# µPC258, 4558

## Low Noise Dual Operational Amplifier

R03DS0145EJ0100
Rev.1.00
2019.06.13

## DESCRIPTION

The µPC258 and 4558 are dual operational amplifier with a built-in phase compensation circuit, feature high speed, wide band and low noise.

Therefore, applications such as active filters, audio amplifiers and VCOs can be realized with a simple circuit configuration.

Depending on the operating ambient temperature, µPC258 is suitable for communication application while µPC4558 is suitable for general-purpose usage.

In addition, special arrangement products with sorted DC items are available.

Along with this series of lineup, the quad type op-amp µPC458 and 4741 with same circuit configuration are also available.

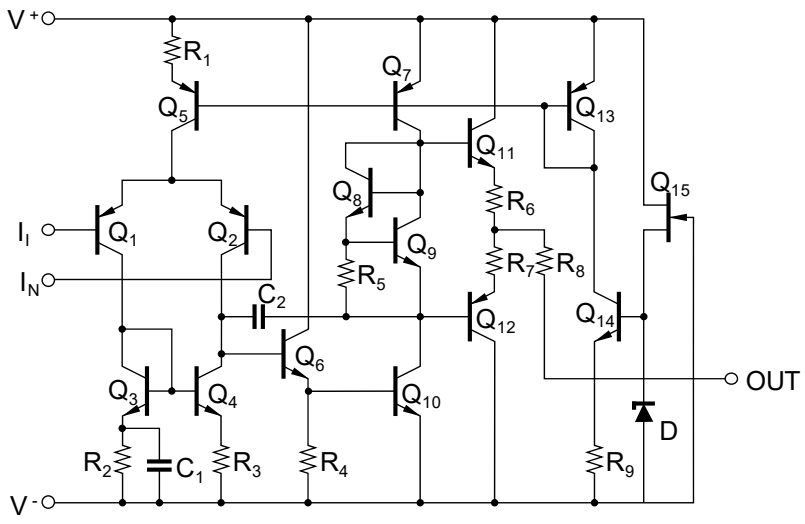
## FEATURES

- Input Offset Voltage ±0.5 mV (TYP.)
- Input Offset Current ±5 nA (TYP.)
- Input Bias Current 60 nA (TYP.)
- Slew Rate 1.0 V/µs (TYP.)
- Input Equivalent Noise Voltage (RIAA) 1.0 $\mu V_{r.m.s.}$ (TYP.)
- Built-In Phase Compensation Circuit
- Built-In Output Short Circuit Protection
- Standard Dual Op-Amp terminal connection (pin compatible)

## ORDERING INFORMATION

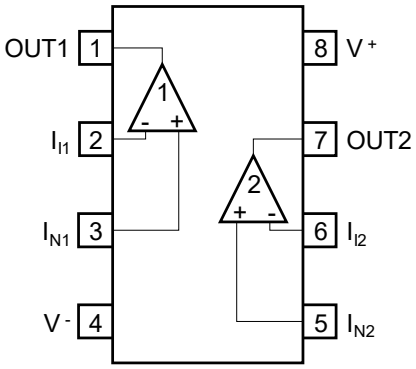
| Ordering Name | Sorting Content | Package |
|---|---|---|
| µPC258G2-A | General product | 8-pin plastic SOP ( 5.72 mm ( 225 mil)) |
| µPC258G2(5)-A | DC item sorted product | 8-pin plastic SOP ( 5.72 mm ( 225 mil)) |
| µPC4558G2-A | General product | 8-pin plastic SOP ( 5.72 mm ( 225 mil)) |
| µPC4558G2 (5)-A | DC item sorted product | 8-pin plastic SOP ( 5.72 mm ( 225 mil)) |

## EQUIVALENT CIRCUIT (1/2 Circuit)




## PIN CONFIGURATION (Top View)

µPC258G2, µPC4558G2




## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °C)

| PARAMETER | SYMBOL | µPC258G2<br>µPC258G2(5) | µPC4558G2<br>µPC4558G2(5) | UNIT |
|---|---|---|---|---|
| Supply Voltage Note1 | $V^+ - V^-$ | -0.3 ~ +36 | | V |
| Differential Input Voltage | $V_{ID}$ | ±30 | | V |
| Input Voltage Note2 | $V_I$ | $V^-$ -0.3 ~ $V^+$ +0.3 | | V |
| Output Applied Voltage Note3 | $V_O$ | $V^-$ -0.3 ~ $V^+$ +0.3 | | V |
| Total Power Dissipation Note4 | $P_T$ | 440 | | mW |
| Output Short Circuit Duration Note5 | | indefinite | | s |
| Operating Ambient Temperature | $T_A$ | -40 ~ +85 | -20 ~ +80 | °C |
| Storage Temperature | $T_{stg}$ | -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 TA ≦ +25 °C. De-rate value at -4.4 mW/°C when TA ＞ 25 °C.

