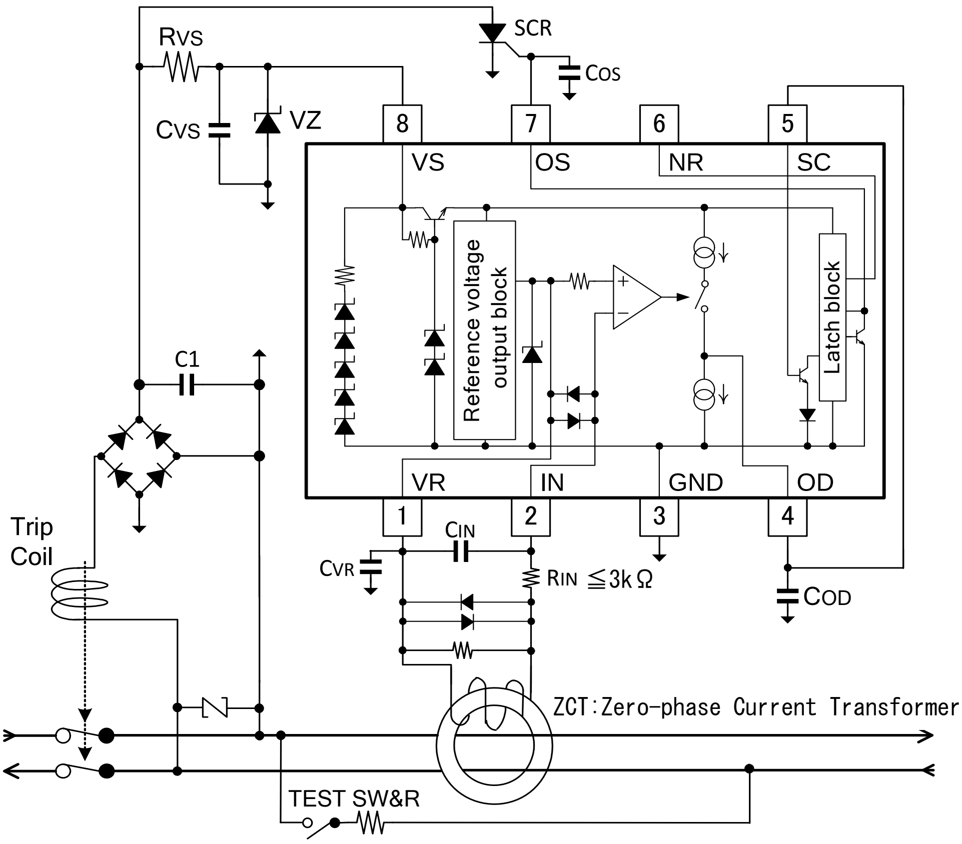
	W(Typ) x D(Typ) x H(Max)
SOP8	5.00mm x 6.20mm x 1.71mm
SIP8	19.30mm x 10.50mm x 3.00mm



Applications

- Earth leakage circuit breaker
- Earth leakage circuit relay
- Industrial Equipment

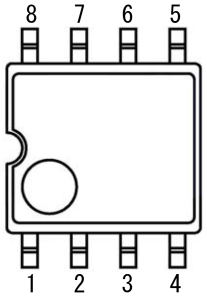
Typical Application Circuit



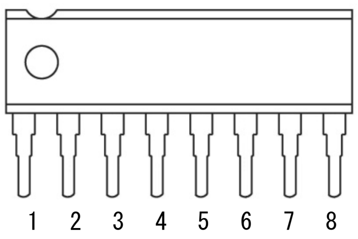
〇Product structure：Silicon monolithic integrated circuit 〇This product has no designed protection against radioactive rays.

Pin Configurations

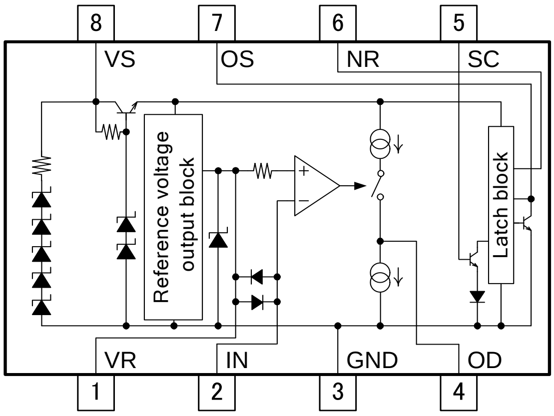
SOP8
(TOP VIEW)



SIP8
(TOP VIEW)



Block Diagrams



Pin Descriptions

Pin No.	Symbol	Function
1	VR	Reference voltage
2	IN	Input
3	GND	Ground
4	OD	Output of input comparator
5	SC	Input of latch circuit
6	NR	Noise absorption
7	OS	Output
8	VS	Power supply

Absolute Maximum Ratings

(Ta=25℃)

Parameter	Symbol	Rating	Unit
Supply current (Note 1)	I_S	8	mA
IN-VR current	I_{IN-VR}	±250	mA
VR pin current	I_{VR}	30	mA
IN terminal current	I_{IN}	30	mA
SC terminal current	I_{SC}	5	mA
Power Supply voltage	V_S	36	V
Input terminal voltage	$V_{VR/IN}$	17	V
OD/SC/NR/OS terminal voltage	$V_{OD/SC/NR/OS}$	8	V
Power dissipation	P_D	0.68(SOP8) (Note 2)	W
		1.12(SIP8) (Note 3)	
Storage temperature	T_{stg}	-55 to ＋150	°C

(Note 1) The power-supply voltage is limited by the internal clamping circuit.
(Note 2) Mounted on 70mm x 70mm x 1.6mm glass epoxy board. Reduce 5.5mW per 1°C above 25°C.
(Note 3) P_D is a value in the package unit. Reduce 9.0mW per 1°C above 25°C.

