

Dual Operational Amplifier

FEATURES ($V^+V^-\approx\pm 2.5V$, typical value)

| | |
|--------------------------------------|--------------------------------|
| •Low Noise | 6.5nV/ \sqrt{Hz} |
| •High Slew Rate | 4V/ μs |
| •Wide Bandwidth | 12MHz |
| •Low Distortion | 0.002% |
| •Supply Voltage | |
| Dual Supply | $\pm 1.1V$ to $\pm 3.5V$ |
| Single Supply | 2.2V to 7V |
| •Low Saturation ($R_L=2.5k\Omega$) | $\pm 2.2V$ typ. |
| •Operating Temperature | $-40^\circ C$ to $125^\circ C$ |
| •Bipolar Technology | |
| •Package Outline | DMP8, SSOP8, MSOP8 (TVSP8)* |

*meet JEDEC MO-187-DA / thin type

DESCRIPTION

The NJM2740 is a dual low saturation output operational amplifier featuring low noise of 6.5nV/ \sqrt{Hz} .

It can be used both single supply and dual supply, by using proper bias voltage.

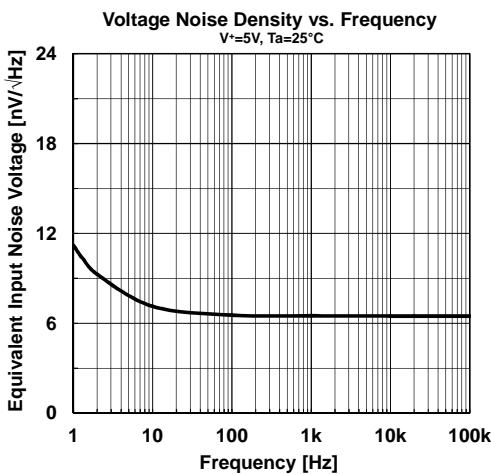
Low operating voltage single 2.2V to 7V or dual $\pm 1.1V$ to $\pm 3.5V$ and low saturation output performance makes NJM2740 suitable for Battery-powered instruments, portable audio devices that require a low voltage and low saturation output.

The NJM2740 is available in 8-pin DMP, SSOP and MSOP(TVSP): meet JEDEC MO-187-DA / thin type package.

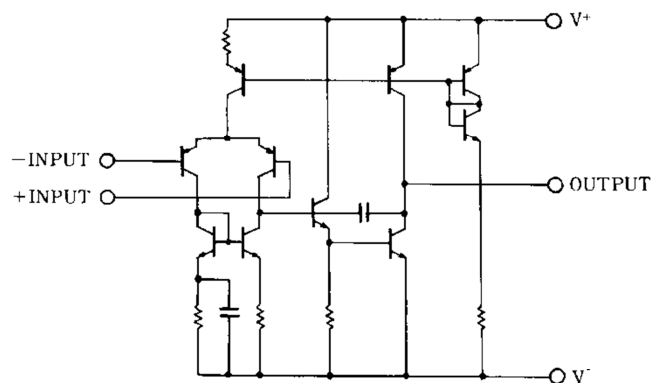
APPLICATIONS

- Portable Audio
- PC Audio
- AD/DA Converter Buffer
- Active Filter

TYPICAL CHARACTERISTICS



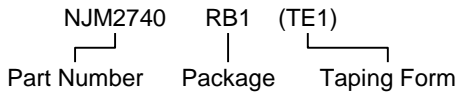
EQUIVALENT CIRCUIT



■ PIN CONFIGURATION

| | | | | |
|--------------|-----------------|-----------------|-------------------|--------------|
| Pin Function | | | | |
| | Package | DMP8 | SSOP8 | MSOP8(TVSP8) |
| Product Name | NJM2740M | NJM2740V | NJM2740RB1 | |

■ PRODUCT NAME INFORMATION



■ ORDER INFORMATION

| Part Number | Package Outline | RoHS | Halogen-Free | Terminal Finish | Marking | Weight (mg) | MOQ (pcs) |
|-------------|-----------------|------|--------------|-----------------|---------|-------------|-----------|
| NJM2740M | DMP8 | ○ | ○ | Sn2Bi | 2740 | 95 | 2000 |
| NJM2740V | SSOP8 | ○ | ○ | Sn2Bi | 2740 | 42 | 2000 |
| NJM2740RB1 | MSOP8(TVSP8) | ○ | ○ | Sn2Bi | 2740 | 18 | 2000 |

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

| PARAMETER | SYMBOL | RATING | UNIT |
|--|--------------------------------|---------------------|------|
| Supply Voltage | V ⁺ /V ⁻ | ±4 | V |
| Input Voltage ⁽¹⁾ | V _{IN} | ±4 | V |
| Differential Input Voltage ⁽¹⁾⁽²⁾ | V _{ID} | ±8 | V |
| Input Current ⁽³⁾ | I _{IN} | 1 | mA |
| Power Dissipation ⁽⁴⁾ | P _D | (2-Layer / 4-Layer) | |
| DMP8 | | 470 / 600 | mW |
| SSOP8 | | 410 / 510 | |
| MSOP8(TVSP8) | | 510 / 680 | |
| Storage Temperature Range | T _{stg} | -40 to +150 | °C |

(1) For supply voltage less than ±4V (8V), the absolute maximum rating is equal to the supply voltage.

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

(3) Input voltages outside the supply voltage will be clamped by ESD protection diodes. If the input voltage exceeds the supply voltage, the input current must be limited 1mA or less by using a restriction resistance.

(4) Power dissipation is the power that can be consumed by the IC at Ta=25°C, and is the typical measured value based on JEDEC condition.

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

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

■ THERMAL CHARACTERISTICS

| Package | SYMBOL | VALUE | UNIT |
|---|---------------|---------------------|------|
| Junction-to-ambient thermal resistance | Θ_{ja} | (2-layer / 4-Layer) | °C/W |
| DMP8 | | 262 / 206 | |
| SSOP8 | | 288 / 230 | |
| TVSP8 | | 244 / 185 | |
| Junction-to-top of package characterization parameter | Ψ_{jt} | (2-layer / 4-Layer) | °C/W |
| DMP8 | | 72 / 65 | |
| SSOP8 | | 46 / 45 | |
| TVSP8 | | 51 / 45 | |

