

# μPC1251A

R03DS0117EJ0100

Rev.1.00

2017.12.25

## Single Power Supply Dual Operational Amplifiers

### Description

μPC1251A is dual operational amplifiers designed for single power supply operation. Main features include low-voltage operation, a common-mode input voltage that range from  $V^-$  (GND) level, an output from a  $V^-$  (GND) level that is determined by the output stage utilizing class C push-pull circuit with 50 μA(TYP.) constant current, and low current consumption.

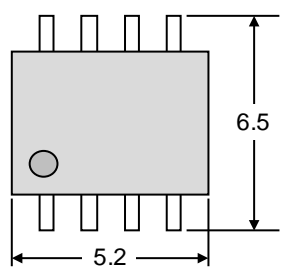
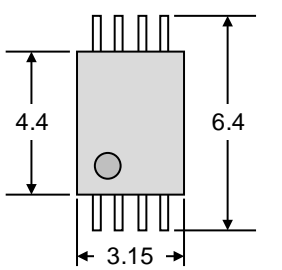
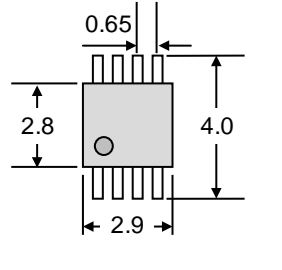
In addition, this amplifier supports both positive and negative power supply and can be used in various amplifier circuits.

μPC451A which is a quad type with the same circuit configuration is also available under this series of operational amplifiers.

### Features

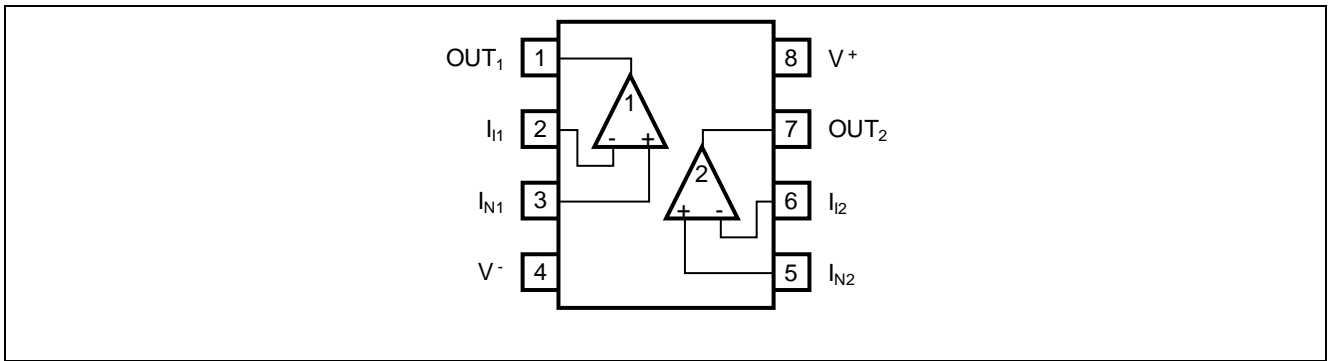
- AEC-Q100 Compliant
- Input Offset Voltage  $\pm 2$  mV (TYP.)
- Input Offset Current  $\pm 5$  nA (TYP.)
- Large Signal Voltage Gain 100000 (TYP.)
- Internal Frequency Compensation
- Output Short-Circuit Protection