Recommended Operating Ratings

Parameter	Symbol	Limits	Unit
Supply voltage	V_S	12 to 22	V
Operating temperature	T_{opr}	-20 to ＋95	°C
External capacitor between VS and GND	C_{VS}	1≦	μF
External capacitor between OS and GND	C_{OS}	≦1	μF

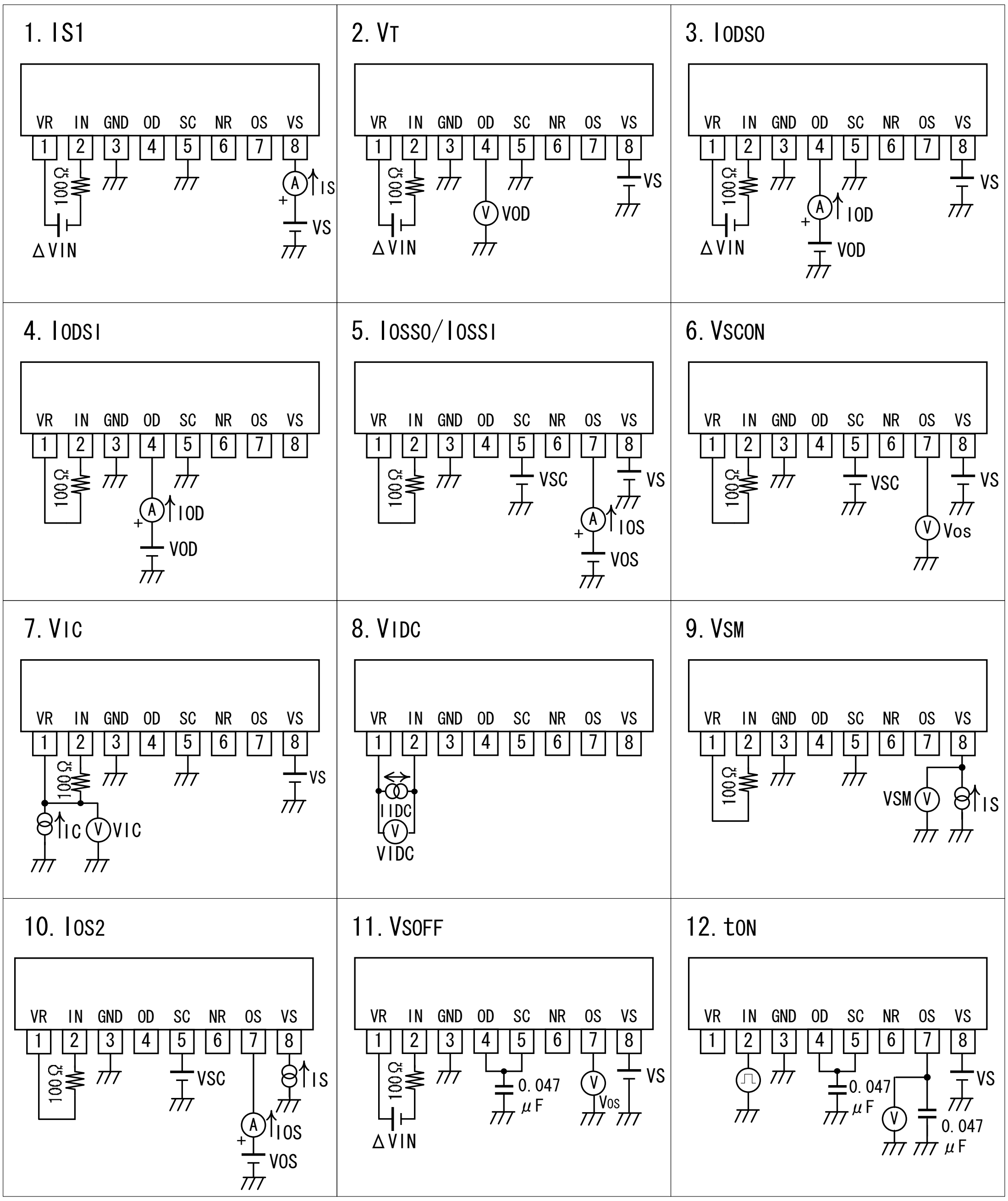
Electrical Characteristics

（Unless otherwise specified, VS=12V, GND=0V, Ta=25℃, Full range: -20°C to +95°C)

