

# Compact High Accuracy Temperature Sensor ICs

## Low current Thermostat Output Temperature Sensor ICs



BDJ□□□0HFV Series

No.11047EBT05

### ●Description

BDJ□□□0HFV series is thermostat output temperature sensor IC with built-in temperature detection element, constant current circuit, high-accuracy reference voltage source in one chip. Temperature detection can be realized at  $\pm 2.5^{\circ}\text{C}$  accuracy without complicated design. It is the best temperature sensor IC for a portable equipment of micro and low current, the power down function, and the battery drive. It is possible to use it for a wide usage such as the heat detection and temperature monitors because it provides with the analog output in addition to the thermostat power output. BDJ□□□0HFV series has 5 products at  $55^{\circ}\text{C}$ ,  $60^{\circ}\text{C}$ ,  $65^{\circ}\text{C}$ ,  $70^{\circ}\text{C}$ ,  $80^{\circ}\text{C}$  detection temperature.

### ●Features

- 1) Detection Temperature lineup at  $55^{\circ}\text{C}$ ,  $60^{\circ}\text{C}$ ,  $65^{\circ}\text{C}$ ,  $70^{\circ}\text{C}$ ,  $80^{\circ}\text{C}$  (5 products)
- 2) Power supply Voltage range 2.4~5.5V.
- 3) High Accuracy thermostat ( typ.  $\pm 1.0^{\circ}\text{C}$ , max.  $\pm 2.5^{\circ}\text{C}$  @ $T_a=55\sim 80^{\circ}\text{C}$  )
- 4) High Accuracy Analog Output ( typ.  $\pm 1.0^{\circ}\text{C}$ , max.  $\pm 2.5^{\circ}\text{C}$  @ $T_a=-30\sim 100^{\circ}\text{C}$  )
- 5) Analog Output Temperature Sensitivity ( typ.  $-8.2\text{mV}/^{\circ}\text{C}$  )
- 6) Low Supply Current ( typ. 7.5 $\mu\text{A}$  )
- 7) Power down control function built in. (PD interface Voltage min 1.5V)
- 8) Small Package ( typ. 1.60mm  $\times$  1.60mm  $\times$  0.60mm )
- 9) Low thermal resistance package ( typ. 187 $^{\circ}\text{C}/\text{W}$  )
- 10) ESD Rating 8kV ( HBM )

### ●Applications

Cell phone, Digital Camera, Thermal Protection for Electrical Equipment (NoteBook PC, FPD-TV, etc.)

### ●Line up matrix

| Product Name | Detect Temp. ( $^{\circ}\text{C}$ ) | OS Output Format |          | Marking |
|--------------|-------------------------------------|------------------|----------|---------|
|              |                                     | Open Drain       | Active L |         |
| BDJ0800HFV   | 80                                  | Open Drain       | Active L | ff      |
| BDJ0700HFV   | 70                                  | Open Drain       | Active L | fh      |
| BDJ0650HFV   | 65                                  | Open Drain       | Active L | fk      |

| Product Name | Detect Temp. ( $^{\circ}\text{C}$ ) | OS Output Format |          | Marking |
|--------------|-------------------------------------|------------------|----------|---------|
|              |                                     | Open Drain       | Active L |         |
| BDJ0600HFV   | 60                                  | Open Drain       | Active L | fm      |
| BDJ0550HFV   | 55                                  | Open Drain       | Active L | fn      |

## ● Absolute Maximum Ratings ( Ta = 25°C )

| Parameter                 | Symbol           | Ratings                      | Unit |
|---------------------------|------------------|------------------------------|------|
| Power Supply Voltage      | V <sub>DD</sub>  | -0.3 to 7.0 <sup>*1</sup>    | V    |
| Input Voltage ( PD )      | V <sub>IN</sub>  | -0.3 to V <sub>DD</sub> +0.3 | V    |
| OS terminal Voltage       | V <sub>OS</sub>  | -0.3 to 7.0 <sup>*1</sup>    | V    |
| OS terminal Current       | I <sub>OS</sub>  | 5.0                          | mA   |
| Power dissipation         | P <sub>d</sub>   | 536 <sup>*2</sup>            | mW   |
| Storage Temperature Range | T <sub>stg</sub> | -55 to 150                   | °C   |

