µPC1251A

Single Power Supply Dual Operational Amplifiers

R03DS0117EJ0100
Rev.1.00
2017.12.25

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.

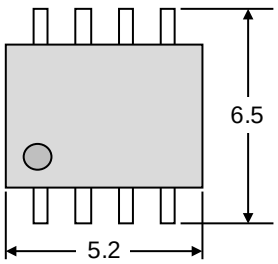
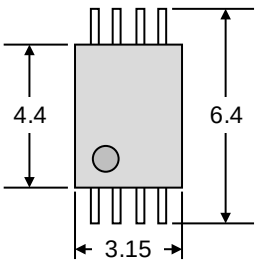
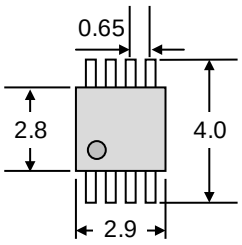
In addition, this amplifier supports both positive and negative power supply and can be used in various amplifier circuits.

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

Features

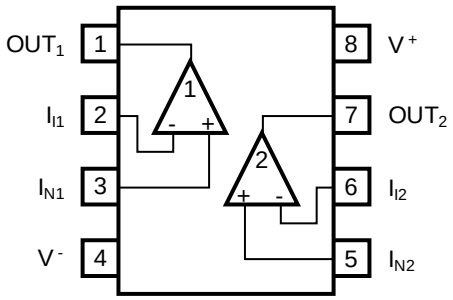
- AEC-Q100 Compliant
- Input Offset Voltage ±2 mV (TYP.)
- Input Offset Current ±5 nA (TYP.)
- Large Signal Voltage Gain 100000 (TYP.)
- Internal Frequency Compensation
- Output Short-Circuit Protection

Product Lineup

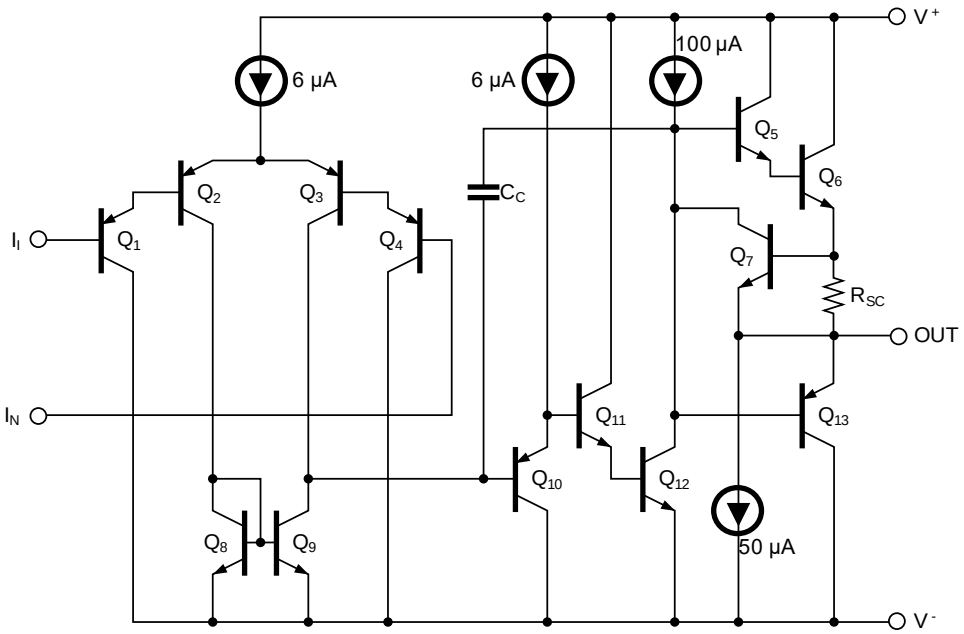
Package	Standard SOP	TSSOP	MSOP
Part Name	µPC1251AG2	µPC1251AGR	µPC1251AMP
Outline Comparison	Unit : mm 	Unit : mm 	Unit : mm 
(Mounting Area Ratio)	(100 %)	(60 %)	(34 %)

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version. Not all products and/or types are available in every country. Please check with Renesas Electronics sales representative for availability and additional information.

