



## NL8902

### High Quality Sound, JFET Input, Dual Audio Operational Amplifier

#### FEATURES

- High Quality Sound
- Low Noise 10nV/ $\sqrt{\text{Hz}}$  at f=1kHz
- Low Distortion 0.0004% at f=1kHz
- High Slew Rate 20V/ $\mu\text{s}$
- Gain Bandwidth Product 9MHz
- Low Input Bias Current 10pA
- High EMI Immunity EMIRR = 82dB (f = 1.8GHz)
- No Phase Reversal over Input Voltage Range
- Unity-Gain Stable
- Operating Voltage Range  $\pm 4.0\text{V}$  to  $\pm 16\text{V}$
- Quiescent Current 2.6mA (Dual)
- JFET Input
- Bipolar Technology
- Package Outline EMP-8-AN  
DFN4035-8-GR

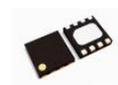
#### DESCRIPTION

The NL8902 is a high quality sound dual audio operational amplifier that applies the high quality sound technology of "MUSES" to a more productive technology.

The NL8902 features high quality sound, low noise, low distortion, high slew rate, and high EMI Immunity. The NL8902 is suitable for preamplifiers, active filters, line amplifiers, and other applications, especially for I/V conversion amplifiers that take advantage of the low input bias current characteristics of JFET inputs.



NL8902AN  
(EMP-8-AN)

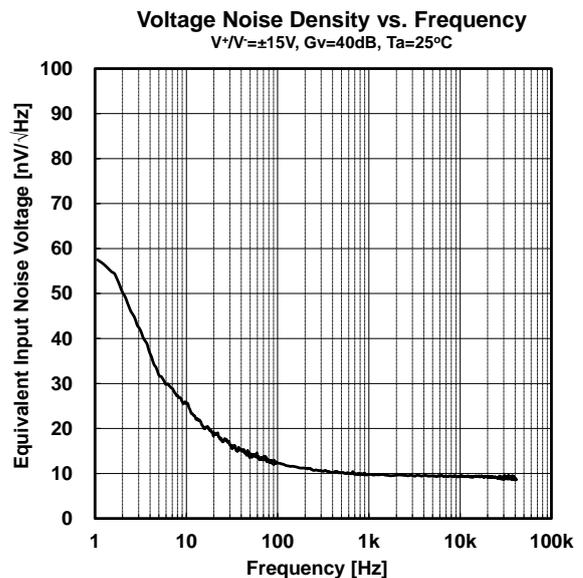
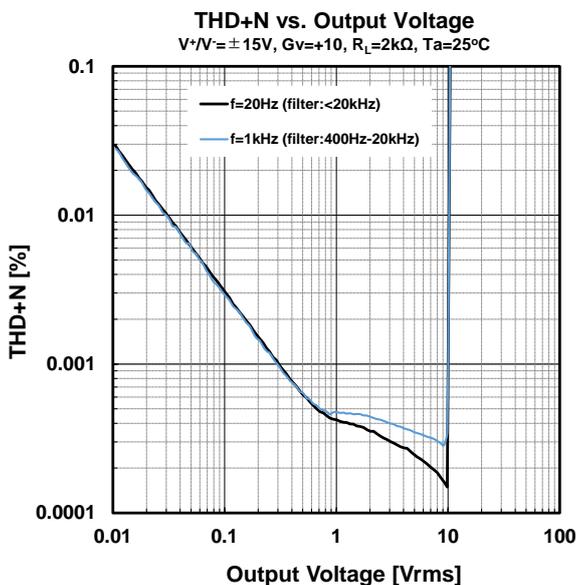


NL8902GR  
(DFN4035-8-GR)

#### APPLICATIONS

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

#### THD+N and Noise



■ PRODUCT NAME INFORMATION

NL8902 aa A bb S

Description of configuration

Suffix	Item	Description
aa	Package code	Indicates the package. Refer to the order information. AN: EMP-8-AN GR: DFN4035-8-GR
A	Version	Indicates the product version. "A" is initial version.
bb	Packing	Refer to the packing specifications.
S	Grade	Indicates the quality grade. S: Standard

Grade

	Applications	Operating Temperature Range	Test Temperature
S	General-purpose and Consumer application	-40°C to 125°C	25°C

■ ORDER INFORMATION

Product Name	Package	RoHS	Halogen-Free	Terminal Finish	Weight (mg)	QUANTITY (pcs/reel)
NL8902ANAE2S	EMP-8-AN	✓	✓	Sn2Bi	76	2000
NL8902GRAE4S	DFN4035-8-GR	✓	✓	Sn2Bi	18	1500

■ PIN DESCRIPTIONS

Product Name	NL8902AN	NL8902GR
Package	EMP-8-AN	DFN4035-8-GR
Pin Functions	<p>(Top View)</p> <p>A OUTPUT 1, A -INPUT 2, A +INPUT 3, V- 4, B +INPUT 5, B -INPUT 6, B OUTPUT 7, V+ 8</p>	<p>(Top View)</p> <p>A OUTPUT 1, A -INPUT 2, A +INPUT 3, V- 4, B +INPUT 5, B -INPUT 6, B OUTPUT 7, V+ 8</p> <p>Exposed Pad on Underside</p> <p>*About Exposed Pad Floating (Electrical open) or connecting to V-. Floating (Electrical open) state is recommended when sound quality is important.</p>

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 <sup>+</sup> - V <sup>-</sup> )	V <sup>+</sup> / V <sup>-</sup>	±18 (36)	V
Input Voltage *1	V <sub>IN</sub>	V <sup>-</sup> -0.3 to V <sup>+</sup> +0.3	V
Input Current *1	I <sub>IN</sub>	±10	mA
Differential Input Voltage *2	V <sub>ID</sub>	±36	V
Storage Temperature	T <sub>stg</sub>	-65 to 150	°C
Junction Temperature *3	T <sub>j</sub>	150	°C

\*1 Input voltages outside the supply voltage will be clamped by ESD protection diodes. If the input voltage exceeds the supply voltage,  
The current must be limited 10mA or less by using a restriction resistance.

\*2 The normal operation will establish when any input is within the "Common-Mode Input Voltage Range" of electrical characteristics. Differential voltage is the voltage difference between +INPUT and -INPUT.

\*3 Calculate the power consumption of the IC from the operating conditions, and calculate the junction temperature with the thermal resistance. Please refer to "Thermal characteristics" for the thermal resistance under our measurement board conditions.

**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 <sub>ja</sub> )	Thermal Characterization Parameter (ψ <sub>jt</sub> )	
EMP-8-AN	157 *1 / 103 *2	16 *1 / 12 *2	°C/W
DFN4035-8-GR	182 *3 / 44 *4	TBD	

θ<sub>ja</sub>: Junction-to-Ambient Thermal Resistance

ψ<sub>jt</sub>: Junction-to-Top Thermal Characterization Parameter

\*1 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).

\*2 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).

\*3 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.)

\*4 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.)

■ ELECTROSTATIC DISCHARGE (ESD) PROTECTION VOLTAGE

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

**ELECTROSTATIC DISCHARGE RATINGS**

The electrostatic discharge tests are done based on JEDEC JS-001 and JS-002.  
In the HBM method, ESD is applied using the power supply pin and GND pin as reference pins.

## ■ RECOMMENDED OPERATING CONDITIONS

	Symbol	Conditions	Rating	Unit
Supply Voltage	$V^+ / V^-$		$\pm 4.0$ to $\pm 16$	V
Operating Temperature	$T_a$		-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.

