# Nisshinbo Micro Devices Inc.

# MUSES8920A

## High-Quality Sound, J-FET Input Dual Operational Amplifier

## FEATURES

- High-quality Sound
- Low Noise 8.0nV/√Hz at f=1kHz
- Low Distortion 0.0004% at f=1kHz
- High Slew Rate 25V/µs
- Gain Bandwidth Product 11MHz
- Low Input Bias Current 5pA
- Operating Voltage ±3.5V to ±17V
- J-FET Input
- Bipolar Technology
- Package Outline SOP8 JEDEC 150mil (EMP8)
  DFN8-X7 (ESON8-X7)

## DESCRIPTION

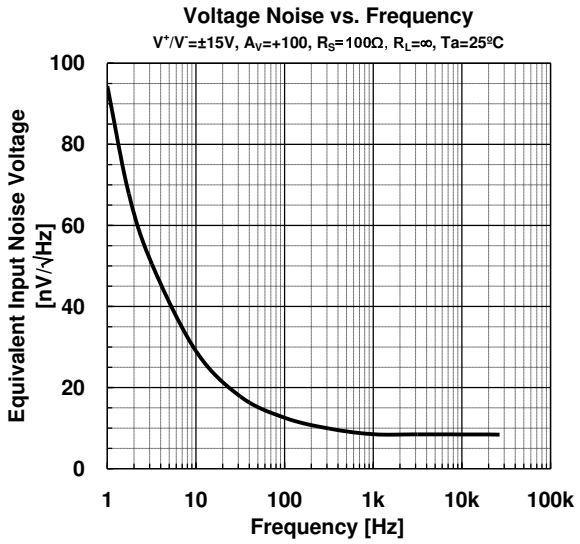
The MUSES8920A is a high-quality sound J-FET input dual operational amplifier, which is optimized for high-end audio, professional audio and portable audio applications.
The MUSES8920A features high-quality sound, low input bias current, low noise, low distortion and high slew rate, and it is suitable for I/V converters, preamplifiers, active filters, headphone amplifiers, and line amplifiers.

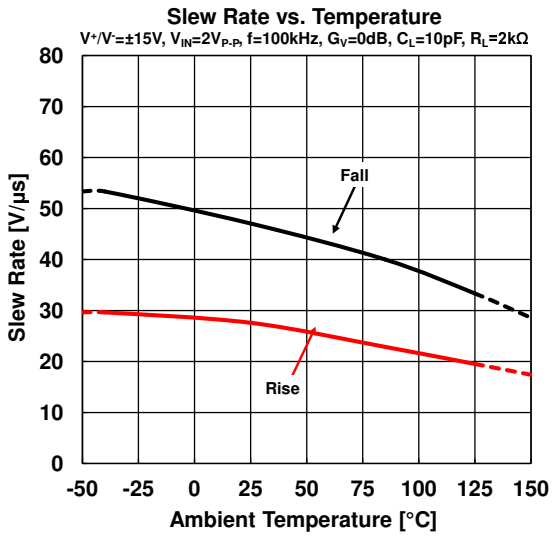


## APPLICATIONS

- Home Audio
- Professional Audio
- Car Audio
- Portable Audio

## Voltage Noise and Slew Rate



## ■ PRODUCT NAME INFORMATION

**MUSES8920A aaa (bbb)**

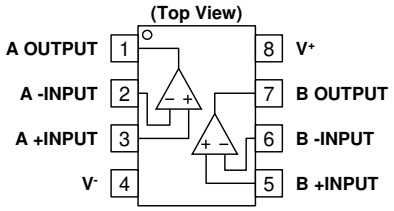
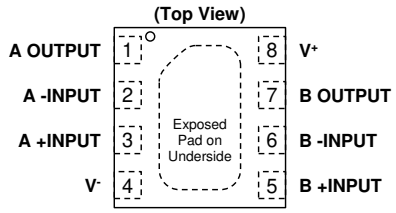
Description of configuration

| Suffix | Item | Description |
|---|---|---|
| aaa | Package code | Indicates the package. Refer to the order information.<br>E: SOP8 JEDEC 150mil (EMP8)<br>KX7: DFN8-X7(ESON8-X7) |
| bbb | Packing | Refer to the packing specifications. |

## ■ ORDER INFORMATION

| PRODUCT NAME | PACKAGE | RoHS | HALOGEN-FREE | PLATING COMPOSITION | WEIGHT (mg) | QUANTITY PER REEL (pcs/reel) |
|---|---|---|---|---|---|---|
| MUSES8920AE(TE1) | SOP8 JEDEC 150mil (EMP8) | ✓ | ✓ | Sn2Bi | 76 | 2000 |
| MUSES8920AKX7(TE3) | DFN8-X7 (ESON8-X7) | ✓ | ✓ | Sn2Bi | 27 | 1500 |

## ■ PIN DESCRIPTIONS

| Product Name | MUSES8920AE | MUSES8920AKX7 |
|---|---|---|
| Package | SOP8 JEDEC 150mil (EMP8) | DFN8-X7 (ESON8-X7) |
| Pin Functions |  |  <br>*About Exposed Pad<br>Floating (Electrical open) or connecting to V-.<br>Floating (Electrical open) state is recommended when sound quality is important. |

| Pin No. | Pin Name | I/O | Description |
|---|---|---|---|
| 1 | A OUTPUT | O | Output channel A |
| 2 | A -INPUT | I | Inverting input channel A |
| 3 | A +INPUT | I | Non-inverting input channel A |
| 4 | $V^-$ | - | Negative supply or Ground (single supply) |
| 5 | B +INPUT | I | Non-inverting input channel B |
| 6 | B -INPUT | I | Inverting input channel B |
| 7 | B OUTPUT | O | Output channel B |
| 8 | $V^+$ | - | Positive supply |

## ■ ABSOLUTE MAXIMUM RATINGS

| | Symbol | Rating | Unit |
|---|---|---|---|
| Supply Voltage (Vs = V+ - V−) | $V^+/ V^-$ | ±18 (36) | V |
| Input Voltage *1 | $V_{IN}$ | $V^-$ -0.3 to $V^-$ +36.3 | V |
| Differential Input Voltage *2 | $V_{ID}$ | ±30 | V |
| Power Dissipation ($T_a$ = 25°C)<br>SOP8 JEDEC 150mil (EMP8)<br>DFN8-X7(ESON8-X7) | $P_D$ | 2-Layer / 4-Layer<br>800 *3 / 1200 *4<br>690 *5 / 2900 *6 | mW |
| Storage Temperature | $T_{stg}$ | -50 to 150 | °C |
| Junction Temperature | | 150 | °C |

*1 "Input Voltage" is independent of supply voltage. Normal operating range as operational amplifier is shown in "Common-Mode Input Voltage Range" of "ELECTRICAL CHARACTERISTICS".
*2 "Differential Input Voltage" is the voltage difference between +INPUT and −INPUT.
*3 2-Layer: Mounted on glass epoxy board (76.2 mm × 114.3 mm × 1.6 mm: based on EIA/JEDEC standard, 2-layer FR-4).
*4 4-Layer: Mounted on glass epoxy board (76.2 mm × 114.3 mm × 1.6 mm: based on EIA/JEDEC standard, 4-layer FR-4).
*5 2-Layer: Mounted on glass epoxy board (101.5 mm × 114.5 mm × 1.6 mm: based on EIA/JEDEC standard, 2-layer FR-4, with exposed pad.)
*6 4-Layer: Mounted on glass epoxy board (101.5 mm × 114.5 mm × 1.6 mm: based on EIA/JEDEC standard, 4-layer FR-4, with exposed pad.)
(For 4-layer: Applying 99.5 mm × 99.5 mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5.)

