

## Single Channel Low power Comparator

### FEATURES ( $V^+=5V$ , $V^-=0V$ , $T_a=25^\circ C$ )

- Guaranteed Temperature: -40 to +125
- Input Offset Voltage: 3mV max.
- Supply Current: 0.5mA max.
- Operating Voltage: +2V to +36V or  $\pm 1V$  to  $\pm 18V$
- Integrated EMI filter
- Low-level Output Voltage: 80mV typ. ( $I_{sink} = 4mA$ )
- Response Time: 1.3 $\mu s$  typ.
- Open Collector Output
- GND sensing
- Internal ESD protection: Human Body Model  $\pm 2000V$  typ.
- Package:
  - NJM8190: SOT-23-5, SC-88A
  - NJM8191: SOT-23-5, SC-88A, DFN6-G1(ESON6-G1)

### GENERAL DESCRIPTION

The NJM8190/NJM8191 are single comparators designed specifically to operate wide range of supply voltage and temperature.

These comparators featured low input offset voltage of 3mV max. low supply current of 0.5mA max. DC characteristics are also 100% tested and guaranteed from -40 to 125.

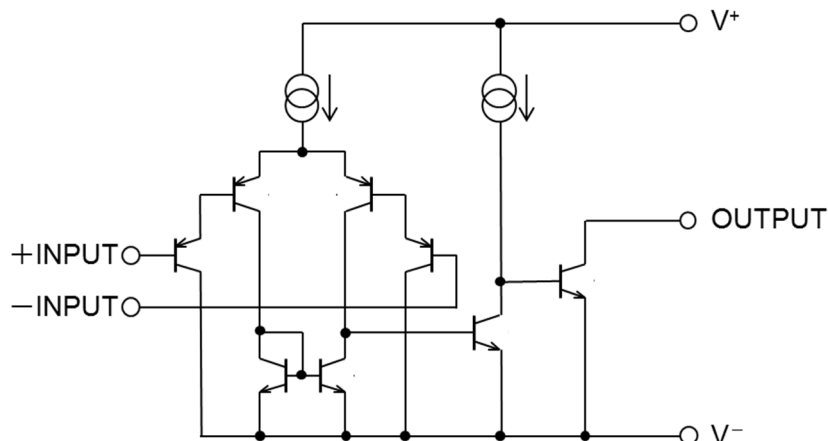
The NJM8190/NJM8191 are available in DFN6-G1(1616) of small size Package, significantly reducing the required portable application's board area.

### PIN CONFIGURATION

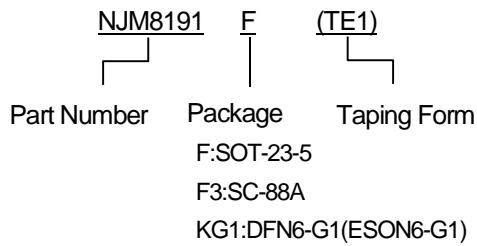
| Parts Number    | NJM8190F | NJM8190F3 | NJM8191F | NJM8191F3 | NJM8191KG1 |
|-----------------|----------|-----------|----------|-----------|------------|
| Package Outline | SOT-23-5 | SC-88A    | SOT-23-5 | SC-88A    | DFN6-G1(*) |
| Pin Function    |          |           |          |           |            |

(\*)Connect to exposed pad to  $V^-$

### EQUIVALENT CIRCUIT



## ■PRODUCT NAME INFORMATION



## ■ORDERING INFORMATION

| PART NUMBER | PACKAGE OUTLINE | RoHS | HALOGEN-FREE | TERMINAL FINISH | MARKING | WEIGHT (mg) | MOQ (pcs) |
|-------------|-----------------|------|--------------|-----------------|---------|-------------|-----------|
| NJM8190F    | SOT-23-5        | yes  | yes          | Sn2Bi           | A5V     | 15          | 3,000     |
| NJM8190F3   | SC-88A          | yes  | yes          | Sn2Bi           | 2A      | 7.5         | 3,000     |
| NJM8191F    | SOT-23-5        | yes  | yes          | Sn2Bi           | A5U     | 15          | 3,000     |
| NJM8191F3   | SC-88A          | yes  | yes          | Sn2Bi           | 29      | 7.5         | 3,000     |
| NJM8191KG1  | DFN6-G1         | yes  | yes          | Sn2Bi           | 8191    | 3.5         | 3,000     |

## ■ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                    | SYMBOL      | RATINGS                   | UNIT             |
|--|-------------|---------------------------|------------------|
| Supply Voltage                               | $V^+ - V^-$ | 36                        | V                |
| Differential Input Voltage                   | $V_{ID}$    | $\pm 36$                  | V                |
| Input Voltage <sup>(1)</sup>                 | $V_{IN}$    | $V^- - 0.3$ to $V^+ + 36$ | V                |
| Output Terminal Input Voltage <sup>(2)</sup> | $V_o$       | $V^- - 0.3$ to $V^+ + 36$ | V                |
| Short-Circuit Output Current to $V^{-(3)}$   |             | Infinite                  |                  |
| Power Dissipation( $T_a=25^\circ$ )          | $P_D$       | (2-layer / 4-layer)       | mW               |
| SOT-23-5 <sup>(4)</sup>                      |             | 480 / 650                 |                  |
| SC-88A <sup>(4)</sup>                        |             | 360 / 490                 |                  |
| DFN6-G1(ESON6-G1) <sup>(5)</sup>             |             | 330 / 1200                |                  |
| Junction Temperature                         | $T_{jmax}$  | +150                      | $^\circ\text{C}$ |
| Storage Temperature Range                    | $T_{stg}$   | - 55 to +150              | $^\circ\text{C}$ |

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

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

(3) Short-circuits from the output to  $V^+$  can cause excessive heating and potential destruction.

(4) Short-circuit can cause excessive heating and destructive dissipation. Values are typical.

(5) Mounted on glass epoxy board. (76.2x114.3x1.6mm:based on EIA/JDEC standard, 2Layers FR4)

Mounted on glass epoxy board. (76.2x114.3x1.6mm:based on EIA/JDEC standard, 4Layers FR4), internal Cu area: 74.2 x 74.2mm

(6) Mounted on glass epoxy board. (101.5x114.5x1.6mm: based on EIA/JEDEC standard, 2Layers FR-4, with Exposed Pad)

Mounted on glass epoxy board. (101.5x114.5x1.6mm: based on EIA/JEDEC standard, 4Layers FR-4, with Exposed Pad)

\*For 4Layers: Applying 99.5x99.5mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5

## ■ THERMAL CHARACTERISTICS

| PARAMETER   | SYMBOL        | VALUE  | UNIT                          |
|---|---------------|--|-------------------------------|
| Junction-to-ambient thermal resistance<br>SOT-23-5 <sup>(7)</sup><br>SC-88A <sup>(7)</sup><br>DFN6-G1(ESON6-G1) <sup>(8)</sup>                | $\theta_{ja}$ | (2-layer / 4-layer)<br>260 / 195<br>355 / 260<br>385 / 110 | $^{\circ}\text{C} / \text{W}$ |
| Junction-to-Top of package characterization parameter<br>SOT-23-5 <sup>(7)</sup><br>SC-88A <sup>(7)</sup><br>DFN6-G1(ESON6-G1) <sup>(8)</sup> | $\psi_{jt}$   | (2-layer / 4-layer)<br>68 / 58<br>91 / 74<br>65 / 26       | $^{\circ}\text{C} / \text{W}$ |

(7) Mounted on glass epoxy board. (76.2x114.3x1.6mm:based on EIA/JDEC standard, 2Layers FR4)

