

EARTH LEAKAGE CURRENT DETECTOR EARTH LEAKAGE CURRENT DETECTOR IC



BD9584F

General Description

BD9584F 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 : 8V to 20V
- Operating temperature range : -20°C to $+90^{\circ}\text{C}$
- Supply current : $250\mu\text{A}(\text{typ.})$
- Trip voltage : 6.4mV to 12.0mV
- Output current ability($T_a = -20^{\circ}\text{C}$) : $250\mu\text{A}(\text{min.})$

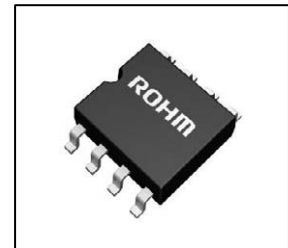
Features

- Small temperature fluctuation and high input sensitivity
- Wide operating temperature range

Packages

SOP8

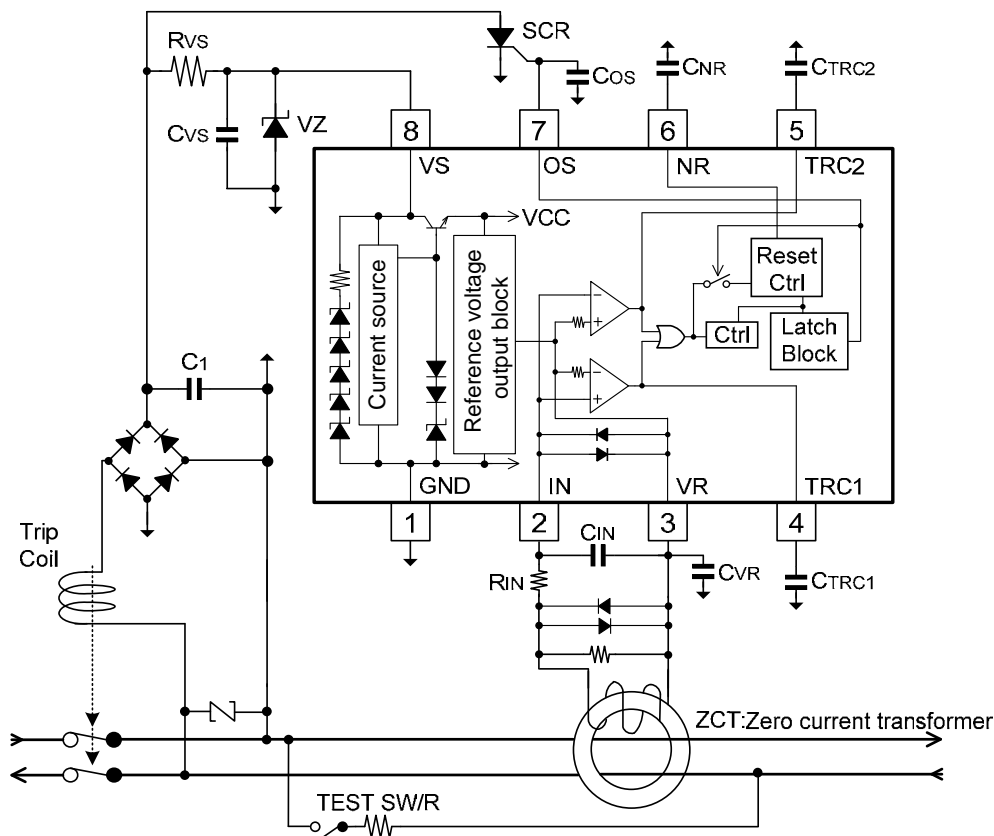
W(Typ.) x D(Typ.) x H(Max.)
 $5.00\text{mm} \times 6.20\text{mm} \times 1.71\text{mm}$



Applications

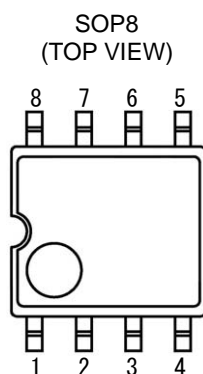
- Earth leakage circuit breaker
- Earth leakage circuit relay

Typical Application Circuit Example

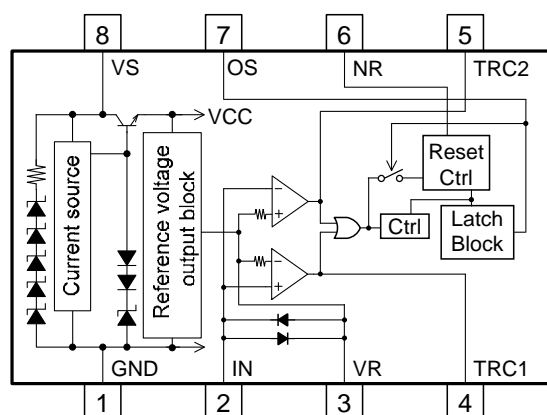


○Product structure : Silicon monolithic integrated circuit ○This product is not designed protection against radioactive rays.

