To our customers,

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Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

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RENESAS

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC277GR-9LG, μPC277MP-KAA, μPC393GR-9LG

SINGLE POWER SUPPLY DUAL COMPARATORS WITH SMALL PACKAGE

<R> DESCRIPTION

The μPC277GR-9LG, μPC277MP-KAA, μPC393GR-9LG are dual comparators which are designed to operate for a single power supply. It includes features of 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 be used for an extensive comparison of various voltages.

The μPC277GR-9LG, μPC277MP-KAA which expands temperature type is suited for wide operating ambient temperature use, and μPC393GR-9LG is used for general purposes.

A DC parameter selection that is compatible to comparators is also available.

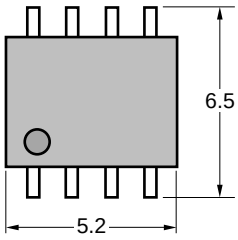
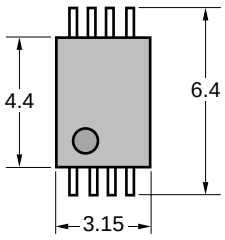
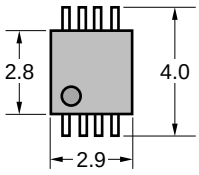
μPC177GR-9LG, μPC339GR-9LG which are quad types with the same circuit configuration are also available as series of comparators.

<R> 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.)
- Small Package

  The mounting area is reduced to 40% or 66% compared to the conventional 8-pin plastic SOP as shown in the following diagram.

- A wired OR is possible as the open collector is output.
- A low voltage operation is possible. $V^+ - V^-$: +2 to +32 V

Package	Standard SOP	TSSOP	TSSOP (2.8 x 2.9)
Subject part number	μPC277G2, μPC393G2	μPC277GR-9LG, μPC393GR-9LG	μPC277MP-KAA
Outline comparison			
(Mounting area ratio)	(100%)	(60%)	(34%)

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The mark <R> shows major revised points.
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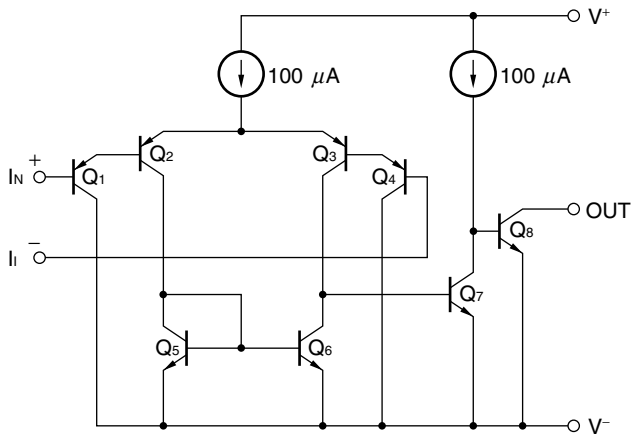
<R> ORDERING INFORMATION

