

UPC277G2, UPC393G2

Single Power Supply Dual Comparator

DESCRIPTION

UPC277, UPC393 are dual comparators designed to operate for a single power supply. The features include low-voltage operation, a common-mode input voltage that range from V^- (GND) level, an open collector output, and low current consumption. Furthermore, these products can operate on a split power supply and used widely for various voltage comparison application.

Depending on the usage and operating ambient temperature range, the UPC277 is design for communication industries and UPC393 is design for general purposes.

In addition, compatible DC parameter selection for the comparators also available.

Along with this series of lineup, the quad type comparators, UPC177 and UPC339 with the same circuit configuration are also available.

FEATURES

- Input Offset Voltage ± 2 mV (TYP.)
- Input Bias Current 25 nA (TYP.)
- Voltage Gain 200000 (TYP.)
- Pulse Response Time 1.3 μ s (TYP.)
- Output Sink Current 16 mA (TYP.)
- A wired OR is possible as the output is an open collector.
- Low Voltage Operation $V^+ - V^-$: 2 ~ 32 V

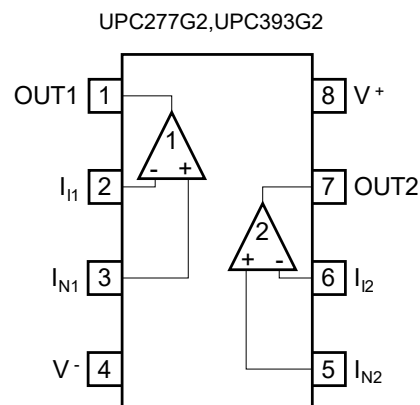
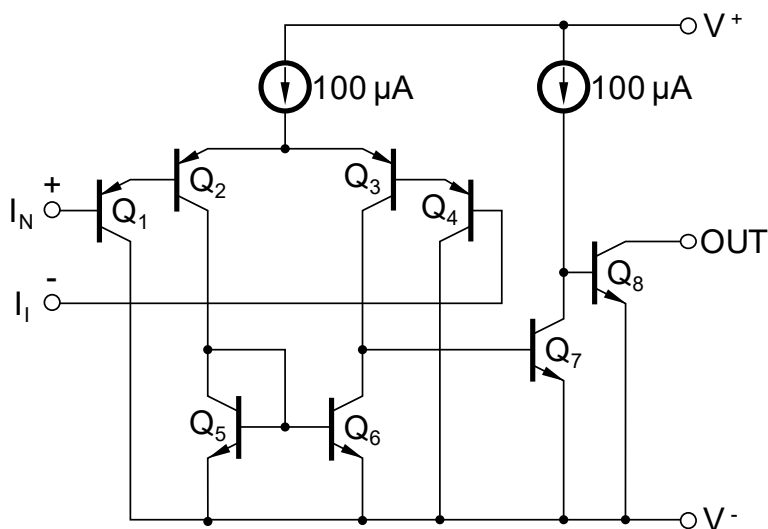
ORDERING INFORMATION

Order Name ⁽¹⁾	Selected Grade	Package
UPC277G2-AP	Standard	8-pin plastic SOP (5.72 mm (225))
UPC277G2(5)-AP	DC parameter selection	8-pin plastic SOP (5.72 mm (225))
UPC393G2-AP	Standard	8-pin plastic SOP (5.72 mm (225))
UPC393G2(5)-AP	DC parameter selection	8-pin plastic SOP (5.72 mm (225))

- (1) Order names containing E1 or E2 indicate that the packaging format is embossed taping.
Pin 1 of E1 is on draw-out side, and pin 1 of E2 is at take-up side.