Pin Configuration (Marking side)



EQUIVALENT CIRCUIT (1/2 Circuit)



ABSOLUTE MAXIMUM RATINGS

(T_A = 25 °C)

Parameter	Symbol	Ratings	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 Note 3	V_O	V^- -0.3 ~ V^+ +0.3	V
Total Power Dissipation Note4	P_T	440	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 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 °C
(Junction − ambient thermal resistance $R_{th(J-A)}$ = 227°C/W)
μPC1251AGR : Derate at -5.5 mW/°C when T_A ＞ 69 °C
(Junction − ambient thermal resistance $R_{th(J-A)}$ = 183°C/W)
μPC1251AMP : Derate at -4.8 mW/°C when T_A ＞ 58 °C
(Junction − ambient thermal resistance $R_{th(J-A)}$ = 208°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)	$V^{\pm}$	±1.5		±15	V
Power Supply Voltage (V^- = GND)	V^+	+3		+30	V

ELECTRICAL CHARACTERISTICS

(T_A = 25 °C, V^+ = +5 V, V^- = GND)

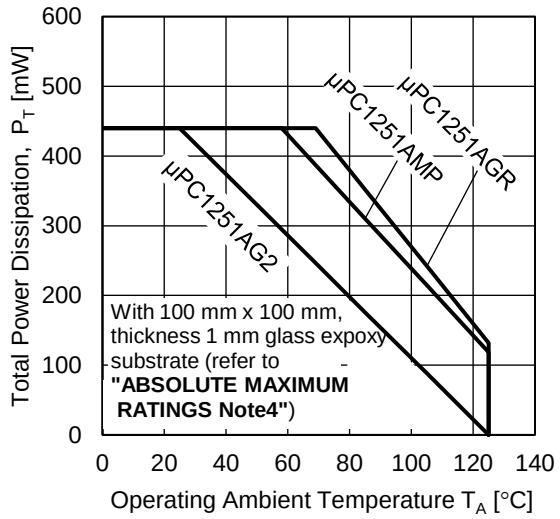
Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Condition
Input Offset Voltage	V_{IO}		±2	±7	mV	R_S = 0 Ω
Input Offset Current	I_{IO}		±5	±50	nA	
Input Bias Current Note 6	I_B		45	250	nA	
Large Signal Voltage Gain	A_V	25000	100000			R_L ≧ 2 kΩ
Circuit Current Note 7	I_{CC}		0.7	1.2	mA	R_L = ∞, I_O = 0 A
Common 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

【**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.

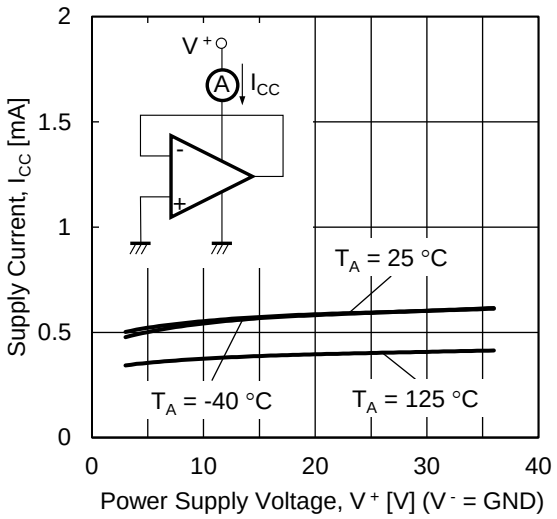
7. This is a current that flows in the internal circuit. This current will flow irrespective of the channel used.

