NL8802

High Quality Sound Dual Operational Amplifier

FEATURES

- High Quality Sound
- Wide Operating Voltage Range ±3.0V to ±22V
- Low Noise 5.5nV/√Hz at f=1kHz
- Low Distortion 0.00005% at f=1kHz
- Wide Gain Bandwidth Product 45MHz
- High Slew Rate 11V/µs
- Quiescent Current 8.0mA (Dual)
- Bipolar Input
- Bipolar Technology
- Package Outline EMP-8-AN
  (Under development) DFN3030-8-GQ

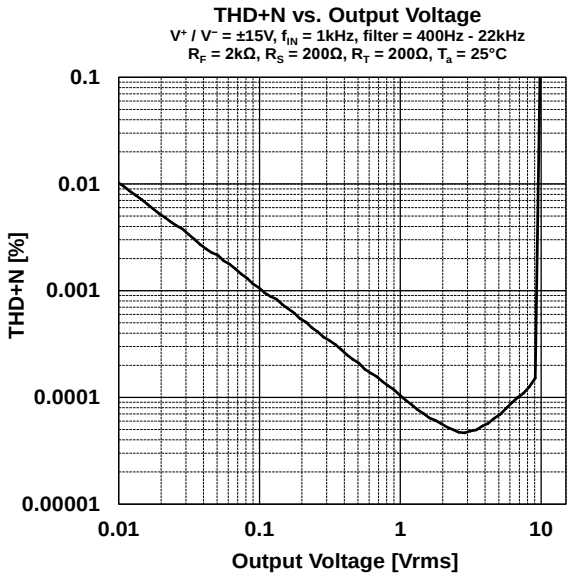
DESCRIPTION

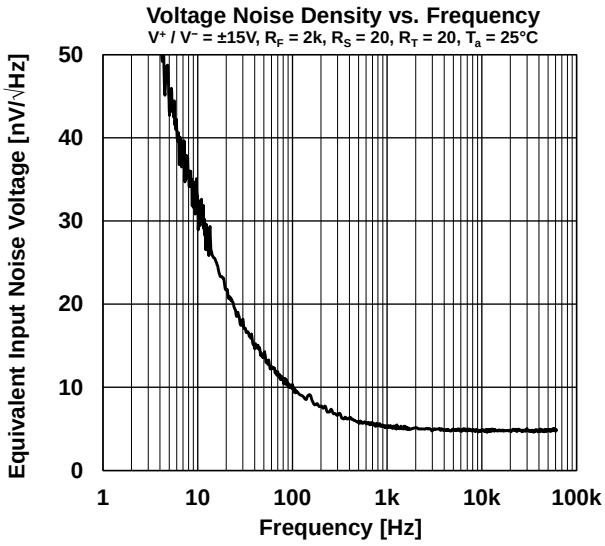
The NL8802 is a high quality sound dual audio operational amplifier that applies the high quality sound technology of "MUSES" to a more productive technology.
The NL8802 features wide operating voltage range, low noise, low distortion, wide bandwidth and high slew rate.
It is the best for audio preamplifiers, active filters and line amplifiers.

APPLICATIONS

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

THD+N and Noise





■ PRODUCT NAME INFORMATION

NL8802 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 GQ: DFN3030-8-QG
A	Version	Indicates the product version. “A” is initial version.
bb	Packing	Refer to the packing specifications.
S	Grade	Indicates the quality grade. “S” means general-purpose and consumer application.

Grade

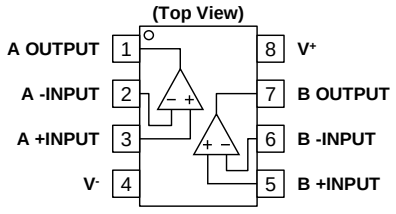
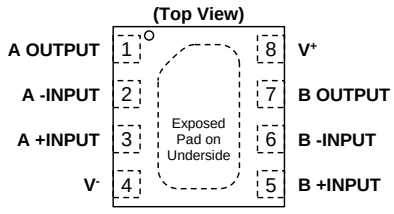
	Applications	Operating Temperature Range	Test Temperature
S	General−purpose and Consumer application	-40°C to 85°C -40°C to 105°C *1	25°C

*1 Recommended Operating Conditions (Operating Temperature2)

■ ORDER INFORMATION

Product Name	Package	RoHS	Halogen-Free	Terminal Finish	Weight (mg)	QUANTITY PER REEL (pcs/reel)
NL8802ANAE1S	EMP-8-AN	✓	✓	Sn2Bi	76	2000
NL8802GQAE3S (Under development)	DFN3030-8-GQ	✓	✓	Sn2Bi	18	1500

■ PIN DESCRIPTIONS

Product Name	NL8802AN	NL8802GQ
Package	EMP-8-AN	DFN3030-8-GQ
Pin Functions		 *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

Parameter	Symbol	Rating	Unit
Supply Voltage (Vs = V^+ - V^-)	V^+/ V^-	±22 (44)	V
Input Voltage *1	V_{IN}	V^- -0.3 to V^- +44	V
Differential Input Voltage *2	V_{ID}	±0.5	V
Input Current *3	I_{IN}	±10	mA
Storage Temperature	T_{stg}	-50 to 150	°C
Junction Temperature *4	T_j	150	°C

*1 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.
*2 Differential input voltage is the voltage difference between +INPUT and −INPUT.
*3 Excessive input current will flow if a differential input voltage in excess of approximately 0.5 V is applied between the inputs, unless some limiting resistance is used.
*4 Calculate the power consumption of the IC from the operating conditions, and calculate the junction temperature with the thermal resistance. 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 (Θja)	Thermal Characterization Parameter (ψjt)	
EMP-8-AN	157 *1 / 103 *2	16 *1 / 12 *2	°C/W
DFN3030-8-GQ	192 *3 / 60 *4	-	

Θja: Junction-to-Ambient Thermal Resistance
ψjt: 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 (EMP-8-AN)

	Conditions	Protection Voltage
HBM	C = 100 pF, R = 1.5 kΩ	±2000 V
CDM		±750 V (Corner pins) ±500 V (Other pins)

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^-		±3.0 to ±22	V
Operating Temperature1	T_{a1}		-40 to 85	°C
Operating Temperature2	T_{a2}	EMP-8-AN *1 $V^+/ V^- \leq \pm 13V$	-40 to +105	°C
		DFN3030-8-GQ *2		

*1 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).
*2 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.)

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

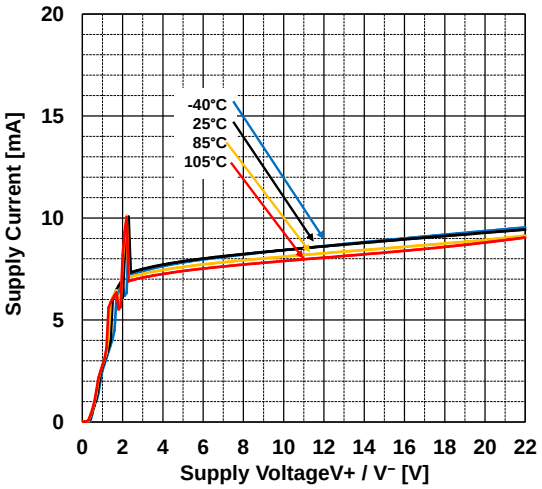
V^+/V^-=±15V, R_L to GND, Ta=25°C, unless otherwise specified

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
DC CHARACTERISTICS						
Supply Current	Icc	No Signal, R_L=∞	-	8.0	16	mA
Input Offset Voltage	V_{IO}	Rs=50Ω	-	1.0	5.0	mV
Input Bias Current	I_B		-	0.5	1.8	μA
Input Offset Current	I_{IO}		-	10	300	nA
Open-Loop Voltage Gain 1	A_{V1}	R_L=10kΩ, V_O=±10V	90	115	-	dB
Open-Loop Voltage Gain 2	A_{V2}	R_L=600Ω, V_O=±10V	80	104	-	dB
Common Mode Rejection Ratio	CMR	V_{ICM}=±12V	80	115	-	dB
Supply Voltage Rejection Ratio	SVR	V^+/V^-=±3.0 to ±22V	80	110	-	dB
Maximum Output Voltage 1	V_{OM1}	R_L =600Ω	±12	±13	-	V
Maximum Output Voltage 2	V_{OM2}	V^+/V^-=±18V, R_L =600Ω	±15	±16	-	V
Common Mode Input Voltage Range	V_{ICM}	CMR≥80dB	±12	±13	-	V
Input Resistance	R_{IN}		-	50	-	kΩ
Short-circuit Output Current	I_O		30	60	-	mA
AC CHARACTERISTICS						
Gain Bandwidth Product	GBW	f=100kHz	-	45	-	MHz
Unity Gain Frequency	f_T	A_V=+100, R_S=100Ω, R_L=2kΩ, C_L=10pF	-	16	-	MHz
Phase Margin	Φ_M	A_V=+100, R_S=100Ω, R_L=2kΩ, C_L=10pF	-	70	-	Deg
Slew Rate	SR	A_V=+10, V_{IN}=0.5Vp-p, R_L=2kΩ, C_L=10pF	-	11	-	V/μs
Total Harmonic Distortion	THD	f=1kHz A_V=+10, Vo=3Vrms, R_L=2kΩ	-	0.00005	-	%
Input Noise Voltage1	e_n	f=1kHz	-	5.5	-	nV/√Hz
Input Noise Voltage2	V_{NI}	f=20Hz to 20kHz	-	0.9	-	μVrms

