µPC1251, µPC358

Single Power Supply Dual Operational Amplifiers

R03DS0116EJ0100
Rev.1.00
2017.12.25

DESCRIPTION

µPC1251, µ PC358 are dual 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, this amplifier can also operate in both positive and negative power supply and can be used extensively in various amplifier circuits.

The µPC1251 is suited for wide operating ambient temperature use due to its temperature expansion type, while µPC358 is for general purposes usage.

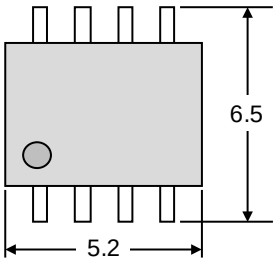
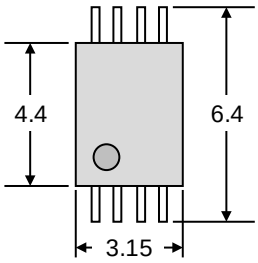
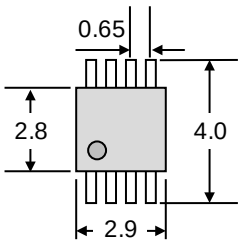
A DC parameter selection that is compatible to operational amplifiers is also available.

µPC451, µ PC324 which are quad 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

Product Lineup

Package	Standard SOP	TSSOP	MSOP
Subject Part Number	µPC1251G2, µPC358G2	µPC1251GR-9LG, µPC358GR-9LG	µPC1251MP-KAA
Outline Comparison	Unit : mm 	Unit : mm 	Unit : mm 
(Mounting Area Ratio)	(100 %)	(60 %)	(34 %)

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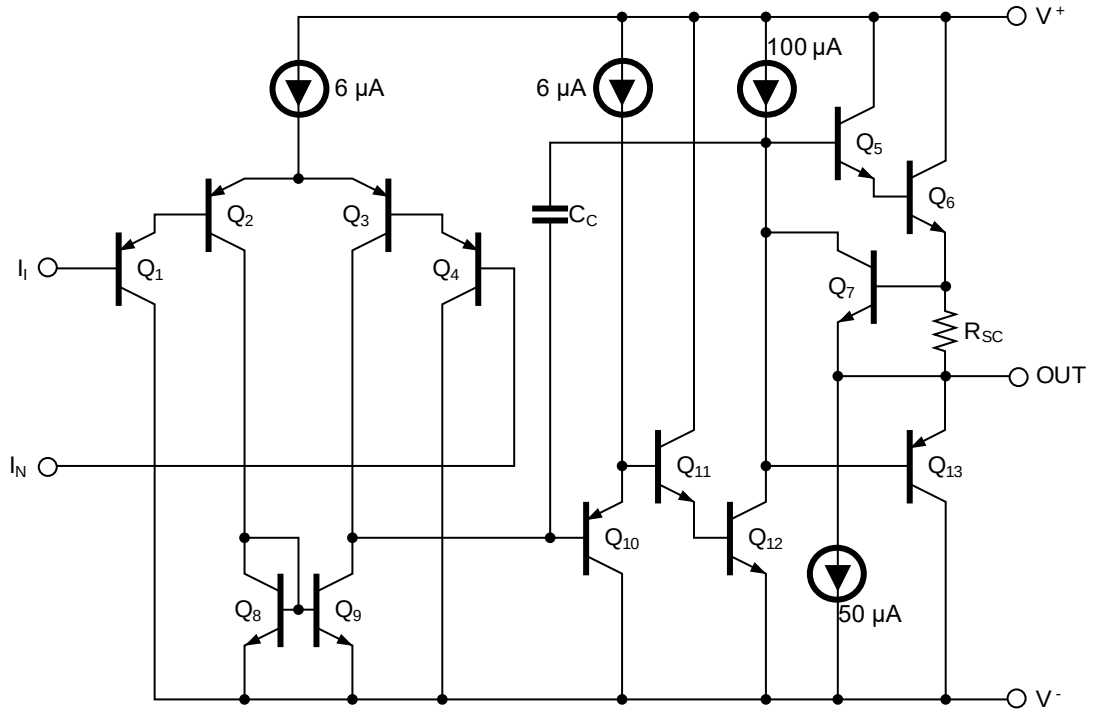
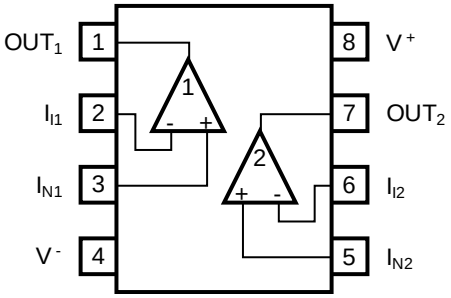
ORDERING INFORMATION