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

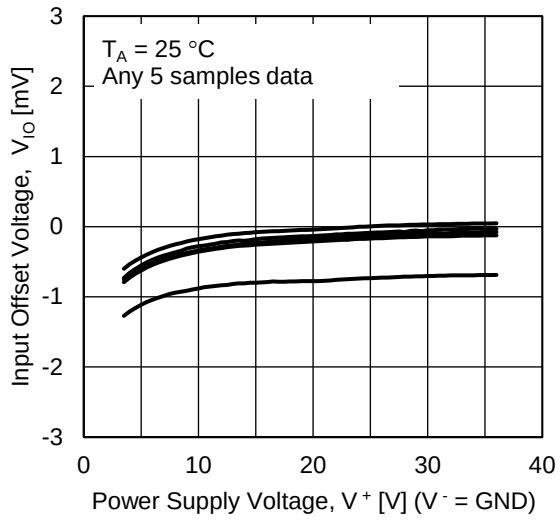
P_T vs. T_A



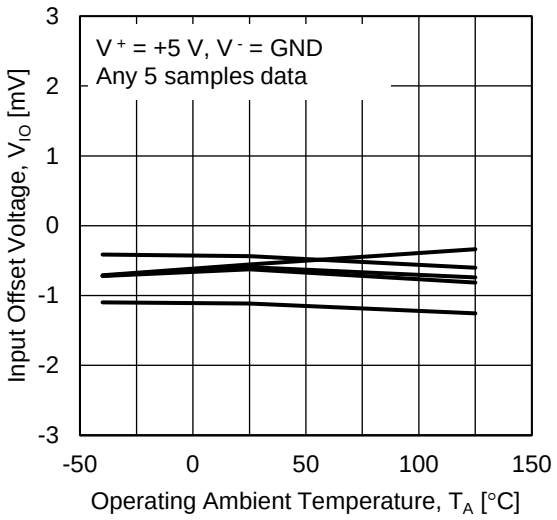
I_{CC} vs. V^+



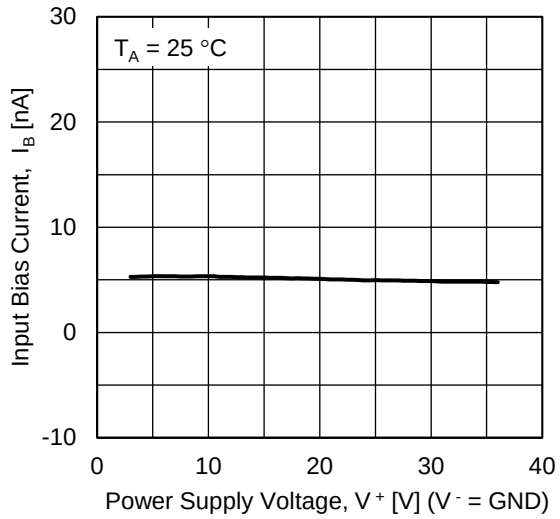
V_{IO} vs. V^+



