Nisshinbo Micro Devices Inc.

NJM2904C/NJM2904CA
SINGLE-SUPPLY DUAL OPERATIONAL AMPLIFIER

FEATURES

- Single Supply
- Operating Voltage +3V to +32V
- Low Operating Current 0.7mA typ.
- Slew Rate 0.6V/µs typ.
- Bipolar Technology
- Package Outline

SOP8, DMP8, SSOP8, EQFN12-E2,
MSOP-8-BM **MEET JEDEC MO-187-DA
MSOP8 (TVSP8) **MEET JEDEC MO-187-DA / THIN TYPE

- Internal ESD protection

Human body model (HBM) ±2000V typ.

- Wide temperature range -40°C to +125°C
- Input Offset Voltage Grade

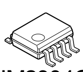
NJM2904C(Normal-Grade)	NJM2904CA(A-Grade)
7mV max.	2mV max.

* NJM2904CME2, NJM2904CBM don't have a A version.

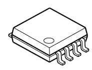
GENERAL DESCRIPTION

The NJM2904C / NJM2904CA consists of two independent, high gain, internally frequency compensated operation amplifiers, which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

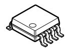
Application areas include transducer amplifiers, DC gain blocks, and all the conventional op amp circuits, which now can be more easily implemented in single power supply systems. For example, the NJM2904C can be directly operated off of the standard +5V power supply voltage, which is used in digital systems and will easily provide the required interface electronics without requiring the additional ±15V power supplies.



NJM2904CG
NJM2904CAG
(SOP8)

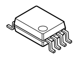


NJM2904CM
NJM2904CAM
(DMP8)



NJM2904CRB1
NJM2904CARB1
(MSOP8(TVSP8))

NJM2904CBM
(MSOP-8-BM)

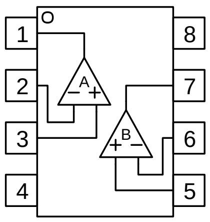


NJM2904CV
NJM2904CAV
(SSOP8)

NJM2904CME2
(EQFN12-E2)

PIN CONFIGURATION

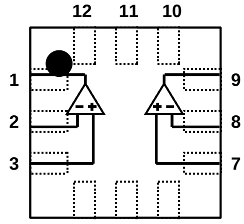
(Top View)



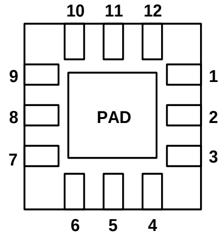
PIN FUNCTION
1.A OUTPUT
2.A - INPUT
3.A + INPUT
4.V-
5.B + INPUT
6.B - INPUT
7.B OUTPUT
8.V+

NJM2904CG/2904CAG
NJM2904CM/2904CAM
NJM2904CRB1/2904CARB1
NJM2904CV/2904CAV
NJM2904CBM

(Top View)



(Bottom View)

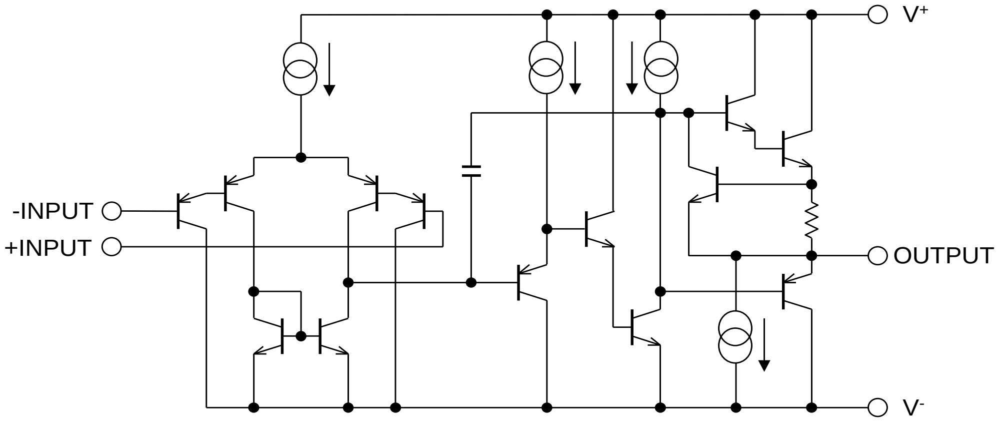


NJM2904CME2 (Note1, 2, 3)

PIN FUNCTION
1. A OUTPUT
2. A –INPUT
3. A +INPUT
4. NC
5. V-
6. NC
7. B +INPUT
8. B –INPUT
9. B OUTPUT
10. NC
11. V+
12. NC

(Note1) The PAD have to be wired as short as possible to connect with a V- terminal.
(Note2) The PAD is electronically connected to the backside of the die. But, there cannot be used as V- pin.
(Note3) The NC pin is not internally connected.

■ EQUIVALENT CIRCUIT (1/2 Shown)



■ ABSOLUTE MAXIMUM RATINGS

(Ta=25˚C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	$V^+ - V^-$	+32	V
Differential Input Voltage (Note4)	V_{ID}	±32	V
Input Voltage (Note5)	V_{IN}	V^- - 0.3 to V^- + 32	V
Output Terminal Input Voltage	Vo	V^- - 0.3 to V^+ +0.3	V
Power Dissipation	P_D	SOP8 : 690 (Note6) 1000(Note7) DMP8 : 470 (Note6) 600 (Note7) MSOP8(TVSP8) : 510(Note6) 680 (Note7) SSOP8 : 430 (Note6) 540(Note7) EQFN12-E2 : 440 (Note8) 680(Note9) MSOP-8-BM : 960(Note10)	mW
Operating Temperature Range	T_{opr}	-40 to +125	˚C
Storage Temperature Range	T_{stg}	-65 to +150	˚C

(Note4)Differential voltage is the voltage difference between +INPUT and -INPUT.
(Note5) Input voltage is the voltage should be allowed to apply to the input terminal independent of the magnitude of V+.
The normal operation will establish when any input is within the Common Mode Input Voltage Range of electrical characteristics.
(Note6) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 2layers, FR-4) mounting
(Note7) EIA/JEDEC STANDARD Test board (76.2 x 114.3 x 1.6mm, 4layers, FR-4) mounting
(Note8) EIA/JEDEC STANDARD Test board (101.5 x 114.3 x 1.6mm, 2layers, FR-4) mounting
(Note9) EIA/JEDEC STANDARD Test board (101.5 x 114.3 x 1.6mm, 4layers, FR-4) mounting
(Note 10) Power consumption is measured on our original specification board (76.2x114.3x0.8mm, 4 layers, FR-4) mounted based on EIA/JEDEC

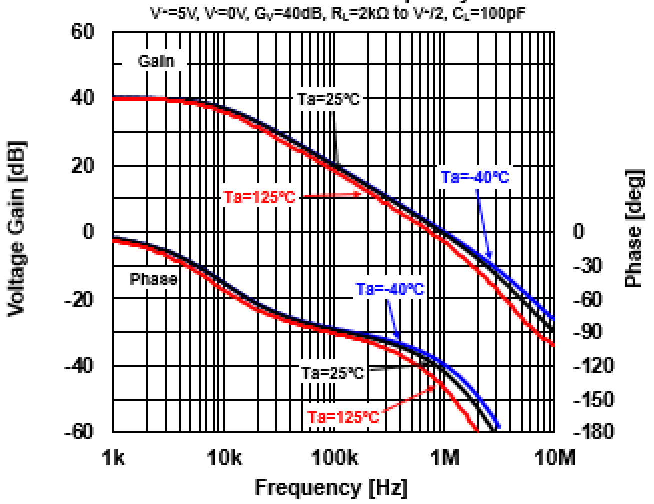
■ELECTRICAL CARACTERISTICS

(V^+=5V, V^-=0V, Ta=25ºC, unless otherwise noted.)

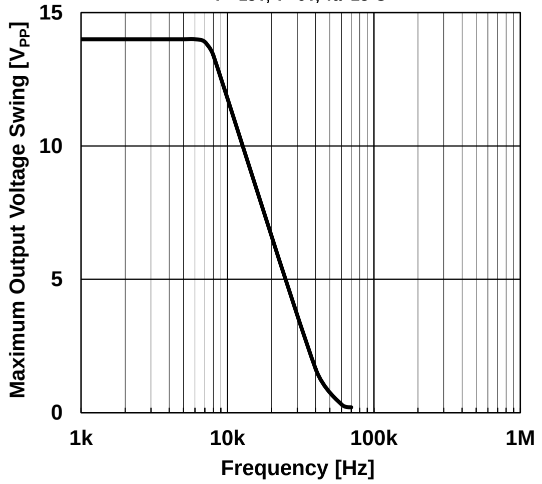
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current (All amplifiers)	I_{SUPPLY}	V^+=5V, no signal	-	0.7	1.2	mA
		V^+=30V, no signal	-	-	2	
Input Offset Voltage	V_{IO}	R_S=0Ω	-	0.5	7	mV
		R_S=0Ω , NJM2904CA	-	0.5	2	
Input Bias Current	I_B		-	20	150	nA
Input Offset Current	I_{IO}		-	2	30	nA
Open-Loop Voltage Gain	A_V	R_L≥2kΩ	94	100	-	dB
Supply Voltage Rejection Ratio	SVR	V^+=5 to 30V,Rs<10kΩ	65	100	-	dB
Common Mode Input Voltage Range	V_{ICM}	V^+=30V, CMR>70dB	0	-	V^+-1.5	V
Common Mode Rejection Ratio	CMR	Rs<10kΩ	70	100	-	dB
Output Source Current	I_{SOURCE}	V^+=15V,V_o=+2V, V_{IN}+=1V, V_{IN}-=0V	20	40	-	mA
Output Sink Current	I_{SINK}	V^+=15V,V_o=+2V, V_{IN}+=0V, V_{IN}-=1V	10	20	-	mA
		V^+=15V,V_o=+0.2V, V_{IN}+=0V, V_{IN}-=1V	12	50	-	µA
High-level output voltage	V_{OH}	R_L=2kΩ,V^+=30V	26	27	-	V
		R_L=10kΩ,V^+=30V	27	28	-	
Low-level output voltage	V_{OL}	R_L=10kΩ	-	5	20	mV
Slew Rate	SR	V^+=15V,V_{IN}=0.5 to 3V,C_L=100pF	-	0.6	-	V/µs
Gain Band Width Product	GBW	V^+=30V,f=100kHz,V_{IN}=10mVrms,R_L=2kΩ, C_L=100pF	-	1.1	-	MHz
Total Harmonic Distortion + Noise	THD+N	f=1kHz,G_v=20dB,R_L=2kΩ,V_o=2V_{pp},C_L=100pF	-	0.02	-	%
Equivalent input noise voltage	e_n	f=1kHz, Rs =100Ω,V^+=30V	-	30	-	nV/√Hz
Channel Separation	CS	1kHz< f <10kHz	-	120	-	dB

■ TYPICAL CHARACTERISTICS

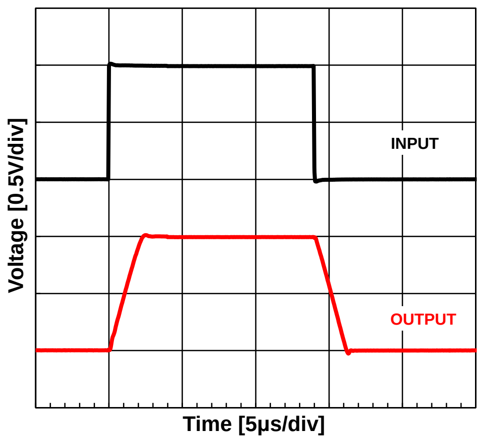
Gain/Phase vs. Frequency
V^+=5V, V^-=0V, G_V=40dB, R_L=2kΩ to V^+/2, C_L=100pF



