



MUSES8920A

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



FEATURES

- High-quality Sound
- Low Noise 8.0nV/ $\sqrt{\text{Hz}}$ at $f=1\text{kHz}$
- Low Distortion 0.0004% at $f=1\text{kHz}$
- High Slew Rate 25V/ μs
- Gain Bandwidth Product 11MHz
- Low Input Bias Current 5pA
- Operating Voltage $\pm 3.5\text{V}$ to $\pm 17\text{V}$
- 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.

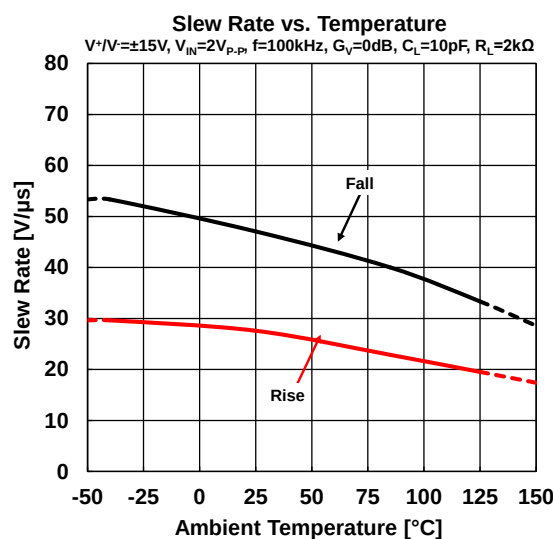
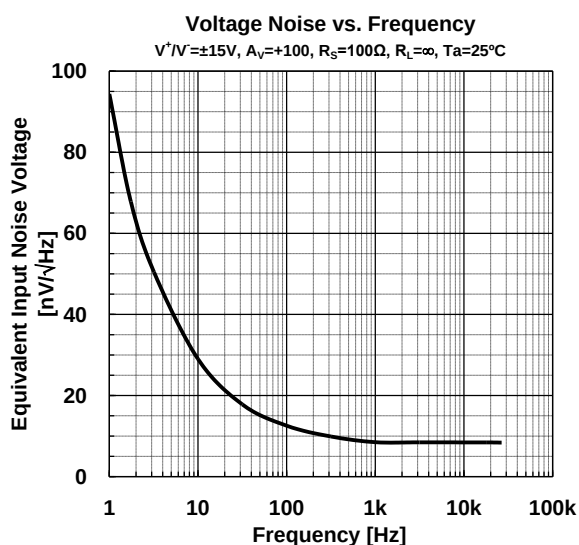


The MUSES logo is a trademark or registered trademark of Nisshinbo Micro Devices Inc.

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. E: SOP8 JEDEC 150mil (EMP8) 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	(Top View) A OUTPUT 1, A -INPUT 2, A +INPUT 3, V⁻ 4, V⁺ 8, B OUTPUT 7, B -INPUT 6, B +INPUT 5	(Top View) A OUTPUT 1, A -INPUT 2, A +INPUT 3, V⁻ 4, V⁺ 8, B OUTPUT 7, B -INPUT 6, B +INPUT 5 *About Exposed Pad Floating (Electrical open) or connecting to V⁻. 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 ($V_s = V^+ - V^-$)	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 ($T_a = 25^\circ\text{C}$) SOP8 JEDEC 150mil (EMP8) DFN8-X7(ESON8-X7)	P_D	2-Layer / 4-Layer 800 ^{*3} / 1200 ^{*4} 690 ^{*5} / 2900 ^{*6}	mW
Storage Temperature	T_{stg}	-50 to 150	$^\circ\text{C}$
Junction Temperature		150	$^\circ\text{C}$

^{*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 (θ_{ja})	Thermal Characterization Parameter (ψ_{jt})	
SOP8 JEDEC 150mil (EMP8) DFN8-X7 (ESON8-X7)	157 ^{*3} / 103 ^{*4} 182 ^{*5} / 44 ^{*6}	16 ^{*3} / 12 ^{*4} -	$^\circ\text{C/W}$

θ_{ja} : Junction-to-Ambient Thermal Resistance

ψ_{jt} : 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).

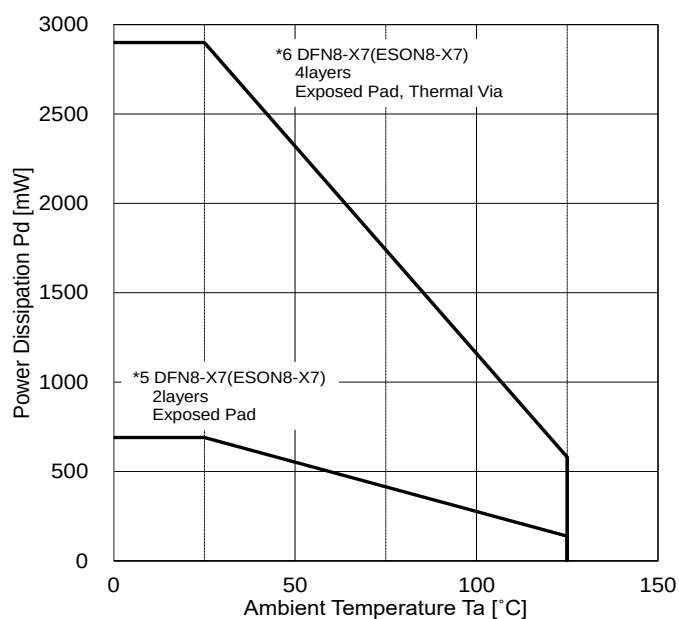
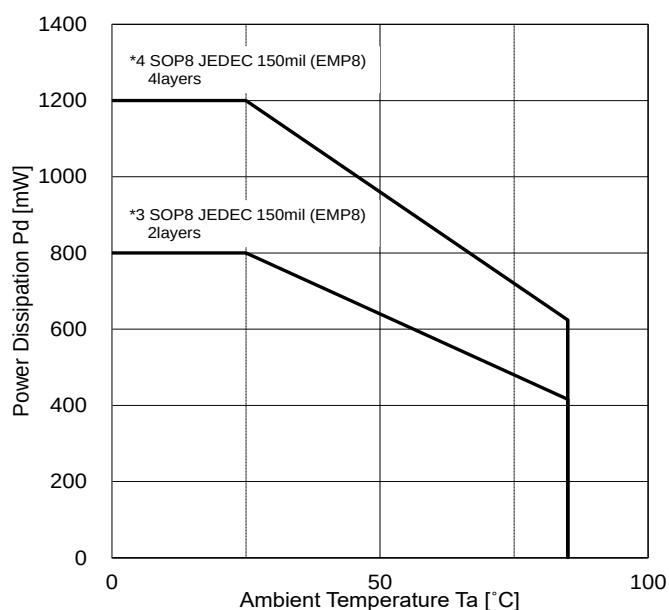
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■ POWER DISSIPATION vs. AMBIENT TEMPERATURE



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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.