**ABSOLUTE MAXIMUM RATINGS**

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the lifetime and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

## ■ THERMAL CHARACTERISTICS

| Package | Measurement Result | | Unit |
|---|---|---|---|
| | Thermal Resistance (Θja) | Thermal Characterization Parameter (ψjt) | |
| SOP8 JEDEC 150mil (EMP8)<br>DFN8-X7 (ESON8-X7) | 157 *3 / 103 *4<br>182 *5 / 44 *6 | 16 *3 / 12 *4<br>- | °C/W |

Θja :Junction-to-Ambient Thermal Resistance
ψjt:Junction-to-Top Thermal Characterization Parameter
*3 2-Layer: Mounted on glass epoxy board (76.2 mm × 114.3 mm × 1.6 mm: based on EIA/JEDEC standard, 2-layer FR-4).
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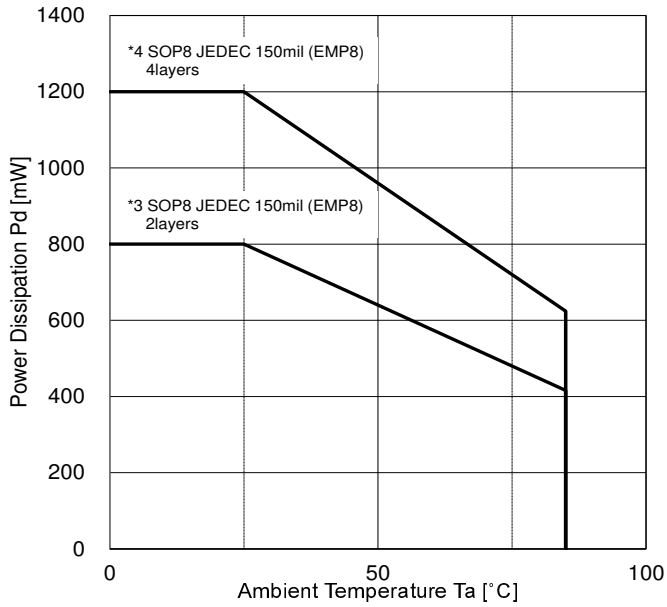
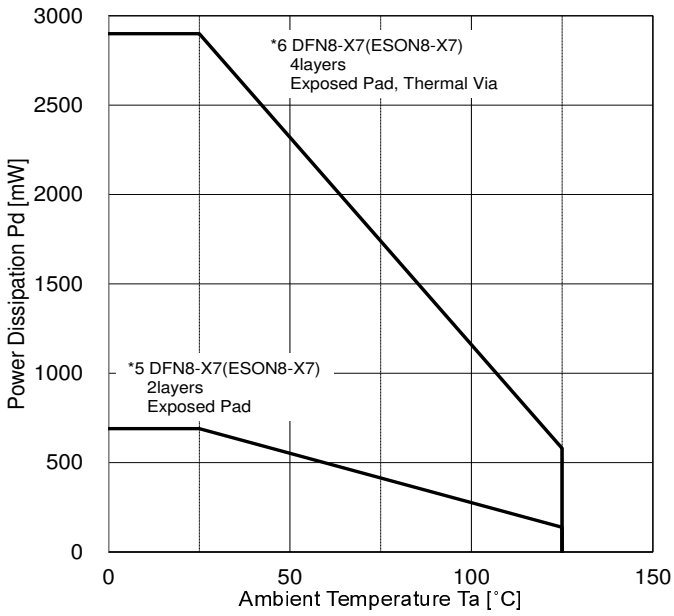
## ■ POWER DISSIPATION vs. AMBIENT TEMPERATURE

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## ■ ELECTROSTATIC DISCHARGE (ESD) PROTECTION VOLTAGE

| | Conditions | Protection Voltage |
|---|---|---|
| HBM | C = 100 pF, R = 1.5 kΩ | ±1000 V |
| CDM | DI-CDM | ±1000 V |

| ELECTROSTATIC DISCHARGE RATINGS |
|---|
| The electrostatic discharge test is done based on JEITA ED-4701.<br>In the HBM method, ESD is applied using the power supply pin and GND pin as reference pins. |

## ■ RECOMMENDED OPERATING CONDITIONS

| | Symbol | Rating | Unit |
|---|---|---|---|
| Supply Voltage | $V^+/ V^-$ | ±3.5 to ±17 | V |
| Operating Temperature<br>SOP8 JEDEC 150mil (EMP8)<br>DFN8-X7 (ESON8-X7) | Ta | <br>-40 to 85<br>-40 to 125 | °C |

**RECOMMENDED OPERATING CONDITIONS**

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

## ■ ELECTRICAL CHARACTERISTICS

$V^+/V^-$=±15V, $R_L$ to GND, Ta=25°C, unless otherwise specified

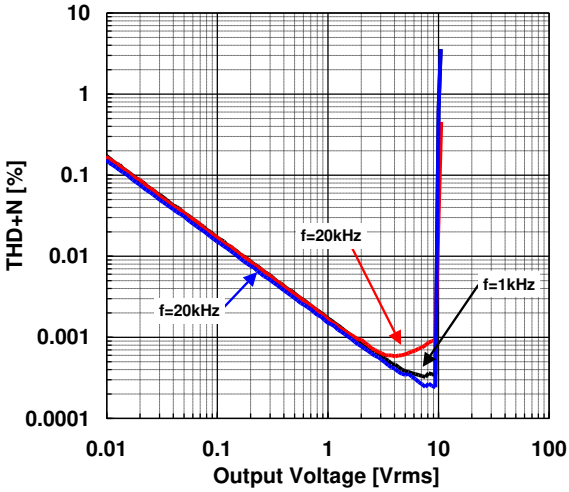
| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | |
| Supply Current | $I_{CC}$ | No Signal, $R_L$=∞ | - | 9.0 | 12.0 | mA |
| Input Offset Voltage | $V_{IO}$ | Rs=50Ω | - | 0.8 | 5.0 | mV |
| Input Bias Current | $I_B$ | | - | 5 | 250 | pA |
| Input Offset Current | $I_{IO}$ | | - | 2 | 220 | pA |
| Voltage Gain 1 | $A_{V1}$ | $R_L$=10kΩ, $V_O$=±13V | 106 | 135 | - | dB |
| Voltage Gain 2 | $A_{V2}$ | $R_L$=2kΩ, $V_O$=±12.8V | 105 | 133 | - | dB |
| Voltage Gain 3 | $A_{V3}$ | $R_L$=600Ω, $V_O$=±12.5V | 105 | 130 | - | dB |
| Common Mode Rejection Ratio | CMR | $V_{ICM}$= ±12.5V *1 | 80 | 110 | - | dB |
| Supply Voltage Rejection Ratio | SVR | $V^+/V^-$=±3.5 to ±17V | 80 | 110 | - | dB |
| Maximum Output Voltage 1 | $V_{OM1}$ | $R_L$ =10kΩ | ±13 | ±14 | - | V |
| Maximum Output Voltage 2 | $V_{OM2}$ | $R_L$ =2kΩ | ±12.8 | ±13.8 | - | V |
| Maximum Output Voltage 3 | $V_{OM3}$ | $R_L$ =600Ω | ±12.5 | ±13.5 | - | V |
| Common Mode<br>Input Voltage Range | $V_{ICM}$ | CMR≥80dB | ±12.5 | ±14 | - | V |
| **AC CHARACTERISTICS** | | | | | | |
| Gain Bandwidth Product | GBW | f=10kHz | - | 11 | - | MHz |
| Unity Gain Frequency | $f_T$ | $A_V$=+100, $R_S$=100Ω, $R_L$=2kΩ, $C_L$=10pF | - | 10 | - | MHz |
| Phase Margin | $\Phi_M$ | $A_V$=+100, $R_S$=100Ω, $R_L$=2kΩ, $C_L$=10pF | - | 70 | - | Deg |
| Slew Rate | SR | $A_V$=1, $V_{IN}$=2Vp-p, $R_L$=2kΩ, $C_L$=10pF | - | 25 | - | V/μs |
| Channel Separation | CS | f=1kHz, $A_V$=+100, $R_S$=1kΩ, $R_L$=2kΩ | - | 150 | - | dB |
| Total Harmonic Distortion | THD | f=1kHz,AV=+10,Vo=5Vrms,RL=2kΩ | - | 0.0004 | - | % |
| Input Noise Voltage1 | $e_n$ | f=1kHz | - | 8.0 | - | nV/√Hz |
| Input Noise Voltage2 | $V_{NI}$ | f=20Hz to 20kHz | - | 1.1 | - | μVrms |

*1 CMR is calculated by specified change in offset voltage. (VICM=0V to +12.5V, VICM=0V to -12.5V)