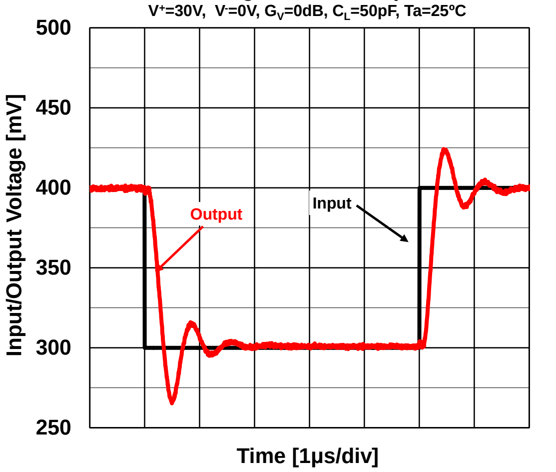
Maximum Output Voltage Swing vs. Frequency
V^+=15V, V^-=0V, Ta=25°C



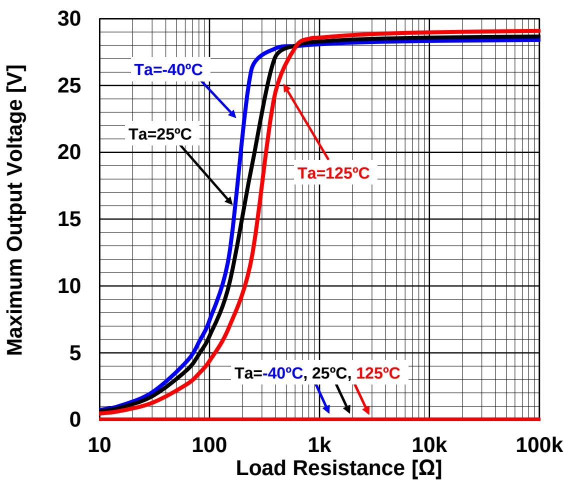
Pulse Response
V^+=15V, V^-=0V, R_L=2kΩ, C_L=100pF, Ta=25°C



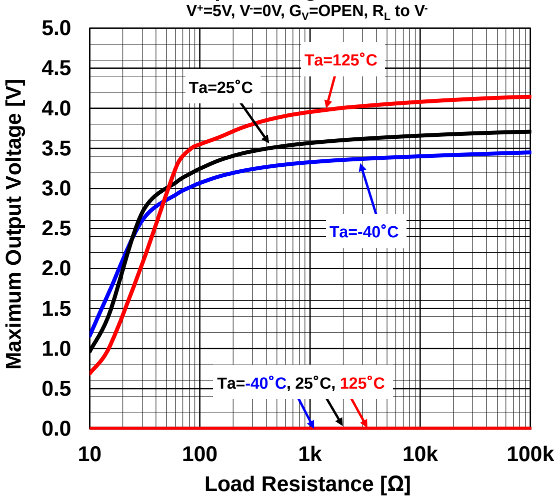
Small Signal Pulse Response
V^+=30V, V^-=0V, G_V=0dB, C_L=50pF, Ta=25°C



Maximum Output Voltage vs. Load Resistance
V^+=30V, V^-=0V, G_V=OPEN, R_L to V^-

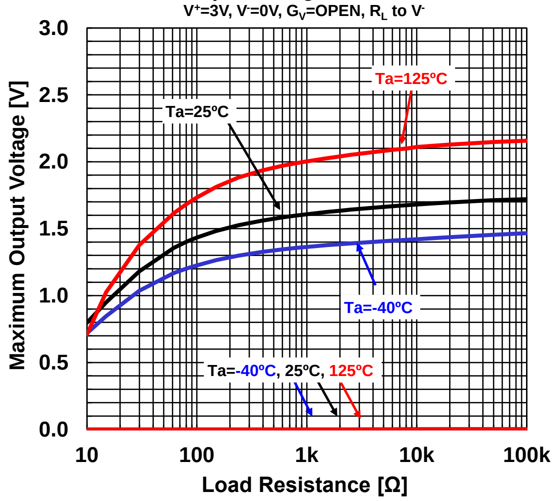


Maximum Output Voltage vs. Load Resistance
V^+=5V, V^-=0V, G_V=OPEN, R_L to V^-

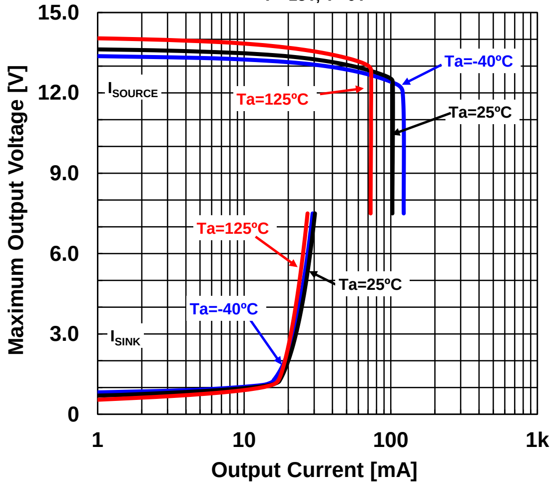


■ TYPICAL CHARACTERISTICS

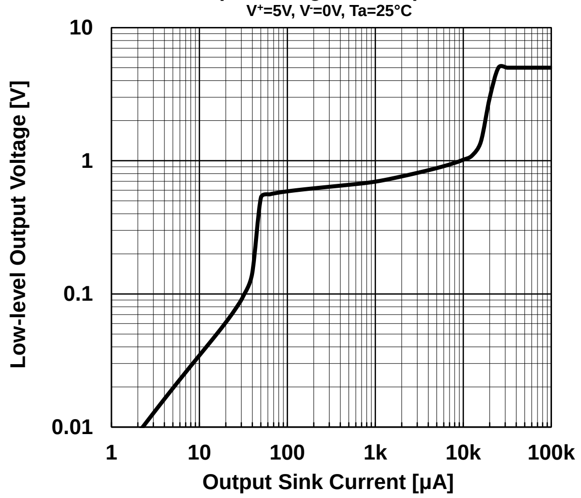
Maximum Output Voltage vs. Load Resistance
V^+=3V, V^-=0V, G_V=OPEN, R_L to V^-



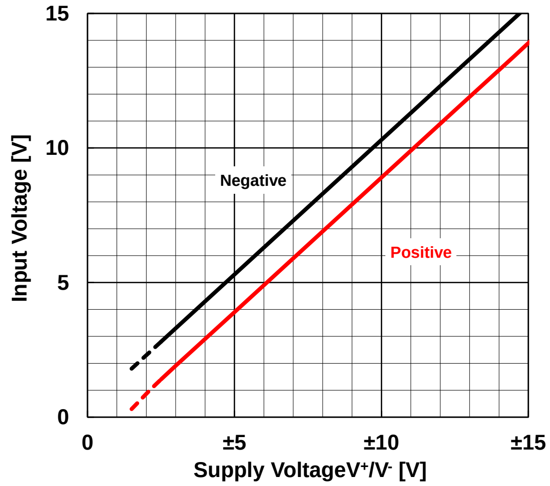
Maximum Output Voltage vs. Output Current
V^+=15V, V^-=0V



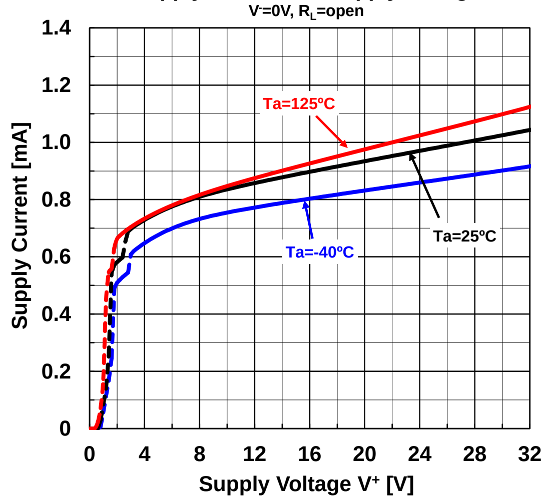
Low-level Output Voltage vs. Output Sink Current
V^+=5V, V^-=0V, Ta=25°C



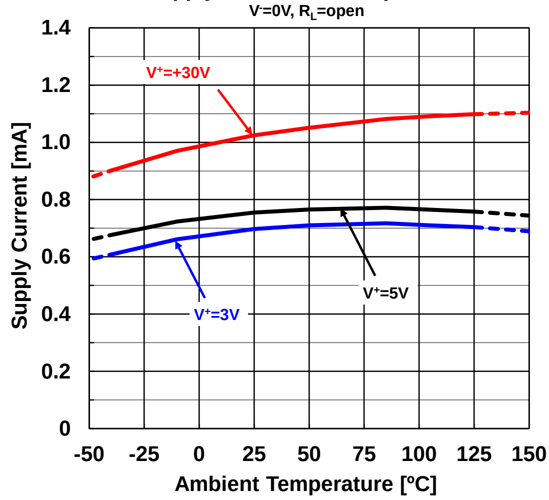
Input Voltage Range vs. Supply Voltage
Ta=25°C



Supply Current vs. Supply Voltage
V^-=0V, R_L=open

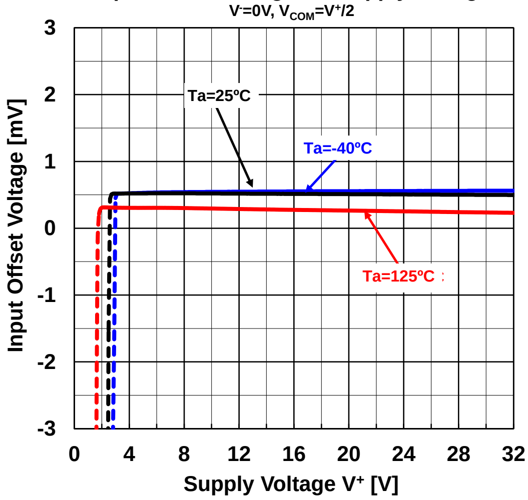


Supply Current vs. Temperature
V^-=0V, R_L=open

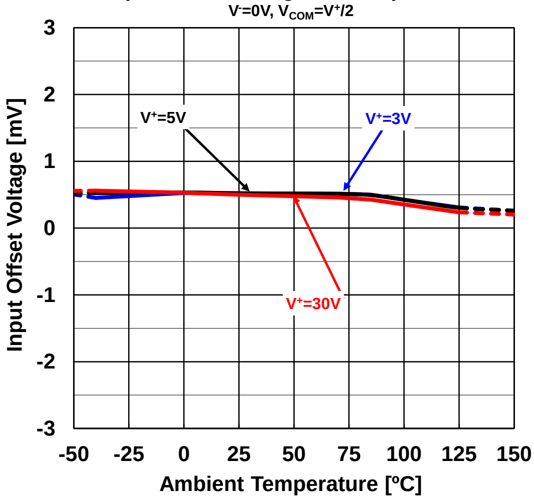


■ TYPICAL CHARACTERISTICS

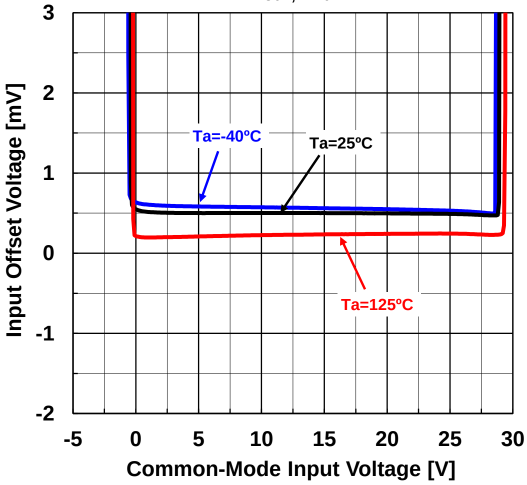
Input Offset Voltage vs. Supply Voltage
V^-=0V, V_{COM}=V^+/2