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 SOP8 JEDEC 150mil (EMP8) DFN8-X7 (ESON8-X7)	T_a	-40 to 85 -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

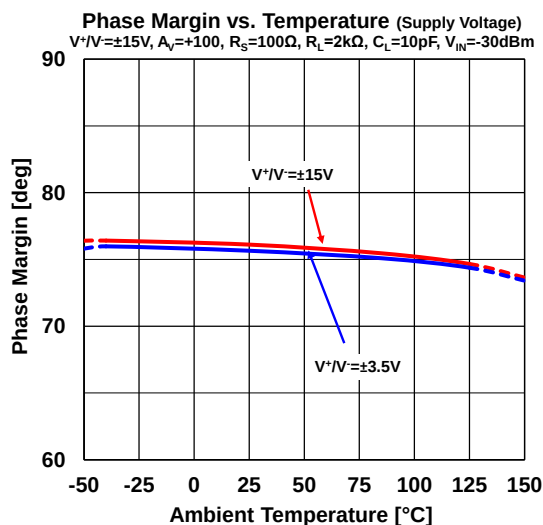
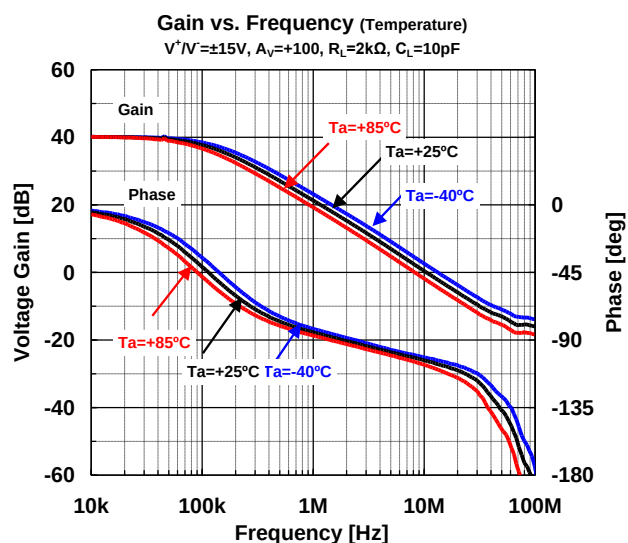
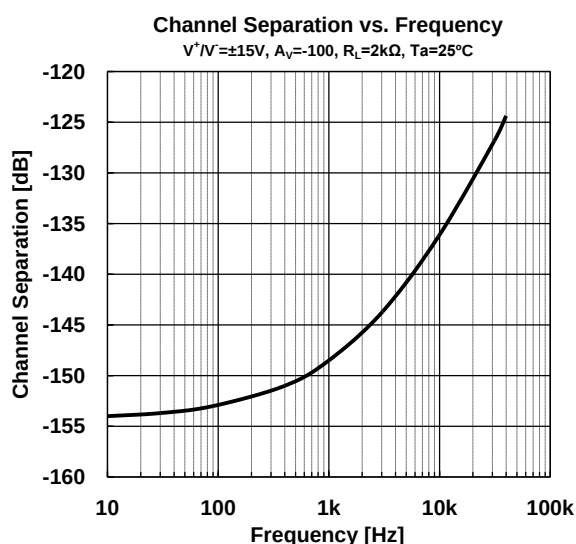
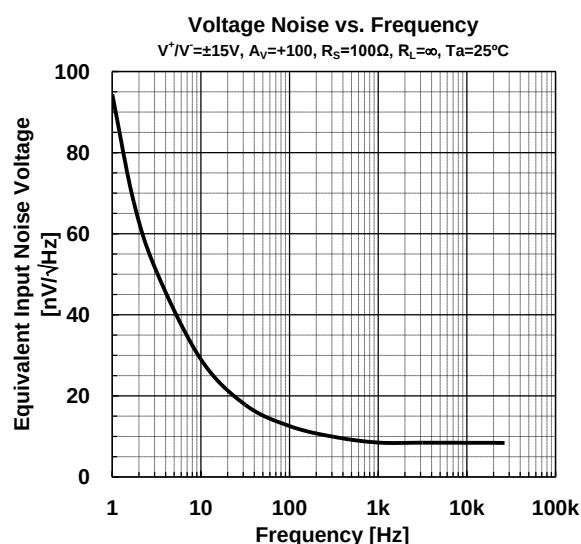
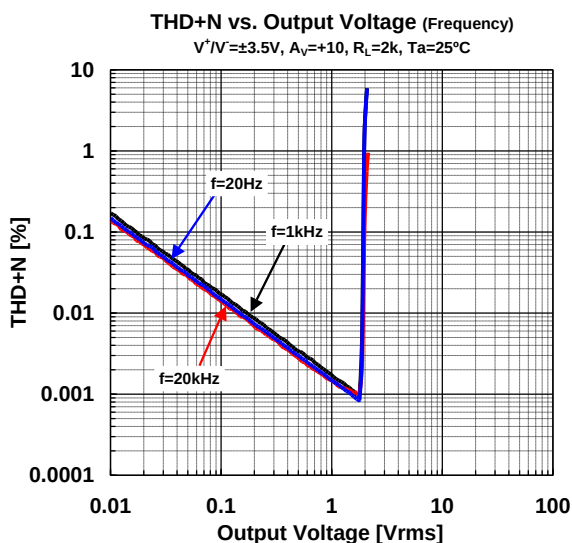
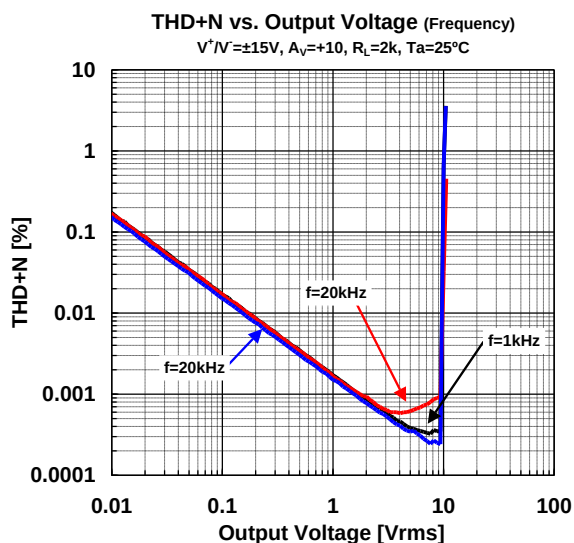
$V^+ / V^- = \pm 15V$, R_L to GND, $T_a = 25^\circ C$, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
DC CHARACTERISTICS						
Supply Current	I_{CC}	No Signal, $R_L = \infty$	-	9.0	12.0	mA
Input Offset Voltage	V_{IO}	$R_S = 50\Omega$	-	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}	$R_L = 10k\Omega$, $V_O = \pm 13V$	106	135	-	dB
Voltage Gain 2	A_{V2}	$R_L = 2k\Omega$, $V_O = \pm 12.8V$	105	133	-	dB
Voltage Gain 3	A_{V3}	$R_L = 600\Omega$, $V_O = \pm 12.5V$	105	130	-	dB
Common Mode Rejection Ratio	CMR	$V_{ICM} = \pm 12.5V^{*1}$	80	110	-	dB
Supply Voltage Rejection Ratio	SVR	$V^+ / V^- = \pm 3.5$ to $\pm 17V$	80	110	-	dB
Maximum Output Voltage 1	V_{OM1}	$R_L = 10k\Omega$	± 13	± 14	-	V
Maximum Output Voltage 2	V_{OM2}	$R_L = 2k\Omega$	± 12.8	± 13.8	-	V
Maximum Output Voltage 3	V_{OM3}	$R_L = 600\Omega$	± 12.5	± 13.5	-	V
Common Mode Input Voltage Range	V_{ICM}	CMR ≥ 80 dB	± 12.5	± 14	-	V
AC CHARACTERISTICS						
Gain Bandwidth Product	GBW	$f = 10kHz$	-	11	-	MHz
Unity Gain Frequency	f_T	$A_V = +100$, $R_S = 100\Omega$, $R_L = 2k\Omega$, $C_L = 10pF$	-	10	-	MHz
Phase Margin	Φ_M	$A_V = +100$, $R_S = 100\Omega$, $R_L = 2k\Omega$, $C_L = 10pF$	-	70	-	Deg
Slew Rate	SR	$A_V = 1$, $V_{IN} = 2V_{p-p}$, $R_L = 2k\Omega$, $C_L = 10pF$	-	25	-	V/ μs
Channel Separation	CS	$f = 1kHz$, $A_V = +100$, $R_S = 1k\Omega$, $R_L = 2k\Omega$	-	150	-	dB
Total Harmonic Distortion	THD	$f = 1kHz$, $A_V = +10$, $V_O = 5V_{rms}$, $R_L = 2k\Omega$	-	0.0004	-	%
Input Noise Voltage1	e_n	$f = 1kHz$	-	8.0	-	nV/ $\sqrt{Hz}$
Input Noise Voltage2	V_{NI}	$f = 20Hz$ to $20kHz$	-	1.1	-	μV_{rms}

