

### ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C)

PARAMETER	SYMBOL	μPC259G2	μPC4560G2	UNIT
Supply Voltage <sup>Note1</sup>	V <sup>+</sup> - V <sup>-</sup>	-0.3 ~ +36		V
Differential Input Voltage	V <sub>ID</sub>	±30		V
Input Voltage <sup>Note2</sup>	V <sub>I</sub>	V <sup>-</sup> -0.3 ~ V <sup>+</sup> +0.3		V
Output Applied Voltage <sup>Note3</sup>	V <sub>O</sub>	V <sup>-</sup> -0.3 ~ V <sup>+</sup> +0.3		V
Total Power Dissipation <sup>Note4</sup>	P <sub>T</sub>	440		mW
Output Short Circuit Duration <sup>Note5</sup>		0		s
Operating Ambient Temperature	T <sub>A</sub>	-40 ~ +85	-20 ~ +80	°C
Storage Temperature	T <sub>stg</sub>	-55 ~ +125		°C

- [Note]
1. Note that reverse connections of the power supply may damage the ICs.
  2. The input terminal must be apply within the input voltage range to avoid deteriorating or damaging the device characteristic. Do not exceed the ratings including during transition state such as ON/OFF, etc. The Op-Amp input voltage must operates within the electrical characteristics range of input common-mode voltage.
  3. The output terminal must be apply within the output voltage range to avoid deteriorating or damaging the device characteristic. Do not exceed the ratings including during transition state such as ON/OFF, etc. The Op-Amp output voltage must operates within the electrical characteristics range of maximum output voltage.
  4. This is the value at T<sub>A</sub> ≤ +25 °C. De-rate value at -4.4 mW/°C when T<sub>A</sub> > 25 °C.
  5. Protection against load shorts is required. Please use the total loss and the de-rating value from Note 4.

### RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Power Supply Voltage	V <sup>±</sup>	±4		±16	V

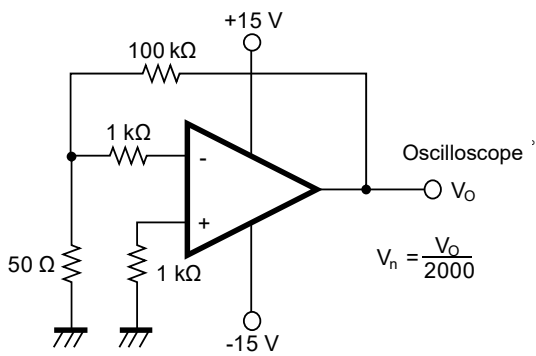
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, V<sup>±</sup> = ±15 V)**

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Input Offset Voltage	V <sub>IO</sub>		±0.5	±6.0	mV	R <sub>s</sub> ≤ 10 kΩ
Input Offset Current	I <sub>IO</sub>		±5	±200	nA	
Input Bias Current <sup>Note6</sup>	I <sub>B</sub>		60	500	nA	
Large Signal Voltage Gain	A <sub>V</sub>	20000	180000			R <sub>L</sub> ≥ 2 kΩ, V <sub>O</sub> = ±10 V
Power Consumption	P <sub>d</sub>		120	170	mW	I <sub>O</sub> = 0 A
Common Mode Rejection Ratio	CMR	70	100		dB	R <sub>s</sub> ≤ 10 kΩ
Supply Voltage Rejection Ratio	SVR		10	150	μV/V	R <sub>s</sub> ≤ 10 kΩ
Output Voltage Swing	V <sub>om</sub>	±12	±14		V	R <sub>L</sub> ≥ 2 kΩ
Output Voltage Swing	V <sub>om</sub>	±10	±13		V	I <sub>O</sub> = ±25 mA
Common Mode Input Voltage Range	V <sub>ICM</sub>	±12	±14		V	
Slew Rate	SR		2.8		V/μs	A <sub>V</sub> = 1
Input Equivalent Noise Voltage	V <sub>n</sub>		6		μV <sub>p-p</sub>	R <sub>s</sub> = 1 kΩ, f = 1 Hz ~ 1 kHz (Fig 1)
Channel Separation			105		dB	f = 1 kHz (Fig 2)