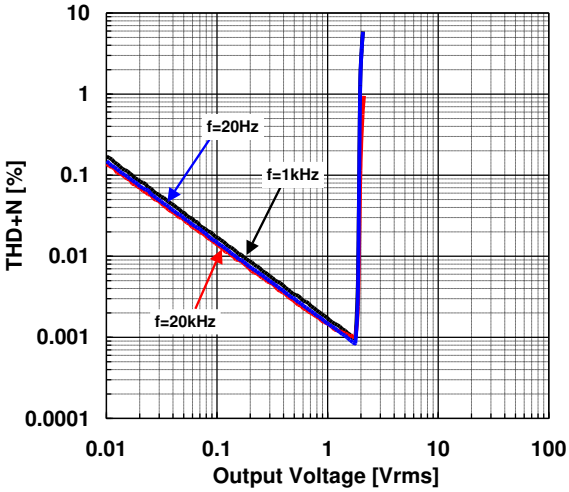
## ■ TYPICAL CARACTERISTICS

Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

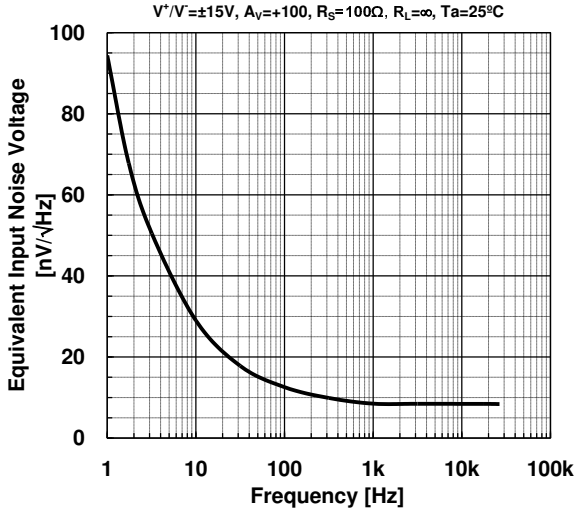
THD+N vs. Output Voltage (Frequency)
V+/V-=±15V, AV=+10, RL=2k, Ta=25ºC



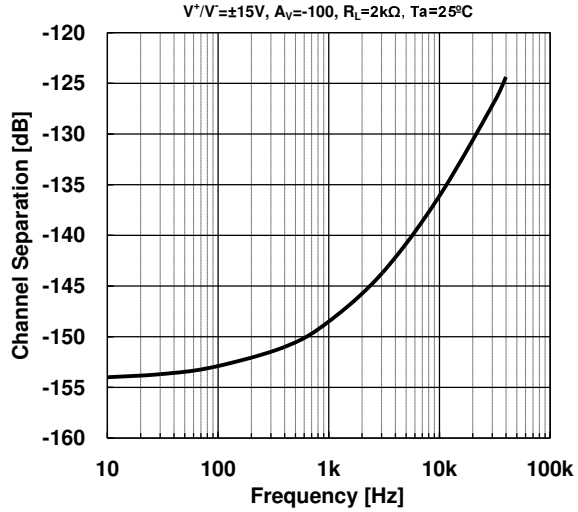

THD+N vs. Output Voltage (Frequency)
V+/V-=±3.5V, AV=+10, RL=2k, Ta=25ºC



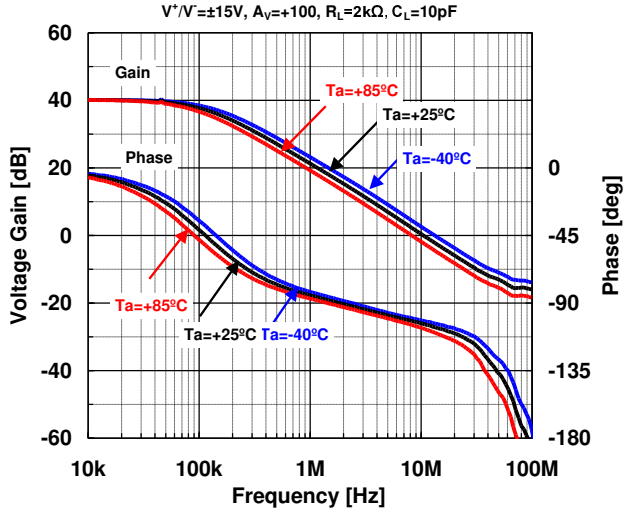

Voltage Noise vs. Frequency
V+/V-=±15V, AV=+100, RS=100Ω, RL=∞, Ta=25ºC



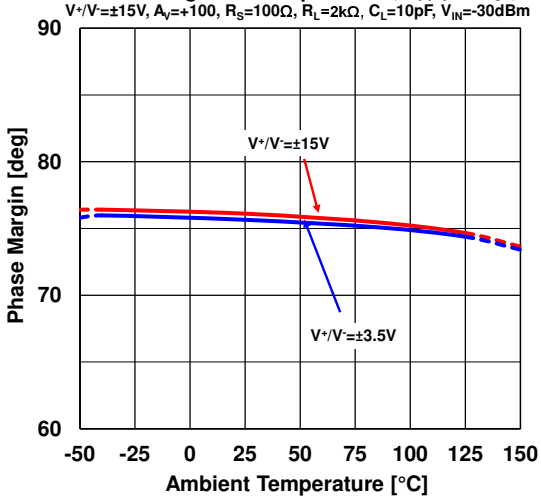

Channel Separation vs. Frequency
V+/V-=±15V, AV=-100, RL=2kΩ, Ta=25ºC




Gain vs. Frequency (Temperature)
V+/V-=±15V, AV=+100, RL=2kΩ, CL=10pF




Phase Margin vs. Temperature (Supply Voltage)
V+/V-=±15V, AV=+100, RS=100Ω, RL=2kΩ, CL=10pF, VIN=-30dBm