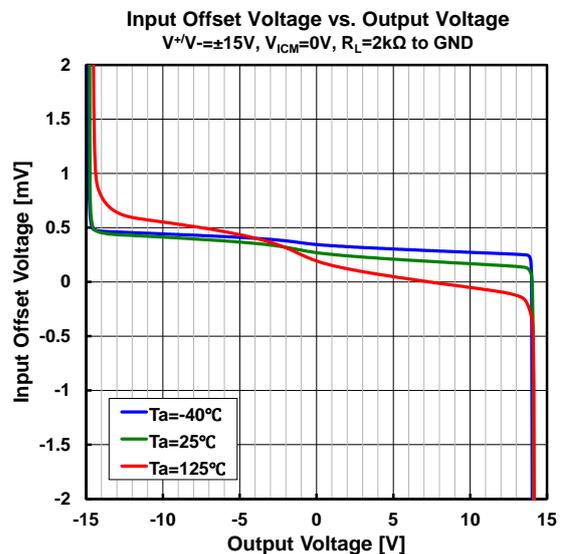
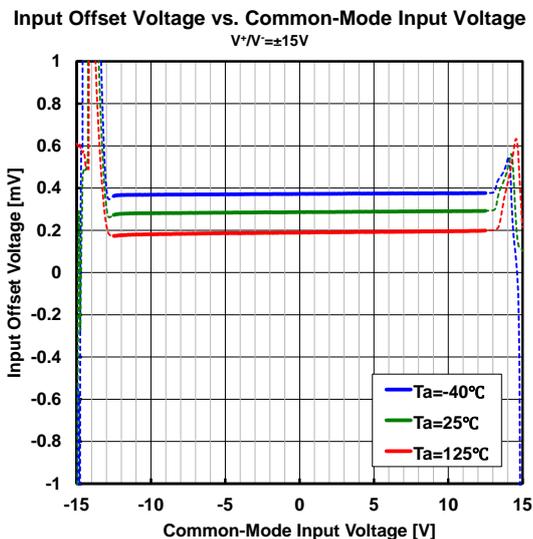
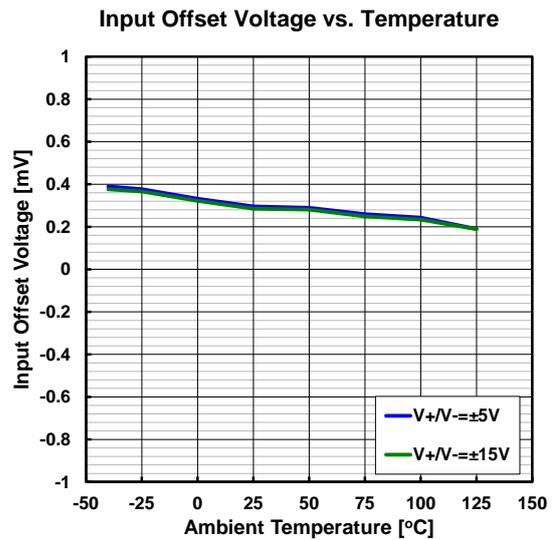
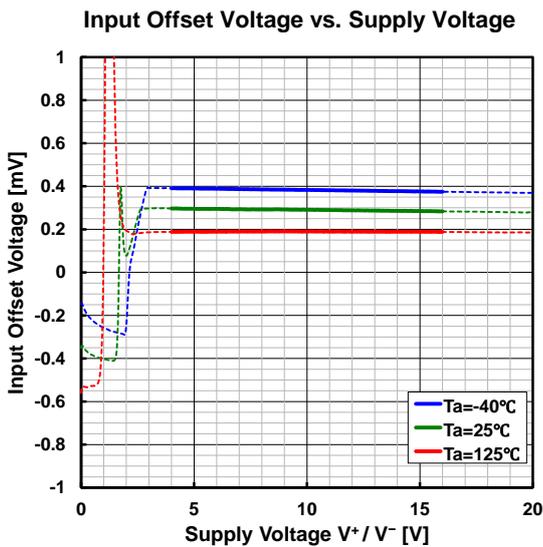
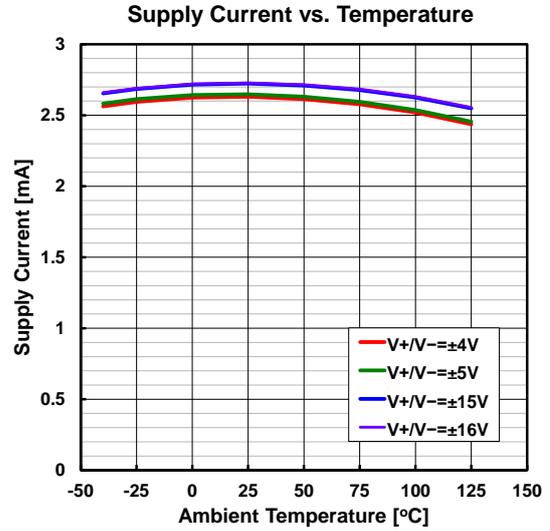
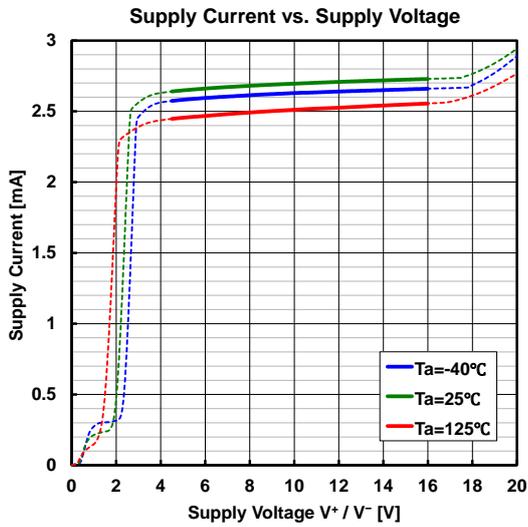
## ■ ELECTRICAL CHARACTERISTICS

$V^+ / V^- = \pm 15V$ ,  $V_{COM} = 0V$ ,  $R_L = 2k\Omega$  to GND,  $T_a = 25^\circ C$ , unless otherwise specified

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>DC CHARACTERISTICS</b>						
Supply Current	$I_{CC}$	No Signal, $R_L = \infty$	-	2.6	4.0	mA
Input Offset Voltage	$V_{IO}$		-	0.8	3.0	mV
Input Bias Current	$I_B$		-	10	80	pA
Input Offset Current	$I_{IO}$		-	5	75	pA
Voltage Gain	$A_V$	$R_L = 2k\Omega$ , $V_O = \pm 13.5V$	90	100	-	dB
Common Mode Rejection Ratio	CMR	$V_{ICM} = \pm 12.5V$	86	115	-	dB
Supply Voltage Rejection Ratio	SVR	$V^+ / V^- = \pm 4.0$ to $\pm 16V$	86	123	-	dB
Maximum Output Voltage 1	$V_{OM1}$	$R_L = 2k\Omega$	$\pm 13.8$	$\pm 14.1$	-	V
Maximum Output Voltage 2	$V_{OM2}$	$R_L = 600\Omega$	$\pm 13.5$	$\pm 13.9$	-	V
Common Mode Input Voltage Range	$V_{ICM}$	CMR $\geq 86$ dB	$\pm 12.5$	$\pm 13.0$	-	V
Short-circuit Output Current	$I_O$		-	50	-	mA
<b>AC CHARACTERISTICS</b>						
Gain Bandwidth Product	GBW	$f = 1MHz$	-	9	-	MHz
Unity Gain Frequency	$f_T$	$C_L = 10pF$	-	7	-	MHz
Phase Margin	$\Phi_M$	$C_L = 10pF$	-	70	-	Deg
Slew Rate	SR	$A_V = +1$ , $V_{IN} = 2V_{p-p}$ , $C_L = 10pF$	-	20	-	V/ $\mu s$
Channel Separation	CS	$f = 1kHz$	-	148	-	dB
Total Harmonic Distortion	THD+N	$f = 1kHz$ , $A_V = +1$ , $V_O = 5V_{rms}$ ,	-	0.0004	-	%
Input Noise Voltage1	$e_n$	$f = 1kHz$	-	10	-	nV/ $\sqrt{Hz}$
Input Noise Voltage2	$V_{NI}$	$f = 20Hz$ to $20kHz$	-	1.4	-	$\mu V_{rms}$