5. 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 | $V^{\pm}$ | ±4 | | ±16 | V |

# ELECTRICAL CHARACTERISTICS

### µPC258, µPC4558 ($T_A$ = 25 °C, $V^{\pm}$ = ±15 V)

| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNIT | TEST CONDITION |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | | ±0.5 | ±6.0 | mV | $R_S \leqq$ 10 kΩ |
| Input Offset Current | $I_{IO}$ | | ±5 | ±200 | nA | |
| Input Bias Current Note6 | $I_B$ | | 60 | 500 | nA | |
| Large Signal Voltage Gain | $A_V$ | 20000 | 100000 | | | $R_L \geqq$ 2 kΩ, $V_O$ = ±10 V |
| Power Consumption | $P_d$ | | 90 | 170 | mW | $I_O$ = 0 A |
| Common Mode Rejection Ratio | CMR | 70 | 90 | | dB | $R_S \leqq$ 10 kΩ |
| Supply Voltage Rejection Ratio | SVR | | 30 | 150 | µV/V | $R_S \leqq$ 10 kΩ |
| Output Voltage Swing | $V_{om}$ | ±12 | ±14 | | V | $R_L \geqq$ 10 kΩ |
| Output Voltage Swing | $V_{om}$ | ±10 | ±13 | | V | $R_L \geqq$ 2 kΩ |
| Common Mode Input Voltage Range | $V_{ICM}$ | ±12 | ±14 | | V | |
| Slew Rate | SR | | 1.0 | | V/µs | $A_V$ = 1 |
| Input Equivalent Noise Voltage | $V_n$ | | 6 | | $\mu V_{p-p}$ | $R_S$ = 1 kΩ, f = 1 Hz ~ 1 kHz (Fig 1) |
| Channel Separation | | | 105 | | dB | f = 1 kHz (Fig 2) |

### µPC258(5), µPC4558(5) ($T_A$ = 25 °C, $V^{\pm}$ = ±15 V)

| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNIT | TEST CONDITION |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | | ±0.5 | ±2.0 | mV | $R_S \leqq$ 10 kΩ |
| Input Offset Current | $I_{IO}$ | | ±5 | ±50 | nA | |
| Input Bias Current Note6 | $I_B$ | | 60 | 100 | nA | |
| Large Signal Voltage Gain | $A_V$ | 50000 | 100000 | | | $R_L \geqq$ 2 kΩ, $V_O$ = ±10 V |
| Power Consumption | $P_d$ | | 90 | 135 | mW | $I_O$ = 0 A |
| Common Mode Rejection Ratio | CMR | 85 | 90 | | dB | $R_S \leqq$ 10 kΩ |
| Supply Voltage Rejection Ratio | SVR | | 30 | 75 | µV/V | $R_S \leqq$ 10 kΩ |
| Output Voltage Swing | $V_{om}$ | ±12.5 | ±14 | | V | $R_L \geqq$ 10 kΩ |
| Output Voltage Swing | $V_{om}$ | ±11 | ±13 | | V | $R_L \geqq$ 2 kΩ |
| Common Mode Input Voltage Range | $V_{ICM}$ | ±13 | ±14 | | V | |
| Slew Rate | SR | | 1.0 | | V/µs | $A_V$ = 1 |
| Input Equivalent Noise Voltage | $V_n$ | | 6 | | $\mu V_{p-p}$ | $R_S$ = 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.