Part Number	Selected Grade	Package	Package Type
μPC277GR-9LG-E1-A Note	Standard	8-pin plastic TSSOP (5.72 mm(225))	• 12 mm wide embossed taping • Pin 1 on draw-out side
μPC277GR-9LG-E2-A Note	Standard	8-pin plastic TSSOP (5.72 mm(225))	• 12 mm wide embossed taping • Pin 1 at take-up side
μPC277GR(5)-9LG-E1-A Note	DC parameter selection	8-pin plastic TSSOP (5.72 mm(225))	• 12 mm wide embossed taping • Pin 1 on draw-out side
μPC277GR(5)-9LG-E2-A Note	DC parameter selection	8-pin plastic TSSOP (5.72 mm(225))	• 12 mm wide embossed taping • Pin 1 at take-up side
μPC277MP-KAA-E1-A Note	Standard	8-pin plastic TSSOP (2.8 x 2.9)	• 12 mm wide embossed taping • Pin 1 on draw-out side
μPC277MP-KAA-E2-A Note	Standard	8-pin plastic TSSOP (2.8 x 2.9)	• 12 mm wide embossed taping • Pin 1 at take-up side
μPC277MP(5)-KAA-E1-A Note	DC parameter selection	8-pin plastic TSSOP (2.8 x 2.9)	• 12 mm wide embossed taping • Pin 1 on draw-out side
μPC277MP(5)-KAA-E2-A Note	DC parameter selection	8-pin plastic TSSOP (2.8 x 2.9)	• 12 mm wide embossed taping • Pin 1 at take-up side
μPC393GR-9LG-E1-A Note	Standard	8-pin plastic TSSOP(5.72 mm(225))	• 12 mm wide embossed taping • Pin 1 on draw-out side
μPC393GR-9LG-E2-A Note	Standard	8-pin plastic TSSOP(5.72 mm(225))	• 12 mm wide embossed taping • Pin 1 at take-up side
μPC393GR(5)-9LG-E1-A Note	DC parameter selection	8-pin plastic TSSOP(5.72 mm(225))	• 12 mm wide embossed taping • Pin 1 on draw-out side
μPC393GR(5)-9LG-E2-A Note	DC parameter selection	8-pin plastic TSSOP(5.72 mm(225))	• 12 mm wide embossed taping • Pin 1 at take-up side

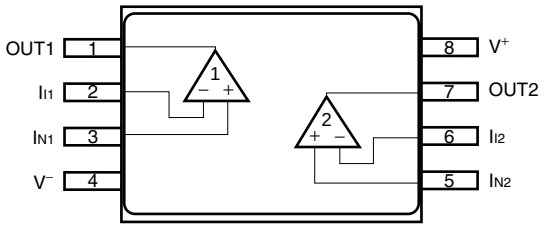
Note Pb-free (This product does not contain Pb in the external electrode and other parts.)

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EQUIVALENT CIRCUIT (1/2 Circuit)



<R> PIN CONFIGURATION (Marking side)



<R> 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
Voltage between V^+ and V^- Note1	$V^+ - V^-$	−0.3 to +36			V
Differential Input Voltage	V_{ID}	±36			V
Input Voltage Note2	V_I	V^- − 0.3 to V^- + 36			V
Output applied Voltage Note3	V_O	V^- − 0.3 to V^- + 36			V
Total Power Dissipation Note4	P_T	440			mW
Output Short Circuit Duration (vs. GND) Note5	t_S	Indefinite			s
Operating Ambient Temperature	T_A	−40 to +125		−40 to +85	°C
Storage Temperature	T_{stg}	−55 to +150		−55 to +125	°C

Note1. Note that reverse connections of the power supply may damage 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 a comparator 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 of 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.

μPC277GR-9LG: Derate at −5.5 mW/°C when T_A > 69°C.

(Junction − ambient thermal resistance $R_{th(J-A)}$ = 183°C/W)

μPC277MP-KAA: Derate at −4.8 mW/°C when T_A > 58°C.

(Junction − ambient thermal resistance $R_{th(J-A)}$ = 208°C/W)

μPC393GR-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 not to exceed the absolute maximum ratings, **Note 4**.

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RECOMMENDED OPERATING CONDITIONS

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

<R> ELECTRICAL CHARACTERISTICS

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

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Offset Voltage	V_{IO}	V_O = 1.4 V, V_{REF} = 1.4 V, R_S = 0 Ω		±2	±5	mV
Input Offset Current	I_{IO}	V_O = 1.4 V		±5	±50	nA
Input Bias Current Note1	I_B	V_O = 1.4 V		17	250	nA
Voltage Gain	A_V	R_L = 15 kΩ		200000		
Circuit Current Note2	I_{CC}	R_L = ∞, I_O = 0 A		0.6	1	mA
Common Mode Input Voltage Range	V_{ICM}		0		V^+ – 1.5	V
Output Saturation Voltage	V_{OL}	$V_{IN(-)}$ = +1 V, $V_{IN(+)}$ = 0 V, $I_{O\,SINK}$ = 4 mA		0.2	0.4	V
Output Sink Current	$I_{O\,SINK}$	$V_{IN(-)}$ = +1 V, $V_{IN(+)}$ = 0 V, $V_O \leq$ 1.5 V	6	16		mA
Output Leakage Current	$I_{O\,LEAK}$	$V_{IN(+)}$ = +1 V, $V_{IN(-)}$ = 0 V, V_O = 5 V		0.1		nA
Pulse Response Time Note3		R_L = 5.1 kΩ, V_{RL} = 5 V,		1.8		μs