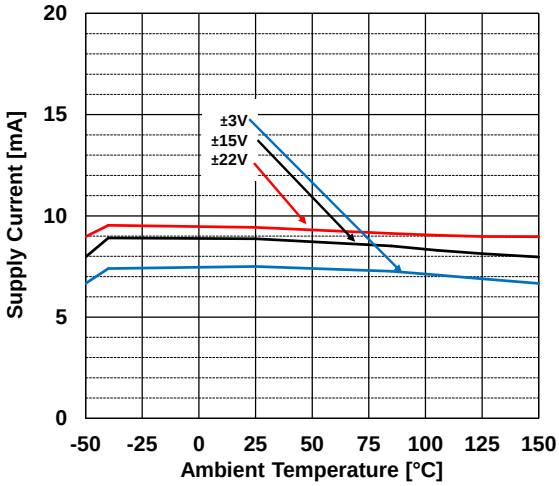
■ TYPICAL CHARACTERISTICS

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

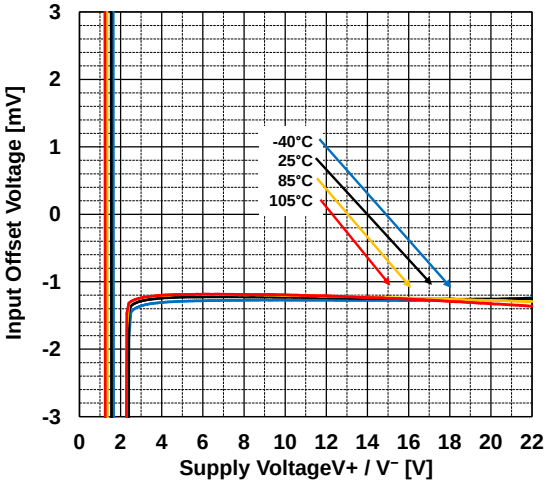
Supply Current vs. Supply Voltage



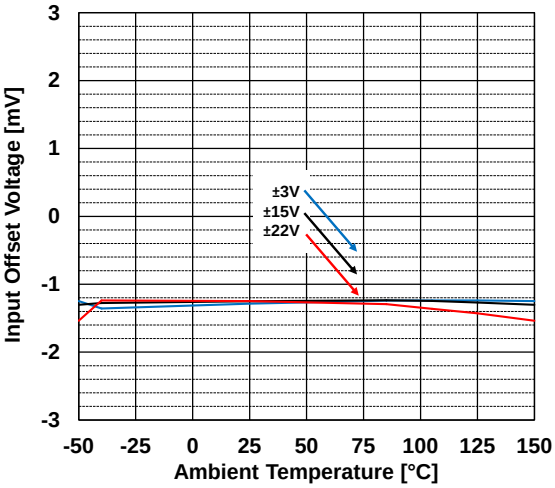
Supply Current vs. Temperature



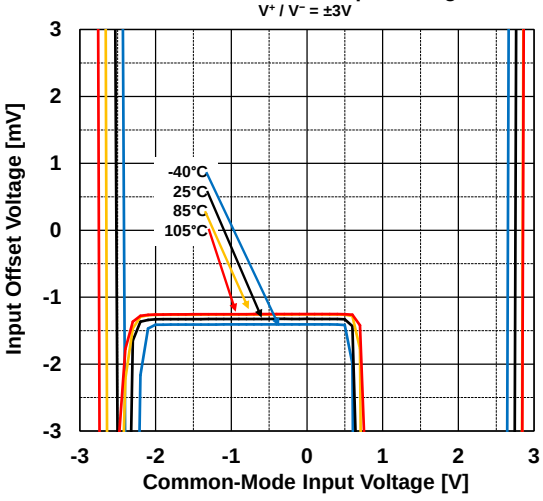
Input Offset Voltage vs. Supply Voltage



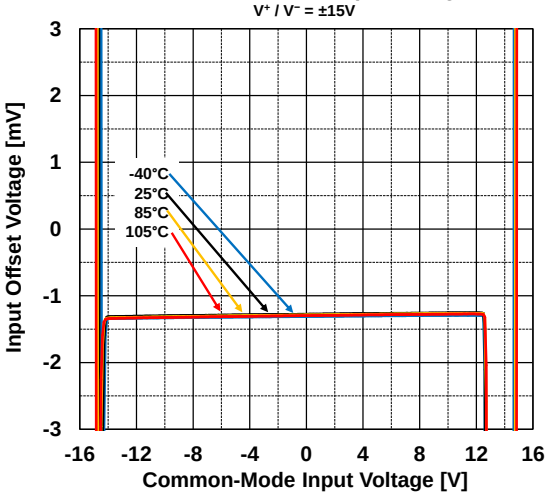
Input Offset Voltage vs. Temperature



Input Offset Voltage
vs. Common-Mode Input Voltage
V⁺ / V⁻ = ±3V



Input Offset Voltage
vs. Common-Mode Input Voltage
V⁺ / V⁻ = ±15V



■ TYPICAL CHARACTERISTICS

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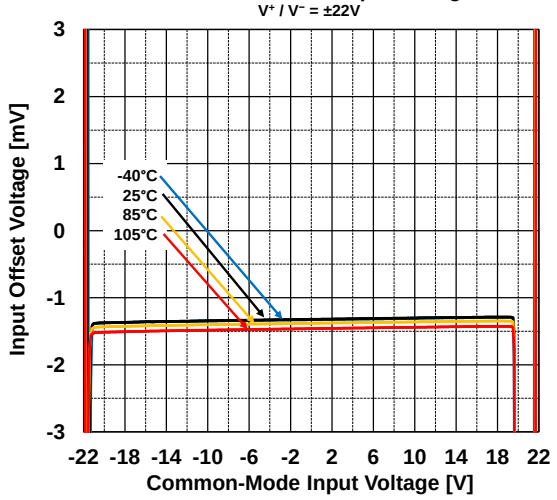
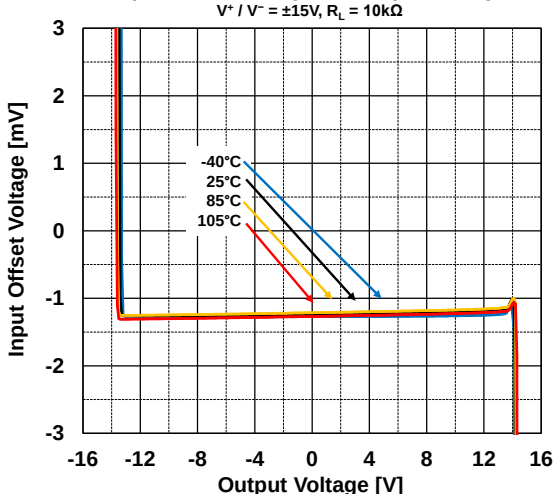
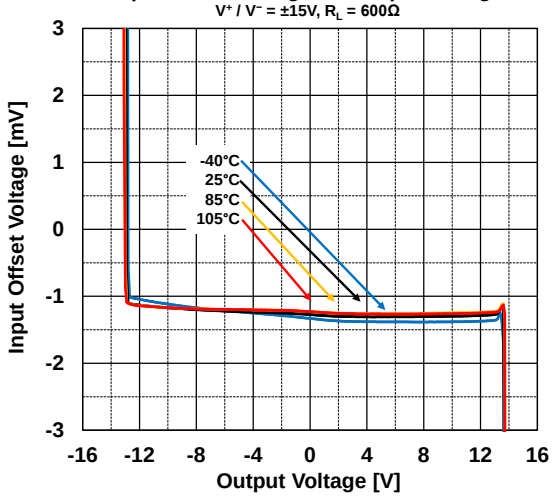
Input Offset Voltage
vs. Common-Mode Input Voltage
V⁺ / V⁻ = ±22V