EQUIVALENT CIRCUIT (1/2 CIRCUIT)

PIN CONFIGURATION (Marking side)

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

Parameter	Symbol	UPC277G2, UPC277G2(5)	UPC393G2, UPC393G2(5)	Unit
Power Supply Voltage ^{Note 1}	$V^+ - V^-$	-0.3 ~ +36		V
Differential Input Voltage	V_{ID}	± 36		V
Input Voltage ^{Note 2}	V_I	$V^- - 0.3 \sim V^- + 36$		V
Output Applied Voltage ^{Note 3}	V_O	$V^- - 0.3 \sim V^- + 36$		V
Total Power Dissipation ^{Note 4}	P_T	440		mW
Output Short Circuit Duration (vs. GND) ^{Note 5}	t_s	Indefinite		s
Operating Ambient Temperature	T_A	-40 ~ +85	-20 ~ +80	$^{\circ}\text{C}$
Storage Temperature	T_{stg}	-55 ~ +125		$^{\circ}\text{C}$

- 【Note】
- Note that reverse connections of the power supply may damage the ICs.
 - The allowable input voltage range without damaging or destructing the device. Independent to power supply voltage range.
Do not apply voltage of V^- (GND) - 0.3 V or less.
Note that the comparator will operate normally when the input voltage applied is within the common mode input voltage range.
 - The input voltage range that can be applied to the output pin externally without deteriorating or damaging the device characteristic. The permitted input voltage that can be applied regardless of the power supply voltage. This specification also includes precaution during transition state such as ON/OFF, etc.
 - Power dissipation value when $T_A \leq +25\text{ }^{\circ}\text{C}$. For $T_A > 25\text{ }^{\circ}\text{C}$, de-rate at $-4.4\text{ mW}/^{\circ}\text{C}$
 - Do not exceed the total power dissipation and de-rating rate in note 4.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Power Supply Voltage (Dual Supply)	$V^{\pm}$	± 1		± 16	V
Power Supply Voltage ($V^- = \text{GND}$)	V^+	+2		+32	V

ELECTRICAL CHARACTERISTICS

UPC277G2, UPC393G2 ($T_A = 25^\circ\text{C}$, $V^+ = +5\text{ V}$, $V^- = \text{GND}$)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Condition
Input Offset Voltage	V_{IO}		± 2	± 5	mV	$V_O = 1.4\text{ V}$, $V_{REF} = 1.4\text{ V}$, $R_S = 0\ \Omega$
Input Offset Current	I_{IO}		± 5	± 50	nA	$V_O \approx 1.4\text{ V}$
Input Bias Current ^{Note 6}	I_B		25	250	nA	$V_O \approx 1.4\text{ V}$
Large Signal Voltage Gain	A_v		200000			$R_L = 15\text{ k}\Omega$
Circuit Current ^{Note 7}	I_{CC}		0.6	1	mA	$R_L = \infty$, $I_O = 0\text{ A}$
Common Mode Input Voltage Range	V_{ICM}	0		$V^+ - 1.5$	V	
Output Saturation Voltage	V_{OL}		0.2	0.4	V	$V_{I(-)} = +1\text{ V}$, $V_{I(+)} = 0\text{ V}$, $I_{O\text{ SINK}} = 4\text{ mA}$
Output Sink Current	$I_{O\text{ SINK}}$	6	16		mA	$V_{I(-)} = +1\text{ V}$, $V_{I(+)} = 0\text{ V}$, $V_O \leq 1.5\text{ V}$
Output Leakage Current	$I_{O\text{ LEAK}}$		0.1		nA	$V_{I(+)} = +1\text{ V}$, $V_{I(-)} = 0\text{ V}$, $V_O = 5\text{ V}$
Pulse Response Time ^{Note 8}			1.3		μs	$R_L = 5.1\text{ k}\Omega$, $V_{RL} = 5\text{ V}$