Part Number	Selected Grade	Package
µPC1251G2-A	Standard	8-pin plastic SOP (5.72 mm (225))
µPC1251G2(5)-A	DC parameter selection	8-pin plastic SOP (5.72 mm (225))
µPC358G2-A	Standard	8-pin plastic SOP (5.72 mm (225))
µPC358G2(5)-A	DC parameter selection	8-pin plastic SOP (5.72 mm (225))
µPC1251GR-9LG-A	Standard	8-pin plastic TSSOP (5.72 mm (225))
µPC1251GR(5)-9LG-A	DC parameter selection	8-pin plastic TSSOP (5.72 mm (225))
µPC1251MP-KAA-A	Standard	8-pin plastic MSOP (2.8 × 2.9)
µPC1251MP(5)-KAA-A	DC parameter selection	8-pin plastic MSOP (2.8 × 2.9)
µPC358GR-9LG-A	Standard	8-pin plastic TSSOP (5.72 mm (225))
µPC358GR(5)-9LG-A	DC parameter selection	8-pin plastic TSSOP (5.72 mm (225))

EQUIVALENT CIRCUIT (1/2 Circuit)



PIN CONFIGURATION (Marking side)



ABSOLUTE MAXIMUM RATINGS

(T_A = 25 °C)

Parameter	Symbol	µPC1251G2, µPC1251G2(5)	µPC358G2, µPC358G2(5)	µPC1251GR, µPC1251GR(5)	µPC1251MP, µPC1251MP(5)	µPC358GR, µPC358GR(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	440					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.

µPC1251G2 : Derate at -4.4 mW/°C when T_A ＞ 25 °C
(Junction − ambient thermal resistance $R_{th(J-A)}$ = 227°C/W)
µPC358G2 : Derate at -4.4 mW/°C when T_A ＞ 25 °C
(Junction − ambient thermal resistance $R_{th(J-A)}$ = 227°C/W)
µPC1251GR-9LG : Derate at -5.5 mW/°C when T_A ＞ 69 °C
(Junction − ambient thermal resistance $R_{th(J-A)}$ = 183°C/W)
µPC1251MP-KAA : Derate at -4.8 mW/°C when T_A ＞ 58 °C
(Junction − ambient thermal resistance $R_{th(J-A)}$ = 208°C/W)
µPC358GR-9LG : Derate at -5.5 mW/°C when T_A ＞ 44 °C
(Junction − ambient thermal resistance $R_{th(J-A)}$ = 183°C/W)

5. Short circuits from the output to V^+ can cause destruction. 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

µPC1251, µPC358 (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		14	250	nA	
Large Signal Voltage Gain	A_V	25000	100000			R_L ≧ 2 kΩ
Circuit Current Note 7	I_{CC}		0.7	1.2	mA	R_L = ∞, I_O = 0 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 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

µPC1251 (5), µPC358 (5) (T_A = 25 °C, V^+ = +5 V, V^- = GND)