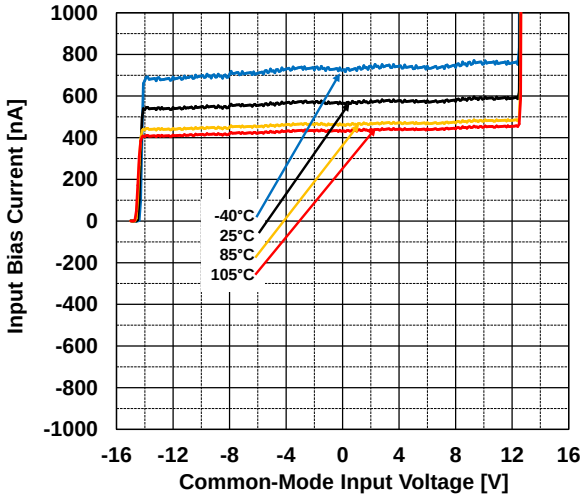
Input Offset Voltage vs. Output Voltage
V⁺ / V⁻ = ±15V, R_L = 10kΩ



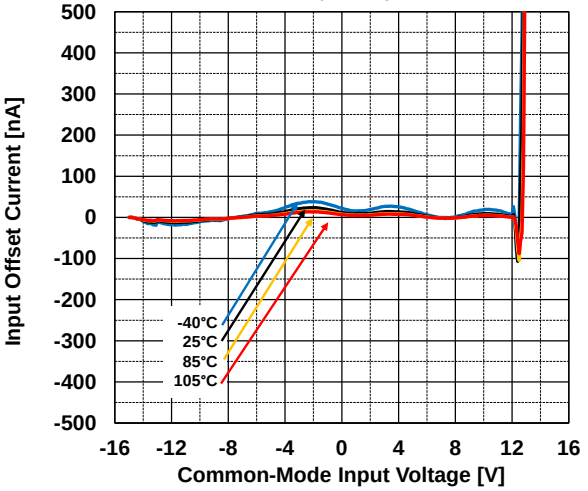
Input Offset Voltage vs. Output Voltage
V⁺ / V⁻ = ±15V, R_L = 600Ω



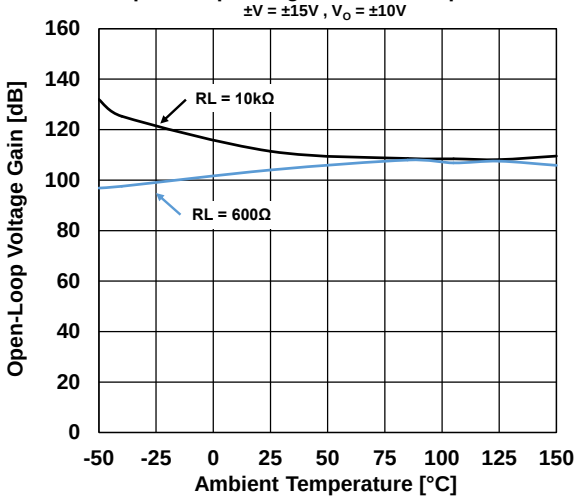
Input Bias Current vs. Common-Mode Input Voltage
V⁺ / V⁻ = ±15V



Input Offset Current vs. Common-Mode InputVoltage
V⁺ / V⁻ = ±15V



Open-Loop Voltage Gain vs. Temperature
±V = ±15V , V_O = ±10V



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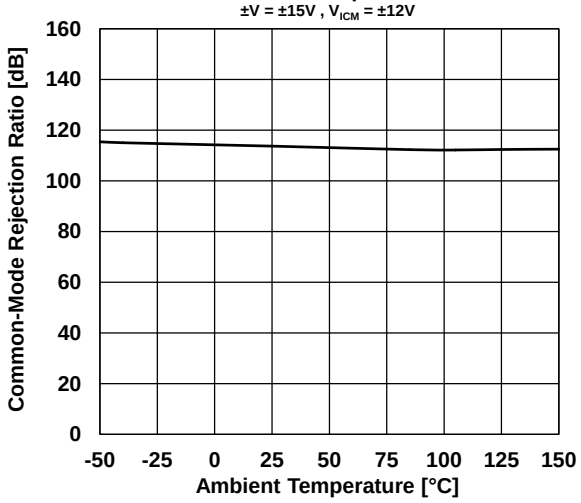
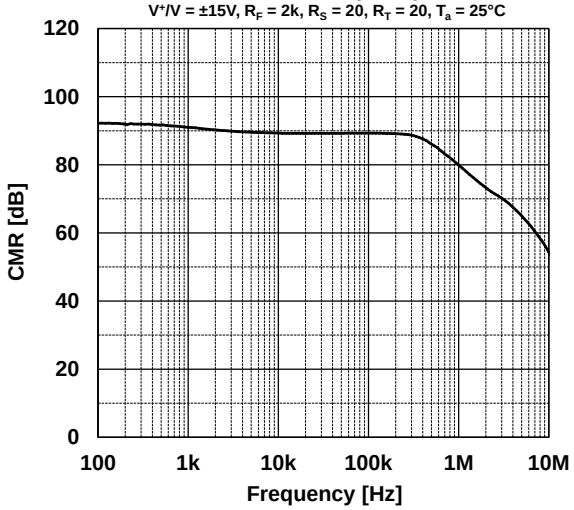
CMR vs. Temperature