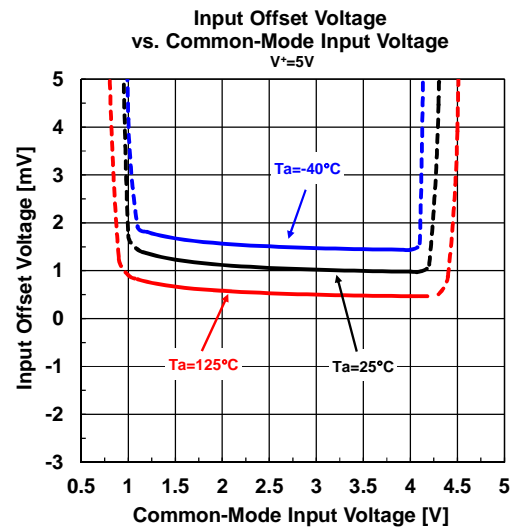
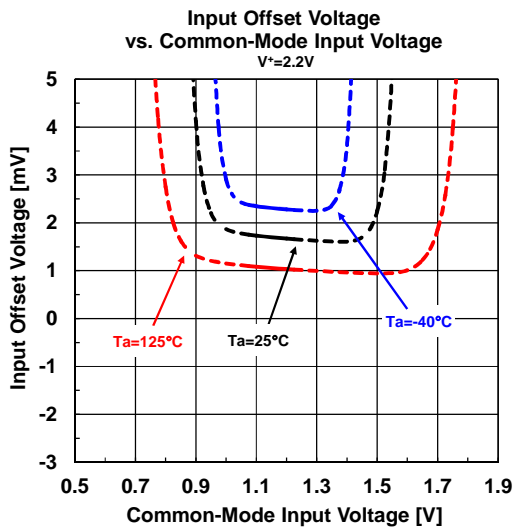
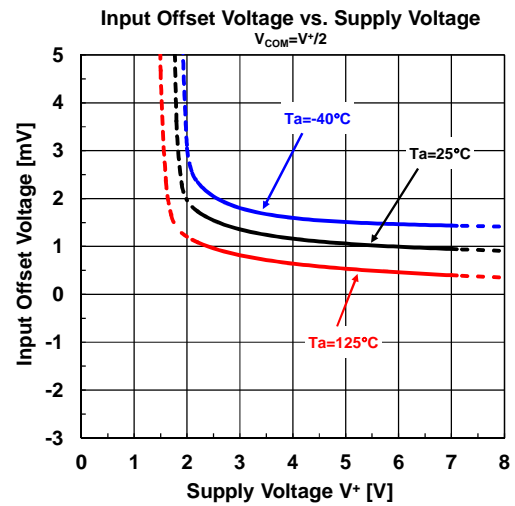
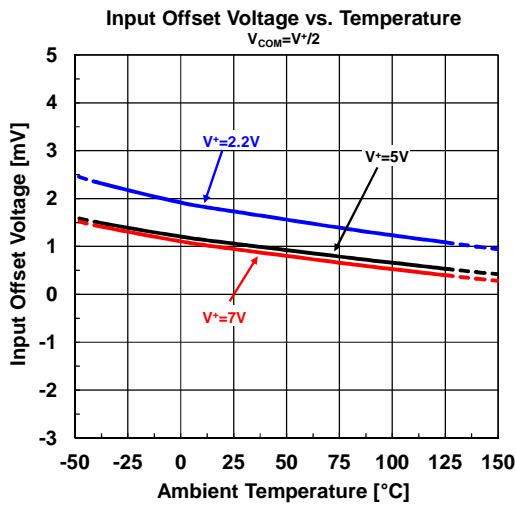
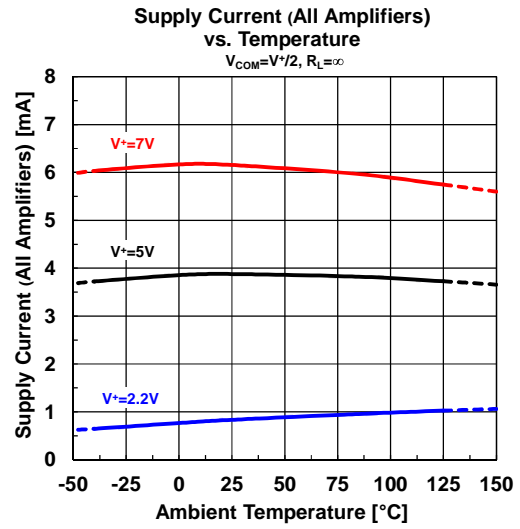
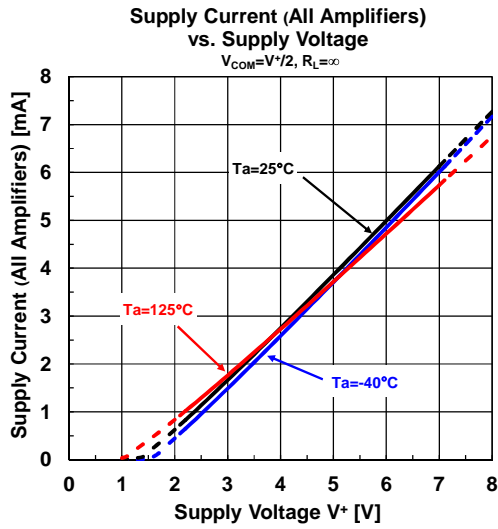
■ RECOMMENDED OPERATING CONDITIONS (Ta=25°C)

| PARAMETER | SYMBOL | VALUE | UNIT |
|------------------------------|-------------|--------------|------|
| Supply Voltage | V^+ / V^- | ±1.1 to ±3.5 | V |
| Dual Supply Single Supply | | 2.2 to 7 | V |
| Operating Temperature Range | T_{opr} | -40 to 125 | °C |

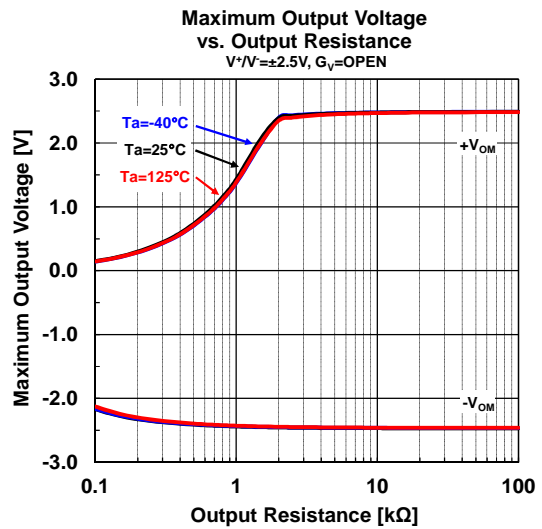
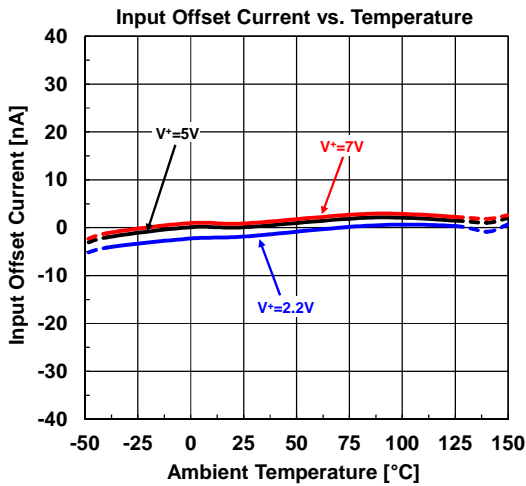
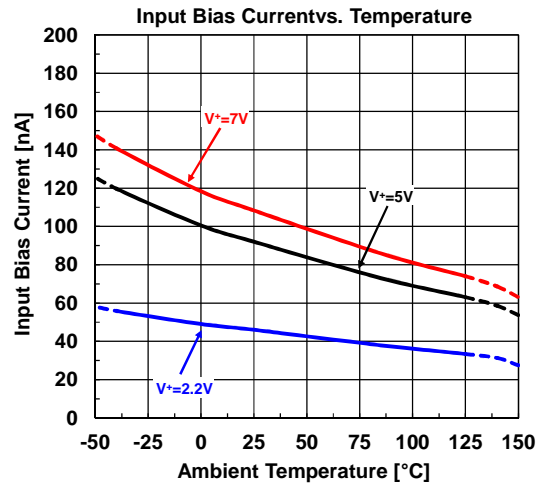
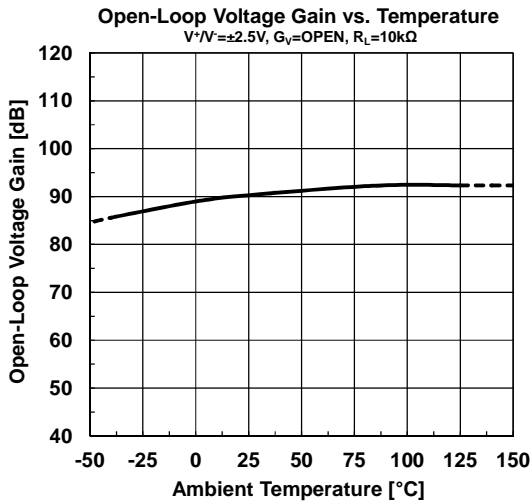
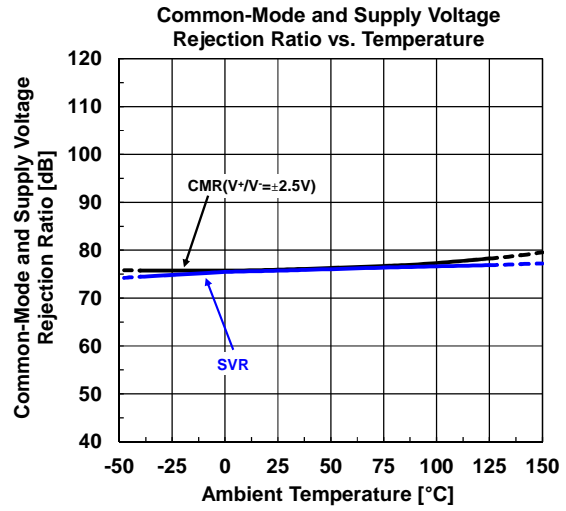
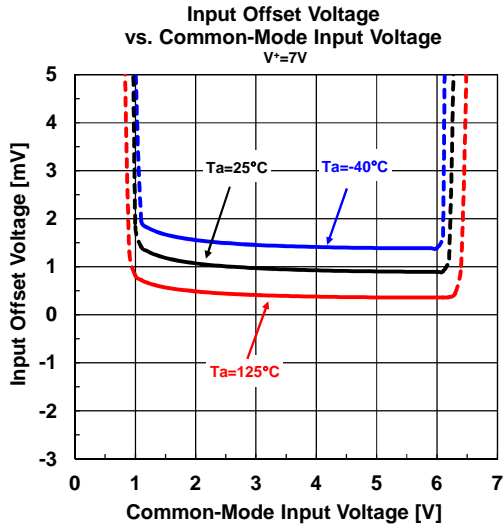
■ ELECTRICAL CHARACTERISTICS (V⁺/V⁻=±2.5V, Ta=25°C)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-----------------------------------|--------------|--------------------------------------|---------------|-------|------|-----------------|
| DC CHARACTERISTICS | | | | | | |
| Input Offset Voltage | V_{IO} | $R_S \leq 10k\Omega$ | - | 1 | 6 | mV |
| Input Bias Current | I_B | | - | 100 | 300 | nA |
| Input Offset Current | I_{IO} | | - | 5 | 100 | nA |
| Open-Loop Voltage Gain | A_V | $R_L \geq 10k\Omega$ | 60 | 80 | - | dB |
| Common-Mode Rejection Ratio | CMR | | 60 | 74 | - | dB |
| Common-Mode Input Voltage Range | V_{ICM} | | -1.4 /+1.5 | - | - | V |
| Maximum Output Voltage | V_{OM} | $R_L \geq 2.5k\Omega$ | ±2 | ±2.2 | - | V |
| Supply Current (All Amplifiers) | I_{SUPPLY} | No Signal, $R_L = \infty$ | - | 3.5 | 5 | mA |
| Supply Voltage Rejection Ratio | SVR | $V^+ / V^- = \pm 1.1V$ to $\pm 3.5V$ | 60 | 80 | - | dB |
| AC CHARACTERISTICS | | | | | | |
| Slew Rate | SR | $A_V = 1, V_{IN} = \pm 1V$ | - | 4 | - | V/ μ s |
| Gain Bandwidth Product | GBW | $f = 10kHz$ | - | 12 | - | MHz |
| Total Harmonic Distortion + Noise | THD+N | $f = 1kHz, V_O = 1V_{rms}$ | - | 0.002 | - | % |
| Equivalent Input Noise Voltage | e_n | $f = 1kHz$ | - | 6.5 | - | nV/ \sqrt{Hz} |

