

## LOW NOISE, BIPOLAR INPUT DUAL AUDIO OPERATIONAL AMPLIFIER

### FEATURES

- Designed for High-Quality Sound
  - Low Noise  $3.5 \text{ nV}/\sqrt{\text{Hz}}$  at 1kHz
  - Low Distortion 0.001%
  - Slew Rate  $6.8 \text{ V}/\mu\text{s}$
  - Gain Bandwidth Product 19 MHz
  - Open-Loop Voltage Gain 120dB
  - Unity-Gain Stable
  - Bipolar Input
  - Supply Voltage  $\pm 4\text{V}$  to  $\pm 18\text{V}$
  - Operating Temperature  $-40^\circ\text{C}$  to  $125^\circ\text{C}$
  - Supply Current (All Amplifiers) 5 mA typ.
  - Package SOP8  
MSOP8 (TVSP8)\*
- \* meet JEDEC MO-187-DA / thin type

### DESCRIPTION

NJM8068 is a low noise bipolar input dual audio operational amplifier has  $3.5 \text{ nV}/\sqrt{\text{Hz}}$  at 1kHz.

The NJM8068 features Low distortion, high slew rate, wide bandwidth and high open-loop gain. In addition, unity-gain stable allows voltage-follower operation. These features make NJM8068 ideal for audio pre amplifier, microphone amplifier, line amplifier and other audio applications. NJM8068 operate over a wide temperature range of  $-40^\circ\text{C}$  to  $125^\circ\text{C}$ , making this IC ideal for use in industrial measurement instruments

The NJM8068 is available in 8-pin SOP and MSOP (TVSP) packages.

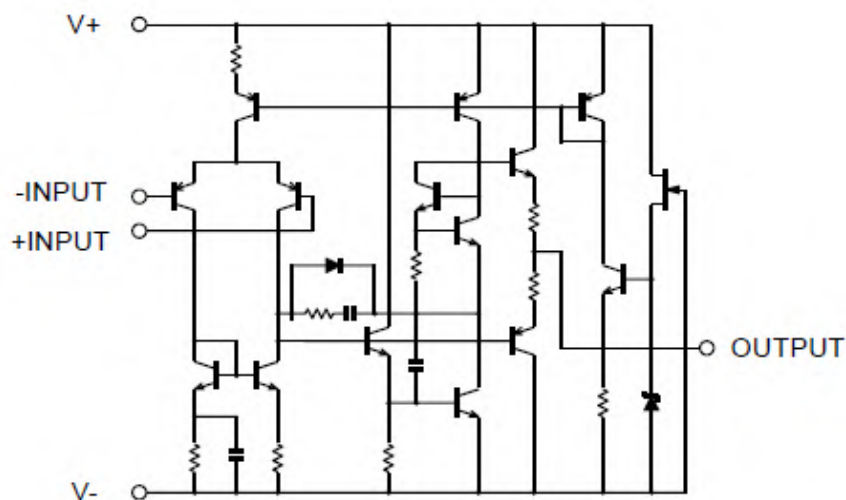
### APPLICATIONS

- Professional Audio Sets
- Audio Pre / Microphone Amplifiers
- Analog / Digital Mixers
- AV Receivers
- Car Audio
- Industrial Measurement Instruments

### ■ RELATED PRODUCT

| PRODUCT NAME | FEATURES                                                                                                                 |
|--------------|--------------------------------------------------------------------------------------------------------------------------|
| NJM8080      | $5 \text{ nV}/\sqrt{\text{Hz}}$ , 0.0005%, $5 \text{ V}/\mu\text{s}$ , 15MHz<br>(Low noise, low distortion audio Op-Amp) |

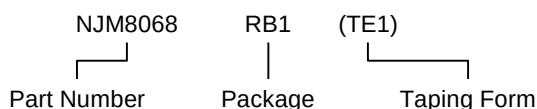
### ■ EQUIVALENT CIRCUIT



## PIN CONFIGURATIONS

| PRODUCT NAME  | NJM8068G | NJM8068B1     |
|---------------|----------|---------------|
| Package       | SOP8     | MSOP8 (TVSP8) |
| Pin Functions |          |               |

## PRODUCT NAME INFORMATION



## ORDER INFORMATION

| PRODUCT NAME | PACKAGE       | RoHS | HALOGEN-FREE | TERMINAL FINISH | MARKING | WEIGHT (mg) | MOQ (pcs) |
|--------------|---------------|------|--------------|-----------------|---------|-------------|-----------|
| NJM8068G     | SOP8          | Yes  | Yes          | Pure Sn         | 8068    | 88          | 2500      |
| NJM8068RB1   | MSOP8 (TVSP8) | Yes  | Yes          | Sn2Bi           | 8068    | 18          | 2000      |

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                 | SYMBOL      | RATING                                                      | UNIT |
|-------------------------------------------|-------------|-------------------------------------------------------------|------|
| Supply Voltage                            | $V^+ / V^-$ | $\pm 18$                                                    | V    |
| Differential Input Voltage <sup>(1)</sup> | $V_{ID}$    | $\pm 36$                                                    | V    |
| Input Voltage <sup>(2)</sup>              | $V_{IN}$    | $V^- - 0.3$ to $V^+ + 36$                                   | V    |
| Output Terminal Input Voltage             | $V_O$       | $V^- - 0.3$ to $V^+ + 0.3$                                  | V    |
| Power Dissipation <sup>(3)</sup>          | $P_D$       | 2-Layer / 4-Layer <sup>(4)</sup><br>690 / 1000<br>510 / 680 | mW   |
| Storage Temperature Range                 | $T_{stg}$   | -65 to 150                                                  | °C   |
| Maximum Junction Temperature              | $T_{jmax}$  | 150                                                         | °C   |

## THERMAL CHARACTERISTICS

| PACKAGE                                                                        | SYMBOL        | VALUE                                                      | UNIT |
|--------------------------------------------------------------------------------|---------------|------------------------------------------------------------|------|
| Junction-to-Ambient Thermal Resistance<br>SOP8<br>MSOP8 (TVSP8)                | $\Theta_{ja}$ | 2-Layer / 4-Layer <sup>(4)</sup><br>181 / 125<br>245 / 184 | °C/W |
| Junction-to-Top of Package Characterization Parameter<br>SOP8<br>MSOP8 (TVSP8) | $\Psi_{jt}$   | 2-Layer / 4-Layer <sup>(4)</sup><br>49 / 43<br>51 / 45     | °C/W |

(1) Differential voltage is the voltage difference between +INPUT and -INPUT.

(2) Input voltage is the voltage should be allowed to apply to the input terminal independent of the magnitude of  $V^+$ .