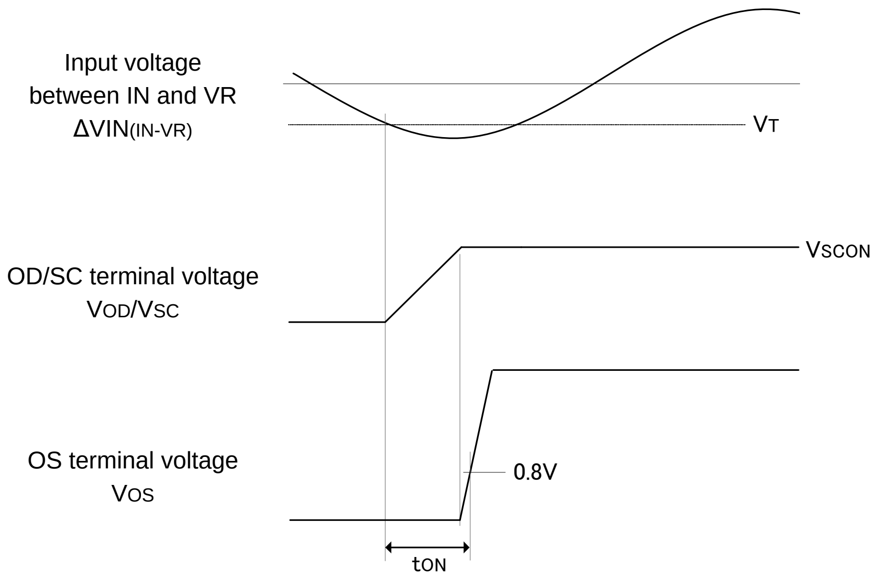
Parameter	Symbol	Temperature range	Limits			Unit	Conditions
			Min	Typ	Max		
Supply current	I_{S1}	-20°C	-	-	520	μA	ΔVIN=V_{VR}-V_{IN}=30mV
		25°C	-	330	500		
		95°C	-	-	460		
Trip voltage	V_T	Full range	4.92	7.50	11.06	mV	V_T=ΔVIN=V_{VR}-V_{IN}
OD Source current	I_{ODSO}	25°C	-27.2	-20.6	-14.0	μA	ΔVIN=V_{VR}-V_{IN}=30mV, V_{OD}=1.2V
OD Sink current	I_{ODSI}	25°C	16.7	26.0	35.3	μA	V_{OD}=0.8V, ΔVIN=V_{VR}-V_{IN}=0mV
OS Source current	I_{OSSO}	-20°C	-200	-	-	μA	V_{SC}=2.0V, V_{OS}=0.8V
		25°C	-100	-	-		
		95°C	-75	-	-		
OS Sink current	I_{OSSI}	Full range	200	-	-	μA	V_{SC}=0.2V, V_{OS}=0.2V
SC ON voltage	V_{SCON}	25°C	1.00	1.24	1.48	V	
Input clamp voltage	V_{IC}	Full range	4.2	5.5	6.7	V	I_{IC}=20mA
Differential input clamp voltage	V_{IDC}	Full range	0.6	1.0	1.4	V	I_{IDC}=100mA
Maximum current voltage	V_{SM}	25°C	26	29	32	V	IS=7mA
Supply current 2 (Note 4)	I_{OS2}	Full range	-100	-	-	μA	IS=900μA,V_{SC}=2.0V V_{OS}=0.8V
Latch OFF Supply Voltage	V_{SOFF}	25°C	2.7	3.7	4.7	V	
Operating time (Note 5)	t_{ON}	25°C	1.8	2.9	4.0	ms	

(Note 4) Supply current 2 is OS source current value when the power supply current(Is=900μA) is given.
(Note 5) Operating time is time until output voltage reaches 0.8V after detecting the leakage signal.
Conditions : Capacitor(0.047μF) is connected between OD(OS) and GND.

Test circuits



Timing Chart



Typical Performance Curves(reference data)