*1 CMR is calculated by specified change in offset voltage. ($V_{ICM} = 0V$ to $+12.5V$, $V_{ICM} = 0V$ to $-12.5V$)

■ TYPICAL CHARACTERISTICS

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

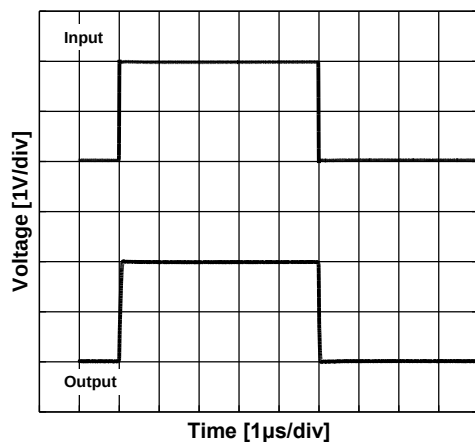


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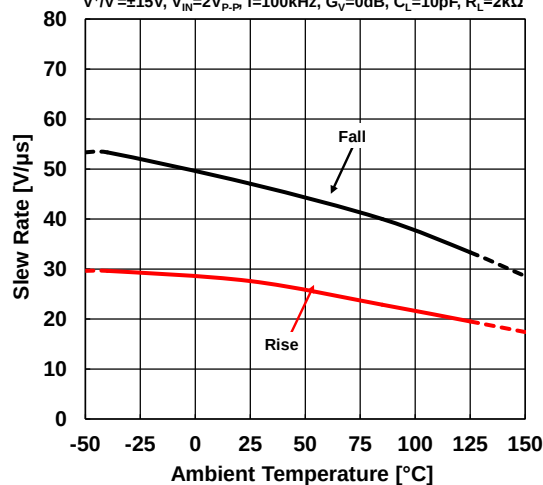
Pulse Response

$V^+/V^- = \pm 15V$, $G_v = 0dB$, $C_L = 10pF$, $R_L = 2k\Omega$, $T_a = 25^\circ C$



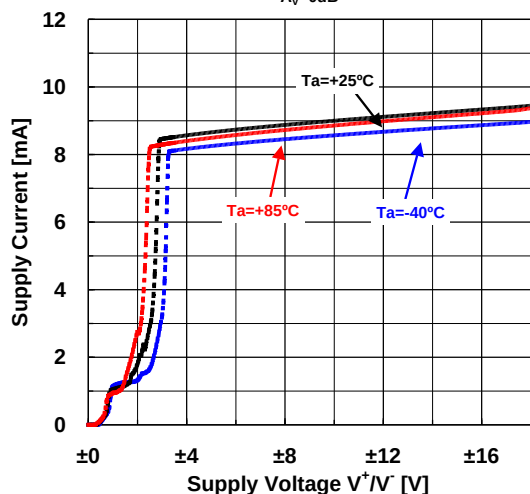
Slew Rate vs. Temperature

$V^+/V^- = \pm 15V$, $V_{IN} = 2V_{P-P}$, $f = 100kHz$, $G_v = 0dB$, $C_L = 10pF$, $R_L = 2k\Omega$



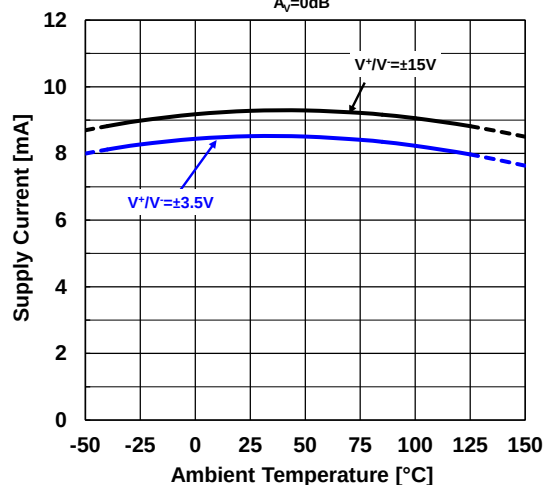
Supply Current vs. Supply Voltage (Temperature)

$A_v = 0dB$



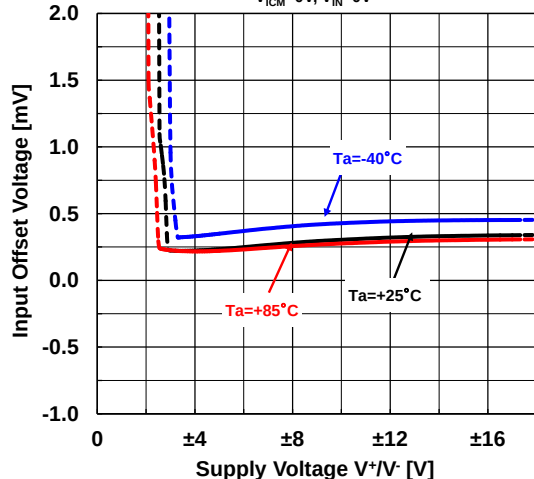
Supply Current vs. Temperature (Supply Voltage)

$A_v = 0dB$



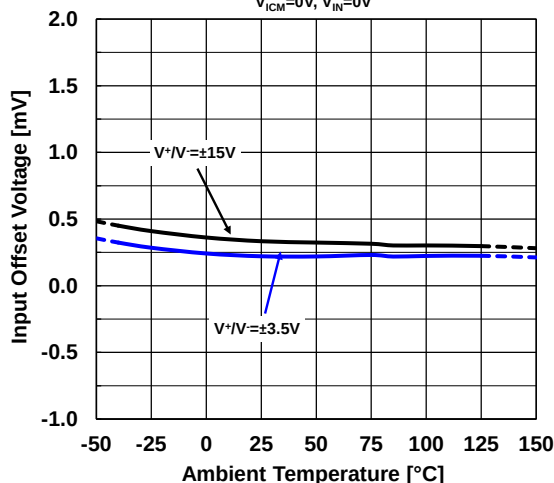
Input Offset Voltage vs. Supply Voltage (Temperature)