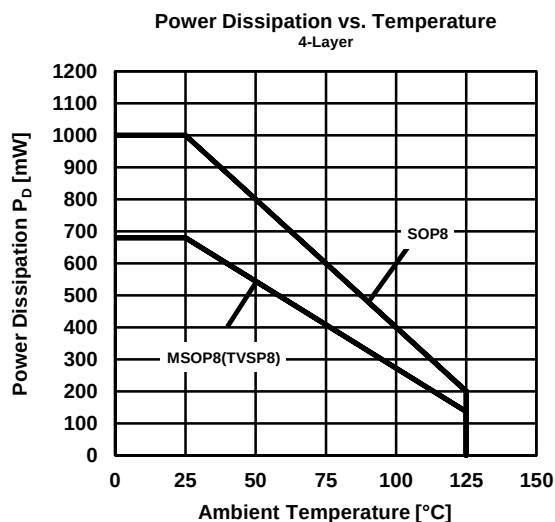
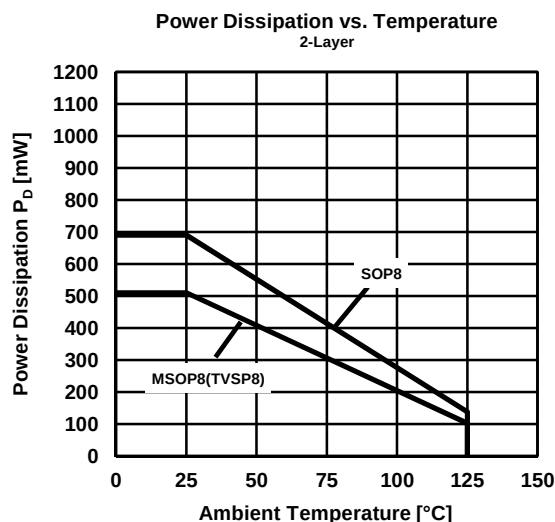
The normal operation will establish when any input is within the "Common-Mode Input Voltage Range" of electrical characteristics.

(3) Power dissipation is the power that can be consumed by the IC at  $T_a = 25^\circ\text{C}$ , and is the typical measured value based on JEDEC condition.

(4) 2-Layer: Mounted on glass epoxy board. (76.2×114.3×1.6 mm: based on EIA/JDEC standard, 2-layer FR-4)

4-Layer: Mounted on glass epoxy board. (76.2×114.3×1.6 mm: based on EIA/JDEC standard, 4-layer FR-4), internal Cu area: 74.2 x 74.2 mm

## ■ POWER DISSIPATION vs. AMBIENT TEMPERATURE



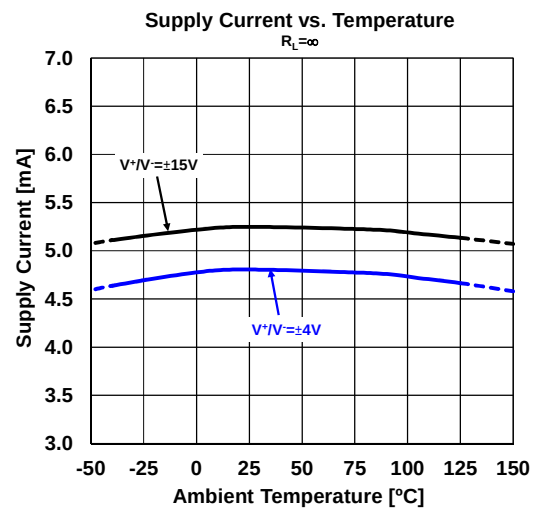
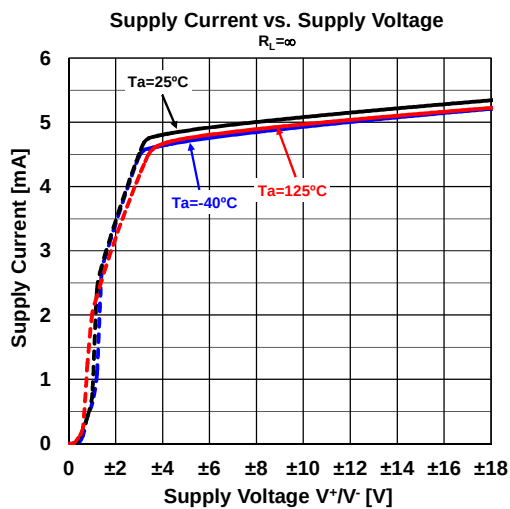
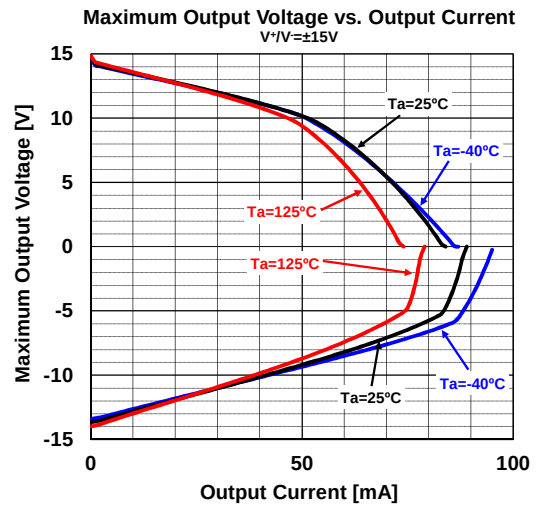
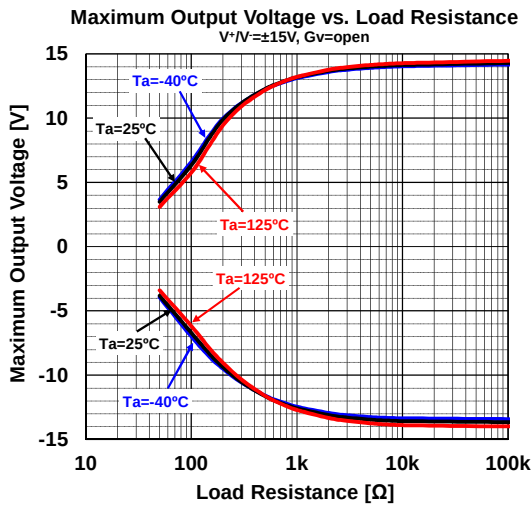
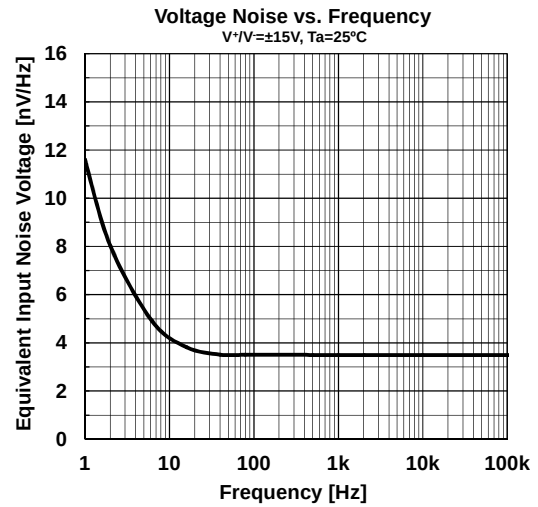
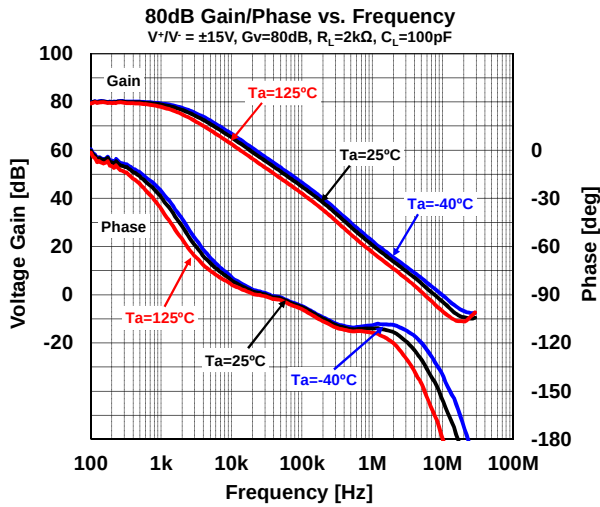
## ■ RECOMMENDED OPERATING CONDITIONS