\*1. Not to exceed P<sub>d</sub>\*2. Reduced by 5.36mW for each increase in Ta of 1°C over 25°C  
( mounted on 70mm × 70mm × 1.6mm Glass-epoxy PCB )

## ● Recommended Operating Conditions

| Parameter                   | Symbol           | Ratings |      |      | Unit |
|-----------------------------|------------------|---------|------|------|------|
|                             |                  | Min.    | Typ. | Max. |      |
| Power Supply Voltage        | V <sub>DD</sub>  | 2.4     | 2.8  | 5.5  | V    |
| Operating Temperature Range | T <sub>opr</sub> | -30     | -    | 100  | °C   |

● Electrical Characteristics ( Unless otherwise specified, V<sub>DD</sub> = 2.8V, Ta = 25°C )

| Parameter                                    | Symbol                | Limits |       |                 | Unit  | Conditions                                 |
|--|-----------------------|--------|-------|-----------------|-------|--|
|  |                       | Min.   | Typ.  | Max.            |       |  |
| Supply Current                               |                       |        |       |                 |       |  |
| Normal function mode                         | I <sub>DD</sub>       | -      | 7.5   | 12.0            | μA    | PD="H"                                     |
| Power Down mode                              | I <sub>DDPD</sub>     | -      | 0.3   | 1.0             | μA    | PD="L"                                     |
| PD   |                       |        |       |                 |       |  |
| Input L Voltage                              | V <sub>IL</sub>       | GND    | -     | 0.2             | V     |  |
| Input H Voltage                              | V <sub>IH</sub>       | 1.5    | -     | V <sub>DD</sub> | V     |  |
| PD Leakage Current                           | I <sub>LPD</sub>      | -      | -     | 1.0             | μA    | PD=2.8V                                    |
| Analog Output                                |                       |        |       |                 |       |  |
| V <sub>Temp</sub> Output Voltage             | V <sub>temp</sub>     | 1.279  | 1.300 | 1.321           | V     | Ta = 30°C                                  |
| V <sub>Temp</sub> Temperature Sensitivity    | V <sub>SE</sub>       | -8.00  | -8.20 | -8.40           | mV/°C | Ta = -30 to 100°C                          |
| V <sub>Temp</sub> Load Regulation            | ΔV <sub>tempRL</sub>  | -      | -     | 1.0             | mV    | difference of I <sub>OUT</sub> : 0μA / 2μA |
| V <sub>Temp</sub> V <sub>DD</sub> Regulation | ΔV <sub>tempVDD</sub> | -      | -     | 4.0             | mV    | V <sub>DD</sub> =2.4~5.5V                  |
| OS Output Open Drain                         |                       |        |       |                 |       |  |
| OS Leakage Current                           | I <sub>L</sub>        | -      | -     | 1.0             | μA    | V <sub>OS</sub> = 5.0V                     |
| OS Output Voltage                            | V <sub>OL</sub>       | -      | -     | 0.4             | V     | I <sub>OS</sub> = 1.0mA                    |

Radiation hardness is not designed.

● Temperature Accuracy ( Unless otherwise specified, V<sub>DD</sub> = 2.8V )

| Parameter                              | Symbol            | Limits |      |      | Unit | Conditions                                  |
|--|-------------------|--------|------|------|------|---|
|  |                   | Min.   | Typ. | Max. |      |   |
| Thermostat                             |                   |        |      |      |      |   |
| Sensing Temperature Accuracy           | T <sub>acc</sub>  | -      | ±1.0 | ±2.5 | °C   |   |
| Sensing Temperature Hysteresis         | T <sub>hys</sub>  | 7.5    | 10.0 | 12.5 | °C   |   |
| Analog Output                          |                   |        |      |      |      |   |
| V <sub>Temp</sub> Temperature Accuracy | T <sub>temp</sub> | -      | ±1.0 | ±2.5 | °C   | V <sub>DD</sub> = 2.8V<br>Ta = -30 to 100°C |

