µPC451A

Single Power Supply Quad Operational Amplifiers

R03DS0115EJ0100
Rev.1.00
2017.12.25

DESCRIPTION

µPC451A is a dual operational amplifier 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.

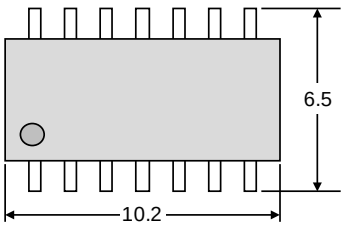
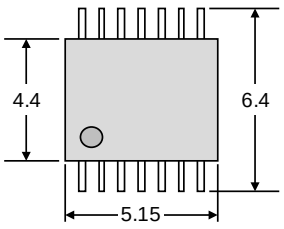
In addition, this amplifier supports both positive and negative power supply and can be used in various amplifier circuits.

µPC1251A which is a dual type with the same circuit configuration is also available under this series of operational amplifiers.

FEATURES

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

PRODUCT LINEUP

Package	Standard SOP	TSSOP
Part Name	µPC451AG2	µPC451AGR
Outline Comparison	Unit : mm 	Unit : mm 

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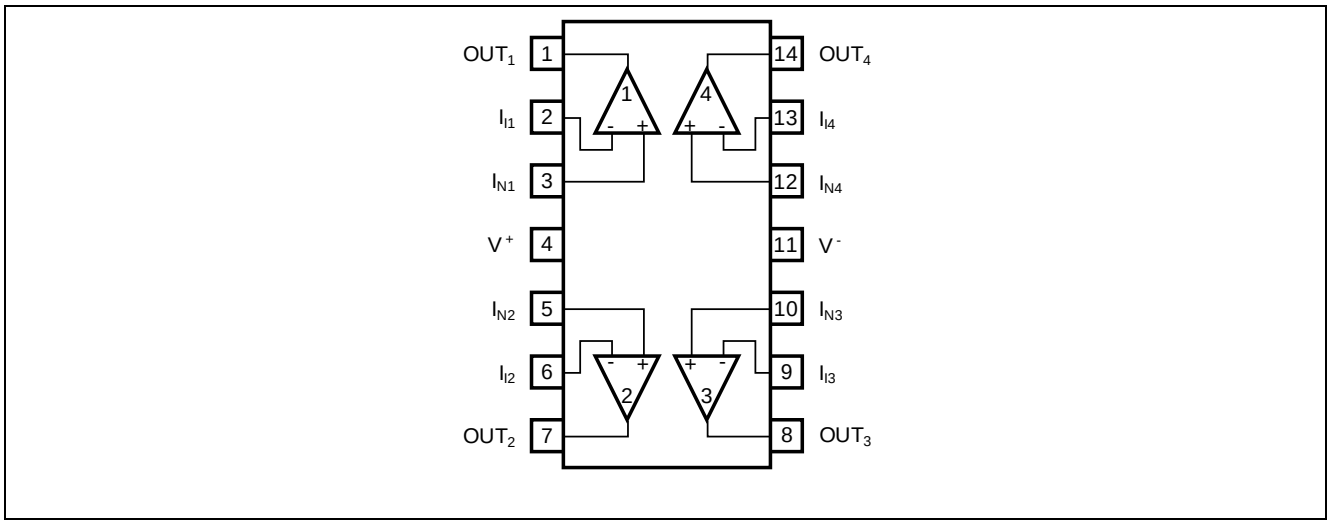
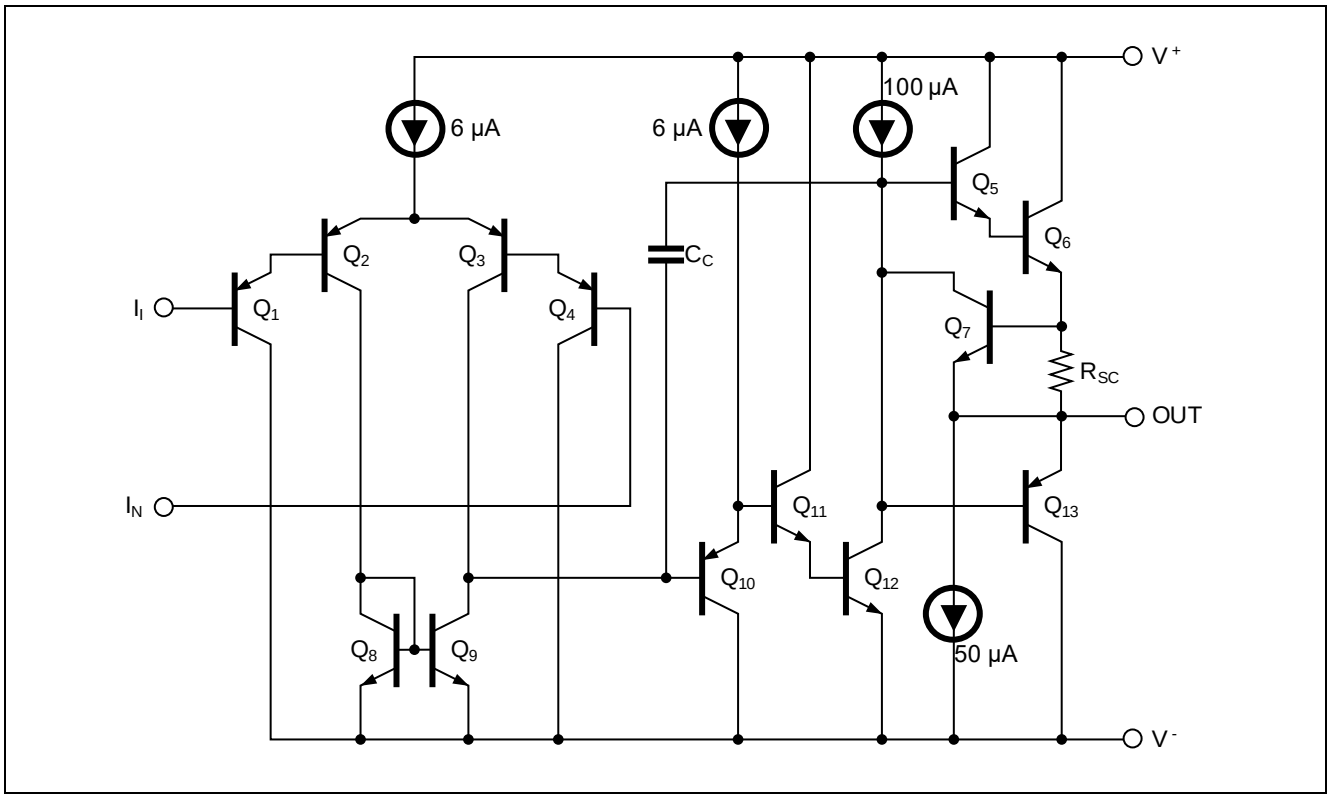
PIN CONFIGURATION (Marking Side)



EQUIVALENT CIRCUIT (1/4 Circuit)



ABSOLUTE MAXIMUM RATINGS

(T_A = 25 °C)

Parameter	Symbol	Ratings	Unit
Voltage between V+ and V- Note 1	$V^+ - V^-$	-0.3 ~ +32	V
Differential Input Voltage	V_{ID}	±32	V
Input Voltage Note 2	V_I	V^- -0.3 ~ V^- +32	V
Output applied Voltage Note 3	V_O	V^- -0.3 ~ V^+ +0.3	V
Total Power Dissipation Note 4	P_T	550	mW
Output Short Circuit Duration Note 5	t_S	Indefinite	s
Operating Ambient Temperature	T_A	-40 ~ +125	°C
Storage Temperature	T_{stg}	-55 ~ +150	°C

【Note】1. Note that reverse connections of the power supply may damage the ICs.