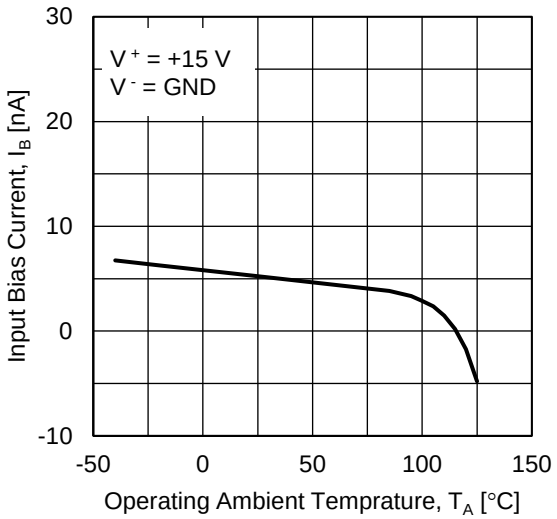
V_{IO} vs. T_A



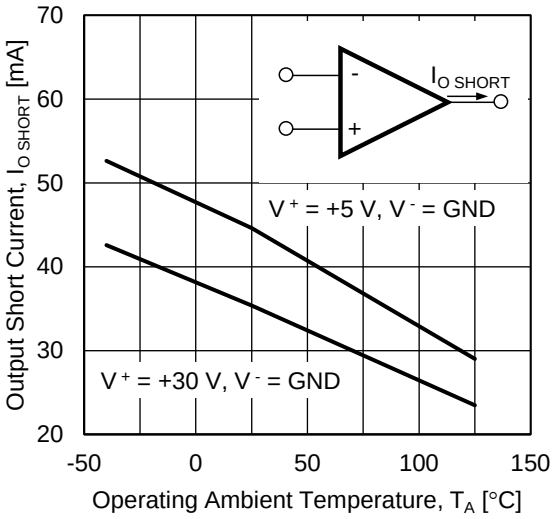
I_B vs. V^+



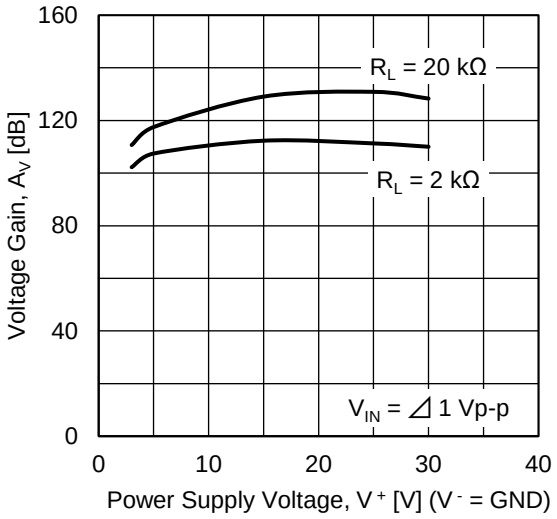
I_B vs. T_A



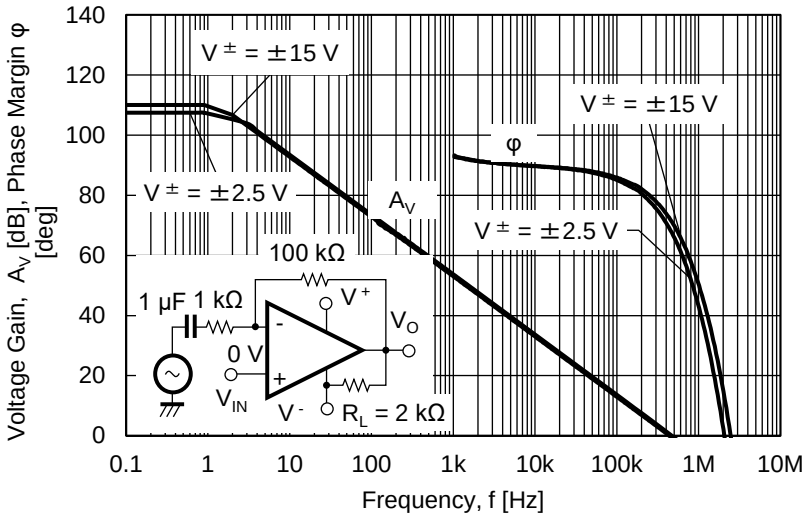
$I_{O\ SHORT}$ vs. T_A