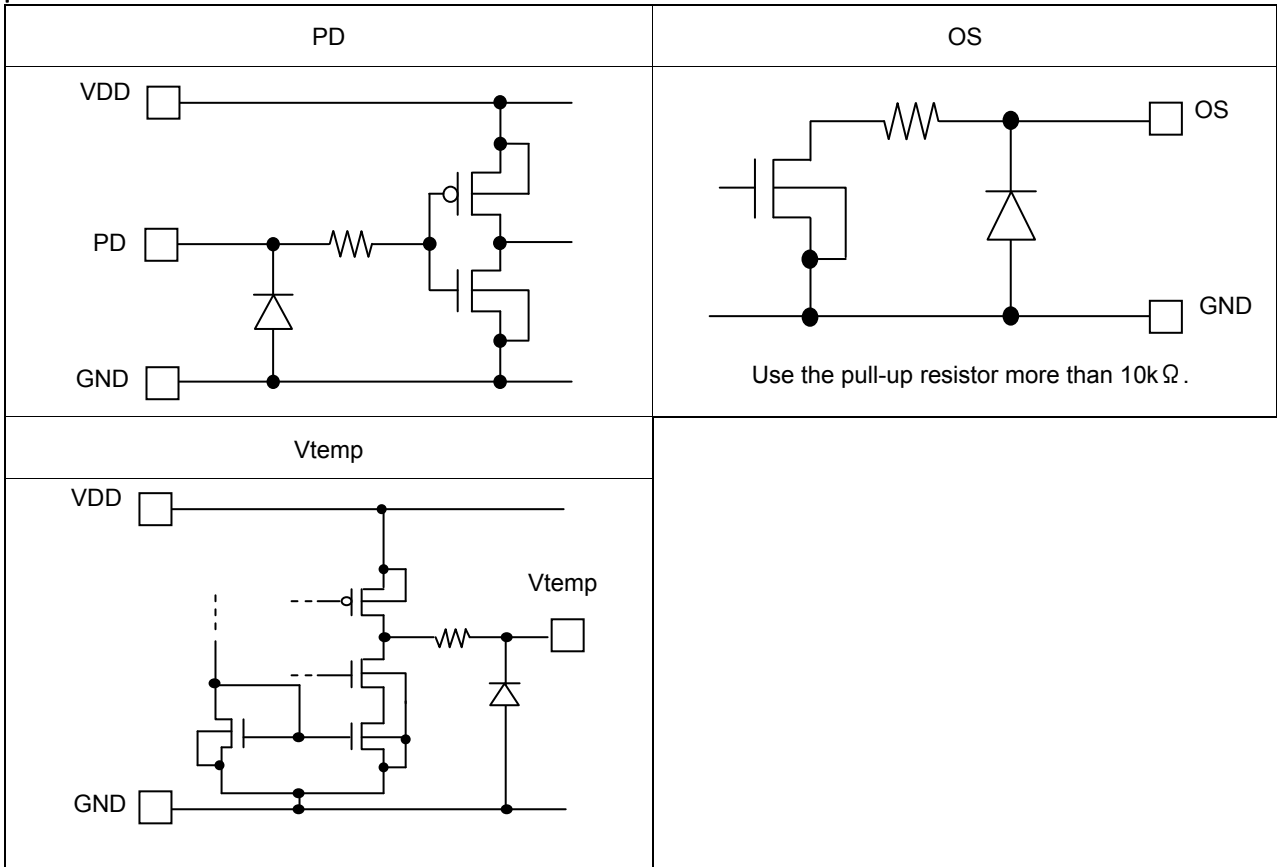
●Block Diagram



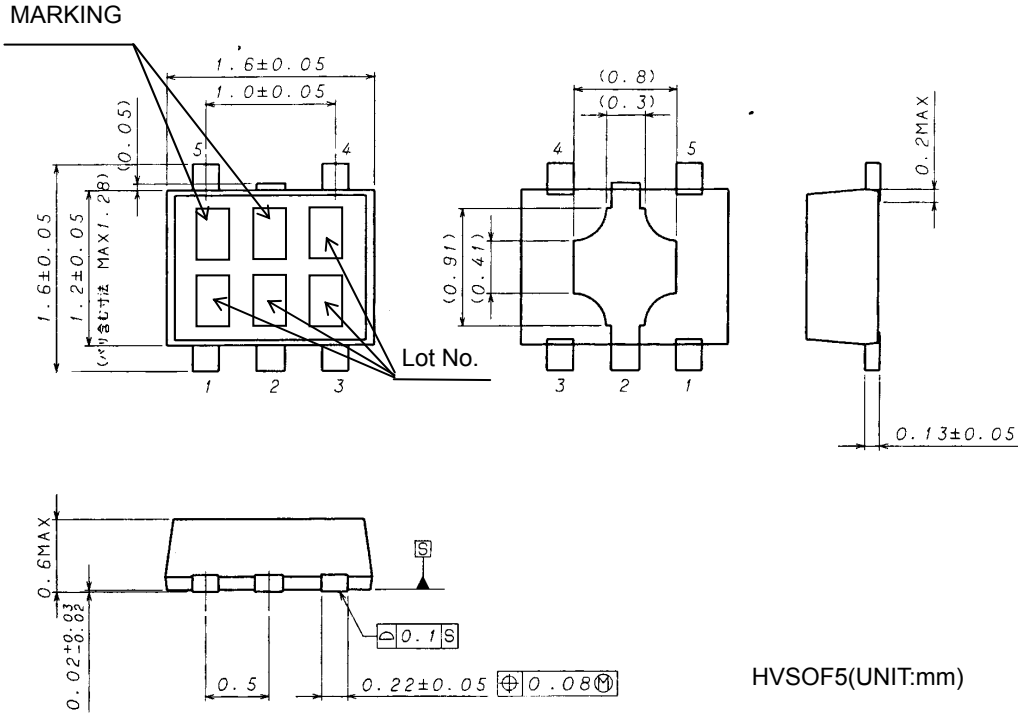
●Pin Description

| PIN NO. | PIN NAME | FUNCTION  | COMMENT  |
|---------|----------|---|--|
| 1       | Vtemp    | Output voltage in inverse proportion to the temperature ( TYP. -8.20mV/°C ) | Set the OPEN state or connect high impedance input node.(over 10MΩ ) |
| 2       | GND      | GROUND  |  |