±V = ±15V , V_{ICM} = ±12V



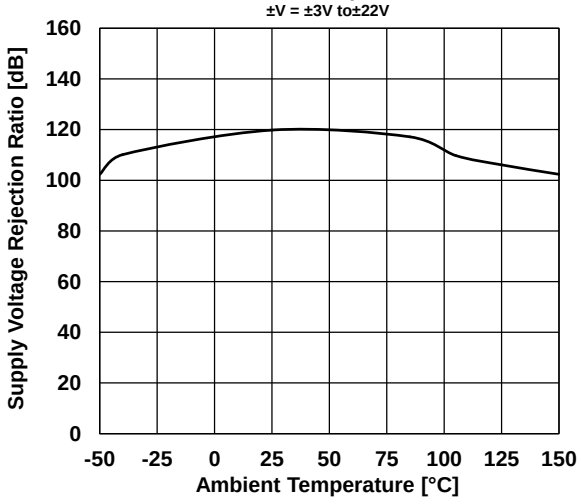
CMR vs Frequency

V^+/V = ±15V, R_F = 2k, R_S = 20, R_T = 20, T_a = 25°C



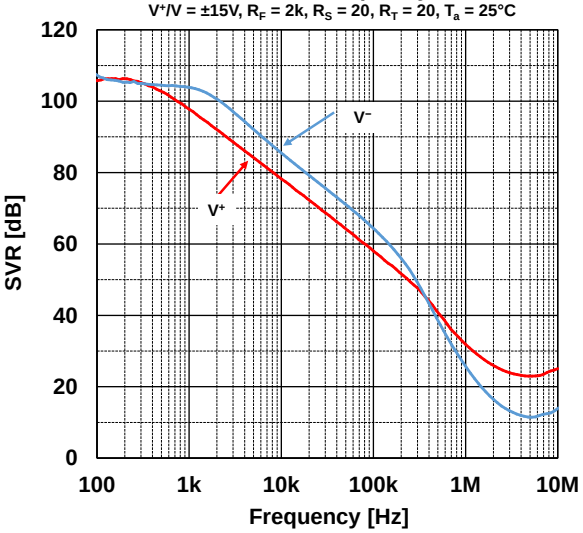
SVR vs. Temperature

±V = ±3V to±22V



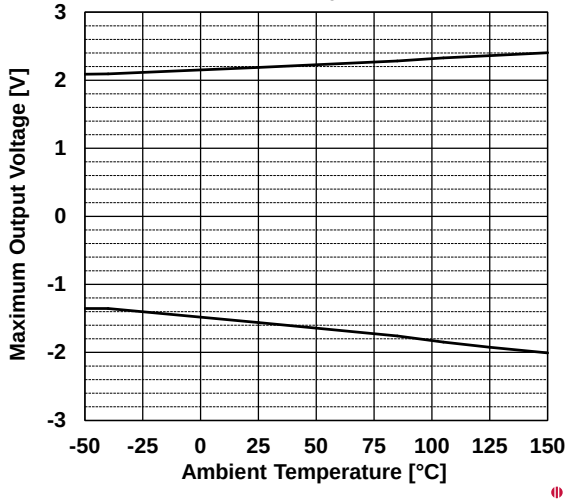
SVR vs Frequency

V^+/V = ±15V, R_F = 2k, R_S = 20, R_T = 20, T_a = 25°C



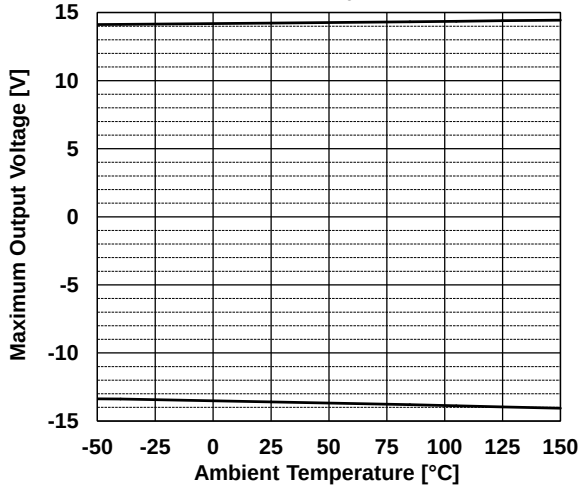
Maximum Output Voltage vs. Temperature

±V = ±3V



Maximum Output Voltage vs. Temperature

±V = ±15V



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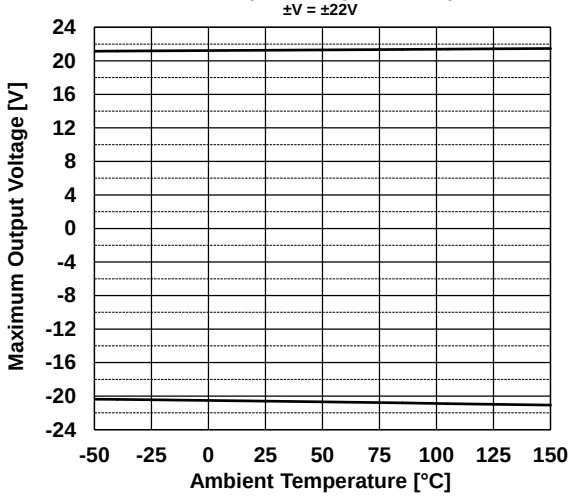
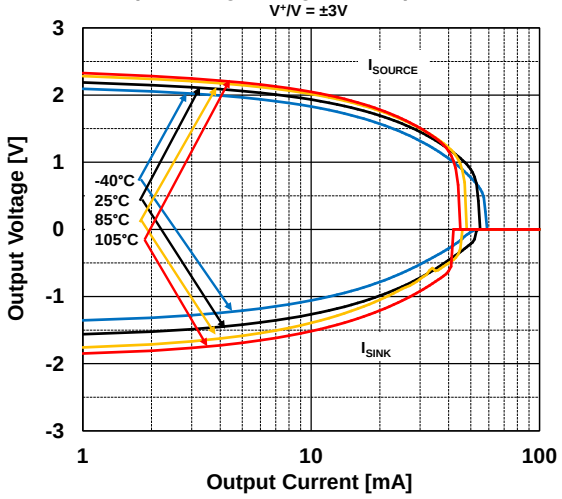
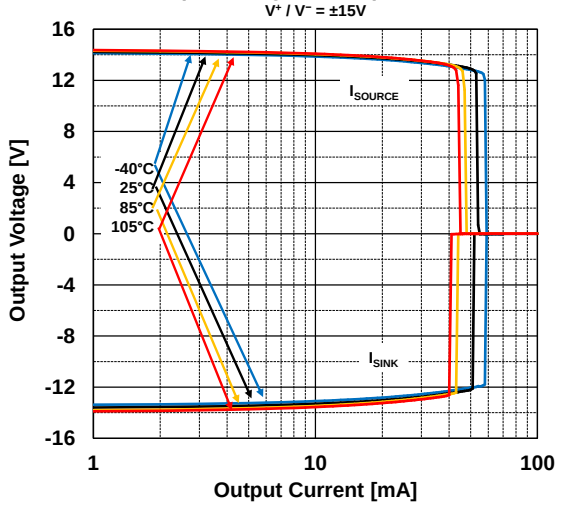
Maximum Output Voltage vs. Temperature



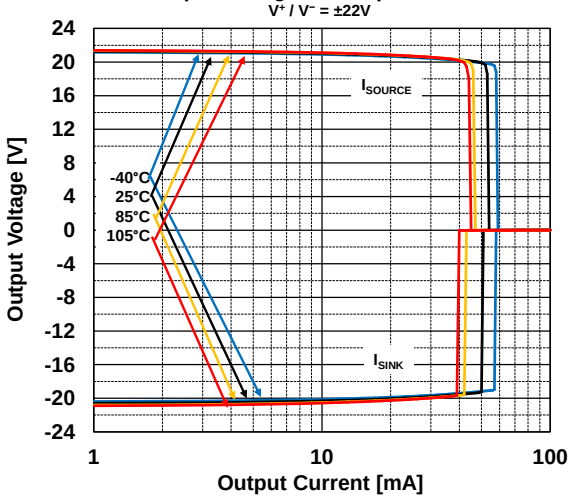
Output VoltageVoltage vs. Output Current



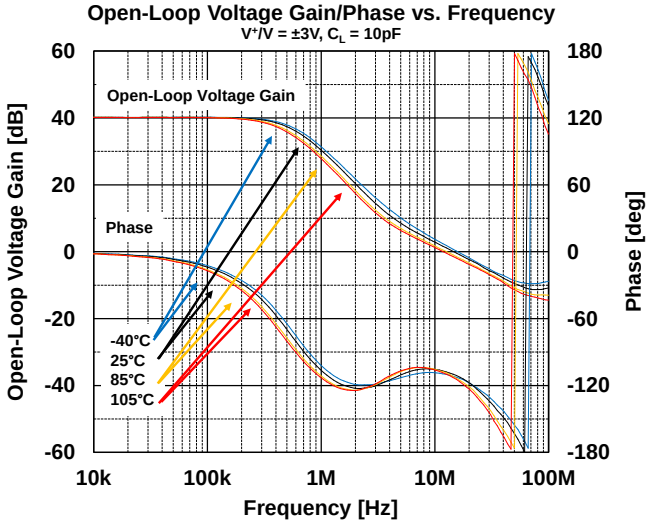
Output Voltage vs. Output Current



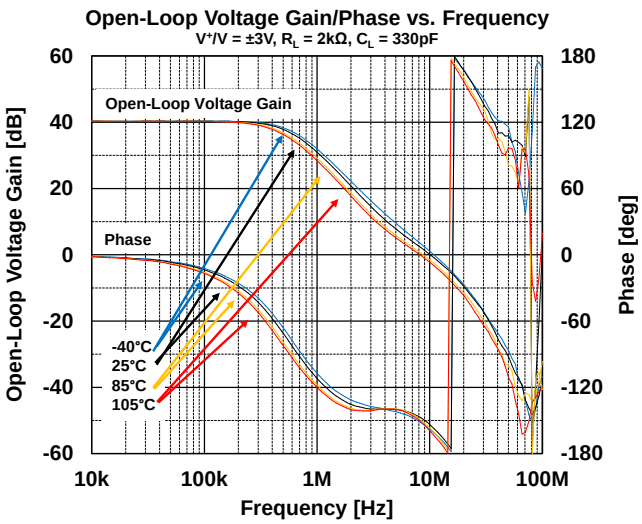
Output Voltage vs. Output Current



Open-Loop Voltage Gain/Phase vs. Frequency



Open-Loop Voltage Gain/Phase vs. Frequency



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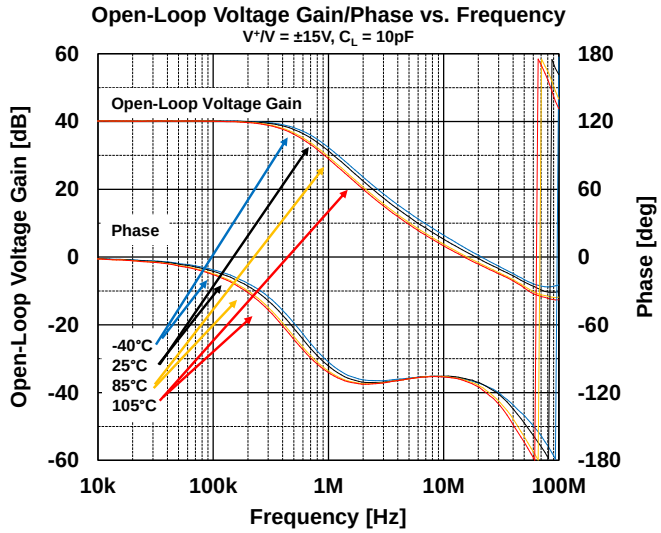