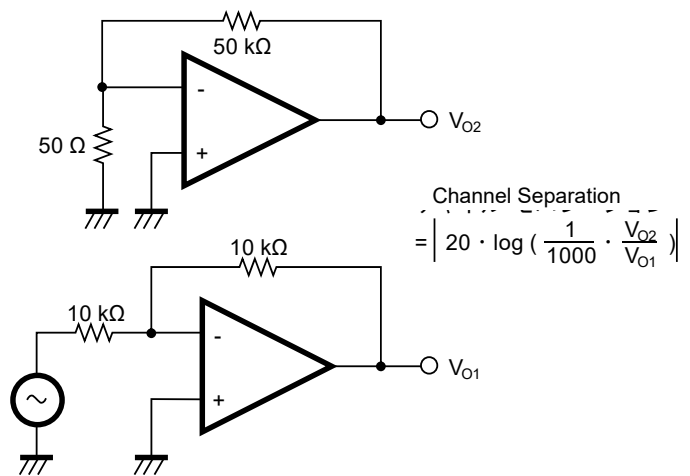
[Note] 6. The direction of the input bias current is the same direction that flows out from the IC because the first stage is composed of PNP transistor.

**TEST CIRCUIT**

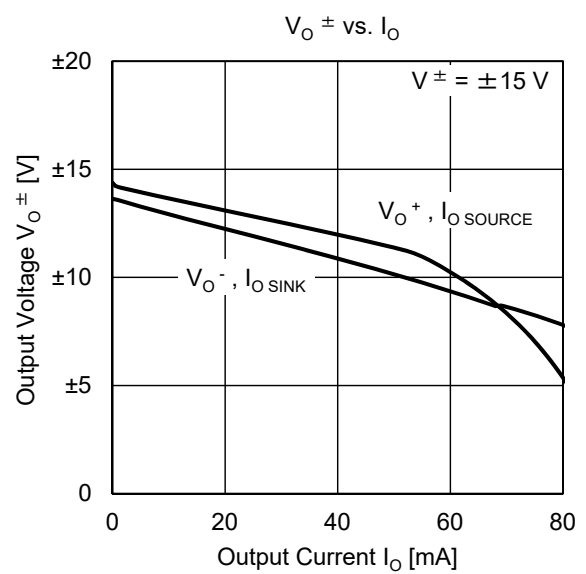