| PARAMETER                   | SYMBOL    | CONDITIONS             | VALUE               | UNIT             |
|-----------------------------|-----------|------------------------|---------------------|------------------|
| Supply Voltage              | $V^+V^-$  | $T_a=25^\circ\text{C}$ | $\pm 4$ to $\pm 18$ | V                |
| Operating Temperature Range | $T_{opr}$ |                        | -40 to 125          | $^\circ\text{C}$ |

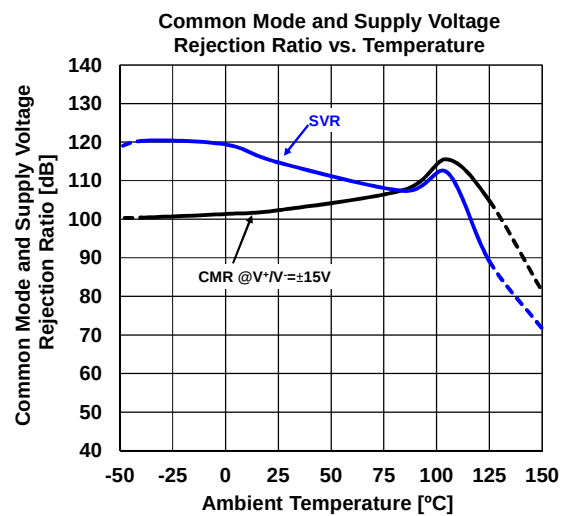
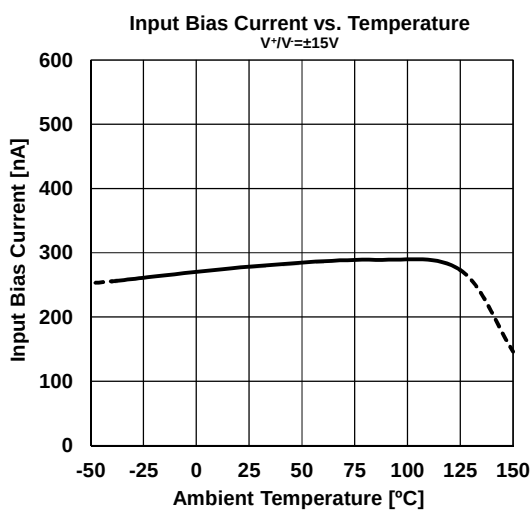
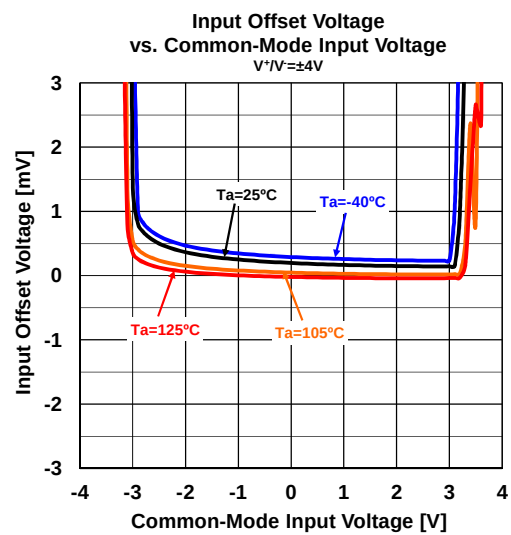
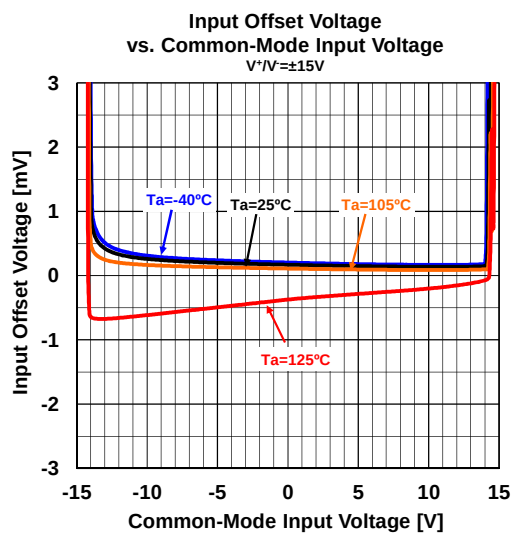
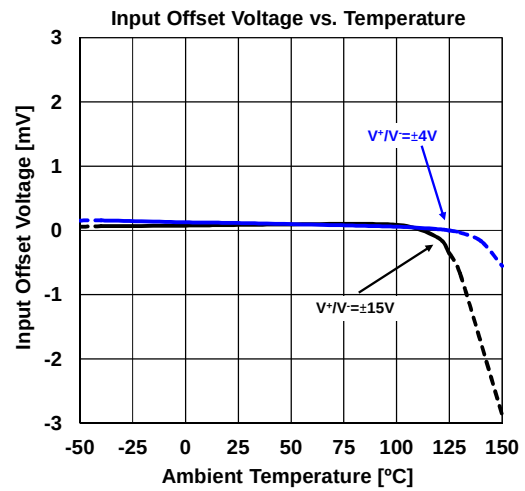
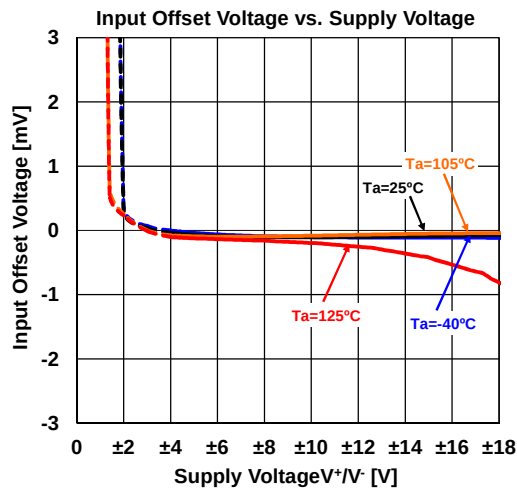
## ■ ELECTRICAL CHARACTERISTICS ( $V^+V^-=\pm 15\text{V}$ , $T_a=25^\circ\text{C}$ , unless otherwise noted.)