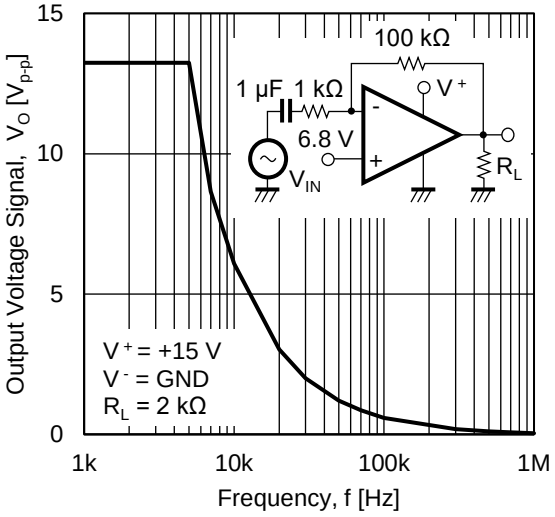
A_V vs. V^+



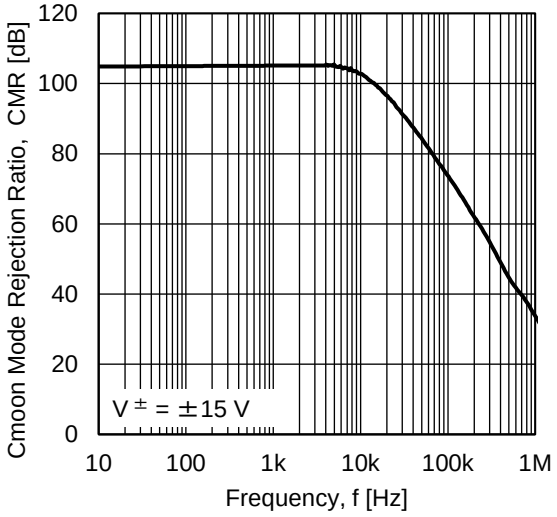
A_V, φ vs. f



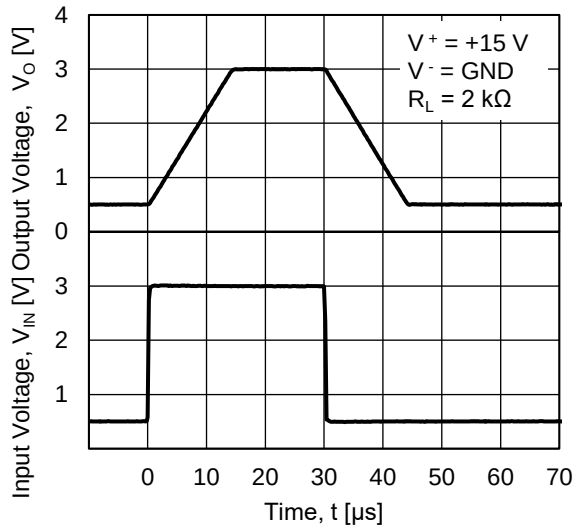
V_O vs. f



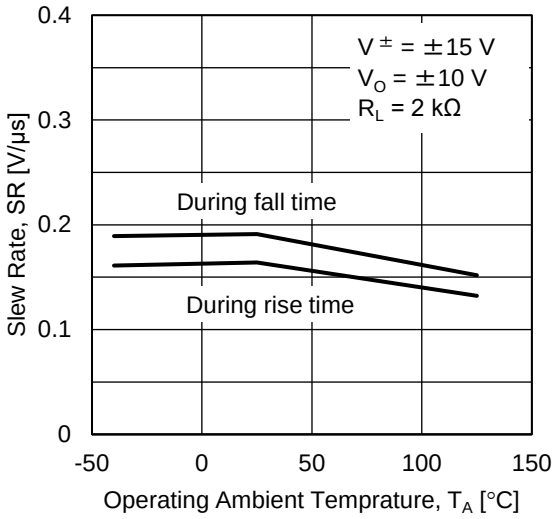
CMR vs. f



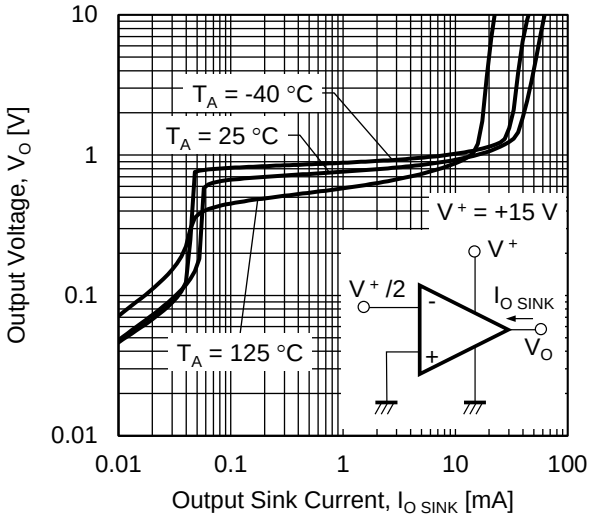