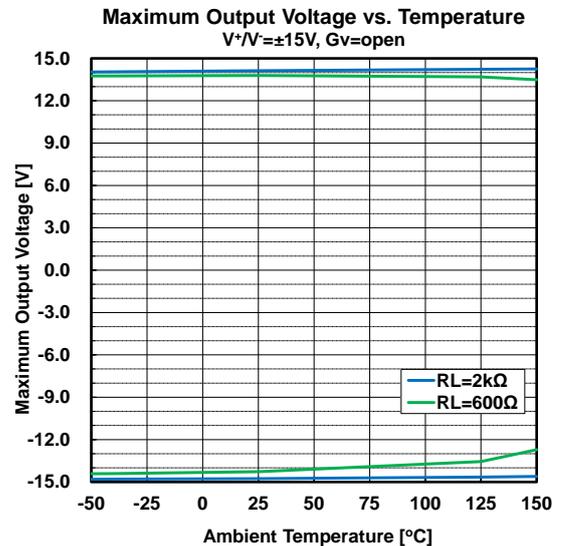
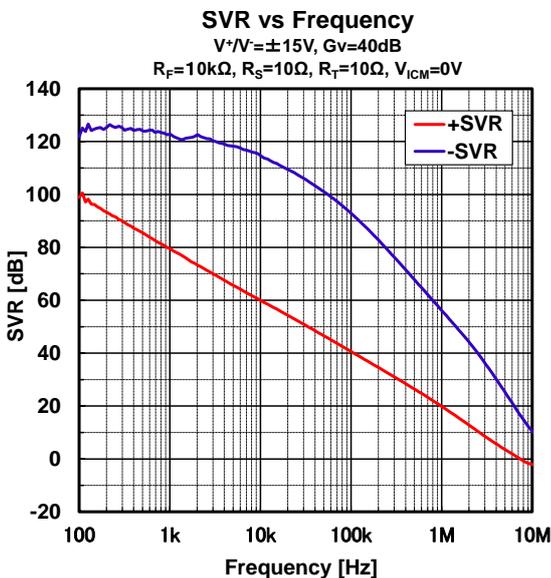
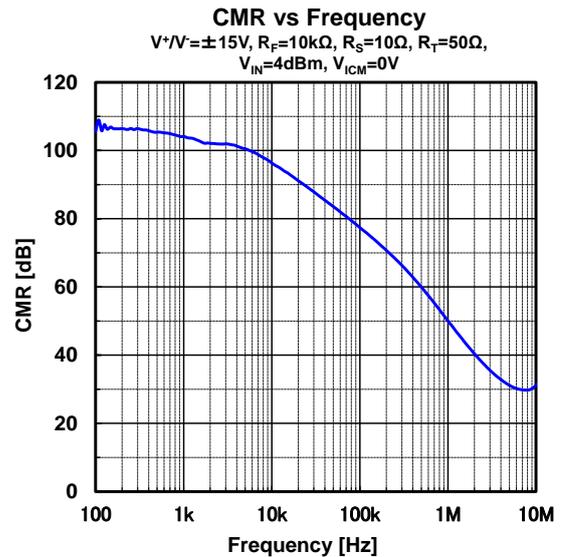
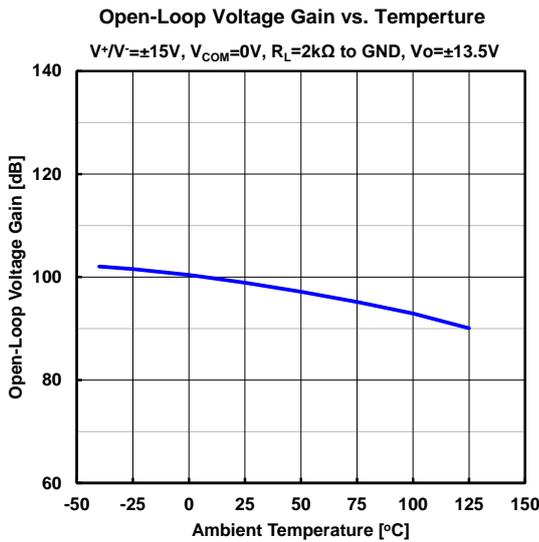
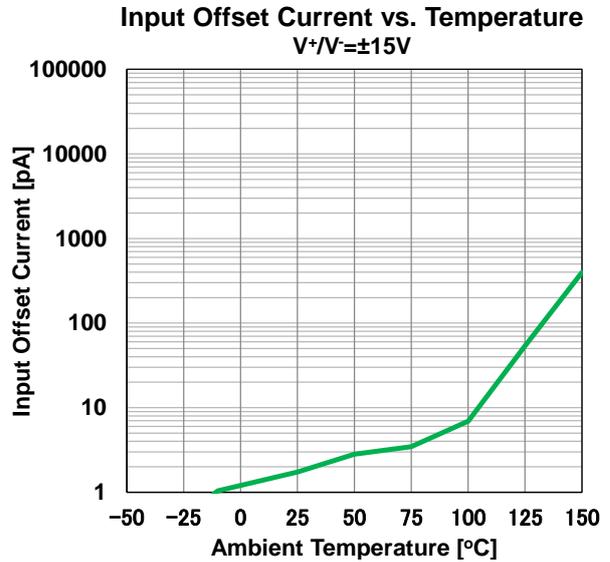
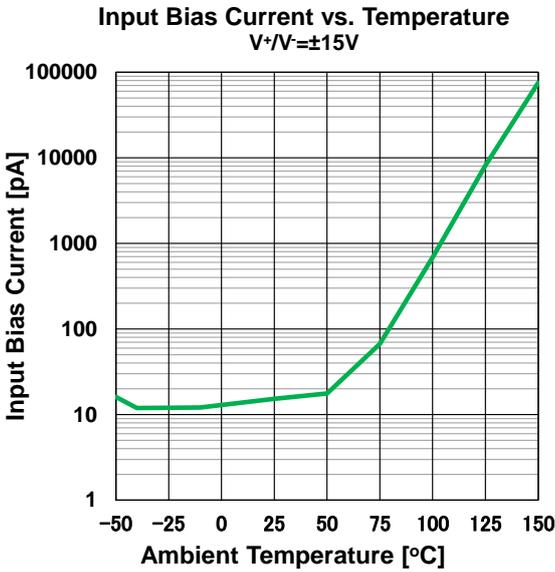
■ TYPICAL CHARACTERISTICS

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



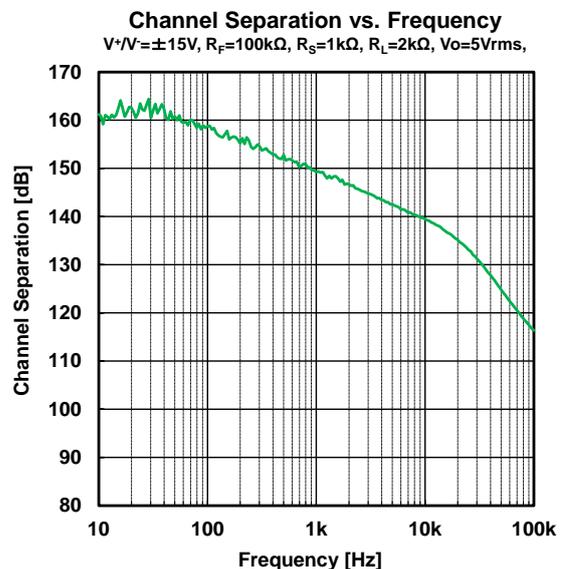
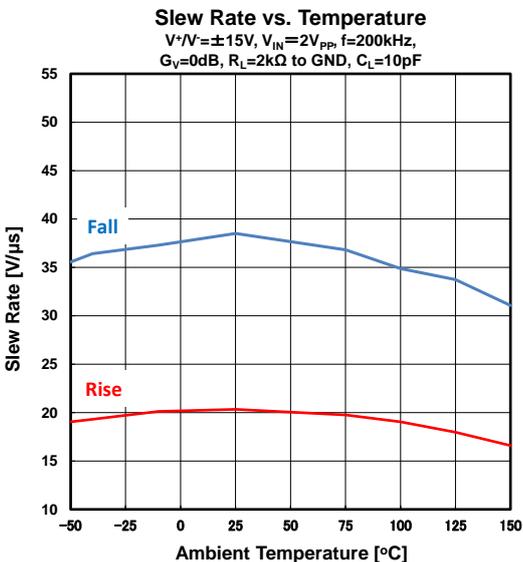
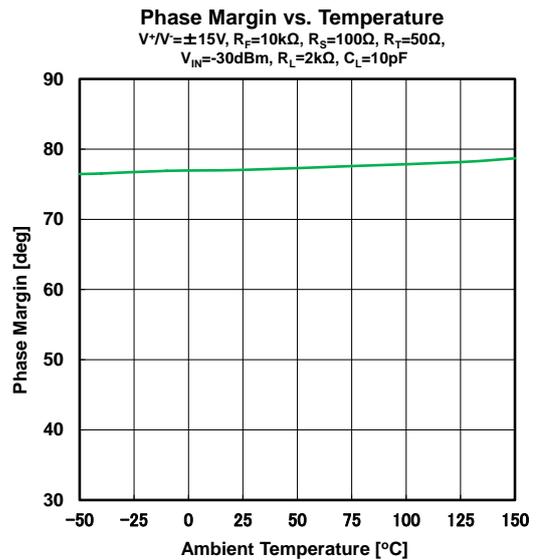
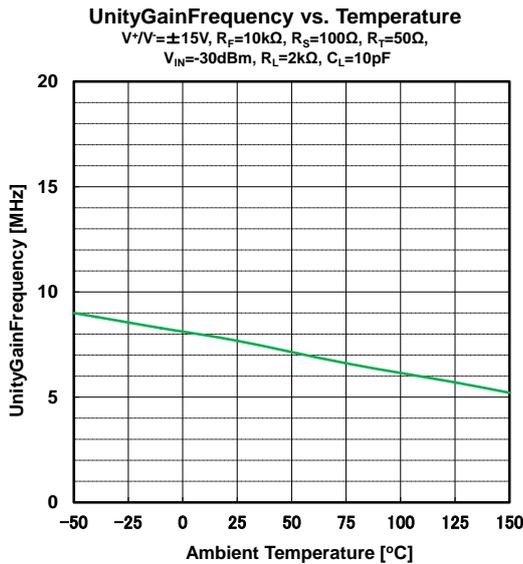
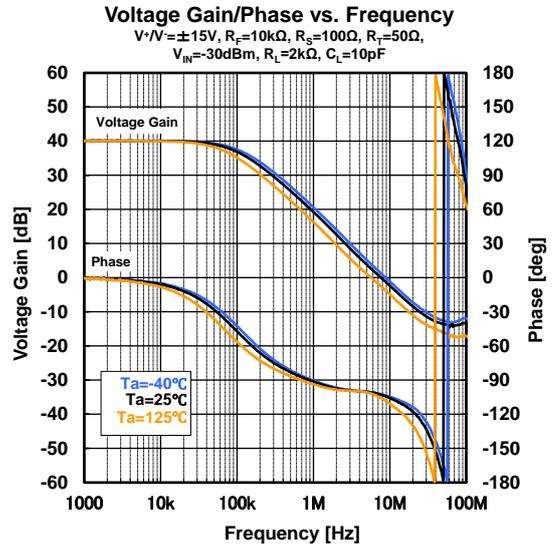
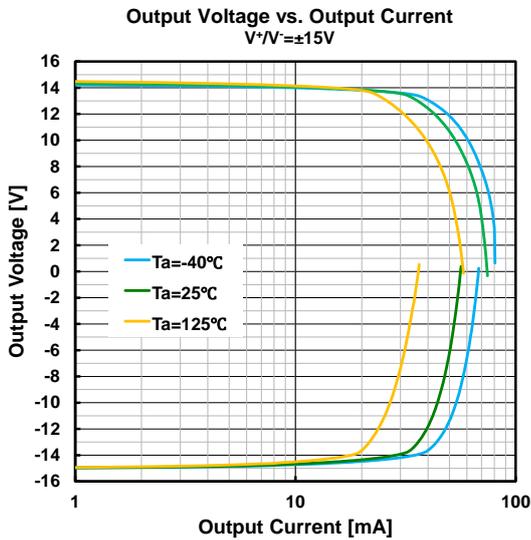
■ TYPICAL CHARACTERISTICS