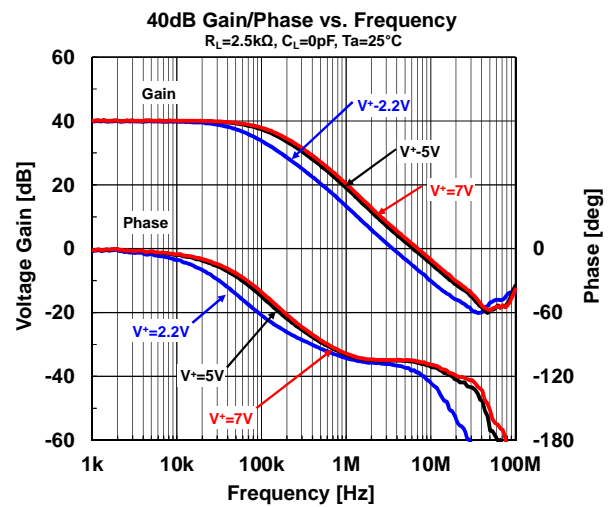
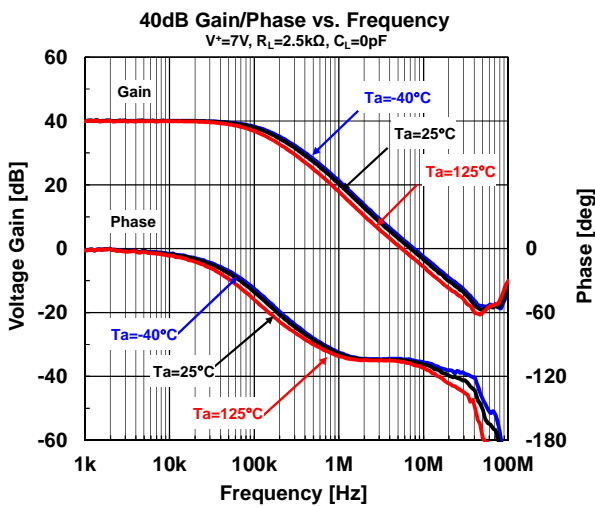
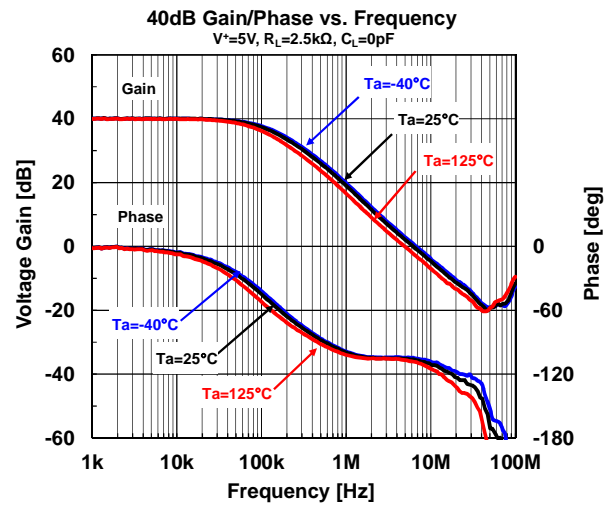
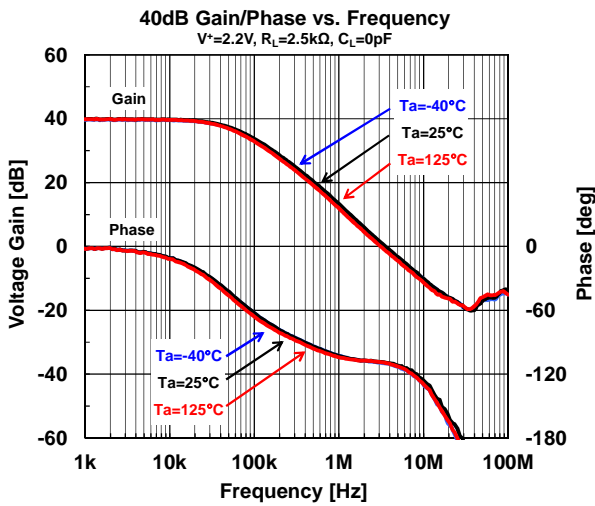
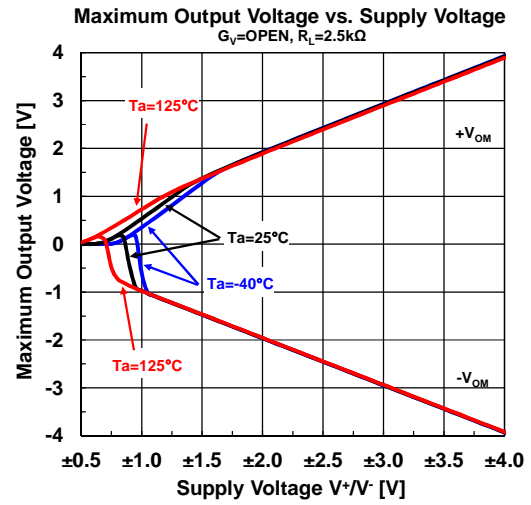
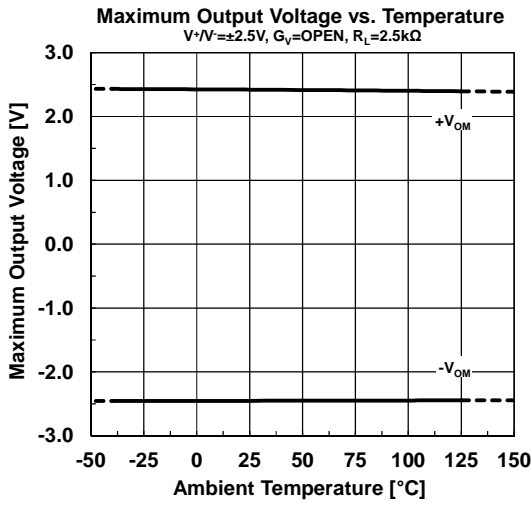
■ TYPICAL CHARACTERISTICS