Pulse Response



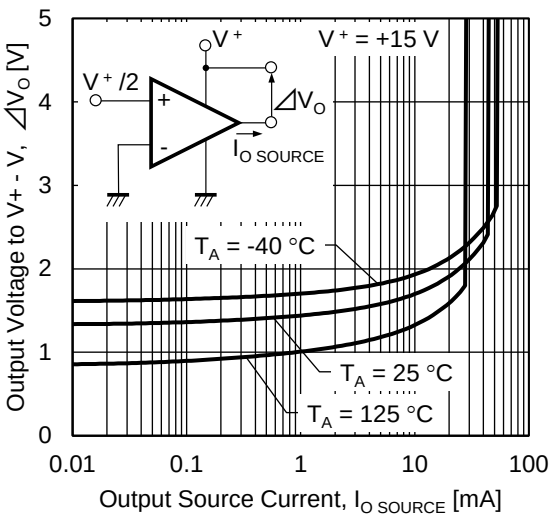
SR vs. T_A



V_O vs. $I_{O\ SINK}$



ΔV_O vs. $I_{O\ SOURCE}$

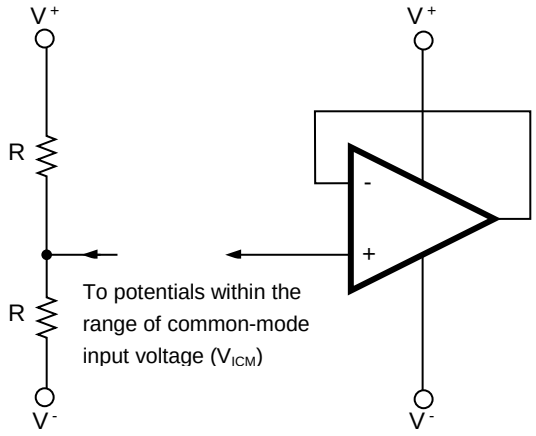


PRECAUTION

- **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).