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



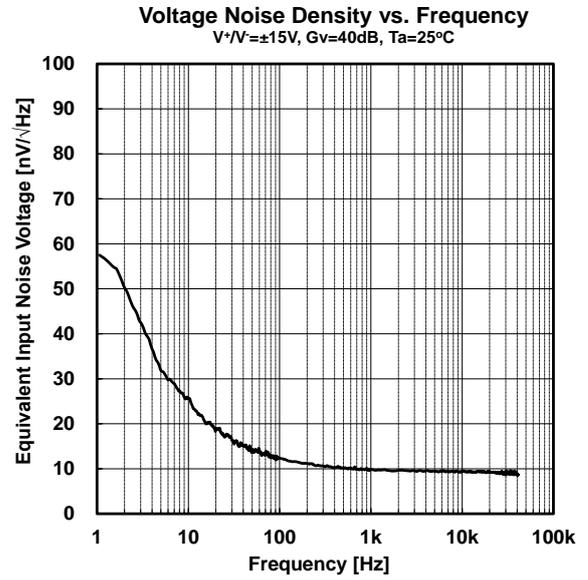
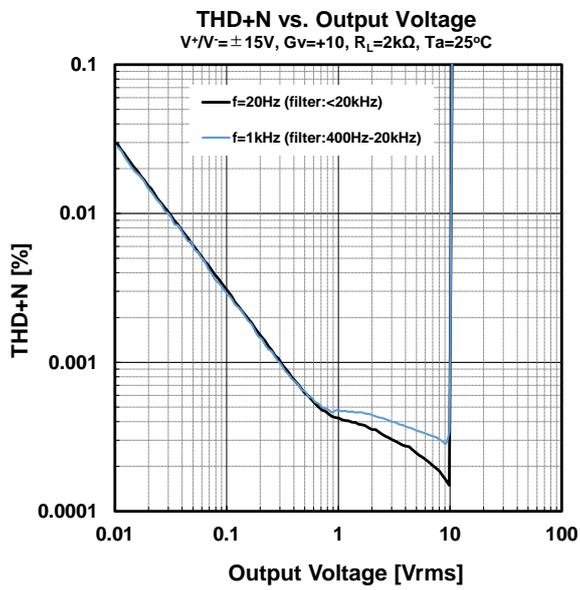
■ TYPICAL CHARACTERISTICS

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



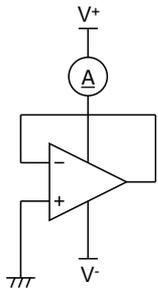
■ TYPICAL CHARACTERISTICS

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



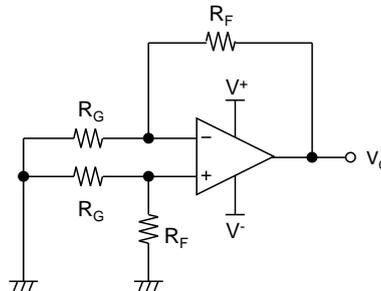
■ TEST CIRCUITS

- I<sub>CC</sub>



- V<sub>IO</sub>, CMR, SVR

R<sub>G</sub>=50Ω, R<sub>F</sub>=50kΩ



$$V_{IO} = \frac{R_G}{(R_G + R_F)} \times V_O$$

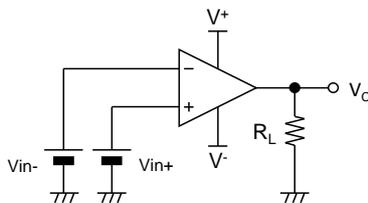
$$CMR = 20 \log \frac{\Delta V_{COM} \left(1 + \frac{R_F}{R_G}\right)}{\Delta V_O}$$

$$SVR = 20 \log \frac{\Delta V_S \left(1 + \frac{R_F}{R_G}\right)}{\Delta V_O}$$

$V_S = V^+ - V^-$

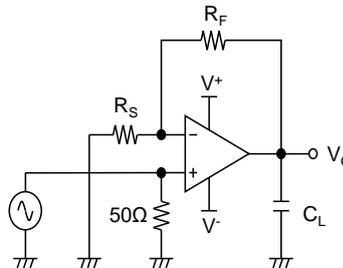
- V<sub>OH</sub>, V<sub>OL</sub>

V<sub>OH</sub>: V<sub>in+</sub> = 1V, V<sub>in-</sub> = 0V  
 V<sub>OL</sub>: V<sub>in+</sub> = -1V, V<sub>in-</sub> = 0V



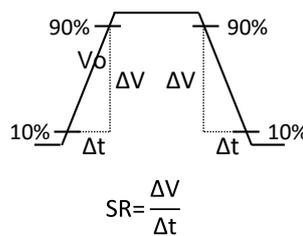
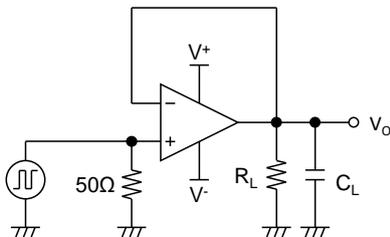
- GBW

R<sub>S</sub>=100Ω, R<sub>F</sub>=10kΩ, C<sub>L</sub>=open

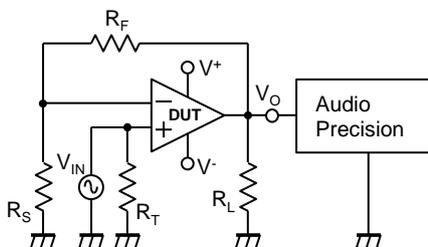


- SR

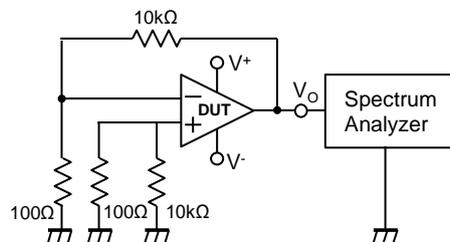
R<sub>L</sub>=2kΩ, C<sub>L</sub>=10pF



- THD+N



- V<sub>NI</sub>



■ APPLICATION NOTE

**Single and Dual Supply Voltage Operation**

The NL8902 works with both single supply and dual supply when the voltage supplied is between V+ and V-. These amplifiers operate from single 8V to 32V supply and dual ±4V to ±16V 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:

$$V_{ICM} (typ.) = V^- + 2.5V \text{ to } V^+ - 2.5V \quad (T_a = 25^\circ C)$$

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:

$$V_{OM} (typ.) = V^- + 0.9V \text{ to } V^+ - 0.9V \quad (R_L = 2k\Omega \text{ to GND}, T_a = 25^\circ C)$$

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.

**No Phase Reversal**

The NL8902 is designed to prevent phase reversal at the input voltage above the common mode input voltage range. Figure1 shows no phase reversal characteristics with the input voltage exceeding the supply voltage. It is designed to prevent phase reversal at the input voltage above the supply voltage, but the input voltage should not exceed the absolute maximum rating of  $V^- - 0.3V$  or  $V^+ + 0.3V$ . The range of normal operation is the common mode input voltage range shown in the electrical characteristics table.

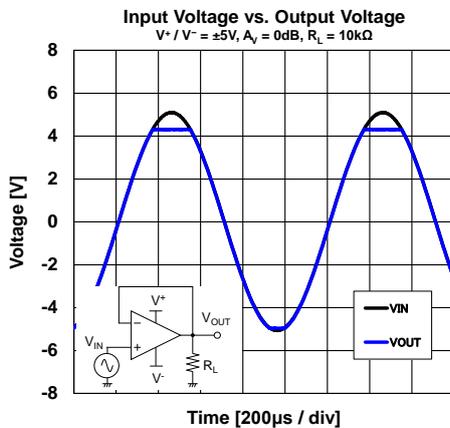


Figure1. No phase reversal

**Capacitive load**

The NL8902 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.

The NL8902 is unity gain stable for capacitive loads of 1000pF. To drive heavier capacitive loads, an isolation resistor,  $R_{ISO}$  as shown Figure2, 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.