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

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Offset Voltage	V_{IO}	V_O = 1.4 V, V_{REF} = 1.4 V, R_S = 0 Ω		±2	±2.5	mV
Input Offset Current	I_{IO}	V_O = 1.4 V		±5	±50	nA
Input Bias Current Note1	I_B	V_O = 1.4 V		17	60	nA
Voltage Gain	A_V	R_L = 15 kΩ		200000		
Circuit Current Note2	I_{CC}	R_L = ∞, I_O = 0 A		0.6	0.8	mA
Common Mode Input Voltage Range	V_{ICM}		0		V^+ – 1.4	V
Output Saturation Voltage	V_{OL1}	$V_{IN(-)}$ = +1 V, $V_{IN(+)}$ = 0 V, $I_{O\,SINK}$ = 4 mA			0.2	V
	V_{OL2}	$V_{IN(-)}$ = +1 V, $V_{IN(+)}$ = 0 V, $I_{O\,SINK}$ = 10 mA			1.5	V
Output Sink Current	$I_{O\,SINK}$	$V_{IN(-)}$ = +1 V, $V_{IN(+)}$ = 0 V, $V_O \leq$ 1.5 V	10	16		mA
Output Leakage Current	$I_{O\,LEAK}$	$V_{IN(+)}$ = +1 V, $V_{IN(-)}$ = 0 V, V_O = 5 V		0.1	100	nA
Pulse Response Time Note3		R_L = 5.1 kΩ, V_{RL} = 5 V,		1.8		μs

Notes1. The input bias current flows in the direction where the IC flows out because the first stage is configured with a PNP transistor.

In addition, the value of this item is a value of when the differential amplified circuit of the input stage is balanced. When the comparator is active, then twice the amount of current will flow to a pin with low potential.

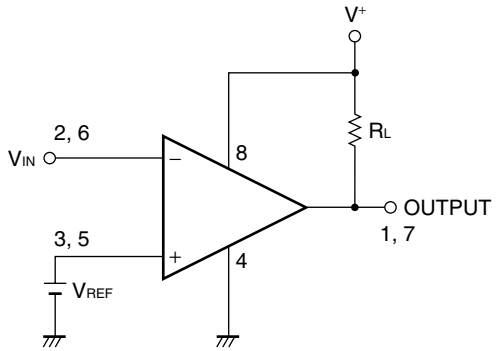
2. This is a current that flows in the internal circuit. This current will flow irrespective of the channel used.

3. This is the value when input oscillation is 100 mV and the over drive is 5 mV.

If the amount of over drive is increased then the response time can be cut down.

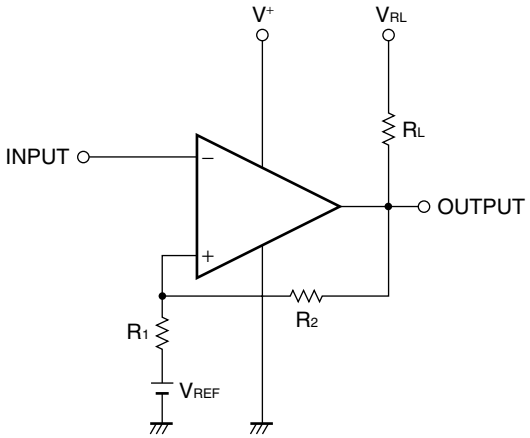
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TYPICAL APPLICATION CIRCUIT EXAMPLE



