µPC451, µPC324

Single Power Supply Quad Operational Amplifiers

R03DS0114EJ0101
Rev.1.01
2018.03.01

DESCRIPTION

µPC451, µ PC324 are quad operational amplifiers designed to operate on a single power supply. The 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 of class C push-pull circuit and a 50 µA(TYP.) constant current, and a low current consumption.

In addition to that, these amplifiers can also operate in both positive and negative power supply and can be used extensively in various amplifier circuits.

The µPC451 is suited for wide operating ambient temperature use due to its temperature expansion type, while µPC324 is for general purposes usage.

A DC parameter selection that is compatible to operational amplifiers is also available.

µPC1251, µ PC358 which are dual types with the same circuit configuration are also available under this series of operational amplifiers.

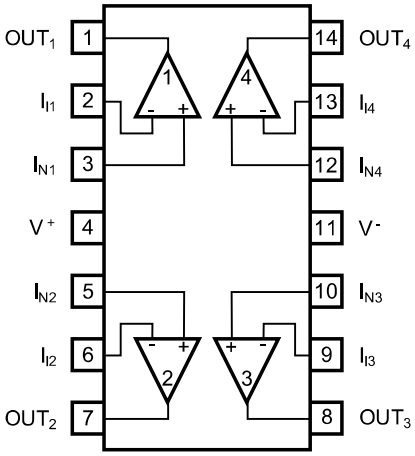
FEATURES

- 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

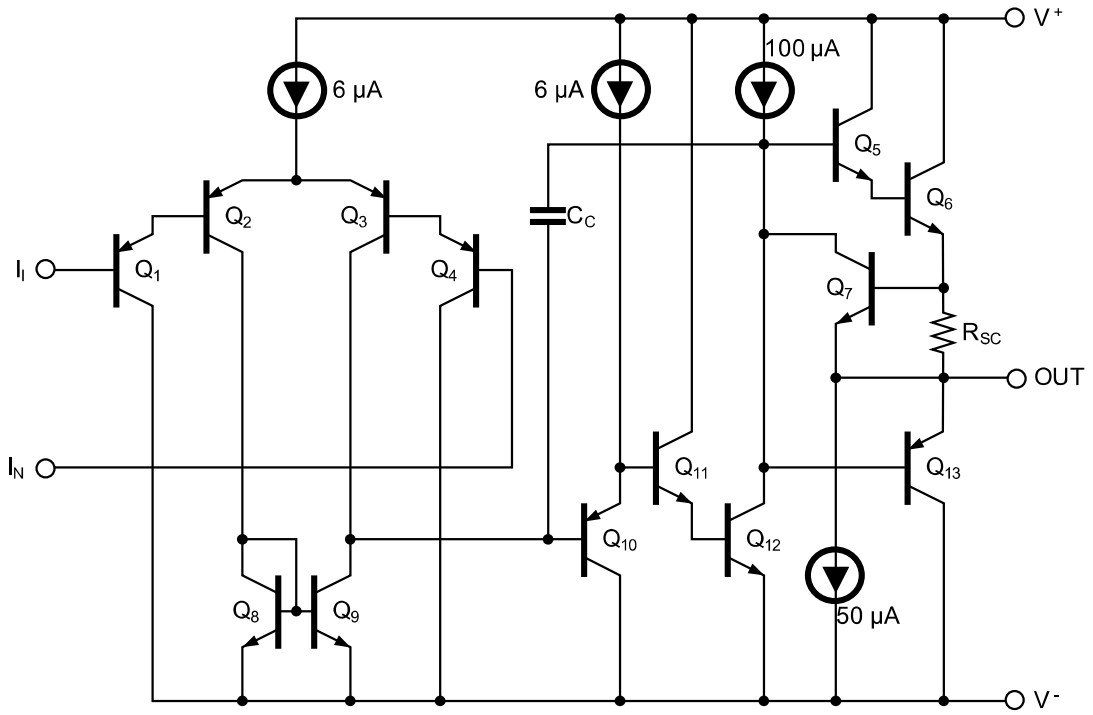
ORDERING INFORMATION

Ordering Name	Selection	Package
µPC451G2-A	General	14-pin plastic SOP (5.72 mm (225))
µPC451G2(5)-A	DC parameter selection	14-pin plastic SOP (5.72 mm (225))
µPC324G2-A	General	14-pin plastic SOP (5.72 mm (225))
µPC324G2(5)-A	DC parameter selection	14-pin plastic SOP (5.72 mm (225))
µPC451GR-9LG-A	General	14-pin plastic TSSOP (5.72 mm (225))
µPC451GR(5)-9LG-A	DC parameter selection	14-pin plastic TSSOP (5.72 mm (225))
µPC324GR-9LG-A	General	14-pin plastic TSSOP (5.72 mm (225))
µPC324GR(5)-9LG-A	DC parameter selection	14-pin plastic TSSOP (5.72 mm (225))

PIN CONFIGURATION (Marking side)



EQUIVALENT CIRCUIT (1/4 Circuit)



ABSOLUTE MAXIMUM RATINGS

(T_A = 25 °C)

Parameter	Symbol	µPC451G2, µPC451G2(5)	µPC324G2, µPC324G2(5)	µPC451GR, µPC451GR(5)	µPC324GR, µPC324GR(5)	Unit