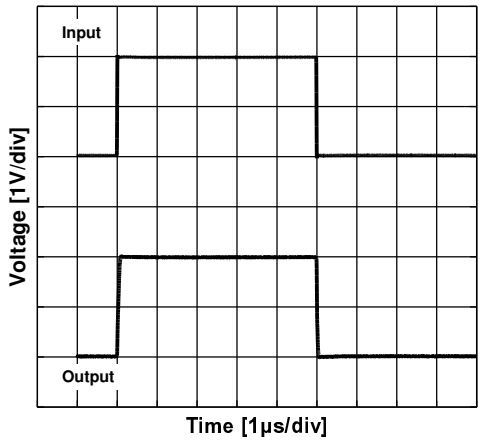


## ■ TYPICAL CARACTERISTICS

Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

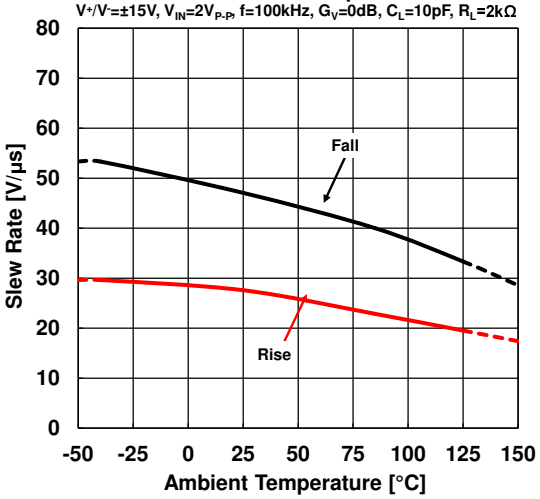
**Pulse Response**

$V^+/V^-$=±15V, Gv=0dB, $C_L$=10pF, $R_L$=2kΩ, Ta=25ºC



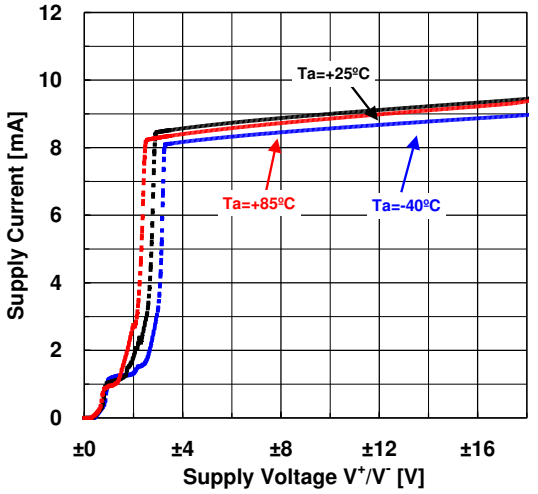

**Slew Rate vs. Temperature**

$V^+/V^-$=±15V, $V_{IN}$=2$V_{P-P}$, f=100kHz, $G_V$=0dB, $C_L$=10pF, $R_L$=2kΩ



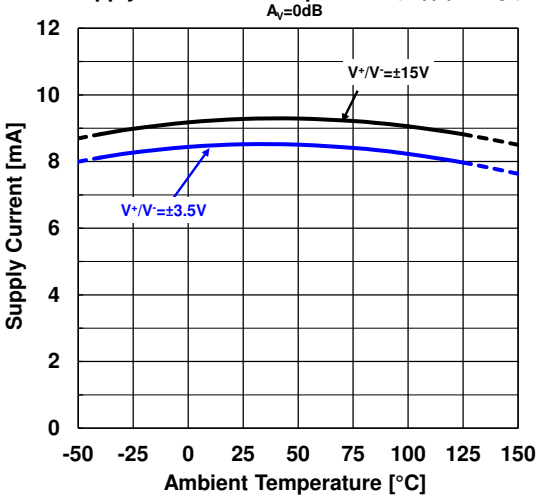

**Supply Current vs. Supply Voltage** (Temperature)

$A_V$=0dB



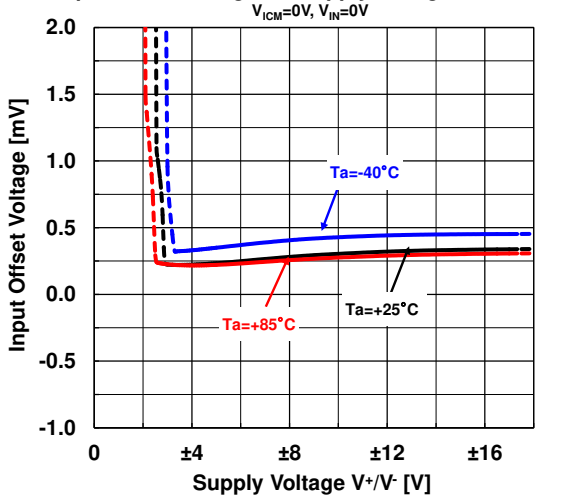

**Supply Current vs. Temperature** (Supply Voltage)

$A_V$=0dB



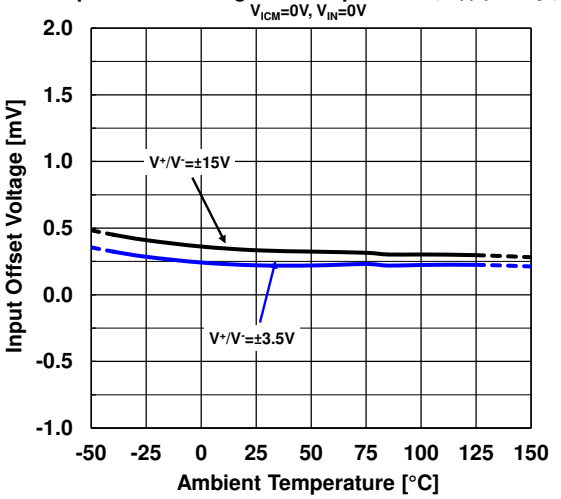

**Input Offset Voltage vs. Supply Voltage** (Temperature)

$V_{ICM}$=0V, $V_{IN}$=0V




**Input Offset Voltage vs. Temperature** (Supply Voltage)

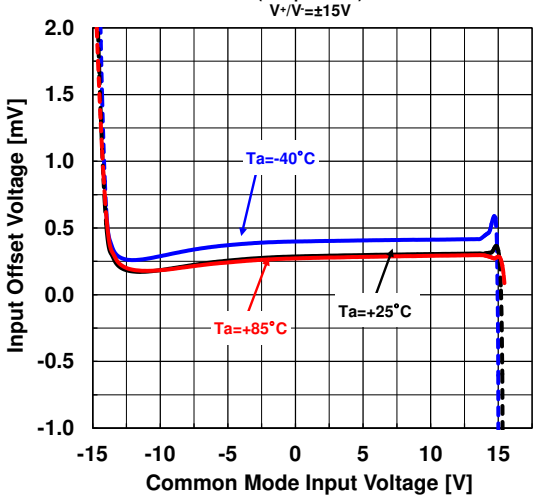
$V_{ICM}$=0V, $V_{IN}$=0V



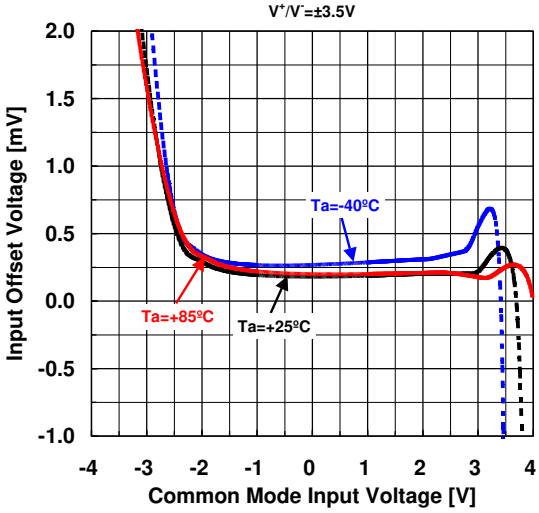
## ■ TYPICAL CARACTERISTICS

**Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.**

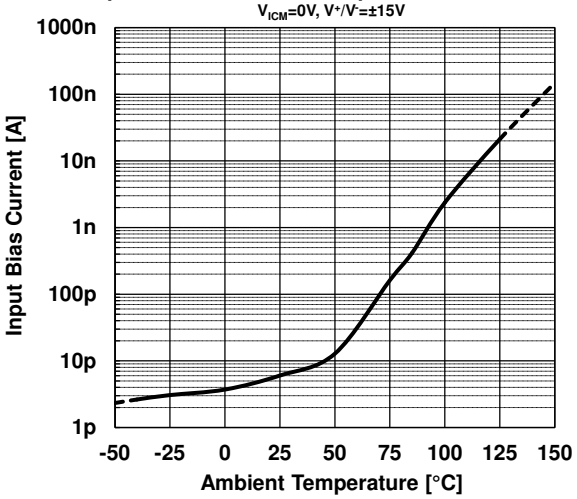
Input Offset Voltage
vs. Common Mode Input Voltage
(Temperature)
V+/V-=±15V



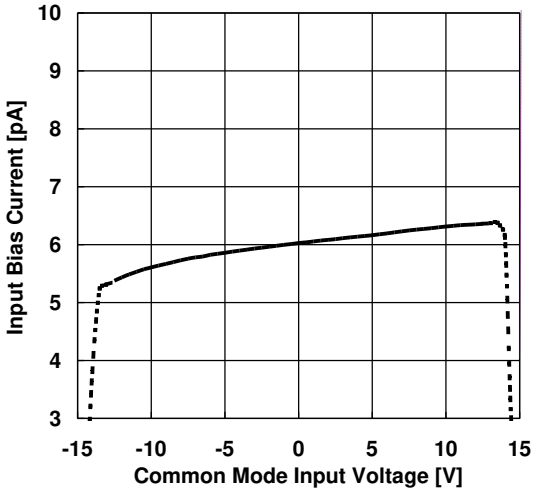

Input Offset Voltage
vs. Common Mode Input Voltage
(Temperature)
V+/V-=±3.5V



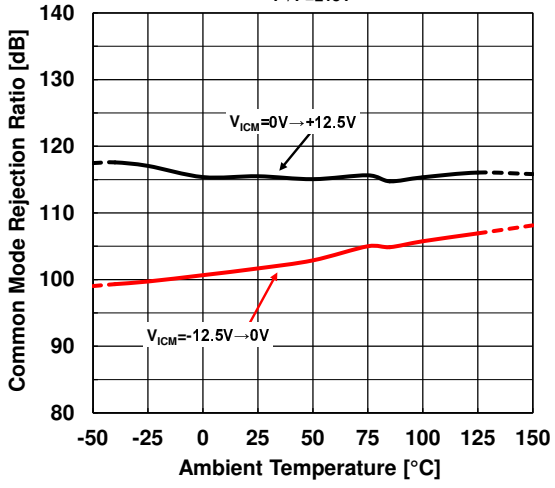

Input Bias Current vs. Temperature (Supply Voltage)
$V_{ICM}$=0V, V+/V-=±15V



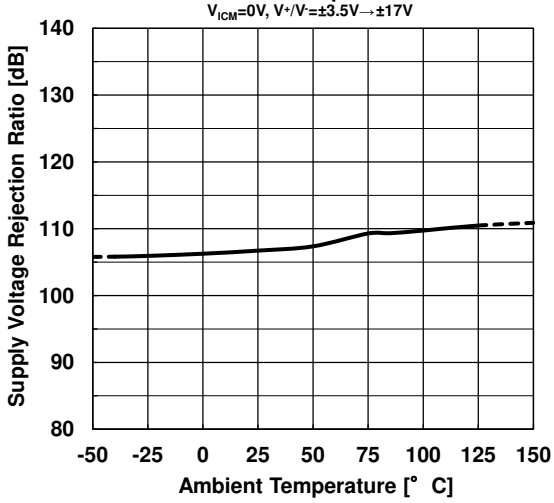

Input Bias Current vs. Common Mode Input Voltage
(Temperature)
V+/V-=±15V, Ta=25ºC