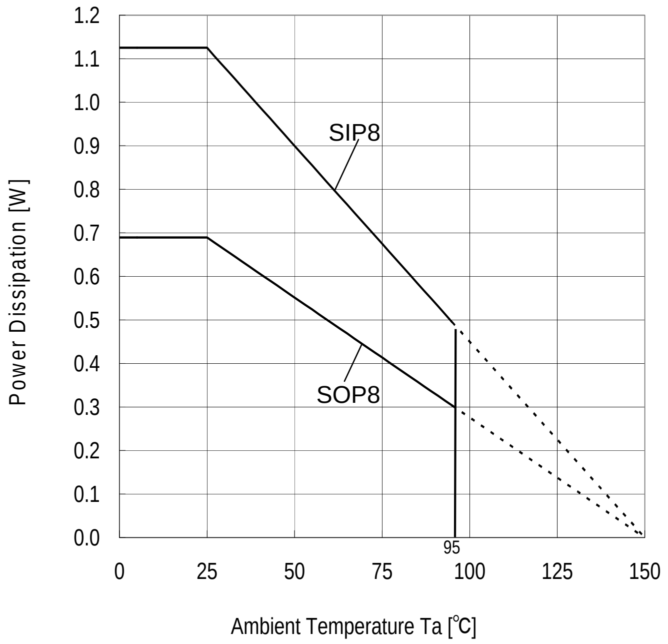


Figure 1
Derating curve

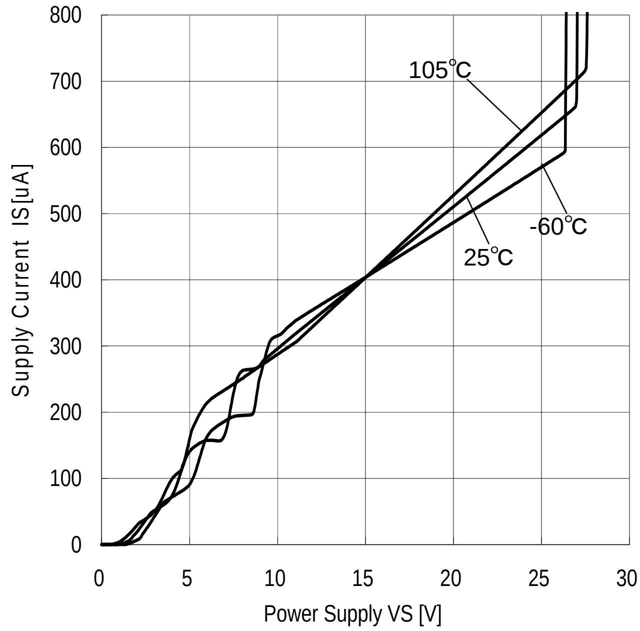


Figure 2
Circuit current - Supply voltage

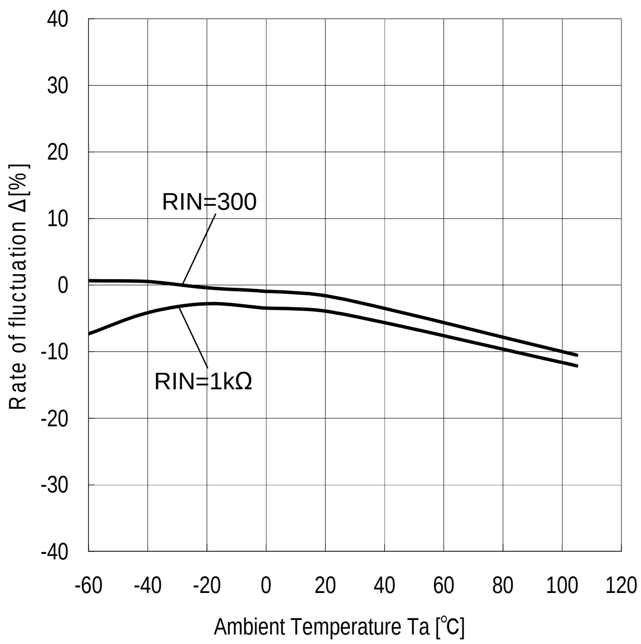


Figure 3
Trip voltage fluctuation rate
- Ambient temperature

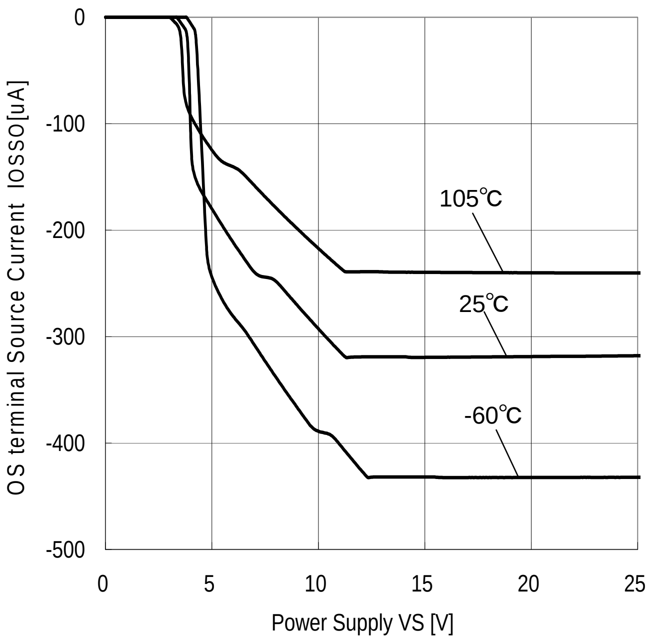


Figure 4
OS terminal source current - Supply voltage

Typical Performance Curves(reference data) - continued

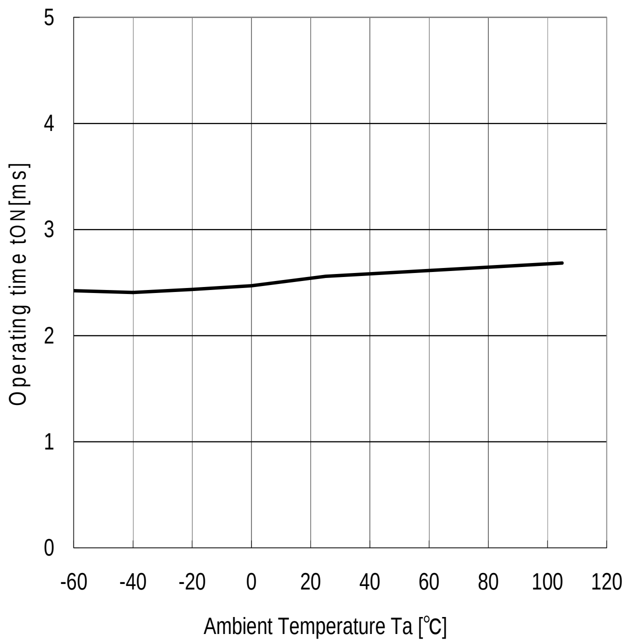


Figure 5
Operating time - Ambient temperature

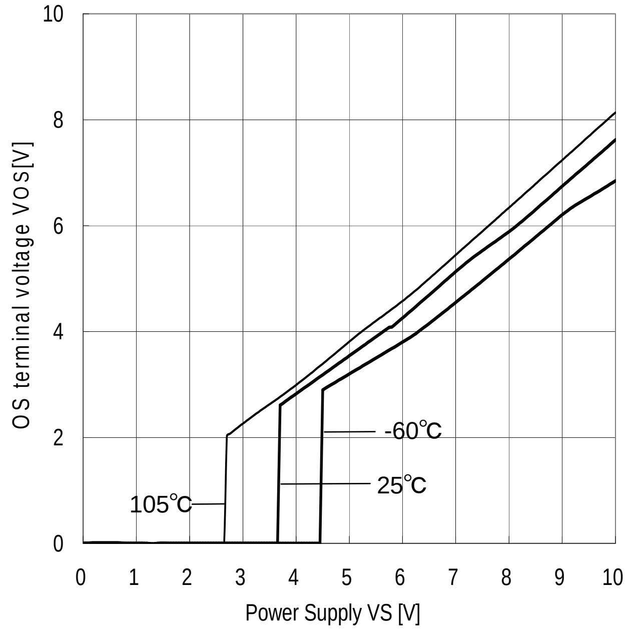


Figure 6
Latch OFF supply voltage - Ambient temperature

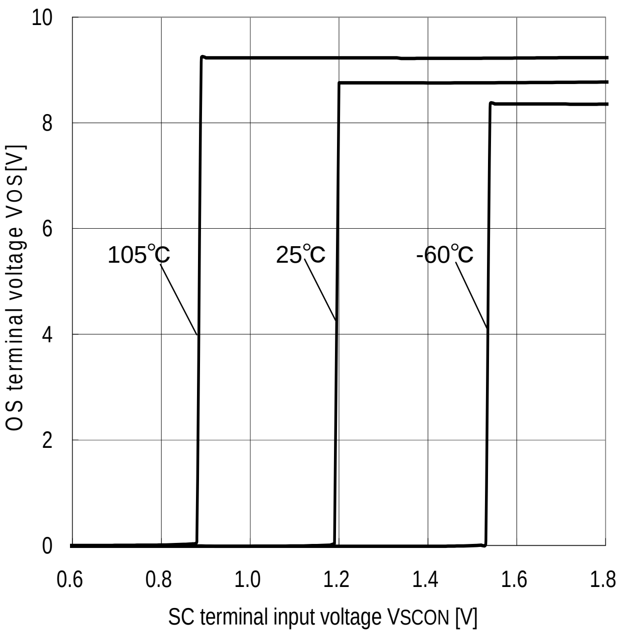


Figure 7
SC ON voltage - Ambient temperature

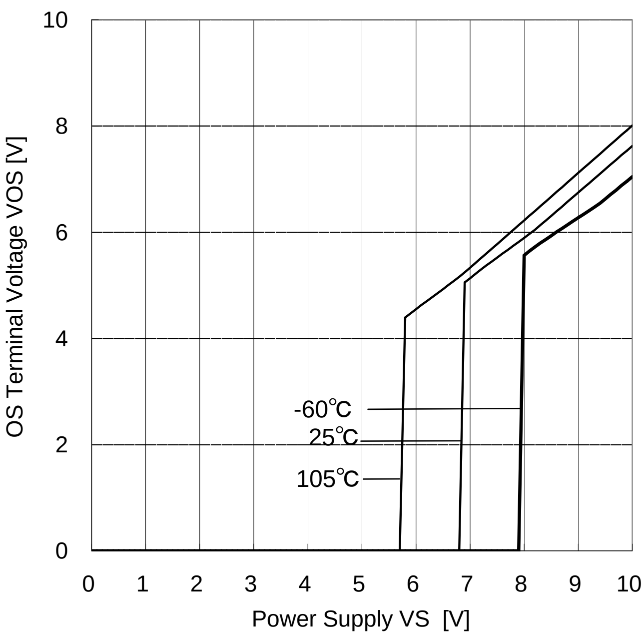


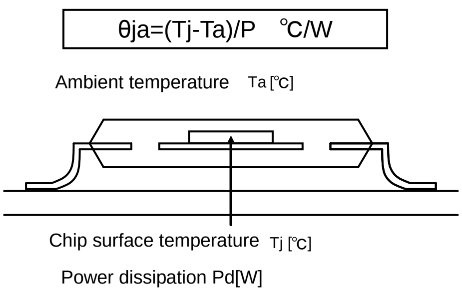
Figure 8
Latch ON supply voltage - Ambient temperature

Power Dissipation

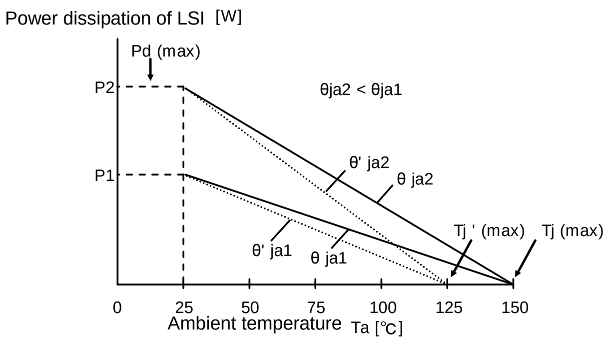
Power dissipation(total loss) indicates the power that can be consumed by IC at Ta=25℃(normal temperature).IC is heated when it consumed power, and the temperature of IC chip becomes higher than ambient temperature. The temperature that can be accepted by IC chip depends on circuit configuration, manufacturing process, and consumable power is limited. Power dissipation is determined by the temperature allowed in IC chip (maximum junction temperature) and thermal resistance of package (heat dissipation capability). The maximum junction temperature is typically equal to the maximum value in the storage temperature range. Heat generated by consumed power of IC radiates from the mold resin or lead frame of the package. The parameter which indicates this heat dissipation capability(hardness of heat release)is called thermal resistance, represented by the symbol θja℃/W.The temperature of IC inside the package can be estimated by this thermal resistance. Fig.9(a) shows the model of thermal resistance of the package. Thermal resistance θja, ambient temperature Ta, junction temperature Tj, and power dissipation Pd can be calculated by the equation below