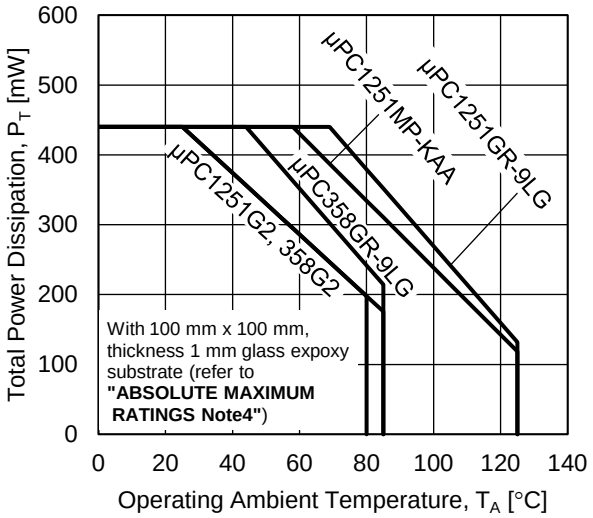
Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Condition
Input Offset Voltage	V_{IO}		±2	±3	mV	R_S = 0 Ω
Input Offset Current	I_{IO}		±5	±50	nA	
Input Bias Current Note 6	I_B		14	60	nA	
Large Signal Voltage Gain	A_V	50000	100000			R_L ≧ 2 kΩ
Circuit Current Note7	I_{CC}		0.7	0.9	mA	R_L = ∞, I_O = 0 A
Common 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 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.

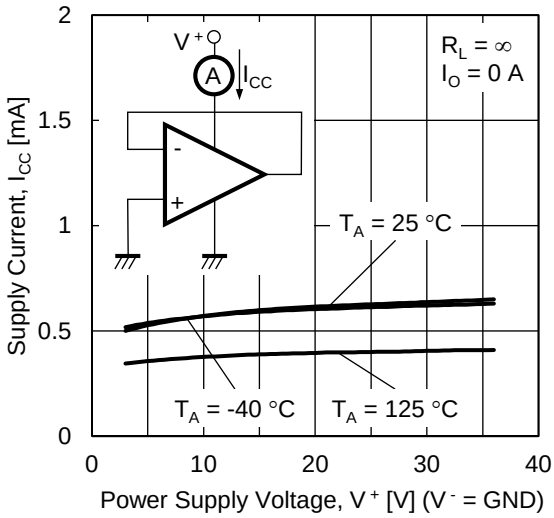
7. This is a current that flows in the internal circuit. This current will flow irrespective of the channel used.