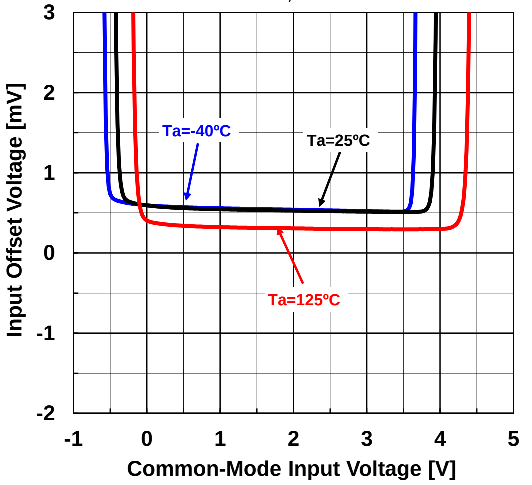
Input Offset Voltage vs. Temperature
V^-=0V, V_{COM}=V^+/2



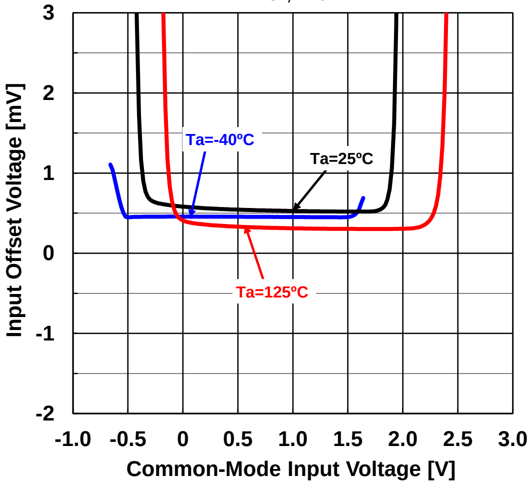
Input Offset Voltage vs. Common-Mode Input Voltage
V^+=30V, V^-=0V



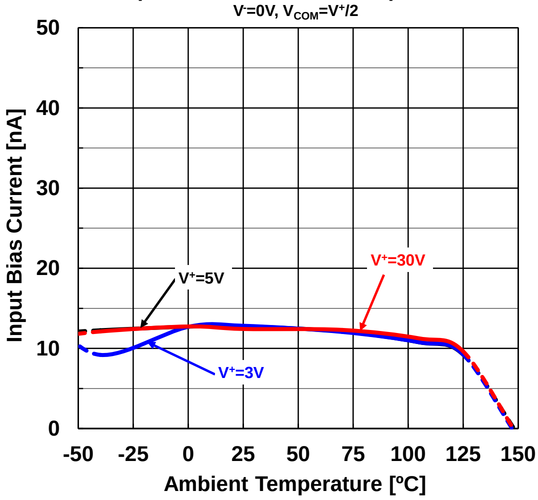
Input Offset Voltage vs. Common-Mode Input Voltage
V^+=5V, V^-=0V



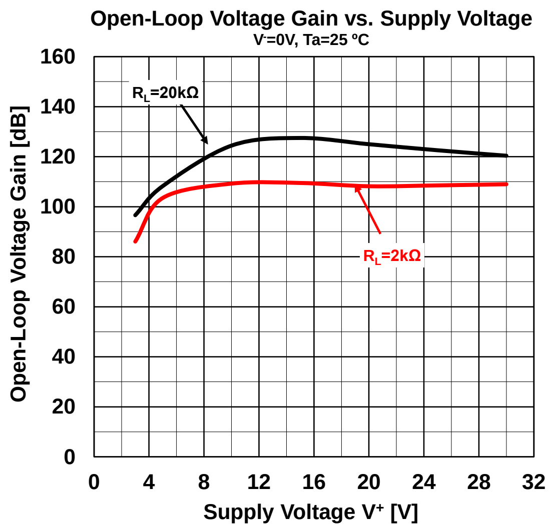
Input Offset Voltage vs. Common-Mode Input Voltage
V^+=3V, V^-=0V

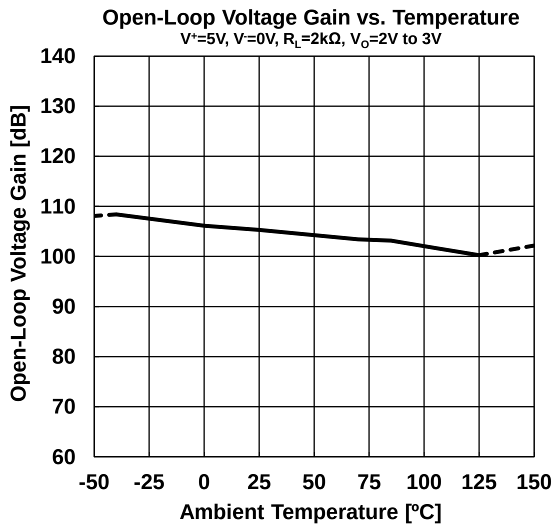


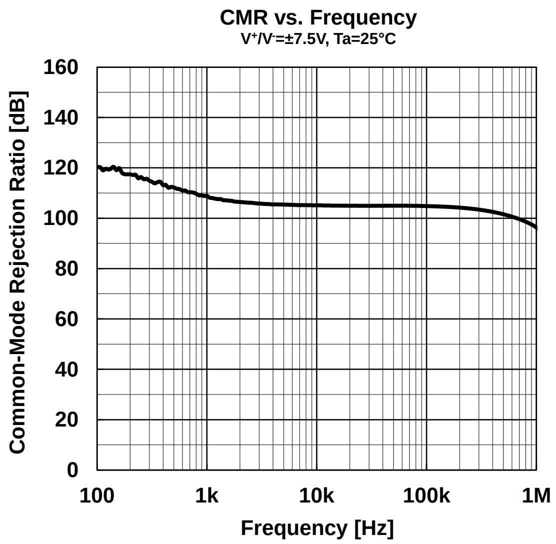
Input Bias Current vs. Temperature
V^-=0V, V_{COM}=V^+/2

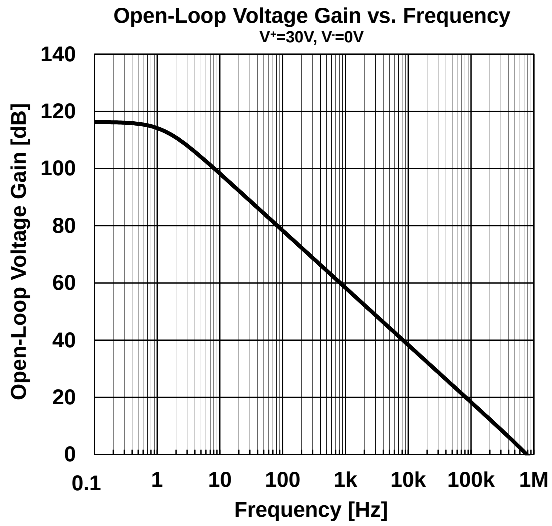


■ TYPICAL CHARACTERISTICS





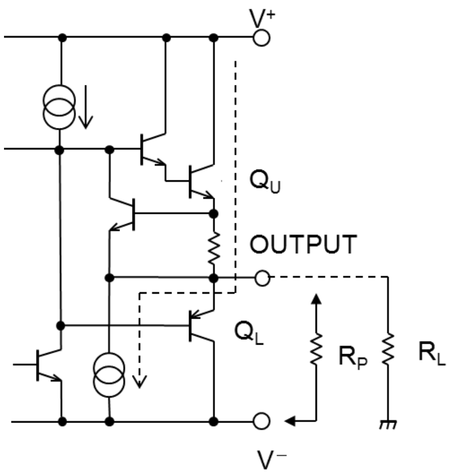




■ APPLICATION

Improvement of Cross-over Distortion

Equivalent circuit at the output stage

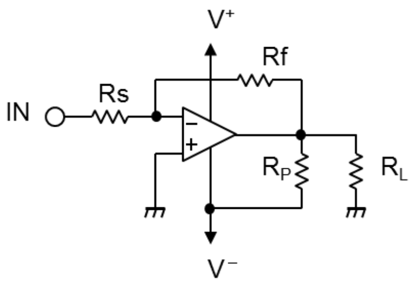


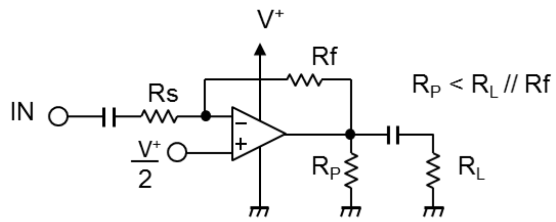
NJM2904C / NJM2904CA,in its static state (No in and output condition) when design,Q_U being biassed by constant current (break down beam) yet,Q_L stays OFF.

While using with both power source mode,the cross-over distortion might occur instantly when Q_L ON.

There might be cases when application for amplifier of audio signals,not only distortion but also the apparent frequency bandwidth being narrowed remarkably.

It is adjustable especially when using both power source mode,constantly to use with higher current on Q_U than the load current (including feedback current),and then connect the pull-down resister R_P at the part between output and V^- pins.

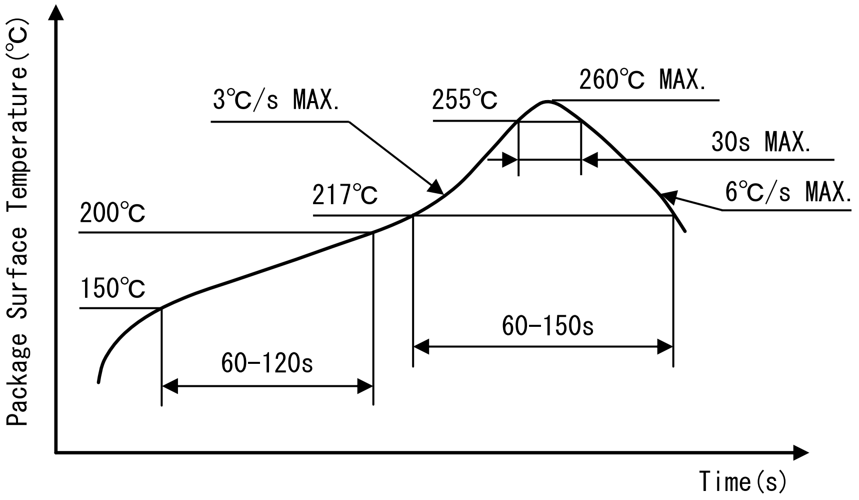




■ REVISION HISTORY

Date	Revision	Changes
October 13, 2023	Ver. 13	･Change of company name and design form ･Revision number (Ver.12 → Ver.13) ･Added revision history ･Added new package (MSOP-8-BM to NJM2904C) ･Graph(Gain/Phase vs Frequency) Y2 axis correction.