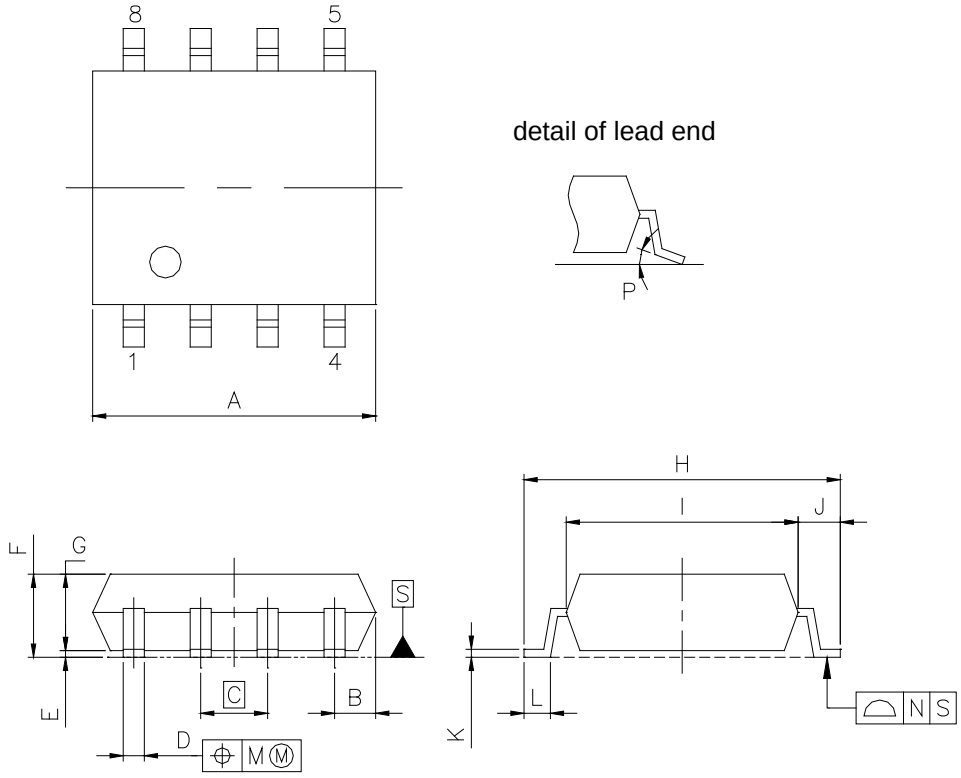
- **Handling of ICs**
  Warpage or bending of a PCB board will apply stress to the ICs, the characteristic may change due to piezoelectric effect. Therefore, pay attention to warpage or bending of the board.

PACKAGE DRAWINGS

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

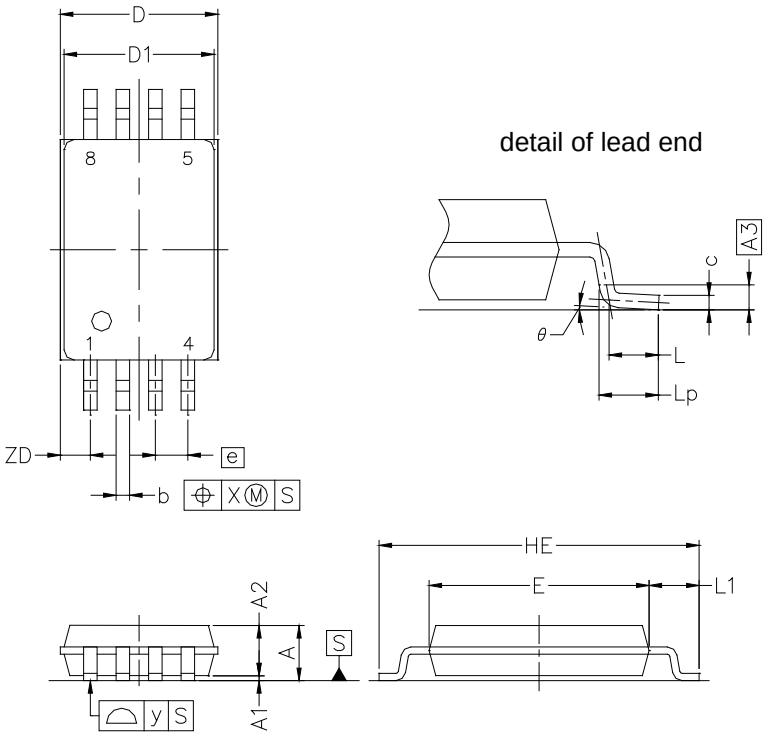
Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