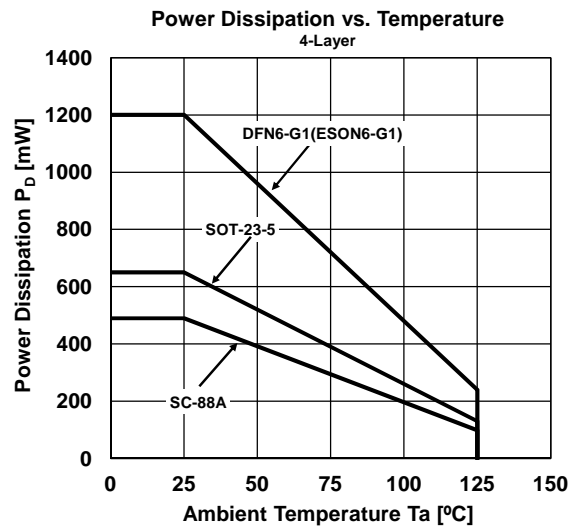
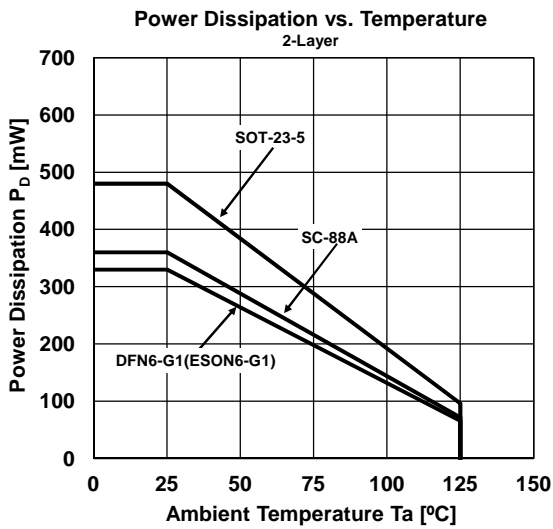
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\*For 4Layers: Applying 99.5x99.5mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5

## ■ POWER DISSIPATION vs. AMBIENT TEMPERATURE



## ■ RECOMMENDED OPERATING CONDITIONS

| PARAMETER                     | SYMBOL      | RATINGS      | UNIT               |
|-------------------------------|-------------|--------------|--------------------|
| Supply Voltage                | $V^+ - V^-$ | 2 to 36      | V                  |
| Operating Ambient Temperature | $T_{opr}$   | - 40 to +125 | $^{\circ}\text{C}$ |

## ■ ELECTRICAL CHARACTERISTICS

(Unless otherwise specified,  $V^+=5V$ ,  $V^-=0V$ ,  $R_L=OPEN$ ,  $T_a=25$  )

| PARAMETER                                       | SYMBOL       | TEST CONDITION   | MIN | TYP. | MAX.      | UNIT    |
|---|--------------|--|-----|------|-----------|---------|
| Input Offset Voltage <sup>(1)</sup>             | $V_{IO}$     | $T_a=25$   | -   | 0.5  | 3         | mV      |
|   |              | $T_a=-40$ to 125   | -   | -    | 4         | mV      |
| Input Offset Current                            | $I_{IO}$     | $T_a=25$   | -   | 0.5  | 50        | nA      |
|   |              | $T_a=-40$ to 125   | -   | -    | 150       |         |
| Input Bias Current <sup>(2)</sup>               | $I_B$        | $T_a=25$   | -   | 20   | 250       |         |
|   |              | $T_a=-40$ to 125   | -   | -    | 400       |         |
| Common Mode Input Voltage                       | $V_{ICM}$    | $V^+=30V$ , $T_a=25$   | 0   | -    | $V^+-1.5$ | V       |
|   |              | $V^+=30V$ , $T_a=-40$ to 125                                       | 0   | -    | $V^+-2.0$ |         |
| Open-Loop Voltage Gain                          | $A_V$        | $V^+=15V$ , $R_L=15k$ ,<br>$V_o=1V$ to 11V                         | 50  | 200  | -         | V/mV    |
| Supply Current                                  | $I_{SUPPLY}$ | $T_a=25$   | -   | 0.3  | 0.5       | mA      |
|   |              | $T_a=-40$ to 125   | -   | -    | 0.9       |         |
|   |              | $V^+=30V$ , $T_a=25$   | -   | 0.4  | 1.2       |         |
|   |              | $V^+=30V$ , $T_a=-40$ to 125                                       | -   | -    | 1.5       |         |
| Differential Input Voltage Range <sup>(3)</sup> | $V_{ID}$     |  | -   | -    | $V^+$     | V       |
| Low-level Output Voltage                        | $V_{OL}$     | $V_{IN+}=0V$ , $V_{IN-}=1V$ , $I_{SINK}=4mA$ ,<br>$T_a=25$         | -   | 80   | 400       | mV      |
|   |              | $V_{IN+}=0V$ , $V_{IN-}=1V$ , $I_{SINK}=4mA$ ,<br>$T_a=-40$ to 125 | -   | -    | 700       |         |
| Output Sink Current                             | $I_{SINK}$   | $V_{IN+}=0V$ , $V_{IN-}=1V$ , $V_o=1.5V$                           | 6   | 16   | -         | mA      |
| Output Leakage Current                          | $I_{LEAK}$   | $V^+=V_o=30V$ , $V_{IN+}=1V$ , $V_{IN-}=0V$ ,<br>$T_a=25$          | -   | 0.1  | -         | nA      |
|   |              | $V^+=V_o=30V$ , $V_{IN+}=1V$ , $V_{IN-}=0V$ ,<br>$T_a=-40$ to 125  | -   | -    | 1         | $\mu A$ |
| Response Time <sup>(4)</sup>                    | $t_{re}$     | $R_L=5.1k$ to $V^+$  | -   | 1.3  | -         | $\mu s$ |
| Large Signal Response Time                      | $t_{RL}$     | $R_L=5.1k$ to $V^+$<br>$V_{ref}=1.4V$ , TTL input                  | -   | 250  | -         | ns      |

