µPC277GR, 277MP, 393GR

Small Package Single Power Supply Dual Comparator

R03DS0141EJ0100
Rev.1.00
2019.1.17

DESCRIPTION

µPC277GR-9LG, µPC277MP-KAA, µPC393GR-9LG are dual comparators designed to operate under single power supply. Features include low-voltage operation, common-mode input voltage range from V− (GND) level, 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.

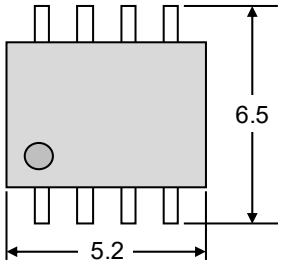
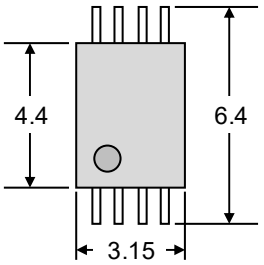
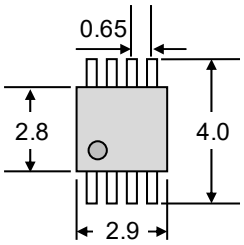
Depending on the usage and operating ambient temperature range, the µPC277GR-9LG, µPC277MP-KAA are designed for extended temperature and suited for wide operating ambient temperature application, while µPC393GR-9LG are designed for general purposes application.

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

Along with this series of lineup, the quad type comparators, µPC177GR-9LG and µPC339GR-9LG with the same circuit configuration are also available.

FEATURES

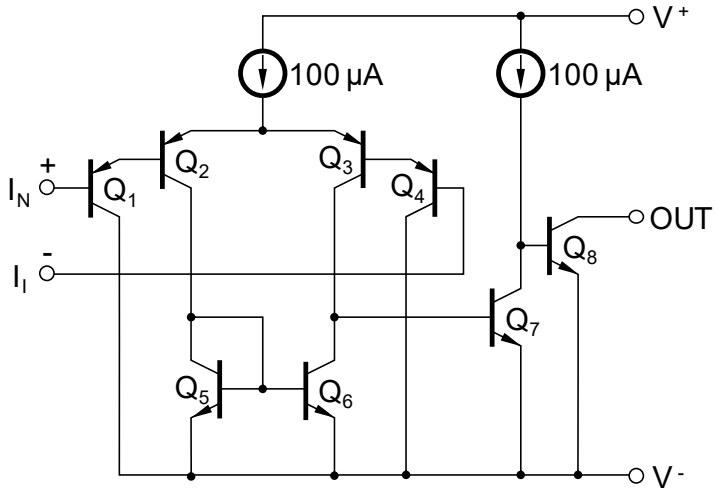
- Input Offset Voltage ±2 mV (TYP.)
- Input Bias Current 17 nA (TYP.)
- Voltage Gain 200000 (TYP.)
- Pulse Response Time 1.8 µs (TYP.)
- Output Sink Current 16 mA (TYP.)
- A wired OR is possible as the output is an open collector.
- Low Voltage Operation $V^+ - V^-$: +2 ~ +32 V
- Small Package (The mounting area is reduced by 40% or 66% compared to conventional 8-pin plastic SOP, as shown in the table below)

Package	Standard SOP	TSSOP	MSOP (2.8 × 2.9)
Part Number	µPC277G2, µPC393G2	µPC277GR-9LG, µPC393GR-9LG	µPC277MP-KAA
Outline Comparison	Unit : mm 	Unit : mm 	Unit : mm 
(Mounting Area Ratio)	(100 %)	(60 %)	(34 %)