UPC277G2(5), UPC393G2(5) ($T_A = 25^\circ\text{C}$, $V^+ = +5\text{ V}$, $V^- = \text{GND}$)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Test Condition
Input Offset Voltage	V_{IO}		± 2	± 2.5	mV	$V_O = 1.4\text{ V}$, $V_{REF} = 1.4\text{ V}$, $R_S = 0\ \Omega$
Input Offset Current	I_{IO}		± 5	± 50	nA	$V_O \approx 1.4\text{ V}$
Input Bias Current ^{Note 6}	I_B		25	60	nA	$V_O \approx 1.4\text{ V}$
Large Signal Voltage Gain	A_v		200000			$R_L = 15\text{ k}\Omega$
Circuit Current ^{Note 7}	I_{CC}		0.6	0.8	mA	$R_L = \infty$, $I_O = 0\text{ A}$
Common Mode Input Voltage Range	V_{ICM}	0		$V^+ - 1.4$	V	
Output Saturation Voltage	V_{OL1}			0.2	V	$V_{I(-)} = +1\text{ V}$, $V_{I(+)} = 0\text{ V}$, $I_{O\text{ SINK}} = 4\text{ mA}$
	V_{OL2}			1.5	V	$V_{I(-)} = +1\text{ V}$, $V_{I(+)} = 0\text{ V}$, $I_{O\text{ SINK}} = 10\text{ mA}$
Output Sink Current	$I_{O\text{ SINK}}$	10	16		mA	$V_{I(-)} = +1\text{ V}$, $V_{I(+)} = 0\text{ V}$, $V_O \leq 1.5\text{ V}$
Output Leakage Current	$I_{O\text{ LEAK}}$		0.1	100	nA	$V_{I(+)} = +1\text{ V}$, $V_{I(-)} = 0\text{ V}$, $V_O = 5\text{ V}$
Response Time ^{Note 8}			1.3		μs	$R_L = 5.1\text{ k}\Omega$, $V_{RL} = 5\text{ V}$

【Note】 6. The current flow direction of the input bias is out from the IC because the first stage of the IC composed of PNP transistor.

The current value is the value when the differential amplified circuit of the input stage is balanced.

When the comparator is active, twice the amount of current will flow to the pin with lower potential.

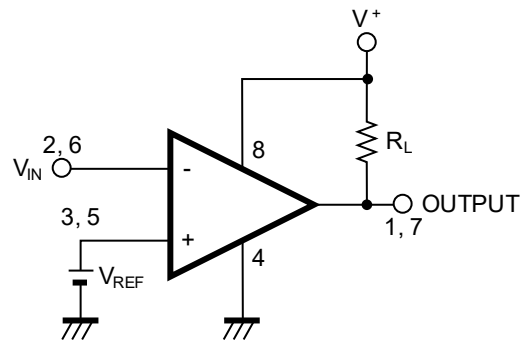
7. Current flowing through the internal circuit. This current flow regardless of the channel used.

8. Values when the input amplitude is 100 mV and the overdrive is 5 mV.

Increasing the overdrive can shorten the response time.

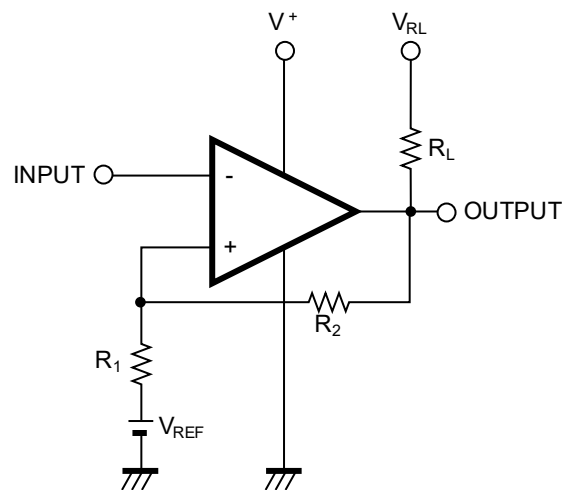
TYPICAL APPLICATION CIRCUIT EXAMPLE

EXAMPLE 1



$$V_{REF} : V^- \sim V^+ - 1.5 [V]$$

EXAMPLE 2 (With Hysteresis)