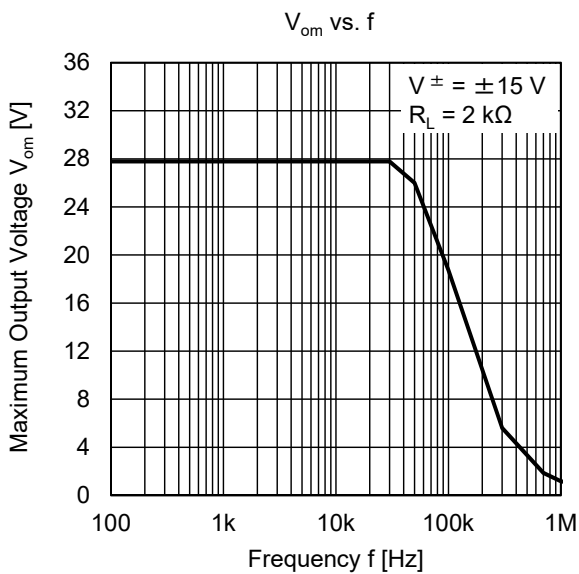
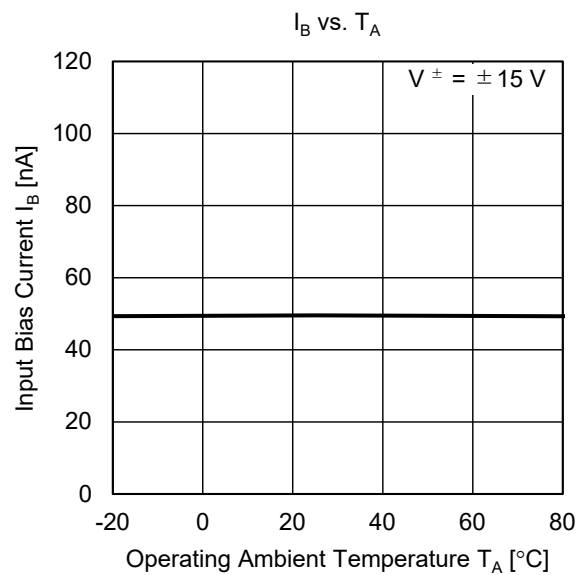
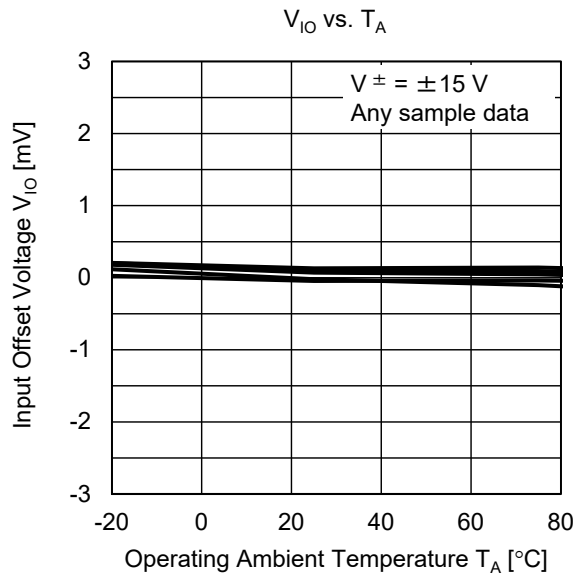
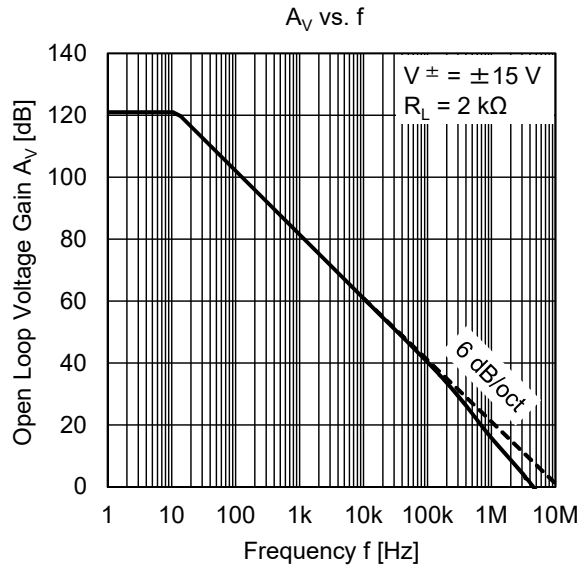
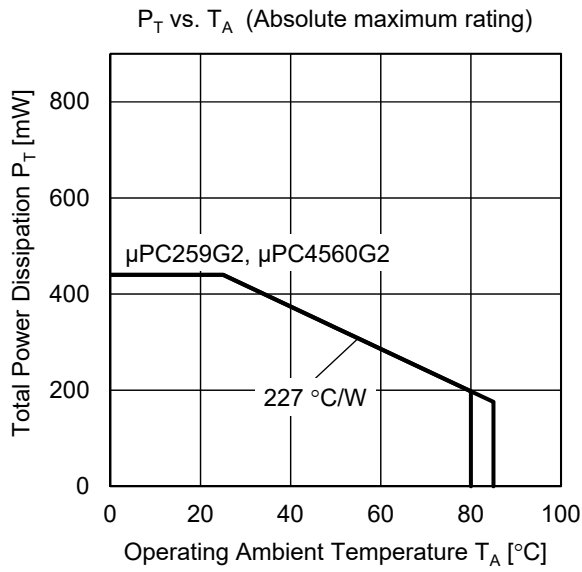
**Fig 1 Noise Test Circuit**