### Product Lineup

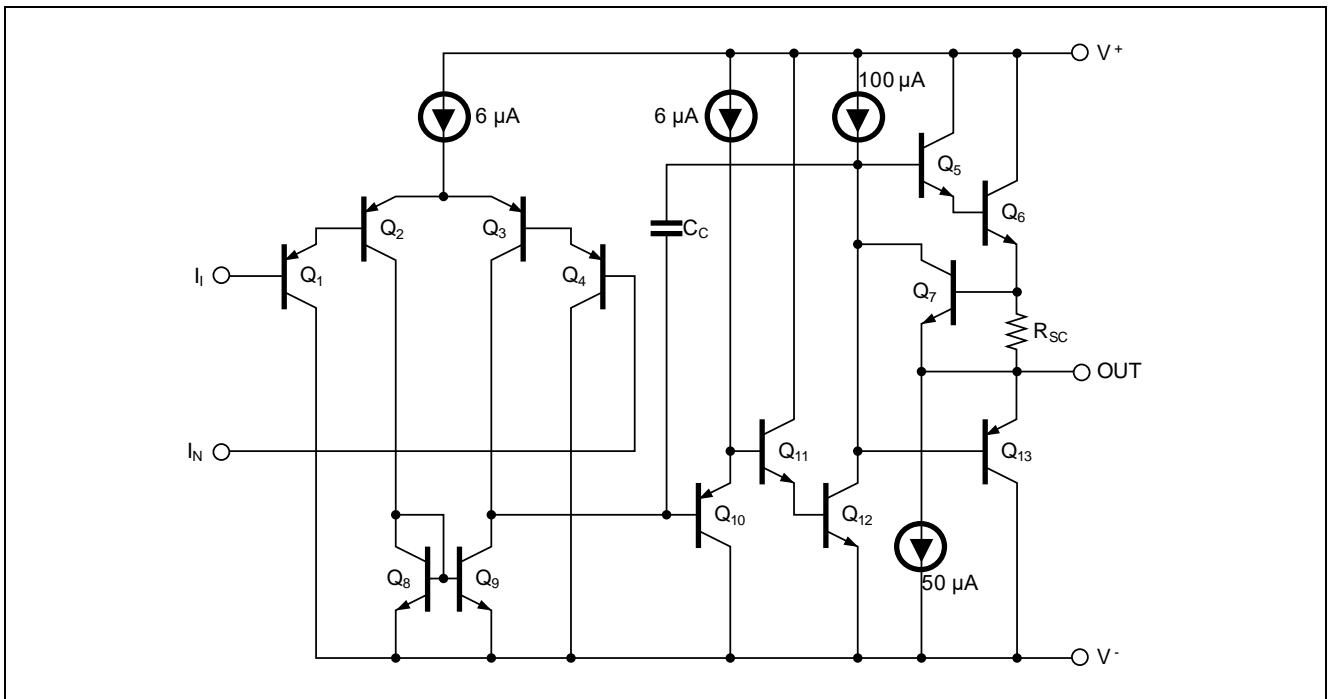
Package	Standard SOP	TSSOP	MSOP
Part Name	μPC1251AG2	μPC1251AGR	μPC1251AMP
Outline Comparison	Unit : mm 	Unit : mm 	Unit : mm 
(Mounting Area Ratio)	(100 %)	(60 %)	(34 %)

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## Pin Configuration (Marking side)



## EQUIVALENT CIRCUIT (1/2 Circuit)



## ABSOLUTE MAXIMUM RATINGS

( $T_A = 25\text{ }^{\circ}\text{C}$ )

Parameter	Symbol	Ratings	Unit
Voltage between V+ and V- <sup>Note 1</sup>	$V^+ - V^-$	-0.3 ~ +32	V
Differential Input Voltage	$V_{ID}$	±32	V
Input Voltage <sup>Note 2</sup>	$V_I$	$V^- - 0.3 \sim V^- + 32$	V
Output applied Voltage <sup>Note 3</sup>	$V_O$	$V^- - 0.3 \sim V^+ + 0.3$	V
Total Power Dissipation <sup>Note 4</sup>	$P_T$	440	mW
Output Short Circuit Duration <sup>Note 5</sup>	$t_s$	Indefinite	s
Operating Ambient Temperature	$T_A$	-40 ~ +125	$^{\circ}\text{C}$
Storage Temperature	$T_{stg}$	-55 ~ +150	$^{\circ}\text{C}$

**[Note] 1.** Note that reverse connections of the power supply may damage the ICs

**2.** The input voltage is allowed to input without damage or destruction independent of the magnitude of V+. Either input signal is not allowed to go negative by more than 0.3 V. In addition, the input voltage that operates normally as an operational amplifier is within the Common Mode Input Voltage range of an electrical characteristic.

**3.** A range where input voltage can be applied to an output pin externally with no deterioration or damage to

the feature (characteristic). The input voltage can be applied regardless of the electric supply voltage. This specification which includes the transition state such as electric power ON/OFF must be kept.

4. This is the value when the glass epoxy substrate (size: 100 mm x 100 mm, thickness: 1 mm, 15% of the substrate area where only one side is copper foiled is filling wired) is mounted.

Note that restrictions will be made to the following conditions for each product, and the derating ratio depending on the operating ambient temperature.

μPC1251AG2 : Derate at -4.4 mW/°C when  $T_A > 25\text{ }^{\circ}\text{C}$

(Junction – ambient thermal resistance  $R_{th(J-A)} = 227^{\circ}\text{C/W}$ )

μPC1251AGR : Derate at -5.5 mW/°C when  $T_A > 69\text{ }^{\circ}\text{C}$

(Junction – ambient thermal resistance  $R_{th(J-A)} = 183^{\circ}\text{C/W}$ )

μPC1251AMP : Derate at -4.8 mW/°C when  $T_A > 58\text{ }^{\circ}\text{C}$

(Junction – ambient thermal resistance  $R_{th(J-A)} = 208^{\circ}\text{C/W}$ )

5. Short circuits from the output to  $V^+$  can cause destruction. ( $V^+ \leq +15\text{V}$ , for any one channel only) Pay careful attention to the total power dissipation by not exceeding the absolute maximum ratings, **Note 4**.