●Pin Configurations



●Block Diagrams



●Pin Descriptions

| Pin No. | Symbol | Function |
|---------|--------|--|
| 1 | GND | Ground |
| 2 | IN | Input |
| 3 | VR | Reference voltage |
| 4 | TRC1 | Capacitor connection for negative side detection |
| 5 | TRC2 | Capacitor connection for positive side detection |
| 6 | NR | Capacitor connection for false signal detection |
| 7 | OS | Output |
| 8 | VS | Power supply |

●Absolute Maximum Ratings

(Ta=25°C)

| Parameter | Symbol | Rating | Unit |
|----------------------------------|------------------|-------------------|------|
| Supply current ^{*1} | IS | 12.5 | mA |
| Supply voltage | VS | 36 | V |
| Input terminal voltage | VVR/IN | 25 | V |
| TRC1/TRC2/NR/OS terminal voltage | VTRC1/TRC2/NR/OS | 8 | V |
| Power dissipation | Pd | 680 ^{*2} | mW |
| Storage temperature | T _{stg} | −55 to +150 | °C |

^{*1} The power-supply voltage is limited by the internal clamping circuit.^{*2} To use at temperature above Ta=25°C reduce 5.5mW/°C. Mounted on a glass epoxy PCB (70mm×70mm×1.6mm)

●Recommended Operating Ratings

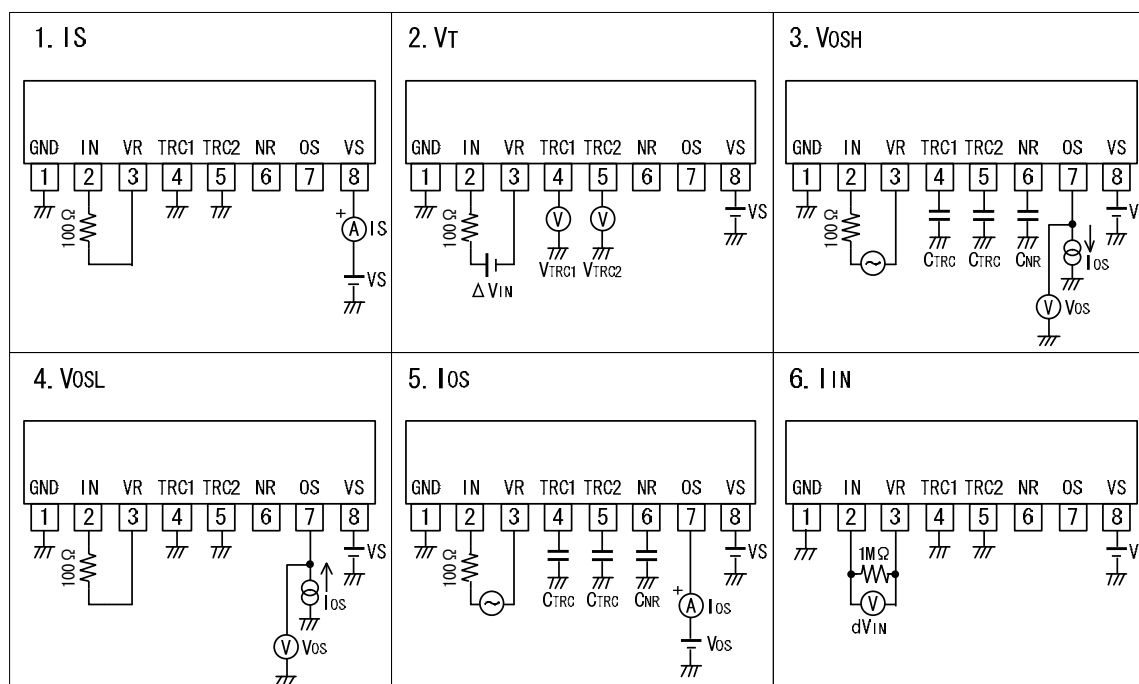
| Parameter | Symbol | Limits | Unit |
|-----------------------|------------------|------------|------|
| Supply voltage | VS | 8 to 20 | V |
| Operating temperature | T _{opr} | −20 to +90 | °C |