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

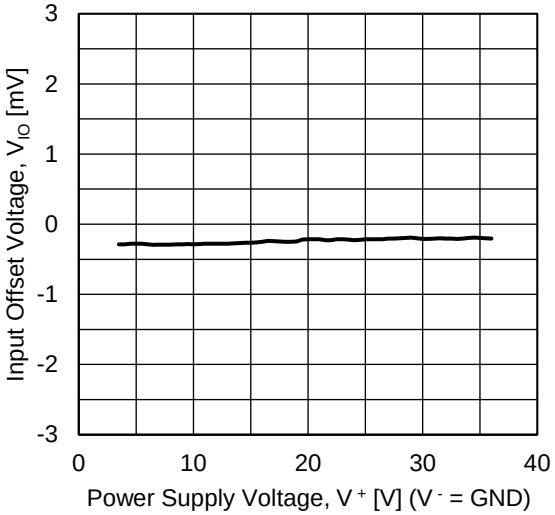
P_T vs. T_A



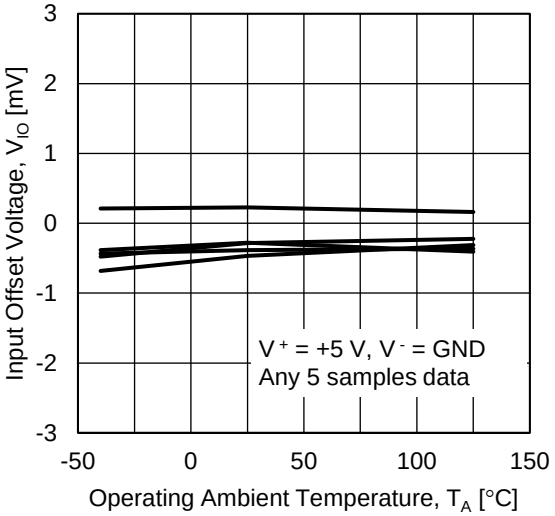
I_{CC} vs. V^+



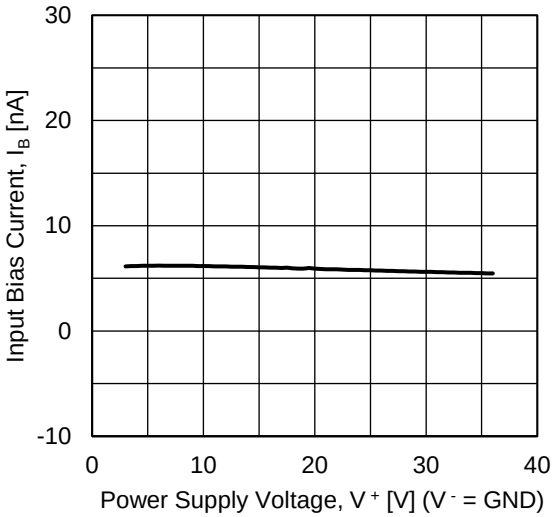
V_{IO} vs. V^+



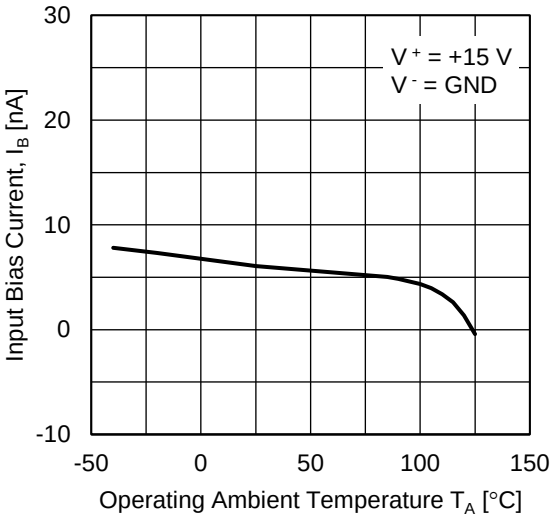
V_{IO} vs. T_A



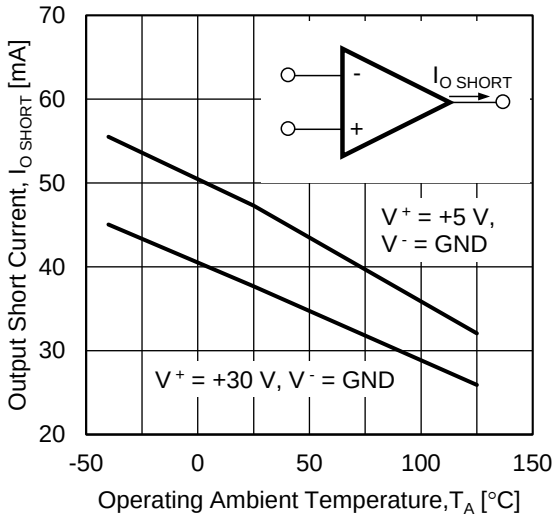
I_B vs. V^+