V_{REF}: V^- to V^+ – 1.5 (V)

Comparator with hysteresis



- Threshold voltage

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

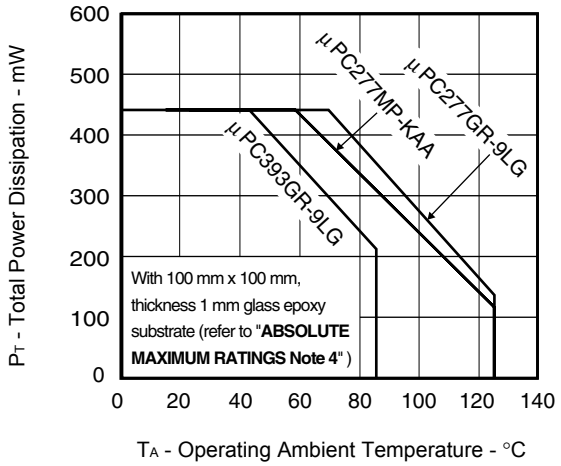
$$V_{TH\,(Low)} \cong V_{REF} - \frac{R_1}{R_1 + R_2} (V_{REF} - V_{OL})$$

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

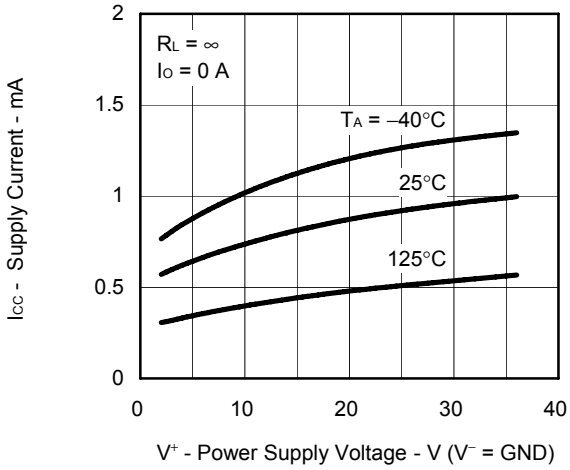
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<R> TYPICAL PERFORMANCE CHARACTERISTICS (T_A = 25°C, TYP.) (Reference value)