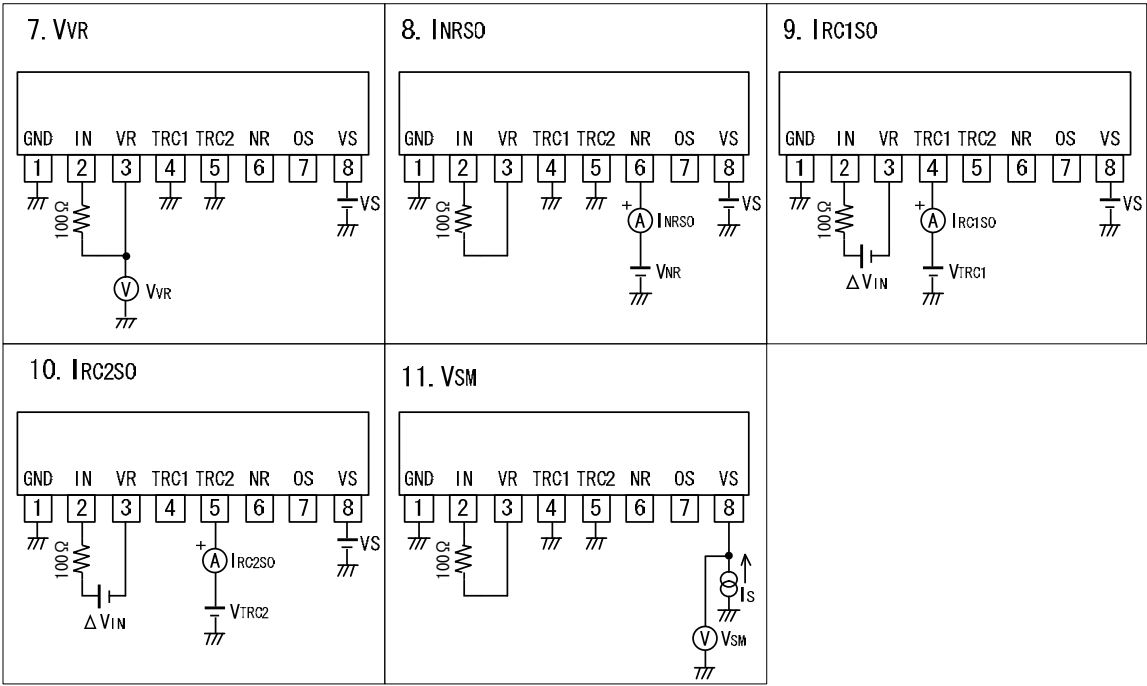
●Electrical Characteristics

(Unless otherwise specified, $V_S=12V$, $GND=0V$, $T_a=25^\circ C$)

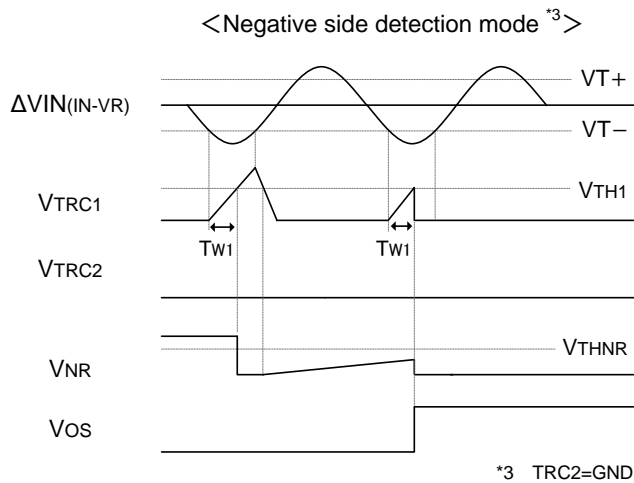
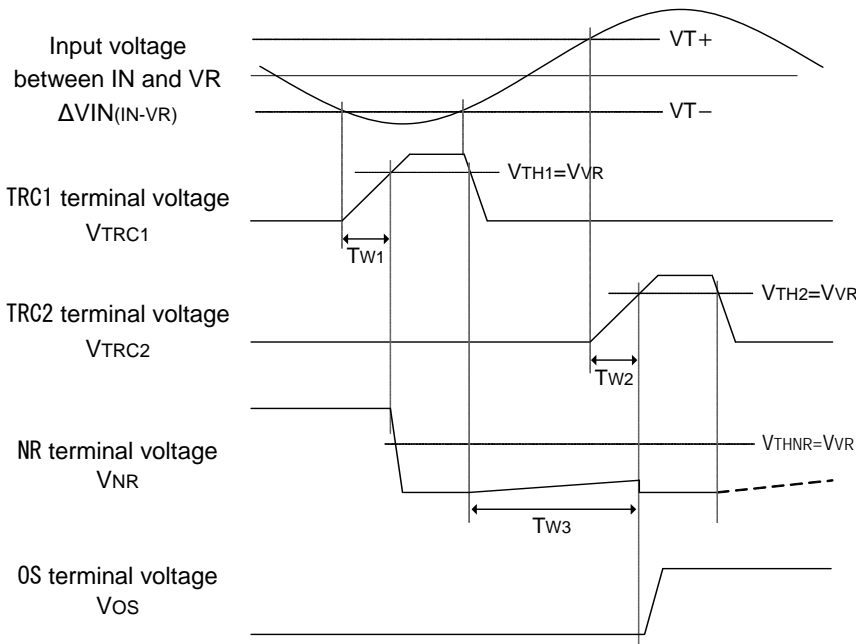
| Parameter | Symbol | Temperature Range | Limits | | | Unit | Conditions |
|-------------------------|-------------|--------------------------------|--------|------|-------|---------|--|
| | | | Min. | Typ. | Max. | | |
| Supply Current(Standby) | I_S | $25^\circ C$ | - | 250 | 340 | μA | |
| Trip Voltage | V_T | $-20^\circ C$ to $+90^\circ C$ | 6.4 | 9.2 | 12.0 | mV | $C_{TRC}=0.047\mu F$ |
| OS HIGH Voltage | V_{OSH} | $25^\circ C$ | 3 | - | - | V | $I_{OS}=250\mu F$, $V_S=8V$ to $20V$ |
| OS LOW Voltage | V_{OSL} | $25^\circ C$ | - | - | 200 | mV | $I_{OS}=-100\mu F$, $V_S=8V$ to $20V$ |
| OS Source Current | I_{OS} | $25^\circ C$ | 250 | - | - | μA | $V_{OS}=0.8V$ |
| IN Input Bias Current | I_{IN} | $25^\circ C$ | - | 100 | - | nA | $V_{VR}=V_{IN}$ |