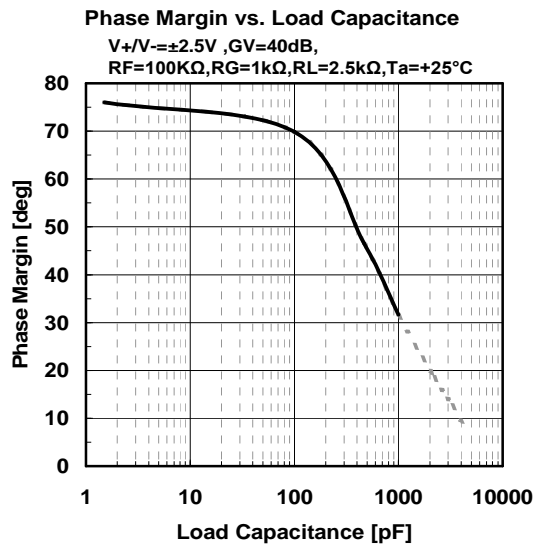
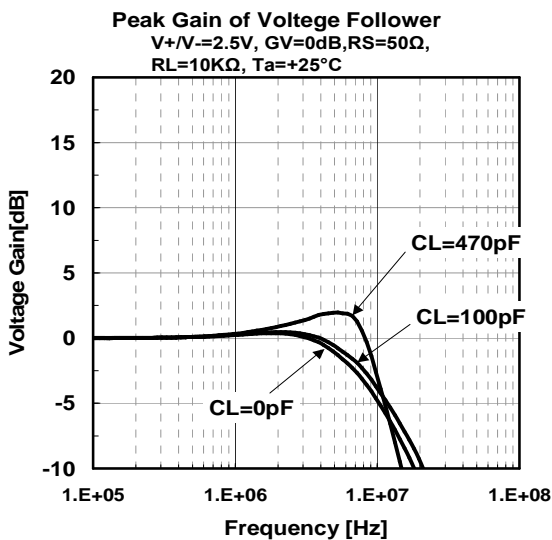
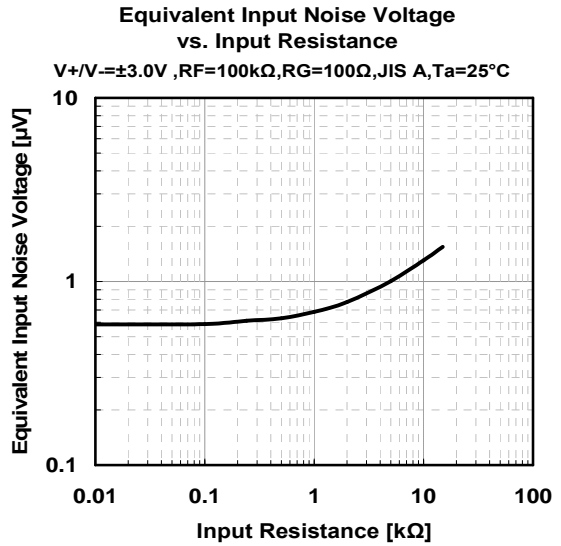
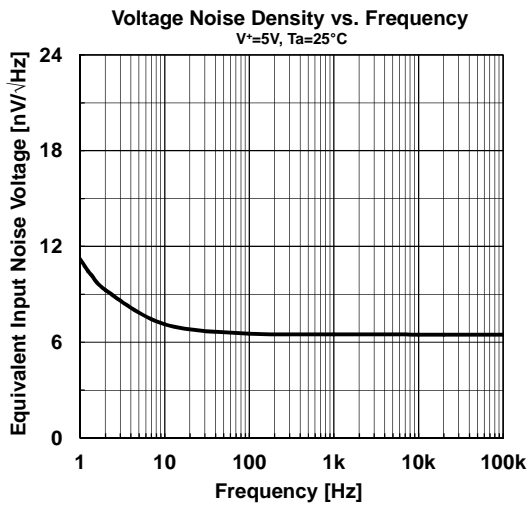
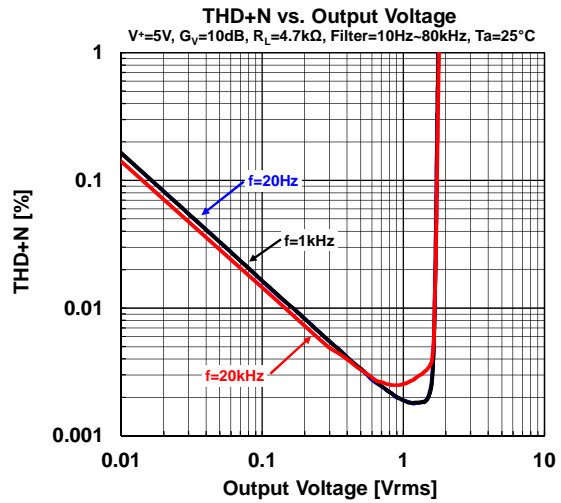
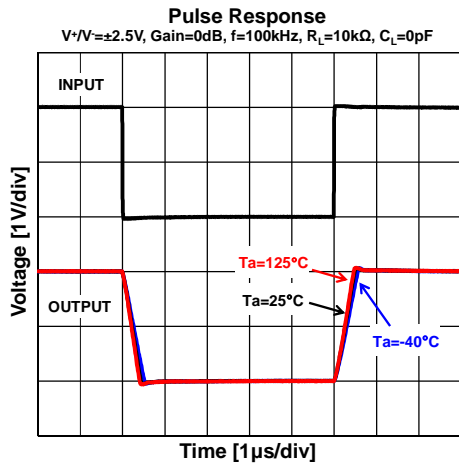
■ TYPICAL CHARACTERISTICS



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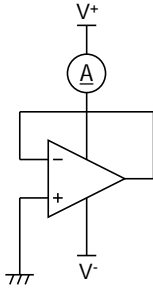


■ TYPICAL CHARACTERISTICS



■ TEST CIRCUIT

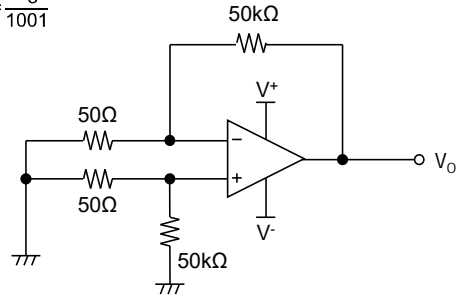
- Supply current



- Input offset voltage

$$V_{IO} = \frac{50}{(50+50k)} \times V_o$$

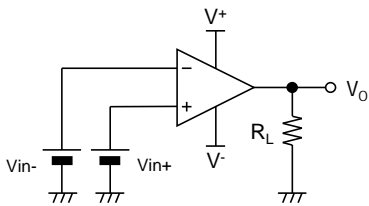
$$V_{IO} = \frac{V_o}{1001}$$



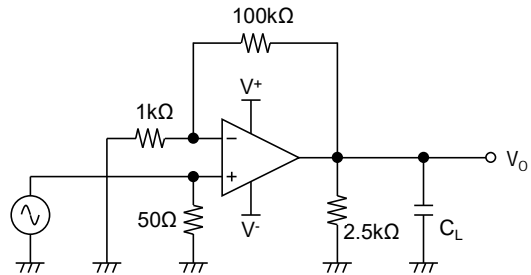
- Maximum output voltage

+Vom; Vin+ = 1V, Vin- = -1V

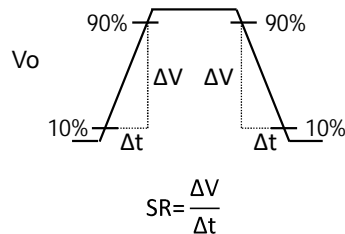
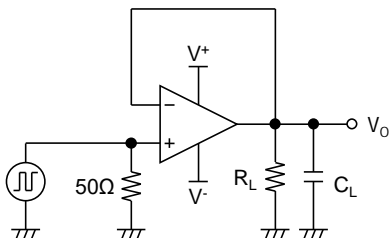
-Vom; Vin+ = -1V, Vin- = 1V



- GBW



- Slew rate



APPLICATION NOTE

Single and Dual Supply Voltage Operation

The NJM2740 works with both single supply and dual supply when the voltage supplied is between V^+ and V^- . These amplifiers operate from single 2.2 to 7V supply and dual $\pm 1.1V$ to $\pm 3.5V$ supply.