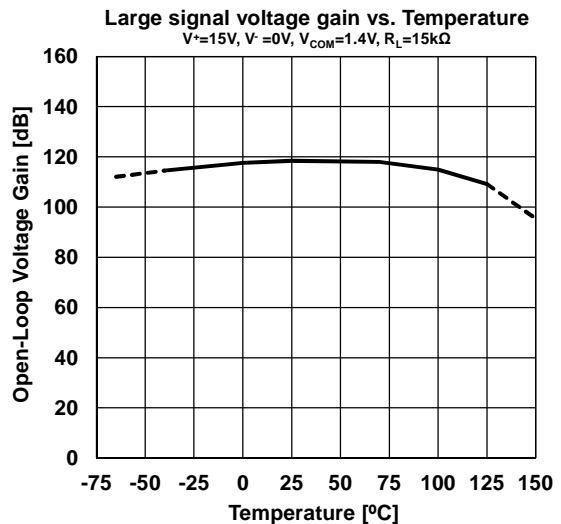
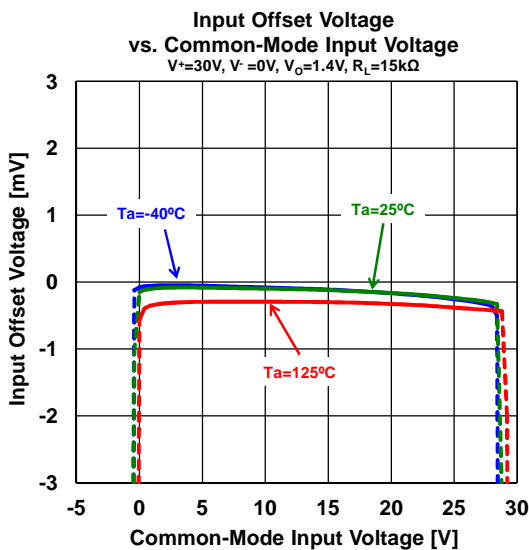
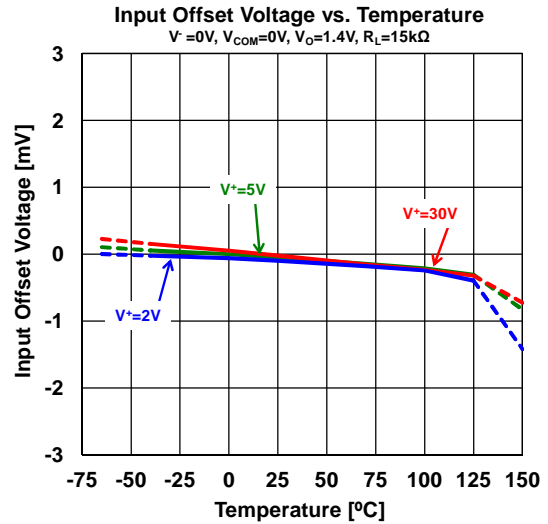
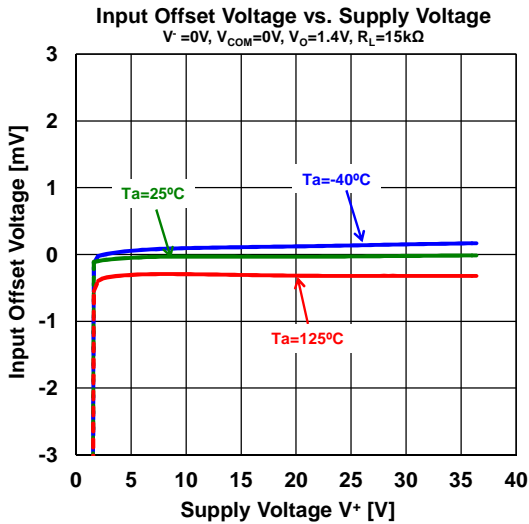
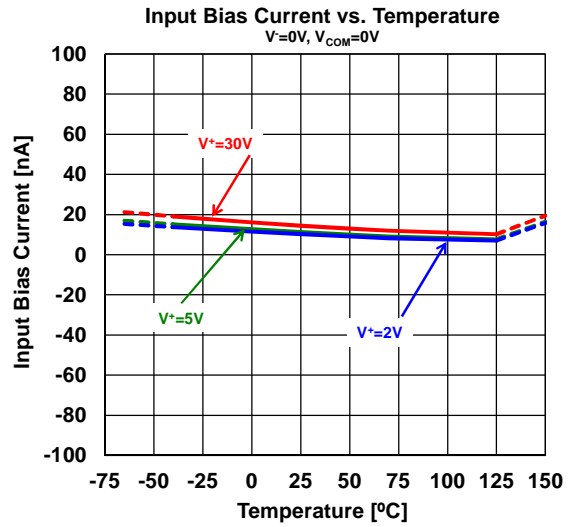
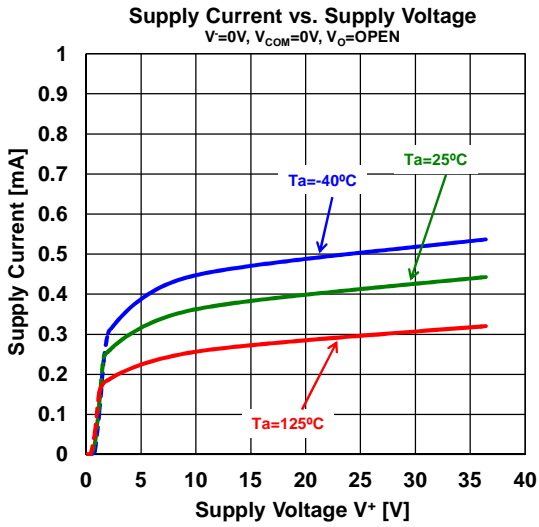
(1)  $V_o=1.4V$ ,  $R_s=0\Omega$ ,  $5V < V^+ < 30V$ ,  $0 < V_{ICM} < (V^+ - 1.5V)$ .

(2) The direction of the input current is out of the IC due to the PNP input stage.

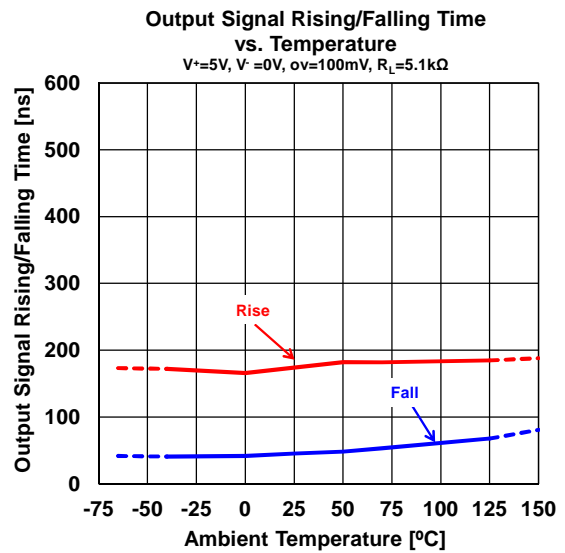
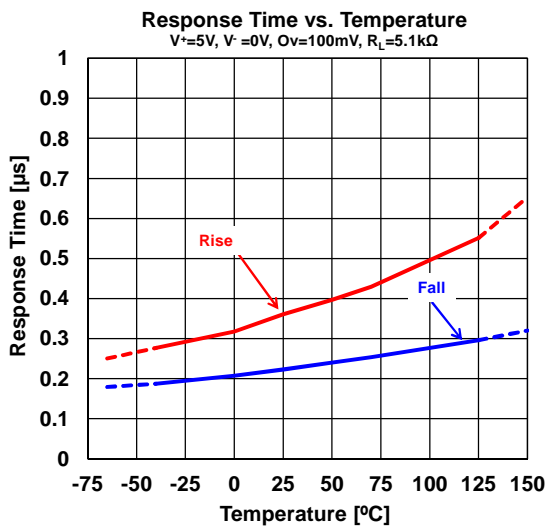
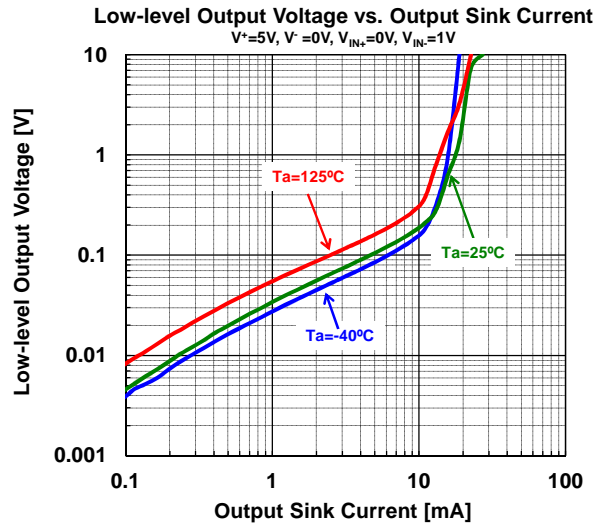
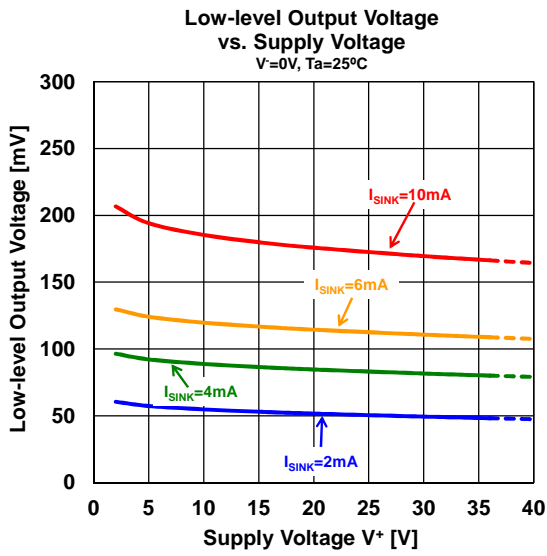
(3) Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage must not be less than -0.3V (or 0.3V below the negative power supply, if used).