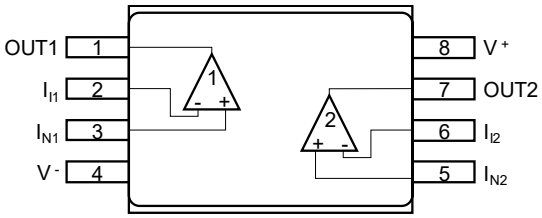
ODERING INFORMATION

Order Name	Selected Grade	Package
µPC277GR-9LG-A	Standard	8-pin plastic TSSOP (5.72 mm (225))
µPC277GR(5)-9LG-A	DC parameter selection	8-pin plastic TSSOP (5.72 mm (225))
µPC277MP-KAA-A	Standard	8-pin plastic TSSOP (2.8 × 2.9)
µPC277MP(5)-KAA-A	DC parameter selection	8-pin plastic TSSOP (2.8 × 2.9)
µPC393GR-9LG-A	Standard	8-pin plastic TSSOP (5.72 mm (225))
µPC393GR(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	µPC277GR-9LG µPC277GR(5)-9LG	µPC277MP-KAA µPC277MP(5)-KAA	µPC393GR-9LG µPC393GR(5) -9LG	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 ~ V^- +36			V
Output Applied Voltage Note 3	V_O	V^- -0.3 ~ 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 ~ +125		-40 ~ +85	°C
Storage Temperature	T_{stg}	-55 ~ +150		-55 ~ +125	°C

【Note】

1. Note that reverse connections of the power supply may damage the ICs.
2. 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.
3. 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.
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 de-rating ratio depending on the operating ambient temperature.
   µPC277GR-9LG : De-rate -5.5 mW/°C when T_A ＞ 69 °C.
   (Junction − ambient thermal resistance $R_{th(J-A)}$ = 183 °C/W)
   µPC277MP-KAA : De-rate -4.8 mW/°C when T_A ＞ 58 °C.
   (Junction − ambient thermal resistance $R_{th(J-A)}$ = 208 °C/W)
   µPC393GR-9LG : De-rate -5.5 mW/°C when T_A ＞ 44 °C.
   (Junction − ambient thermal resistance $R_{th(J-A)}$ = 183 °C/W)
5. Short circuit at the V + side may destroy the IC. Please use the total loss and the de-rating factor of 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^- = GND)	V^+	+2		+32	V

ELECTRICAL CHARACTERISTICS

μPC277GR-9LG, μPC277MP-KAA, μPC393GR-9LG (T_A = 25 °C, V^+ = +5 V, V^- = GND)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Input Offset Voltage	V_{IO}		±2	±5	mV	V_O = 1.4 V, V_{REF} = 1.4 V, R_S = 0 Ω
Input Offset Current	I_{IO}		±5	±50	nA	V_O = 1.4 V
Input Bias Current Note 6	I_B		17	250	nA	V_O = 1.4 V
Large Signal Voltage Gain	A_V		200000			R_L = 15 kΩ
Circuit Current Note 7	I_{CC}		0.6	1	mA	R_L = ∞, I_O = 0 A
Common Mode Input Voltage Range	V_{ICM}	0		V^+ -1.5	V	
Output Saturation Voltage	V_{OL}		0.2	0.4	V	$V_{IN(-)}$ = +1 V, $V_{IN(+)}$ = 0 V, $I_{O\ SINK}$ = 4 mA
Output Sink Current	$I_{O\ SINK}$	6	16		mA	$V_{IN(-)}$ = +1 V, $V_{IN(+)}$ = 0 V, V_O ≦ 1.5 V
Output Leakage Current	$I_{O\ LEAK}$		0.1		nA	$V_{IN(+)}$ = +1 V, $V_{IN(-)}$ = 0 V, V_O = 5 V
Pulse Response Time Note 8			1.8		μs	R_L = 5.1 kΩ, V_{RL} = 5 V

μPC277GR(5)-9LG, μPC277MP(5)-KAA, μPC393GR(5)-9LG (T_A = 25 °C, V^+ = +5 V, V^- = GND)