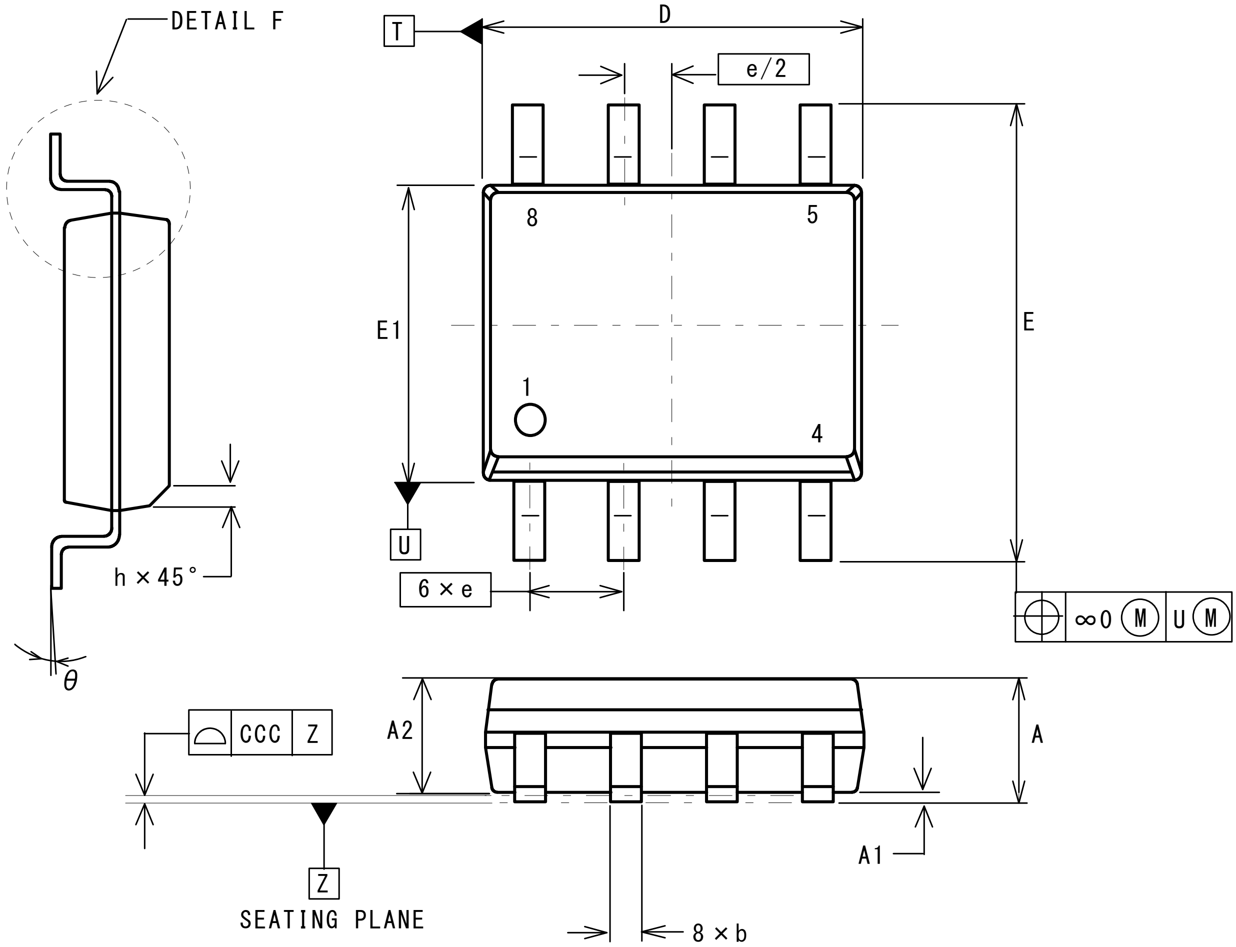
■ HEAT-RESISTANCE PROFILES

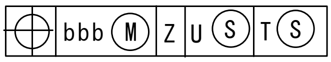


Reflow profile

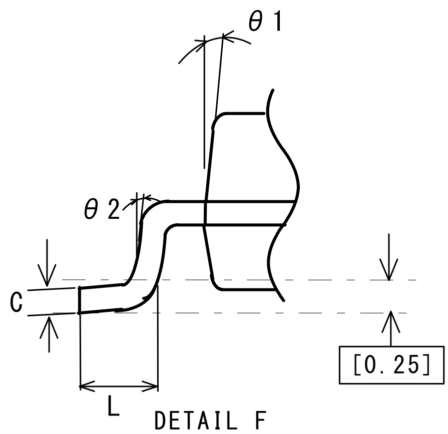
■ PACKAGE DIMENSIONS

UNIT: mm





DESCRIPTION	SYMBOL	INCH			MILLIMETER		
		MIN	NCM	MAX	MIN	NCM	MAX
TOTAL THICKNESS	A	.053		.069	1.35		1.75
STAND OFF	A_1	.004		.010	0.10		0.25
MOLD THICKNESS	A_2	.049		–	1.25		–
LEAD WIDTH	b	.014		.019	0.35		0.49
L/F THICKNESS	c	.007		.010	0.19		0.25
BODY SIZE	D	.189		.197	4.80		5.00
	E_1	.150		.157	3.80		4.00
LEAD PITCH	E	.228		.244	5.80		6.20
	e	.050 BSC			1.27 BSC		
	L	.015		.049	0.40		1.25
	h	.010		.020	0.25		0.50
	θ	0°		8°	0°		7°
	θ_1	5°		15°	5°		15°
	θ_2	2°	7°	12°	2°	7°	12°
LEAD EDGE OFFSET	∞0	.010			0.25		
LEAD OFFSET	bbb	.010			0.25		
COPLANARITY	ccc	.004			0.10		

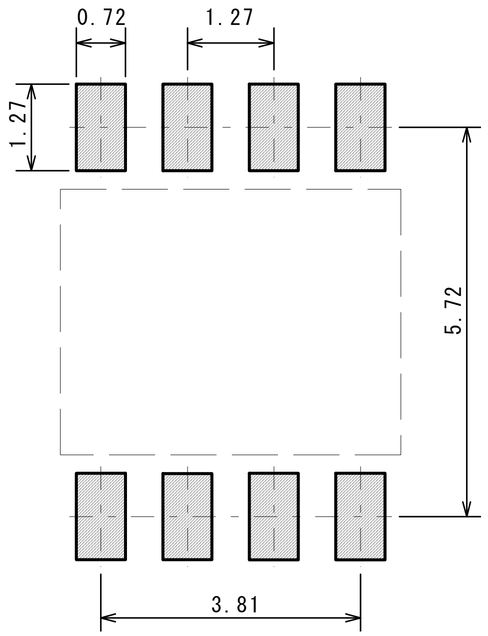


Nisshinbo Micro Devices Inc.

SOP8 JEDEC 150mil

■ **EXAMPLE OF SOLDER PADS DIMENSIONS**

UNIT: mm



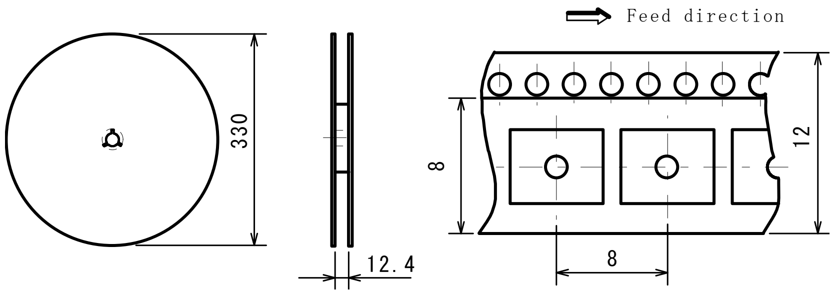
Nisshinbo Micro Devices Inc.