CMR vs. Temperature
V+/V-=±15V



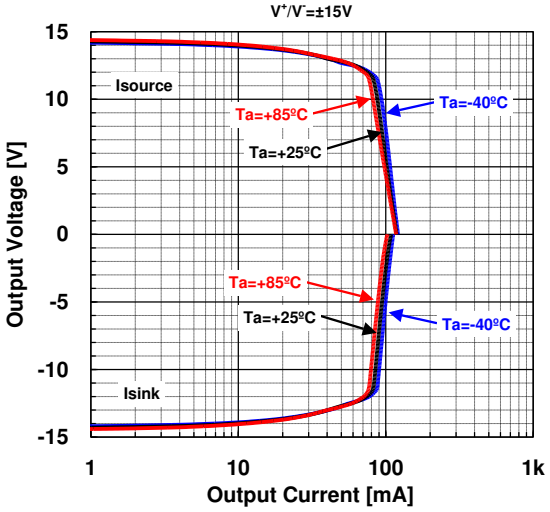

SVR vs. Temperature
$V_{ICM}$=0V, V+/V-=±3.5V→±17V



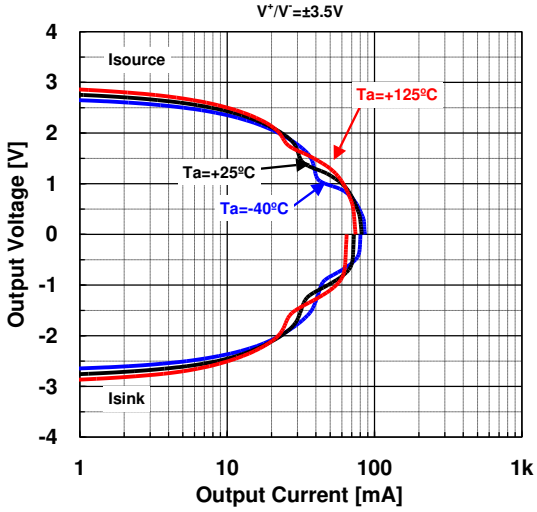
## ■ TYPICAL CARACTERISTICS

Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

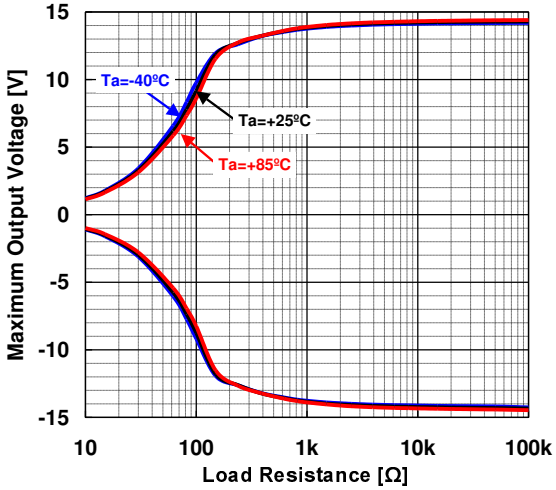
**Output Voltage vs. Output Current (Temperature)**
$V^+/V^-$=±15V