| PARAMETER                           | SYMBOL       | TEST CONDITIONS                              | MIN      | TYP        | MAX  | UNIT                         |
|-------------------------------------|--------------|----------------------------------------------|----------|------------|------|------------------------------|
| <b>INPUT/OUTPUT CHARACTERISTICS</b> |              |                                              |          |            |      |                              |
| Input Offset Voltage                | $V_{IO}$     | $R_S \leq 10\text{k}\Omega$                  | -        | 0.3        | 3    | mV                           |
| Input Bias Current                  | $I_B$        |                                              | -        | 260        | 1000 | nA                           |
| Input Offset Current                | $I_{IO}$     |                                              | -        | 5          | 200  | nA                           |
| Open-Loop Voltage Gain              | $A_V$        | $R_L=2\text{k}\Omega$ , $V_O=\pm 10\text{V}$ | 90       | 120        | -    | dB                           |
| Common-Mode Rejection Ratio         | CMR          |                                              | 80       | 110        | -    | dB                           |
| Input Resistance                    | $R_{IN}$     |                                              | 50       | 300        | -    | $\text{k}\Omega$             |
| Common-Mode Input Voltage Range     | $V_{ICM}$    |                                              | $\pm 12$ | $\pm 13.5$ | -    | V                            |
| Maximum Output Voltage              | $V_{OM}$     | $R_L \geq 2\text{k}\Omega$                   | $\pm 12$ | $\pm 13.5$ | -    | V                            |
| <b>POWER SUPPLY</b>                 |              |                                              |          |            |      |                              |
| Supply Current (All Amplifiers)     | $I_{SUPPLY}$ |                                              | -        | 5          | 8    | mA                           |
| Supply Voltage Rejection Ratio      | SVR          |                                              | 80       | 120        | -    | dB                           |
| <b>AC CHARACTERISTICS</b>           |              |                                              |          |            |      |                              |
| Gain Bandwidth Product              | GBW          | $f=100\text{kHz}$                            | -        | 19         | -    | MHz                          |
| Unity Gain Frequency                | $f_T$        | $G_V=0\text{dB}$                             | -        | 7.5        | -    | MHz                          |
| Slew Rate                           | SR           | $R_L \geq 2\text{k}\Omega$                   | -        | 6.8        | -    | V/ $\mu\text{s}$             |
| <b>Noise, Distortion</b>            |              |                                              |          |            |      |                              |
| Equivalent Input Noise Voltage      | $e_n$        | $f=1\text{kHz}$                              | -        | 3.5        | -    | $\text{nV}/\sqrt{\text{Hz}}$ |
|                                     |              | FLAT, $f=20\text{Hz}$ to $20\text{kHz}$      | -        | 0.5        | 0.7  | $\mu\text{V}_{rms}$          |
| Total Harmonic Distortion + Noise   | THD+N        |                                              | -        | 0.001      | -    | %                            |
| Channel Separation                  | CS           |                                              | -        | 120        | -    | dB                           |

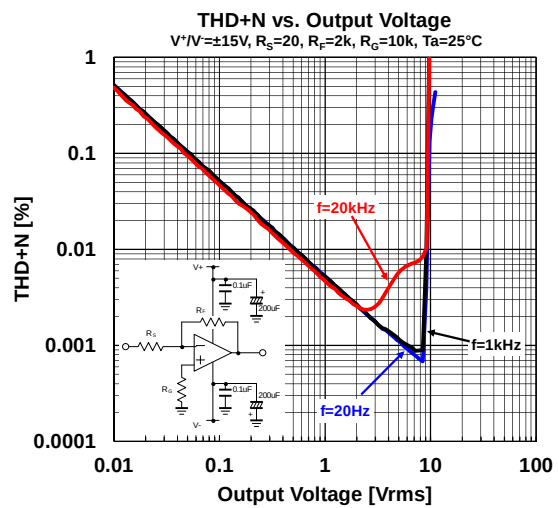
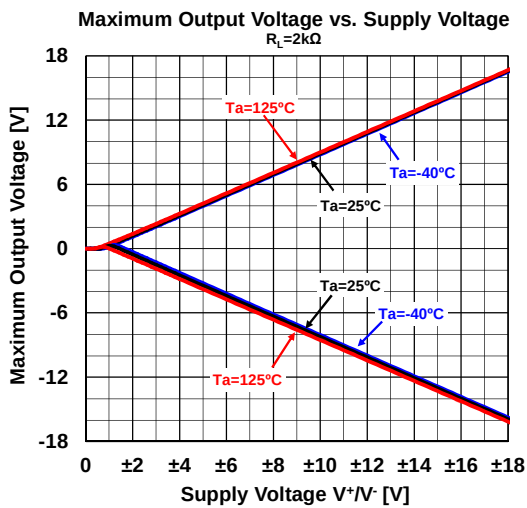
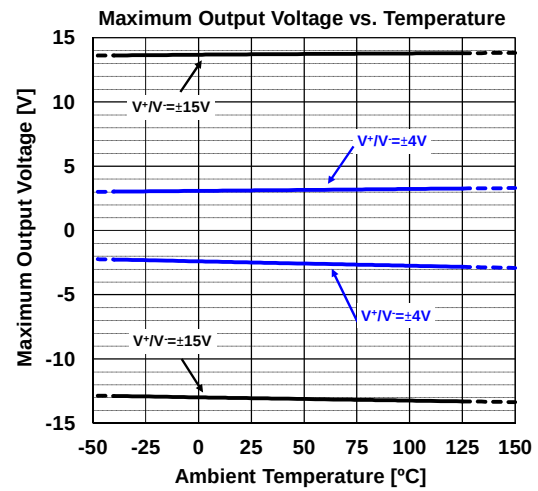
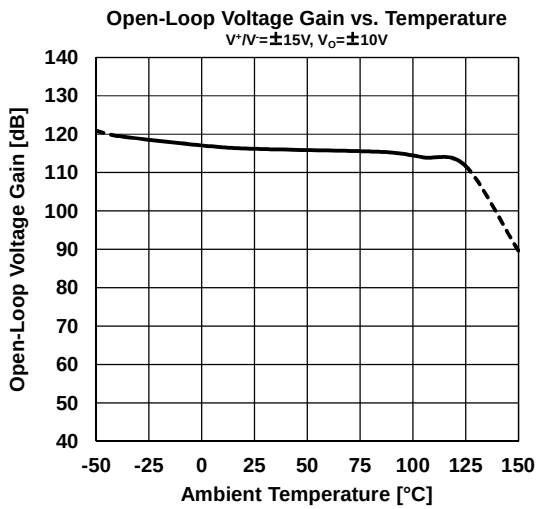
## ■ TYPICAL CHARACTERISTICS