(4) The response time specified is for a 100mV input step with 5mV overdrive.

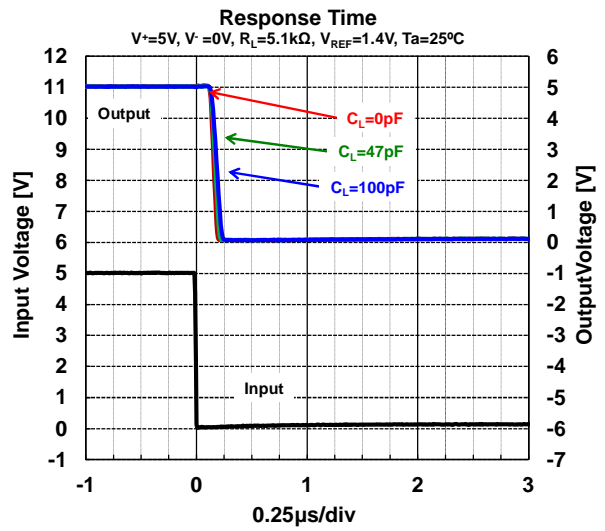
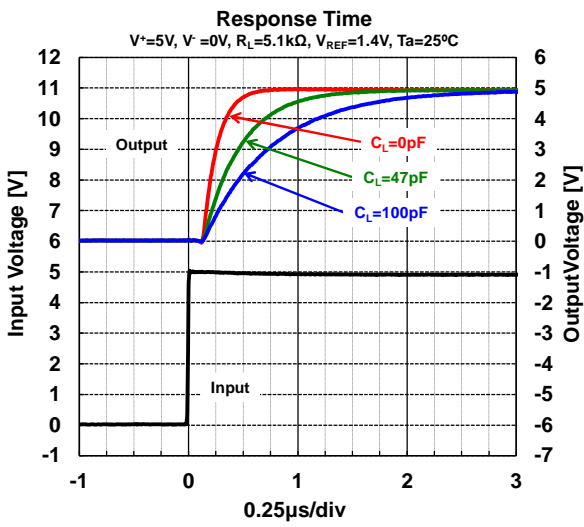
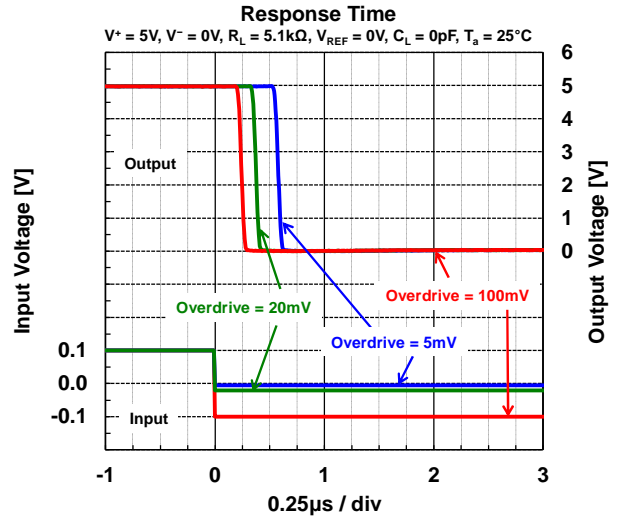
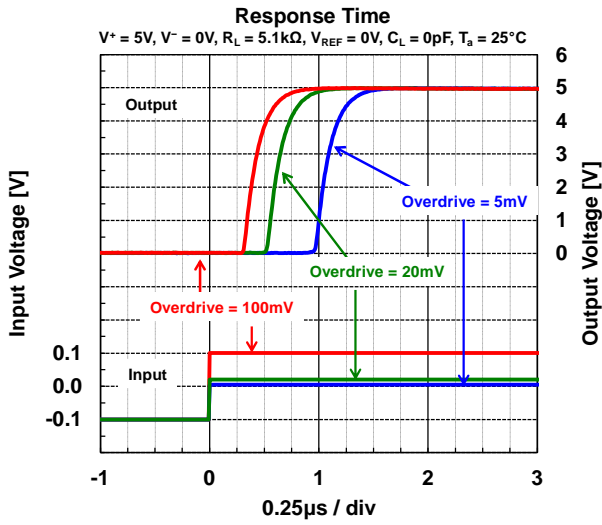
## ■ TYPICAL CHARACTERISTICS



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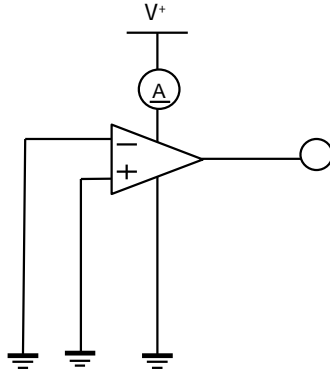
## ■ TYPICAL CHARACTERISTICS



## ■ TYPICAL TEST CIRCUIT

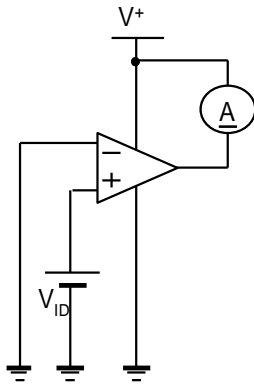
### ● Supply Current ( $I_{SUPPLY}$ )

- $V^+=5V, V^-=0V, T_a=25^\circ C, -40$  to  $125^\circ C$
- $V^+=30V, V^-=0V, T_a=25^\circ C, -40$  to  $125^\circ C$



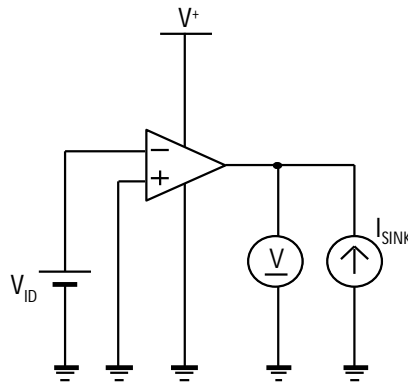
### ● Output Leakage Current ( $I_{LEAK}$ )

- $V^+=30V, V^-=0V, V_{IN+}=1V, V_{IN-}=0V, T_a=25^\circ C, -40$  to  $125^\circ C$



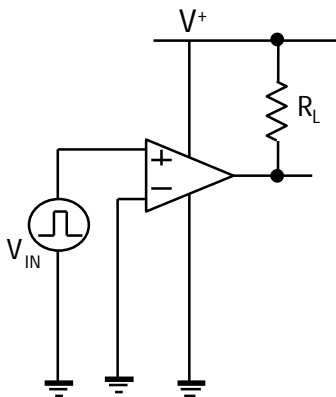
### ● Low-level Output Voltage ( $V_{OL}$ )

- $V^+=5V, V^-=0V, V_{IN+}=0V, V_{IN-}=1V, I_{SINK}=4mA, T_a=25^\circ C, -40$  to  $125^\circ C$

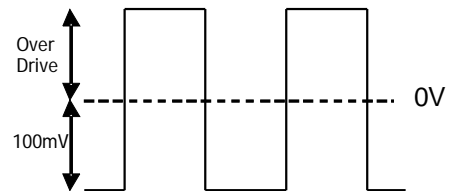


### ● Response Time ( $t_{re}$ )

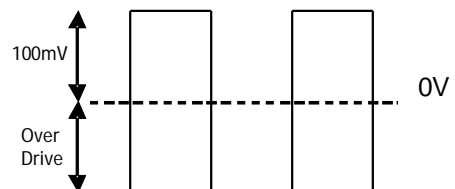
- $V^+=5V, V^-=0V, R_L=5.1k$



Input Wave Form  
(Rise Measurement)



Input Wave Form  
(Fall Measurement)





## ■APPLICATION NOTE

### EMIRR(EMI Rejection Ratio) Definition

EMIRR is a parameter indicating the EMI robustness of an comparator. The definition of EMIRR is given by the following a formula (1). We can grasp the tolerance of the RF signal by measuring an RF signal and offset voltage shift quantity.