**Fig 1 Noise Test Circuit**

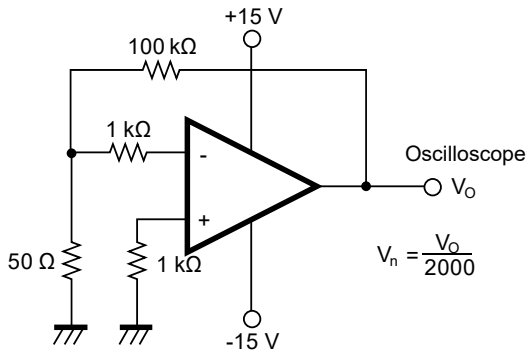
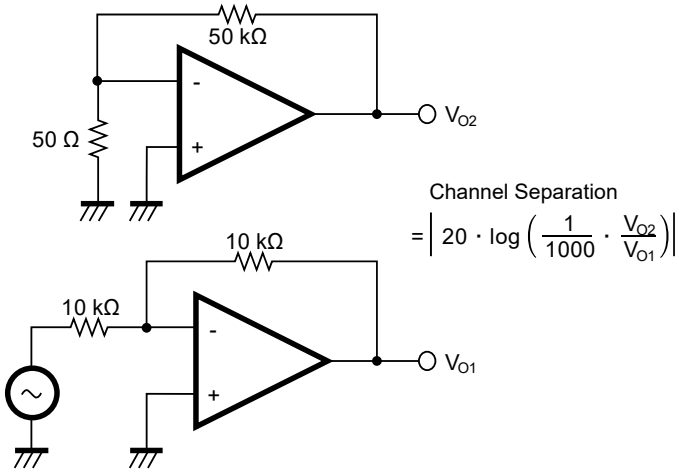
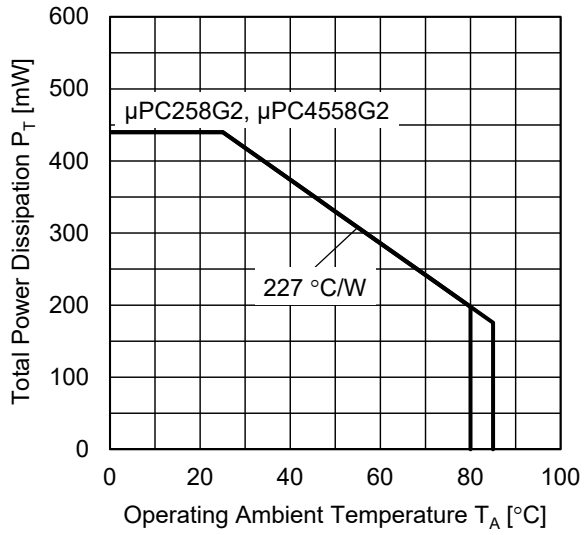



**Fig 2 Channel Separation Test Circuit**

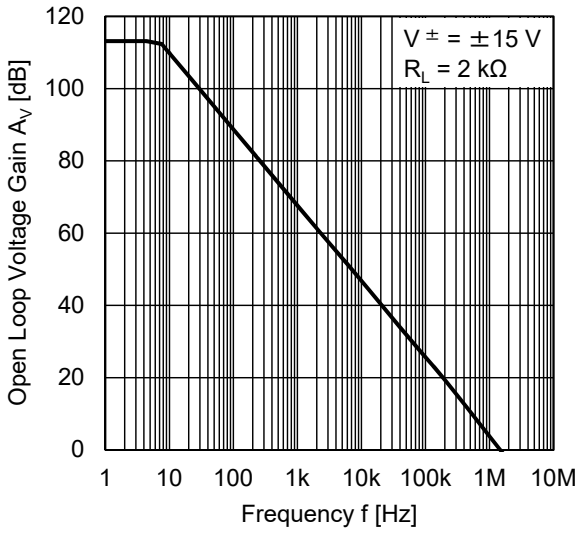


## ELECTRICAL CHARACTERISTICS CURVE ($T_A$ = 25 °C, TYP.) (REFERENCE VALUE)

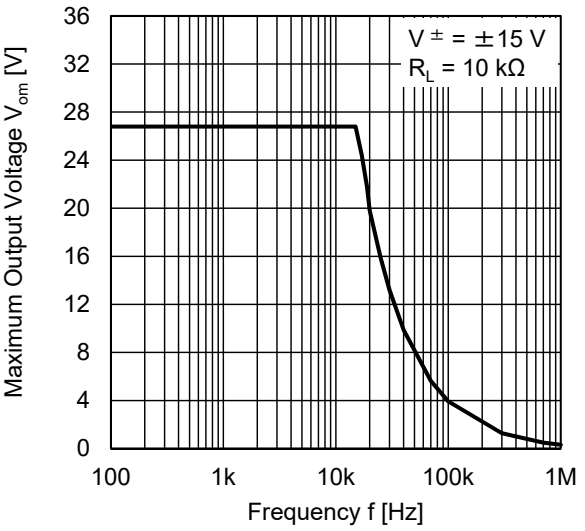
$P_T$ vs. $T_A$ (Absolute maximum rating)