2. The input voltage range that can be applied to the input terminal without deterioration or destruction of characteristics. It can be applied regardless of the power supply voltage as long as it is within the rating.
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.
µPC451AG2 : Derate at -5.5 mW/°C when T_A ＞ 25 °C
µPC451AGR : Derate at -7.0 mW/°C when T_A ＞ 71 °C

5. Short circuits from the output to V^+ can cause destruction. (V^+ ≦ +15V, 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)	$V^{\pm}$	±1.5		±15	V
Power Supply Voltage (V^- = GND)	V^+	+3		+30	V

ELECTRICAL CHARACTERISTICS

(T_A = 25 °C, V^+ = +5 V, V^- = GND)

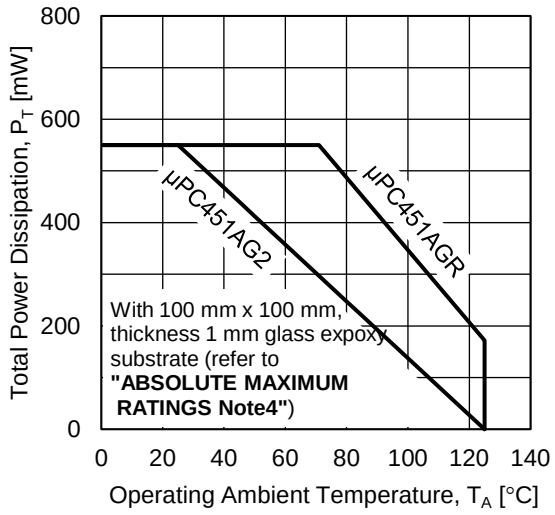
Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Condition
Input Offset Voltage	V_{IO}		±2	±7	mV	R_S = 0 Ω
Input Offset Current	I_{IO}		±5	±50	nA	
Input Bias Current Note 6	I_B		26	250	nA	
Large Signal Voltage Gain	A_V	25000	100000			R_L ≧ 2 kΩ
Circuit Current Note 7	I_{CC}		1.0	2	mA	R_L = ∞, I_O = 0 A
Common Mode Rejection Ratio	CMR	65	85		dB	
Supply Voltage Rejection Ratio	SVR	65	100		dB	
Output Voltage Swing	V_O	0		V^+ -1.5	V	R_L = 2 kΩ (connected to GND)
Common Mode Input Voltage Range	V_{ICM}	0		V^+ -1.5	V	
Output Source Current	$I_{O\ SOURCE}$	20	40		mA	$V_{IN\ (+)}$ = +1 V, $V_{IN\ (-)}$ = 0 V
Output Sink Current	$I_{O\ SINK1}$	10	20		mA	$V_{IN\ (-)}$ = +1 V, $V_{IN\ (+)}$ = 0 V
	$I_{O\ SINK2}$	12	50		µA	$V_{IN\ (-)}$ = +1 V, $V_{IN\ (+)}$ = 0 V, V_O = 200 mV
Channel Separation			120		dB	f = 1 ~ 20 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.

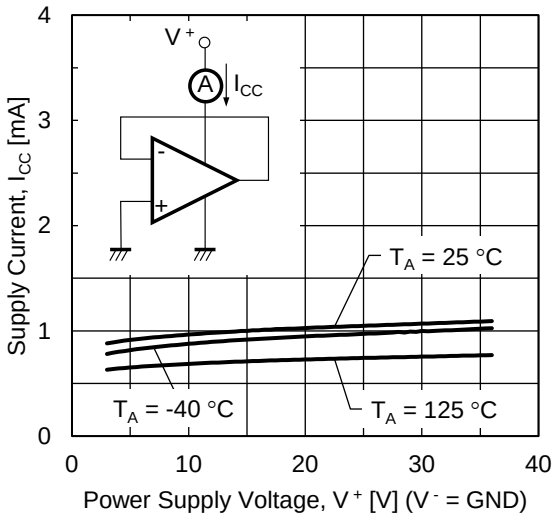
7. This is a current that flows in the internal circuit. This current will flow irrespective of the channel used.

TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25 °C, TYP.) (Reference Value)

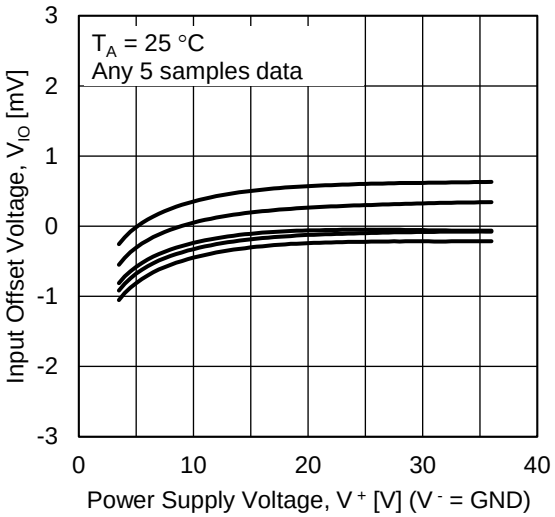
P_T vs. T_A



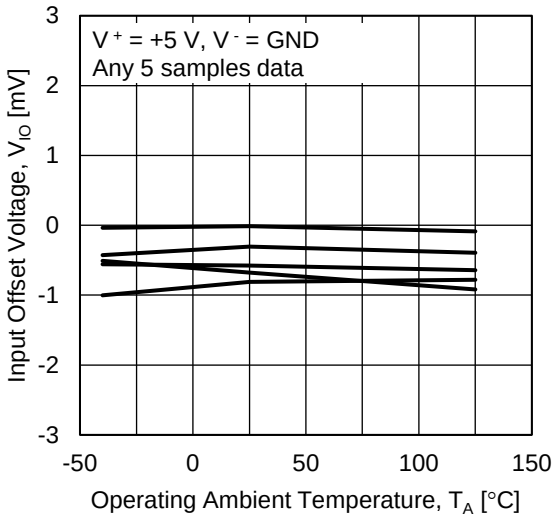
I_{CC} vs. V^+



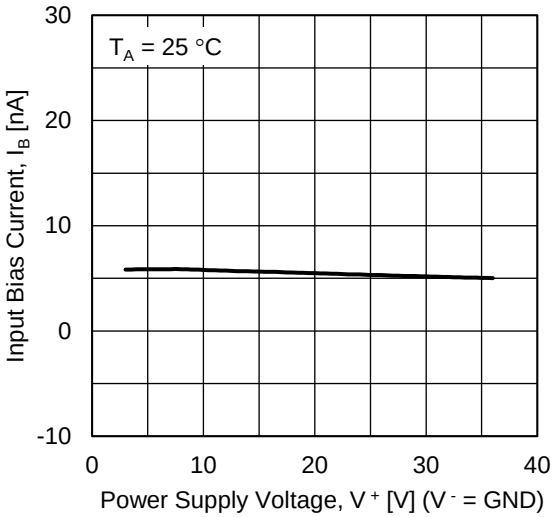
V_{IO} vs. V^+



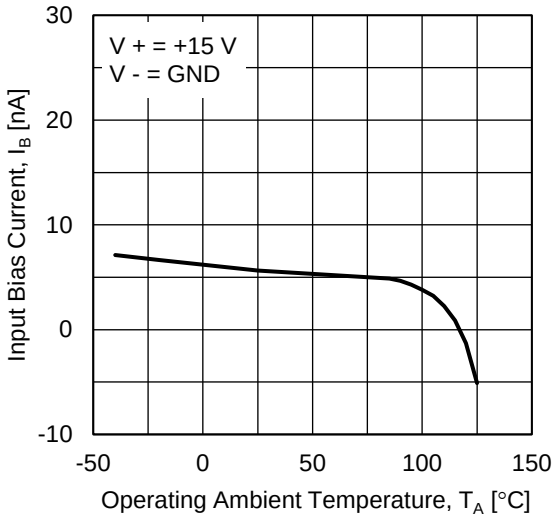
V_{IO} vs. T_A



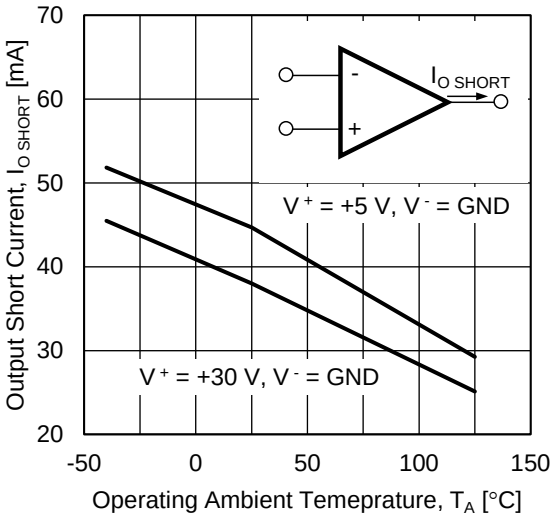