| 3       | PD       | PD control<br>H : Normal function mode<br>L : Power Down mode               | "H" Thermostat and Analog output operation.<br>"L" Power Down state. |
| 4       | OS       | Digital thermostat output   | Open Drain Active L.<br>Use the pull-up resistor more than 10kΩ .    |
| 5       | VDD      | POWER SUPPLY  |  |

●Equivalent Circuit

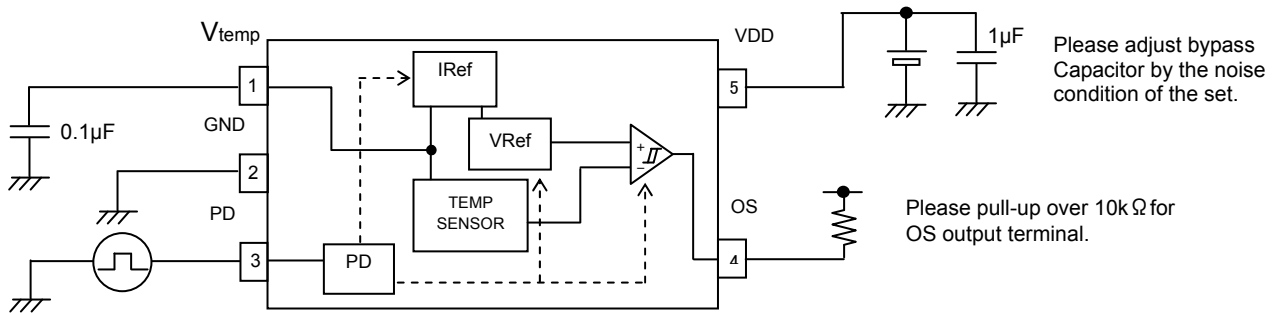


●Package Outlines ( HVSO5 )



●Block Diagram

Please adjust Capacitor by the noise condition of the set.