SOP8 JEDEC 150mil

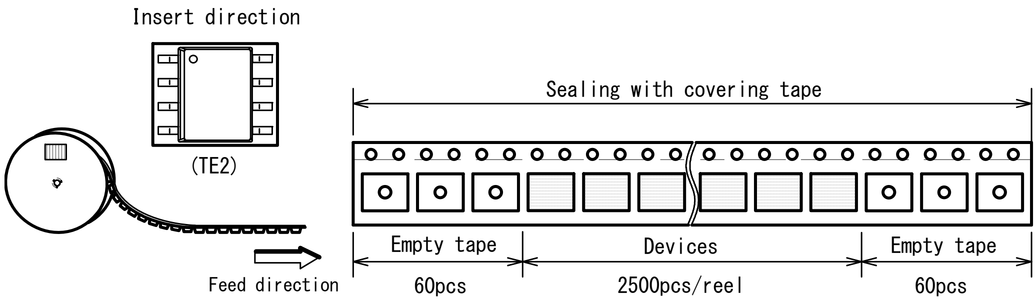
■ PACKING SPEC

UNIT: mm

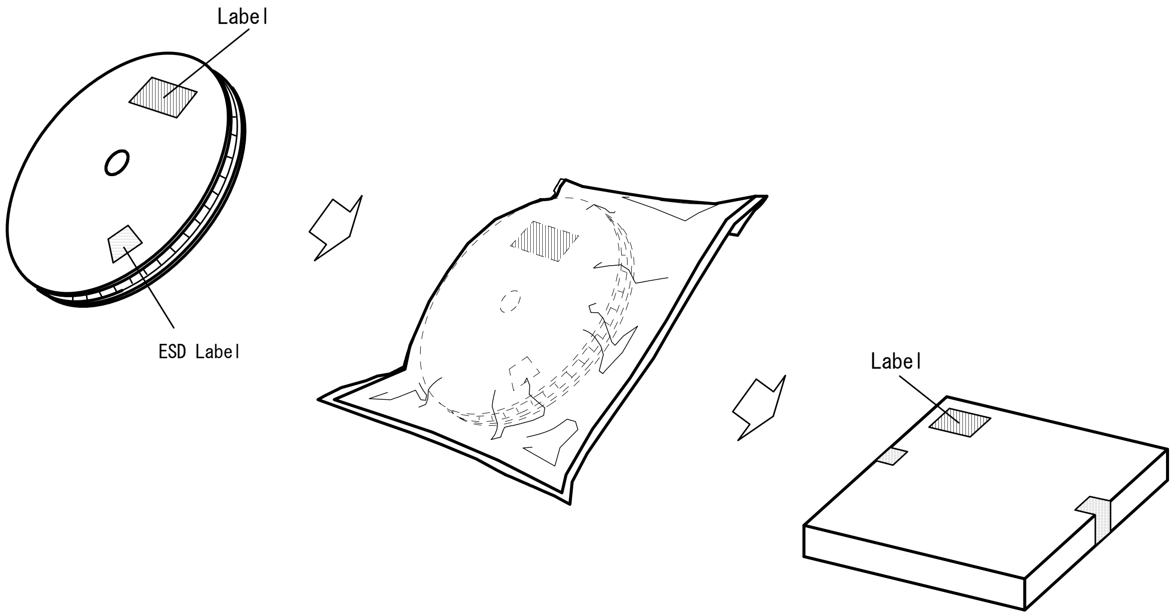
REEL DIMENSIONS / TAPING DIMENSIONS



TAPING STATE



PACKING STATE

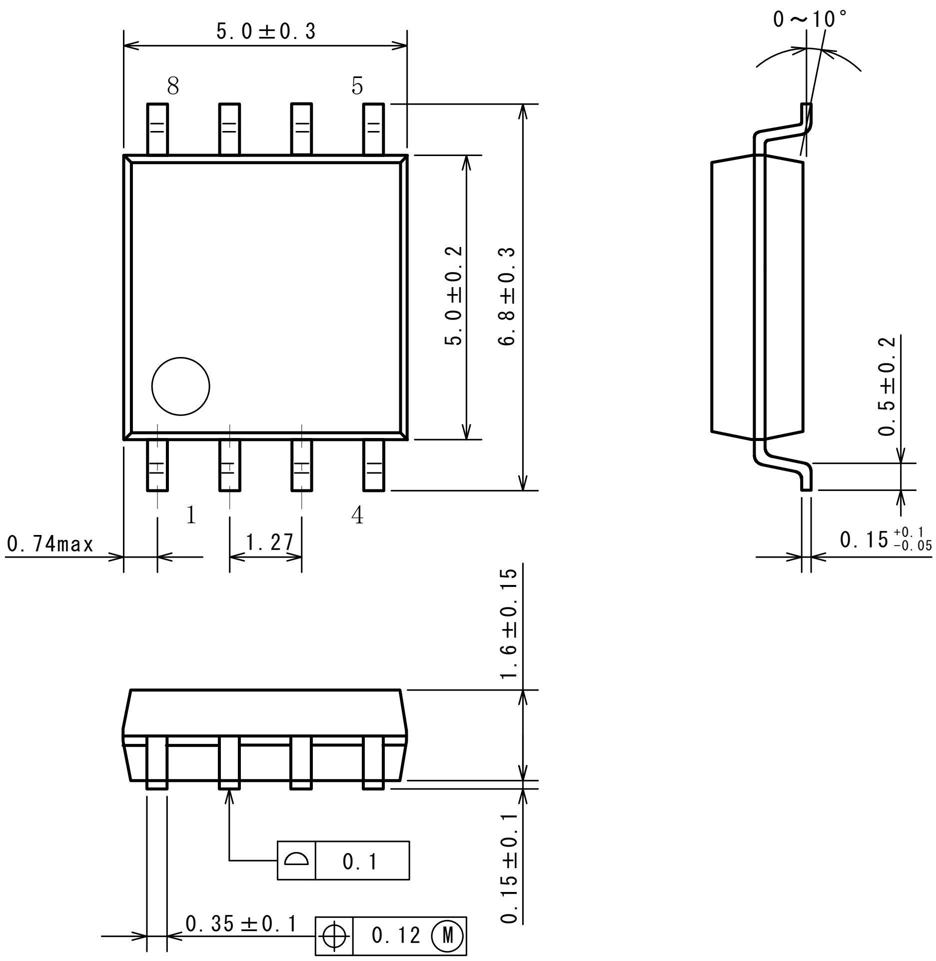


Nisshinbo Micro Devices Inc.

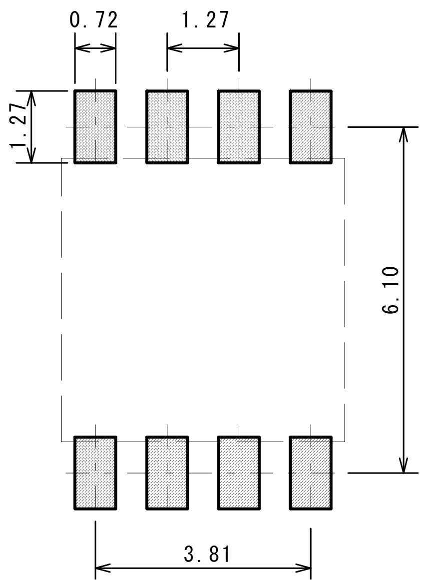
DMP8

■ **PACKAGE DIMENSIONS**

UNIT: mm



■ **EXAMPLE OF SOLDER PADS DIMENSIONS**



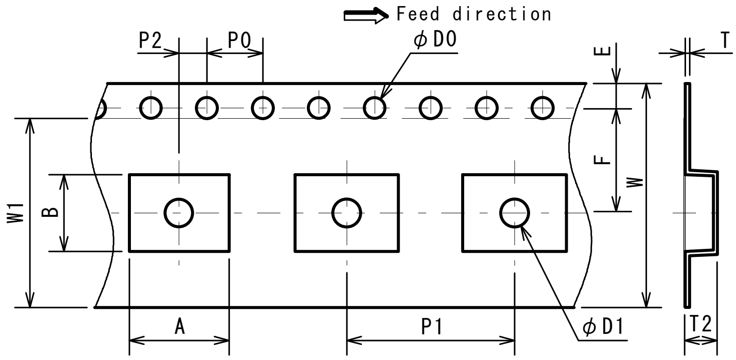
Nisshinbo Micro Devices Inc.

DMP8

■ PACKING SPEC

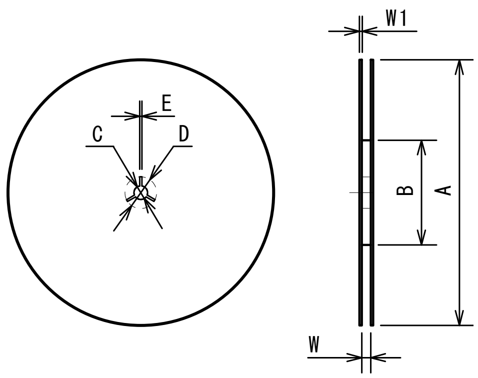
UNIT: mm

TAPING DIMENSIONS



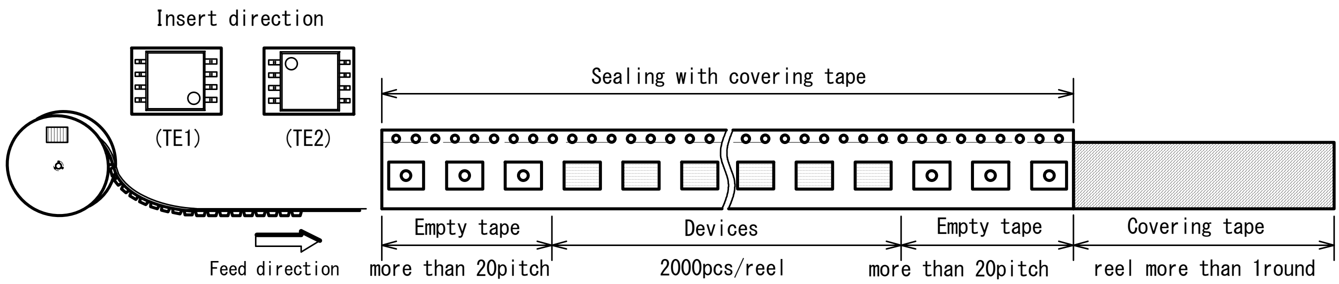
SYMBOL	DIMENSION	REMARKS
A	7.1	BOTTOM DIMENSION
B	5.4	BOTTOM DIMENSION
D0	1.55±0.05	
D1	2.05±0.1	
E	1.75±0.1	
F	7.5±0.1	
P0	4.0±0.1	
P1	12.0±0.1	
P2	2.0±0.1	
T	0.3±0.05	
T2	2.3	
W	16.0±0.3	
W1	13.5	THICKNESS 0.1max

REEL DIMENSIONS

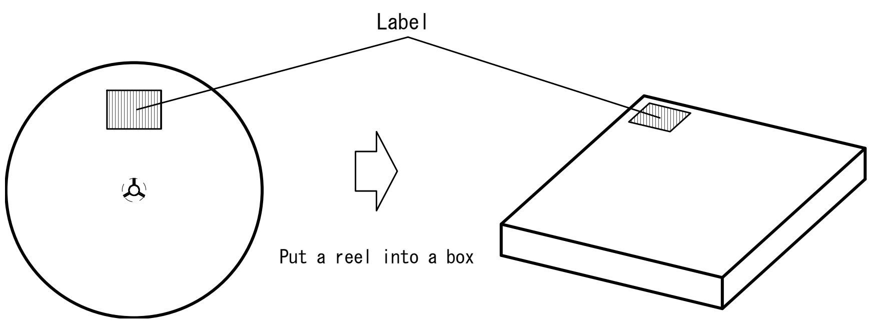


SYMBOL	DIMENSION
A	ϕ330±2
B	ϕ 80±1
C	ϕ 13±0.2
D	ϕ 21±0.8
E	2±0.5
W	17.5±0.5
W1	2±0.2

TAPING STATE



PACKING STATE



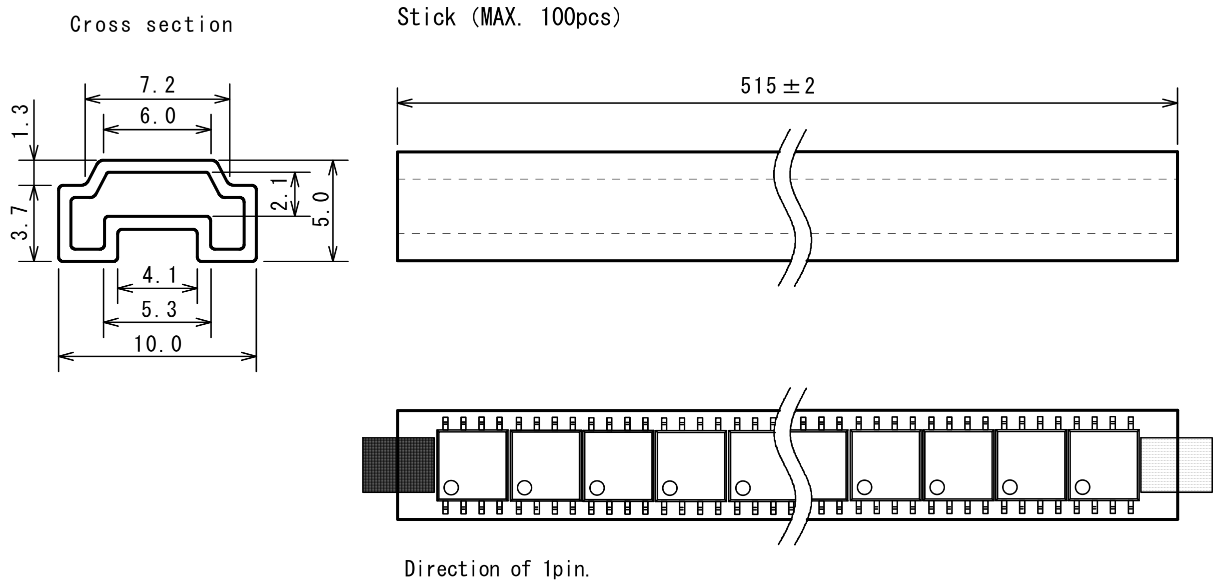
Nisshinbo Micro Devices Inc.