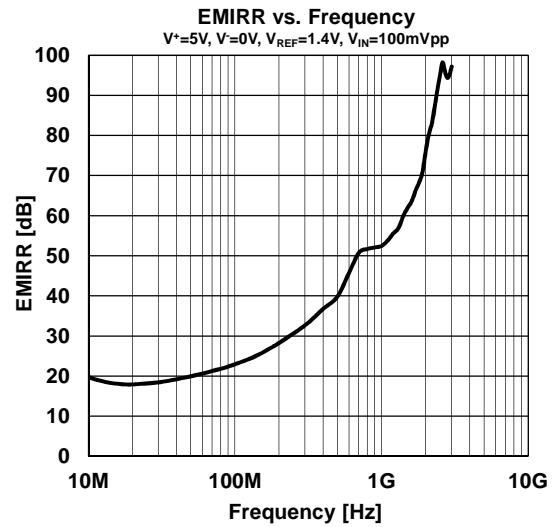
$$EMIRR = 20 \cdot \log \left( \frac{V_{RF\_PEAK}}{|\Delta V_{IO}|} \right) \quad \dots(1)$$

$V_{RF\_PEAK}$  : RF Signal Amplitude [ Vp ]

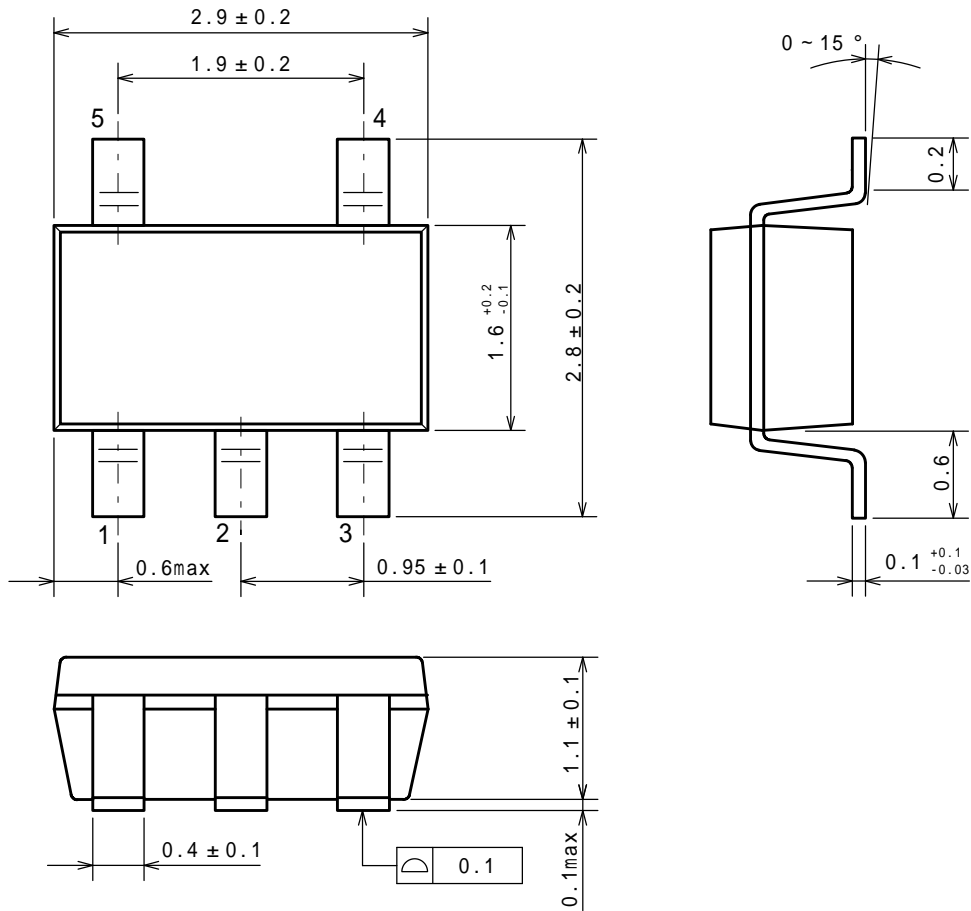
$V_{IO}$  : Input offset voltage shift quantity [ V ]

Offset voltage shift is small so that a value of EMIRR is big. And it understands that the tolerance for the RF signal is high. In addition, about the input offset voltage shift with the RF signal, there is the thinking that influence applied to the input terminal is dominant. Therefore, generally the EMIRR becomes value that applied an RF signal to +INPUT terminal.

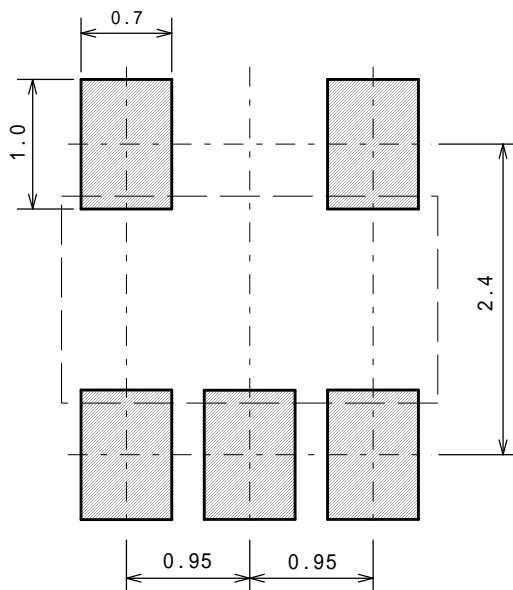
\*For details, refer to " Application Note for EMI Immunity" in our HP: <http://www.njr.com/>