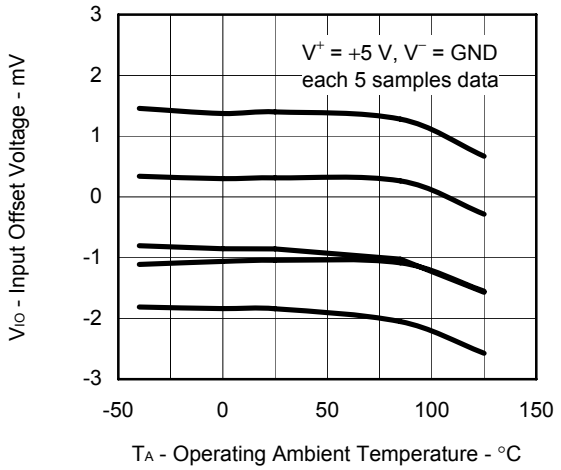
P_T vs. T_A



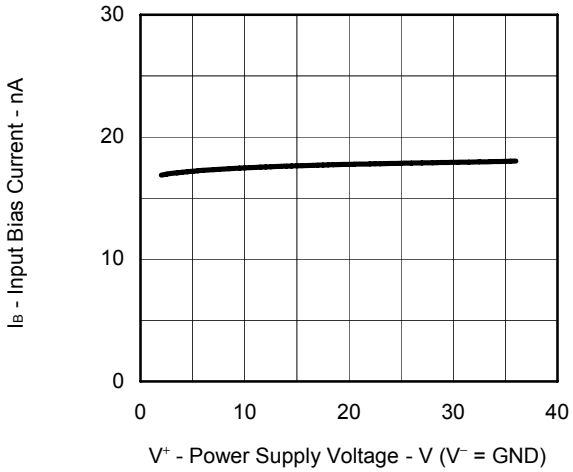
I_{CC} vs. V^+



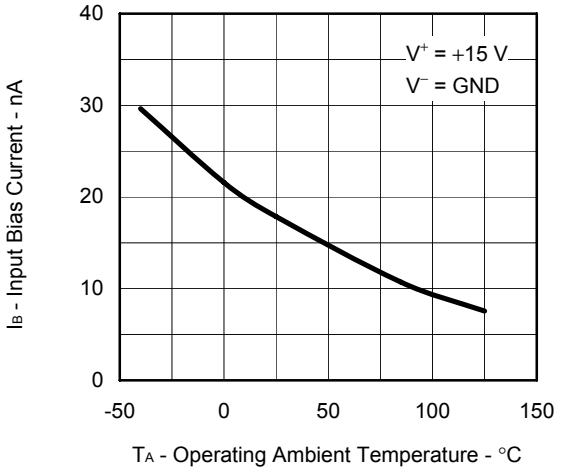
V_{IO} vs. T_A



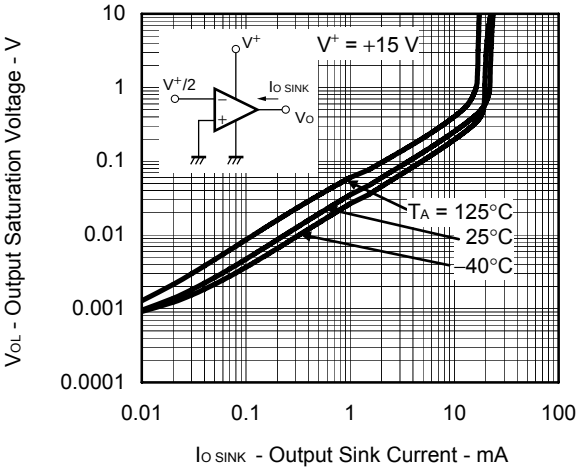
I_B vs. V^+



I_B vs. T_A

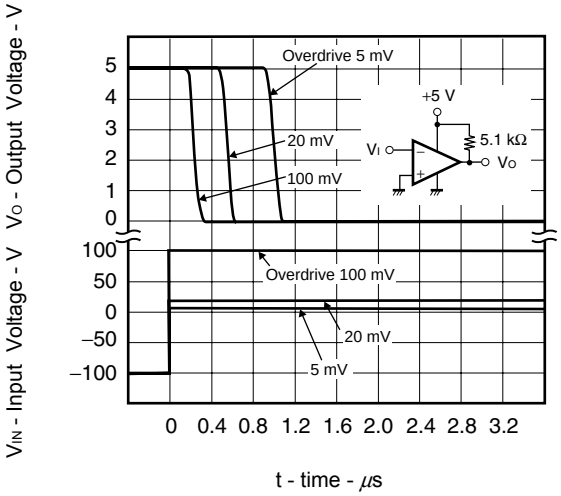


V_{OL} vs. $I_{O\ SINK}$

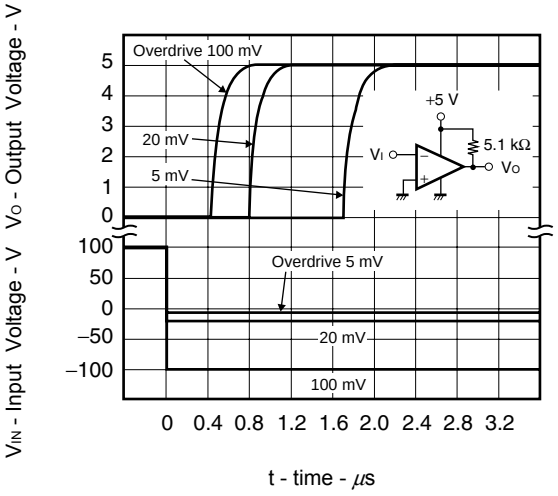


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PULSE RESPONSE I
(OUTPUT FALL)