$$\theta ja = (Tj - Ta) / Pd \quad ℃/W \qquad ・・・・・ \quad (Ⅰ)$$

Derating curve in Fig.9(b) 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, package condition, wind velocity, etc even when the same of package is used. Thermal reduction curve indicates a reference value measured at a specified condition. Fig.10(a) show a derating curve for an example of BD95820F-LB and BD95820N-LB.

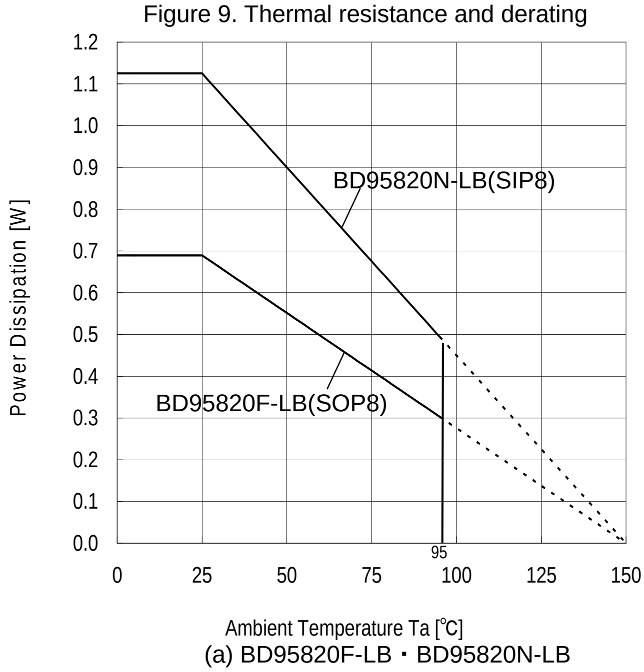


(a) Thermal resistance



(b) Derating curve

Figure 9. Thermal resistance and derating



(a) BD95820F-LB・BD95820N-LB

	Derating curve slope	UNIT
BD95820F-LB(SOP8)	5.5	mW/℃
BD95820N-LB(SIP8)	9.0	

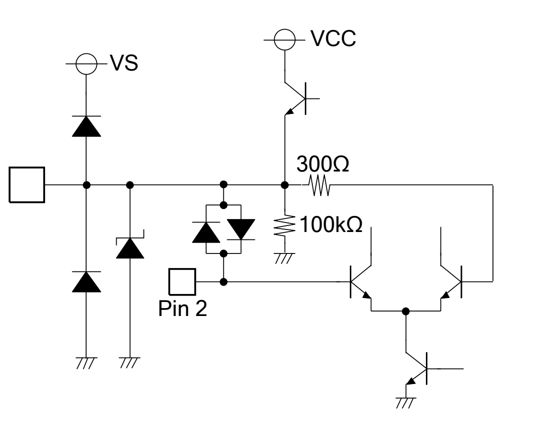
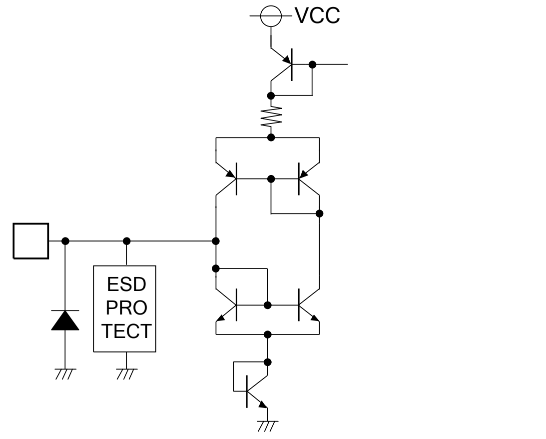
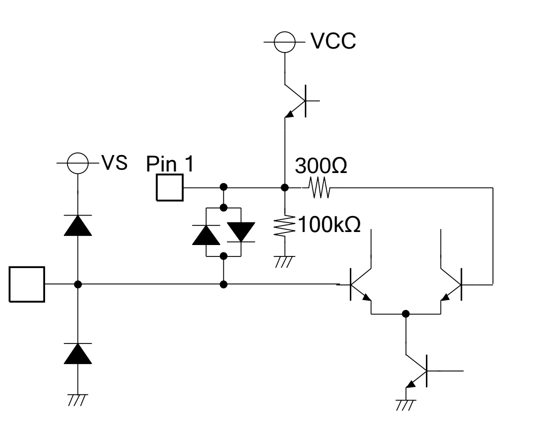
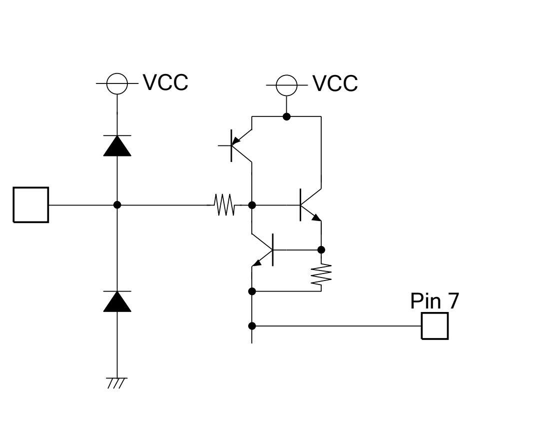
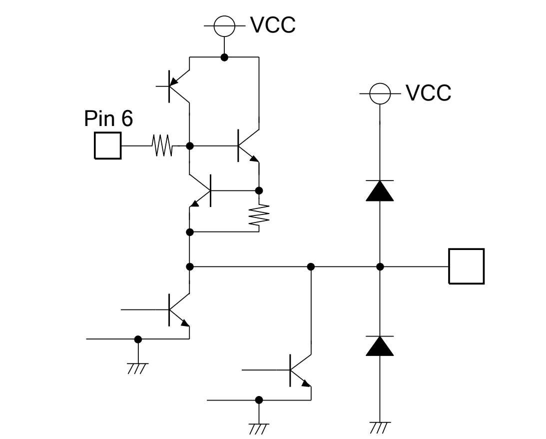