●Reference Data

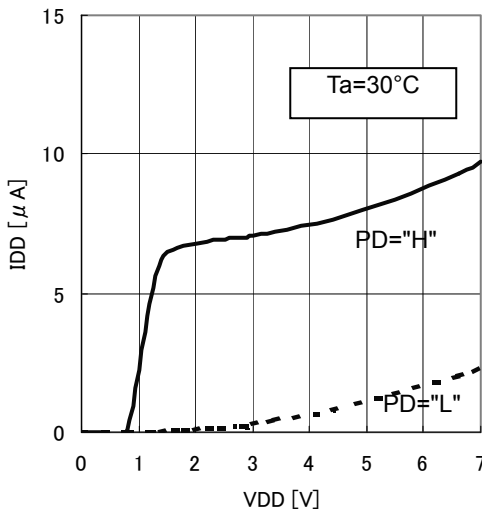


Fig1. Supply Current(IDD) vs. Supply Voltage



Fig2. Vtemp Voltage vs. Supply Voltage

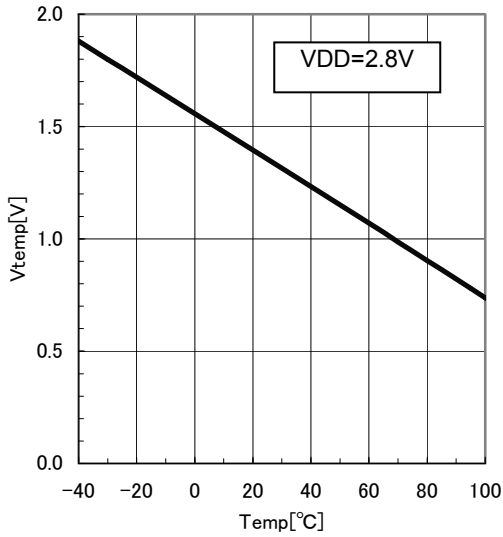


Fig3. Vtemp Voltage vs. Temperature

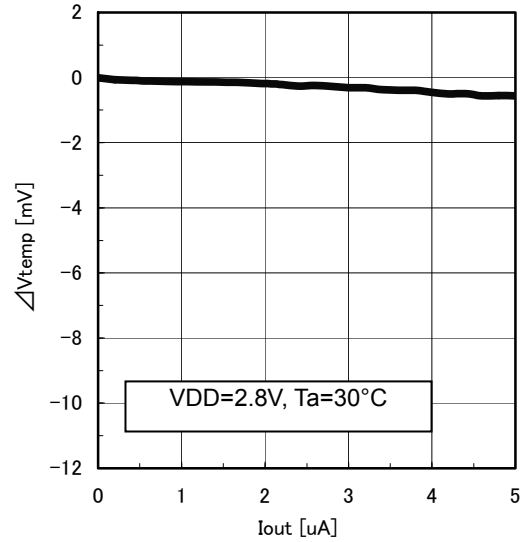


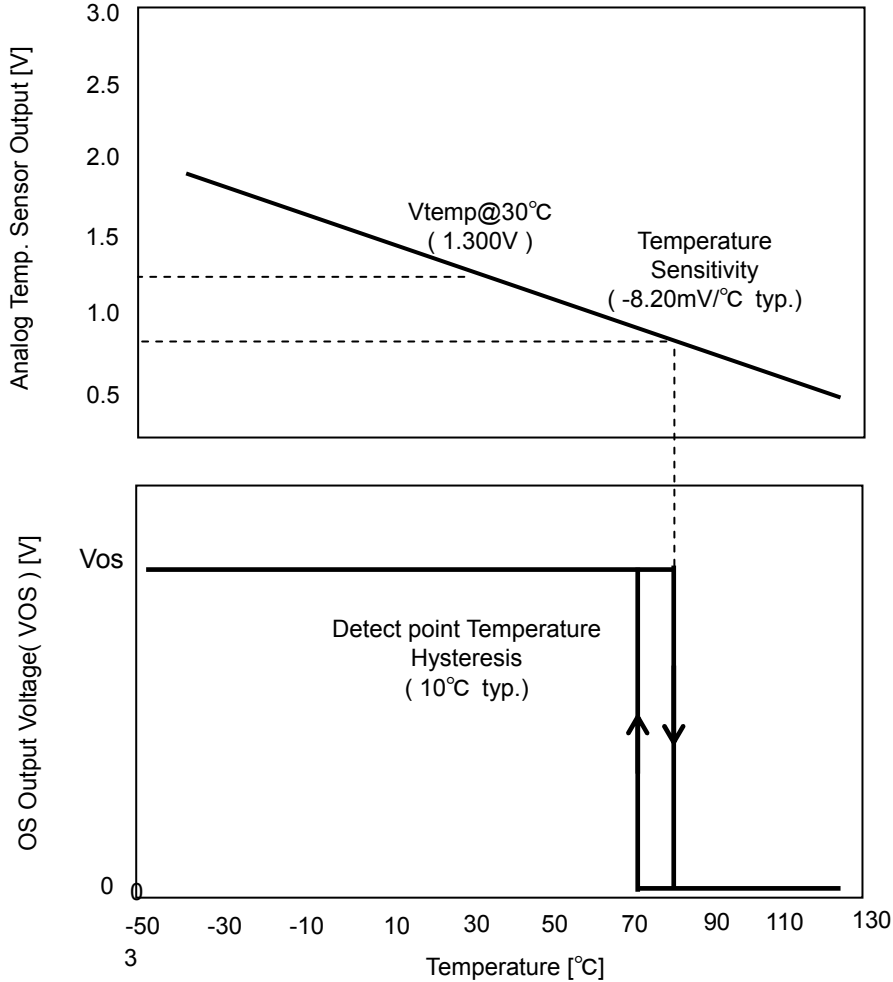
Fig4. Vtemp Voltage vs. Output Current