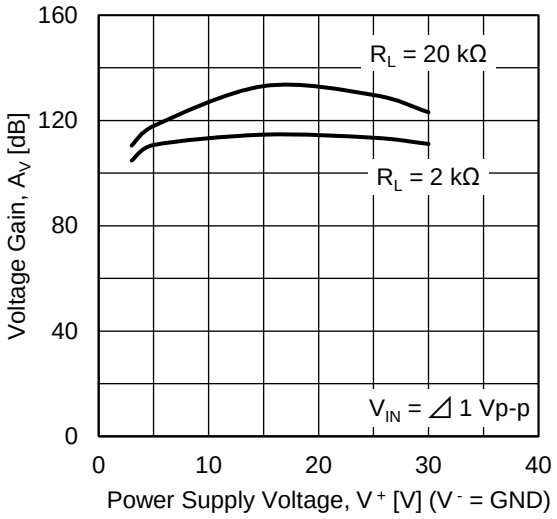
I_B vs. T_A



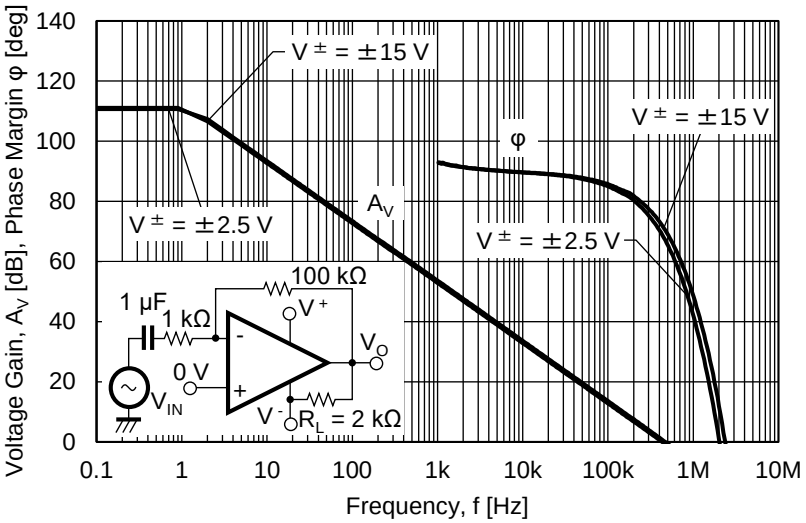
$I_{O\ SHORT}$ vs. T_A



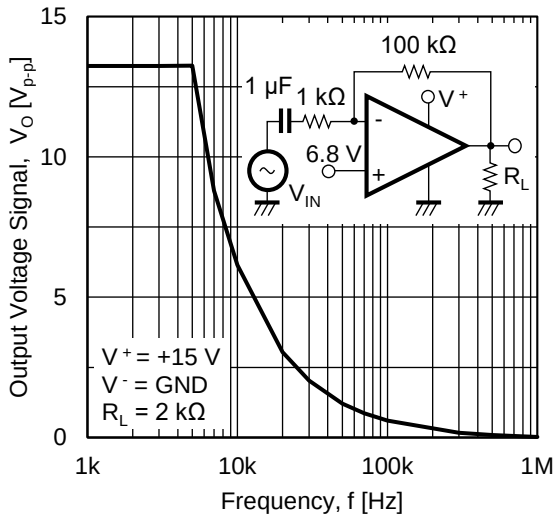
A_V vs. V^+



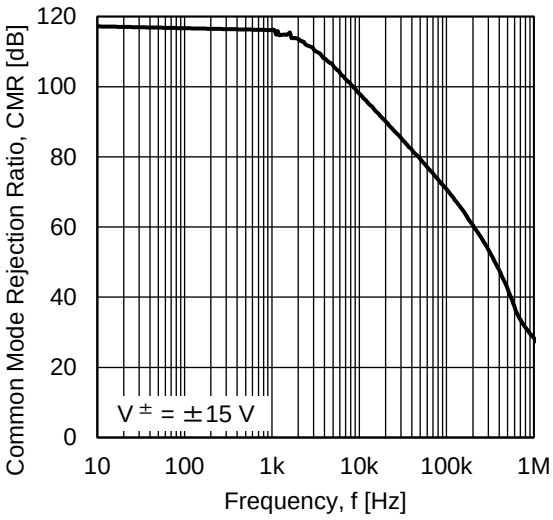
A_V, φ vs. f



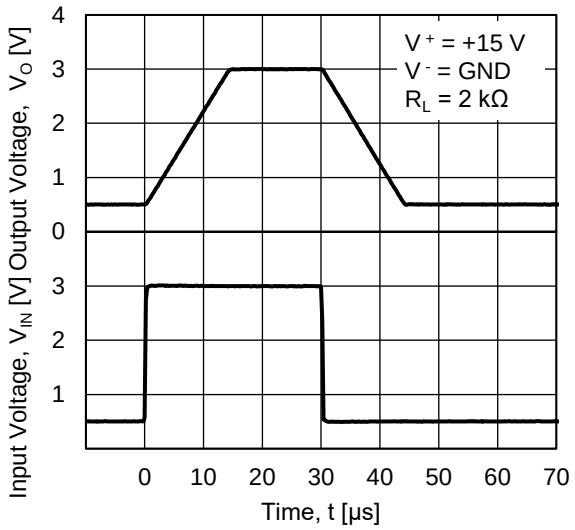
V_O vs. f



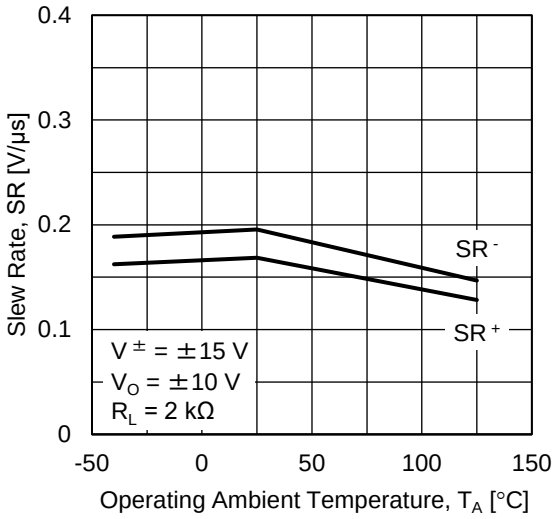
CMR vs. f