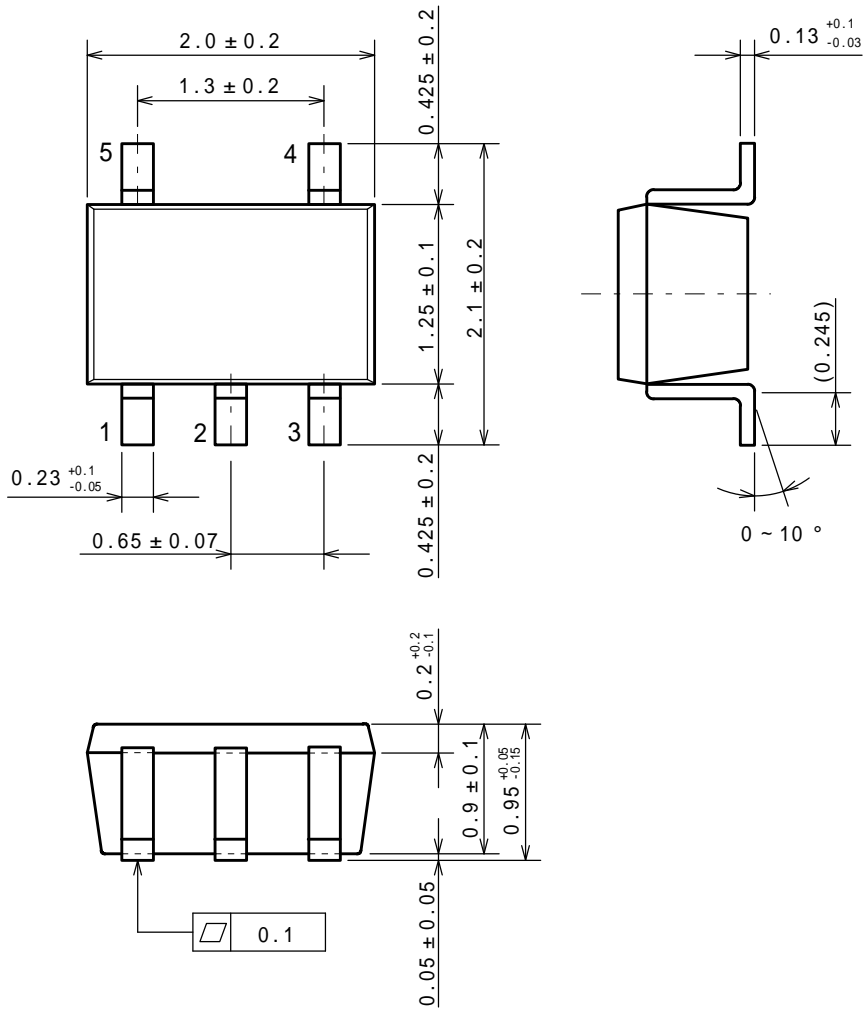
### PACKAGE DIMENSIONS



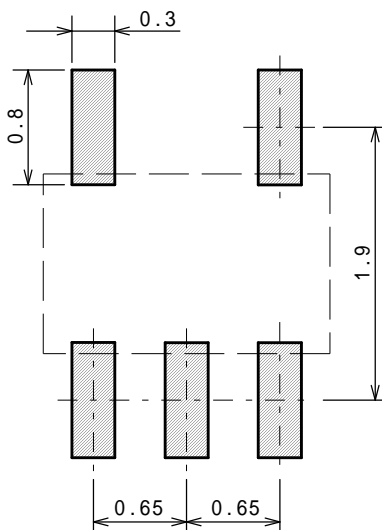
### EXAMPLE OF SOLDER PADS DIMENSIONS



### PACKAGE DIMENSIONS

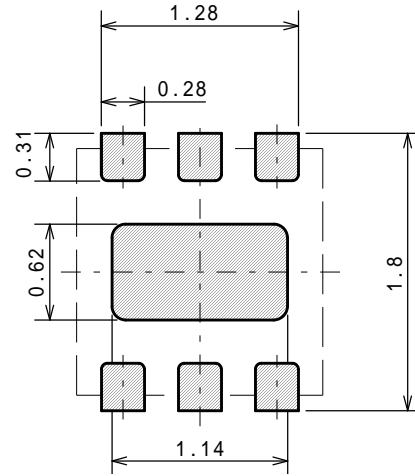
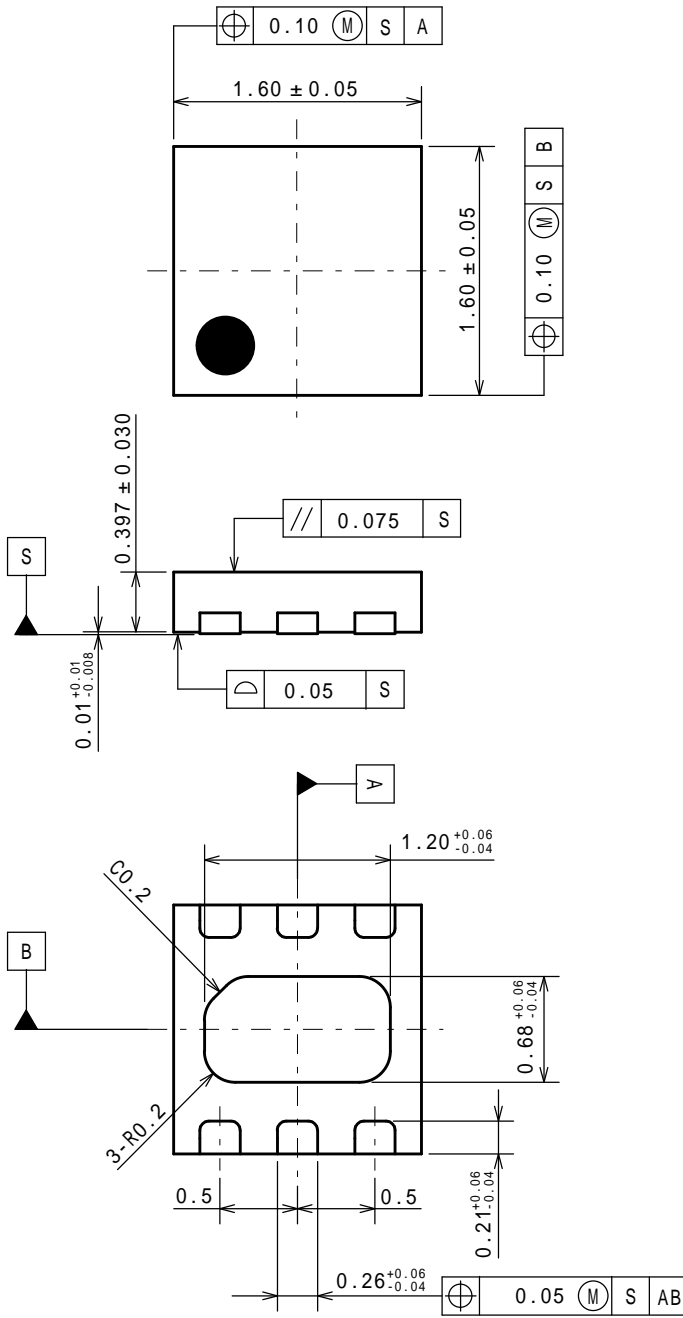


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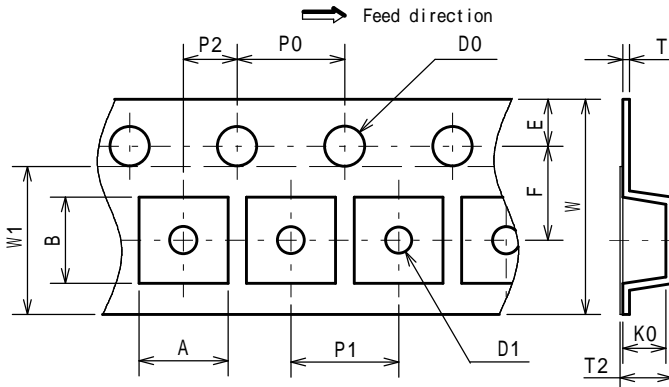
## PACKAGE DIMENSIONS

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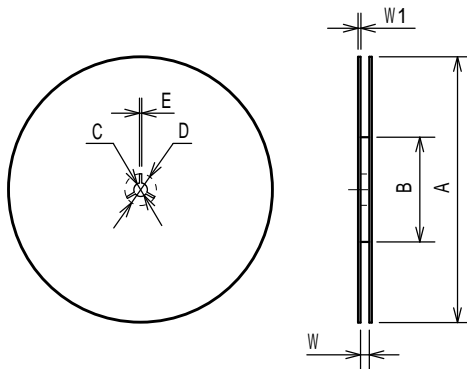
### PACKING SPEC