Fig5. OS Output Voltage vs. Load Current

●Function Diagram(ex. 80°C detect Active “L” type BDJ0800HFV)

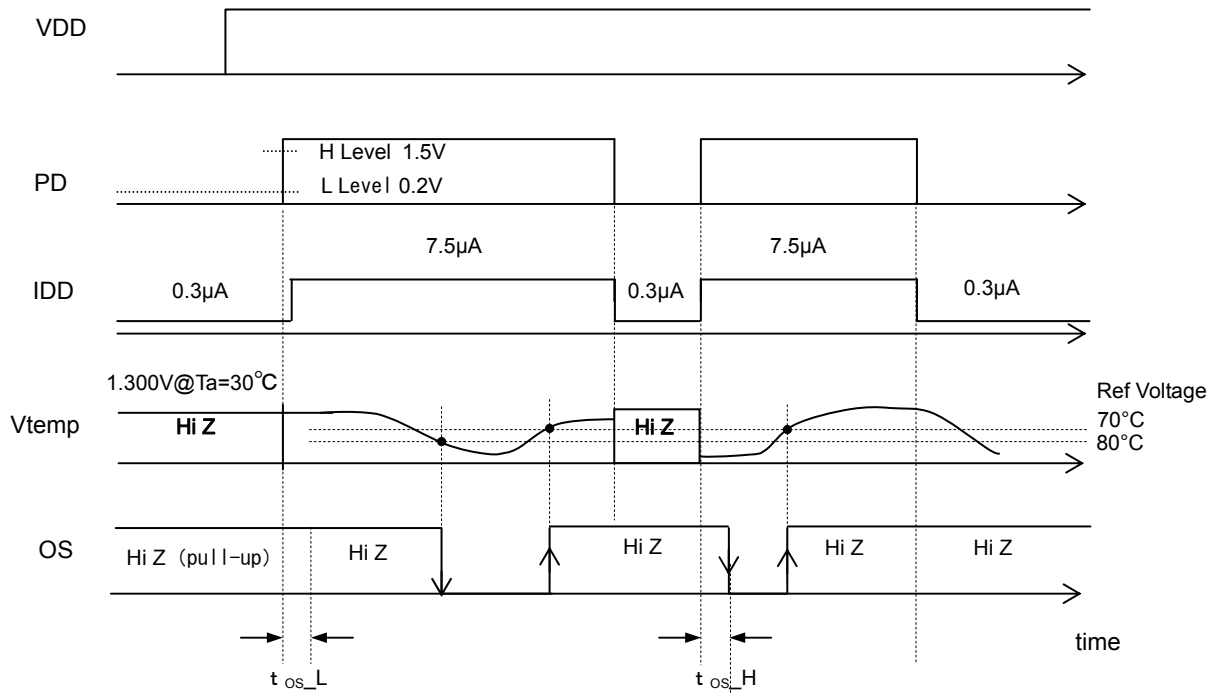
Temperature sensor internal IC sense temperature, Vtemp terminal output voltage convert temperature.  
 Vtemp value is 1.300[V] at Ta = 30[°C].  
 The value of Vtemp voltage reduce reversely proportional temperature at rate of -8.2mV/°C.