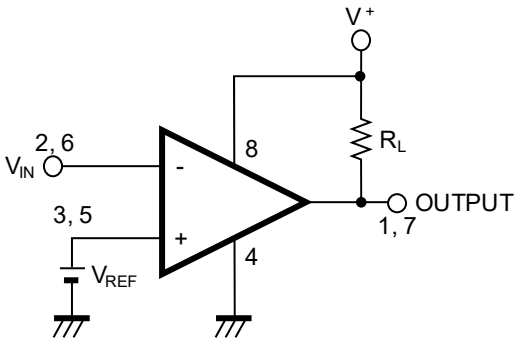
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Input Offset Voltage	V_{IO}		±2	±2.5	mV	V_O = 1.4 V, V_{REF} = 1.4 V, R_S = 0 Ω
Input Offset Current	I_{IO}		±5	±50	nA	V_O = 1.4 V
Input Bias Current Note 6	I_B		17	60	nA	V_O = 1.4 V
Large Signal Voltage Gain	A_V		200000			R_L = 15 kΩ
Circuit Current Note 7	I_{CC}		0.6	0.8	mA	R_L = ∞, I_O = 0 A
Common Mode Input Voltage Range	V_{ICM}	0		V^+ -1.4	V	
Output Saturation Voltage	V_{OL1}			0.2	V	$V_{IN(-)}$ = +1 V, $V_{IN(+)}$ = 0 V, $I_{O\ SINK}$ = 4 mA
	V_{OL2}			1.5	V	$V_{IN(-)}$ = +1 V, $V_{IN(+)}$ = 0 V, $I_{O\ SINK}$ = 10 mA
Output Sink Current	$I_{O\ SINK}$	10	16		mA	$V_{IN(-)}$ = +1 V, $V_{IN(+)}$ = 0 V, V_O ≦ 1.5 V
Output Leakage Current	$I_{O\ LEAK}$		0.1	100	nA	$V_{IN(+)}$ = +1 V, $V_{IN(-)}$ = 0 V, V_O = 5 V
Pulse Response Time Note8			1.8		μs	R_L = 5.1 kΩ, V_{RL} = 5 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.。

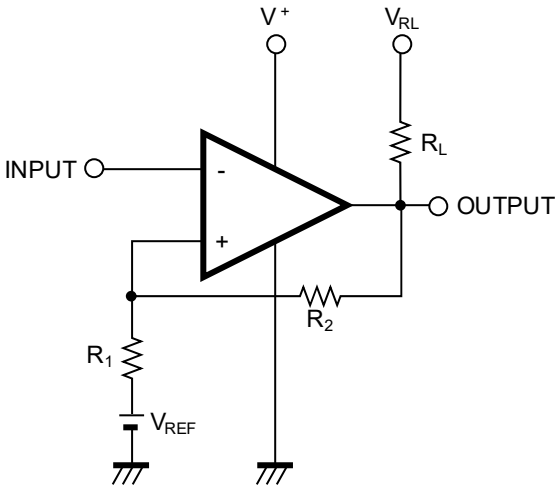
8. Values when the input amplitude is 100 mV and the overdrive is 5 mV.
Increasing the overdrive can shorten the response time.

TYPICAL APPLICATION EXAMPLE



V_{REF} : V^- ~ V^+ -1.5 [V]

Comparator with hysteresis



- Threshold Voltage

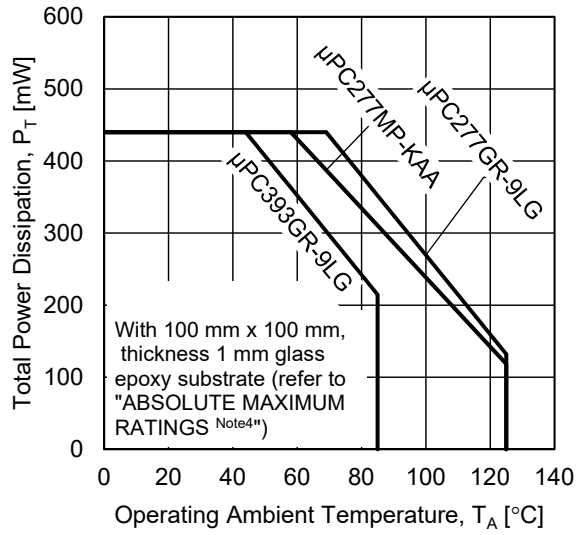
$$V_{TH\ (High)} \fallingdotseq V_{REF} + \frac{R_1}{R_L + R_2 + R_1}(V_{RL} - V_{REF})$$