#### TAPING DIMENSIONS



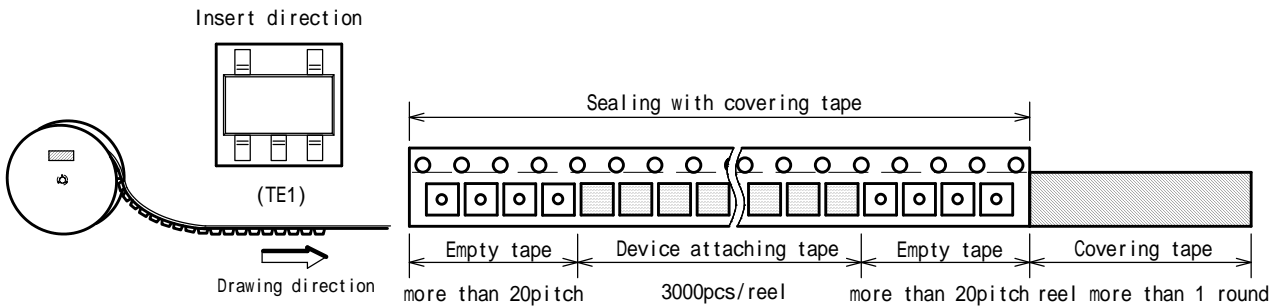
| SYMBOL | DIMENSION       | REMARKS          |
|--------|-----------------|------------------|
| A      | $3.3 \pm 0.1$   | BOTTOM DIMENSION |
| B      | $3.2 \pm 0.1$   | BOTTOM DIMENSION |
| D0     | 1.55            |                  |
| D1     | 1.05            |                  |
| E      | $1.75 \pm 0.1$  |                  |
| F      | $3.5 \pm 0.05$  |                  |
| P0     | $4.0 \pm 0.1$   |                  |
| P1     | $4.0 \pm 0.1$   |                  |
| P2     | $2.0 \pm 0.05$  |                  |
| T      | $0.25 \pm 0.05$ |                  |
| T2     | 1.82            |                  |
| K0     | $1.5 \pm 0.1$   |                  |
| W      | $8.0 \pm 0.3$   |                  |
| W1     | 5.5             | THICKNESS 0.1MAX |

#### REEL DIMENSIONS

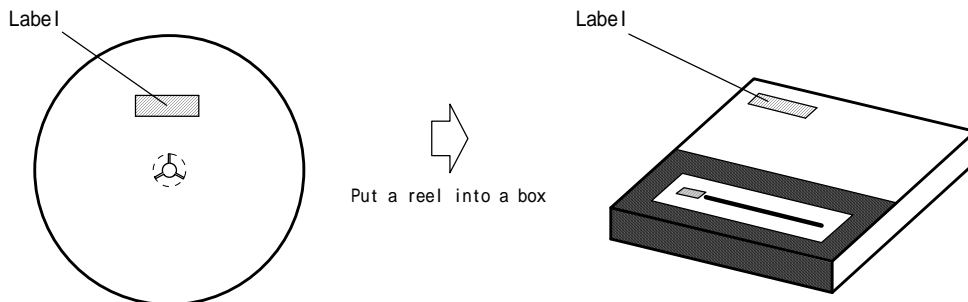


| SYMBOL | DIMENSION     |
|--------|---------------|
| A      | $180 \pm 1$   |
| B      | $60 \pm 1$    |
| C      | $13 \pm 0.2$  |
| D      | $21 \pm 0.8$  |
| E      | $2 \pm 0.5$   |
| W      | $9 \pm 0.5$   |
| W1     | $1.2 \pm 0.2$ |

#### TAPING STATE

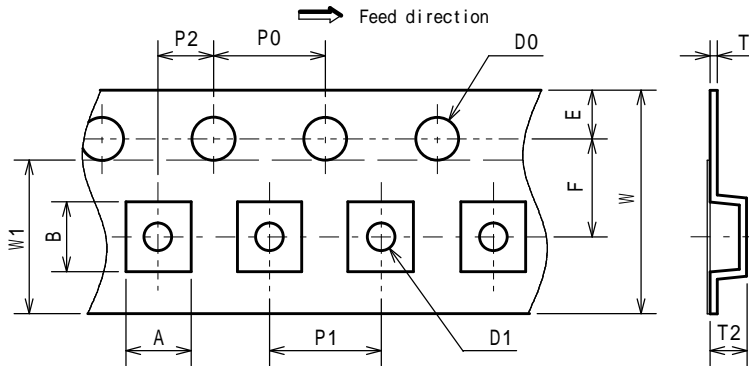


#### PACKING STATE



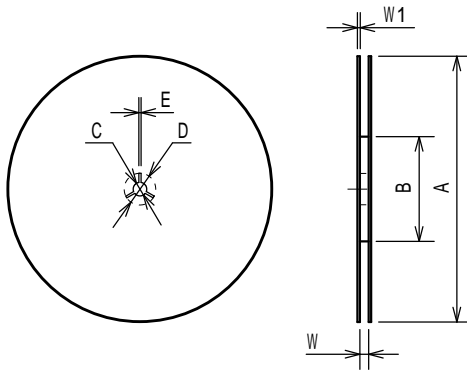
### PACKING SPEC

#### TAPING DIMENSIONS



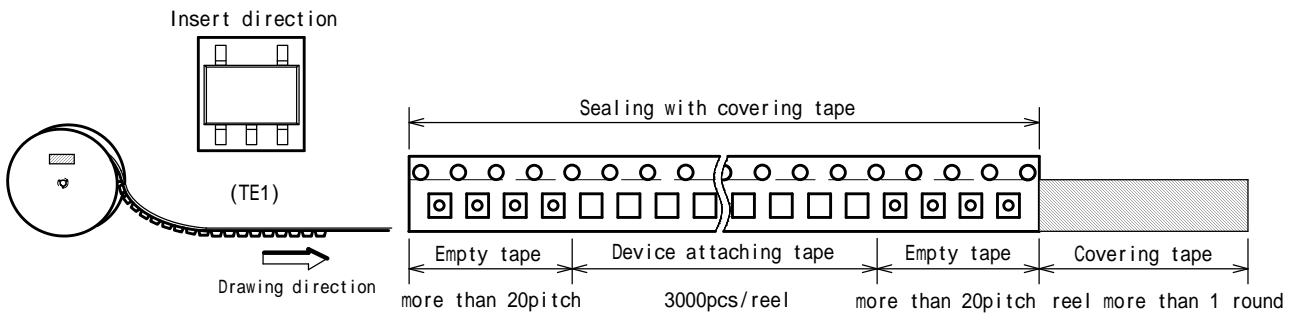
| SYMBOL | DIMENSION   | REMARKS          |
|--------|-------------|------------------|
| A      | 2.3 ± 0.1   | BOTTOM DIMENSION |
| B      | 2.5 ± 0.1   | BOTTOM DIMENSION |
| D0     | 1.55 ± 0.05 |                  |
| D1     | 1.05 ± 0.05 |                  |
| E      | 1.75 ± 0.1  |                  |
| F      | 3.5 ± 0.05  |                  |
| P0     | 4.0 ± 0.1   |                  |
| P1     | 4.0 ± 0.1   |                  |
| P2     | 2.0 ± 0.05  |                  |
| T      | 0.25 ± 0.05 |                  |
| T2     | 1.3 ± 0.1   |                  |
| W      | 8.0 ± 0.2   |                  |
| W1     | 5.5         | THICKNESS 0.1max |

#### REEL DIMENSIONS

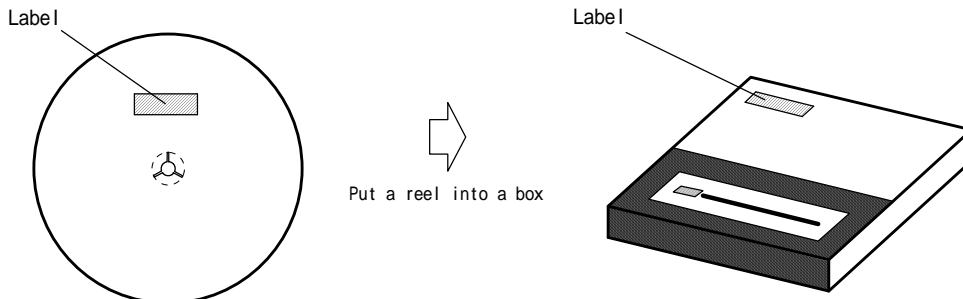


| SYMBOL | DIMENSION |
|--------|-----------|
| A      | 180 ± 1   |
| B      | 60 ± 1    |
| C      | 13 ± 0.2  |
| D      | 21 ± 0.8  |
| E      | 2 ± 0.5   |
| W      | 9 ± 0.5   |
| W1     | 1.2 ± 0.2 |