## ■ TYPICAL CHARACTERISTICS

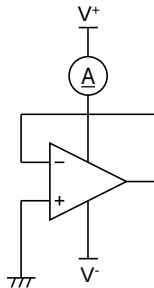


## ■ TYPICAL CHARACTERISTICS



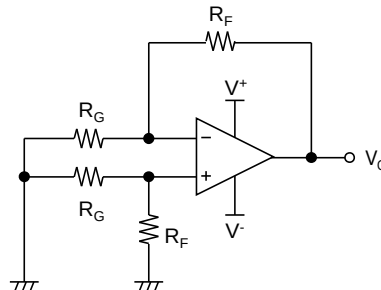
## ■ TEST CIRCUITS

### • $I_{SUPPLY}$



### • $V_{IO}$ , CMR, SVR

$R_G=50\Omega$ ,  $R_F=50k\Omega$



$$V_{IO} = \frac{R_G}{(R_G + R_F)} \times V_O$$

$$CMR = 20 \log \frac{\Delta V_{COM} \left( 1 + \frac{R_F}{R_G} \right)}{\Delta V_O}$$

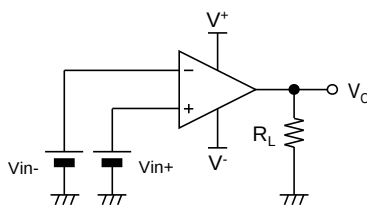
$$SVR = 20 \log \frac{\Delta V_S \left( 1 + \frac{R_F}{R_G} \right)}{\Delta V_O}$$

$V_S = V^+ - V^-$

### • $V_{OH}$ , $V_{OL}$

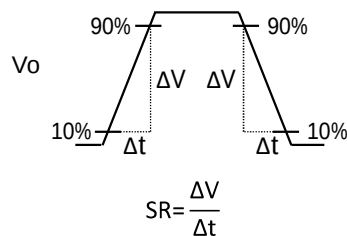
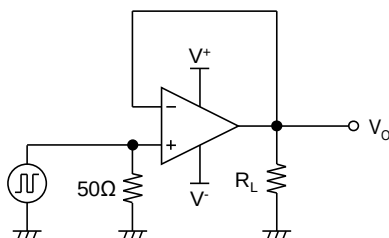
$V_{OH}$ :  $V_{in+} = 1V$ ,  $V_{in-} = -1V$