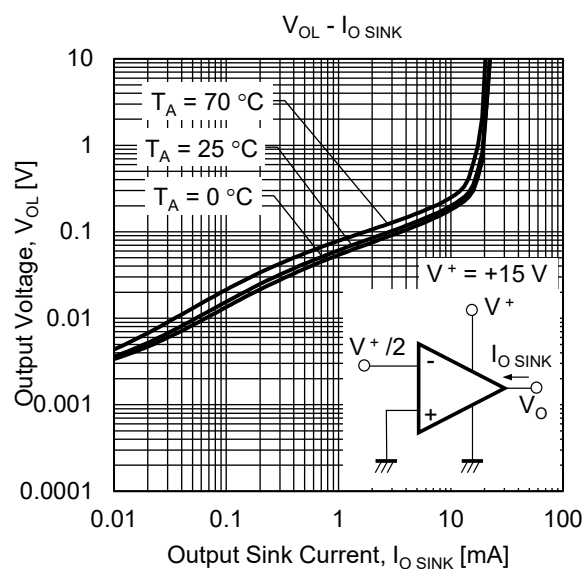
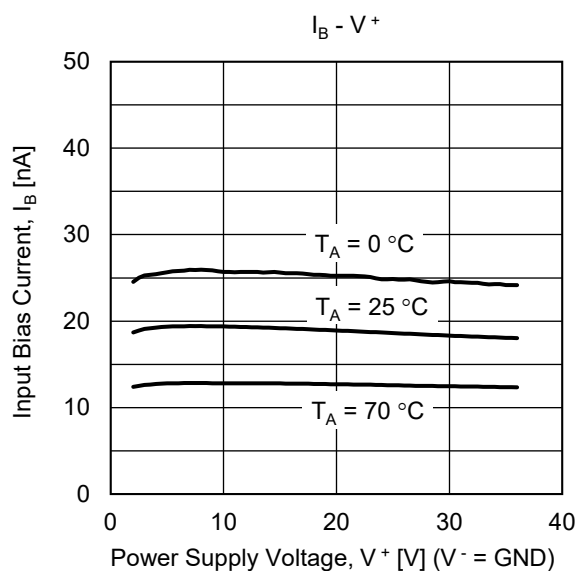
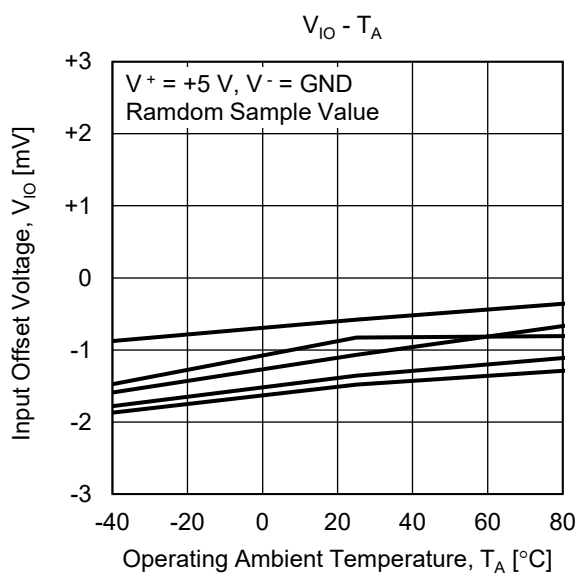
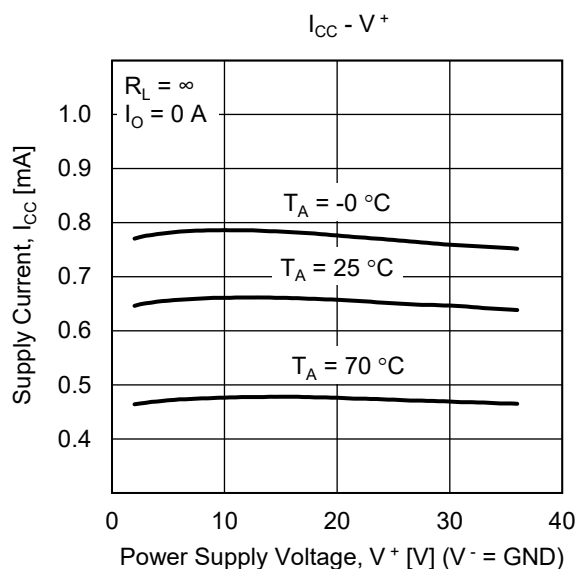
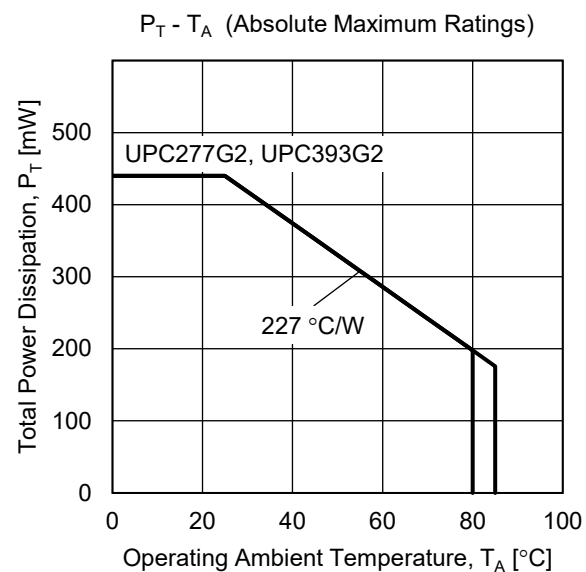