DMP8

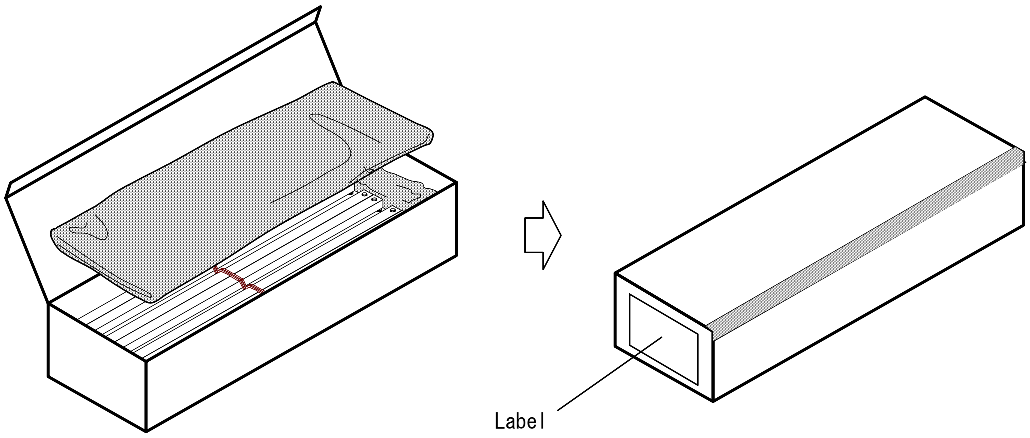
■ PACKING SPEC

UNIT: mm

STICK DIMENSIONS



PACKING STATE

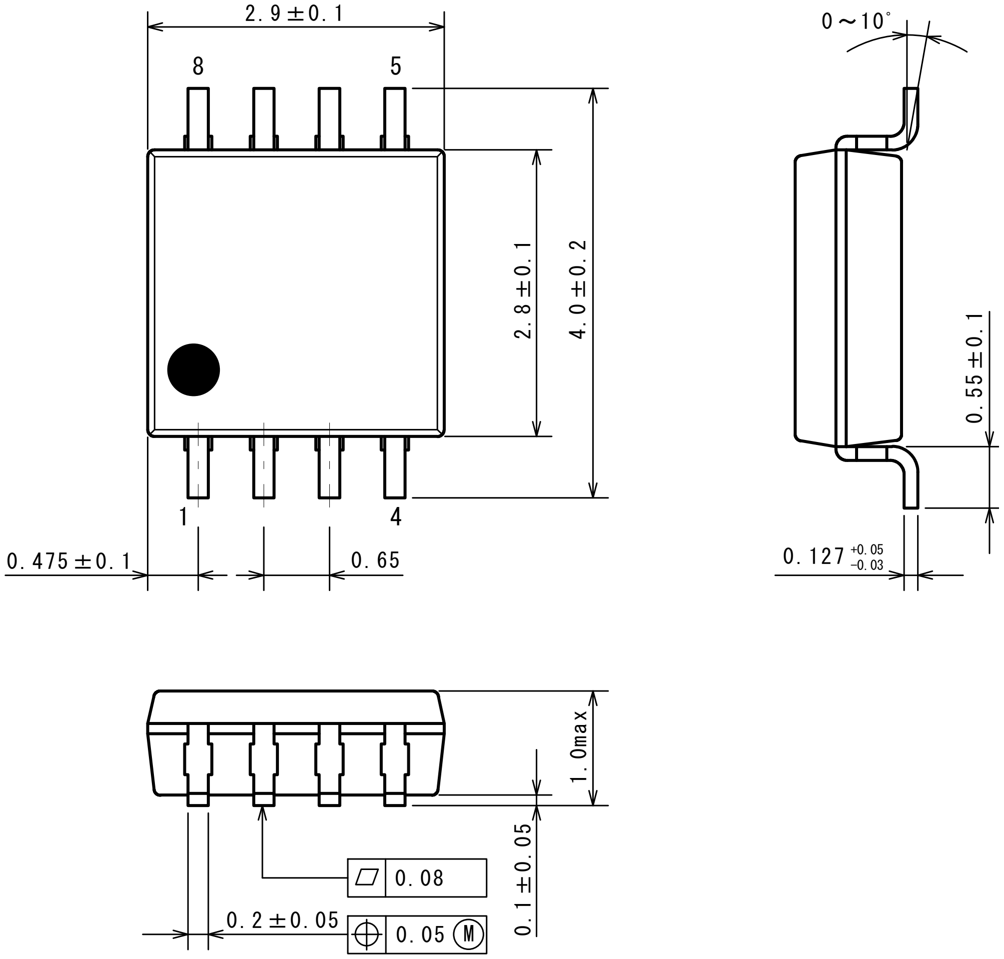


Nisshinbo Micro Devices Inc.

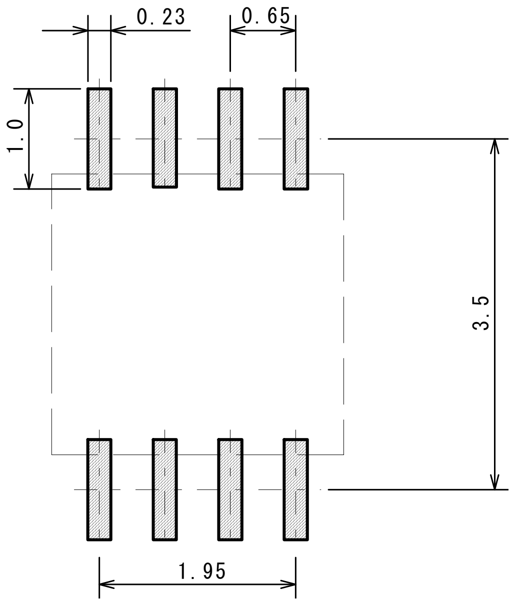
MSOP8 MEET JEDEC MO-187-DA / THIN TYPE (TVSP8)

■ **PACKAGE DIMENSIONS**

UNIT: mm



■ **EXAMPLE OF SOLDER PADS DIMENSIONS**



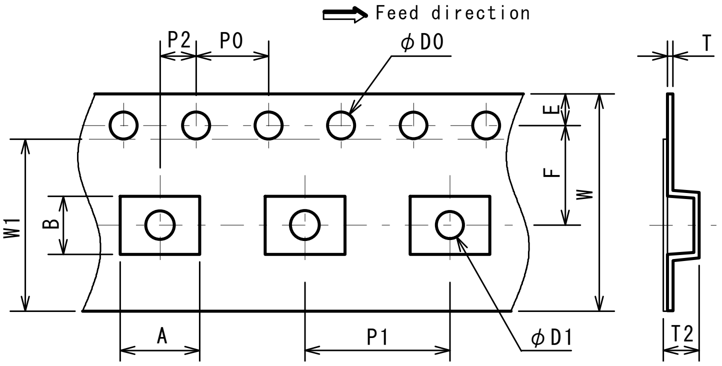
Nisshinbo Micro Devices Inc.

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

■ PACKING SPEC

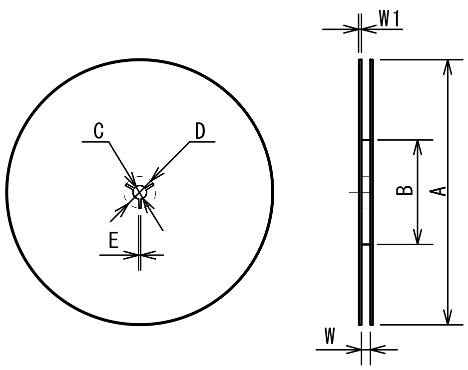
UNIT: mm

TAPING DIMENSIONS



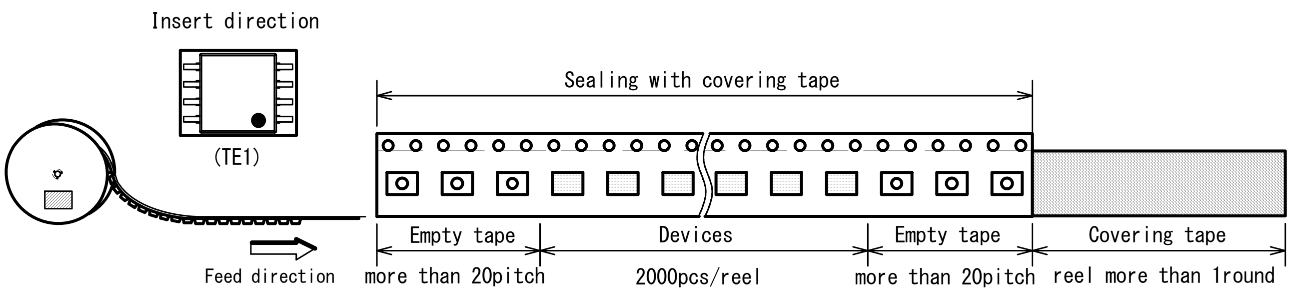
SYMBOL	DIMENSION	REMARKS
A	4.4	BOTTOM DIMENSION
B	3.2	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	$1.5^{+0.1}_{0}$	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.30±0.05	
T2	1.75 (MAX.)	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

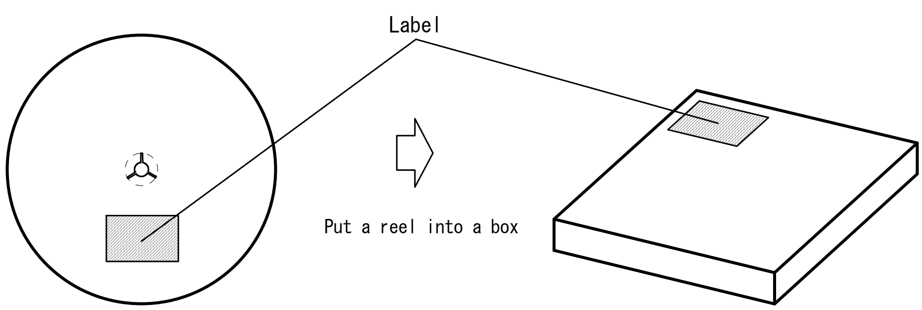


SYMBOL	DIMENSION
A	ϕ254±2
B	ϕ100±1
C	ϕ 13±0.2
D	ϕ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2.0±0.2

TAPING STATE



PACKING STATE

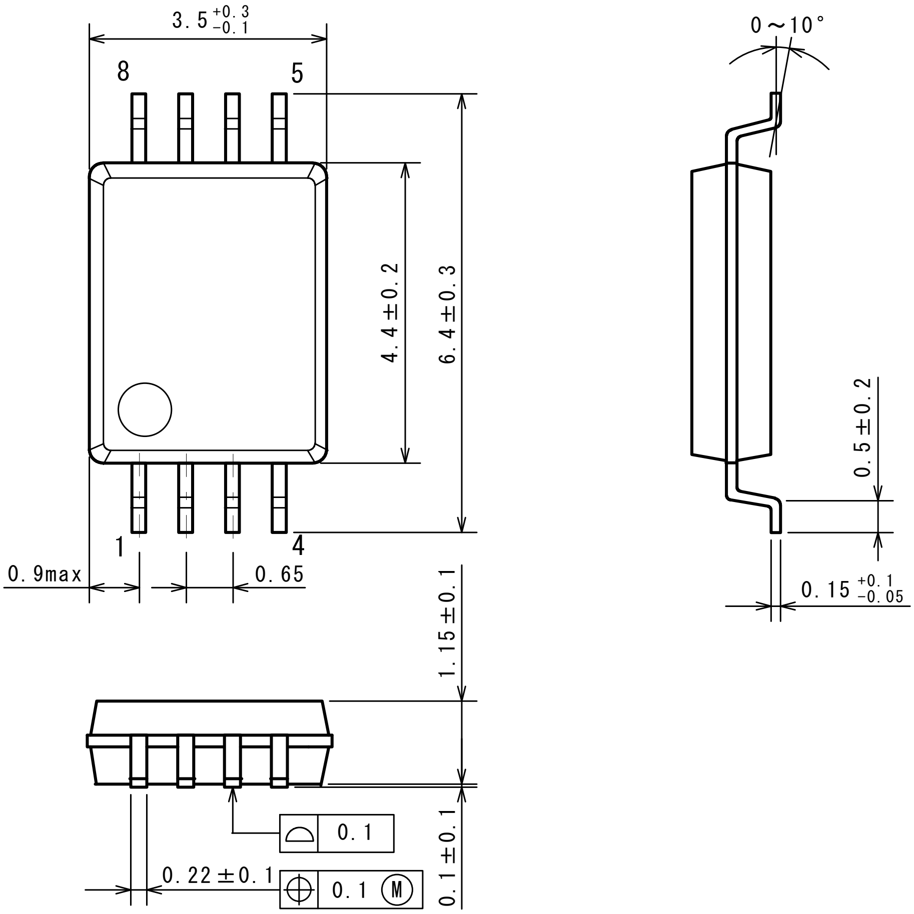


Nisshinbo Micro Devices Inc.