#### TAPING STATE

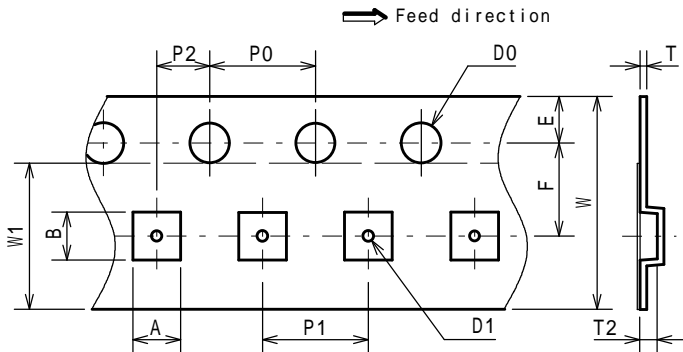


#### PACKING STATE



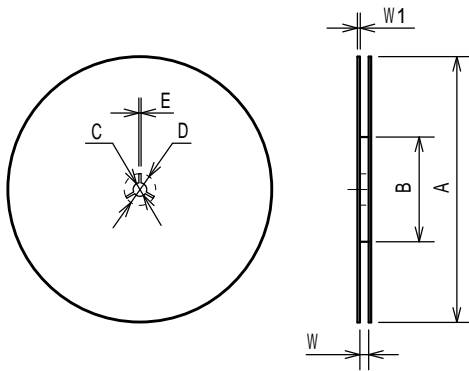
### PACKING SPEC

#### TAPING DIMENSIONS



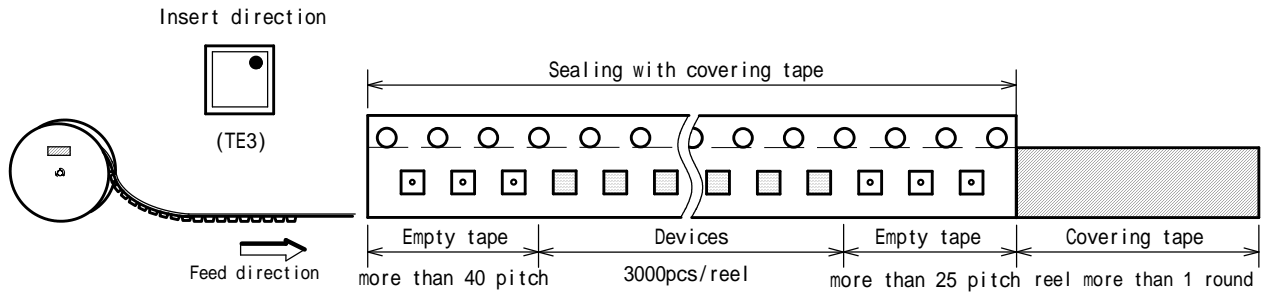
| SYMBOL | DIMENSION                        | REMARKS          |
|--------|----------------------------------|------------------|
| A      | 1.85 ± 0.05                      | BOTTOM DIMENSION |
| B      | 1.85 ± 0.05                      | BOTTOM DIMENSION |
| D0     | 1.5 <sup>+0.1</sup> <sub>0</sub> |                  |
| D1     | 0.5 ± 0.1                        |                  |
| E      | 1.75 ± 0.1                       |                  |
| F      | 3.5 ± 0.05                       |                  |
| P0     | 4.0 ± 0.1                        |                  |
| P1     | 4.0 ± 0.1                        |                  |
| P2     | 2.0 ± 0.05                       |                  |
| T      | 0.25 ± 0.05                      |                  |
| T2     | 0.65 ± 0.05                      |                  |
| W      | 8.0 ± 0.2                        |                  |
| W1     | 5.5                              | THICKNESS 0.1max |

#### REEL DIMENSIONS

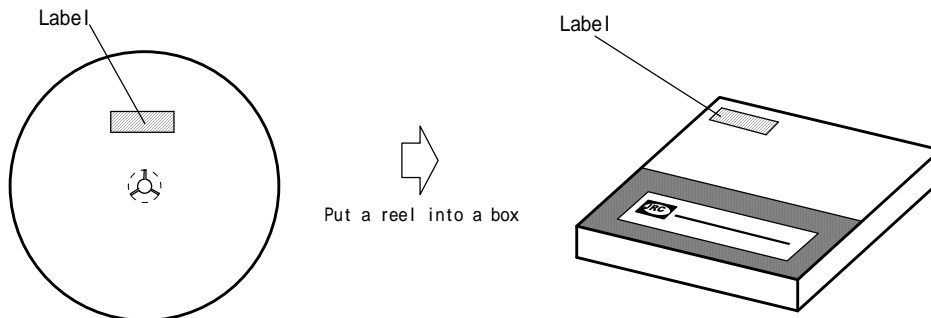


| SYMBOL | DIMENSION                        |
|--------|----------------------------------|
| A      | 180 <sup>0</sup> <sub>-1.5</sub> |
| B      | 60 <sup>+1</sup> <sub>0</sub>    |
| C      | 13 ± 0.2                         |
| D      | 21 ± 0.8                         |
| E      | 2 ± 0.5                          |
| W      | 9 <sup>+0.3</sup> <sub>0</sub>   |
| W1     | 1.2                              |

#### TAPING STATE

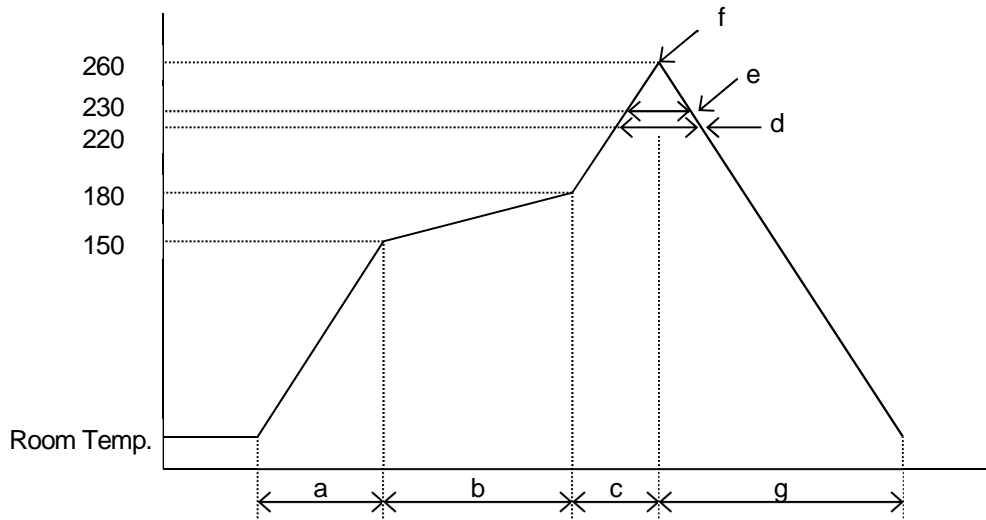


#### PACKING STATE



## RECOMMENDED MOUNTING METHOD

\*Recommended reflow soldering procedure



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

\*The temperature indicates at the surface of mold package.

## REVISION HISTORY

| Date        | Revision | Changes  |
|-------------|----------|--|
| 17.APR.2017 | Ver.1.0  | Initial Version  |
| 26.Feb.2021 | Ver.2.0  | Corrected of response time in typical characteristics. |



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