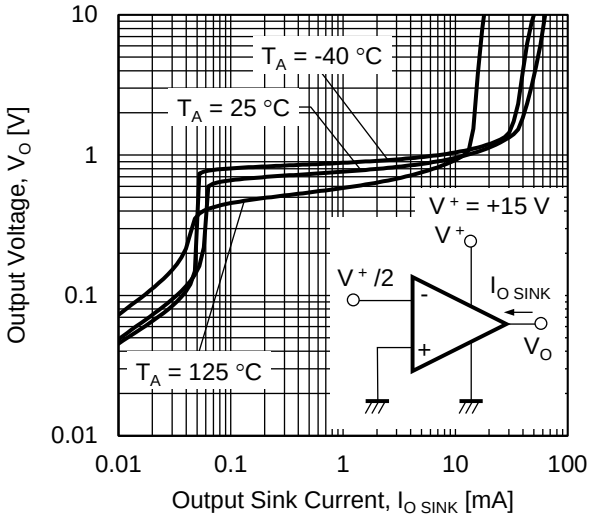
Pulse Response



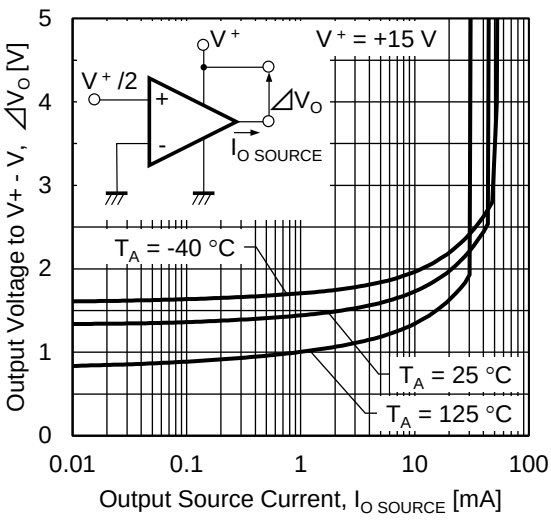
SR - T_A



V_O vs. $I_{O\ SINK}$



ΔV_O vs. $I_{O\ SOURCE}$

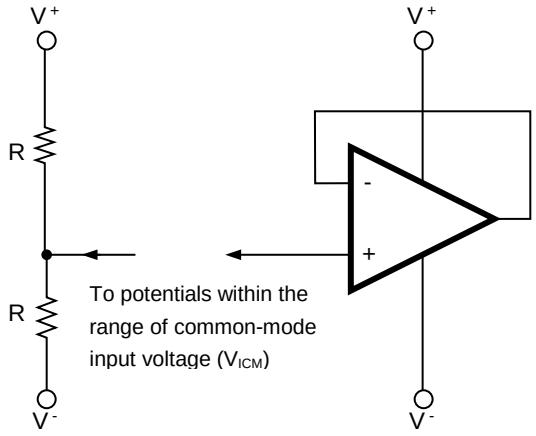


USE WITH PRECAUTIONS

- **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**

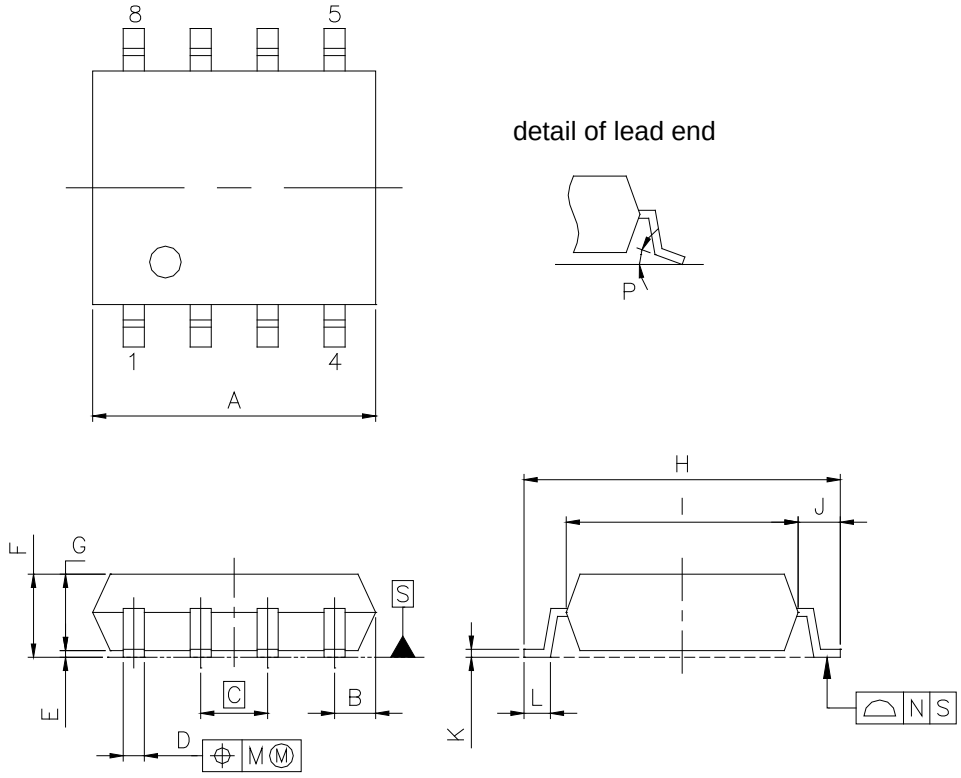