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



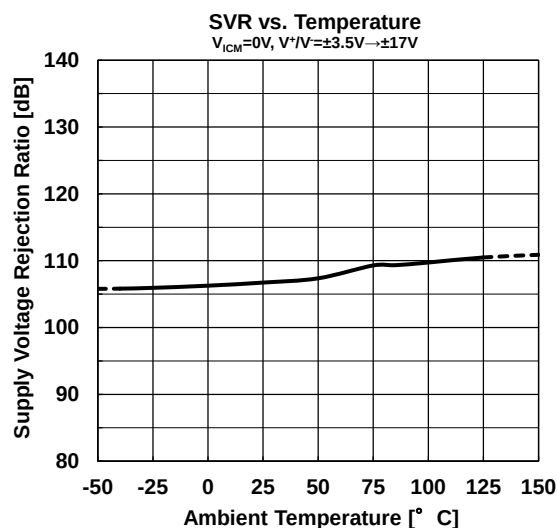
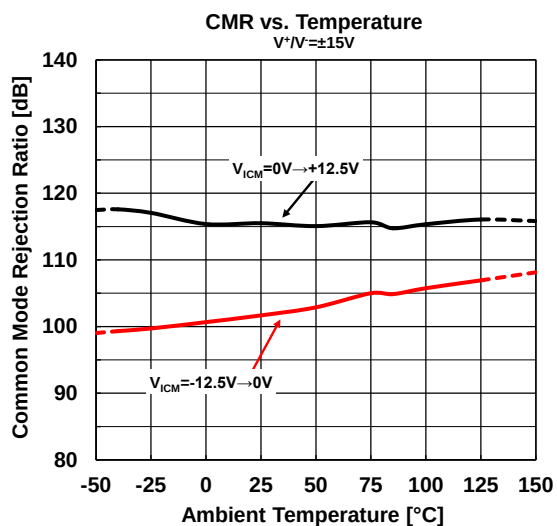
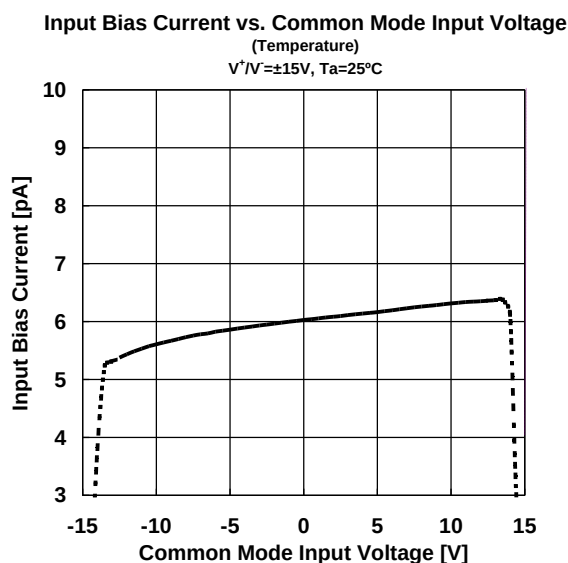
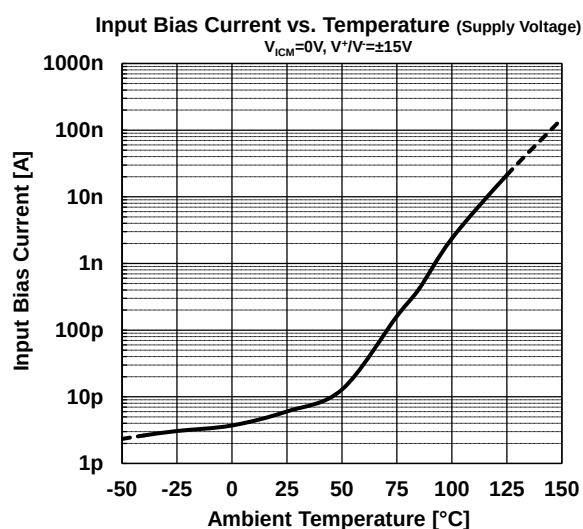
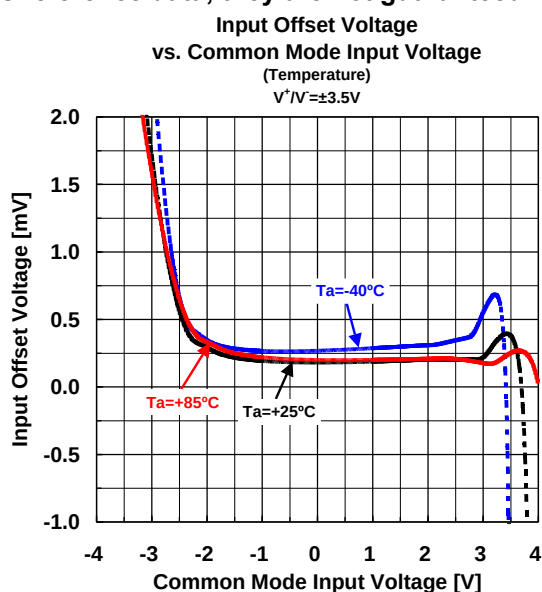
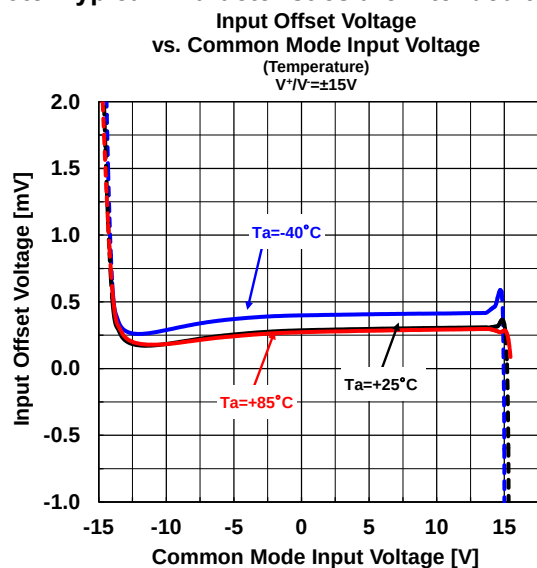
Input Offset Voltage vs. Temperature (Supply Voltage)