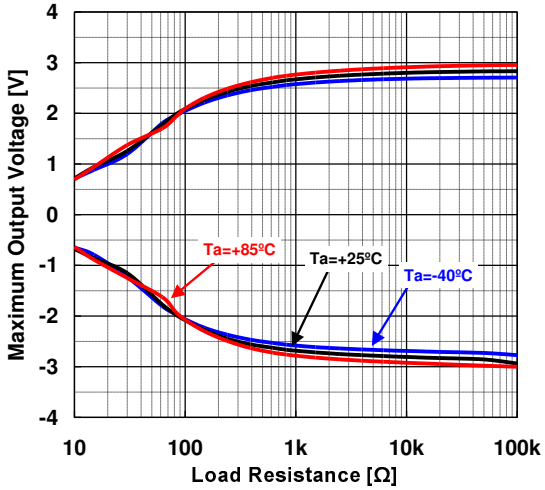

**Output Voltage vs. Output Current (Temperature)**
$V^+/V^-$=±3.5V




**Maximum Output Voltage vs. Load Resistance**
(Temperature)
$V^+/V^-$=±15V, Gv=open, $R_L$ to 0V




**Maximum Output Voltage vs. Load Resistance**
(Temperature)
$V^+/V^-$=±3.5V, Gv=open, $R_L$ to 0V



## ■ TEST CIRCUITS

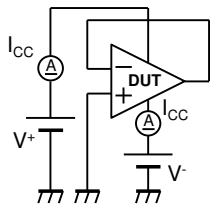



Figure 1. Supply Current

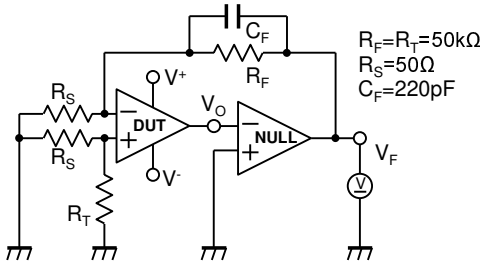



Figure 2. Input Offset Voltage

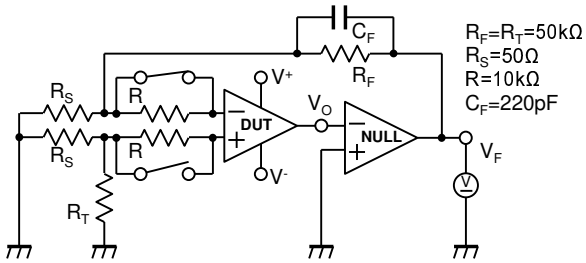



Figure 3. Input Bias Current

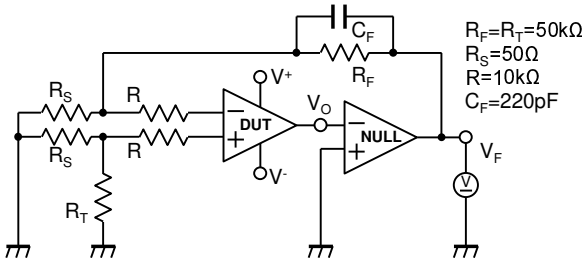



Figure 4. Input Offset Current

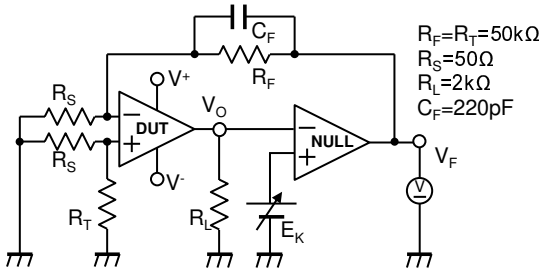



Figure 5. Open-Loop Voltage Gain

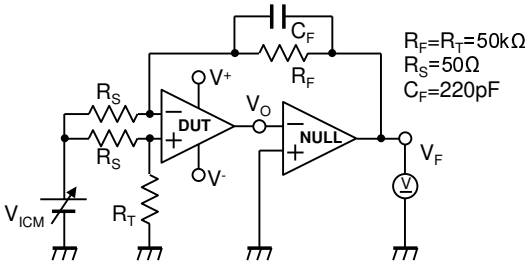



Figure 6. Common Mode Rejection Ratio

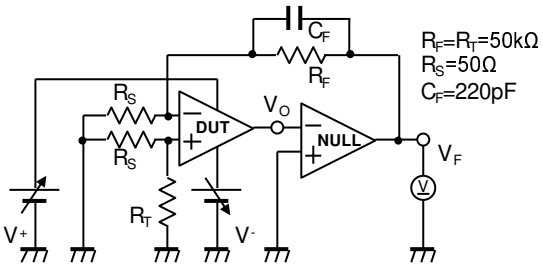



Figure 7. Supply Voltage Rejection Ratio

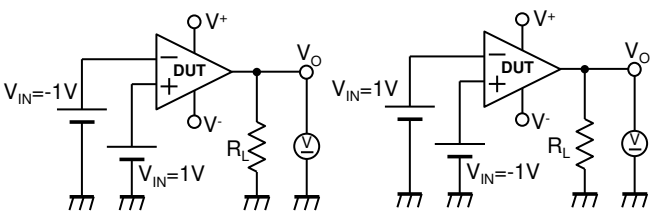



Figure 8. Maximum Output Voltage

## ■ TEST CIRCUITS

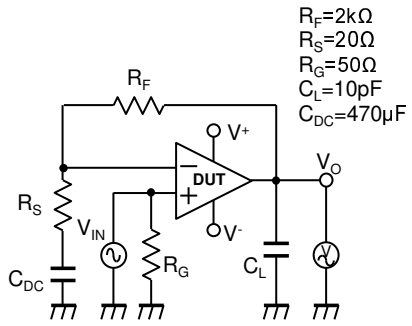



Figure 9. Gain Bandwidth Product

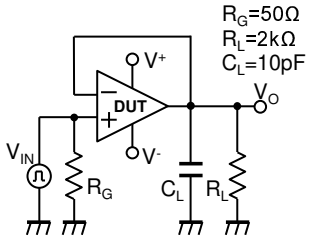



Figure 10. Slew Rate

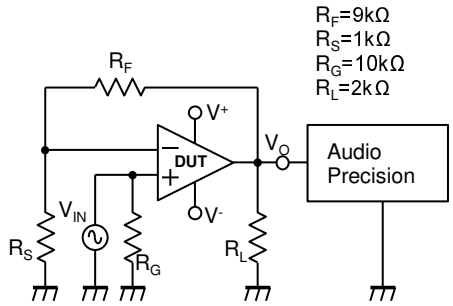



Figure 11. Total Harmonic Distor

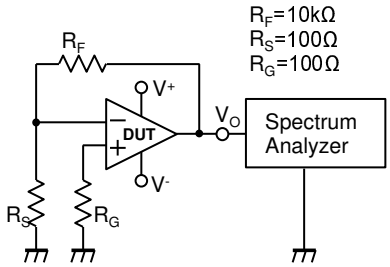
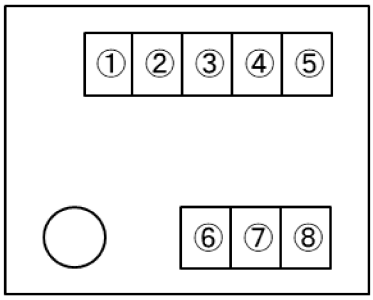



Figure 12. Input Noise Voltage

## ■ MARKING SPECIFICATION (SOP8 JEDEC 150mil (EMP8))

①②③④⑤: Product Cord  Refer to Part Marking List
⑥⑦⑧: Control Number



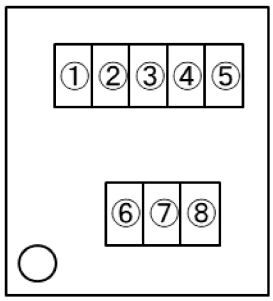

**SOP8 JEDEC 150mil (EMP8) Part Markings**

Part Marking List (SOP8 JEDEC 150mil (EMP8))

| Product Name | ① | ② | ③ | ④ | ⑤ |
|---|---|---|---|---|---|
| MUSES8920AE | 8 | 9 | 2 | 0 | A |

## ■ MARKING SPECIFICATION (DFN8-X7 (ESON8-X7))

①②③④⑤: Product Cord  Refer to Part Marking List
⑥⑦⑧: Control Number




**DFN8-X7 (ESON8-X7) Part Markings**

Part Marking List (DFN8-X7 (ESON8-X7))

| Product Name | ① | ② | ③ | ④ | ⑤ |
|---|---|---|---|---|---|
| MUSES8920AKX7 | 8 | 9 | 2 | 0 | A |

| NOTICE |
|---|
| There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact our sales or distributor before attempting to use AOI. |

## ■ NOTE

**Precaution for counterfeit semiconductor products**

We have recently detected many counterfeit semiconductor products that have very similar appearances to our operational amplifier “MUSES” in the world-wide market.In most cases, it is hard to distinguish them from our regular products by their appearance, and some of them have very poor quality and performance.
They can not provide equivalent quality of our regular product, and they may cause breakdowns or malfunctions if used in your systems or applications.

We would like our customers to purchase “MUSES” through our official sales channels : our sales branches, sales subsidiaries and distributors.

Please note that we hold no responsibilities for any malfunctions or damages caused by using counterfeit products. We would appreciate your understanding.

## ■ REVISION HISTORY

| Date | Revision | Contents of Changes |
|---|---|---|
| March 1, 2024 | Ver. 1.0 | Initial release |