Common-Mode Input Voltage Range

When the supply voltage does not meet the condition of electrical characteristics, the range of common-mode input voltage is as follows:

$$V_{ICM} (typ.) = V^- + 1.1V \text{ to } V^+ - 1.1V \quad (T_a = 25^\circ C)$$

Difference of V_{ICM} when Temperature change, refer to typical characteristic graph.

During designing, consider variations in characteristics for use with allowance.

Maximum Output Voltage Range

When the supply voltage does not meet the condition of electrical characteristics, the range of the typ. value of the maximum output voltage is as follows:

$$V_{OM} (typ.) = V^+ + 0.3V \text{ to } V^- - 0.3V \quad (R_L = 2.5k\Omega \text{ to } V^+/2, T_a = 25^\circ C)$$

During designing, consider variations in characteristics and temperature characteristics for use with allowance. In addition, also note that the output voltage range becomes narrow as shown in typical characteristics graph when an output current increases.

Input Voltage Exceeding the Supply Voltage

Inputs of the NJM2740 are protected by ESD diodes (shown in Figure1) that will conduct if the input voltages exceed the power supplies by more than approximately 300mV. Momentary voltages greater than 300mV beyond the power supply, inputs can be tolerated if the current is limited to 1mA.

Figure2 is easily accomplished with an input resistor. If the input voltage exceeds the supply voltage, the input current must be limited 1mA or less by using a restriction resistance (R_{LIMIT}) as shown in figure2.

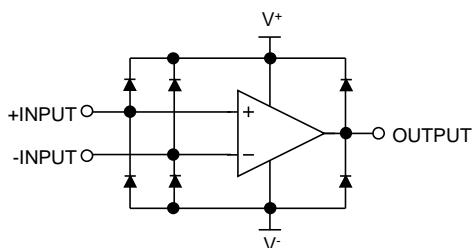


Figure1. Simplified Schematic

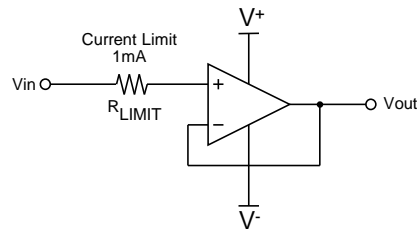


Figure2. Input Current Protection for Voltages exceeding the Supply Voltage.

Capacitive load

The NJM2740 can use at unity gain follower, but the unity gain follower is the most sensitive configuration to capacitive loading. The combination of capacitive load placed directly on the output of an amplifier along with the output impedance of the amplifier creates a phase lag which in turn reduces the phase margin of the amplifier. If phase margin is significantly reduced, the response will cause overshoot and ringing in the step response. It is 30 degree phase margin at 1000pF capacitive load.

To drive heavy capacitive loads, an isolation resistor, R_{ISO} as shown Figure3, should be used. R_{ISO} improves the feedback loop's phase margin by making the output load resistive at higher frequencies. The larger the value of R_{ISO} , the more stable the output voltage will be. However, larger values of R_{ISO} result in reduced output swing, reduced output current drive and reduced frequency bandwidth.

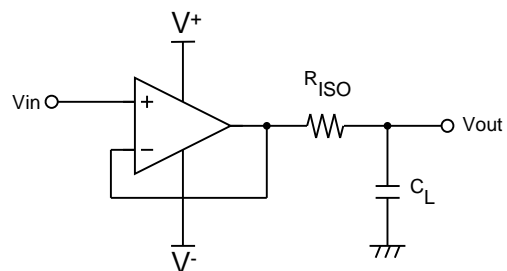
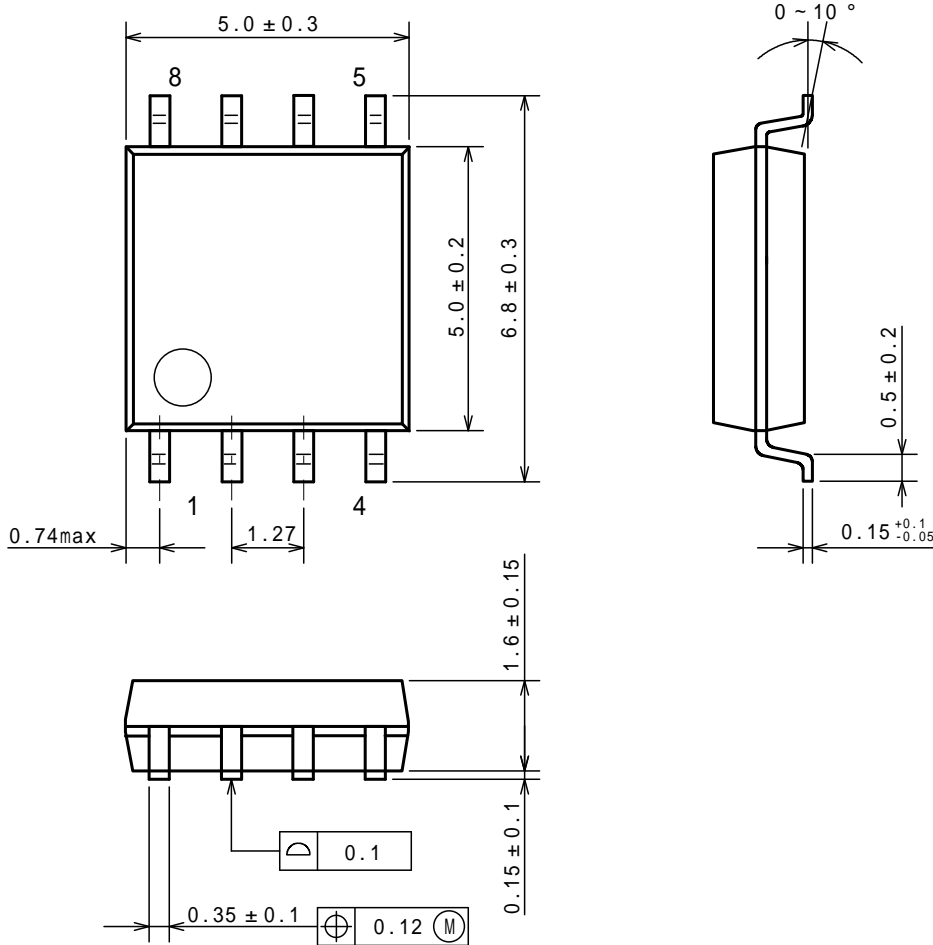