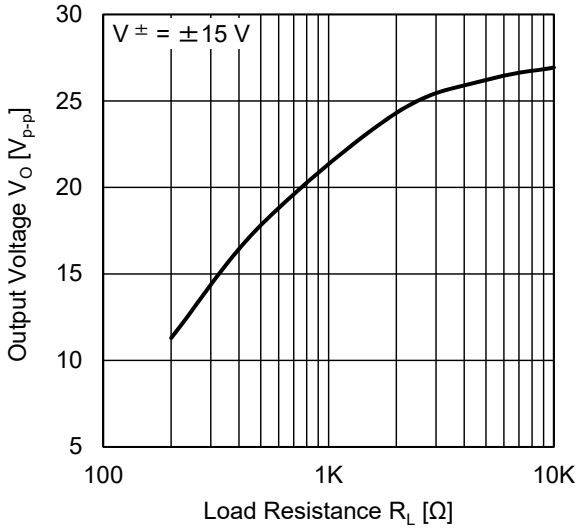

$A_V$ vs. f



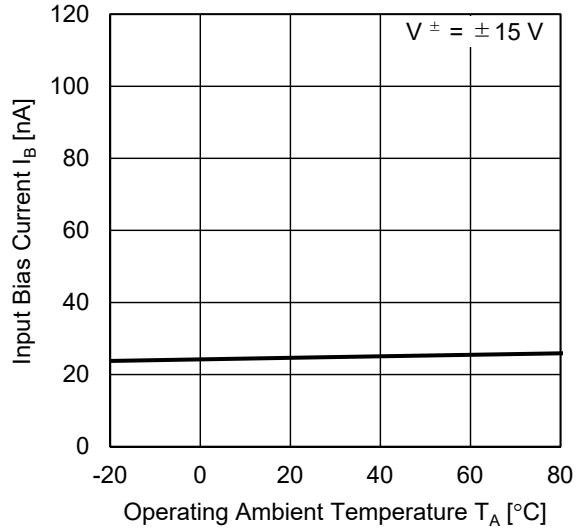

$V_{om}$ vs. f



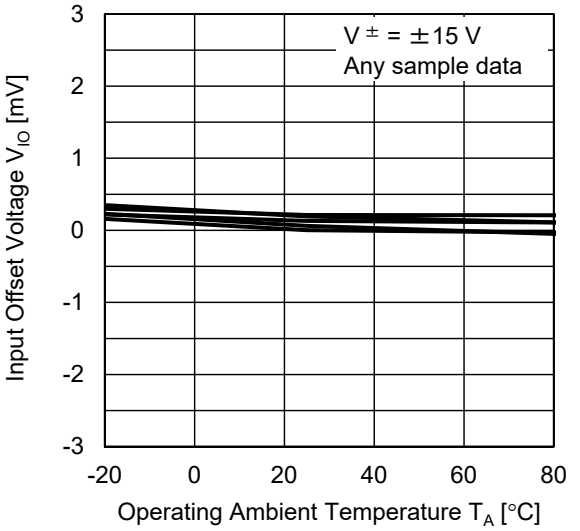

$V_O$ vs. $R_L$



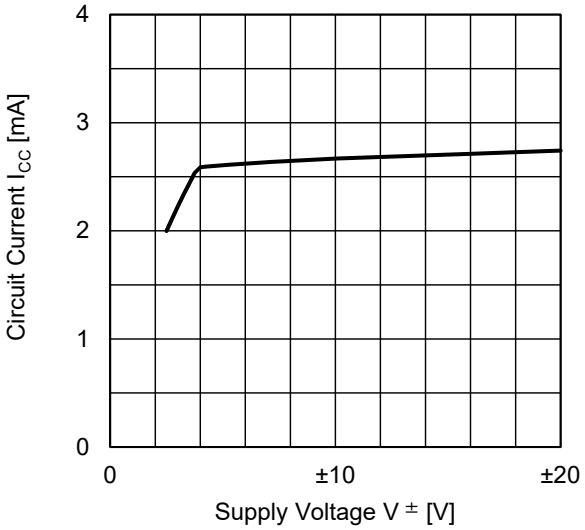

$I_B$ vs. $T_A$



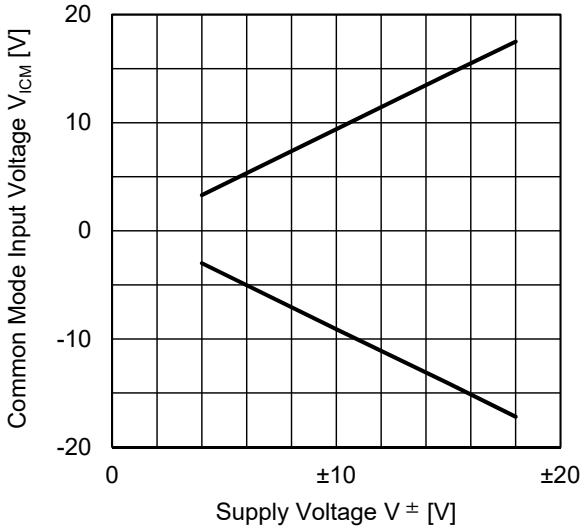

$V_{IO}$ vs. $T_A$



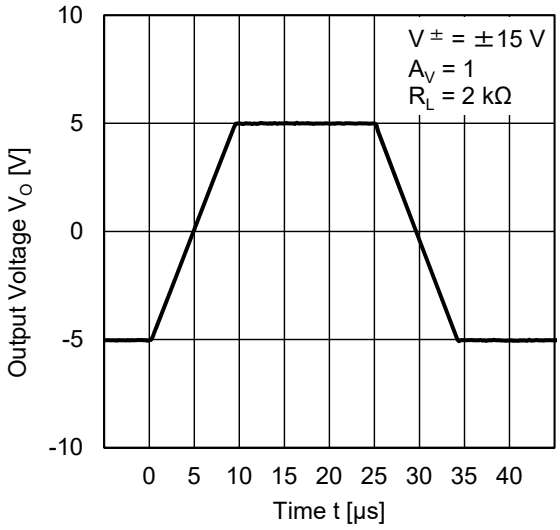