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



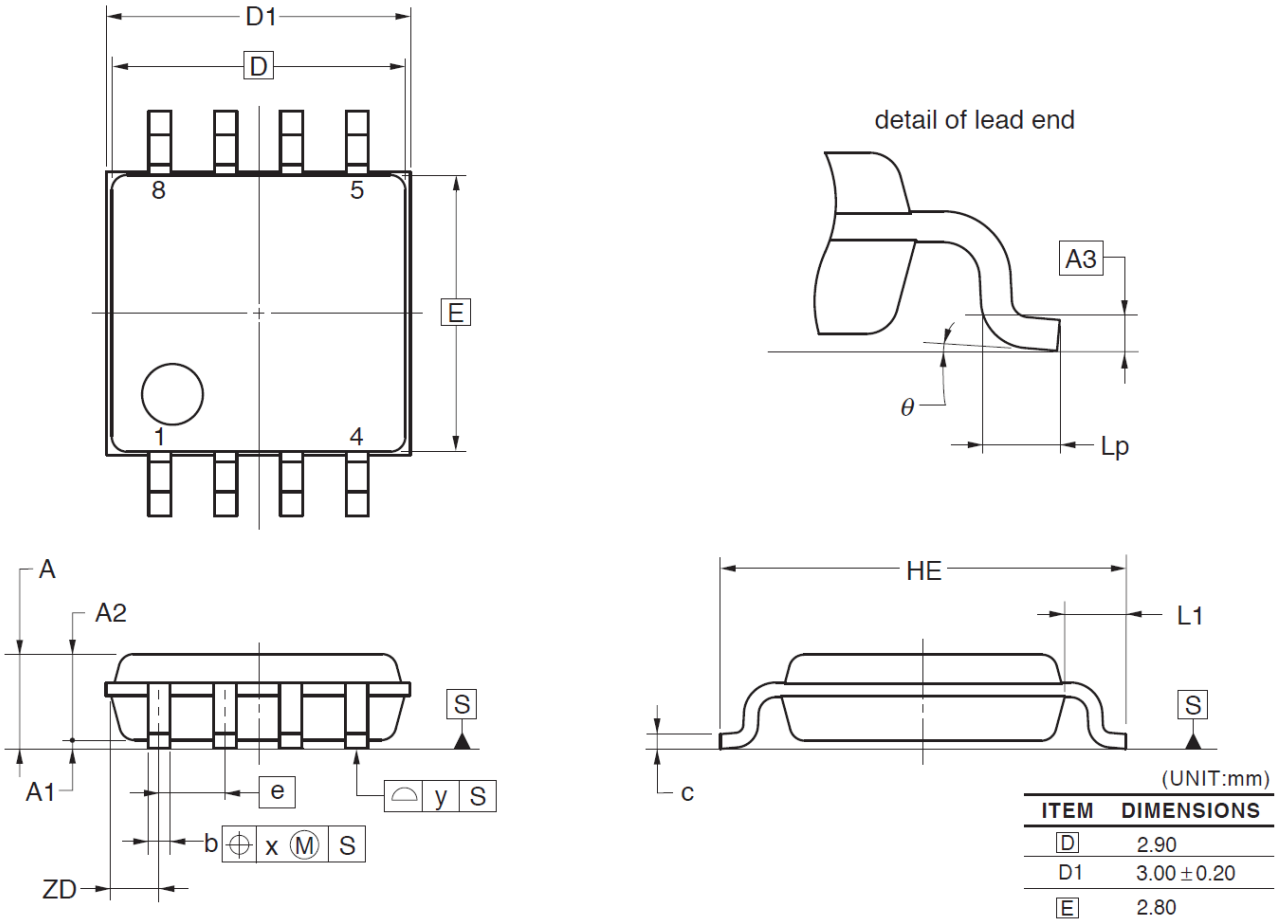
NOTE

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	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$
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.

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
5. Renesas Electronics products are classified according to the following two quality grades: “Standard” and “High Quality”. The intended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

   Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user’s manual or other Renesas Electronics document.
6. When using Renesas Electronics products, refer to the latest product information (data sheets, user’s manuals, application notes, “General Notes for Handling and Using Semiconductor Devices” in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)

RENESAS

SALES OFFICES Renesas Electronics Corporation http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338

Colophon 7.0