$V_{OL}$ :  $V_{in+} = -1V$ ,  $V_{in-} = 1V$



### • SR

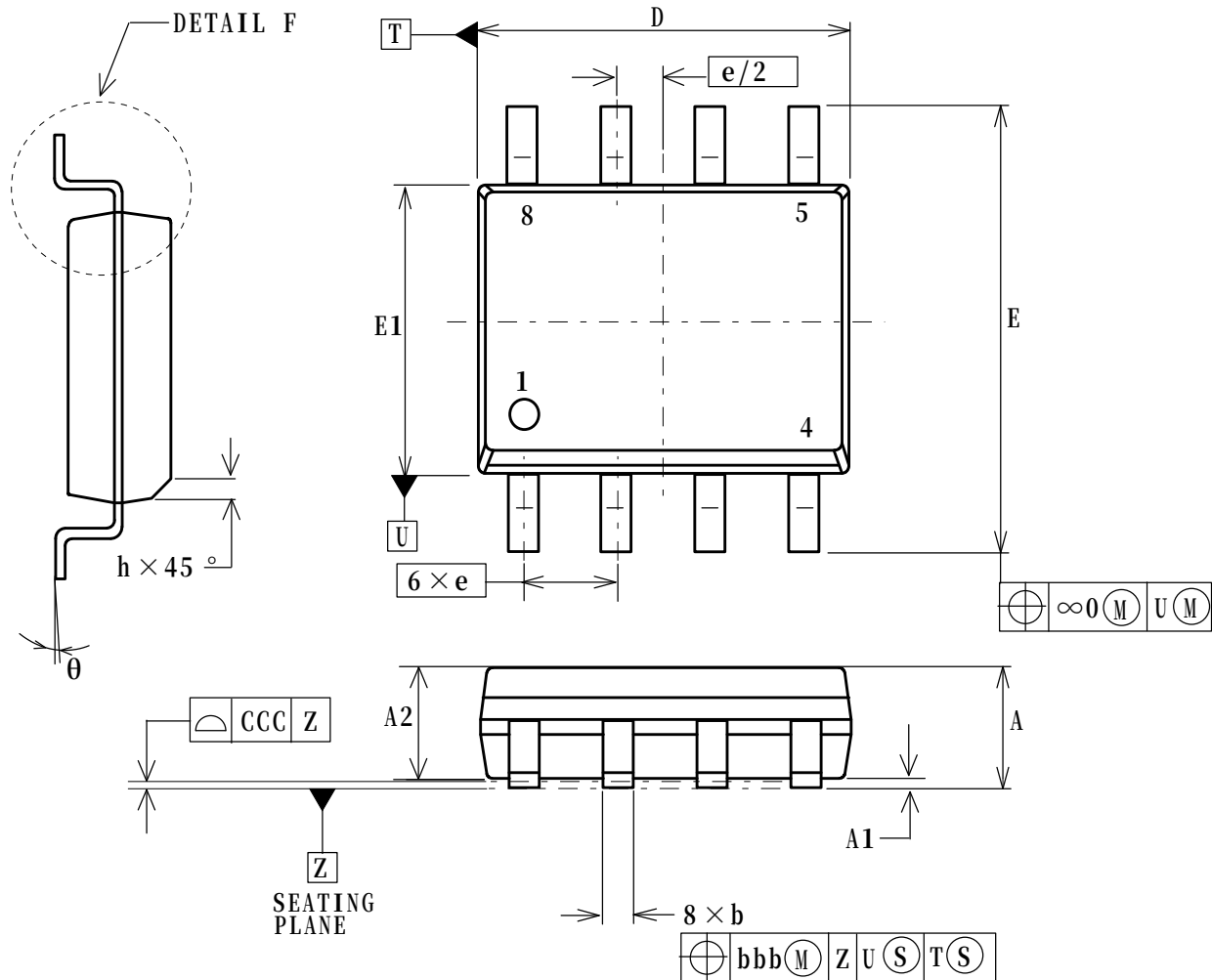
$R_L=2k\Omega$



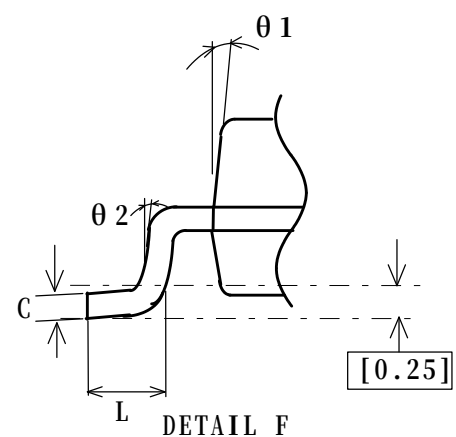
## SOP8

Unit: mm

### ■ PACKAGE DIMENSIONS



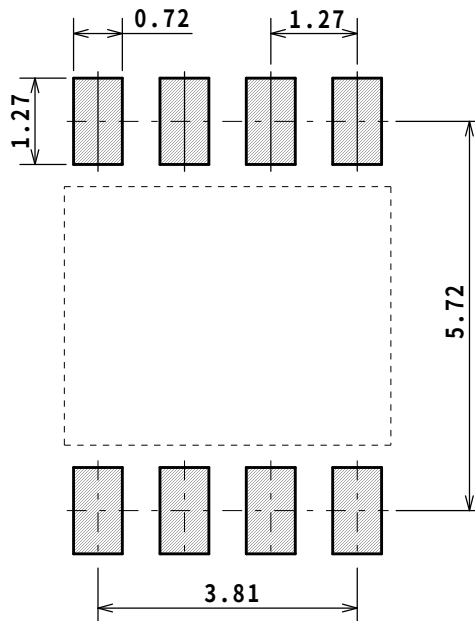
| DESCRIPTION      | SYMBOL     | INCH     |     |      | MILLIMETER |     |      |
|------------------|------------|----------|-----|------|------------|-----|------|
|                  |            | MIN      | NCM | MAX  | MIN        | NCM | MAX  |
| TOTAL THICKNESS  | A          | .053     |     | .069 | 1.35       |     | 1.75 |
| STAND OFF        | A1         | .004     |     | .010 | 0.10       |     | 0.25 |
| MOLD THICKNESS   | A2         | .049     |     | -    | 1.25       |     | -    |
| LEAD WIDTH       | b          | .014     |     | .019 | 0.35       |     | 0.49 |
| L/F THICKNESS    | C          | .007     |     | .010 | 0.19       |     | 0.25 |
| BODY SIZE        | D          | .189     |     | .197 | 4.80       |     | 5.00 |
|                  | E1         | .150     |     | .157 | 3.80       |     | 4.00 |
|                  | E          | .228     |     | .244 | 5.80       |     | 6.20 |
| LEAD PITCH       | e          | .050 BSC |     |      | 1.27 BSC   |     |      |
|                  | L          | .015     |     | .049 | 0.40       |     | 1.25 |
|                  | h          | .010     |     | .020 | 0.25       |     | 0.50 |
|                  | $\theta$   | 0°       |     | 7°   | 0°         |     | 7°   |
|                  | $\theta 1$ | 5°       |     | 15°  | 5°         |     | 15°  |
|                  | $\theta 2$ | 2°       | 7°  | 12°  | 2°         | 7°  | 12°  |
| LEAD EDGE OFFSET | $\infty 0$ | .010     |     |      | 0.25       |     |      |
| LEAD OFFSET      | bbb        | .010     |     |      | 0.25       |     |      |
| COPLANARITY      | CCC        | .004     |     |      | 0.10       |     |      |



## SOP8

Unit: mm

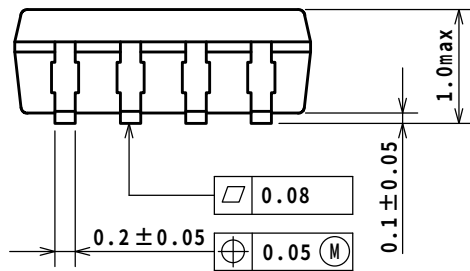
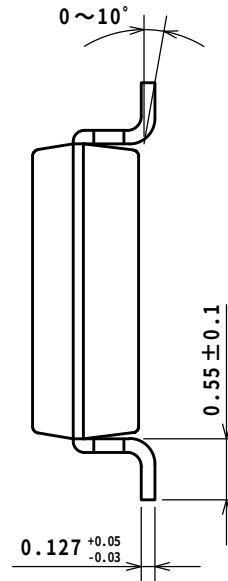
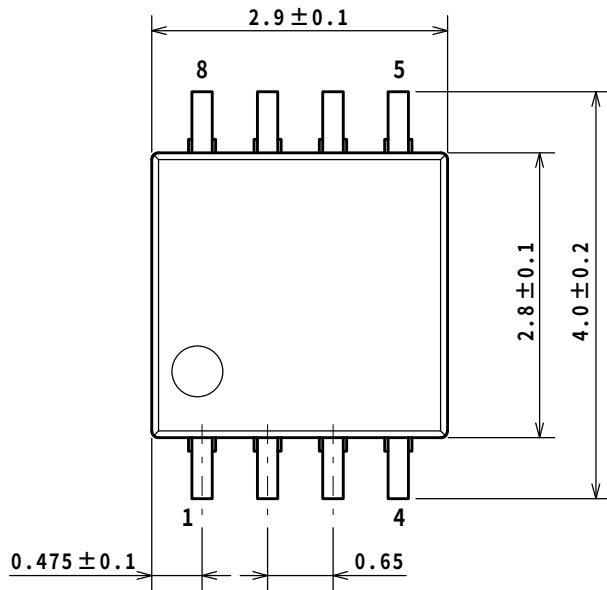
### ■ EXAMPLE OF SOLDER PADS DIMENSIONS



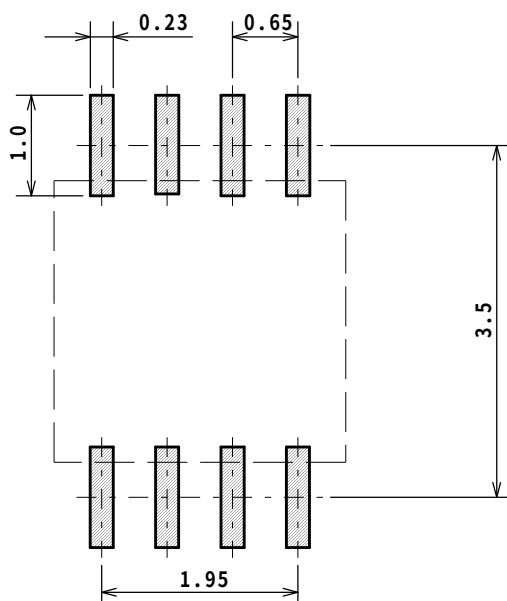
## MSOP8 (TVSP8) JEDEC MO-187-DA/THIN TYPE