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Power Supply Voltage (Split)	$V^{\pm}$	$\pm 1.5$		$\pm 15$	V
Power Supply Voltage ( $V^- = \text{GND}$ )	$V^+$	+3		+30	V

## ELECTRICAL CHARACTERISTICS

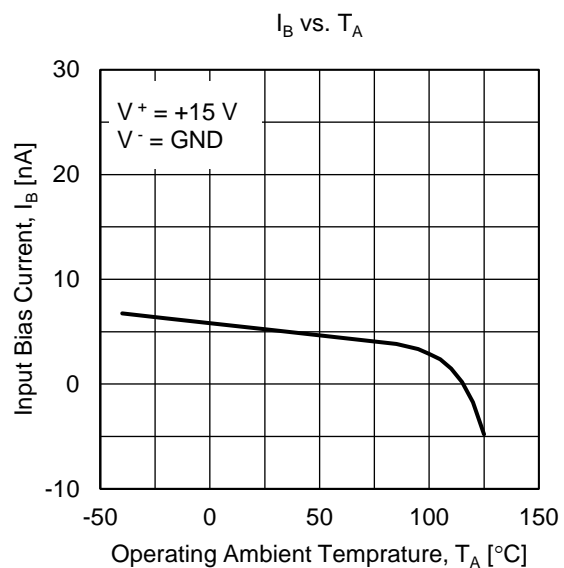
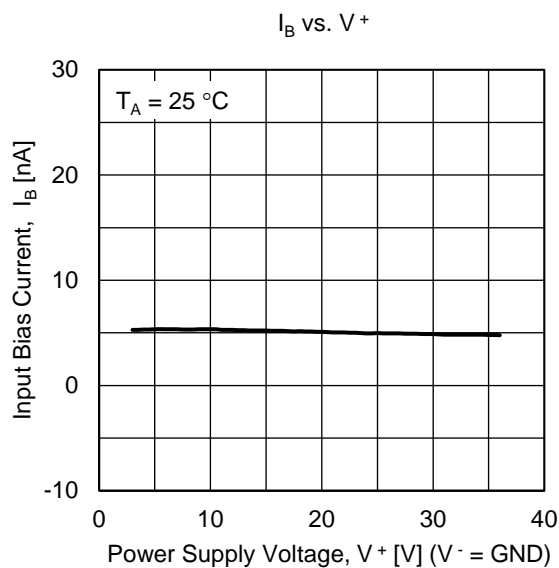
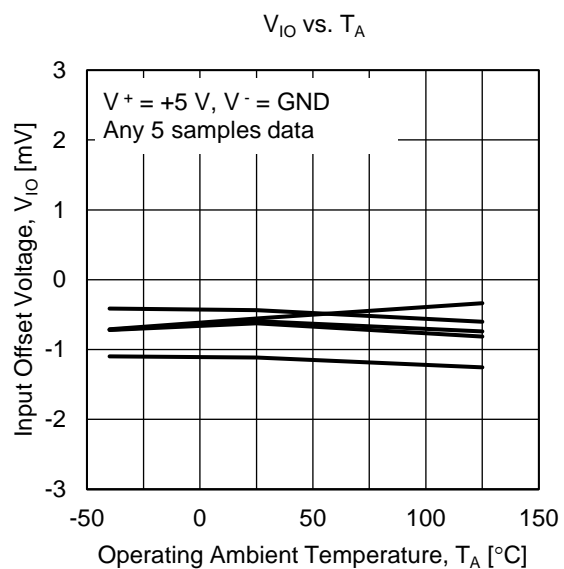
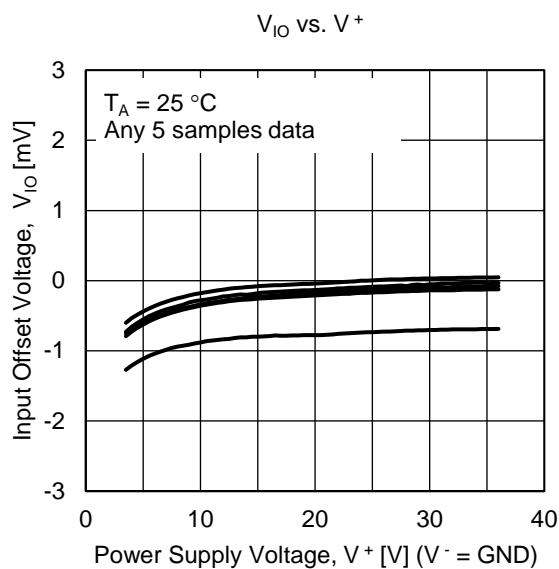
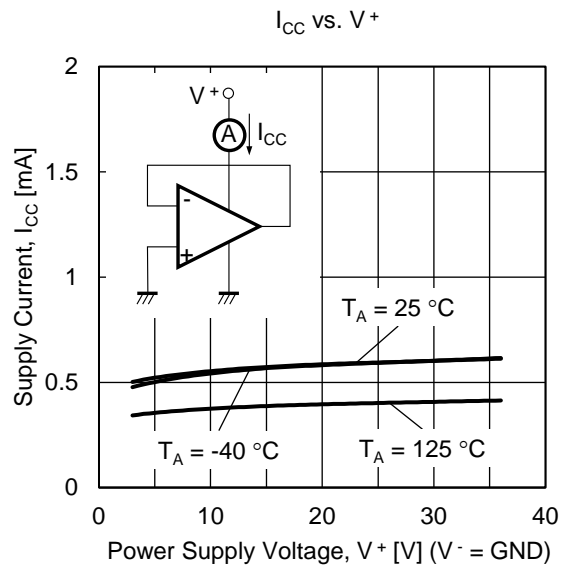
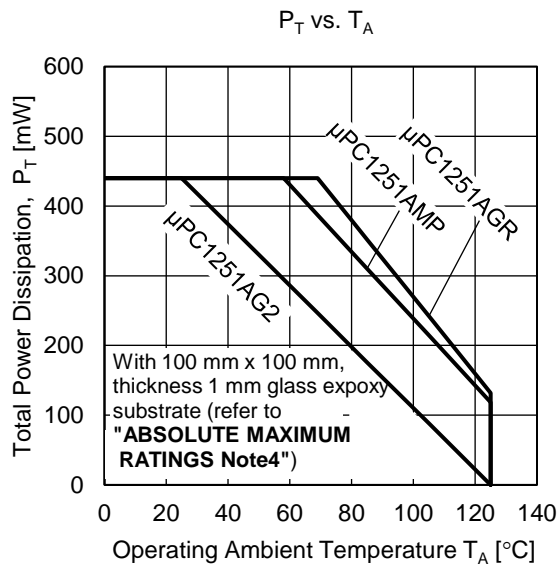
( $T_A = 25\text{ }^{\circ}\text{C}$ ,  $V^+ = +5\text{ V}$ ,  $V^- = \text{GND}$ )