I_B vs. V^+



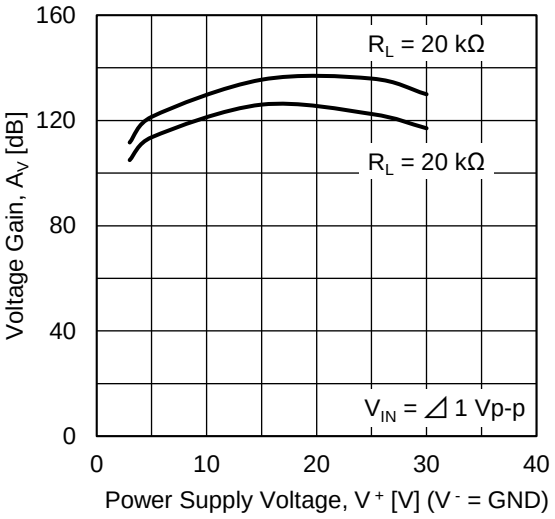
I_B vs. T_A



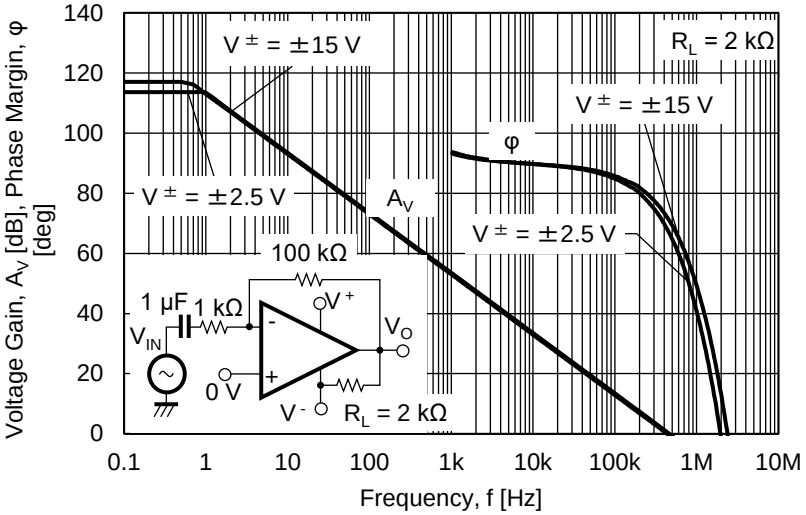
$I_{O\ SHORT}$ vs. T_A



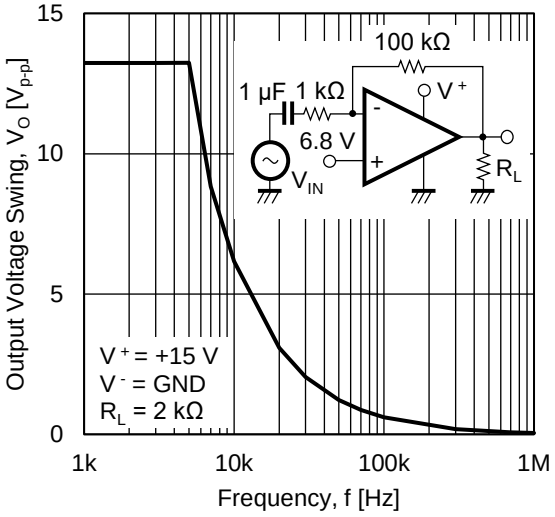
A_V vs. V^+



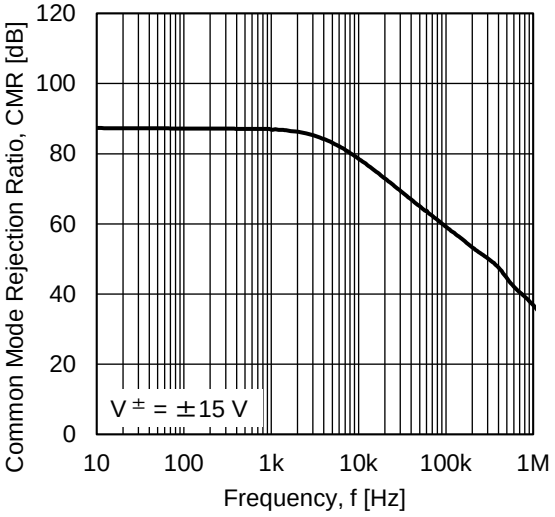
AV, φ vs. f



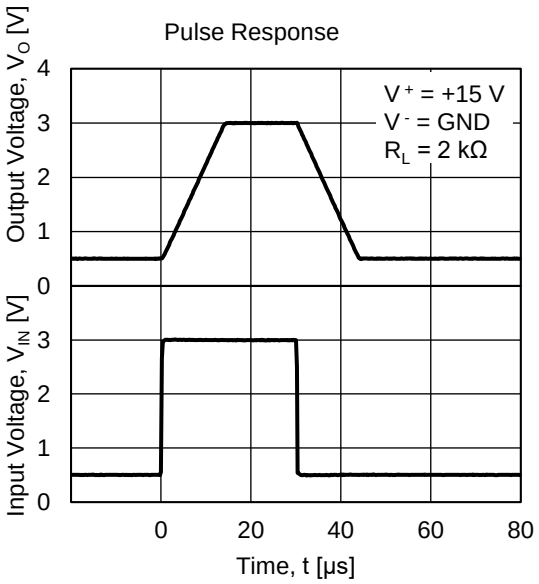
V_O vs. f



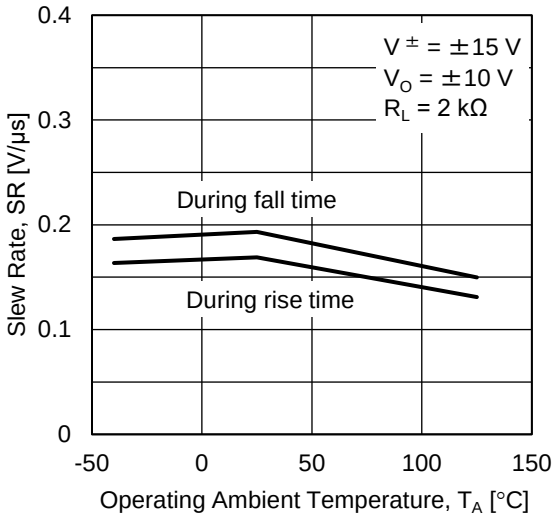
CMR vs. f