Voltage between V+ and V– Note1	$V^+ - V^-$	-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 Note3	V_o	V^- -0.3 ~ V^+ +0.3				V
Total Power Dissipation Note4	P_T	550				mW
Output Short Circuit Duration Note5	t_S	Indefinite				s
Operating Ambient Temperature	T_A	-40 ~ +85	-20 ~ +80	-40 ~ +125	-40 ~ +85	°C
Storage Temperature	T_{stg}	-55 ~ +125		-55 ~ +150	-55 ~ +125	°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.

µPC4511G2, 324G2: Derate at -5.5 mW/°C when T_A ＞ 25 °C
µPC451GR-9LG : Derate at -7.0 mW/°C when T_A ＞ 71 °C
(Junction − ambient thermal resistance $R_{th(J-A)}$ = 144°C/W)
µPC324GR-9LG : Derate at -7.0 mW/°C when T_A ＞ 46 °C
(Junction − ambient thermal resistance $R_{th(J-A)}$ = 144°C/W)

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)	$V^±$	±1.5		±15	V
Power Supply Voltage (V^- = GND)	V^+	+3		+30	V

ELECTRICAL CHARACTERISTICS

µPC451, µPC324 (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		15	250	nA	
Large Signal Voltage Gain	A_V	25000	100000			R_L ≧ 2 kΩ
Circuit Current note 7	I_{CC}		1.2	2.0	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

µPC451(5), µPC324(5) (T_A = 25 °C, V^+ = +5 V, V^- = GND)

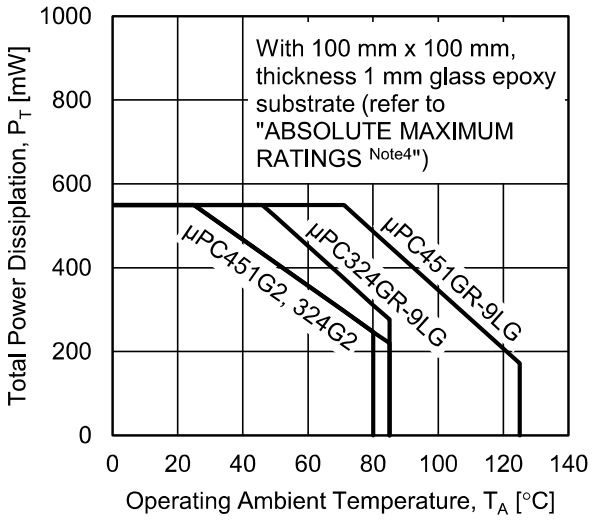
Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Condition
Input Offset Voltage	V_{IO}		±2	±3	mV	R_S = 0 Ω
Input Offset Current	I_{IO}		±5	±50	nA	
Input Bias Current Note 6	I_B		15	60	nA	
Large Signal Voltage Gain	A_V	50000	100000			R_L ≧ 2 kΩ
Circuit Current Note7	I_{CC}		1.2	1.5	mA	R_L = ∞, I_O = 0 A
Common 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^+ -1.4	V	
Output Source Current	$I_{O\ SOURCE}$	30	40		mA	$V_{IN\ (+)}$ = +1 V, $V_{IN\ (-)}$ = 0 V
Output Sink Current	$I_{O\ SINK1}$	15	20		mA	$V_{IN\ (-)}$ = +1 V, $V_{IN\ (+)}$ = 0 V
	$I_{O\ SINK2}$	30	50	70	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.