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

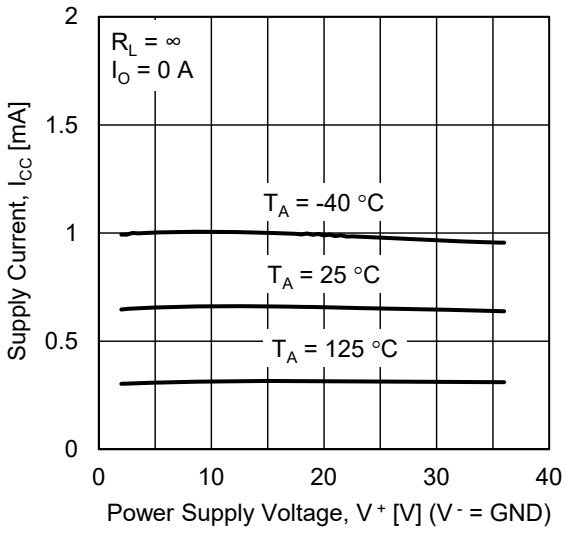
($V_{RL} > V_{REF} > V_{OL}$)

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

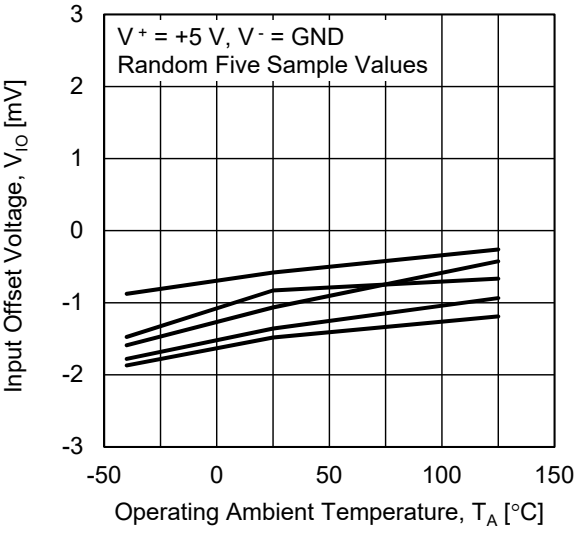
P_T vs. T_A



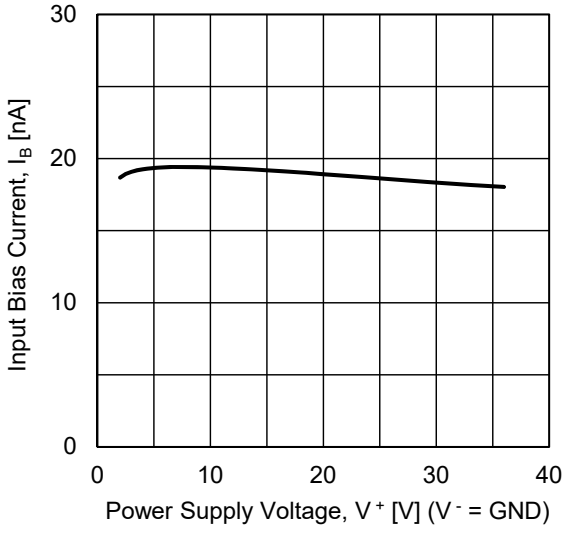
I_{CC} vs. V^+