Figure3. Isolating capacitive load

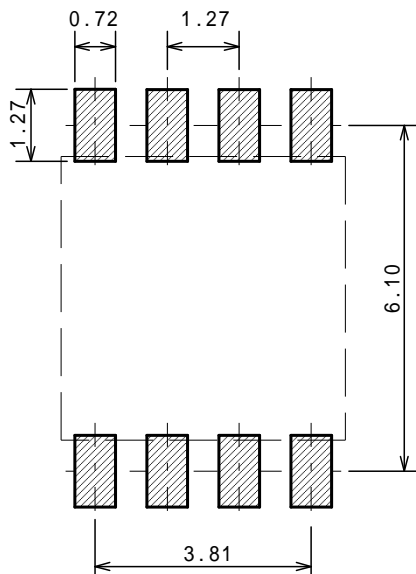
DMP8

Unit: mm

■PACKAGE DIMENSIONS



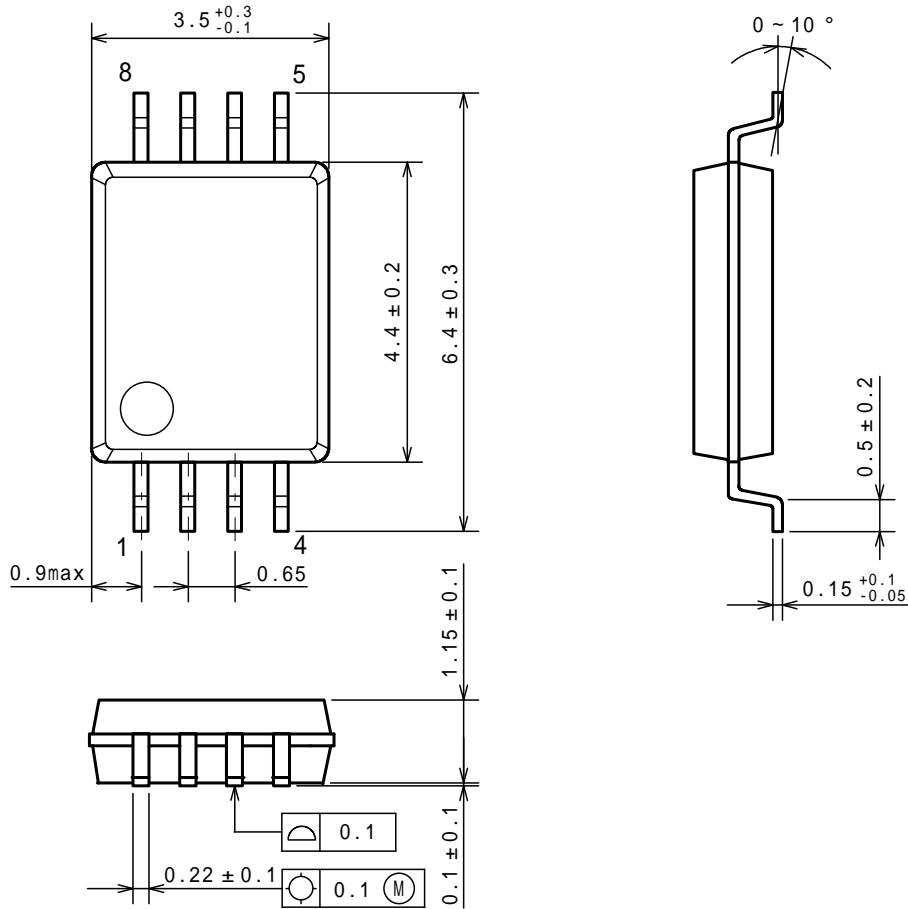
■EXAMPLE OF SOLDER PADS DIMENSIONS



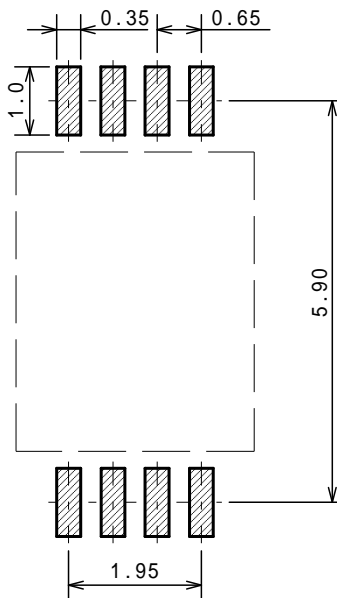
SSOP8

Unit: mm

■PACKAGE DIMENSIONS



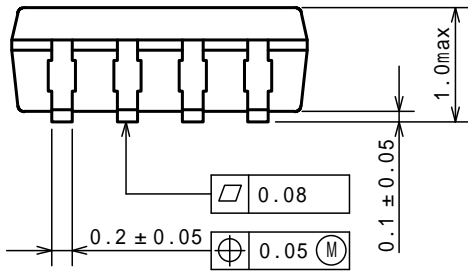
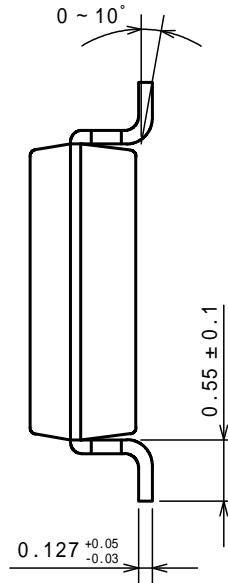
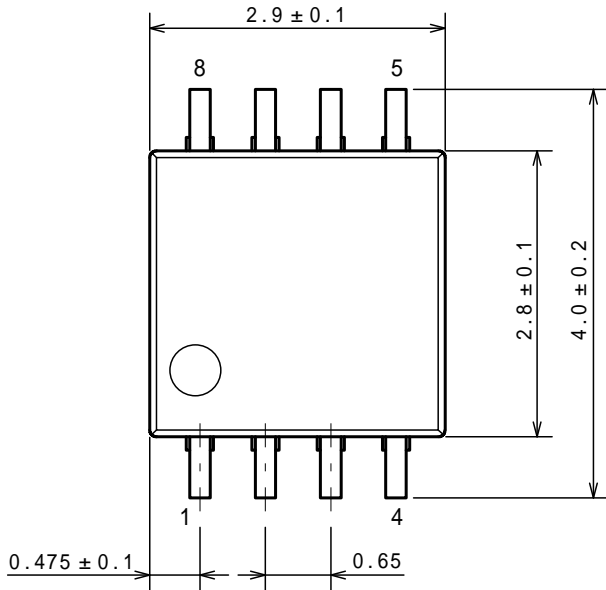
■EXAMPLE OF SOLDER PADS DIMENSIONS