| VR Voltage | V_{VR} | $25^\circ C$ | 2.1 | 2.4 | 2.7 | V | $V_S=8V$ to $20V$ |
| NR Source Current | I_{NRSO} | $25^\circ C$ | 6.9 | 9.9 | 12.9 | μA | $V_{NR}=2.7V$, $V_{VR}=V_{IN}$ |
| NR Threshold Voltage | V_{THNR} | $25^\circ C$ | 2.1 | 2.4 | 2.7 | V | |
| TW3 Pulse Width | T_{W3} | $25^\circ C$ | 53.7 | 80.0 | 129.1 | ms | $C_{NR}=0.33\mu F$ |
| TRC1 Source Current | I_{RC1SO} | $25^\circ C$ | 35.9 | 51.3 | 66.7 | μA | $V_{TRC1}=2.0V$, $\Delta V_{IN}=V_{IN}-V_{VR}=-0.3V$ |
| TRC1 Threshold Voltage | V_{TH1} | $25^\circ C$ | 2.1 | 2.4 | 2.7 | V | |
| TW1 Pulse Width | T_{W1} | $25^\circ C$ | 1.48 | 2.20 | 3.53 | ms | $C_{TRC}=0.047\mu F$ |
| TRC2 Source Current | I_{RC2SO} | $25^\circ C$ | 35.9 | 51.3 | 66.7 | μA | $V_{TRC2}=2.0V$, $\Delta V_{IN}=V_{IN}-V_{VR}=+0.3V$ |
| TRC2 Threshold Voltage | V_{TH2} | $25^\circ C$ | 2.1 | 2.4 | 2.7 | V | |
| TW2 Pulse Width | T_{W2} | $25^\circ C$ | 1.48 | 2.20 | 3.53 | ms | $C_{TRC}=0.047\mu F$ |
| VS Clamp Voltage | V_{SM} | $25^\circ C$ | 27.8 | 29.4 | 31.0 | V | $I_S=10.5mA$ |