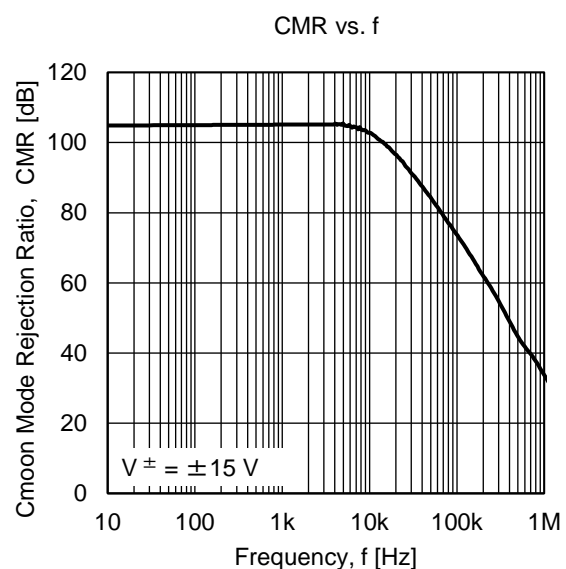
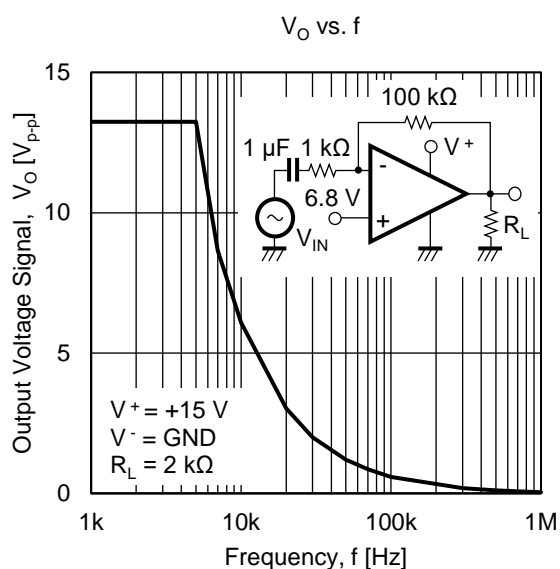
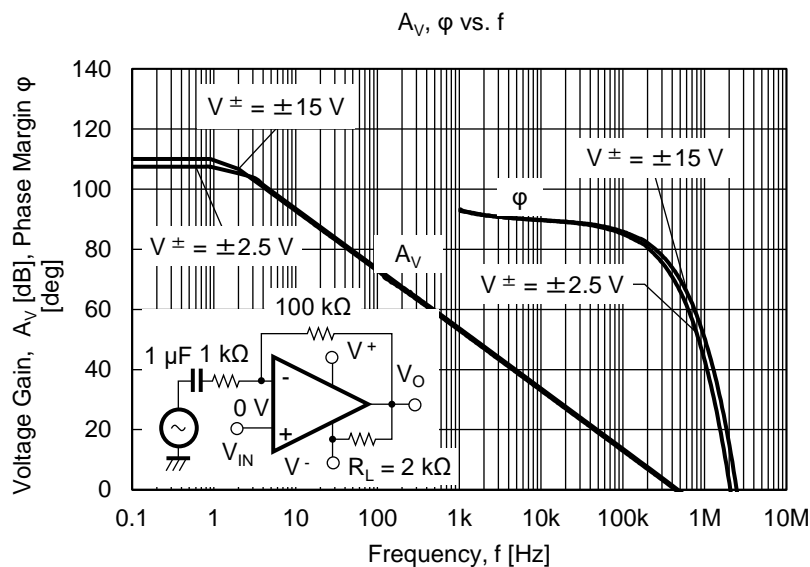
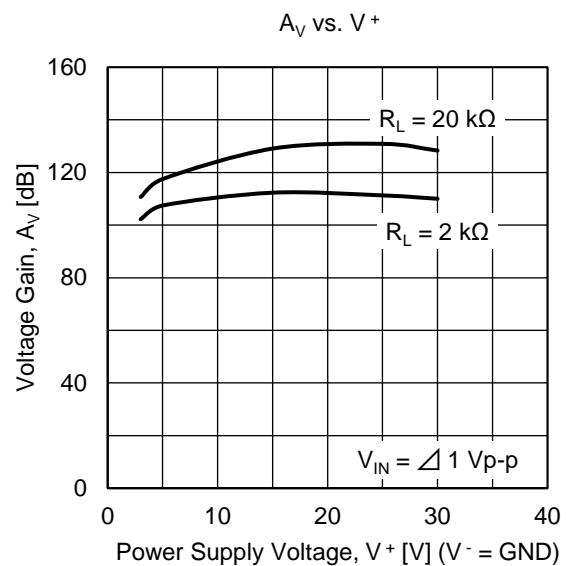
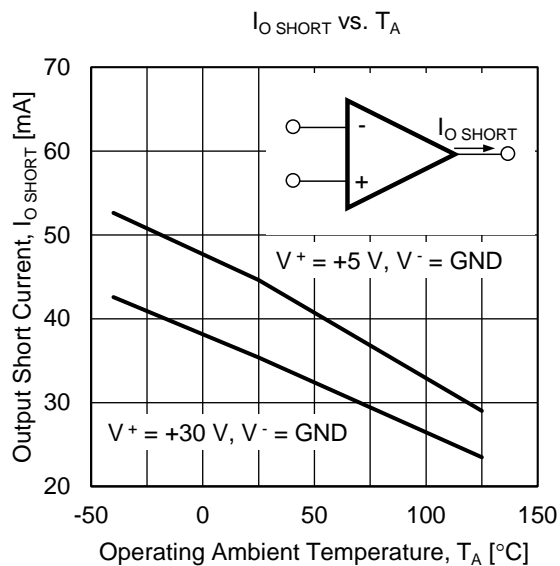
Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Condition
Input Offset Voltage	$V_{IO}$		$\pm 2$	$\pm 7$	mV	$R_S = 0\text{ }\Omega$
Input Offset Current	$I_{IO}$		$\pm 5$	$\pm 50$	nA	
Input Bias Current <sup>Note 6</sup>	$I_B$		45	250	nA	
Large Signal Voltage Gain	$A_V$	25000	100000			$R_L \geq 2\text{ k}\Omega$
Circuit Current <sup>Note 7</sup>	$I_{CC}$		0.7	1.2	mA	$R_L = \infty$ , $I_O = 0\text{ A}$
Common Mode Rejection Ratio	CMR	65	70		dB	
Supply Voltage Rejection Ratio	SVR	65	100		dB	
Output Voltage Swing	$V_O$	0		$V^+ - 1.5$	V	$R_L = 2\text{ k}\Omega$ (connected to GND)
Common Mode Input Voltage Range	$V_{ICM}$	0		$V^+ - 1.5$	V	
Output Source Current	$I_{O\text{ SOURCE}}$	20	40		mA	$V_{IN(+)} = +1\text{ V}$ , $V_{IN(-)} = 0\text{ V}$
Output Sink Current	$I_{O\text{ SINK1}}$	10	20		mA	$V_{IN(-)} = +1\text{ V}$ , $V_{IN(+)} = 0\text{ V}$
	$I_{O\text{ SINK2}}$	12	50		$\mu\text{A}$	$V_{IN(-)} = +1\text{ V}$ , $V_{IN(+)} = 0\text{ V}$ , $V_O = 200\text{ mV}$
Channel Separation			120		dB	$f = 1 \sim 20\text{ kHz}$