  When stress is added to the ICs due to warpage or bending of a board, the characteristic may fluctuates due to piezoelectric effect. Therefore, pay attention to warpage or bending of a board.

PACKAGE DRAWINGS

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

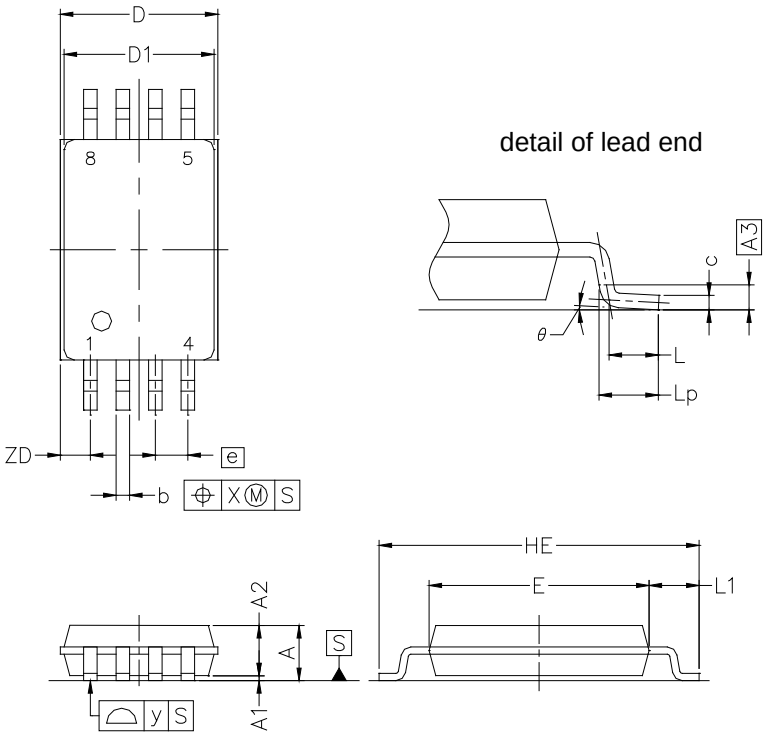
Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