●Test circuits

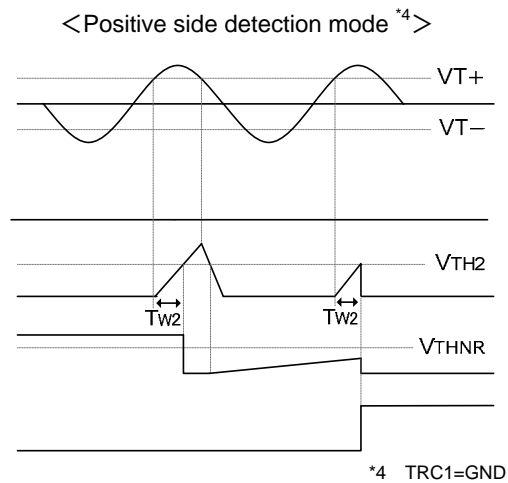




●Timing Chart



*3 TRC2=GND



*4 TRC1=GND

● Typical Performance Curves(reference data)

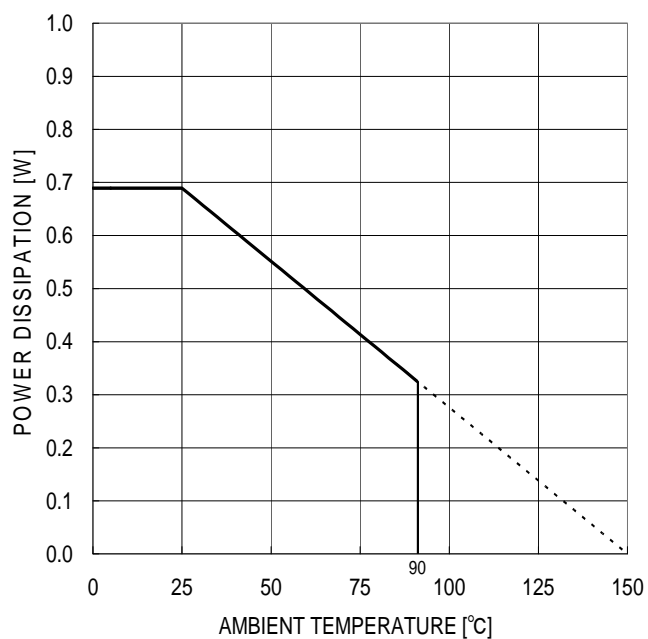


Figure 1
Derating curve

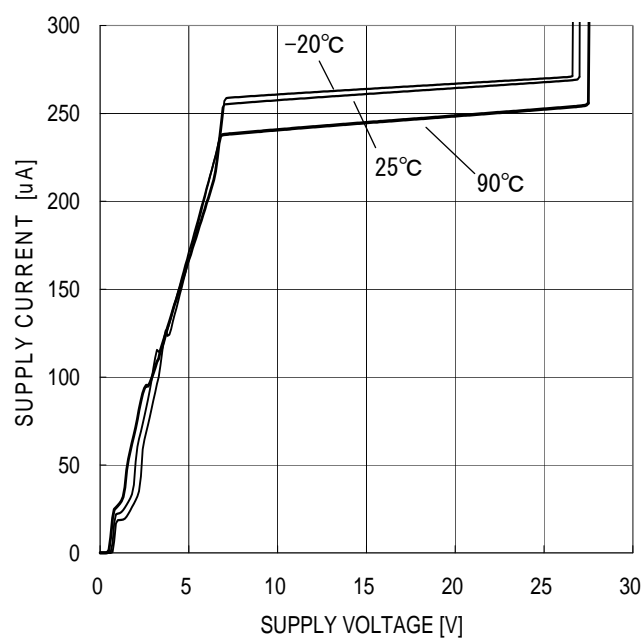


Figure 2
Supply current - Supply voltage

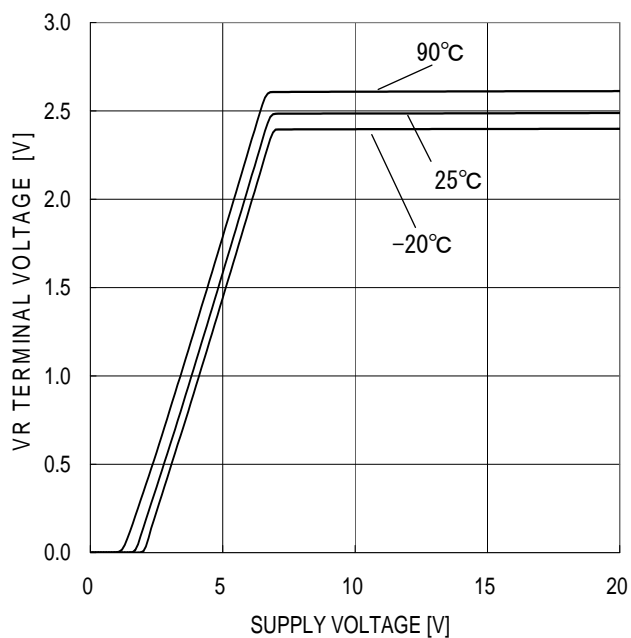


Figure 3
VR terminal voltage
- Supply voltage

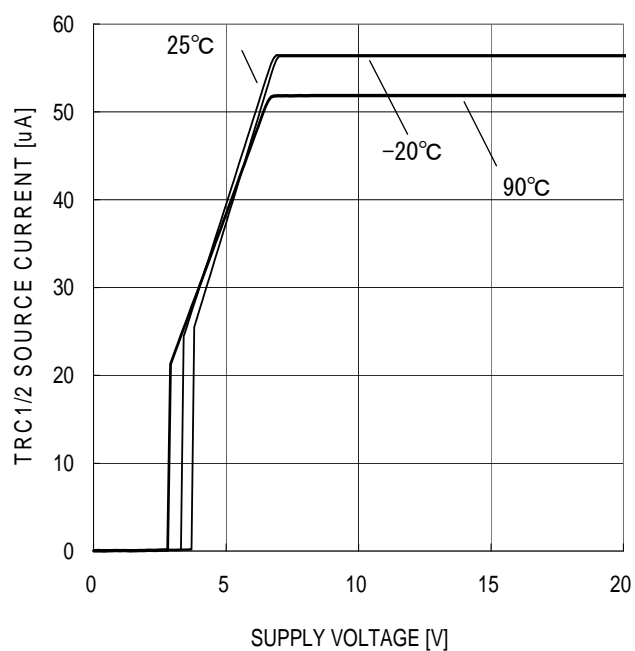


Figure 4
TRC1/2 terminal source current
- Supply voltage

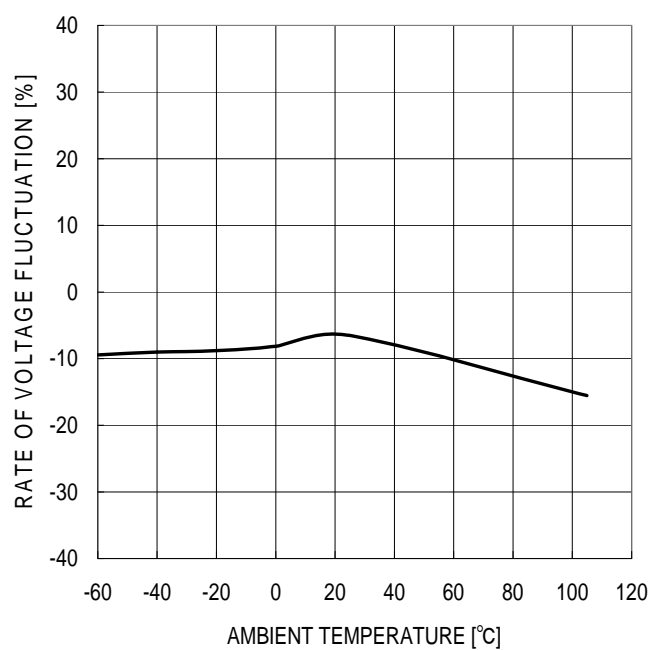


Figure 5
Trip voltage fluctuation rate
- Ambient temperature

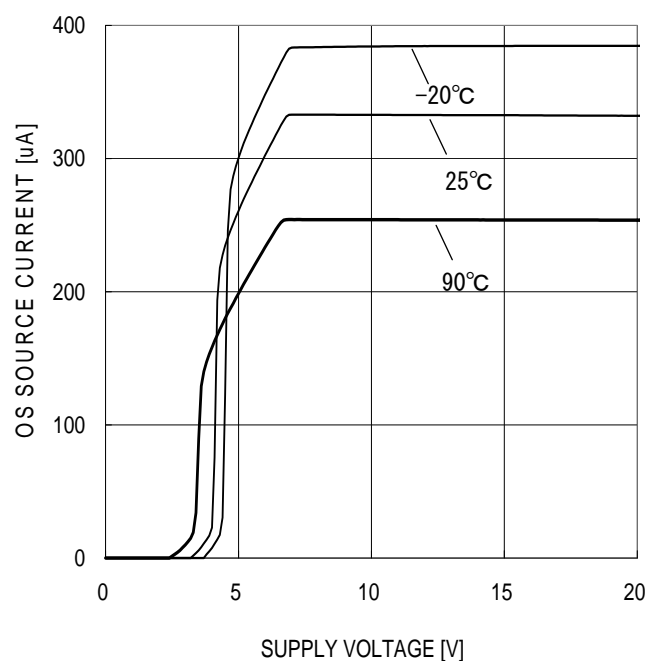


Figure 6
OS terminal source current - Supply voltage

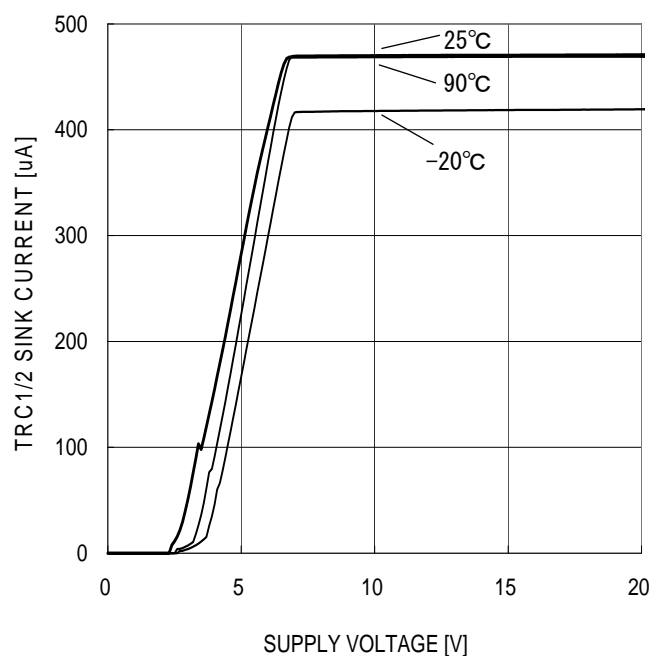


Figure 7
TRC1/2 terminal source current - Supply voltage