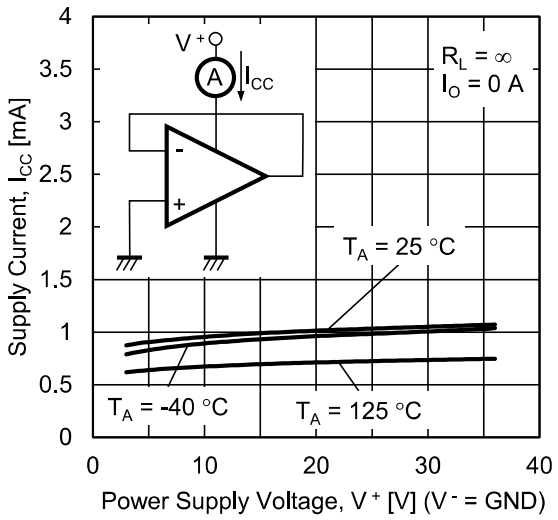
7. This is a current that flows in the internal circuit. This current will flow irrespective of the channel used.

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

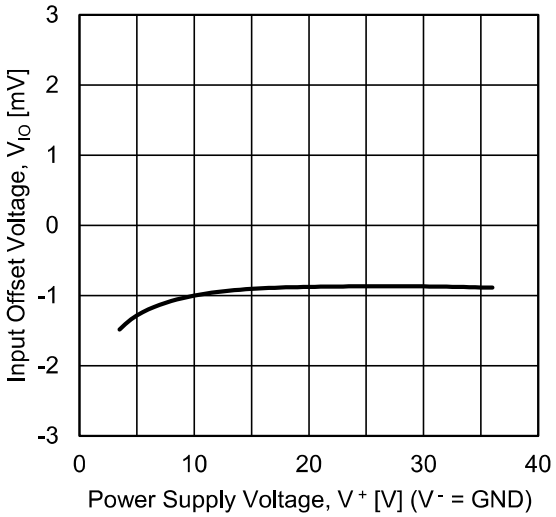
P_T vs. T_A



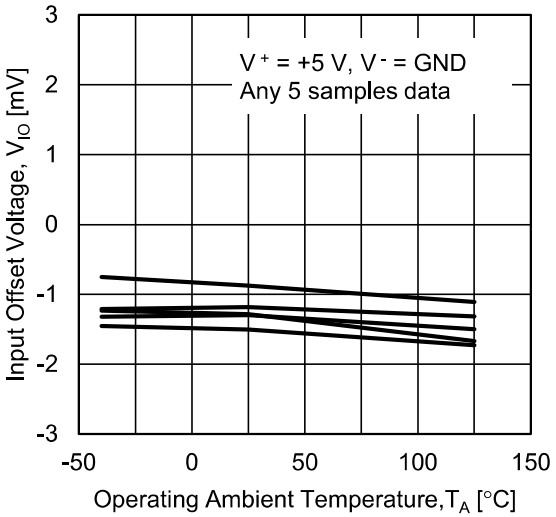
I_{CC} vs. V^+



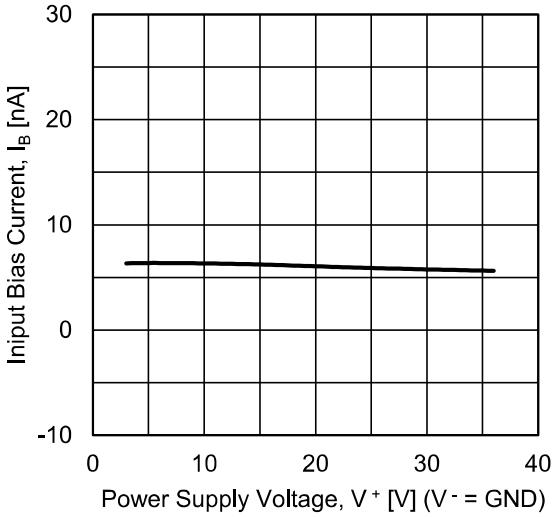
V_{IO} vs. V^+



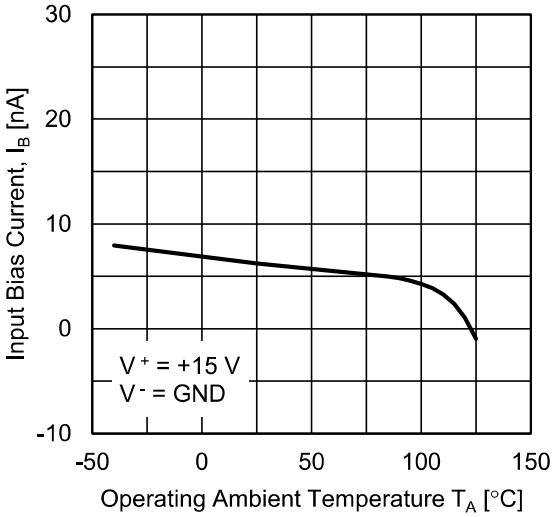
V_{IO} vs. T_A