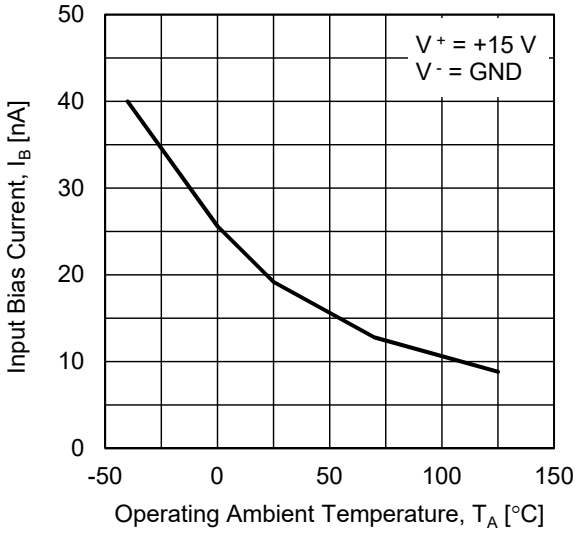
V_{IO} vs. T_A



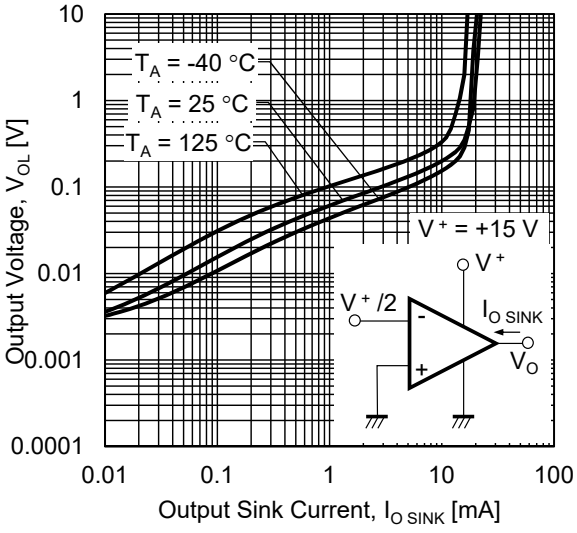
I_B vs. V^+



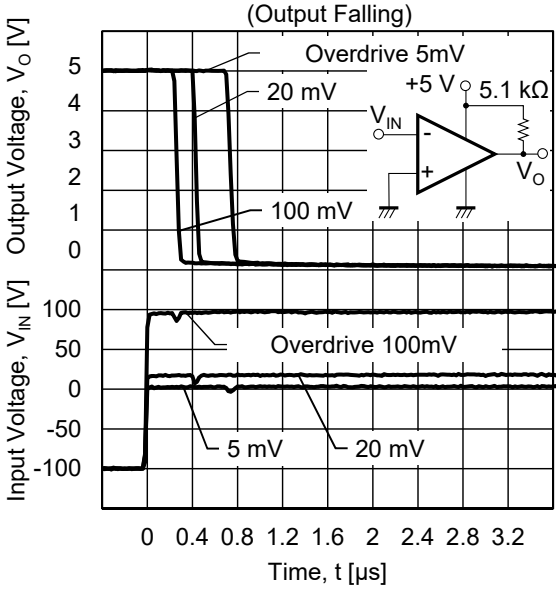
I_B vs. T_A



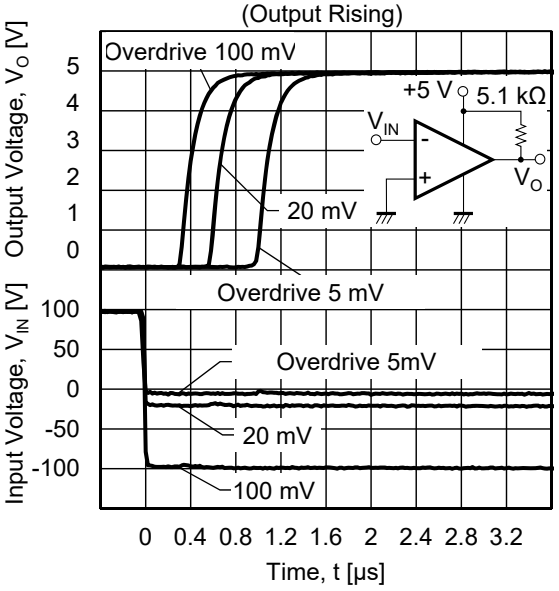
V_{OL} vs. $I_{O\ SINK}$



Pulse Response Characteristic I
(Output Falling)