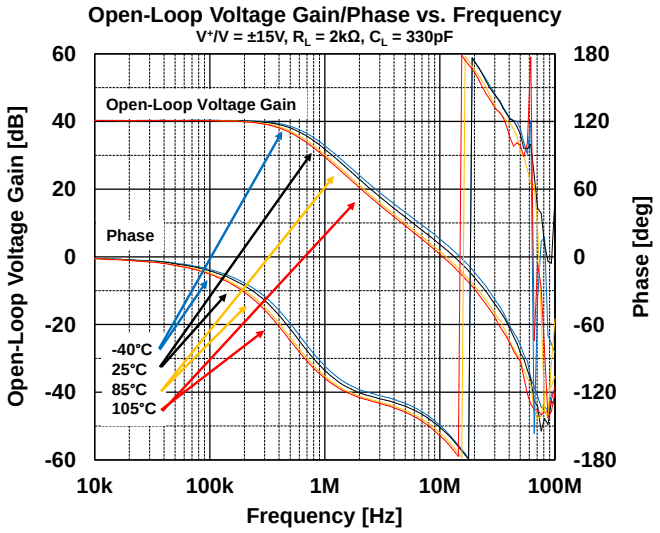

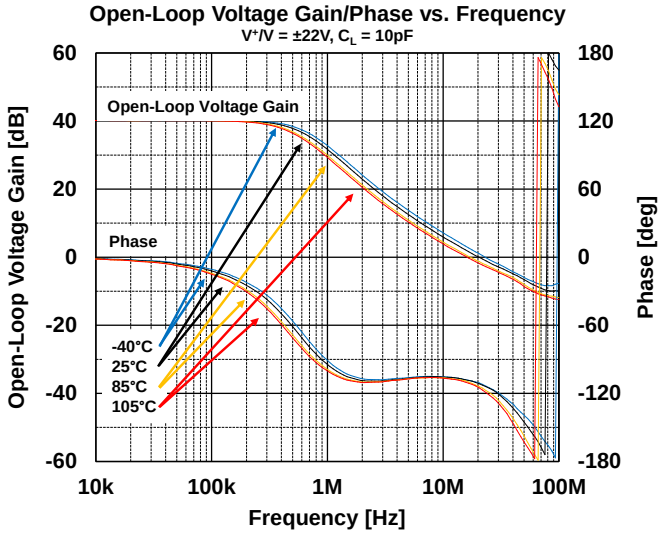

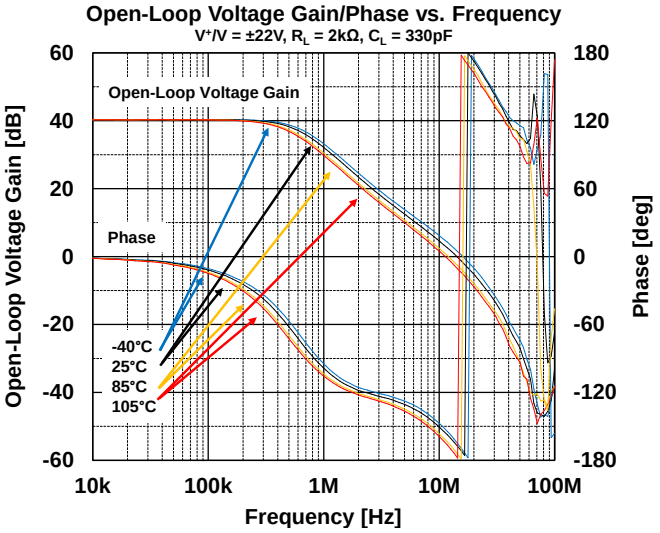

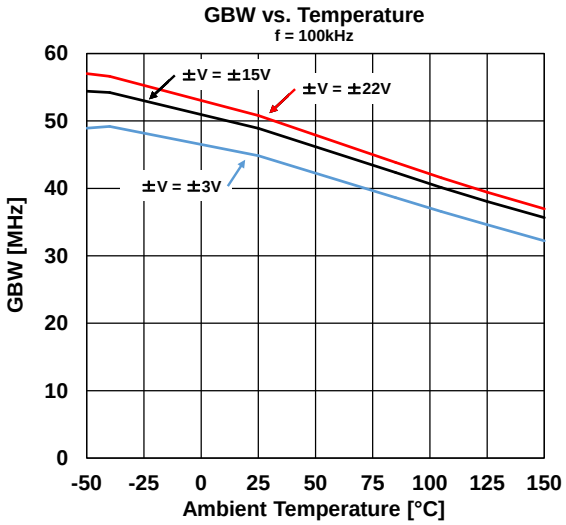

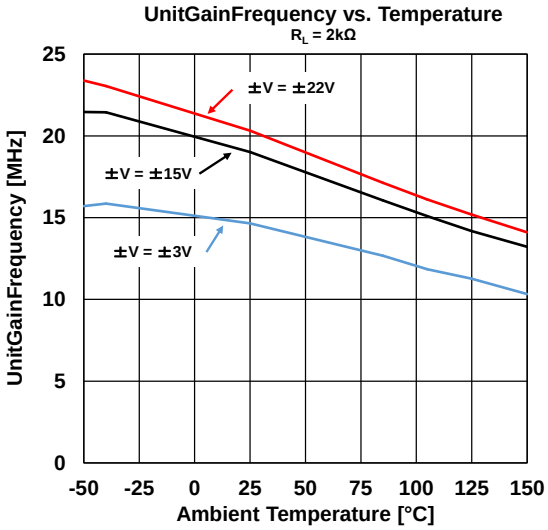

■ TYPICAL CHARACTERISTICS

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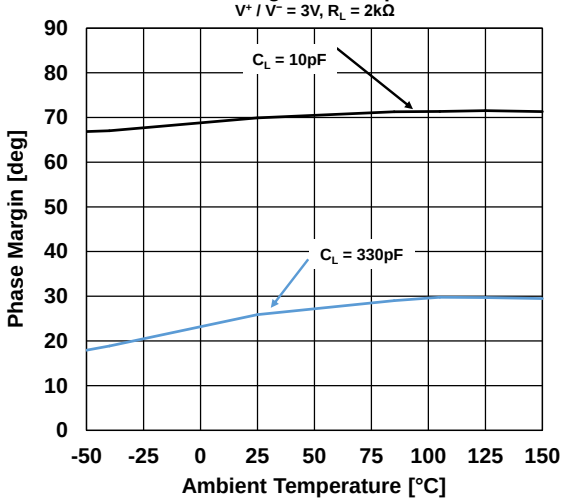
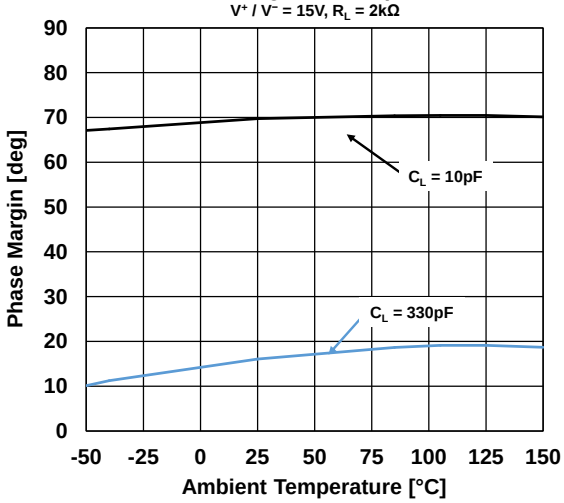
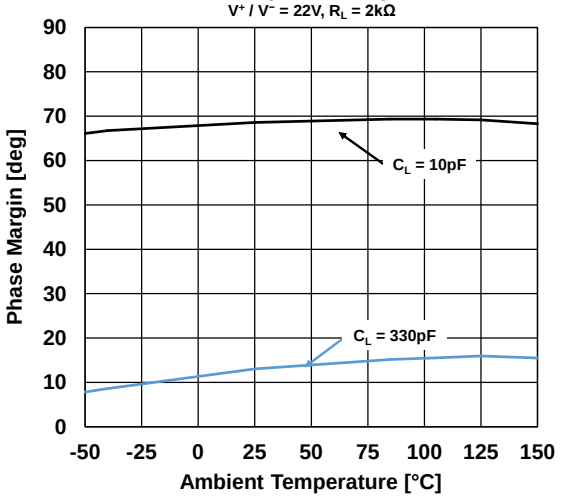
Phase Margin vs. Temperature
V⁺ / V⁻ = 3V, R_L = 2kΩ



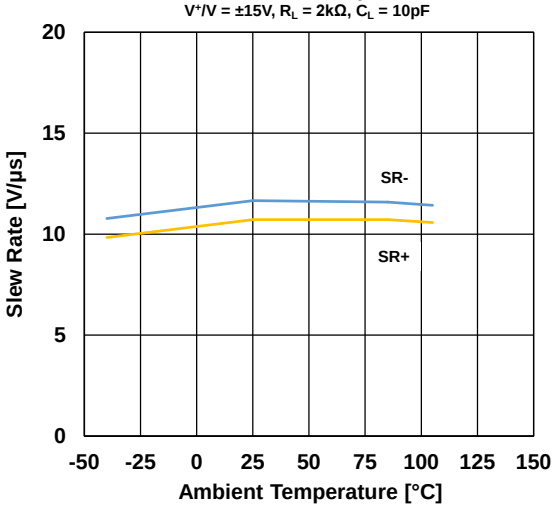
Phase Margin vs. Temperature
V⁺ / V⁻ = 15V, R_L = 2kΩ