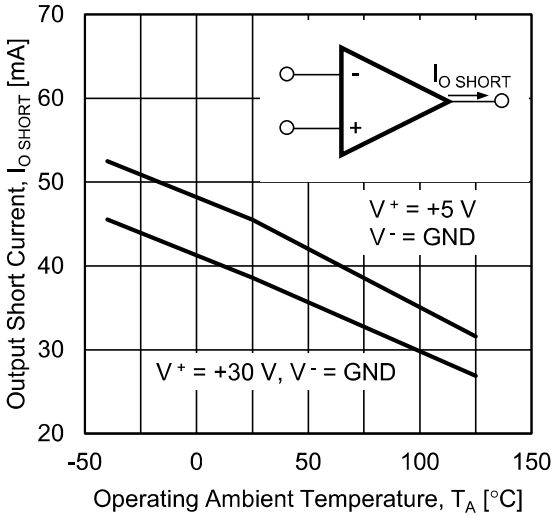
I_B vs. V^+



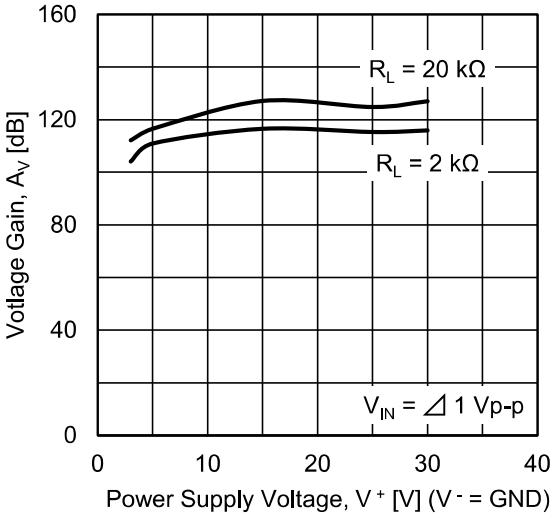
I_B vs. T_A



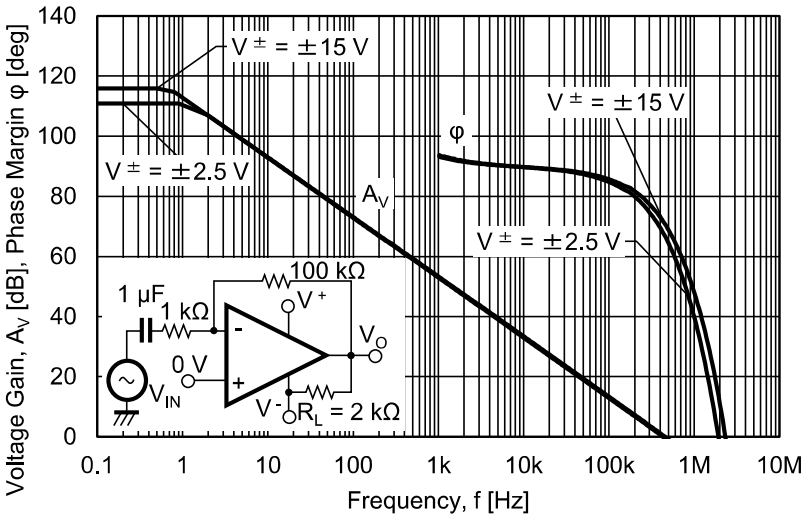
$I_{O\ SHORT}$ vs. T_A



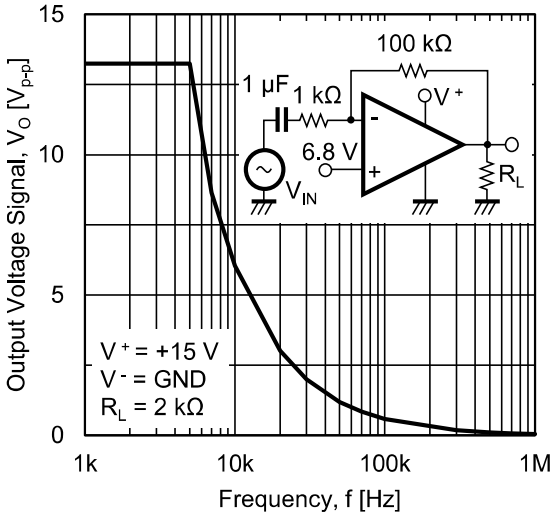
A_V vs. V^+



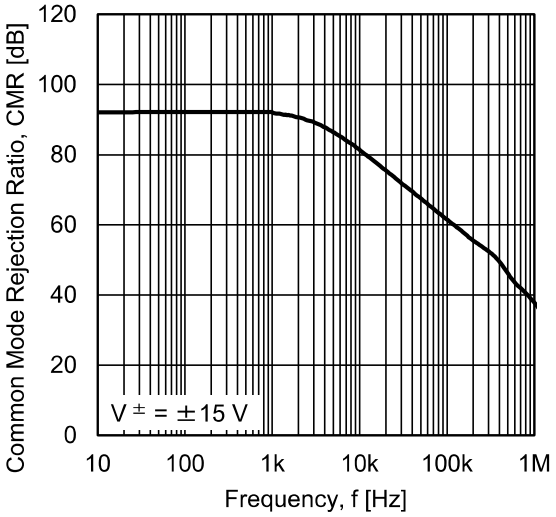
A_V, φ vs. f

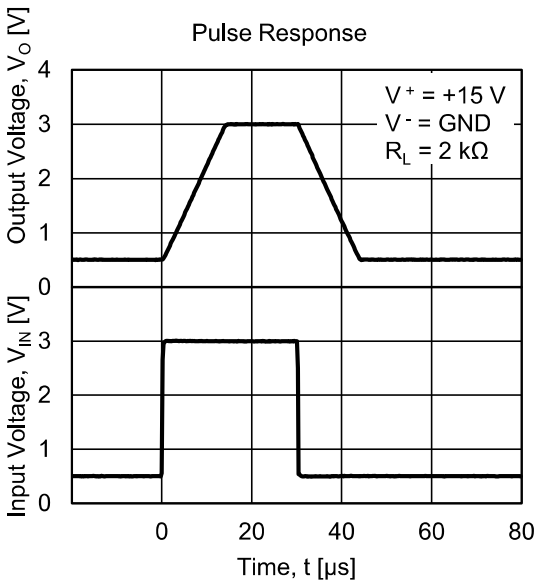


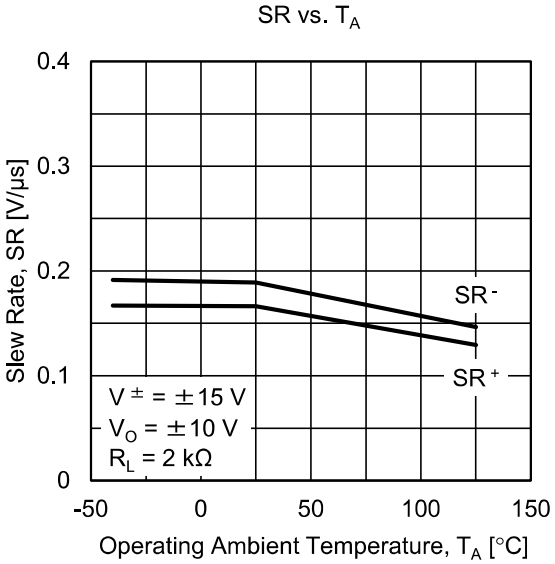
V_O vs. f

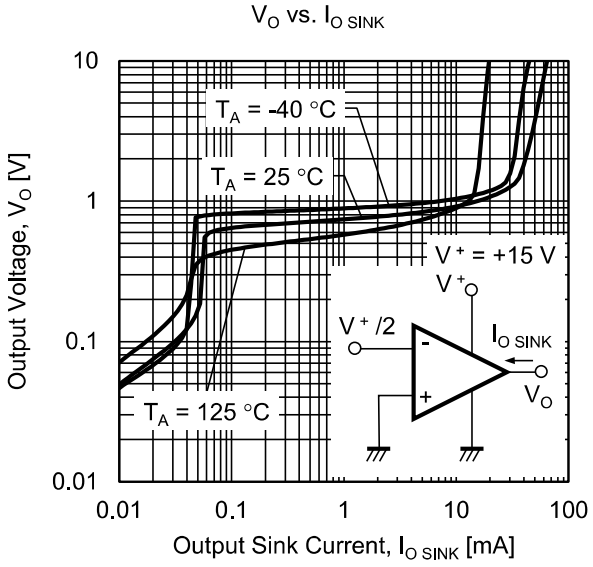


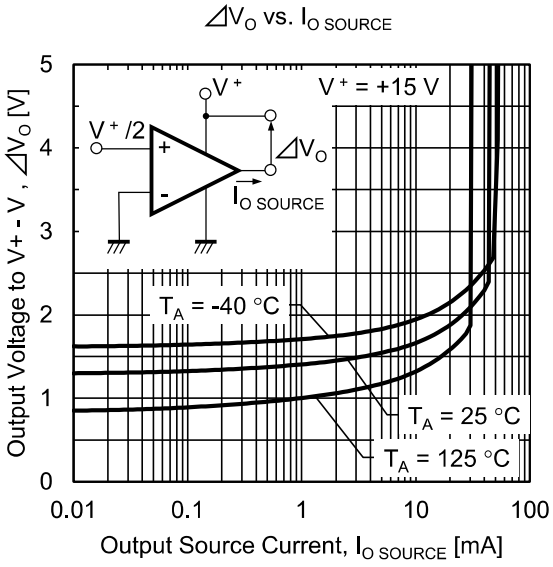
CMR vs. f