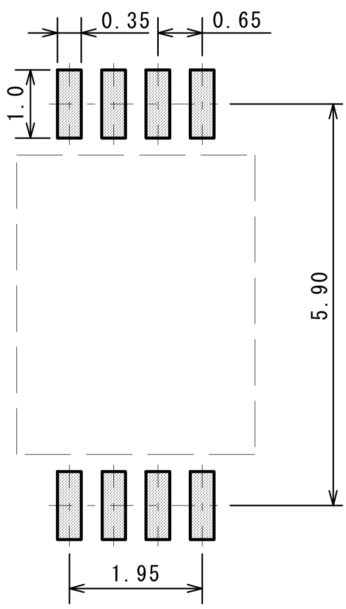
SSOP8

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



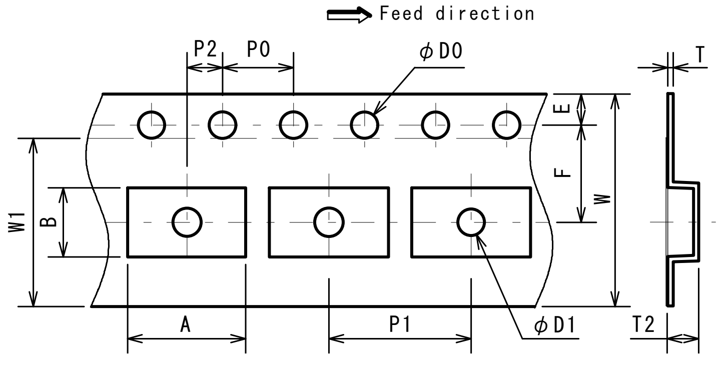
Nisshinbo Micro Devices Inc.

SSOP8

■ PACKING SPEC

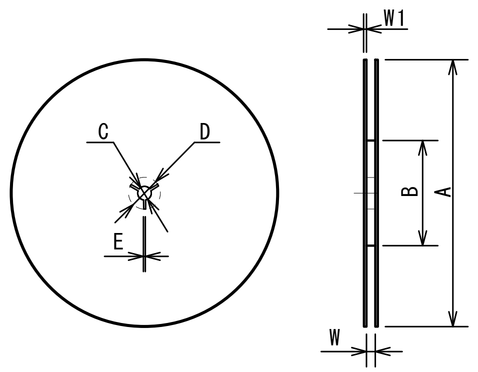
UNIT: mm

TAPING DIMENSIONS



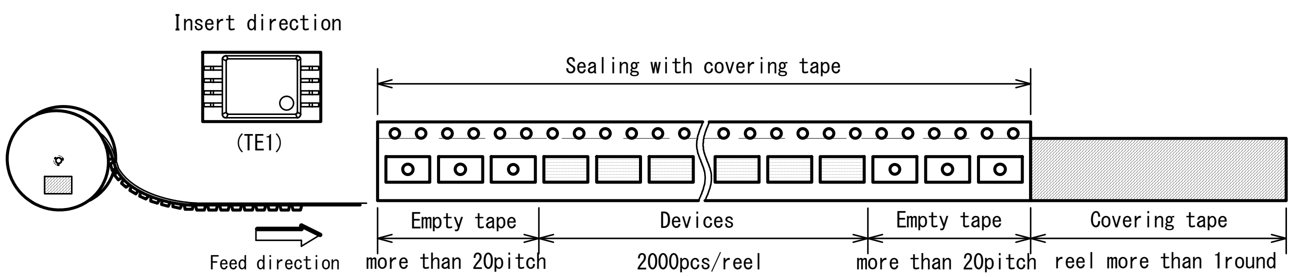
SYMBOL	DIMENSION	REMARKS
A	6.7	BOTTOM DIMENSION
B	3.9	BOTTOM DIMENSION
D0	1.55±0.05	
D1	1.55±0.1	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.3±0.05	
T2	2.2	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

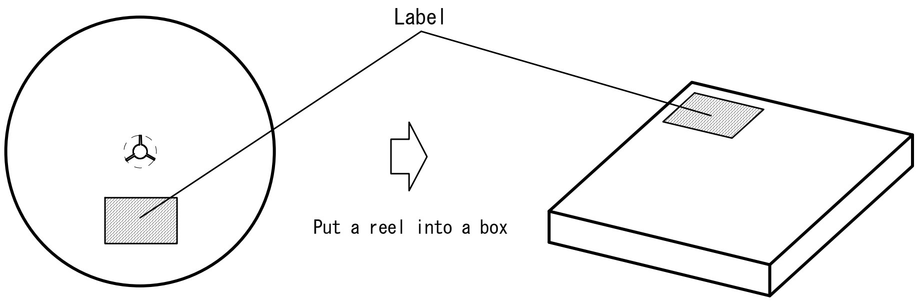


SYMBOL	DIMENSION
A	ϕ254±2
B	ϕ100±1
C	ϕ 13±0.2
D	ϕ 21±0.8
E	2±0.5
W	13.5±0.5
W1	2±0.2

TAPING STATE

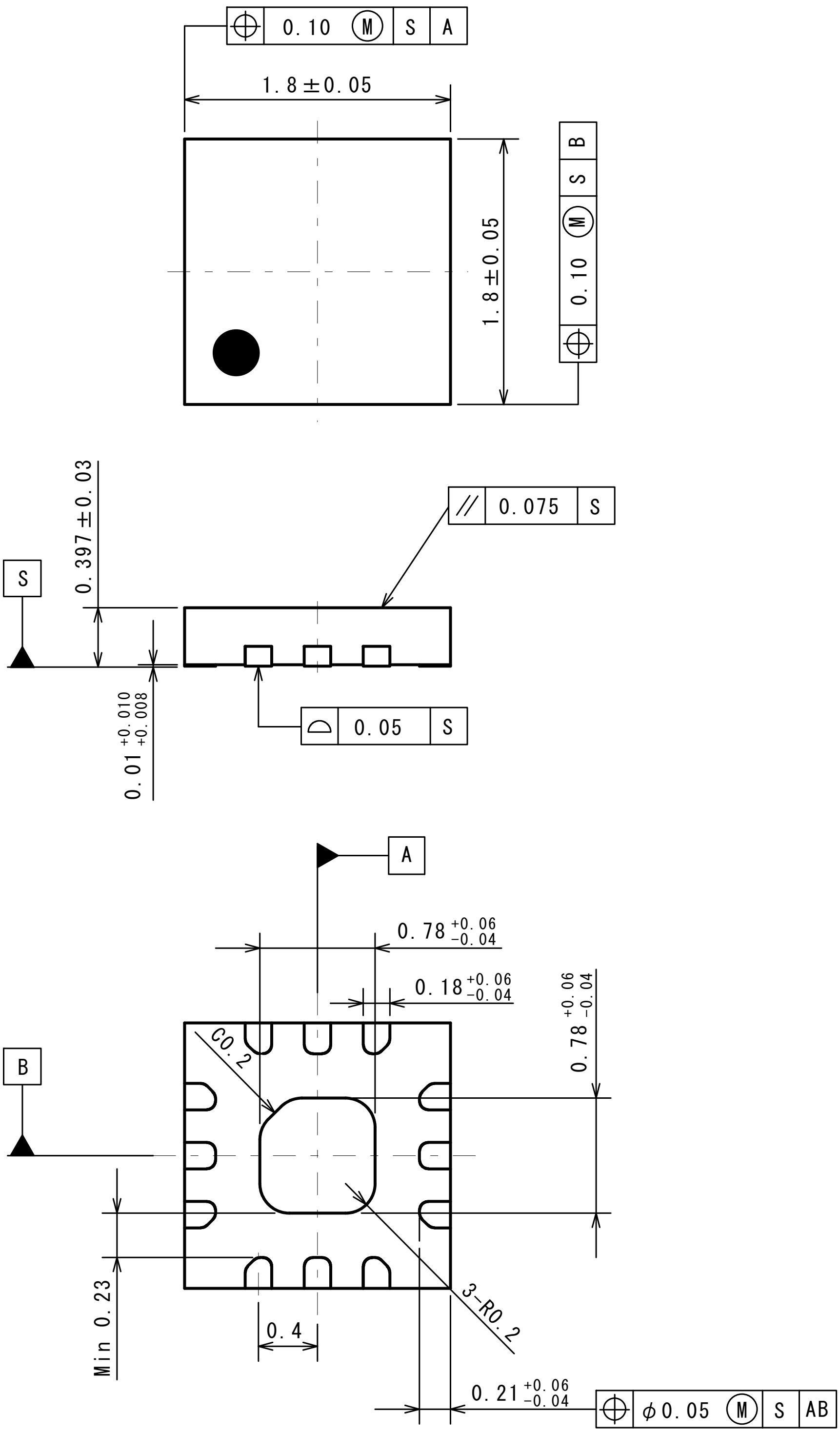


PACKING STATE



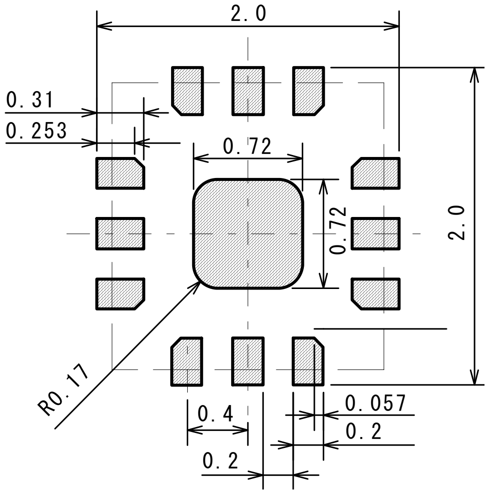
■ PACKAGE DIMENSIONS

UNIT: mm



■ **EXAMPLE OF SOLDER PADS DIMENSIONS**

UNIT: mm



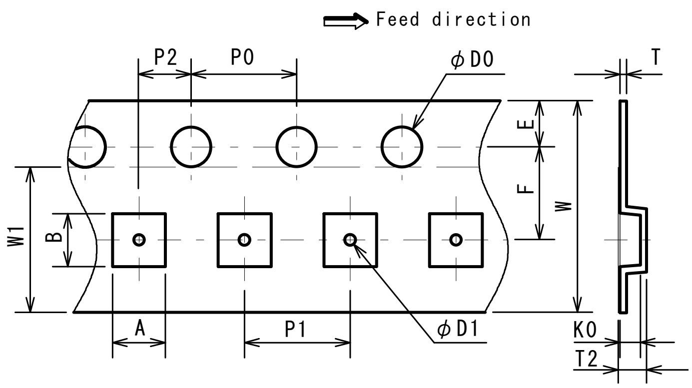
Nisshinbo Micro Devices Inc.