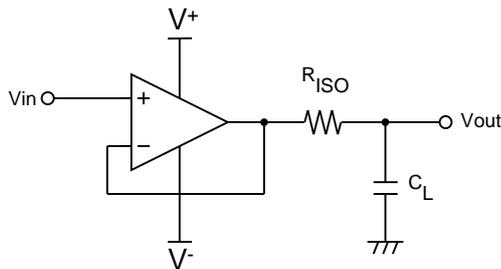


Figure2. Isolating capacitive load

**EMIRR (EMI Rejection Ratio) Definition**

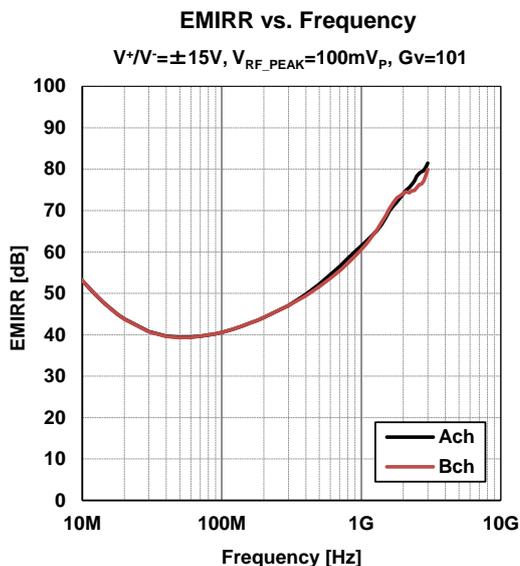
EMIRR is a parameter indicating the EMI robustness of an OpAmp. The definition of EMIRR is given by the following equation1.

$$EMIRR = 20 \cdot \log_{10} \left( \frac{V_{RF\_PEAK}}{|\Delta V_{IO}|} \right) \quad \text{--- eq.1}$$

$V_{RF\_PEAK}$ : RF Signal Amplitude [V<sub>P</sub>]

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

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

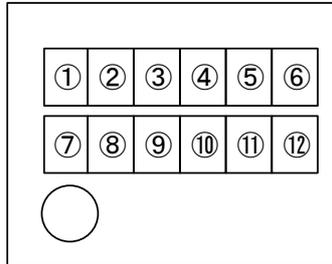


# Nisshinbo Micro Devices Inc.

## ■ MARKING SPECIFICATION (EMP-8-AN)

①②③④⑤⑥⑦⑧: Product Cord Refer to Part Marking List

⑨⑩⑪⑫: Control Number



**EMP-8-AN Part Markings**

<b>NOTICE</b>
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.

Part Marking List (EMP-8-AN)

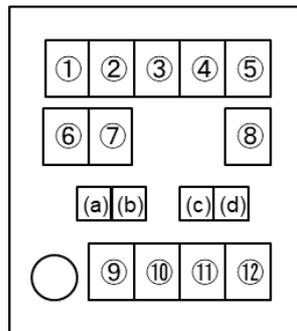
Product Name	①	②	③	④	⑤	⑥	⑦	⑧
NL8902ANAE2S	L	8	9	0	2	A	S	A

## ■ MARKING SPECIFICATION (DFN4035-8-GR)

①②③④⑤⑥⑦⑧: Product Cord Refer to Part Marking List

⑨⑩⑪⑫: Control Number

(a)(b)(c)(d): Control Number



**DFN4035-8-GR Part Markings**

<b>NOTICE</b>
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.

Part Marking List (DFN4035-8-GR)

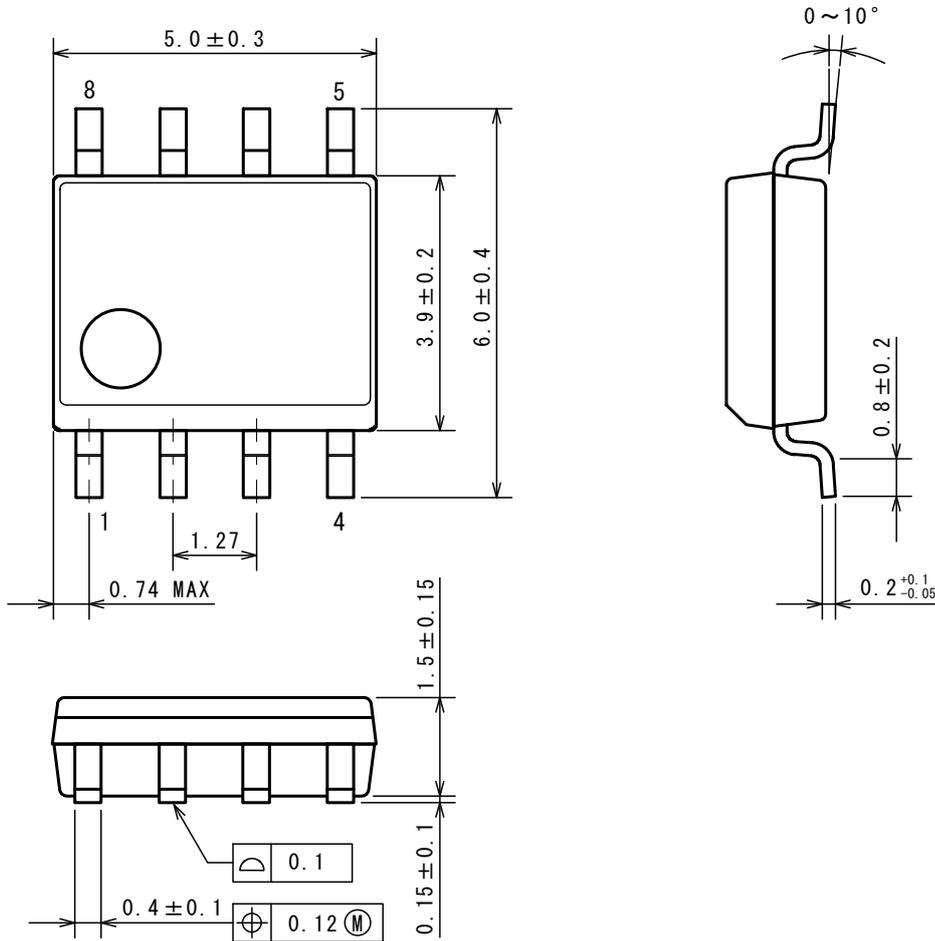
Product Name	①	②	③	④	⑤	⑥	⑦	⑧
NL8902GRAE4S	L	8	9	0	2	A	S	A

## ■ REVISION HISTORY

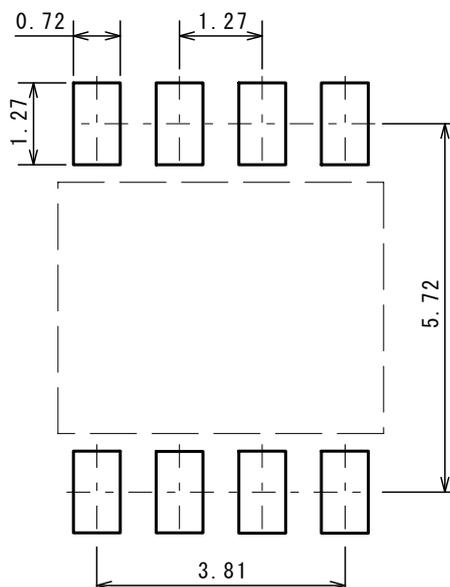
Date	Revision	Contents of Changes
April 11, 2025	Ver. 1.0	Initial release