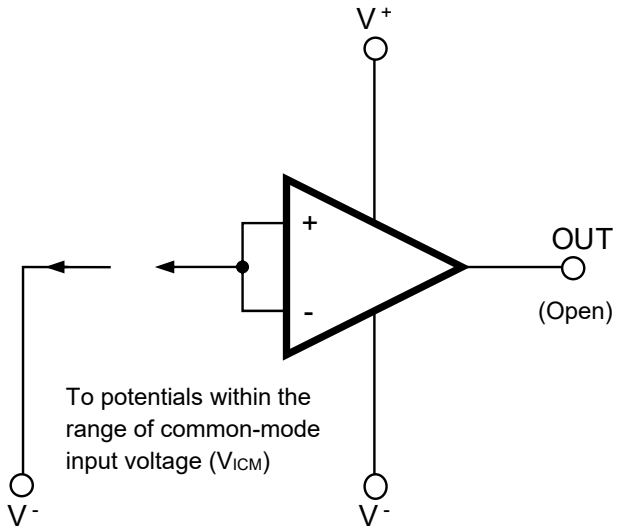
Pulse Response Characteristic II
(Output Rising)



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} (TYP.) : V^- ~ V^+ -1.5 [V] (T_A = 25 °C)

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

- **Range of input current**
  The Input Bias Current [IB] specified in the electrical characteristics table, is the average value of current flowing through the +input terminal [IN] and the current flowing through the –input terminal [II} in the balanced state of the differential amplifier circuit of the input stage (with negative feedback).
  Therefore, since the differential amplifier circuit of the input stage is not balanced during comparison operation (in the case of comparator operation), the input current flows twice as much towards the low potential terminal.

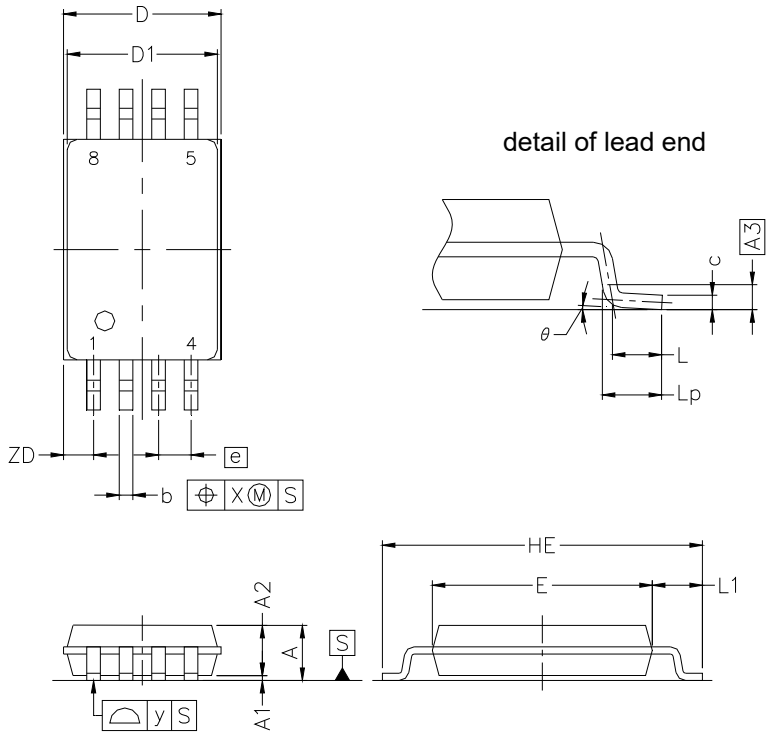
- **Handling of ICs**
  When stress is added to the ICs due to warpage or bending of a board, the characteristic may fluctuates due to piezoelectric (piezo) effect. Therefore, pay attention to warpage or bending of a board.