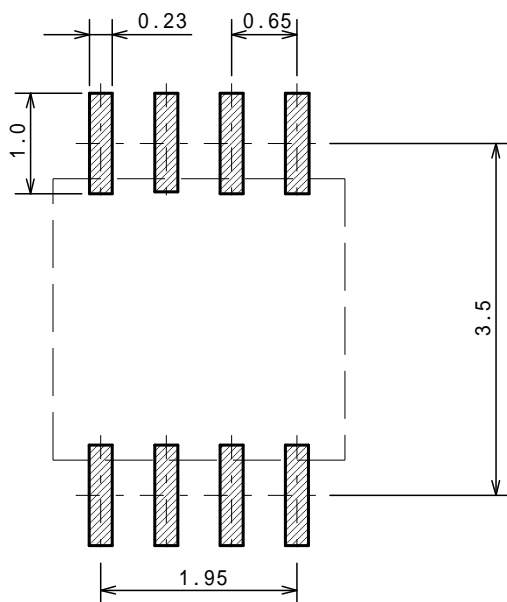
MSOP8 JEDEC MO-187-DA/THIN TYPE

Unit: mm

■PACKAGE DIMENSIONS



■EXAMPLE OF SOLDER PADS DIMENSIONS

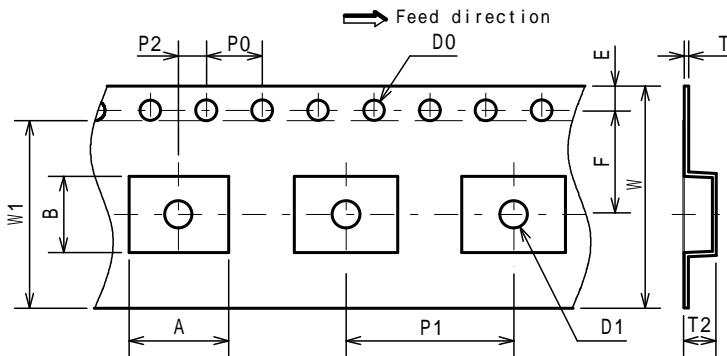


DMP8

PACKING SPEC

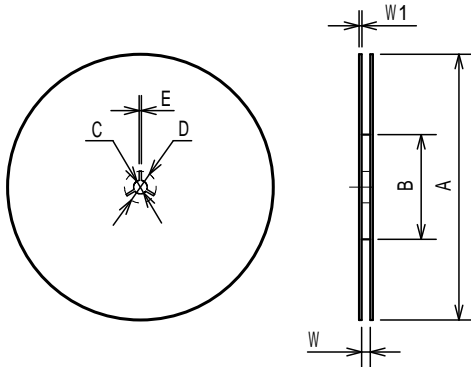
Unit: mm

TAPING DIMENSIONS



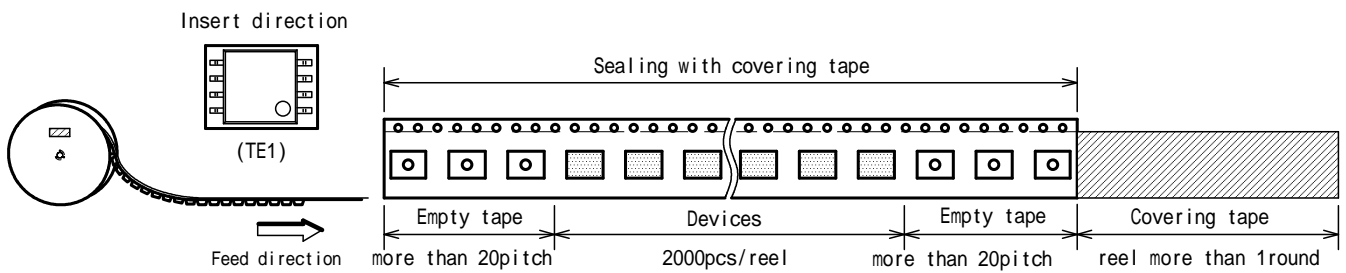
| SYMBOL | DIMENSION | REMARKS |
|--------|-------------|------------------|
| A | 7.1 | BOTTOM DIMENSION |
| B | 5.4 | BOTTOM DIMENSION |
| D0 | 1.55 ± 0.05 | |
| D1 | 2.05 ± 0.1 | |
| E | 1.75 ± 0.1 | |
| F | 7.5 ± 0.1 | |
| P0 | 4.0 ± 0.1 | |
| P1 | 12.0 ± 0.1 | |
| P2 | 2.0 ± 0.1 | |
| T | 0.3 ± 0.05 | |
| T2 | 2.3 | |
| W | 16.0 ± 0.3 | |
| W1 | 13.5 | THICKNESS 0.1max |

REEL DIMENSIONS

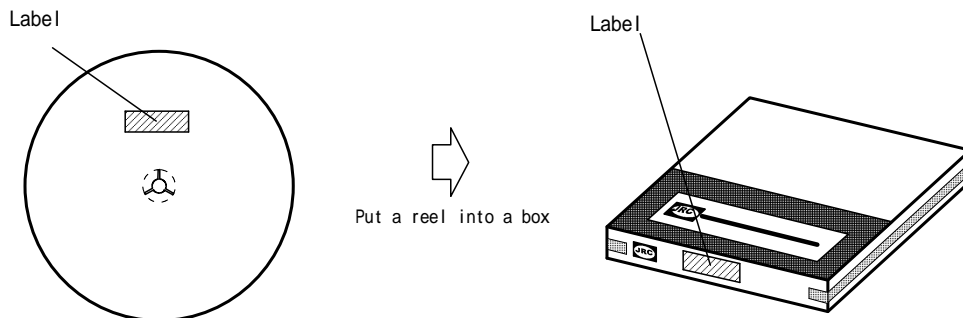


| SYMBOL | DIMENSION |
|--------|------------|
| A | 330 ± 2 |
| B | 80 ± 1 |
| C | 13 ± 0.2 |
| D | 21 ± 0.8 |
| E | 2 ± 0.5 |
| W | 17.5 ± 0.5 |
| W1 | 2 ± 0.2 |

TAPING STATE



PACKING STATE

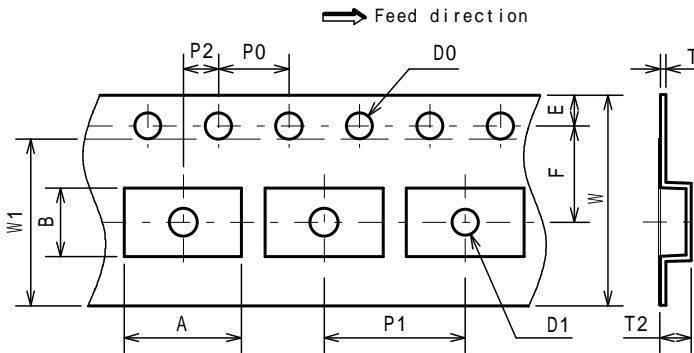


SSOP8

PACKING SPEC

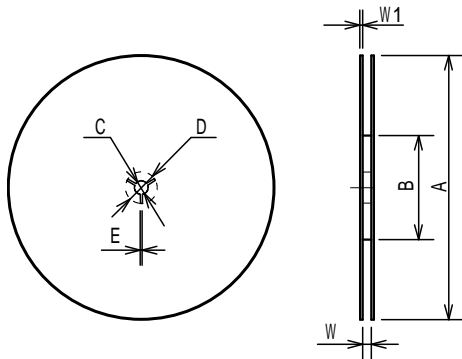
Unit: mm

TAPING DIMENSIONS



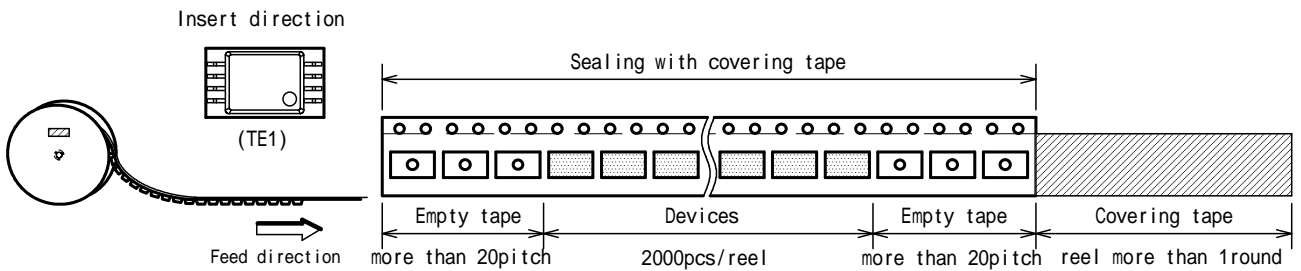
| SYMBOL | DIMENSION | REMARKS |
|--------|-------------|------------------|
| A | 6.7 | BOTTOM DIMENSION |
| B | 3.9 | BOTTOM DIMENSION |
| D0 | 1.55 ± 0.05 | |
| D1 | 1.55 ± 0.1 | |
| E | 1.75 ± 0.1 | |
| F | 5.5 ± 0.05 | |
| P0 | 4.0 ± 0.1 | |
| P1 | 8.0 ± 0.1 | |
| P2 | 2.0 ± 0.05 | |
| T | 0.3 ± 0.05 | |
| T2 | 2.2 | |
| W | 12.0 ± 0.3 | |
| W1 | 9.5 | THICKNESS 0.1max |

REEL DIMENSIONS

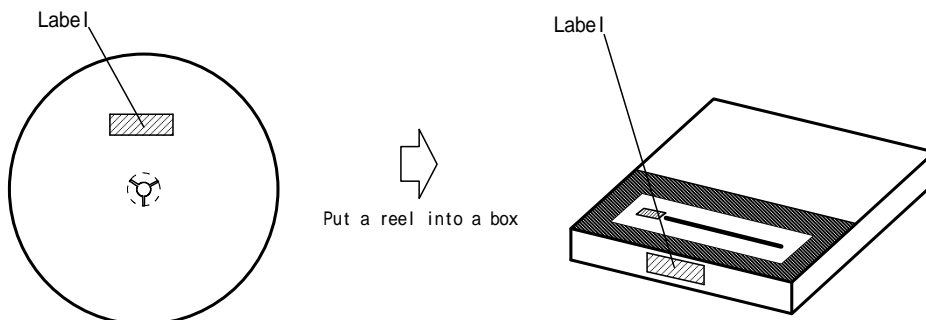


| SYMBOL | DIMENSION |
|--------|------------|
| A | 254 ± 2 |
| B | 100 ± 1 |
| C | 13 ± 0.2 |
| D | 21 ± 0.8 |
| E | 2 ± 0.5 |
| W | 13.5 ± 0.5 |
| W1 | 2 ± 0.2 |