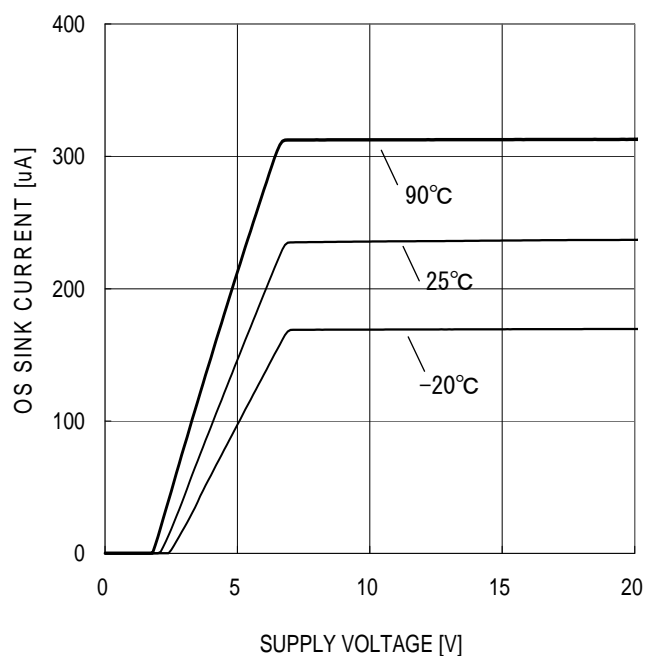


Figure 8
OS terminal sink current - Supply voltage

●Power Dissipation

Power dissipation (total loss) indicates the power that can be consumed by IC at $T_a=25^{\circ}\text{C}$ (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 $\theta_{ja}^{\circ}\text{C/W}$. 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 θ_{ja} , ambient temperature T_a , junction temperature T_j , and power dissipation P_d can be calculated by the equation below

$$\theta_{ja} = (T_j - T_a) / P_d \quad ^{\circ}\text{C/W} \quad \dots \dots (I)$$

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 θ_{ja} . Thermal resistance θ_{ja} 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) shows a derating curve for an example of BD9584F.