If the temperature over detect temperature, internal comparator operate OS output “H” to “L”.(ex.active “L” Type)  
 In case of OS return to “H”,the temperature 10°C lower than detect temperature.

●Operation Sequence

(ex.80°C detect Active"L"type BDJ0800HFV)



BDJ0800HFV operate start after PD"H"Input.  
Please read OS terminal signal below wait time after PD "H" Input.

| Ta                 | Symbol            | Wait time |
|--------------------|-------------------|-----------|
| Under detect Temp. | t <sub>os_L</sub> | 200µs     |
| Over detect Temp.  | t <sub>os_H</sub> | 1000µs    |

**●Notes for use**

- 1) Absolute Maximum Ratings  
An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down devices, thus making impossible to identify breaking mode such as a short circuit or an open circuit. If any special mode exceeding the absolute maximum ratings is assumed, consideration should be given to take physical safety measures including the use of fuses, etc.
- 2) GND voltage  
Make setting of the potential of the GND terminal so that it will be maintained at the minimum in any operating state.
- 3) Pin short and mistake fitting  
When mounting the IC on the PCB, pay attention to the orientation of the IC. If there is a placement mistake, the IC may be burned up.
- 4) Operation in strong electric field  
Be noted that using ICs in the strong electric field can malfunction them.
- 5) Mutual impedance  
Use short and wide wiring tracks for the power supply and ground to keep the mutual impedance as small as possible. Use a capacitor to keep ripple to a minimum.



●Ordering part number

|             |   |   |              |   |               |   |            |   |   |                                     |   |   |
|-------------|---|---|--------------|---|---------------|---|------------|---|---|-------------------------------------|---|---|
| B           | D | J | 0            | 8 | 0             | 0 | H          | F | V | -                                   | T | R |
| Series Name |   |   | Detect Temp. |   | Output Format |   | Package    |   |   | Packaging and forming specification |   |   |
|             |   |   | 080: 80°C    |   | 0 : active L  |   | HFV:HVSOF5 |   |   | TR: Embossed tape and reel          |   |   |
|             |   |   | 070: 70°C    |   | 1 : active H  |   |            |   |   |                                     |   |   |
|             |   |   | 065: 65°C    |   |               |   |            |   |   |                                     |   |   |
|             |   |   | 060: 60°C    |   |               |   |            |   |   |                                     |   |   |
|             |   |   | 055: 55°C    |   |               |   |            |   |   |                                     |   |   |

HVSOF5



<Tape and Reel information>

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

\*Order quantity needs to be multiple of the minimum quantity.

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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 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.

## Precaution for Mounting / Circuit board design

- 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.

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.
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### 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 Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [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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