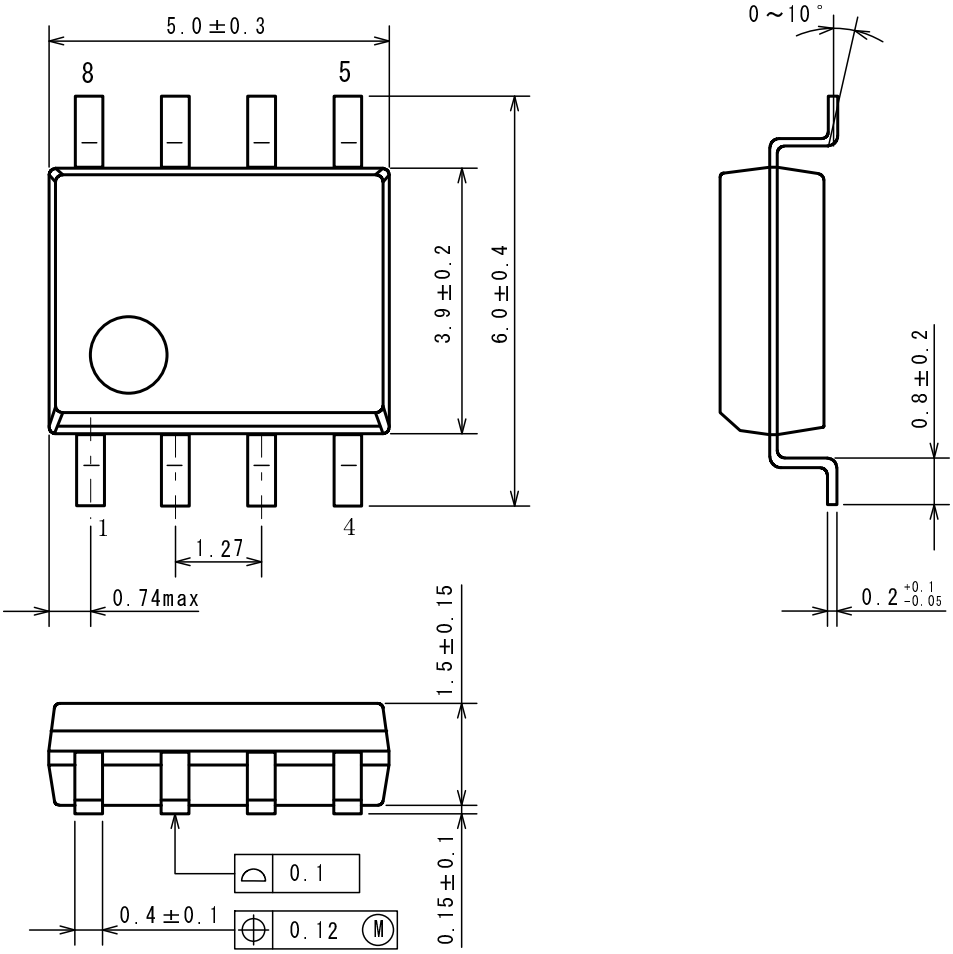
**Nisshinbo Micro Devices Inc.**

# SOP8 JEDEC 150mil(EMP8)

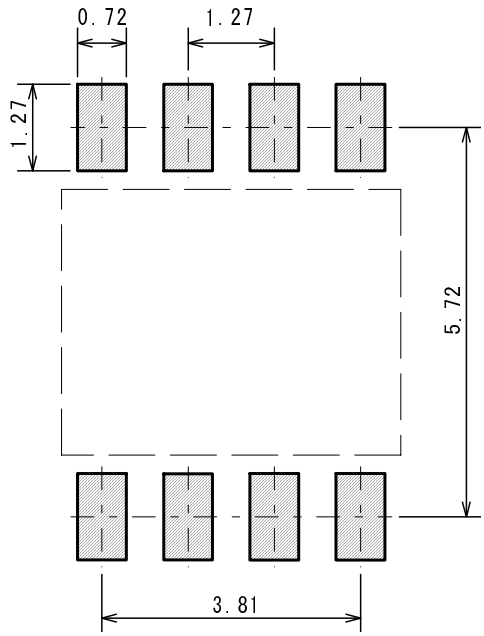
PI-SOP8 JEDEC 150mil-E-B

## ■ PACKAGE DIMENSIONS

UNIT: mm




## ■ EXAMPLE OF SOLDER PADS DIMENSIONS



# Nisshinbo Micro Devices Inc.

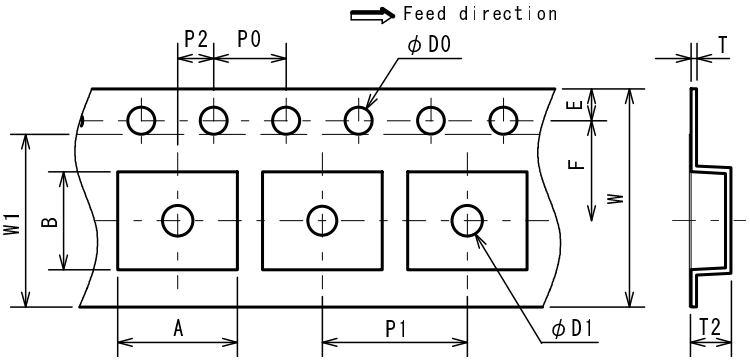
## SOP8 JEDEC 150mil(EMP8)

PI-SOP8 JEDEC 150mil-E-B

### ■ PACKING SPEC

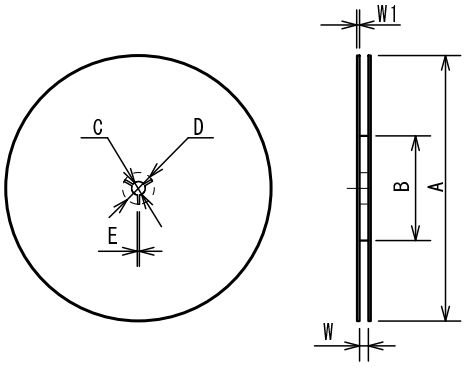
UNIT: mm

#### TAPING DIMENSIONS



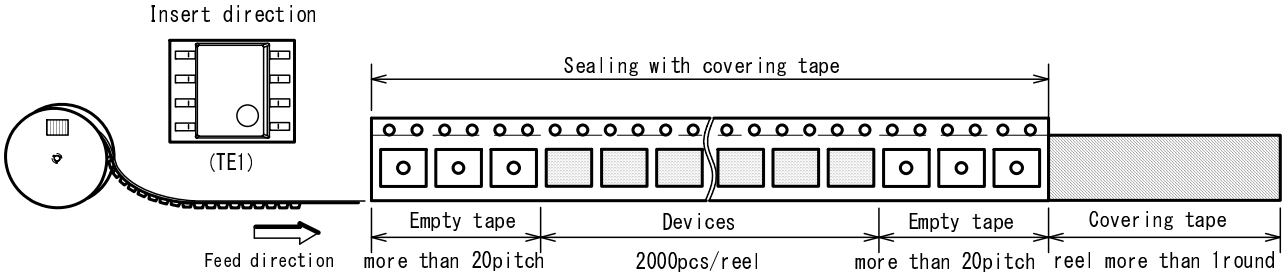

| SYMBOL | DIMENSION | REMARKS |
|---|---|---|
| A | 6.6 | BOTTOM DIMENSION |
| B | 5.4 | BOTTOM DIMENSION |
| D0 | $1.5^{+0.1}_{0}$ | |
| D1 | 1.7±0.1 | |
| E | 1.75±0.1 | |
| F | 5.5±0.05 | |
| P0 | 4.0±0.1 | |
| P1 | 8.0±0.1 | |
| P2 | 2.0±0.05 | |
| T | 0.30±0.05 | |
| T2 | 2.2 | |
| W | 12.0±0.3 | |
| W1 | 9.5 | THICKNESS 0.1max |

#### REEL DIMENSIONS

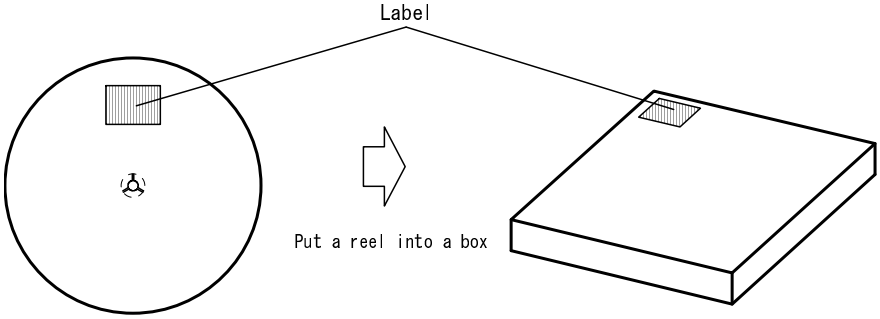



| SYMBOL | DIMENSION |
|---|---|
| A | φ330±2 |
| B | φ 80±1 |
| C | φ 13±0.2 |
| D | φ 21±0.8 |
| E | 2±0.5 |
| W | 13.5±0.5 |
| W1 | 2.0±0.2 |