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°

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



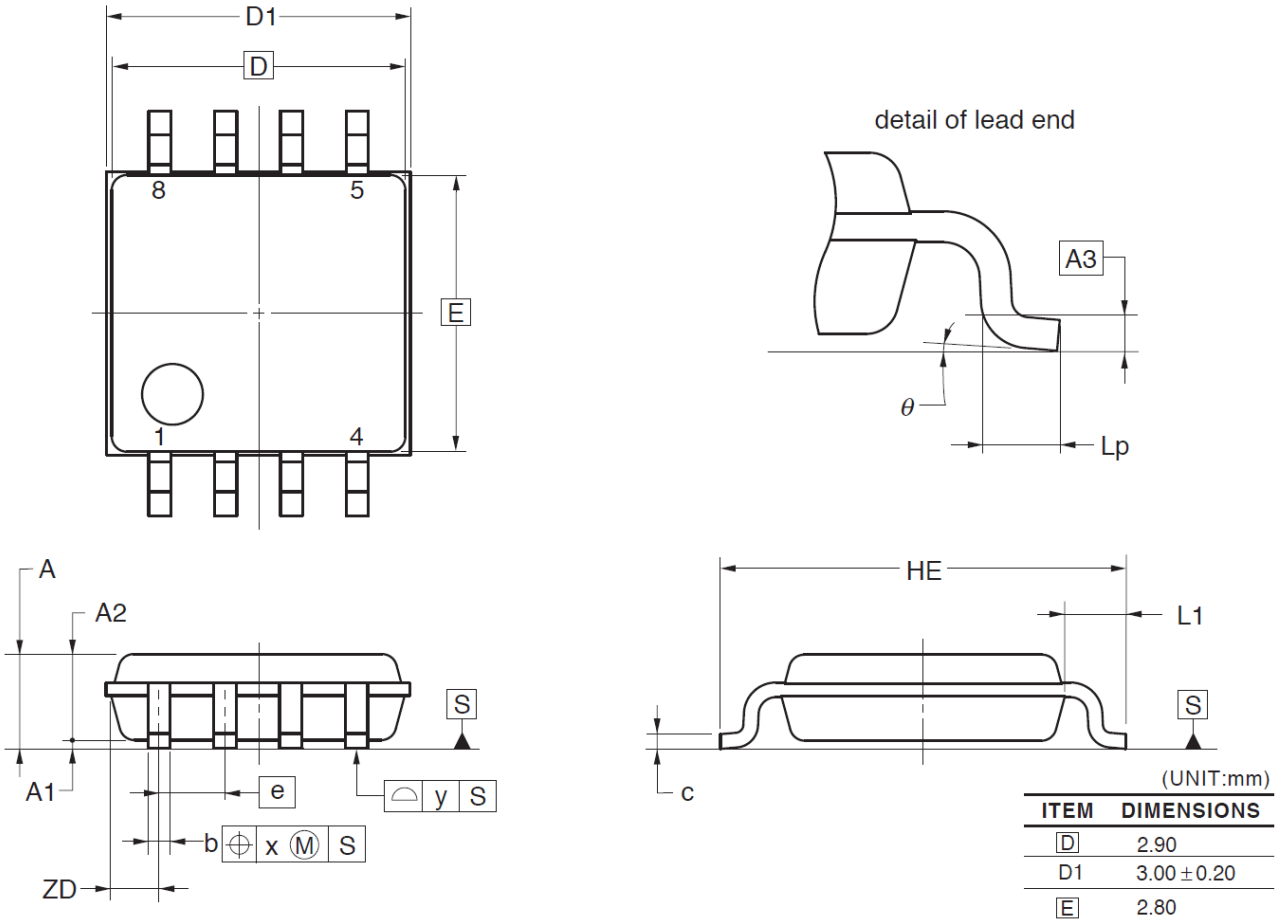
NOTE

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 +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	0.60

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



(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	$0.145^{+0.05}_{-0.03}$
Lp	0.37 ±0.10
x	0.10
y	0.10
θ	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$
ZD	0.525

NOTE

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

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