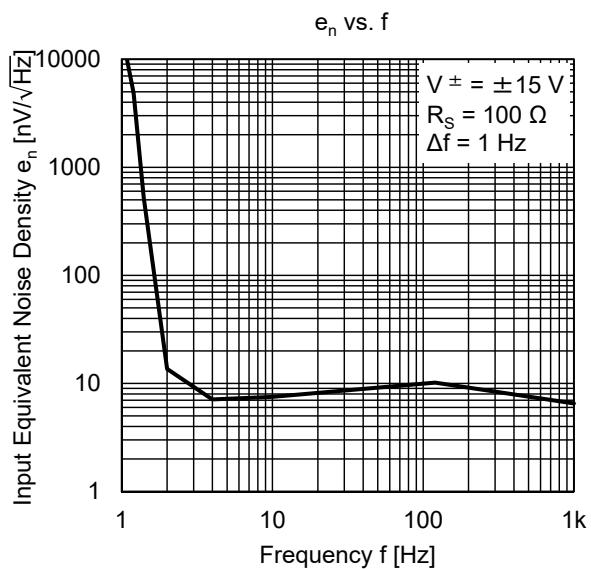
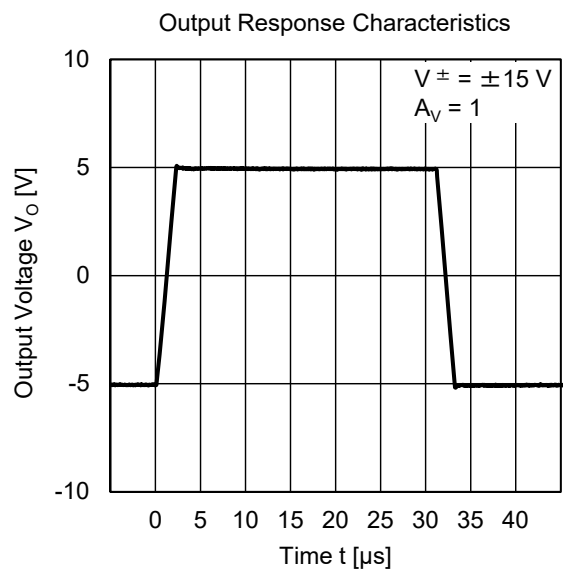
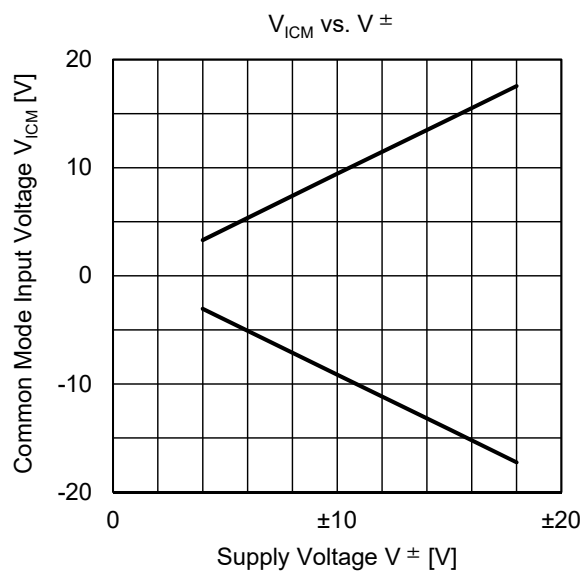
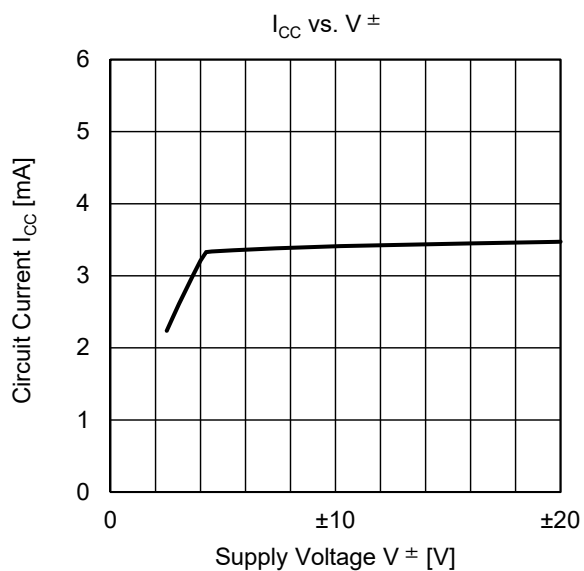