PACKAGE DRAWINGS

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



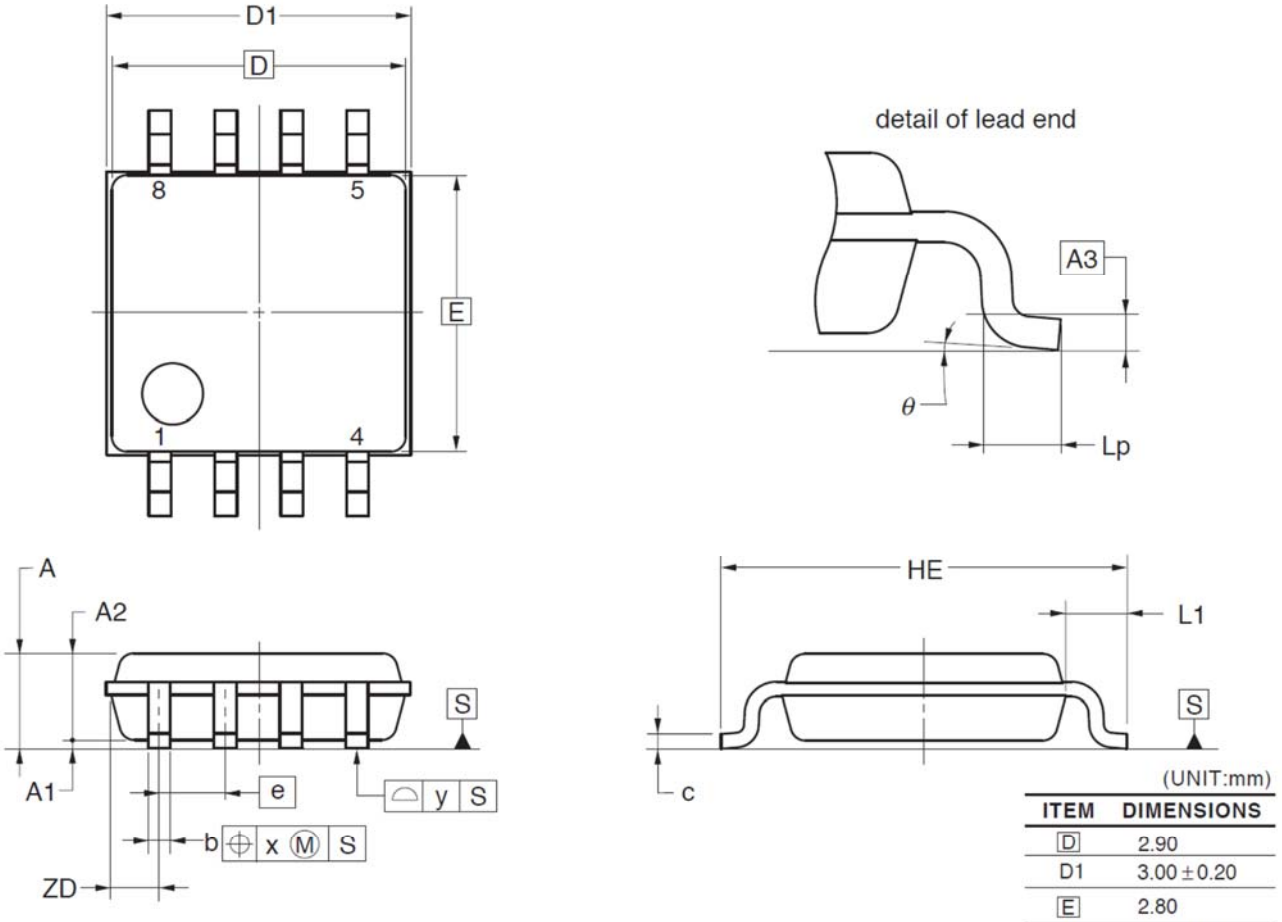
NOTE

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

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6. 使用瑞萨电子产品时，请参阅最新产品信息（数据表、使用说明书、应用指南、可靠性手册中的“半导体元件处理和使用一般注意事项”等），并确保使用条件在瑞萨电子指定的最大额定值、电源工作电压范围、散热特性、安装条件等范围内使用。对于在上述指定范围之外使用瑞萨电子产品而产生的任何故障、失效或事故，瑞萨电子概不承担任何责任。
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