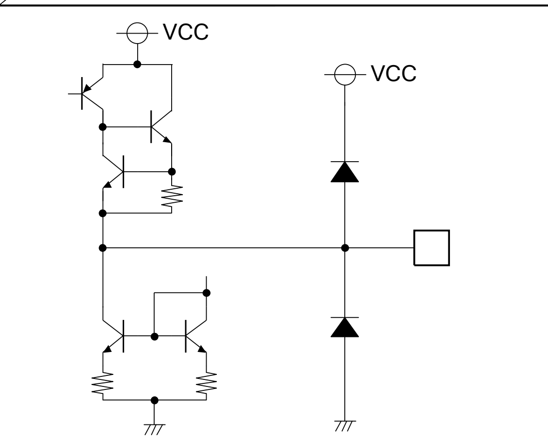
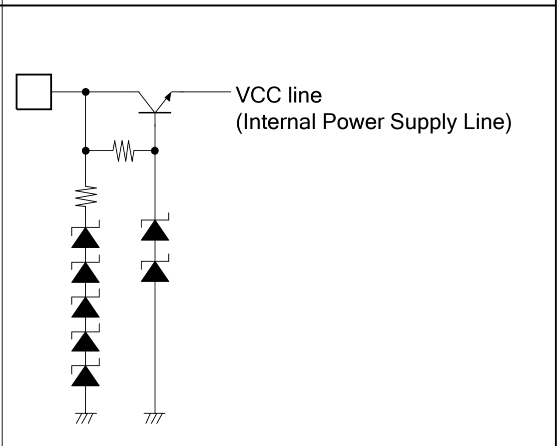
When using the unit above Ta=25℃, subtract the value above per degree℃

BD95820F-LB : Permissible dissipation is a value when glass epoxy board 70mm×70mm×1.6mm (cooper foil area below 3%) is mounted.

BD95820N-LB : Permissible dissipation is a value in the package unit.

Figure 10. Derating curve

I/O equivalence circuit

Pin 1 [VR]		Pin 5 [SC]	
Pin 2 [IN]		Pin 6 [NR]	
Pin 3 [GND]		Pin 7 [OS]	
Pin 4 [OD]		Pin 8 [VS]	

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. The absolute maximum rating of the Pd stated in this specification is when the IC is mounted on a 70mm x 70mm x 1.6mm glass epoxy board. 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.

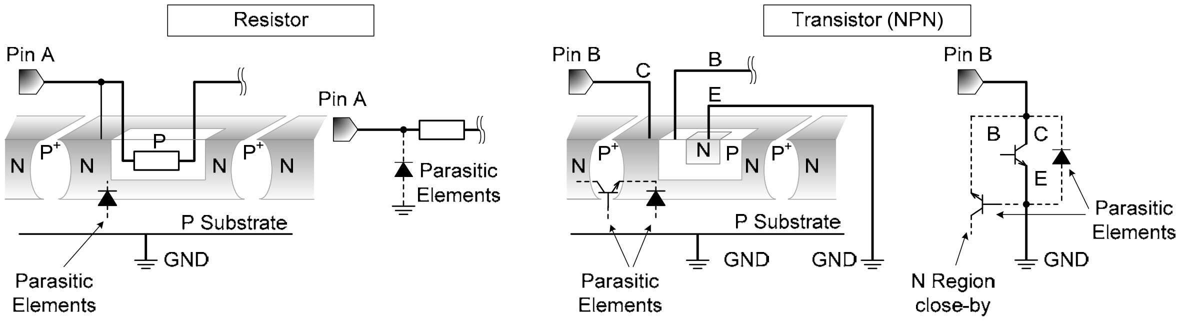
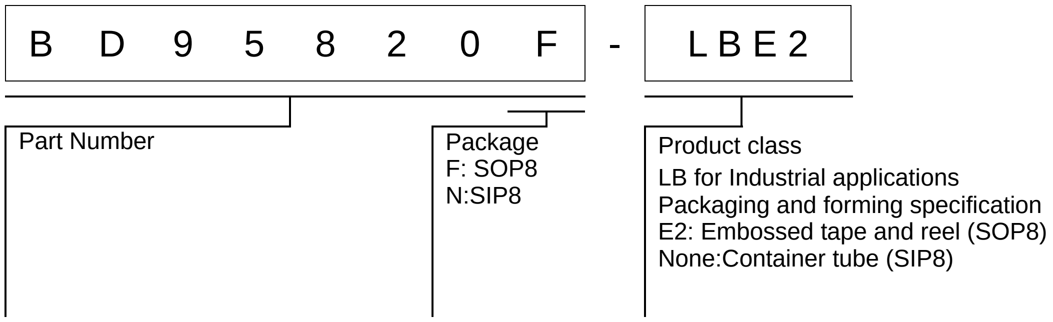