$I_{CC}$ vs. V ±



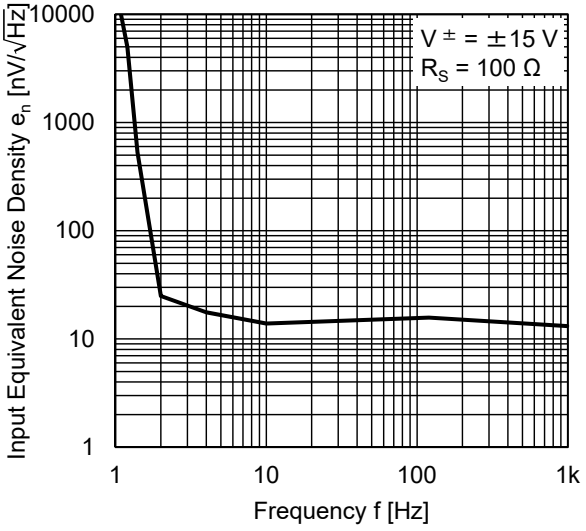

$V_{ICM}$ vs. V ±




Output Response Characteristics

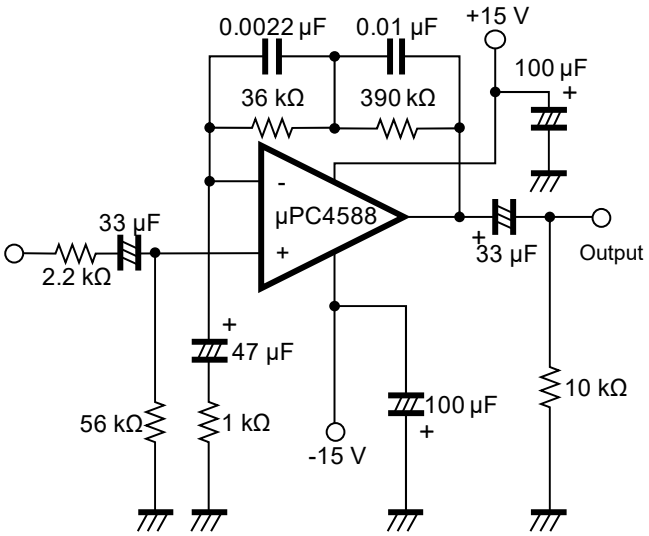



$e_n$ vs. f



## APPLICATION CIRCUIT

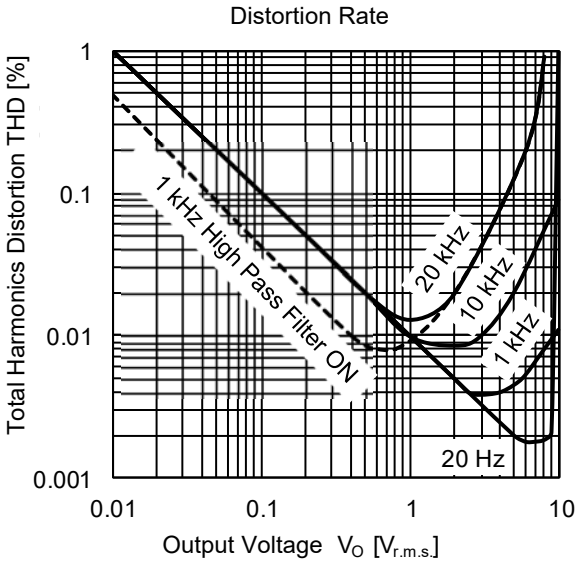
### RIAA Pre-amplifier $A_V$ = 32.5 dB




### Standard Characteristics (Reference Value)

Distortion Rate 0.03 % ($V_O$ = 1 $V_{r.m.s}$, f = 1 kHz)