TAPING STATE



PACKING STATE

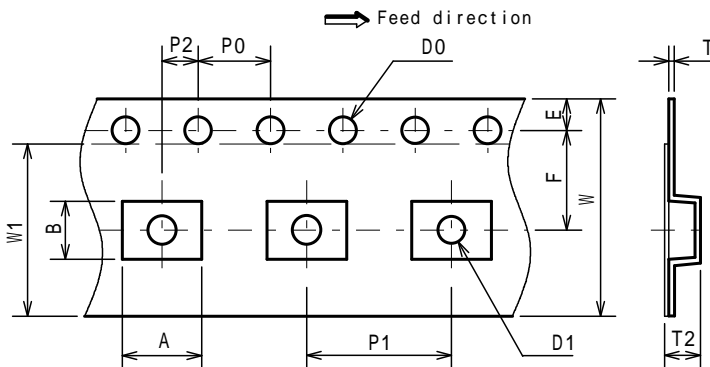


MSOP8 MEET JEDEC MO-187-DA/THIN TYPE

PACKING SPEC

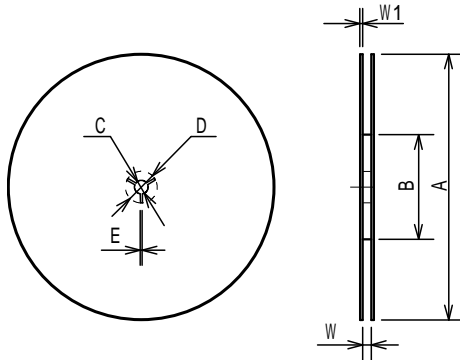
Unit: mm

TAPING DIMENSIONS



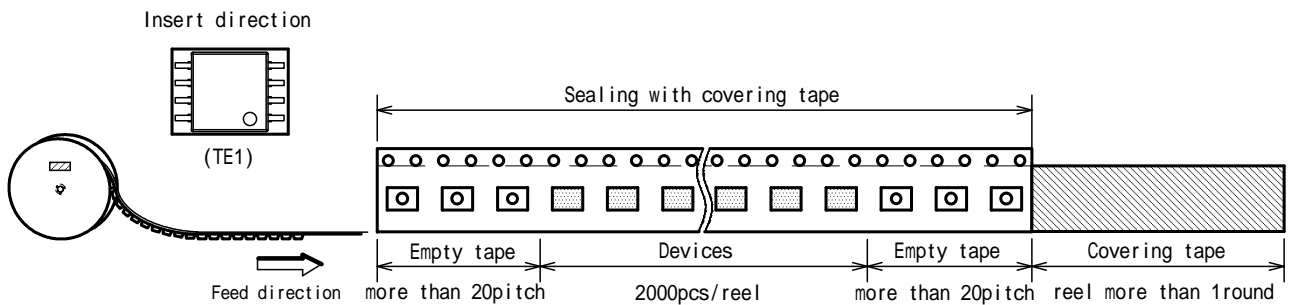
| SYMBOL | DIMENSION | REMARKS |
|--------|----------------------------------|------------------|
| A | 4.4 | BOTTOM DIMENSION |
| B | 3.2 | BOTTOM DIMENSION |
| D0 | 1.5 ^{+0.1} ₀ | |
| D1 | 1.5 ^{+0.1} ₀ | |
| E | 1.75 ± 0.1 | |
| F | 5.5 ± 0.05 | |
| P0 | 4.0 ± 0.1 | |
| P1 | 8.0 ± 0.1 | |
| P2 | 2.0 ± 0.05 | |
| T | 0.30 ± 0.05 | |
| T2 | 1.75 (MAX.) | |
| W | 12.0 ± 0.3 | |
| W1 | 9.5 | THICKNESS 0.1max |

REEL DIMENSIONS

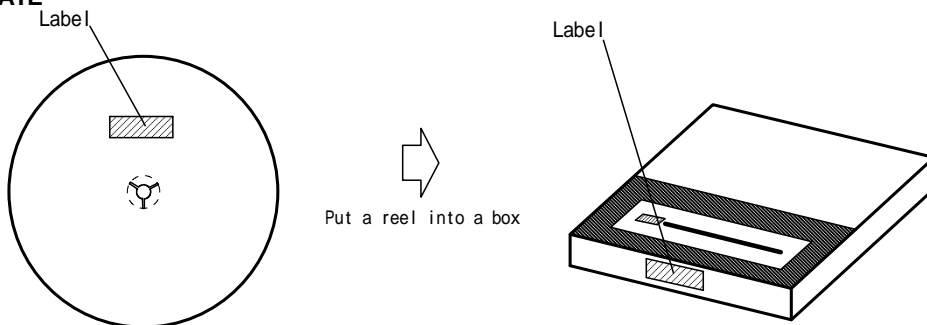


| SYMBOL | DIMENSION |
|--------|------------|
| A | 254 ± 2 |
| B | 100 ± 1 |
| C | 13 ± 0.2 |
| D | 21 ± 0.8 |
| E | 2 ± 0.5 |
| W | 13.5 ± 0.5 |
| W1 | 2.0 ± 0.2 |

TAPING STATE

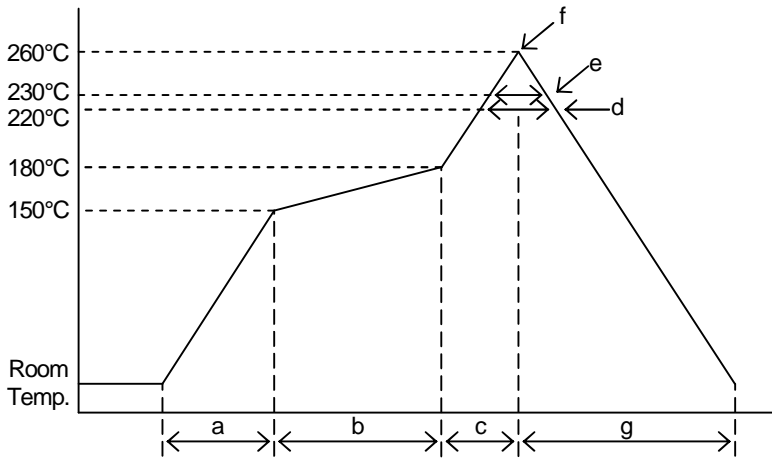


PACKING STATE



■ RECOMMENDED MOUNTING METHOD

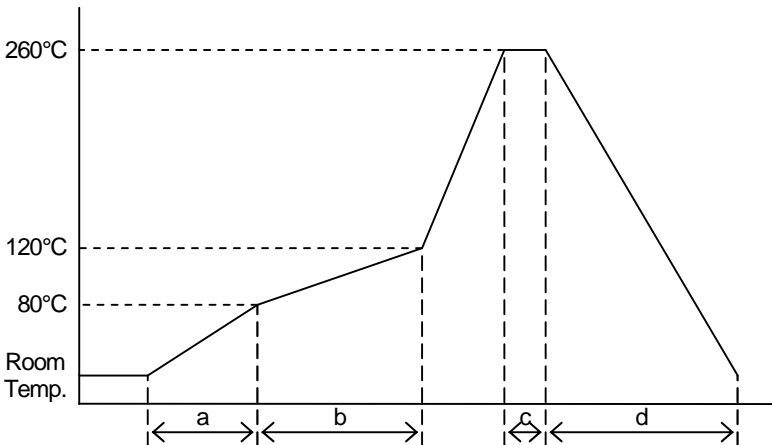
INFRARED REFLOW SOLDERING PROFILE



| | | |
|---|--------------------------|------------------|
| 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.

FLOW SOLDERING PROFILE



| | | |
|---|--------------------------|------------------|
| a | Temperature ramping rate | 1 to 7°C/s |
| b | Pre-heating temperature | 80 to 120°C |
| | Pre-heating time | 60 to 120s |
| c | Peak temperature | lower than 260°C |
| | Peak time | shorter than 10s |
| d | Temperature ramping rate | 1 to 7°C/s |

The temperature indicates at the surface of mold package.

IRON SOLDERING PROFILE

Temperature of Iron: not exceeding 350°C
Soldering time: within 3s (At 1 lead)

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