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



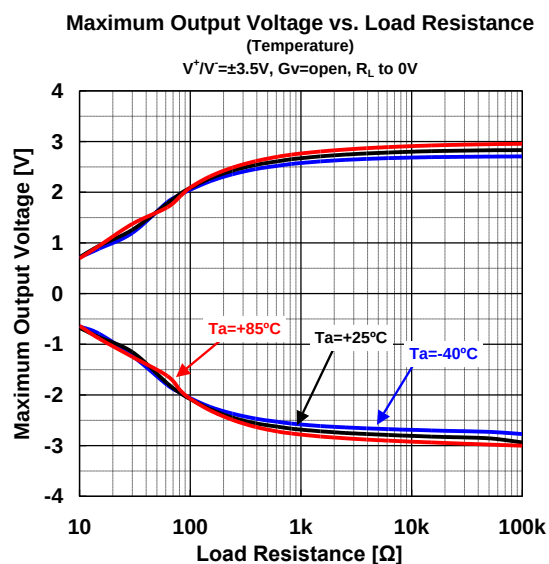
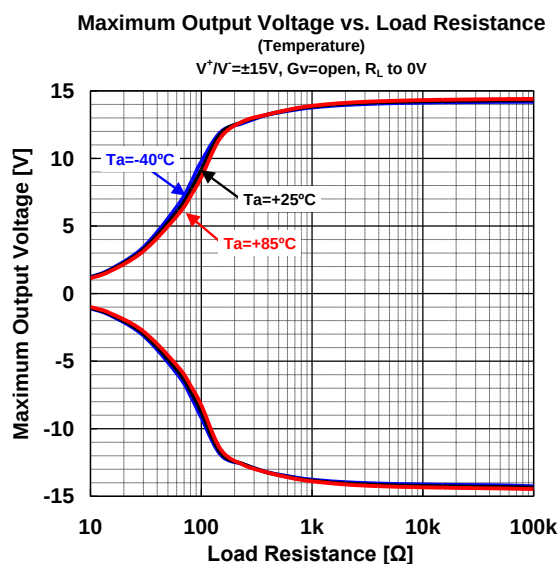
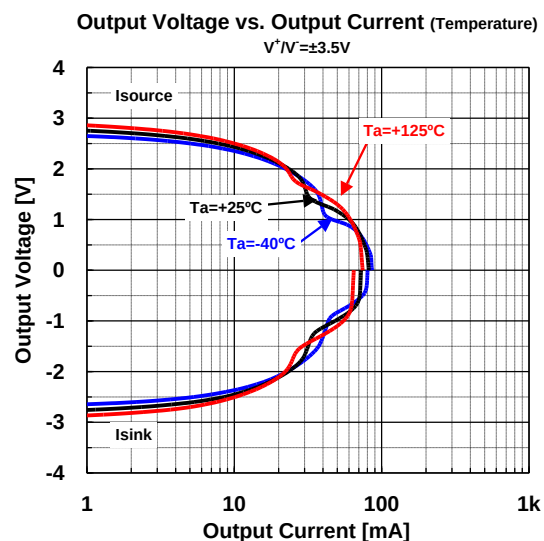
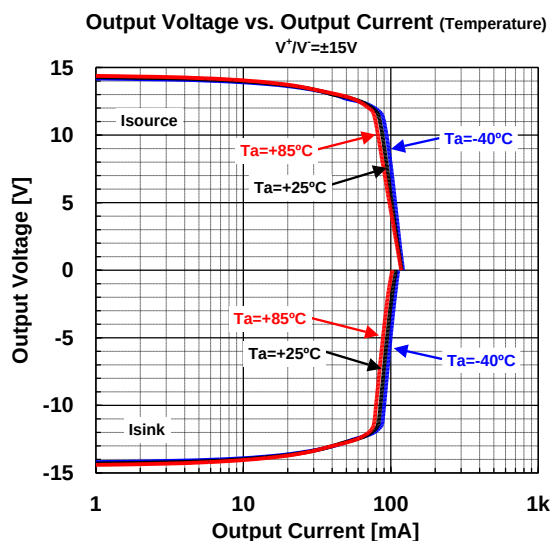
■ TYPICAL CHARACTERISTICS