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



# Nisshinbo Micro Devices Inc.

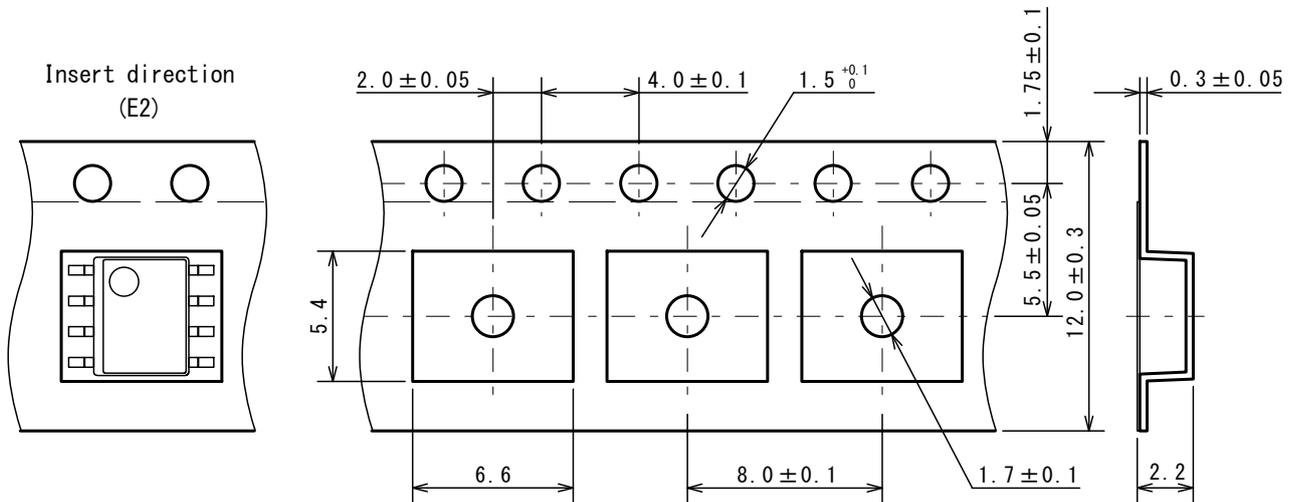
EMP-8-AN

PI-EMP-8-AN-E-B

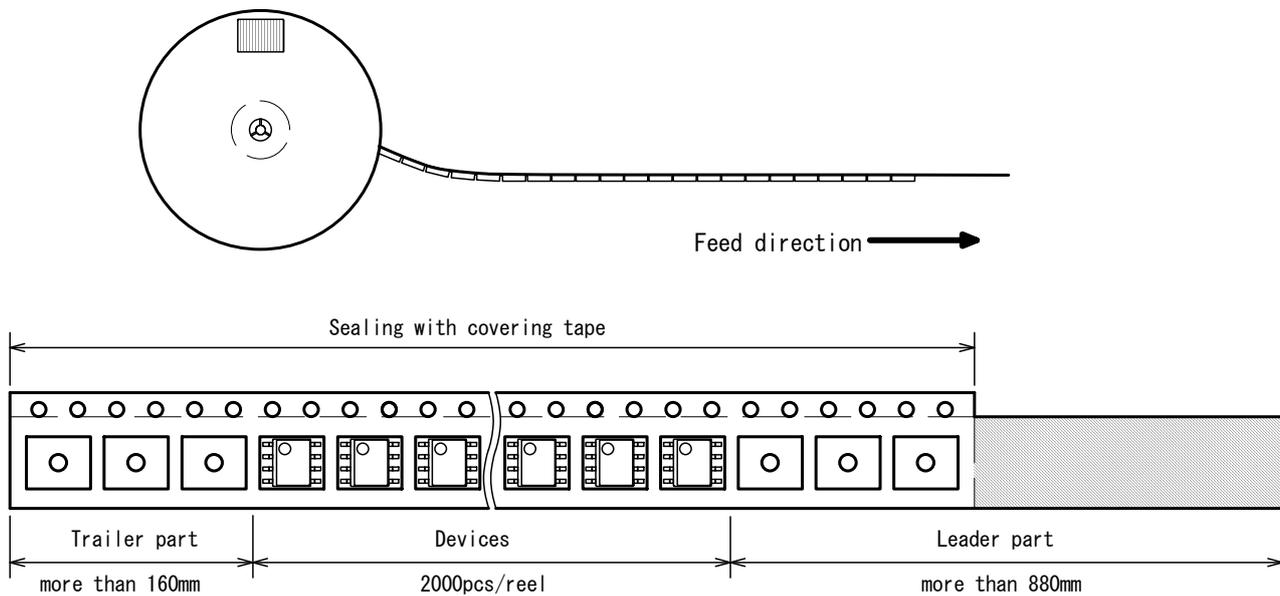
■ PACKING SPEC

UNIT: mm

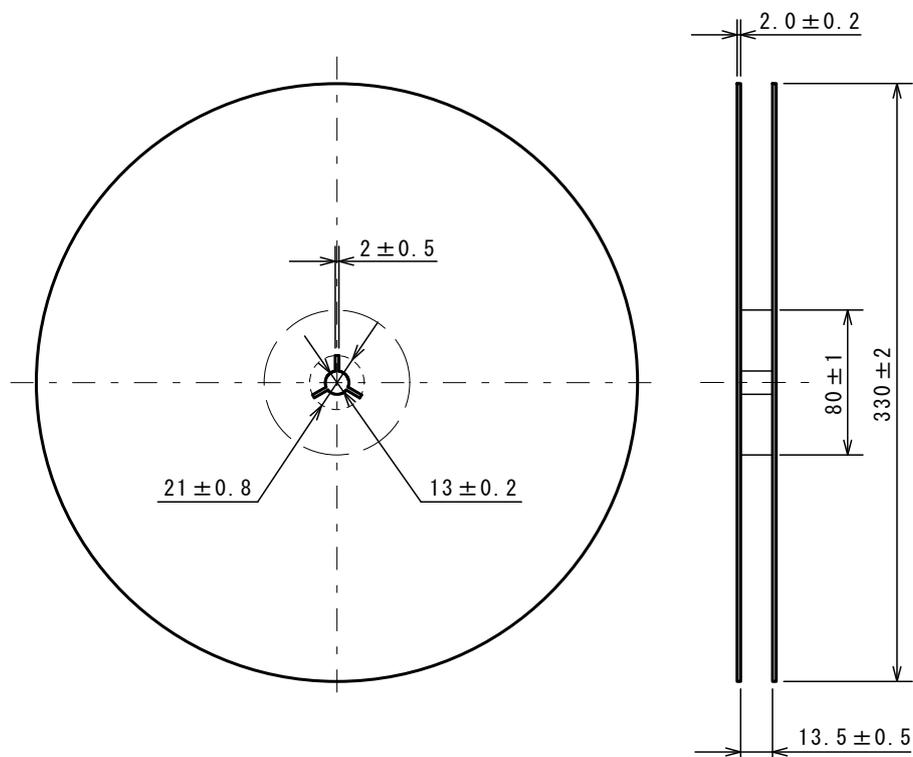
(1) Taping dimensions / Insert direction



(2) Taping state



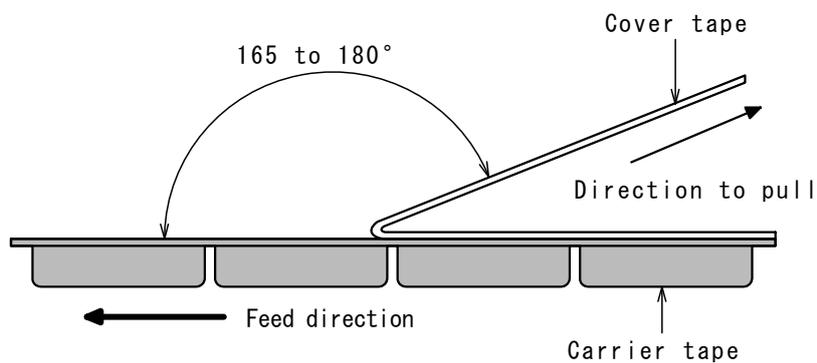
## (3) Reel dimensions



## (4) Peeling strength

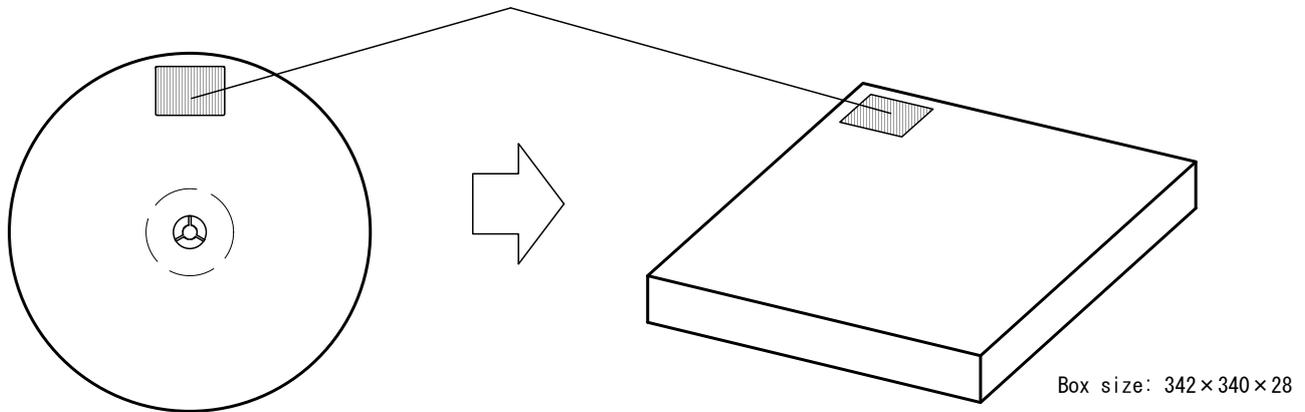
Peeling strength of cover tape

- Peeling angle: 165 to 180° degrees to the taped surface.
- Peeling speed: 300mm/min
- Peeling strength: 0.1 to 1.3N