Unit: mm

### ■ PACKAGE DIMENSIONS



### ■ EXAMPLE OF SOLDER PADS DIMENSIONS

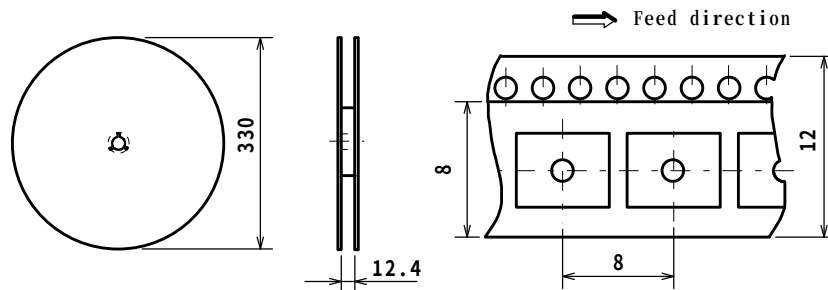


## SOP8

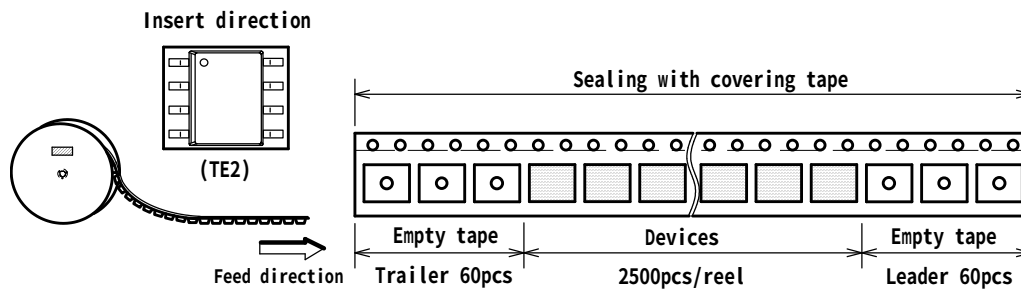
### ■ PACKING SPEC

Unit: mm

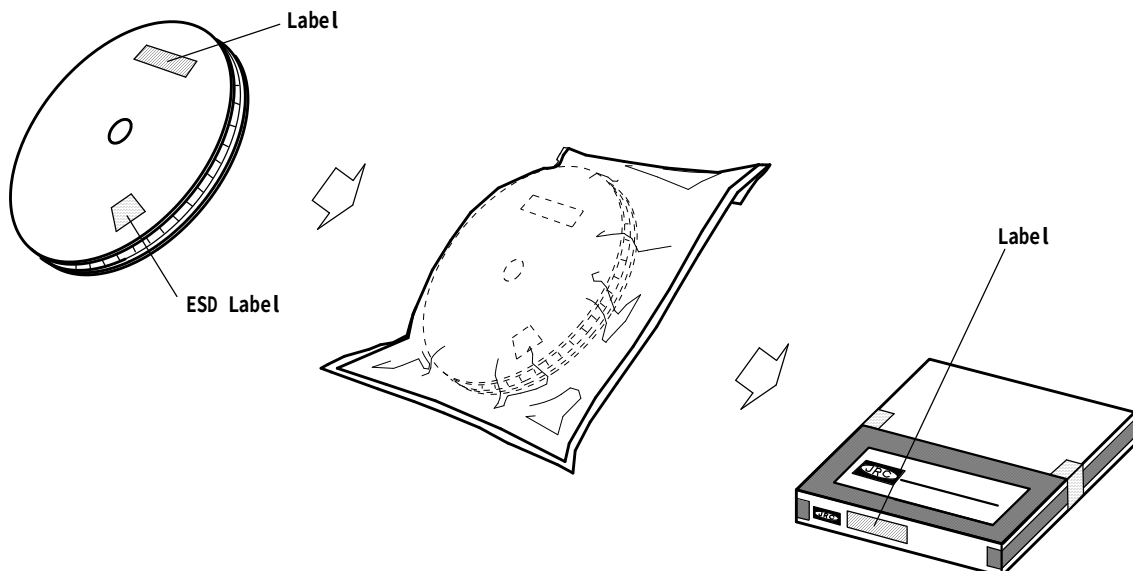
#### REEL DIMENSIONS / TAPING DIMENSIONS