**[Note] 6.** The absolute value of the input bias current is small, thus the direction of the current flowing from the inside of the IC may be reversed due to variations in the product during high temperature.

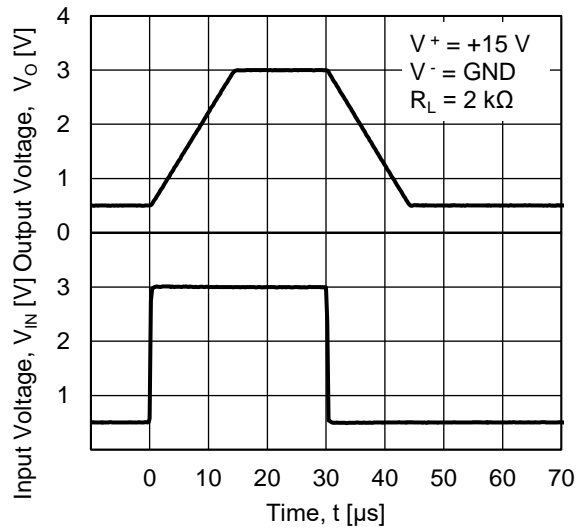
**7.** This is a current that flows in the internal circuit. This current will flow irrespective of the channel used.

TYPICAL PERFORMANCE CHARACTERISTICS ( $T_A = 25\text{ }^{\circ}\text{C}$ , TYP.) (Reference Value)

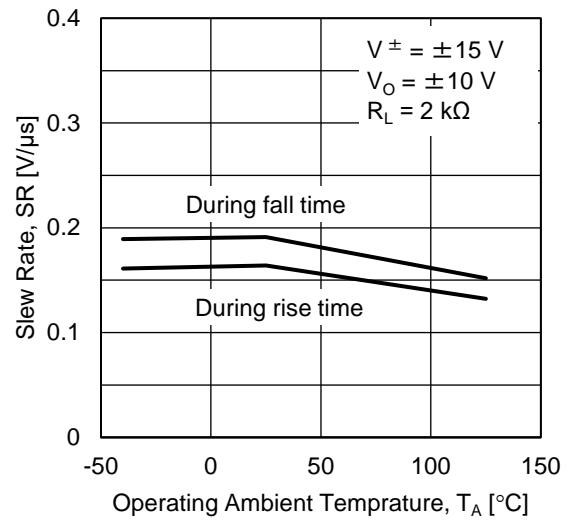




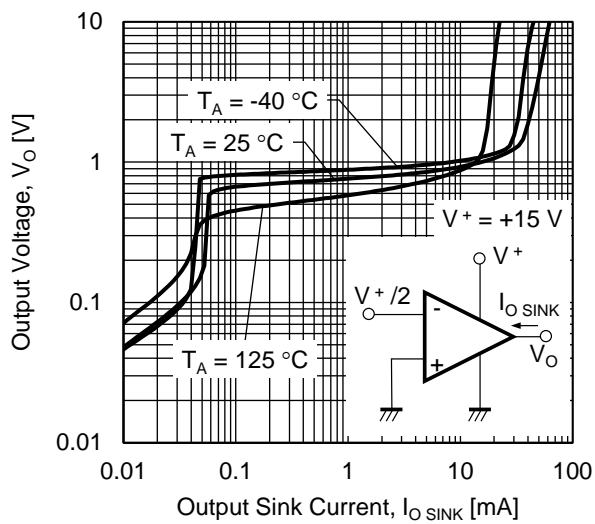
Pulse Response



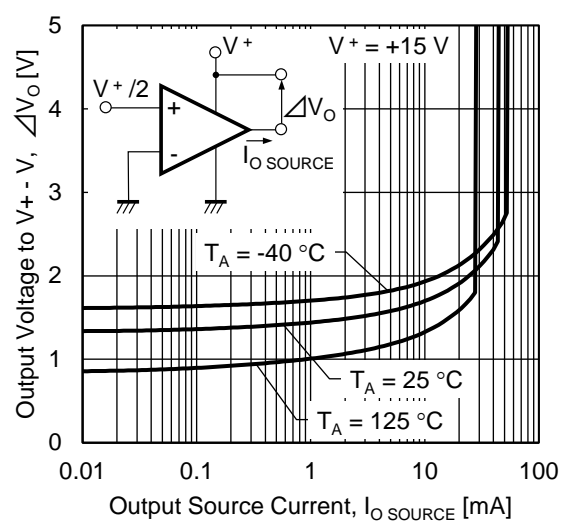
SR vs.  $T_A$



$V_O$  vs.  $I_{O \text{ SINK}}$



$\Delta V_O$  vs.  $I_{O \text{ SOURCE}}$

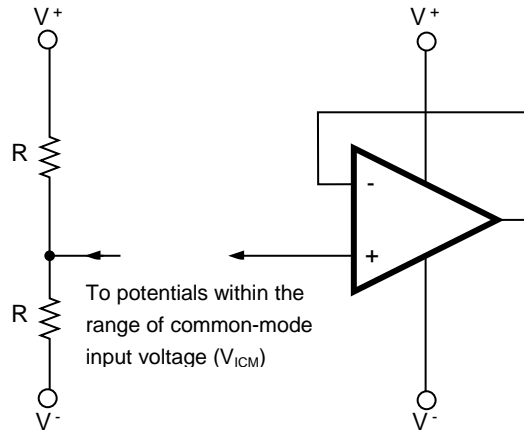


## PRECAUTION

- **The process of unused circuits**

If there is unused circuit, the following connection is recommended.