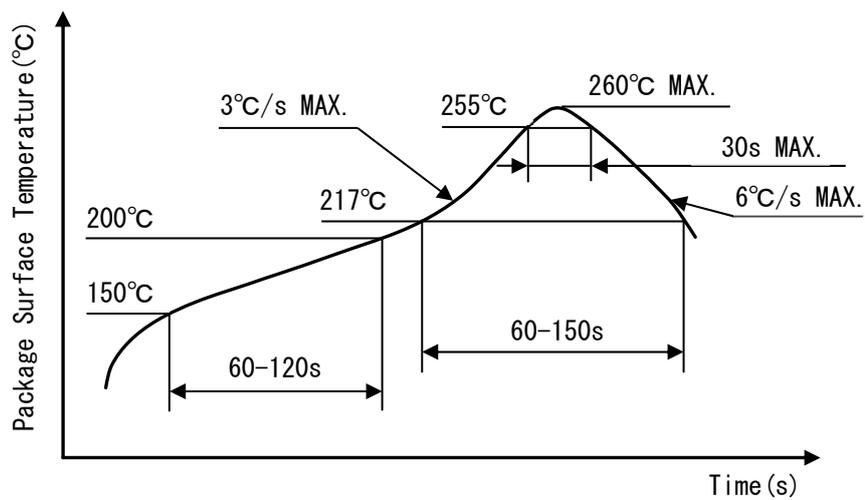


(5) Packing state

<Label> Product name, Quantity, Lot No, Mark



■ HEAT-RESISTANCE PROFILES



Reflow profile

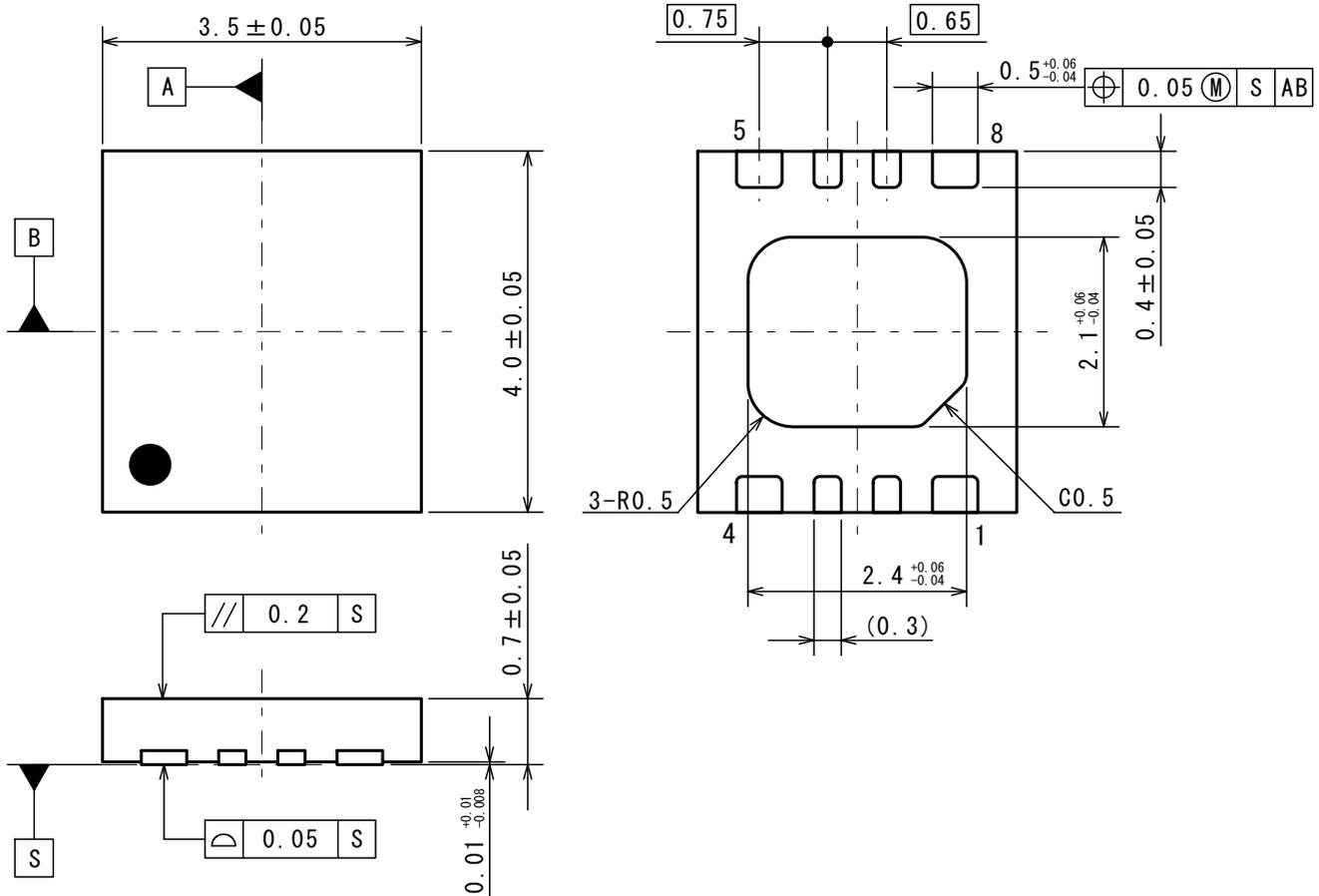
# Nisshinbo Micro Devices Inc.