Figure 11. Example of monolithic IC structure

13. Input Resistance R_{IN}

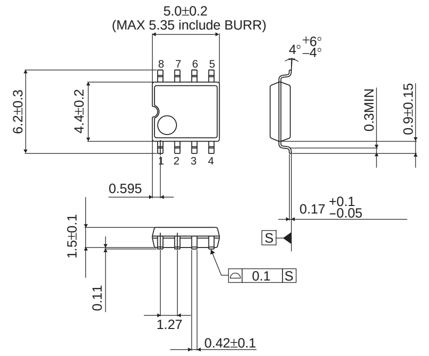
Input resistance RIN sets it in less than 3kΩ.
The input bias current to IN terminal increases at the time of the power supply start before reaching the operating power supply range, and when input resistance is louder than 3kΩ, the voltage between the input terminals becomes larger than trip voltage, and may malfunction.

Ordering Information



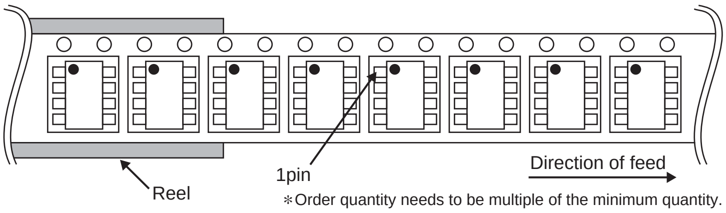
Physical Dimension Tape and Reel Information

SOP8



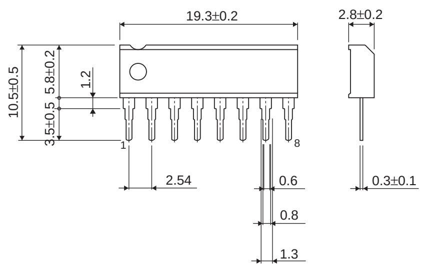
<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin 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)



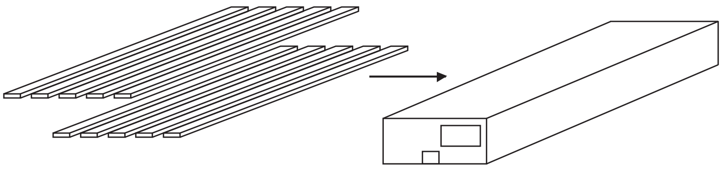
※Order quantity needs to be multiple of the minimum quantity.

SIP8



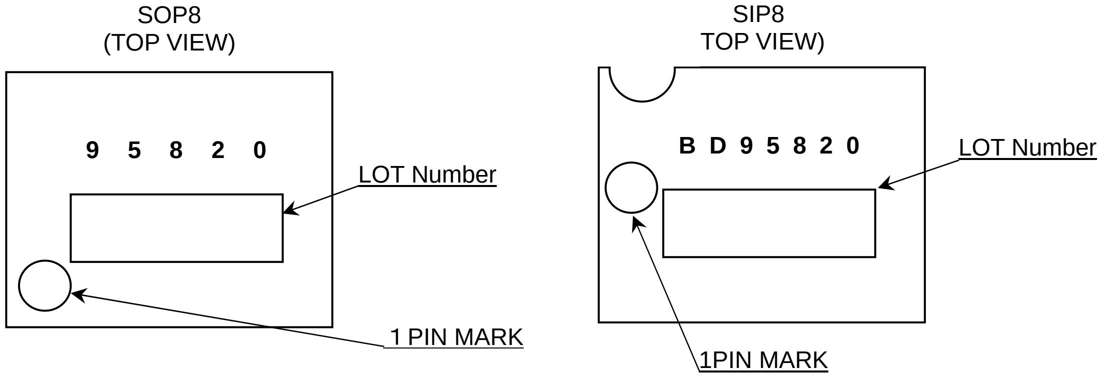
<Tape and Reel information>

Container	Tube
Quantity	1000pcs
Direction of feed	Direction of products is fixed in a container tube



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

Marking Diagrams



Revision History

Date	Revision	Changes
13.Jun.2014	001	New Release

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, 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 not designed 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.

Precaution Regarding Intellectual Property Rights

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data. ROHM shall not be in any way responsible or liable for infringement of any intellectual property rights or other damages arising from use of such information or data.:

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Other Precaution

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2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.

3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.

General Precaution

1. Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.

2. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.

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