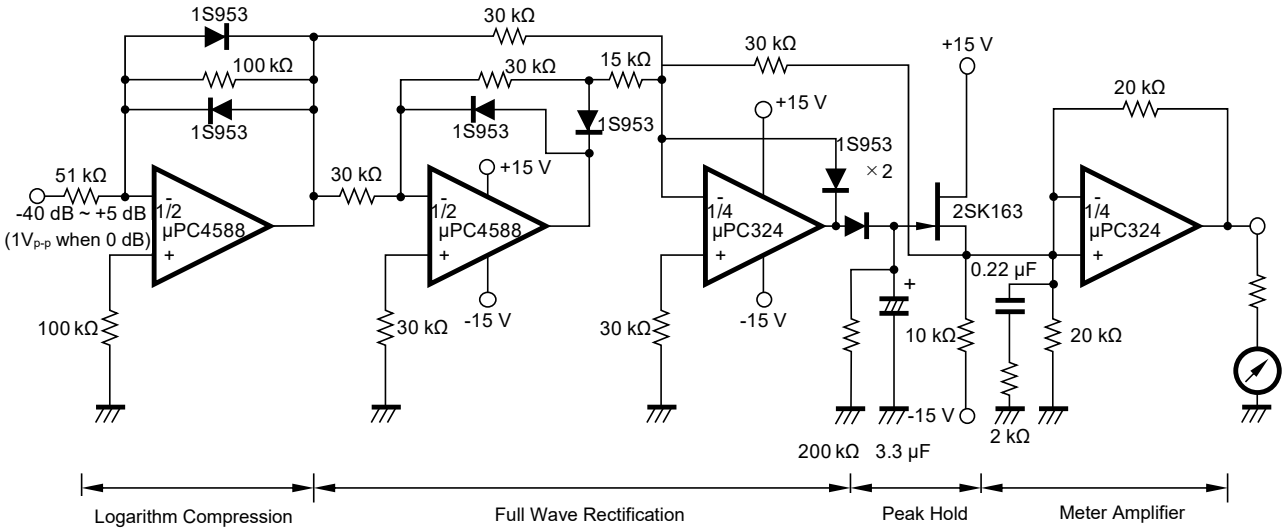
Noise 1.0 $\mu V_{r.m.s.}$ [Input referred, Input shorted, average peak voltage value]




### Peak Level Meter

This circuit converts the peak voltage (about ± 10 mV ~ ± 10 V) of the input signal to a DC voltage (about 0.2 V ~ 1.3 V) and drives the meter.