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■ TEST CIRCUITS

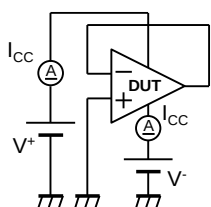


Figure 1. Supply Current

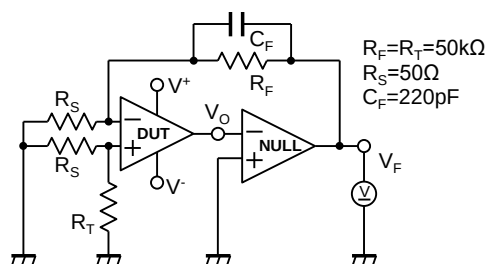


Figure 2. Input Offset Voltage

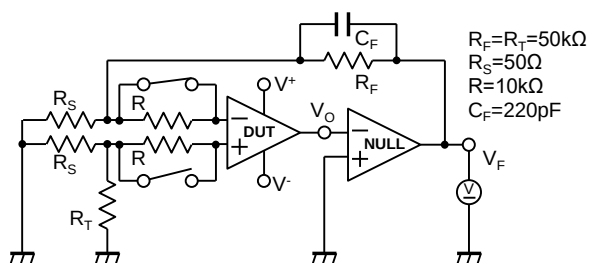


Figure 3. Input Bias Current

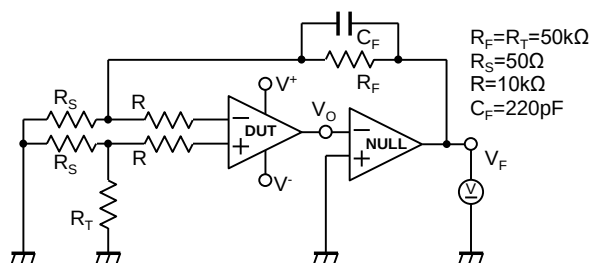


Figure 4. Input Offset Current

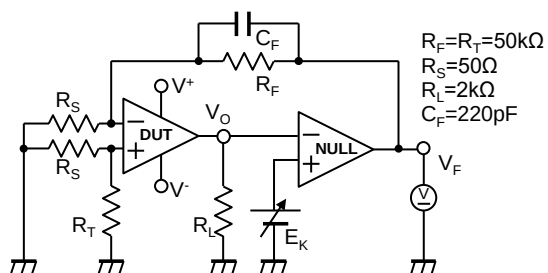


Figure 5. Open-Loop Voltage Gain

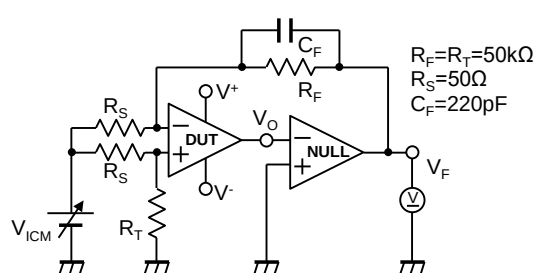


Figure 6. Common Mode Rejection Ratio

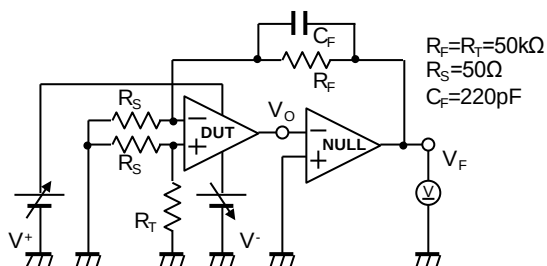


Figure 7. Supply Voltage Rejection Ratio

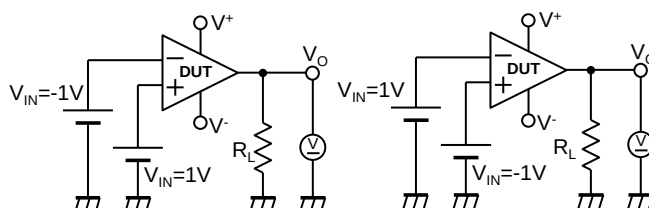


Figure 8. Maximum Output Voltage

■ TEST CIRCUITS

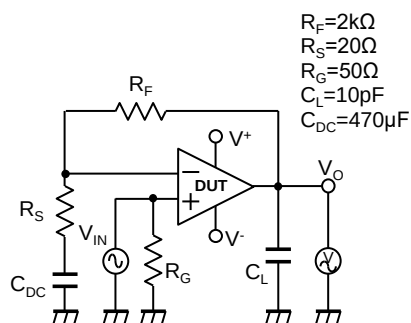


Figure 9. Gain Bandwidth Product

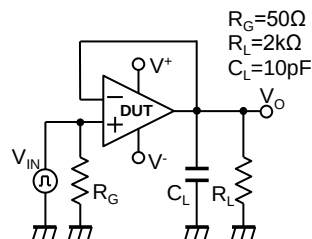


Figure 10. Slew Rate

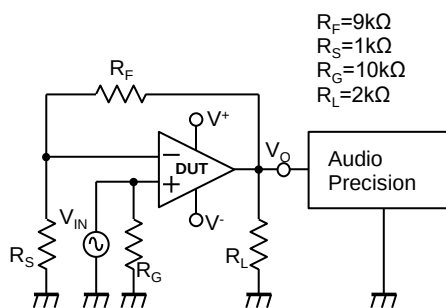


Figure 11. Total Harmonic Distor

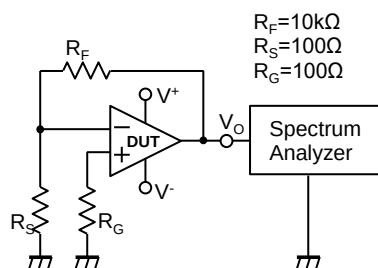
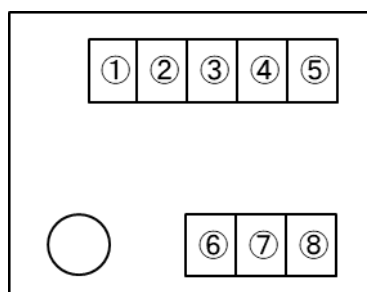


Figure 12. Input Noise Voltage

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

①②③④⑤: Product Cord Refer to Part Marking List

⑥⑦⑧: Control Number



SOP8 JEDEC 150mil (EMP8) Part Markings

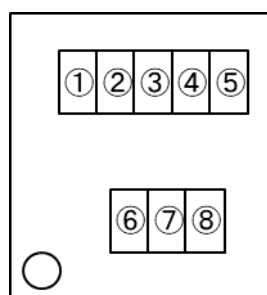
Part Marking List (SOP8 JEDEC 150mil (EMP8))

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

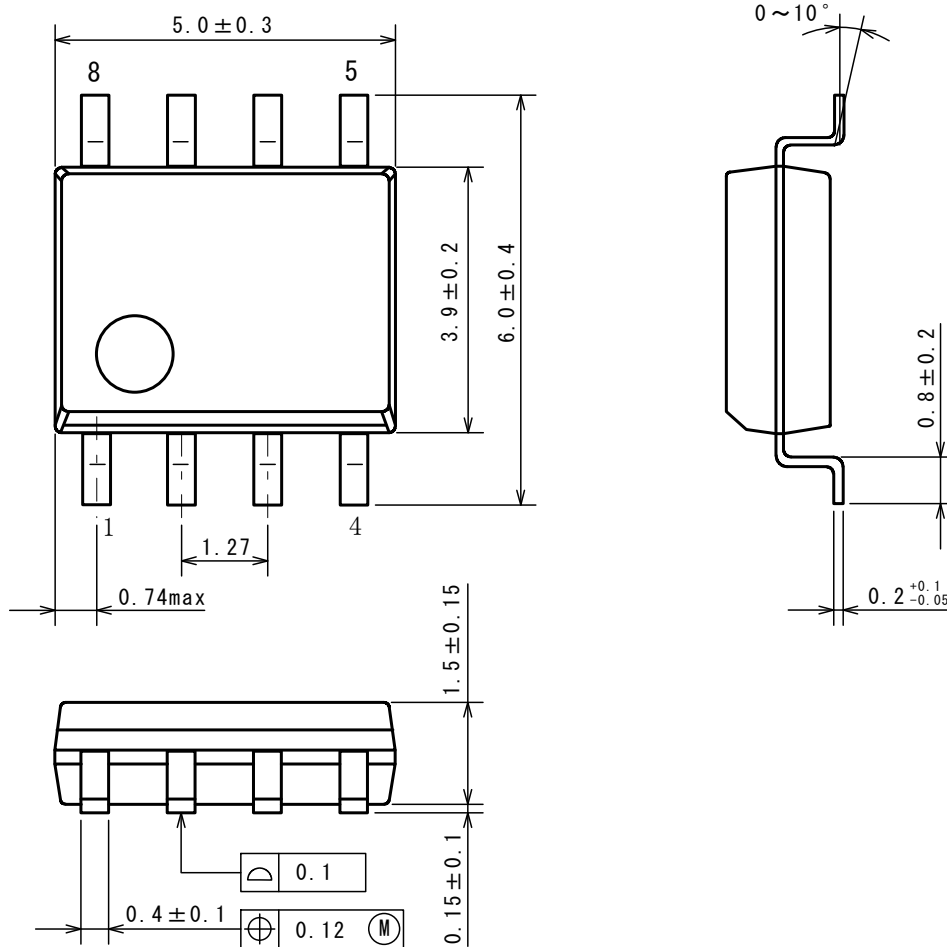
Nisshinbo Micro Devices Inc.

SOP8 JEDEC 150mil(EMP8)

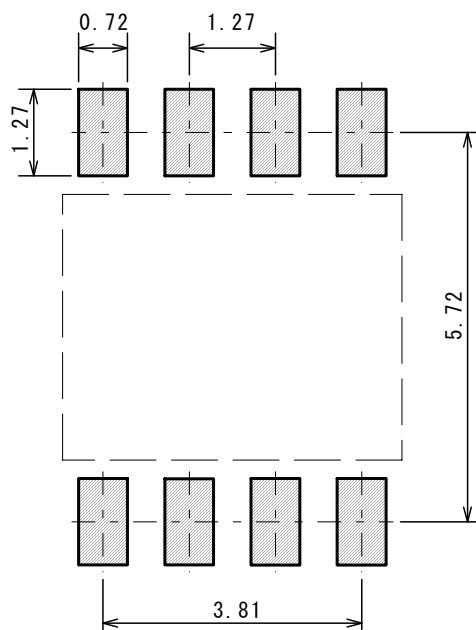
PI-SOP8 JEDEC 150mil-E-B

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



Nisshinbo Micro Devices Inc.