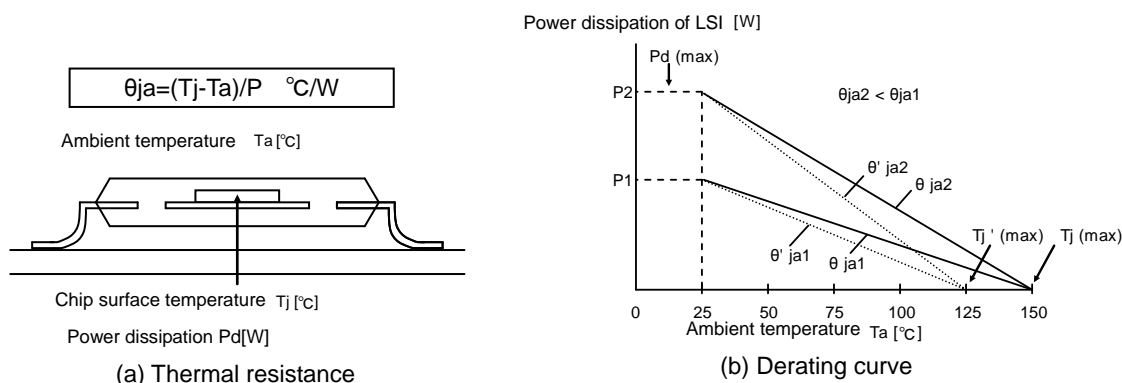
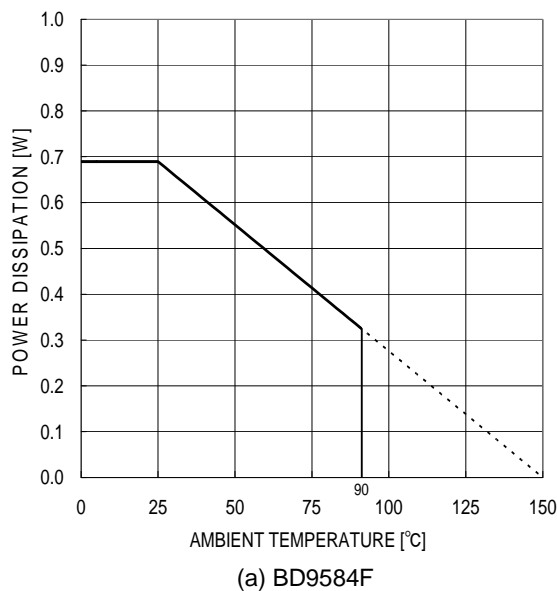


Figure 9. Thermal resistance and derating



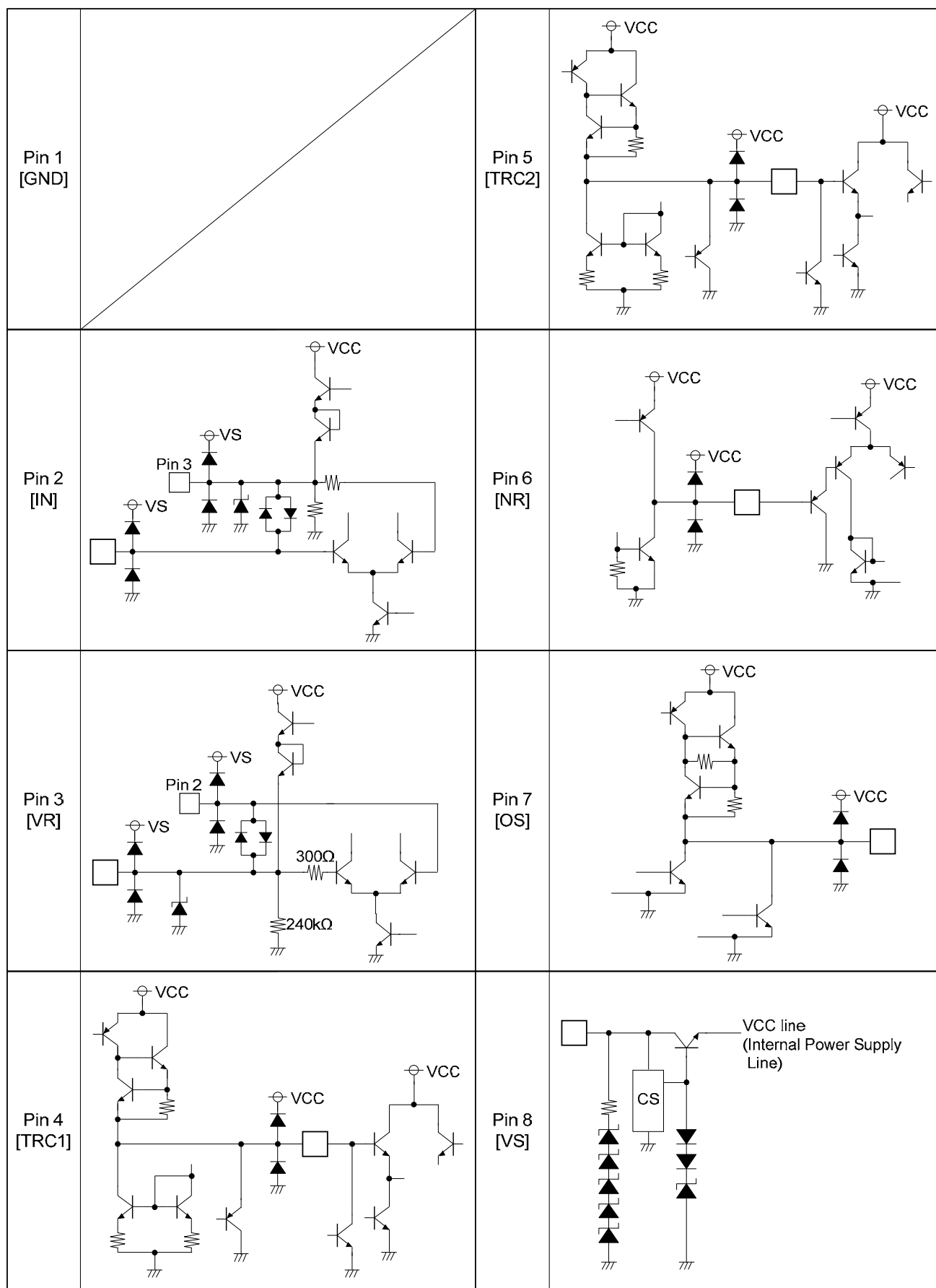
(a) BD9584F

| | Derating curve slope | UNIT |
|---------|----------------------|-------|
| BD9584F | 5.5 | mW/°C |

When using the unit above $T_a=25^{\circ}\text{C}$, subtract the value above per degree $^{\circ}\text{C}$
 Permissible dissipation is a value when FR4 glass epoxy board 70mm×70mm×1.6mm
 (copper foil area below 3%) is mounted.