Pulse Response
Output Voltage, V_O [V]
Input Voltage, V_{IN} [V]
V^+ = +15 V
V^- = GND
R_L = 2 kΩ
Time, t [µs]


SR vs. T_A
Slew Rate, SR [V/µs]
SR-
SR+
$V^\pm$ = ±15 V
V_O = ±10 V
R_L = 2 kΩ
Operating Ambient Temperature, T_A [°C]


V_O vs. $I_{O\ SINK}$
Output Voltage, V_O [V]
T_A = -40 °C
T_A = 25 °C
T_A = 125 °C
V^+ = +15 V
V^+
V^+ /2
$I_{O\ SINK}$
V_O
Output Sink Current, $I_{O\ SINK}$ [mA]

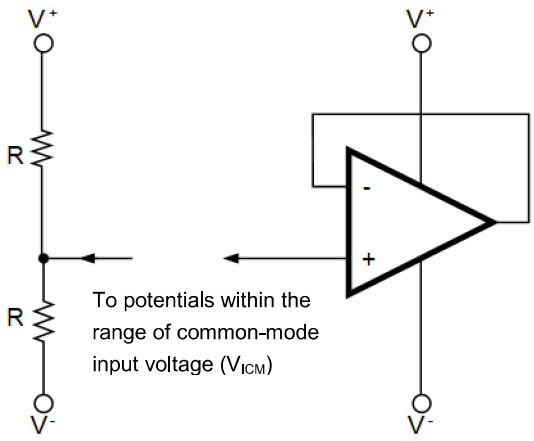

ΔV_O vs. $I_{O\ SOURCE}$
Output Voltage to V+ - V , ΔV_O [V]
V^+
V^+ /2
ΔV_O
$I_{O\ SOURCE}$
V^+ = +15 V
T_A = -40 °C
T_A = 25 °C
T_A = 125 °C
Output Source Current, $I_{O\ SOURCE}$ [mA]

PRECAUTIONS

- **The process of unused circuits**

  If there is an 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, it may cause degradation of characteristics or damage, by a conduction of a parasitic diode within an IC. 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).