**Fig 2 Channel Separation Test Circuit**



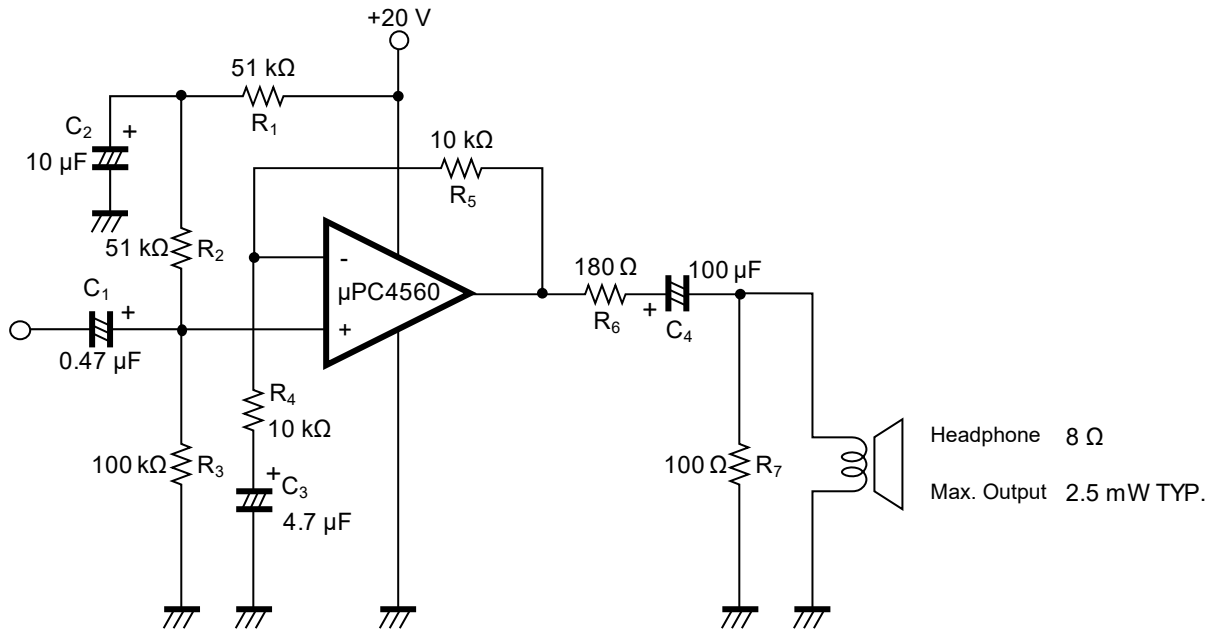
**ELECTRICAL CHARACTERISTICS CURVE (T<sub>A</sub> = 25 °C, TYP.) (REFERENCE VALUE)**