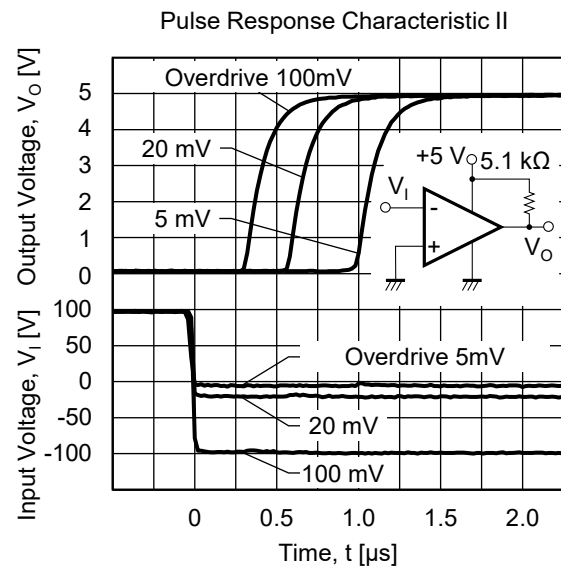
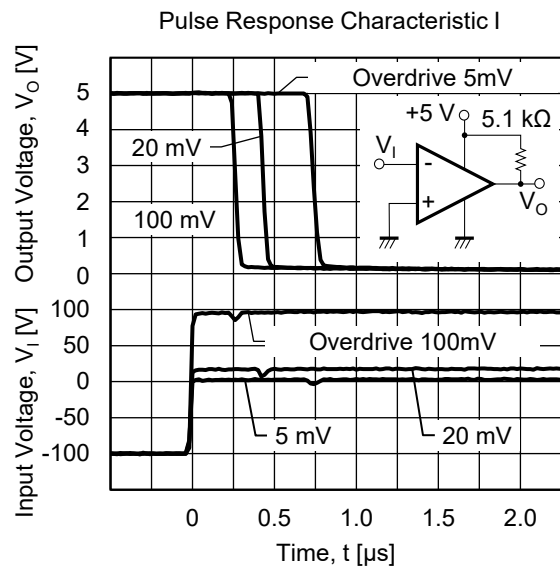
- Threshold Voltage