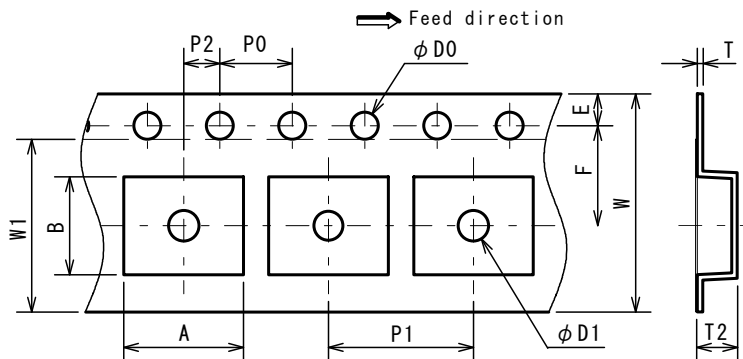
SOP8 JEDEC 150mil(EMP8)

PI-SOP8 JEDEC 150mil-E-B

■ PACKING SPEC

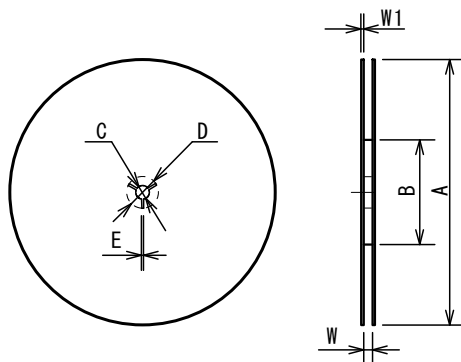
UNIT: mm

TAPING DIMENSIONS



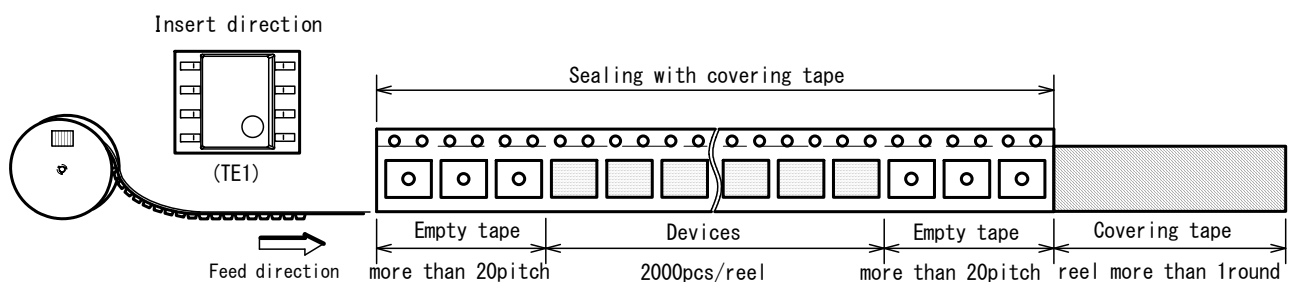
SYMBOL	DIMENSION	REMARKS
A	6.6	BOTTOM DIMENSION
B	5.4	BOTTOM DIMENSION
D0	1.5 ^{+0.1} ₀	
D1	1.7±0.1	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.30±0.05	
T2	2.2	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

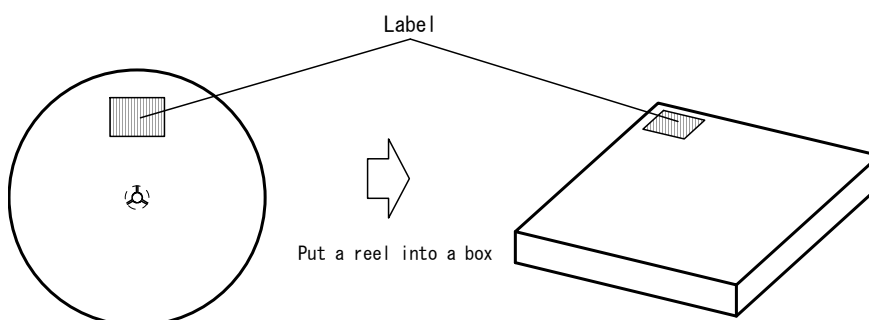


SYMBOL	DIMENSION
A	φ 330±2
B	φ 80±1
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2.0±0.2