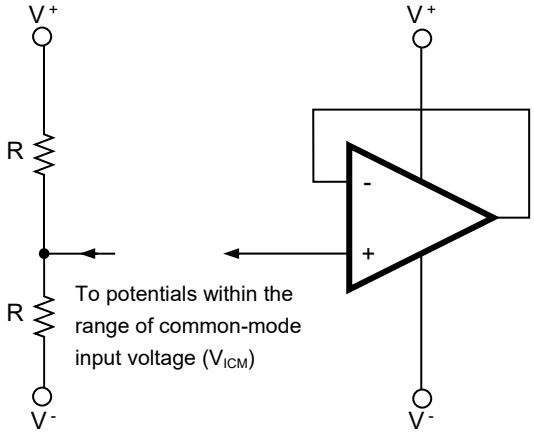
This output voltage is proportional to the logarithmic value of input peak voltage, thus providing a wider dynamic range indication compared to conventional linear indication methods.



## 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 ($V^-$ = 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.
  $V_{ICM}$ (TYP.) : $V^-$ +1 ~ $V^+$ -1 [V] ($T_A$ = 25 °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:
  $V_{om}{}^+$ (TYP.) : $V^+$ -1 [V] ($T_A$ = 25 °C), $V_{om}{}^-$ (TYP.) : $V^-$ +1 [V] ($T_A$ = 25 °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 ($V_{om}{}^+$ - $V_{om}{}^-$) will become narrow when the output current increases.

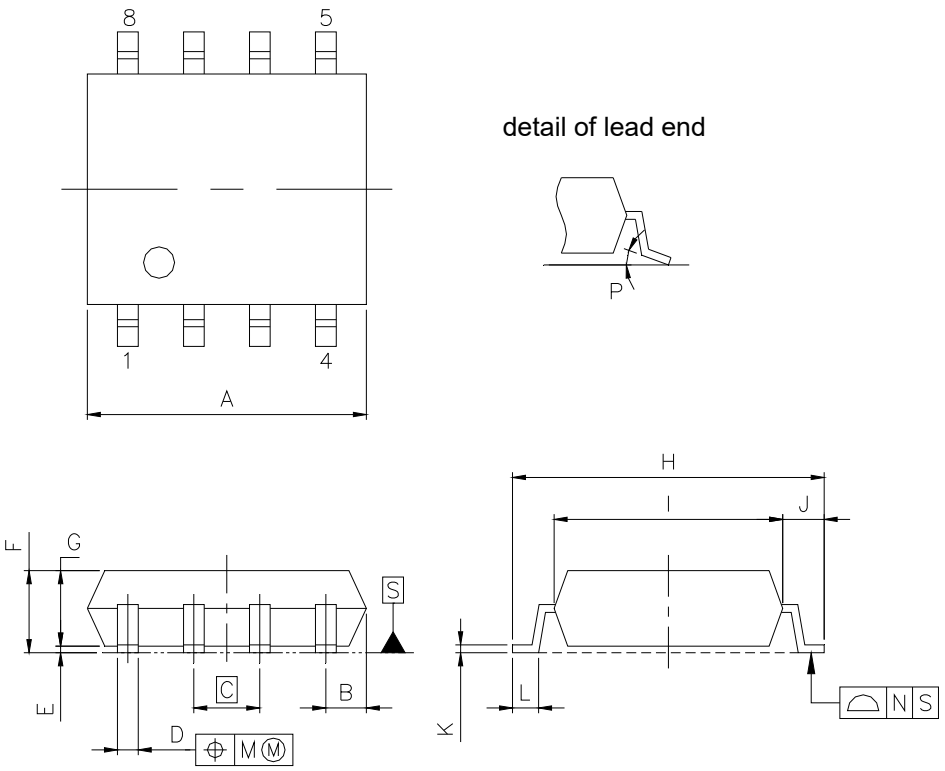
- **Handling of ICs**
  When stress is added to the ICs due to warpage or bending of a board, the characteristic may fluctuates due to piezoelectric (piezo) effect. Therefore, pay attention to warpage or bending of a board.

## 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 +0.17 -0.20 |
| B | 0.78 MAX |
| C | 1.27 (T.P) |
| D | 0.42 +0.08 -0.07 |
| 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 +0.08 -0.07 |
| L | 0.6 ±0.2 |
| M | 0.12 |
| N | 0.10 |
| P | 3° +7° -3° |