$$V_{TH (High)} \doteq V_{REF} + \frac{R_1}{R_L + R_2 + R_1} (V_{RL} - V_{REF})$$

$$V_{TH (Low)} \doteq V_{REF} - \frac{R_1}{R_1 + R_2} (V_{REF} - V_{OL})$$

$$(V_{RL} > V_{REF} > V_{OL})$$

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

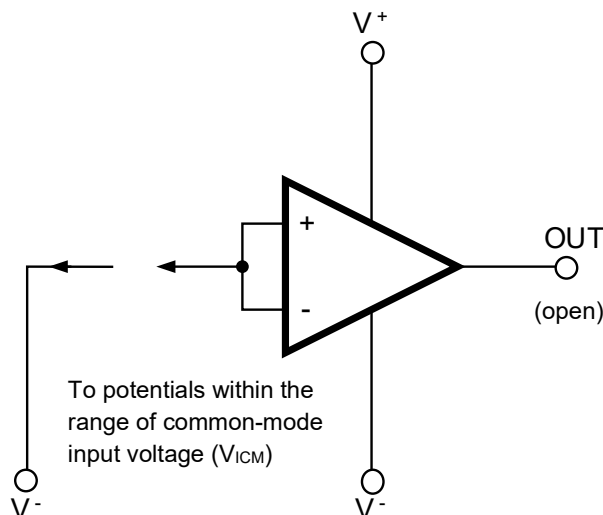


USE WITH PRECAUTIONS

• Managing unused circuits

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

Process example of unused circuits



• 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 clamping 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.

$$V_{ICM} \text{ (TYP.): } V^- \sim V^+ - 1.5 \text{ [V] (} T_A = 25 \text{ } ^\circ\text{C)}$$

During designing, do include some tolerance by considering temperature characteristics etc.

• Range of input current

The "Input Bias Current [I_B]" specified in the electric characteristic table, is the average current value flowing to the +input pin [I_N] and the - input pin [I_I] when the operation amplifier input stage are balanced (in a state where negative feedback is applied).

When the comparator is active, the input stage of the differential amplified circuit will not be balance during comparison, the amount of input current flow is twice the amount to the pin with lower potential.