TAPING STATE

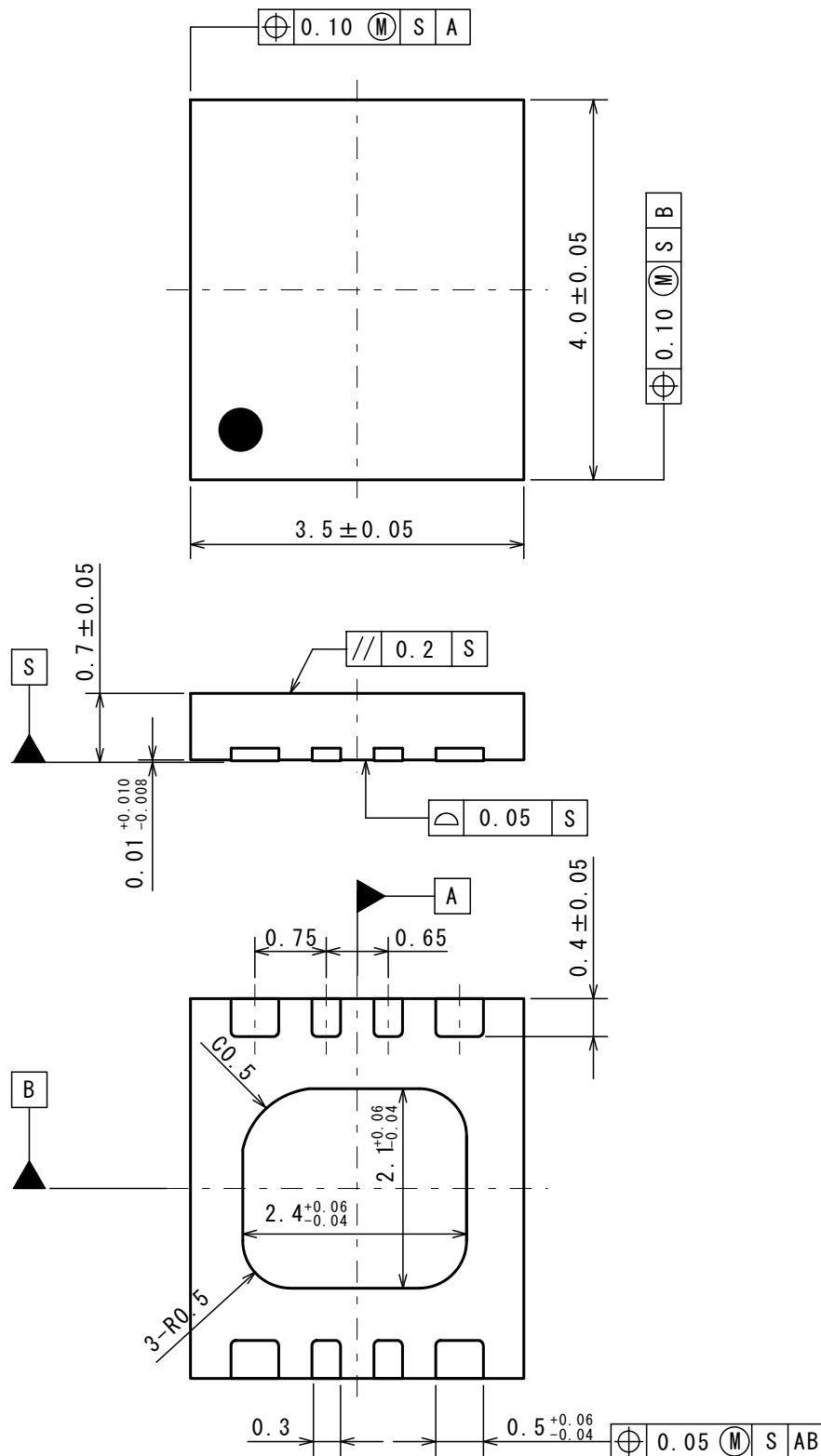


PACKING STATE



■ PACKAGE DIMENSIONS

UNIT: mm



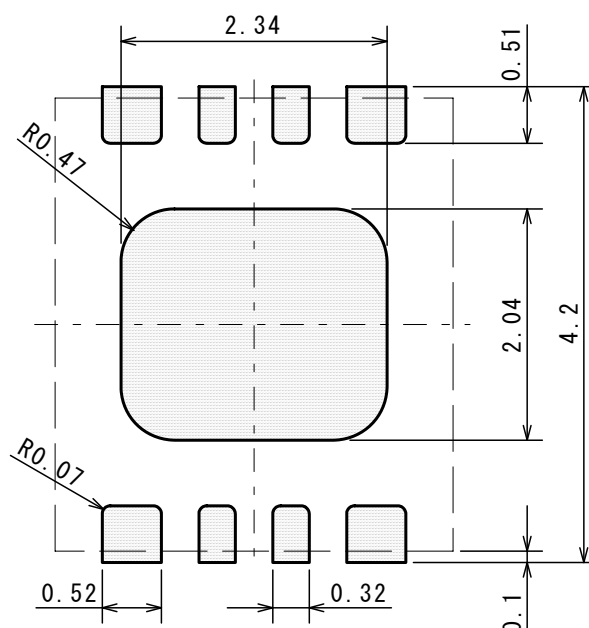
Nisshinbo Micro Devices Inc.

DFN8-X7(ESON8-X7)

PI-DFN8-X7-E-B

■ EXAMPLE OF SOLDER PADS DIMENSIONS

UNIT: mm



Nisshinbo Micro Devices Inc.

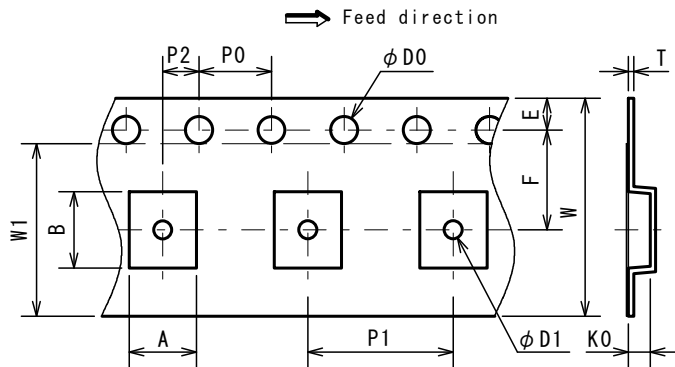
DFN8-X7(ESON8-X7)

PI-DFN8-X7-E-B

■ PACKING SPEC

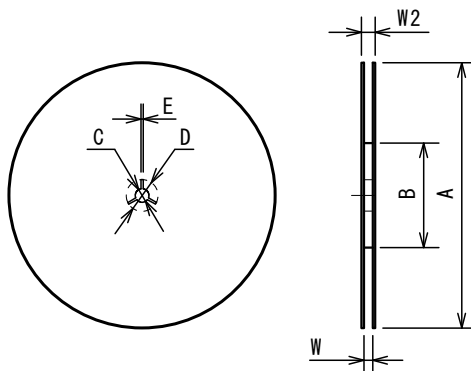
UNIT: mm

TAPING DIMENSIONS



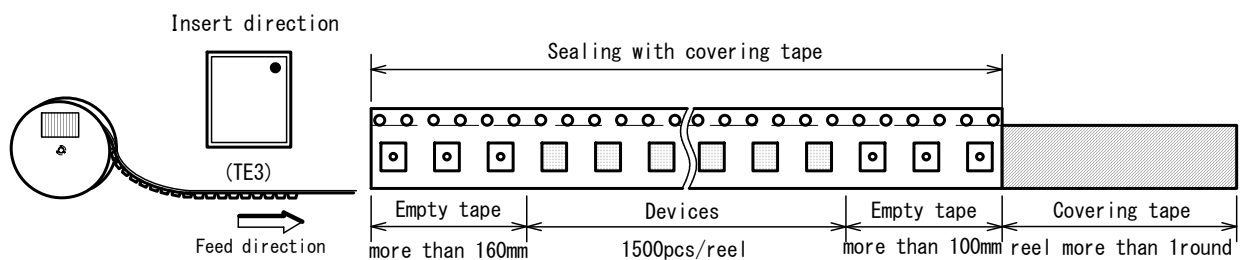
SYMBOL	DIMENSION	REMARKS
A	3.7 ± 0.05	BOTTOM DIMENSION
B	4.2 ± 0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{-0}$	
D1	1.0 ± 0.1	
E	1.75 ± 0.1	
F	5.5 ± 0.05	
P0	4.0 ± 0.1	
P1	8.0 ± 0.1	
P2	2.0 ± 0.05	
T	0.25 ± 0.05	
K0	0.85 ± 0.05	
W	$12.0^{+0.3}_{-0.1}$	
W	9.5	THICKNESS 0.1max

REEL DIMENSIONS

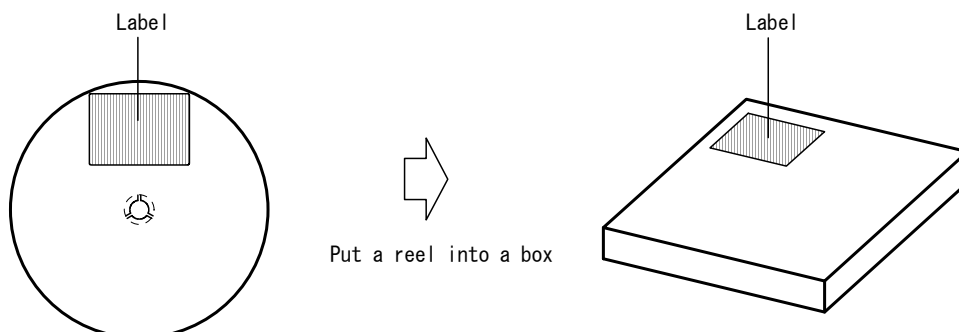


SYMBOL	DIMENSION
A	$\phi 180^{+0}_{-3}$
B	$\phi 60^{+1}_{-0}$
C	$\phi 13 \pm 0.2$
D	$\phi 21 \pm 0.8$
E	2 ± 0.5
W	13^{+1}_{-0}
W2	15.4 ± 1.0

TAPING STATE



PACKING STATE



1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to our sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without the prior written consent of us.
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 - 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 (automotive, airplane, railroad, ship, etc.)
 - Various Safety Devices
 - Traffic control system
 - Combustion equipment

In case your company desires to use this product for any applications other than general electronic equipment mentioned above, make sure to contact our company in advance. Note that the important requirements mentioned in this section are not applicable to cases where operation requirements such as application conditions are confirmed by our company in writing after consultation with your company.

6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. The 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. We 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.
8. **Quality Warranty**
 - 8-1. **Quality Warranty Period**

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.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. 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.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.



Nisshinbo Micro Devices Inc.

Official website

<https://www.nisshinbo-microdevices.co.jp/en/>

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