Figure 10. Derating curve

● I/O equivalence circuit



●Operational Notes

- 1) Absolute maximum ratings
Absolute maximum ratings are the values which indicate the limits, within which the given voltage range can be safely charged to the terminal. However, it does not guarantee the circuit operation.
- 2) Power dissipation Pd
Using the unit in excess of the rated power dissipation may cause deterioration in electrical characteristics due to a rise in chip temperature, including reduced current capability. Therefore, please take into consideration the power dissipation (Pd) under actual operating conditions and apply a sufficient margin in thermal design. Refer to the thermal derating curves for more information.
- 3) Terminal short-circuits
When the output and power supply terminals are shorted, excessive output current may flow, resulting in undue heat generation and, subsequently, destruction.
- 4) Ground terminal voltage
All time, Ground terminal voltage should keep lowest voltage.
In addition, please confirm whether there is not really a terminal becoming the voltage that is lower than GND including a transitional phenomenon.
- 5) Operation in a strong electromagnetic field
Operation in a strong electromagnetic field may cause malfunctions.
- 6) Short-circuit between pins and erroneous mounting
Incorrect mounting may damage the IC. In addition, the presence of foreign particles between the outputs, the output and the power supply, or the output and GND may result in IC destruction.
- 7) IC handling
Applying mechanical stress to the IC by deflecting or bending the board may cause fluctuations in the electrical characteristics due to piezo resistance effects.
- 8) Board inspection
Connecting a capacitor to a pin with low impedance may stress the IC. Therefore, discharging the capacitor after every process is recommended. In addition, when attaching and detaching the jig during the inspection phase, ensure that the power is turned off before inspection and removal. Furthermore, please take measures against ESD in the assembly process as well as during transportation and storage.

Status of this document

The Japanese version of this document is formal specification. A customer may use this translation version only for a reference to help reading the formal version.

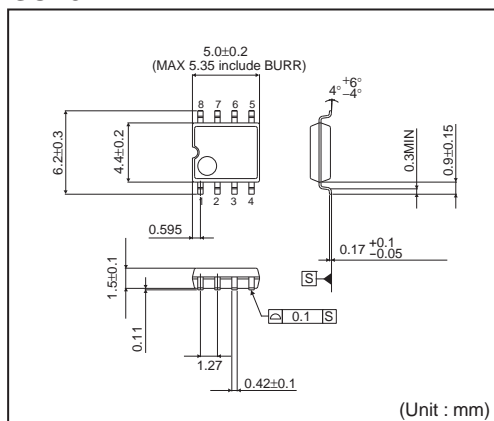
If there are any differences in translation version of this document formal version takes priority.

●Ordering Information

| | |
|--------------------|---|
| B D 9 5 8 4 F | E 2 |
| Part Number | Packaging and forming specification E2: Embossed tape and reel (SOP8) |
| Package F: SOP8 | |

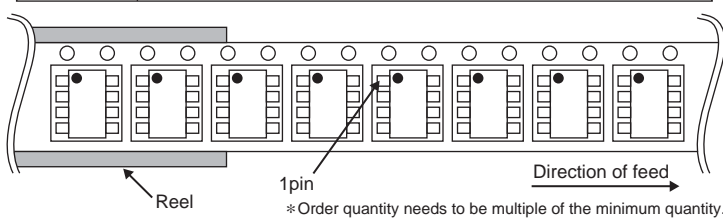
●Physical Dimension Tape and Reel Information

SOP8

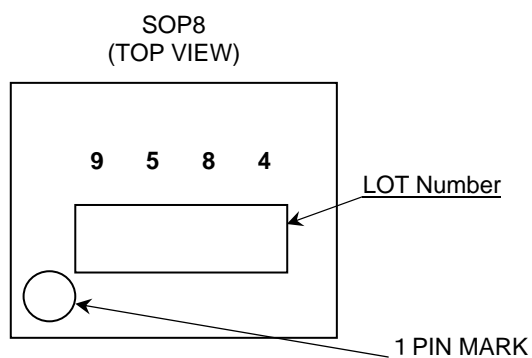


<Tape and Reel information>

| | |
|-------------------|---|
| 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) |



●Marking Diagrams



●Revision History

| Date | Revision | Changes |
|------------|----------|-------------|
| 2012.10.30 | 001 | New Release |

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| JAPAN | USA | EU | CHINA |
|-----------|-----------|------------|-----------|
| CLASS III | CLASS III | CLASS II b | CLASS III |
| CLASS IV | | CLASS III | |

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 - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
 - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
 - Sealing or coating our Products with resin or other coating materials
 - 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
 - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- 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.
- De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

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- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

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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).

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 - [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.

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