DFN4035-8-GR

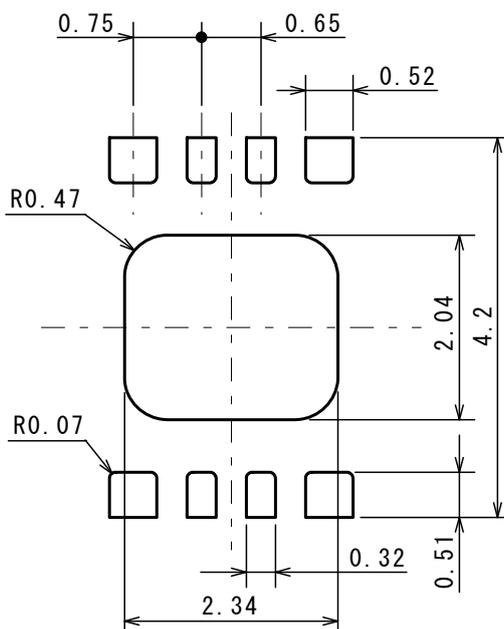
PI-DFN4035-8-GR-E-A

## ■ PACKAGE DIMENSIONS

UNIT: mm



## ■ EXAMPLE OF SOLDER PADS DIMENSIONS



# Nisshinbo Micro Devices Inc.

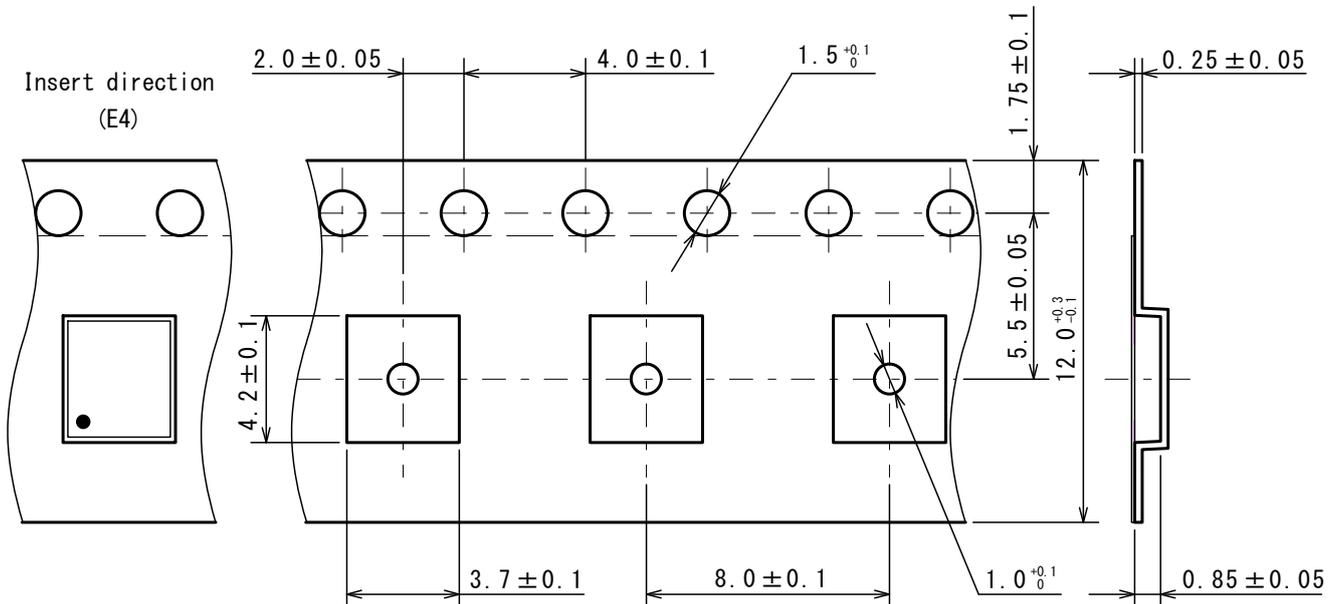
DFN4035-8-GR

PI-DFN4035-8-GR-E-A

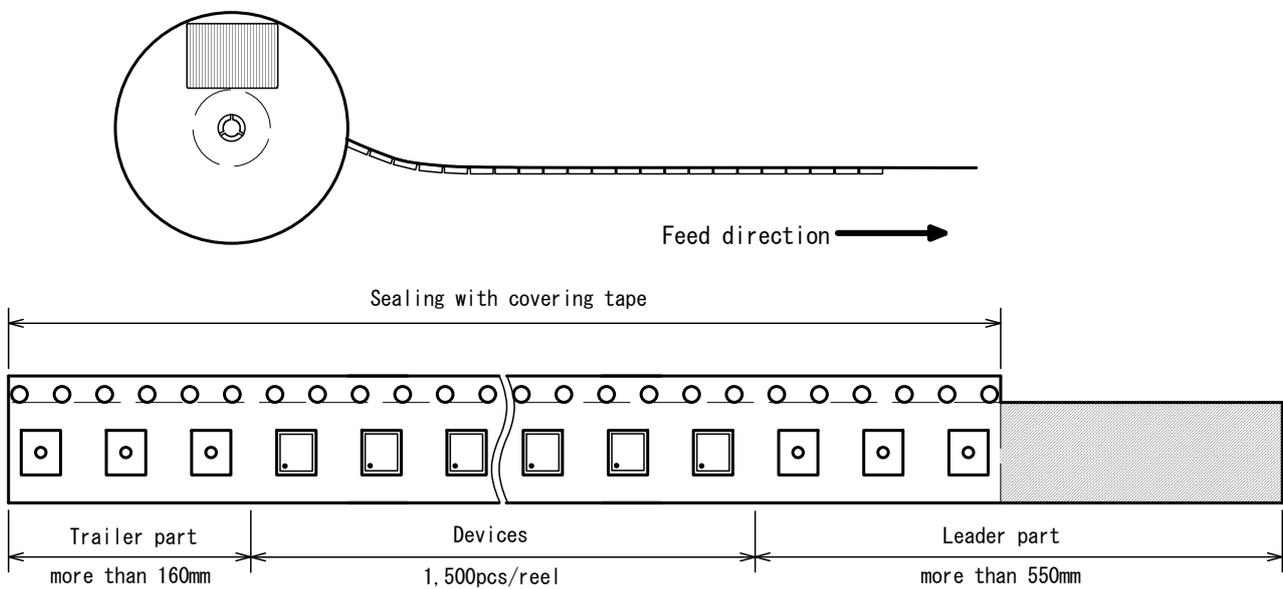
■ PACKING SPEC

UNIT: mm

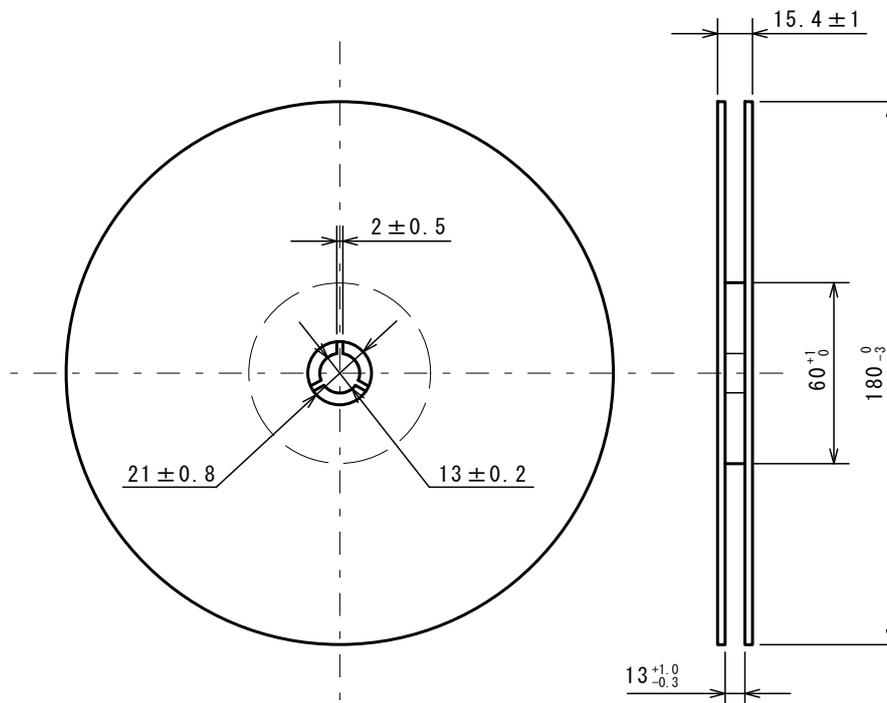
(1) Taping dimensions / Insert direction



(2) Taping state



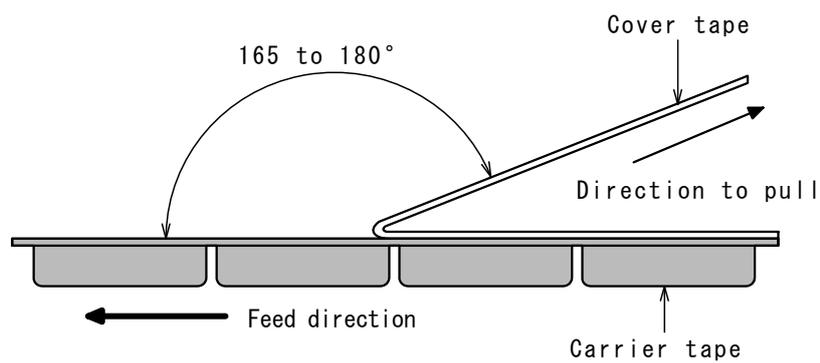
(3) Reel dimensions



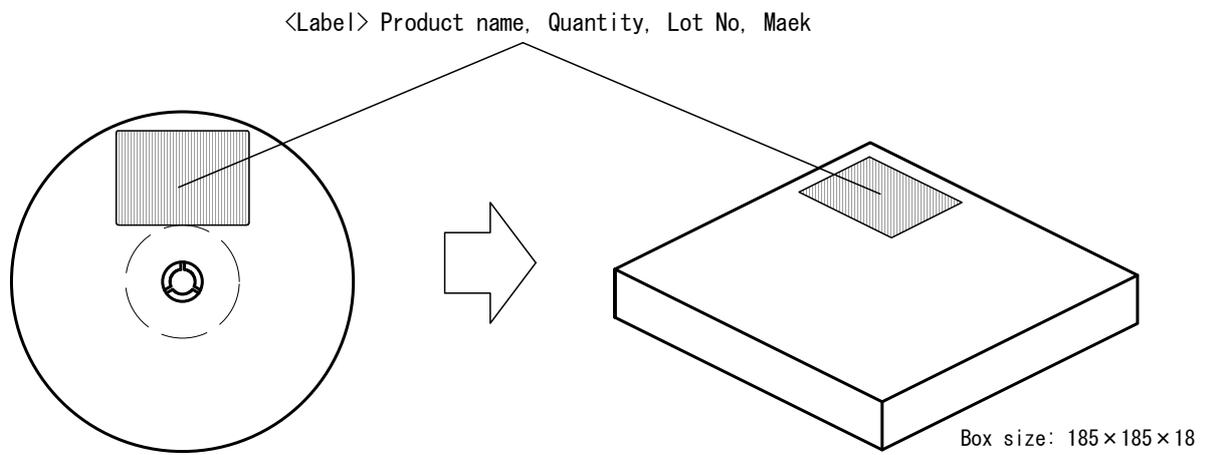
(4) Peeling strength

Peeling strength of cover tape

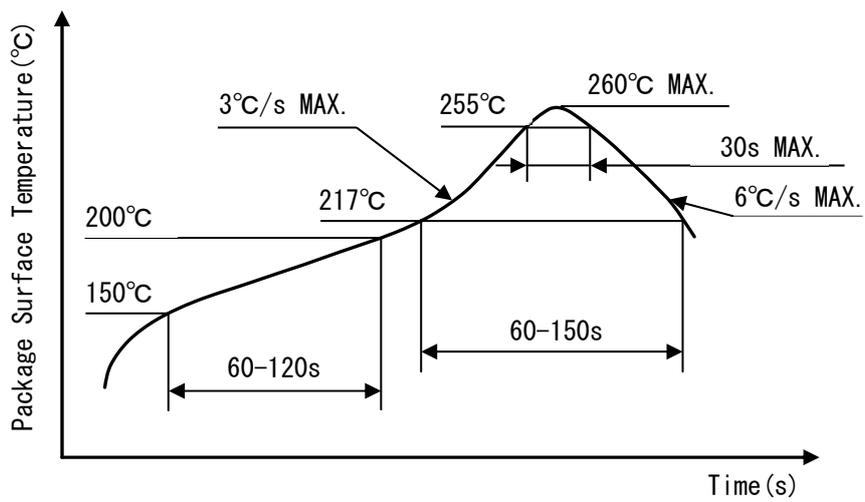
- Peeling angle  $165$  to  $180^\circ$  degrees to the taped surface.
- Peeling speed  $300\text{mm}/\text{min}$
- Peeling strength  $0.1$  to  $1.3\text{N}$



(5) Packing state



■ HEAT-RESISTANCE PROFILES



Reflow profile

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.
3. This product and any technical information relating thereto are subject to complementary export controls (so-called KNOW controls) under the Foreign Exchange and Foreign Trade Law, and related politics ministerial ordinance of the law. (Note that the complementary export controls are inapplicable to any application-specific products, except rockets and pilotless aircraft, that are insusceptible to design or program changes.) Accordingly, when exporting or carrying abroad this product, follow the Foreign Exchange and Foreign Trade Control Law and its related regulations with respect to the complementary export controls.
4. The technical information described in this document shows typical characteristics and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under our or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death should first contact us.
  - 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/>

**Purchase information**

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