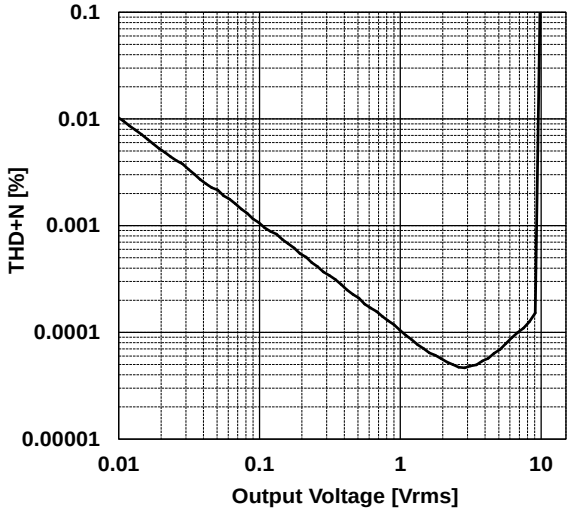
Phase Margin vs. Temperature
V⁺ / V⁻ = 22V, R_L = 2kΩ



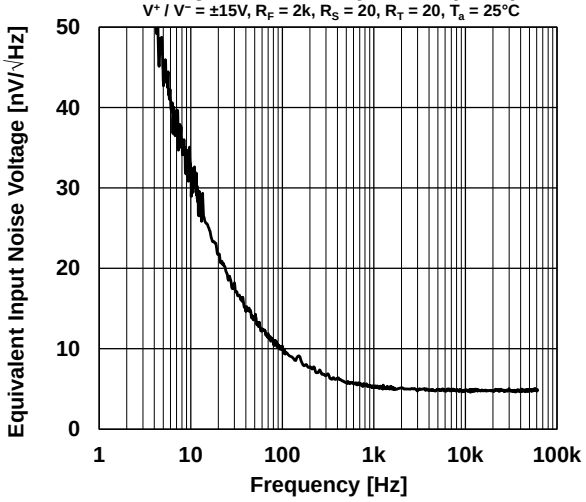
Slew Rate vs. Temperature
V⁺/V = ±15V, R_L = 2kΩ, C_L = 10pF



THD+N vs. Output Voltage
V⁺ / V⁻ = ±15V, f_{IN} = 1kHz, filter = 400Hz - 22kHz
R_F = 2kΩ, R_S = 200Ω, R_T = 200Ω, T_a = 25°C



Voltage Noise Density vs. Frequency
V⁺ / V⁻ = ±15V, R_F = 2k, R_S = 20, R_T = 20, T_a = 25°C



■ TEST CIRCUITS

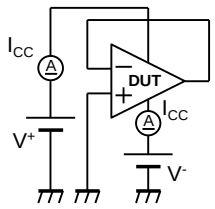


Figure 1. Supply Current

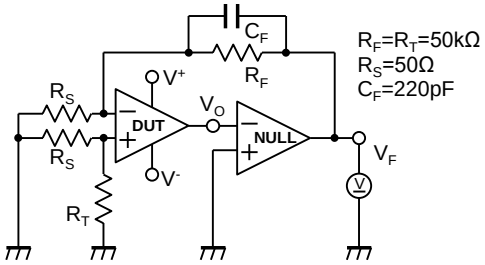


Figure 2. Input Offset Voltage

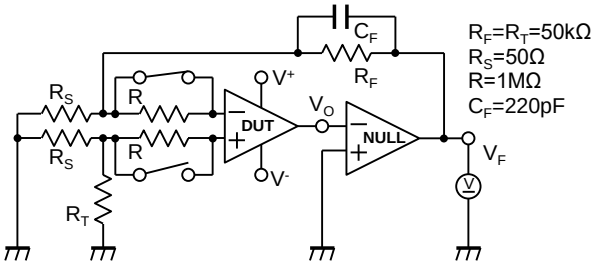


Figure 3. Input Bias Current

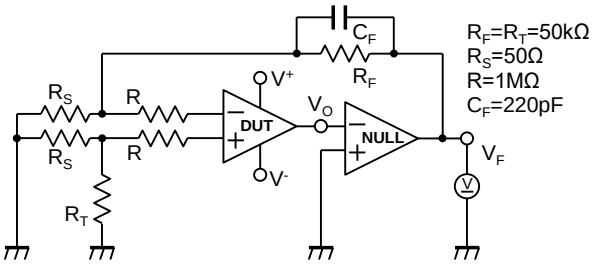


Figure 4. Input Offset Current

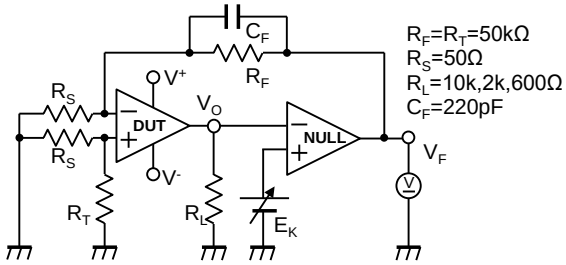


Figure 5. Open-Loop Voltage Gain

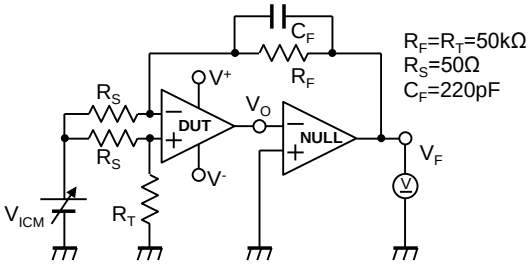


Figure 6. Common Mode Rejection Ratio

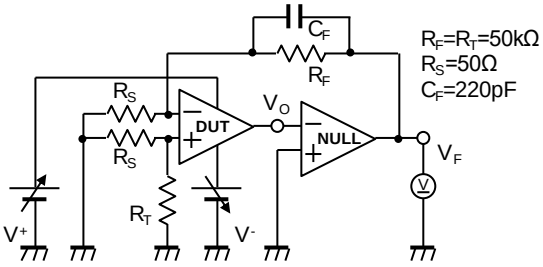


Figure 7. Supply Voltage Rejection Ratio

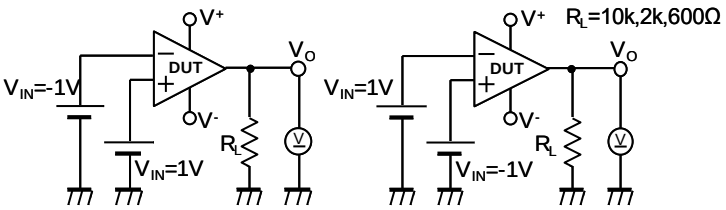


Figure 8. Maximum Output Voltage

■ TEST CIRCUITS

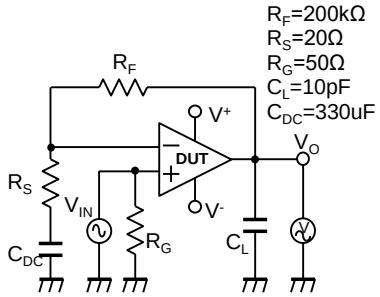


Figure 9. Gain Bandwidth Product

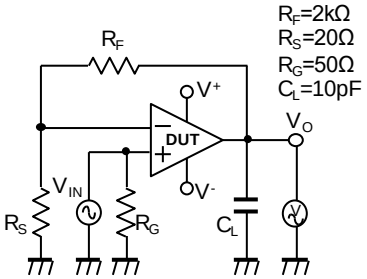


Figure 10.Unity Gain Frequency, Phase Margin

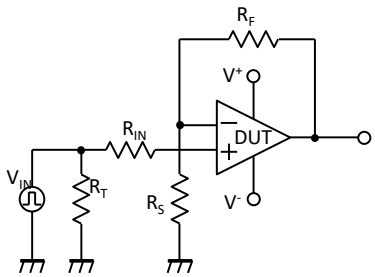


Figure 11. Slew Rate

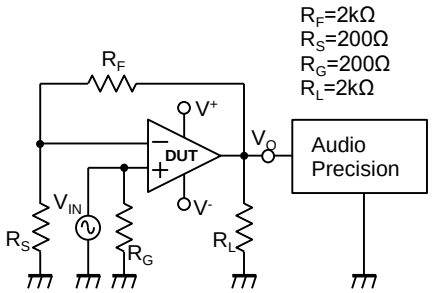


Figure 12. Total Harmonic Distortion

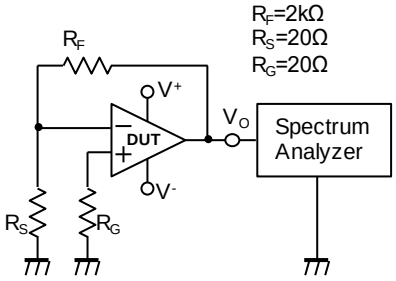
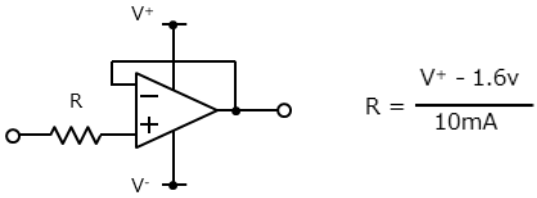


Figure 13. Input Noise Voltage

■ APPLICATION NOTE

Internal Diode Protection

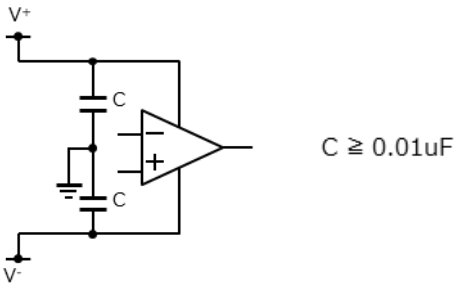
When using in a voltage follower circuit, insert a current limiting resistor into the input terminal as shown in Figure 1 to avoid destroying the internal input diode when the power is turned on.