### Process example of unused circuits



**Remark:** A midpoint potential of  $V^+$  and  $V^-$  is applied to this example.

- **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 clamp 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.):  $V^-$  to  $V^+ - 1.5$  (V) ( $T_A = 25^\circ\text{C}$ ).

During designing, do include some tolerance by considering temperature characteristics and 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.):  $V^+ - 1.5$  (V) ( $T_A = 25^\circ\text{C}$ ),  $V_{om-}$  (TYP.): ( $I_{O\text{ SINK}} \leq 50 \mu\text{A}$ ): Approx.  $V^-$  (V) ( $T_A = 25^\circ\text{C}$ ).

During designing, include some tolerance such as characteristics variation and temperature characteristics consideration and so forth. In addition, also note that the output voltage range ( $V_{om+} - V_{om-}$ ) will become narrow when an output current increases.

- **Operation of output**

This IC output level consist of a class C push-pull. Therefore, when a load resistance is connected to the midpoint potential of  $V^+$ ,  $V^-$ , a crossover distortion occurs during the transition state of output current flow direction (source, sink).

- **Handling of ICs**

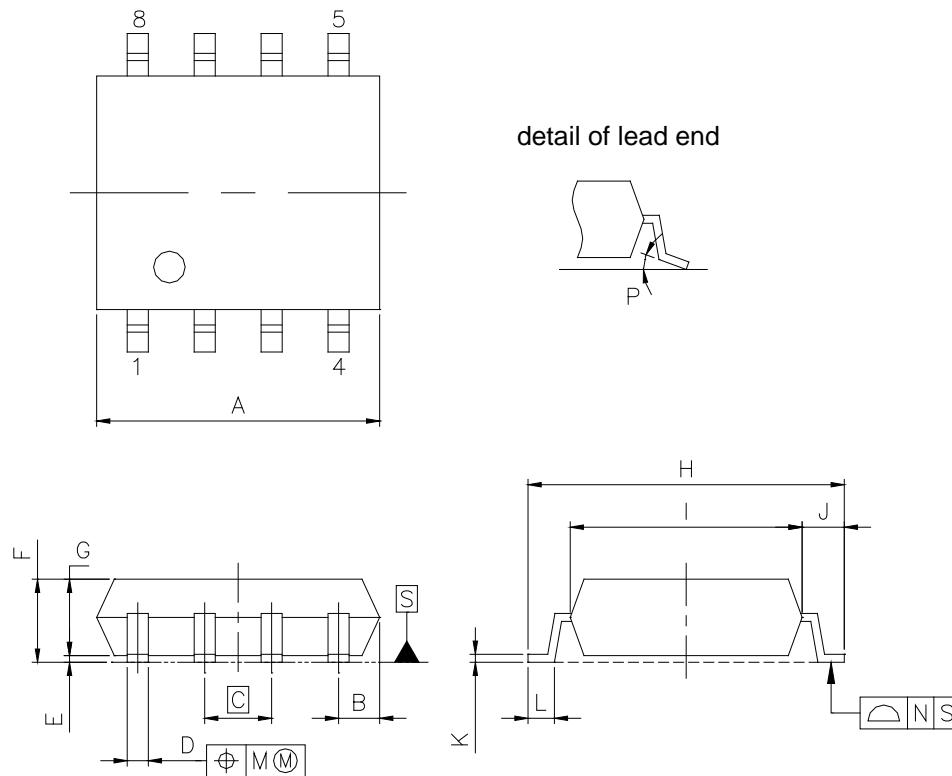
Warpage or bending of a PCB board will apply stress to the ICs, the characteristic may change due to piezoelectric effect. Therefore, pay attention to warpage or bending of the board.