EQFN12-E2

■ PACKING SPEC

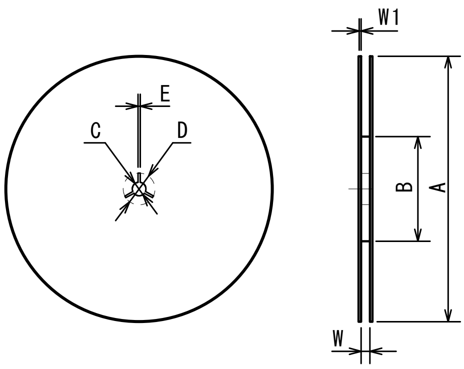
UNIT: mm

TAPING DIMENSIONS



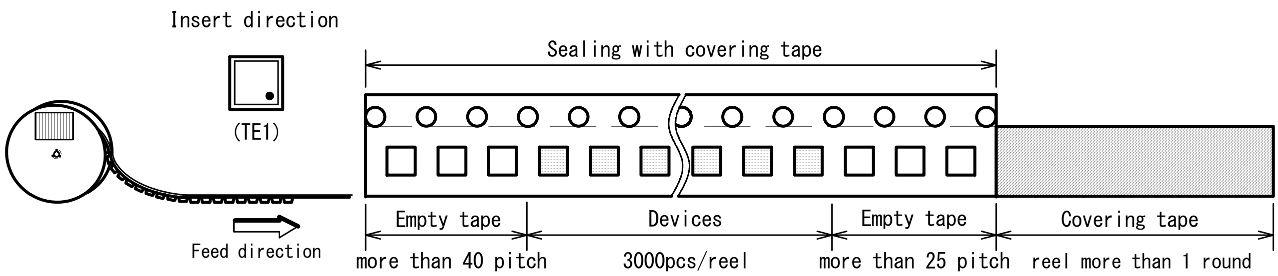
SYMBOL	DIMENSION	REMARKS
A	2.0±0.05	BOTTOM DIMENSION
B	2.0±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	0.9	
K0	0.55±0.05	
W	$8.0^{+0.3}_{-0.1}$	
W1	5.5	THICKNESS 0.1MAX

REEL DIMENSIONS

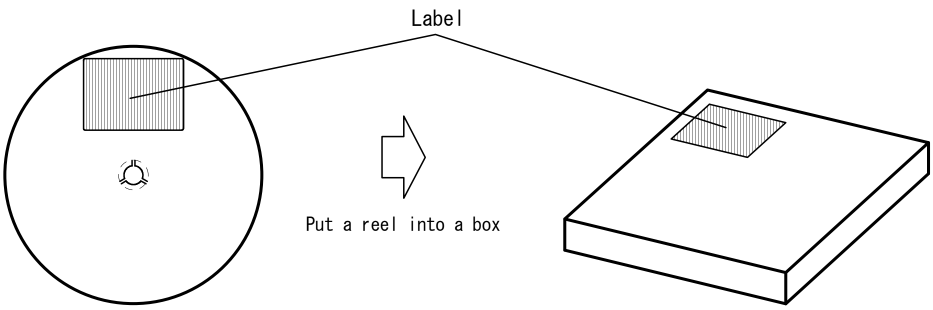


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	$\phi 60^{+1}_{0}$
C	φ13±0.2
D	φ21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE



PACKING STATE

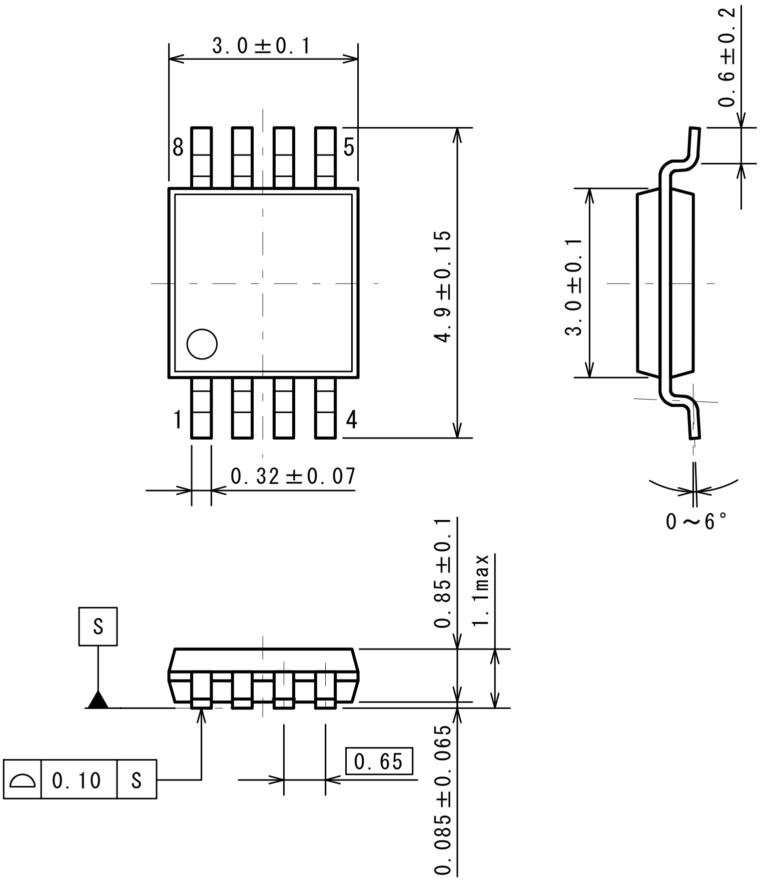


Nisshinbo Micro Devices Inc.

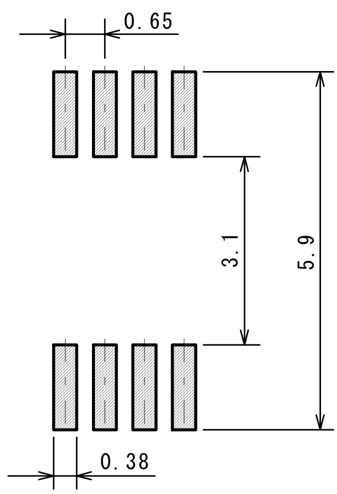
MSOP-8-BM

■ **PACKAGE DIMENSIONS**

UNIT: mm



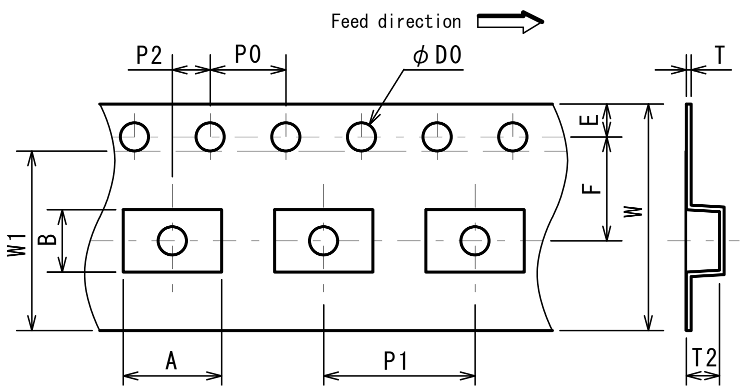
■ **EXAMPLE OF SOLDER PADS DIMENSIONS**



■ PACKING SPEC

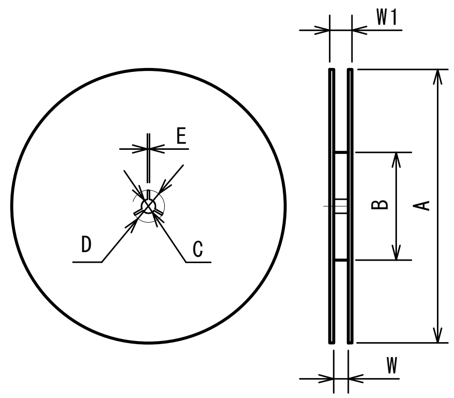
UNIT: mm

TAPING DIMENSIONS



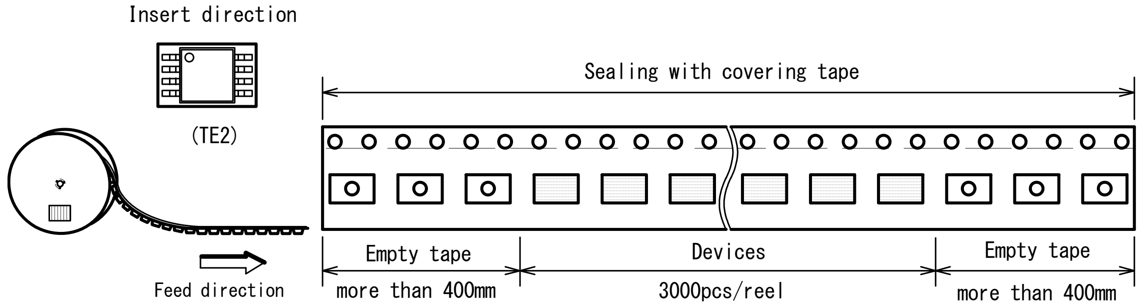
SYMBOL	DIMENSION	REMARKS
A	5.2	BOTTOM DIMENSION
B	3.3	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	$1.5^{+0.1}_{0}$	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.05	
T	0.25±0.02	
T2	1.5±0.1	
W	$12.0^{+0.3}_{-0.1}$	
W1	9.5±0.1	THICKNESS 0.048

REEL DIMENSIONS

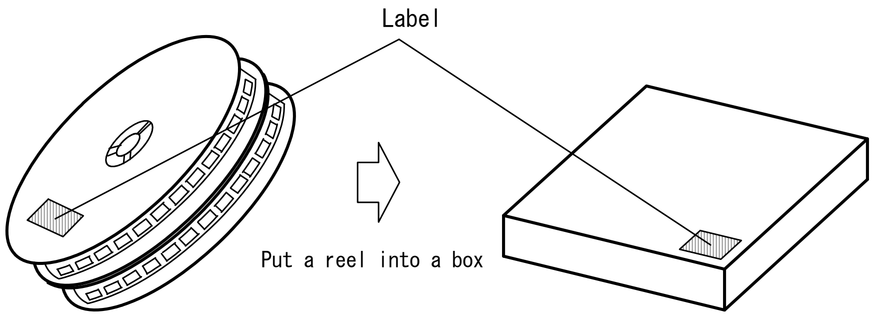


SYMBOL	DIMENSION
A	φ330±1
B	φ100±0.05
C	φ 13±0.2
D	φ 21.0
E	1.9±0.4
W	12.4^{+1}_{0}
W1	17.6^{+1}_{0}

TAPING STATE



PACKING STATE



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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.
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    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.
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    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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