(Figure 1)

Oscillation Countermeasures

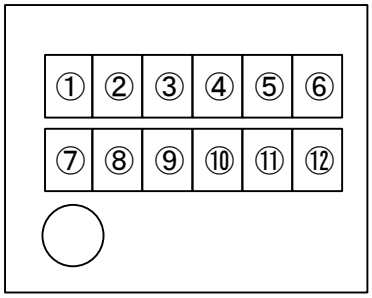
The device may oscillate due to Power wiring resistance. Place the bypass capacitor in Figure 2 close to the device.



(Figure 2)

■ MARKING SPECIFICATION (EMP-8-AN)

①②③④⑤⑥⑦⑧: Product Cord Refer to Part Marking List
⑨⑩⑪⑫: Control Number



EMP-8-AN Part Markings

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.

Part Marking List (EMP-8-AN)

Product Name	①	②	③	④	⑤	⑥	⑦	⑧
NL8802ANAE1S	L	8	8	0	2	A	S	A

■ REVISION HISTORY

Date	Revision	Contents of Changes
October 30, 2023	Ver. 1.0	Initial release

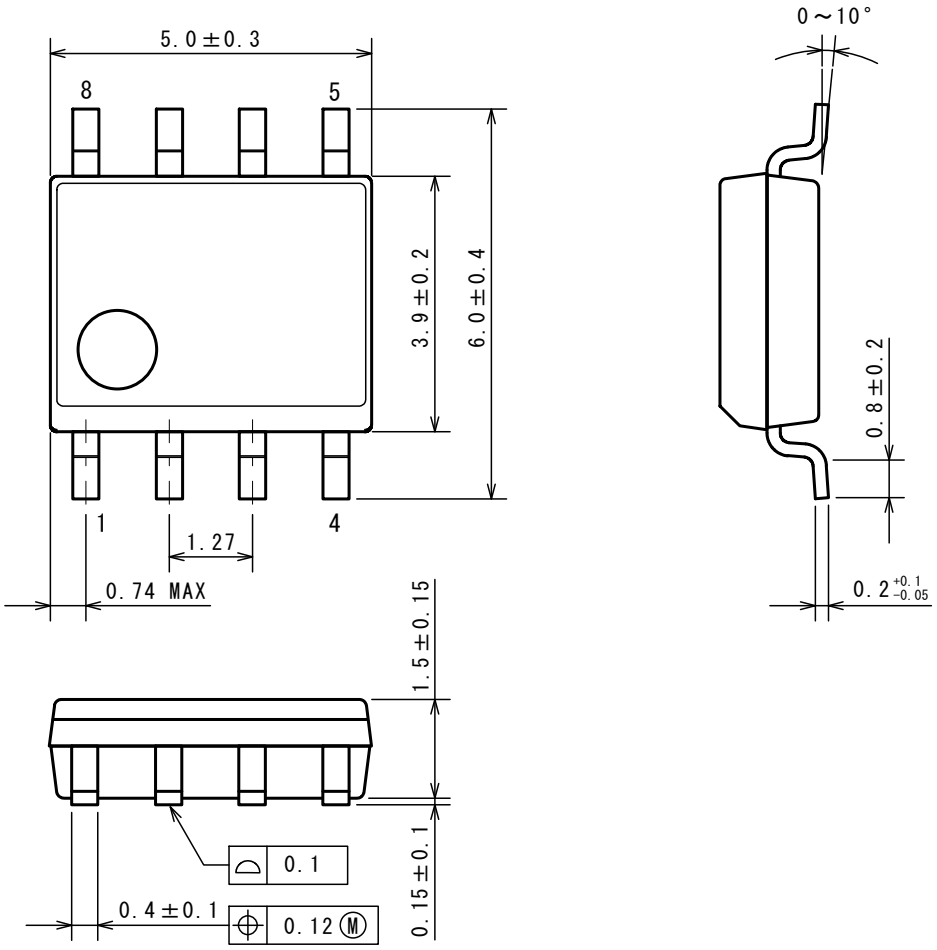
Nisshinbo Micro Devices Inc.

EMP-8-AN

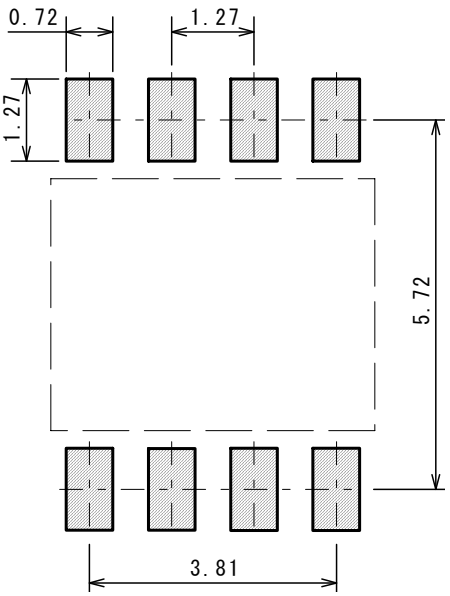
PI-EMP-8-AN-E-A

■ PACKAGE DIMENSIONS

UNIT: mm



■ EXAMPLE OF SOLDER PADS DIMENSIONS



Nisshinbo Micro Devices Inc.