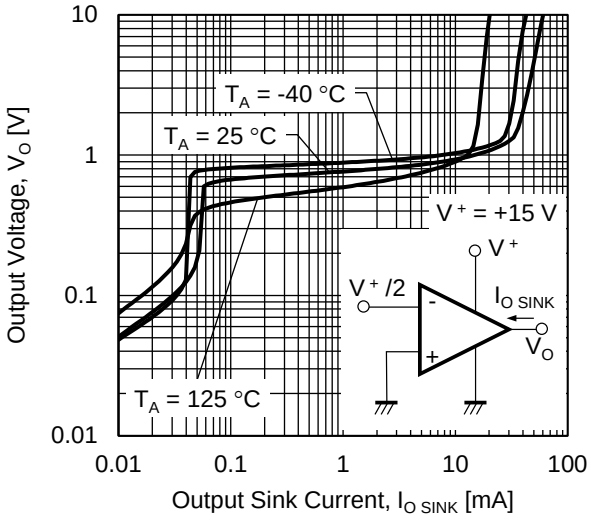
Pulse Response



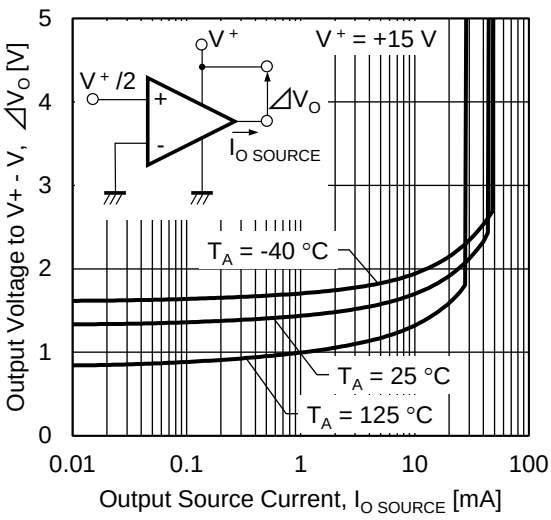
SR vs. T_A



V_O vs. $I_{O\ SINK}$



ΔV_O vs. $I_{O\ SOURCE}$

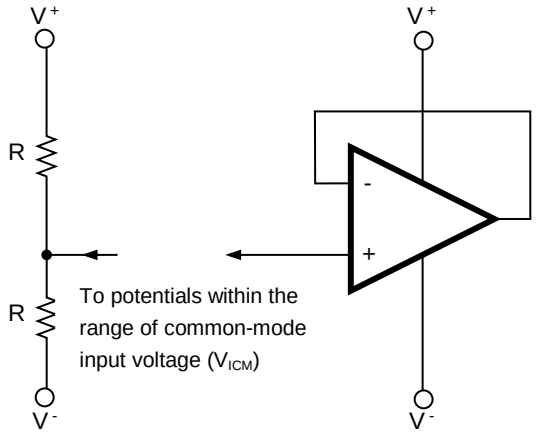


PRECAUTION

- **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°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°C), V_{om}^- (TYP.) ($I_{O\ SINK} \leq 50$ µA): Approx. V^- (V) (T_A = 25°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).

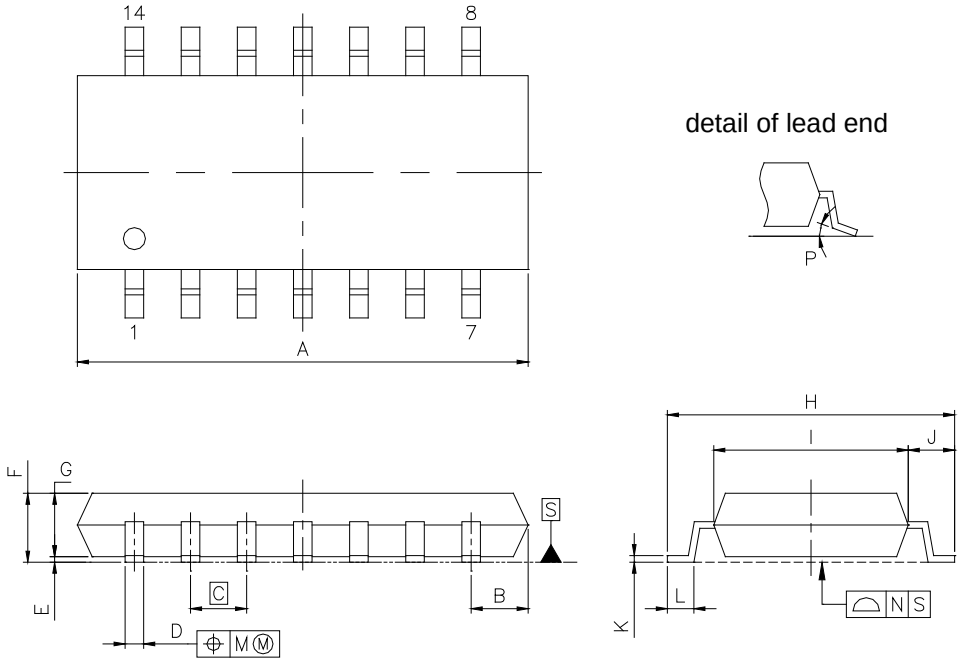
- **Handling of ICs**
  Warpage or bending of a PCB board will apply stress to the ICs, the characteristic may change due to piezoelectric effect. Therefore, pay attention to warpage or bending of the board.