# 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.

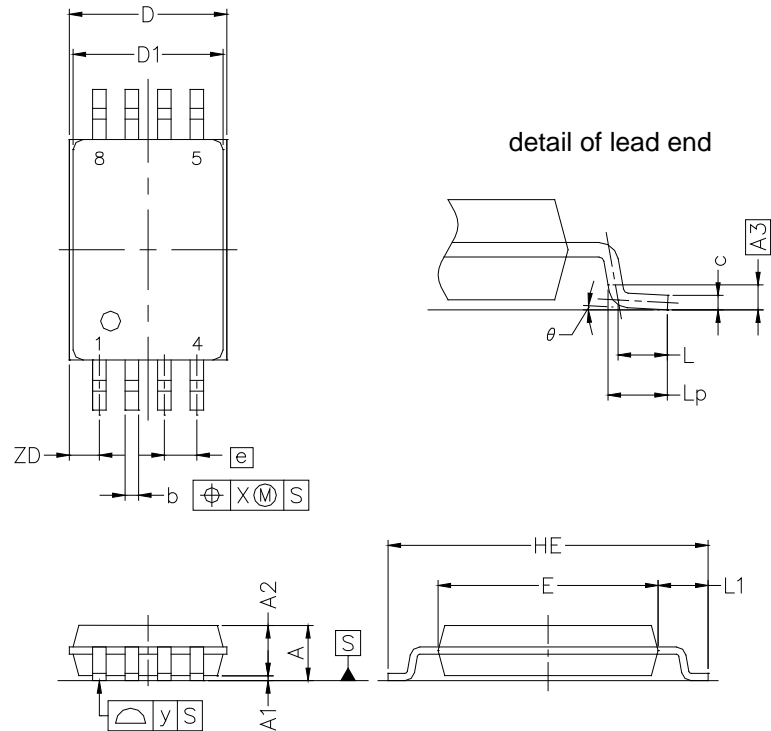
ITEM	MILLIMETERS
A	5.2 $^{+0.17}_{-0.20}$
B	0.78 MAX
C	1.27 (T.P)
D	0.42 $^{+0.08}_{-0.07}$
E	0.1 $\pm 0.1$
F	1.59 $\pm 0.21$
G	1.49
H	6.5 $\pm 0.3$
I	4.4 $\pm 0.15$
J	1.1 $\pm 0.2$
K	0.17 $^{+0.08}_{-0.07}$
L	0.6 $\pm 0.2$
M	0.12
N	0.10
P	3° $^{+7}_{-3}$



8-PIN PLASTIC TSSOP

JEITA Package code	RENESAS code	Previous code	MASS(TYP.) [g]
P-TSSOP8-0225-0.65	PTSP0008JD-A	P8GR-65-9LG	—

Unit : mm



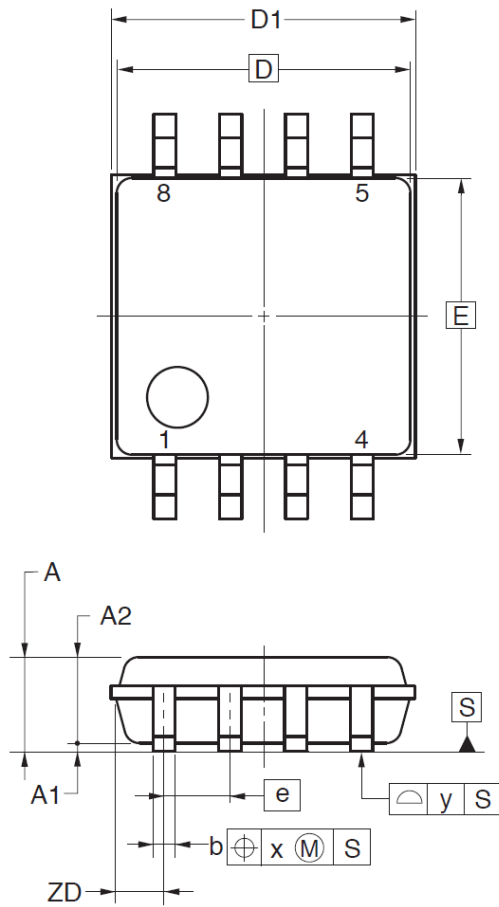
**NOTE**

Each lead centerline is located within 0.10 mm of its true position at maximum material condition.

ITEM	MILLIMETERS
D	3.15 ±0.15
D1	3.00 ±0.10
E	4.40 ±0.10
HE	6.40 ±0.20
A	1.20 MAX.
A1	0.10 ±0.05
A2	1.00 ±0.05
A3	0.25
b	0.24 <sup>+0.06</sup> <sub>-0.05</sub>
c	0.145 ±0.055
L	0.5
Lp	0.60 ±0.15
L1	1.00 ±0.20
θ	3° <sup>+5°</sup> <sub>-3°</sub>
e	0.65
x	0.10
y	0.10
ZD	0.60

8-PIN PLASTIC MSOP

JEITA Package Code	RENESAS Code	Previous Code	MASS (TYP.) [g]
P-TSSOP8-2.8x2.9-0.65	PTSP0008JF-A	P8MP-65-KAA-1	0.02



**NOTE**

Each lead centerline is located within 0.10 mm of its true position at maximum material condition.

(UNIT:mm)	
ITEM	DIMENSIONS
D	2.90
D1	3.00 ± 0.20
E	2.80
HE	4.00 ± 0.20
e	0.65
b	0.22 ± 0.05
A	1.03 MAX.
A1	0.08 ± 0.05
A2	0.85 ± 0.05
A3	0.25
L1	0.60 ± 0.20
c	0.145 <sup>+0.05</sup> <sub>-0.03</sub>
Lp	0.37 ± 0.10
x	0.10
y	0.10
θ	3° <sup>+5°</sup> <sub>-3°</sub>
ZD	0.525

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