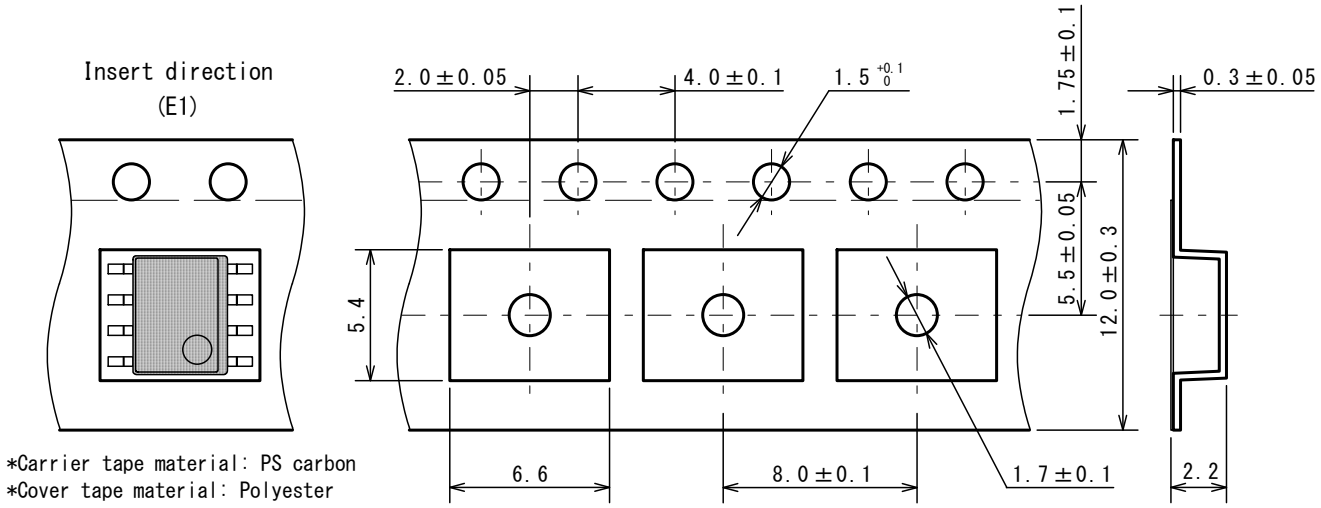
EMP-8-AN

PI-EMP-8-AN-E-A

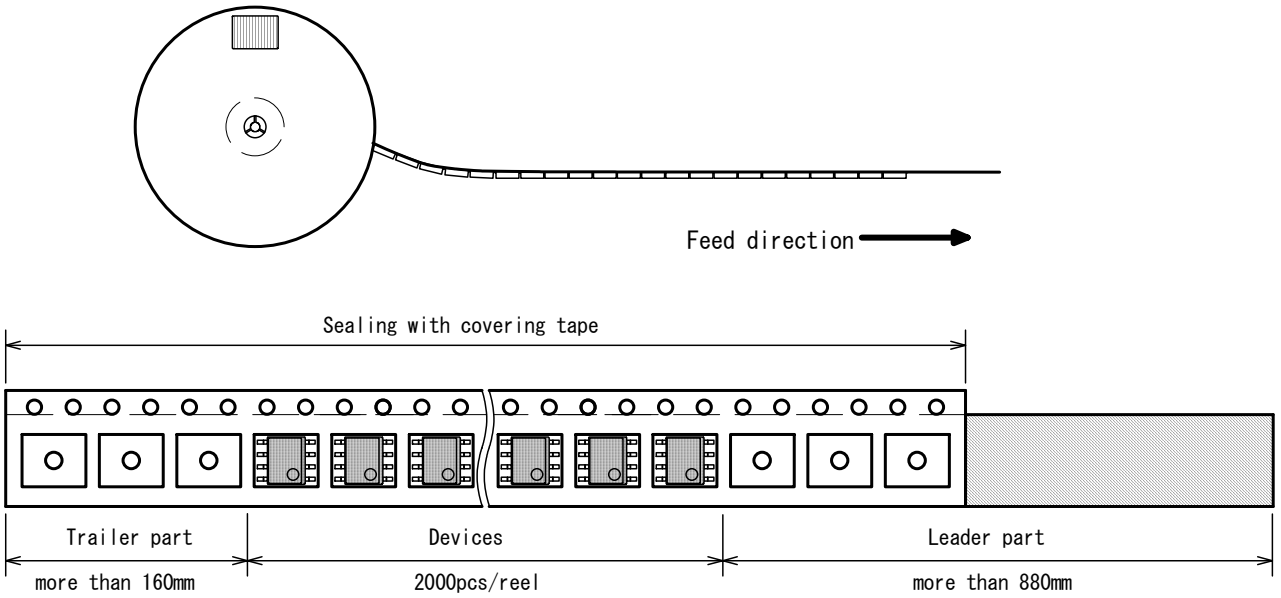
■ PACKING SPEC

UNIT: mm

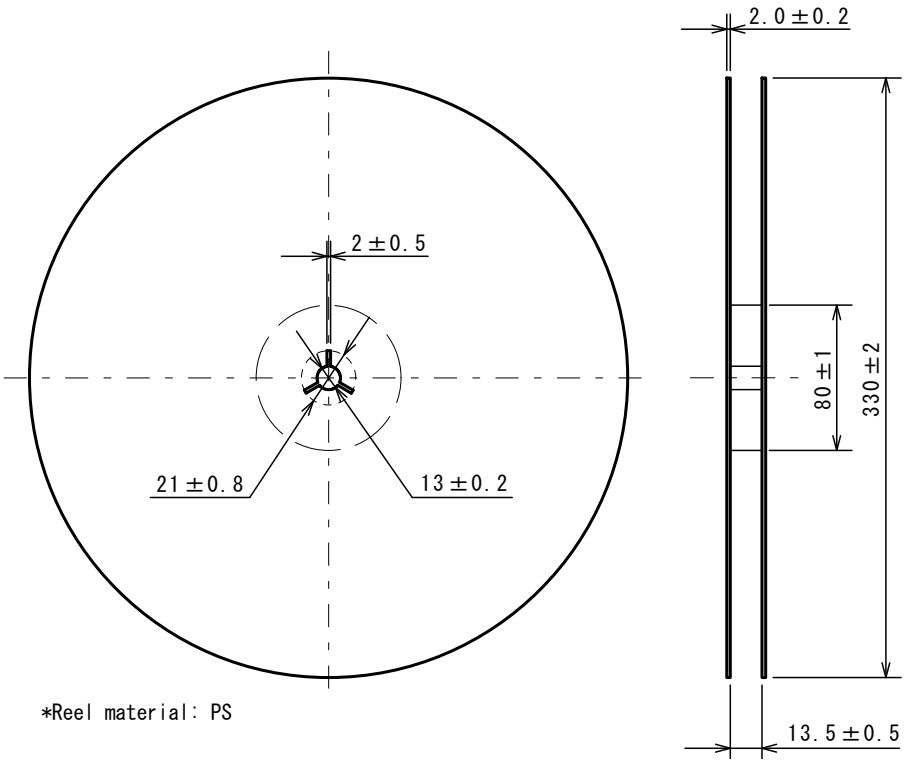
(1) Taping dimensions / Insert direction



(2) Taping state



(3) Reel dimensions

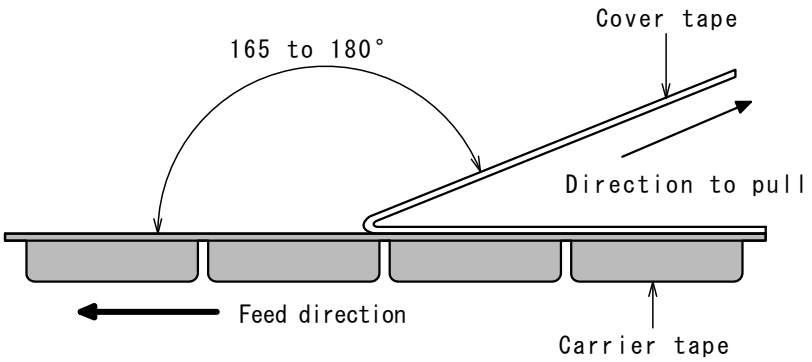


*Reel material: PS

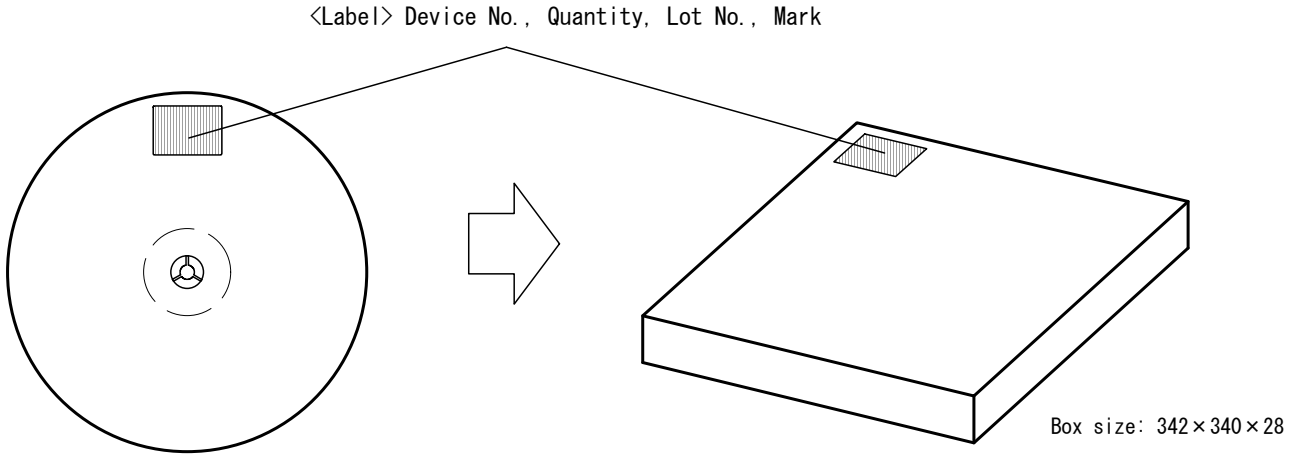
(4) Peeling strength

Peeling strength of cover tape

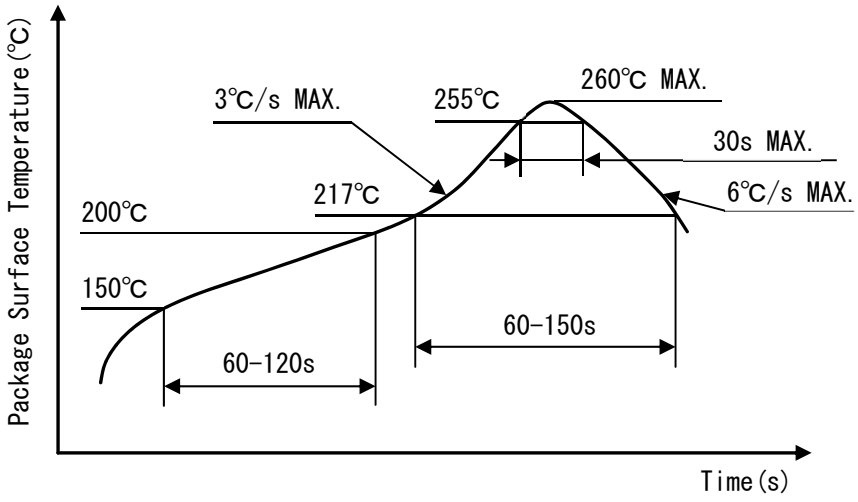
- Peeling angle 165 to 180° degrees to the taped surface.
- Peeling speed 300mm/min
- Peeling strength 0.1 to 1.3N



(5) Packing state



■ **HEAT-RESISTANCE PROFILES**



Reflow profile

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    - Various Safety Devices
    - Traffic control system
    - Combustion equipment

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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.
    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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