#### TAPING STATE



#### PACKING STATE

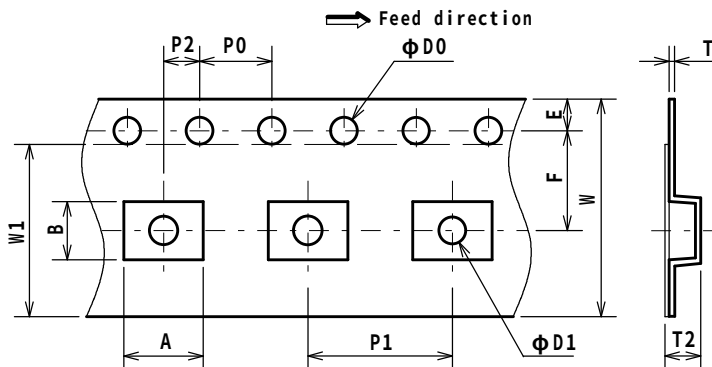


## MSOP8 (TVSP8) MEET JEDEC MO-187-DA/THIN TYPE

### PACKING SPEC

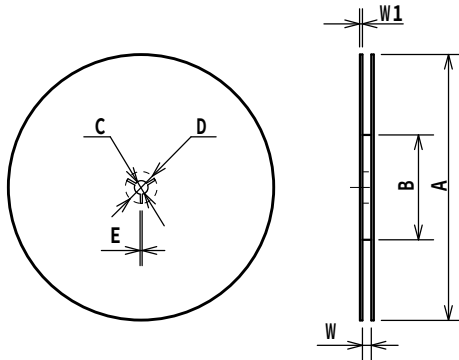
Unit: mm

#### TAPING DIMENSIONS



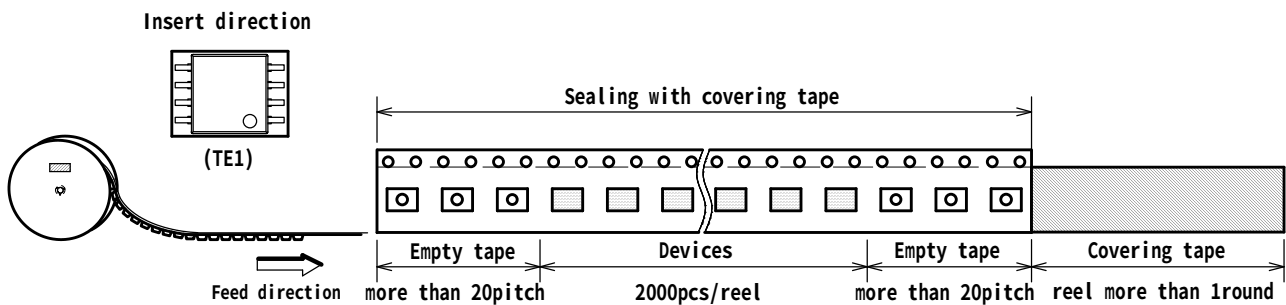
| SYMBOL | DIMENSION             | REMARKS          |
|--------|-----------------------|------------------|
| A      | 4.4                   | BOTTOM DIMENSION |
| B      | 3.2                   | BOTTOM DIMENSION |
| D0     | $1.5^{+0.1}_0$        |                  |
| D1     | $1.5^{+0.1}_0$        |                  |
| E      | $1.75 \pm 0.1$        |                  |
| F      | $5.5 \pm 0.05$        |                  |
| P0     | $4.0 \pm 0.1$         |                  |
| P1     | $8.0 \pm 0.1$         |                  |
| P2     | $2.0 \pm 0.05$        |                  |
| T      | $0.30 \pm 0.05$       |                  |
| T2     | $1.75 \text{ (MAX.)}$ |                  |
| W      | $12.0 \pm 0.3$        |                  |
| W1     | 9.5                   | THICKNESS 0.1max |

#### REEL DIMENSIONS

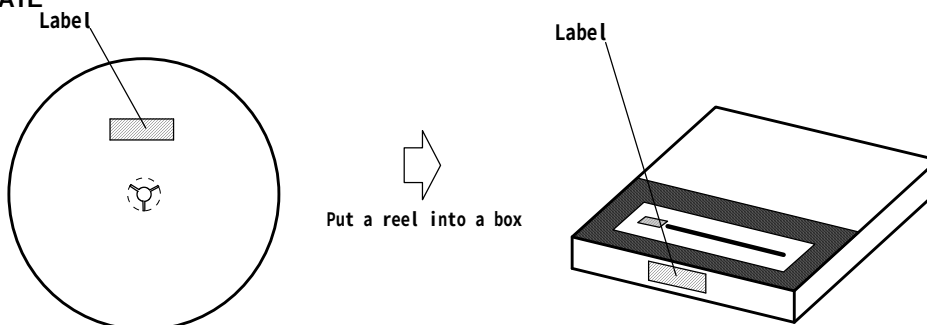


| SYMBOL | DIMENSION         |
|--------|-------------------|
| A      | $\phi 254 \pm 2$  |
| B      | $\phi 100 \pm 1$  |
| C      | $\phi 13 \pm 0.2$ |
| D      | $\phi 21 \pm 0.8$ |
| E      | $2 \pm 0.5$       |
| W      | $13.5 \pm 0.5$    |
| W1     | $2.0 \pm 0.2$     |

#### TAPING STATE

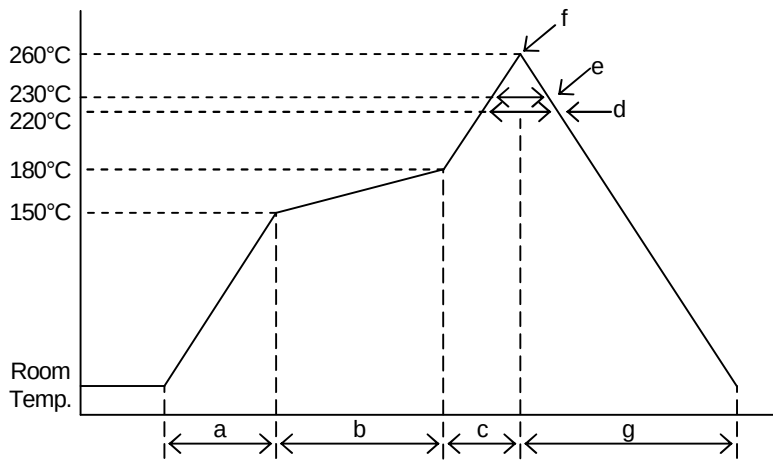


#### PACKING STATE



## ■ RECOMMENDED MOUNTING METHOD

### INFRARED REFLOW SOLDERING PROFILE



|   |                          |                  |
|---|--------------------------|------------------|
| a | Temperature ramping rate | 1 to 4°C/s       |
| b | Pre-heating temperature  | 150 to 180°C     |
|   | Pre-heating time         | 60 to 120s       |
| c | Temperature ramp rate    | 1 to 4°C/s       |
| d | 220°C or higher time     | shorter than 60s |
| e | 230°C or higher time     | shorter than 40s |
| f | Peak temperature         | lower than 260°C |
| g | Temperature ramping rate | 1 to 6°C/s       |

The temperature indicates at the surface of mold package.

**[ CAUTION ]**

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The introduction of external contaminants (e.g. dust, oil or cosmetics) can result in failures of semiconductor products.
4. NJR offers a variety of semiconductor products intended for particular applications. It is important that you select the proper component for your intended application. You may contact NJR's Sale's Office if you are uncertain about the products listed in this datasheet.
5. Special care is required in designing devices, machinery or equipment which demand high levels of reliability. This is particularly important when designing critical components or systems whose failure can foreseeably result in situations that could adversely affect health or safety. In designing such critical devices, equipment or machinery, careful consideration should be given to amongst other things, their safety design, fail-safe design, back-up and redundancy systems, and diffusion design.
6. The products listed in this datasheet may not be appropriate for use in certain equipment where reliability is critical or where the products may be subjected to extreme conditions. You should consult our sales office before using the products in any of the following types of equipment.
  - Aerospace Equipment
  - Equipment Used in the Deep Sea
  - Power Generator Control Equipment (Nuclear, steam, hydraulic, etc.)
  - Life Maintenance Medical Equipment
  - Fire Alarms / Intruder Detectors
  - Vehicle Control Equipment (Airplane, railroad, ship, etc.)
  - Various Safety Devices
7. NJR's products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. NJR shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products. The products are sold without warranty of any kind, either express or implied, including but not limited to any implied warranty of merchantability or fitness for a particular purpose.
8. Warning for handling Gallium and Arsenic (GaAs) Products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
9. The product specifications and descriptions listed in this datasheet are subject to change at any time, without notice.



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