#### TAPING STATE




#### PACKING STATE



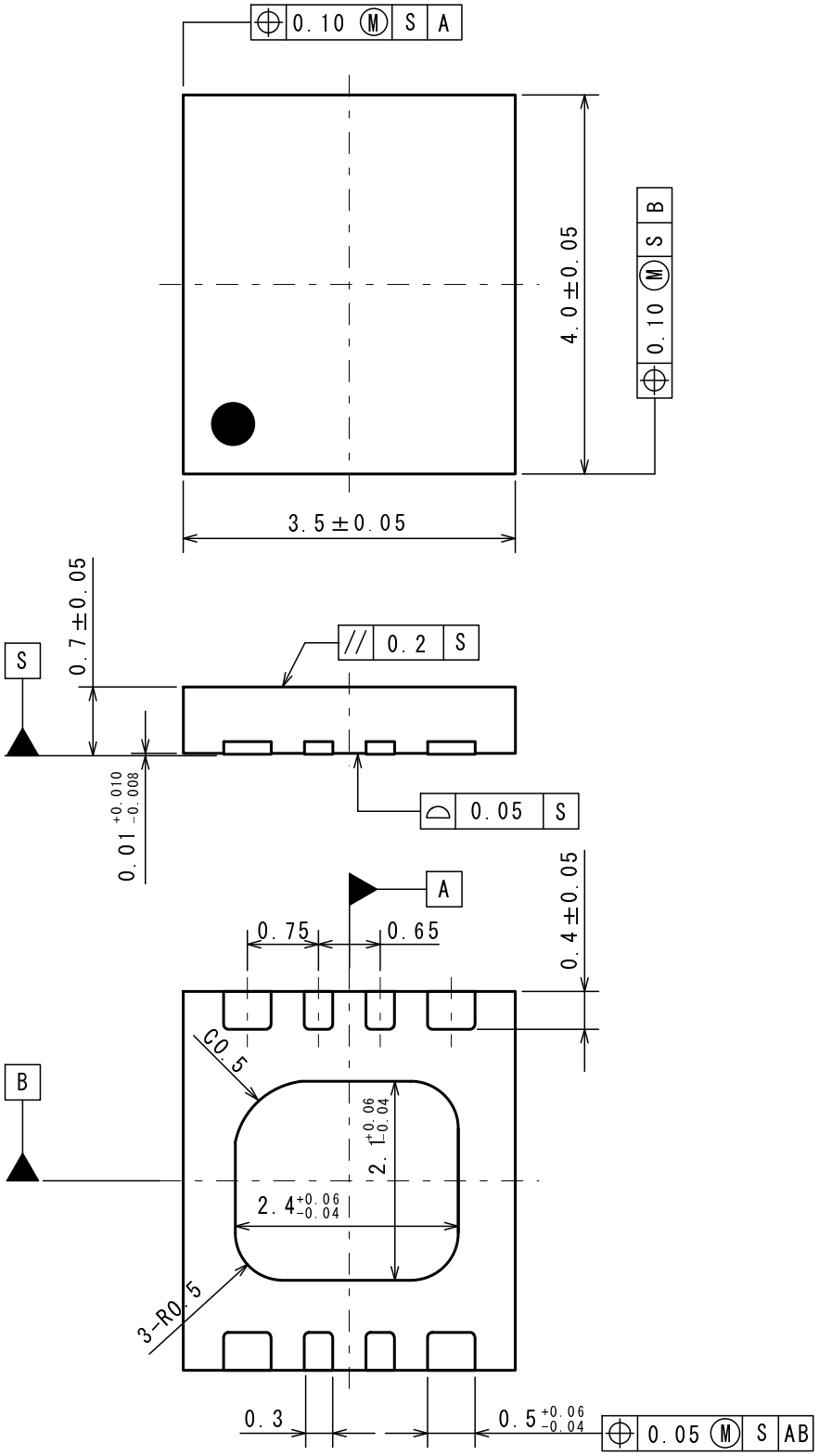
**Nisshinbo Micro Devices Inc.**

DFN8-X7(ESON8-X7)

PI-DFN8-X7-E-B

■ **PACKAGE DIMENSIONS**

UNIT: mm



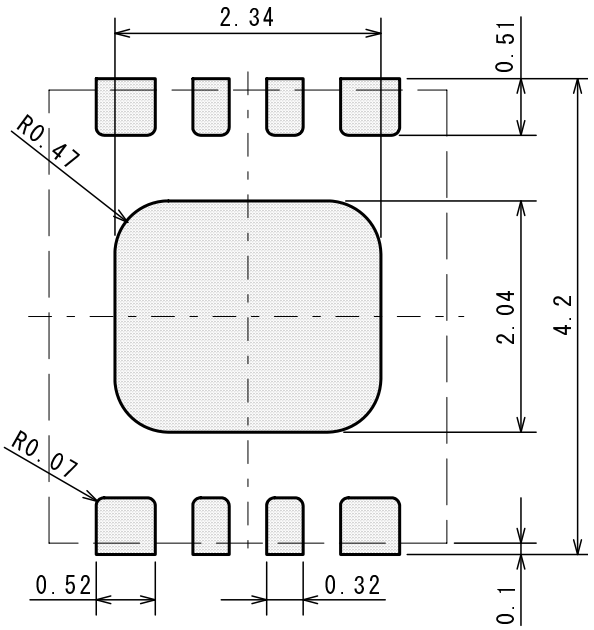
**Nisshinbo Micro Devices Inc.**

DFN8-X7(ESON8-X7)

PI-DFN8-X7-E-B

## ■ EXAMPLE OF SOLDER PADS DIMENSIONS

UNIT: mm



**Nisshinbo Micro Devices Inc.**

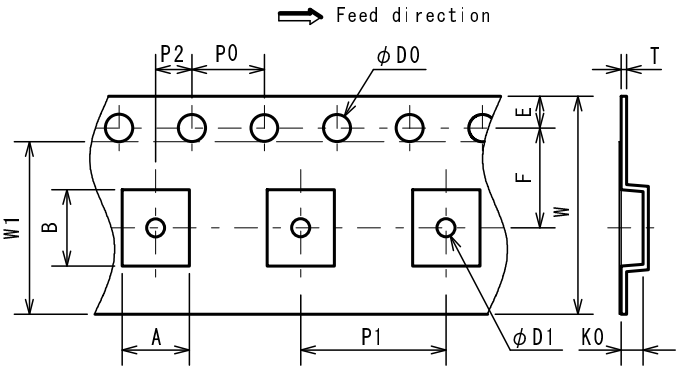
# DFN8-X7(ESON8-X7)

PI-DFN8-X7-E-B

## ■ PACKING SPEC

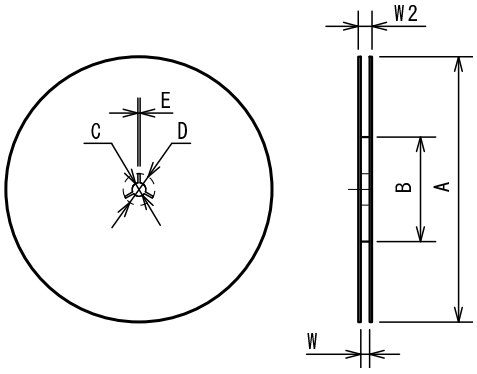
UNIT: mm

### TAPING DIMENSIONS



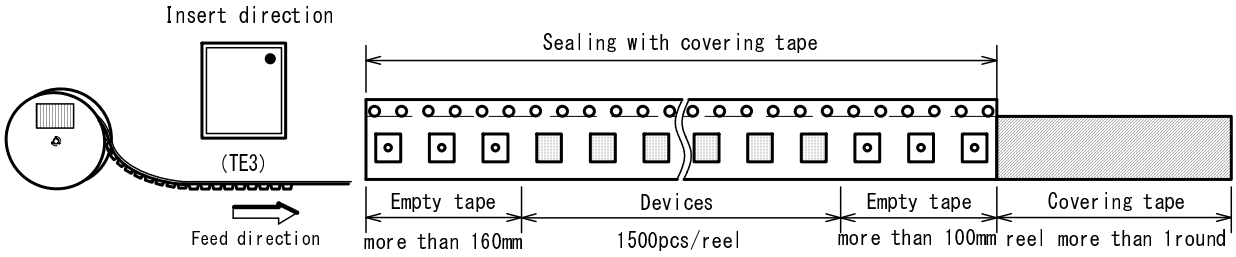

| SYMBOL | DIMENSION | REMARKS |
|---|---|---|
| A | 3.7±0.05 | BOTTOM DIMENSION |
| B | 4.2±0.05 | BOTTOM DIMENSION |
| D0 | 1.5 $^{+0.1}_{0}$ | |
| D1 | 1.0±0.1 | |
| E | 1.75±0.1 | |
| F | 5.5±0.05 | |
| P0 | 4.0±0.1 | |
| P1 | 8.0±0.1 | |
| P2 | 2.0±0.05 | |
| T | 0.25±0.05 | |
| K0 | 0.85±0.05 | |
| W | 12.0 $^{+0.3}_{-0.1}$ | |
| W | 9.5 | THICKNESS 0.1max |

### REEL DIMENSIONS




| SYMBOL | DIMENSION |
|---|---|
| A | φ180 $^{0}_{-3}$ |
| B | φ 60 $^{+1}_{0}$ |
| C | φ 13±0.2 |
| D | φ 21±0.8 |
| E | 2±0.5 |
| W | 13 $^{+1}_{0}$ |
| W2 | 15.4±1.0 |

### TAPING STATE

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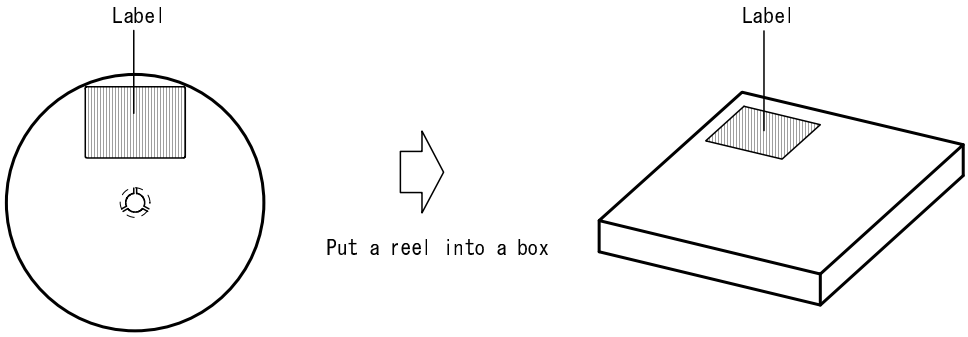

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    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
    8-2. Quality Warranty Remedies
    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
    8-3. Remedies after Quality Warranty Period
    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
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