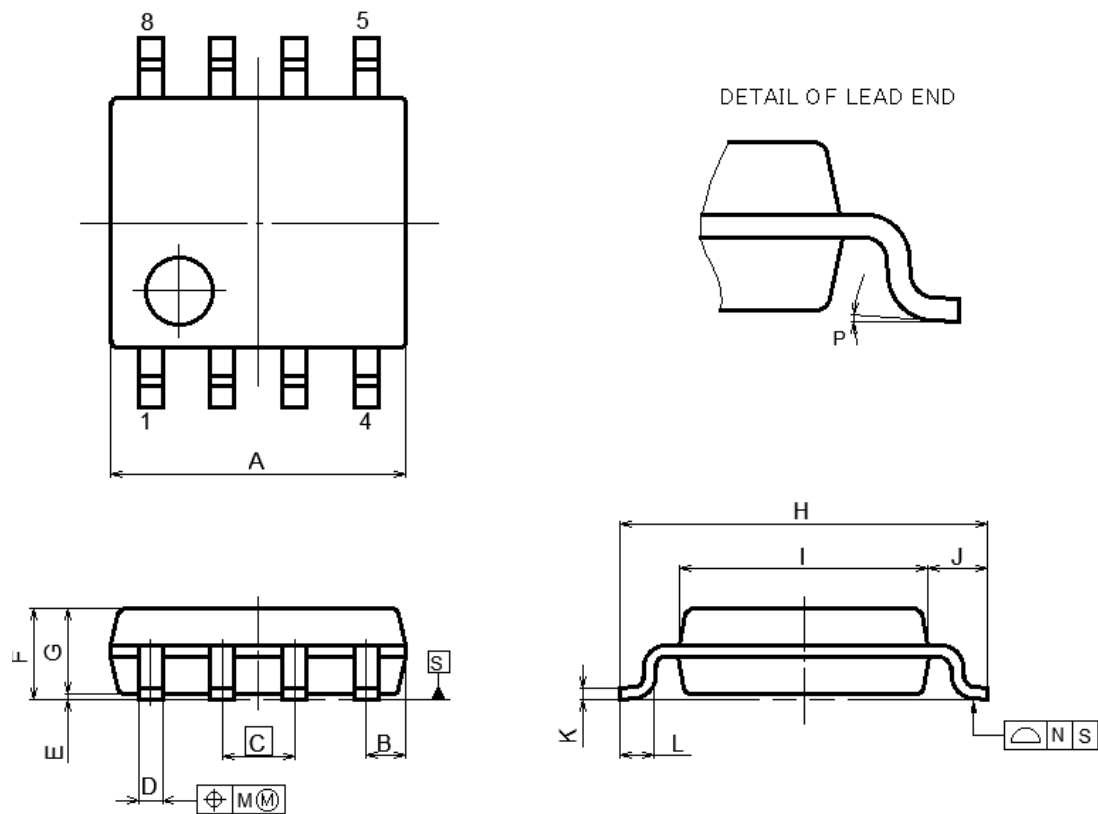
• Handling of ICs

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	MASS (TYP.) [g]
P-LSOP8-4.4×5.2-1.27	PLSP0008DE-A	0.09[g]



NOTE

EACH LEAD CENTERLINE IS LOCATED WITHIN 0.12 MM OF ITS TRUE POSITION(T.P.) AT MAXIMUM MATERIAL CONDITION.

(UNIT:mm)

ITEM	DIMENSIONS
A	5.2±0.17
B	0.78MAX
C	1.27(T.P)
D	0.40±0.05
E	0.1±0.1
F	1.59±0.21
G	1.49
H	6.5±0.3
I	4.4±0.1
J	1.05±0.15
K	0.2±0.07
L	0.6±0.20
M	0.1MAX
N	0.1MAX
P	4°±4°

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 be responsible for determining what licenses are required from any third parties, and obtaining such licenses for the lawful import, export, manufacture, sales, utilization, distribution or other disposal of any products incorporating Renesas Electronics products, if required.
5. 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.
6. 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.

7. No semiconductor product is absolutely secure. Notwithstanding any security measures or features that may be implemented in Renesas Electronics hardware or software products, Renesas Electronics shall have absolutely no liability arising out of any vulnerability or security breach, including but not limited to any unauthorized access to or use of a Renesas Electronics product or a system that uses a Renesas Electronics product. RENESAS ELECTRONICS DOES NOT WARRANT OR GUARANTEE THAT RENESAS ELECTRONICS PRODUCTS, OR ANY SYSTEMS CREATED USING RENESAS ELECTRONICS PRODUCTS WILL BE INVULNERABLE OR FREE FROM CORRUPTION, ATTACK, VIRUSES, INTERFERENCE, HACKING, DATA LOSS OR THEFT, OR OTHER SECURITY INTRUSION ("Vulnerability Issues"). RENESAS ELECTRONICS DISCLAIMS ANY AND ALL RESPONSIBILITY OR LIABILITY ARISING FROM OR RELATED TO ANY VULNERABILITY ISSUES. FURTHERMORE, TO THE EXTENT PERMITTED BY APPLICABLE LAW, RENESAS ELECTRONICS DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THIS DOCUMENT AND ANY RELATED OR ACCOMPANYING SOFTWARE OR HARDWARE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE.
8. 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.
9. 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.
10. 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.
11. 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.
12. 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.
13. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
14. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.5.0-1 October 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

Contact information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/