PACKAGE DRAWINGS

14-PIN PLASTIC SOP

JEITA Package code	RENESAS code	Previous code	MASS (TYP.) [g]
P-SOP14-0225-1.27	PRSP0014DI-A	P14GR-50-225B	0.14

Unit : mm



NOTE

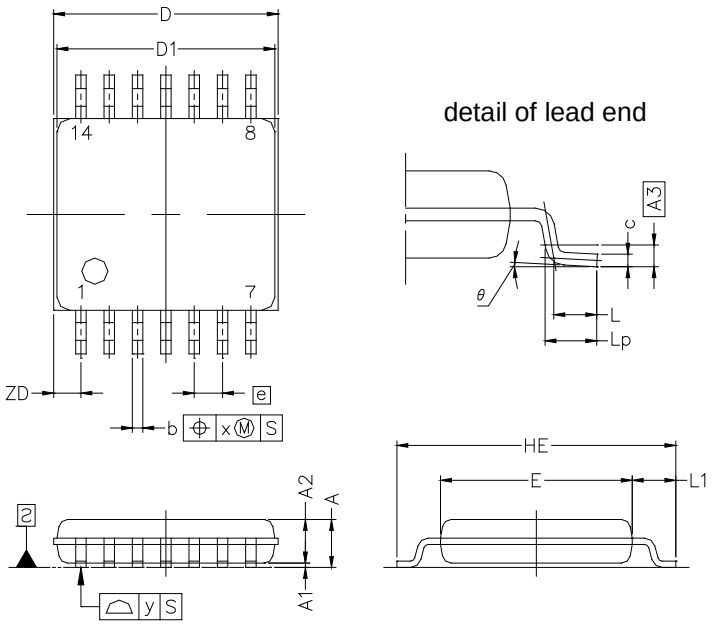
Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	10.2 ±0.26
B	1.42 MAX
C	1.27 (T.P)
D	0.42 +0.08 -0.07
E	0.1 ±0.1
F	1.59 +0.21 -0.2
G	1.49
H	6.5 ±0.2
I	4.4 ±0.1
J	1.1 ±0.16
K	0.17 +0.08 -0.07
L	0.6 ±0.2
M	0.1
N	0.10
P	3° +7° -3°

14-PIN PLASTIC TSSOP

JEITA Package code	RENESAS code	Previous code	MASS(TYP.) [g]
P-TSSOP14-0225-0.65	PTSP0014JB-A	P14GR-65-9LG-1	–

Unit : mm



NOTE

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

ITEM	MILLIMETERS
D	5.15 ±0.15
D1	5.00 ±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 +0.06 -0.05
c	0.145 ±0.055
L	0.5
Lp	0.60 ±0.15
L1	1.00 ±0.20
θ	3° +5° -3°
e	0.65
x	0.10
y	0.10
ZD	0.625

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RENESAS

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Colophon 7.0