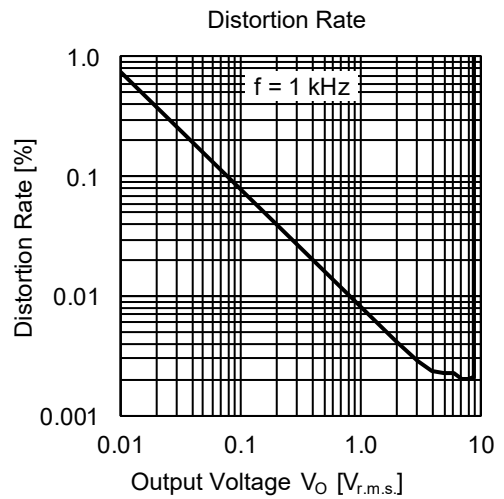
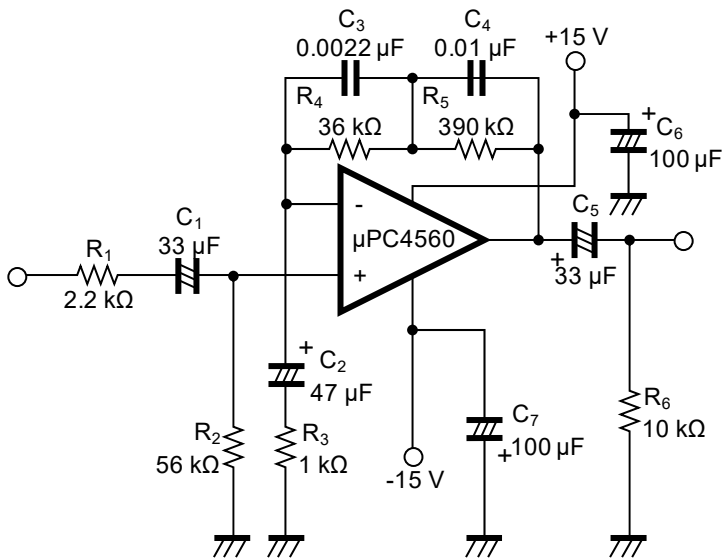


## APPLICATION CIRCUIT EXAMPLE

### Headphone Amplifier



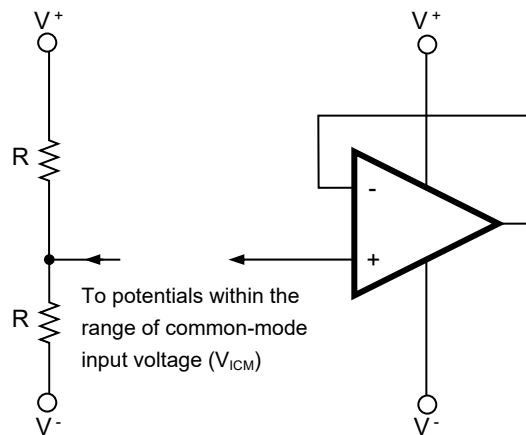
### RIAA Amplifier



## USE WITH PRECAUTIONS

- Managing unused circuits  
If there is an unused circuit, the following connection is recommended.

### Example of handling unused circuit



Note in this example, an intermediate voltage of  $V^+$  and  $V^-$  is applied.

- Power Supply (Dual Power Supply / Single Power Supply)**

The op amp operates when a predetermine voltage is applied between  $V^+ - V^-$ . Therefore, while it operates from a single power supply ( $V^- = \text{GND}$ ), it is not possible to operate the input and output near GND. So please be careful of the common-mode input voltage range and maximum output voltage.

- Ratings of input/output pin voltage**

When the voltage of input/output pin exceeds the absolute maximum rating, the parasitic diode within the IC may conduct, causing characteristics degradation or damage. In addition, if the input pin is lower than  $V^-$ , or the output pin exceeds the power supply voltage, it is recommended to make a clamping circuit using a diode with low forward voltage (e.g.: Schottky diode) as protection.

- Range of common-mode input voltage**

When the supply voltage does not meet the condition of electrical characteristics, the range of common-mode input voltage is as follows.

$$V_{\text{ICM}} (\text{TYP.}) : V^- + 1 \sim V^+ - 1 [\text{V}] (T_A = 25 \text{ }^\circ\text{C})$$

During designing, do include some margin by considering characteristics variation, temperature characteristics etc.