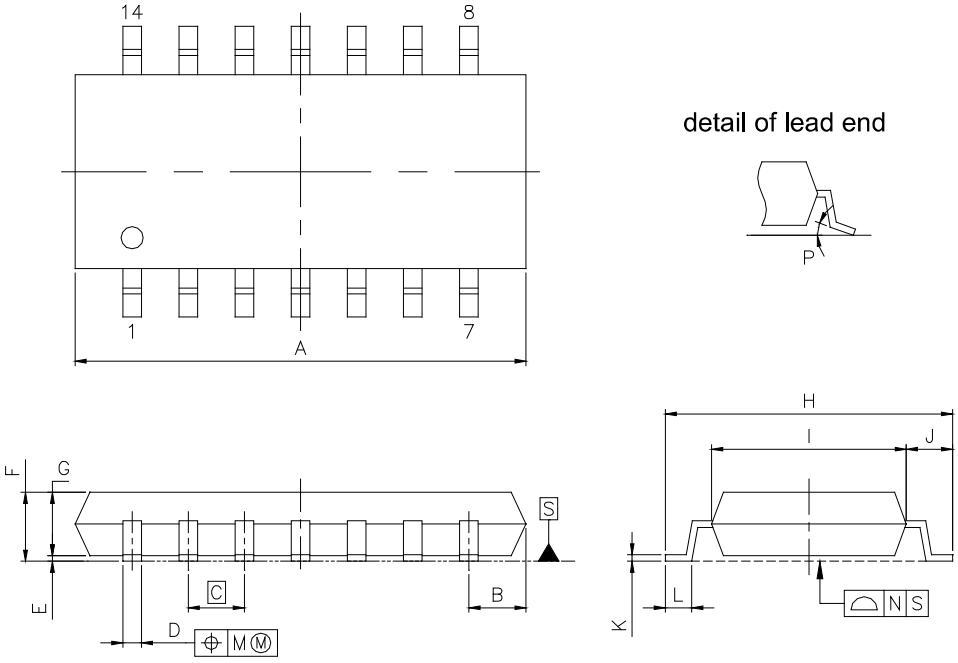
- **Handling of ICs**
  When stress is added to the ICs due to warpage or bending of a board, the characteristic may fluctuates due to piezoelectric effect. Therefore, pay attention to warpage or bending of a board.

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

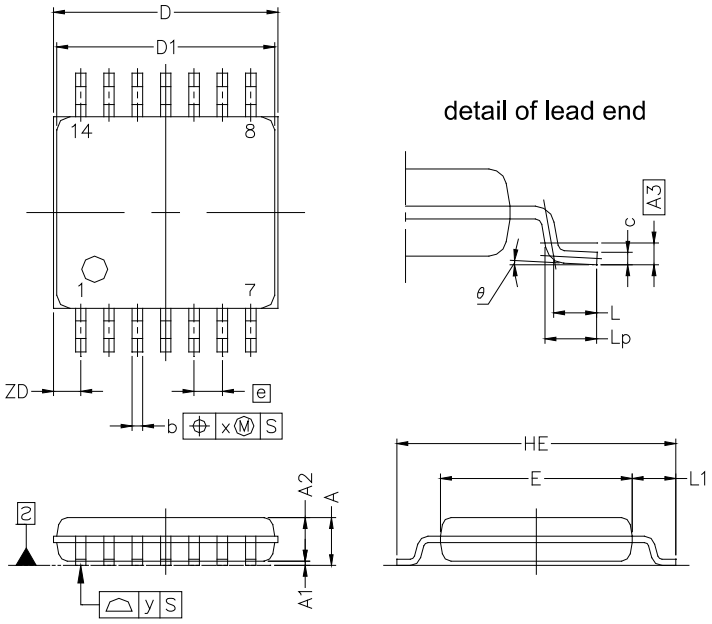
Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

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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