- Maximum Output Voltage**

The TYP. value range of the maximum output voltage when the supply voltage does not meet the condition of electrical characteristics is as follows:

$$V_{\text{om}^+} (\text{TYP.}) : V^+ - 1 [\text{V}] (T_A = 25 \text{ }^\circ\text{C}), V_{\text{om}^-} (\text{TYP.}) : V^- + 1 [\text{V}] (T_A = 25 \text{ }^\circ\text{C})$$

During designing, do include some margin by considering characteristics variation, temperature characteristics and so on. In addition, also note that the output voltage range ( $V_{\text{om}^+} - V_{\text{om}^-}$ ) will become narrow when the output current increases.

- Handling of ICs**

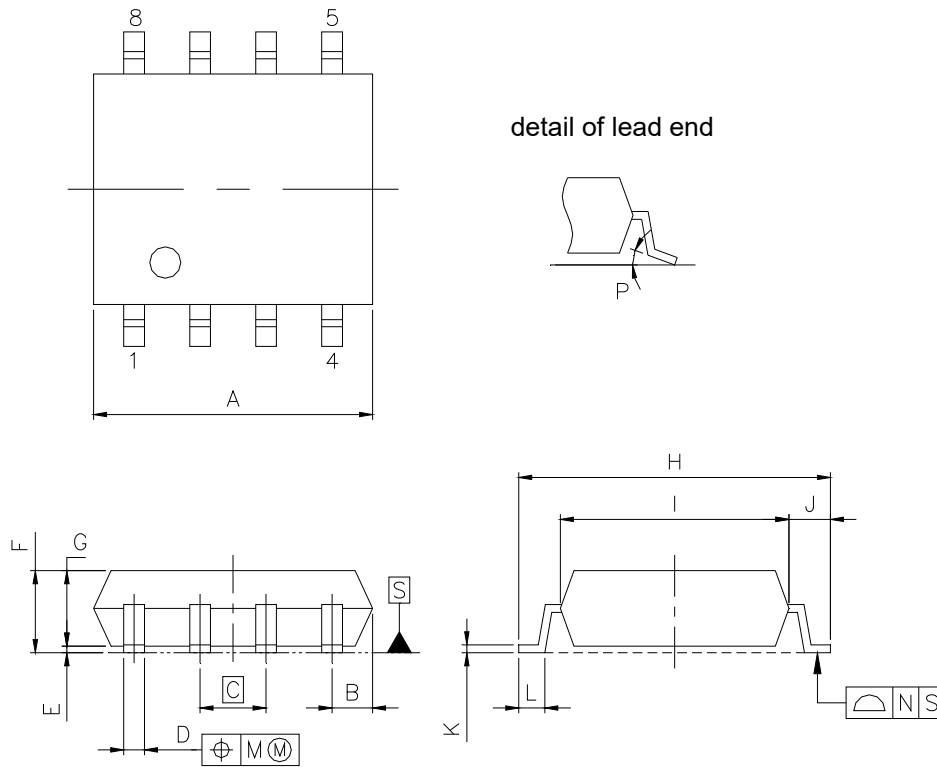
When stress is added to the ICs due to warpage or bending of a board, the characteristic may fluctuates due to piezoelectric (piezo) effect. Therefore, pay attention to warpage or bending of a board.

## PACKAGE DRAWINGS

### 8-PIN PLASTIC SOP

JEITA Package code	RENESAS code	Previous code	MASS (TYP.) [g]
P-SOP8-0225-1.27	PRSP0008DL-A	S8GM-50-225B	0.08

Unit: mm



#### NOTE

Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	5.2 <sup>+0.17</sup> / <sub>-0.20</sub>
B	0.78 MAX
<span style="border: 1px solid black; padding: 2px;">C</span>	1.27 (T.P)
D	0.42 <sup>+0.08</sup> / <sub>-0.07</sub>
E	0.1 ±0.1
F	1.59 ±0.21
G	1.49
H	6.5 ±0.3
I	4.4 ±0.15
J	1.1 ±0.2
K	0.17 <sup>+0.08</sup> / <sub>-0.07</sub>
L	0.6 ±0.2
M	0.12
N	0.10
P	3° <sup>+7°</sup> / <sub>-3°</sub>

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