PULSE RESPONSE II
(OUTPUT RISE)



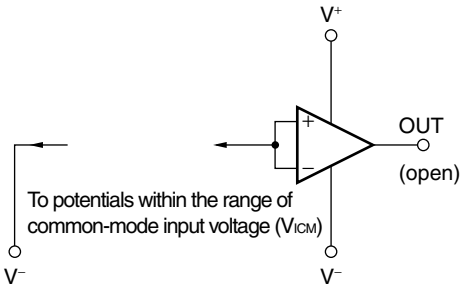
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<R> PRECAUTIONS FOR USE

O The process of unused circuits

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

Process example of unused circuits



O 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 damages, by a conduction of a parasitic diode within an IC. In addition, when the input/output pin may be lower than V^-, it is recommended to make a clump circuit by a diode whose forward voltage is low (e.g.: Schottky diode) for protection.

O 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, temperature characteristics for use with allowance.

O Range of Input Current

The “Input Bias Current [I_B]” of the electric feature specification list is specified in accordance with the operation amplifier. It is an average value of the current that flows in the +input pin [I_N] and the –input pin [I_I] when the differential amplified circuit of an input stage is balanced (negative feedback is provided).

Therefore, because the differential amplified circuit of the input stage will not be balanced during comparison (when comparator is active), the input current will flow, with twice the amount of current, to a pin with low potential.

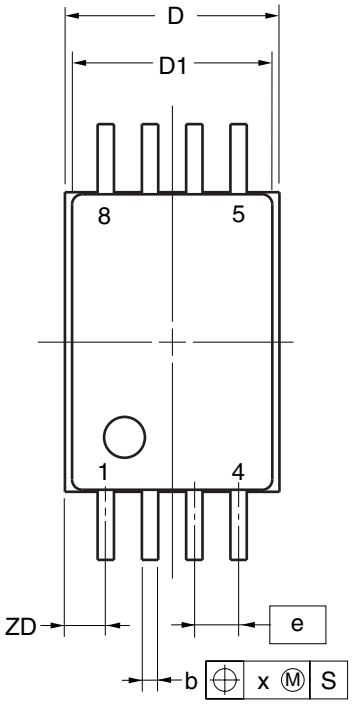
O Handling of ICs

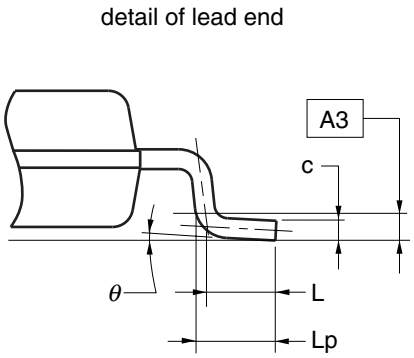
When stress is added to ICs due to warpage or bending of a board, the characteristic fluctuates due to piezoelectric effect. Therefore, pay attention to warpage or bending of a board.

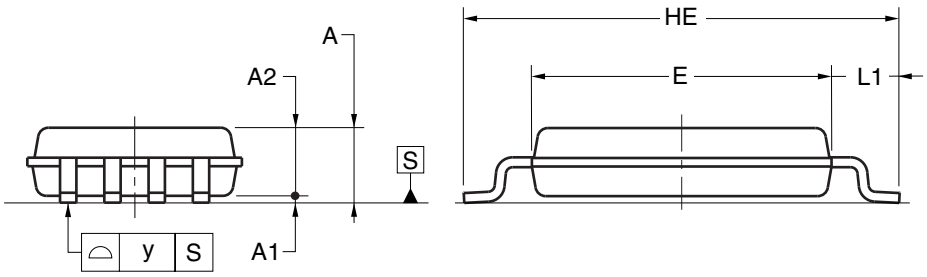
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PACKAGE DRAWINGS (Unit: mm)

8-PIN PLASTIC TSSOP (5.72mm (225))







(UNIT:mm)

ITEM	DIMENSIONS
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	0.50
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

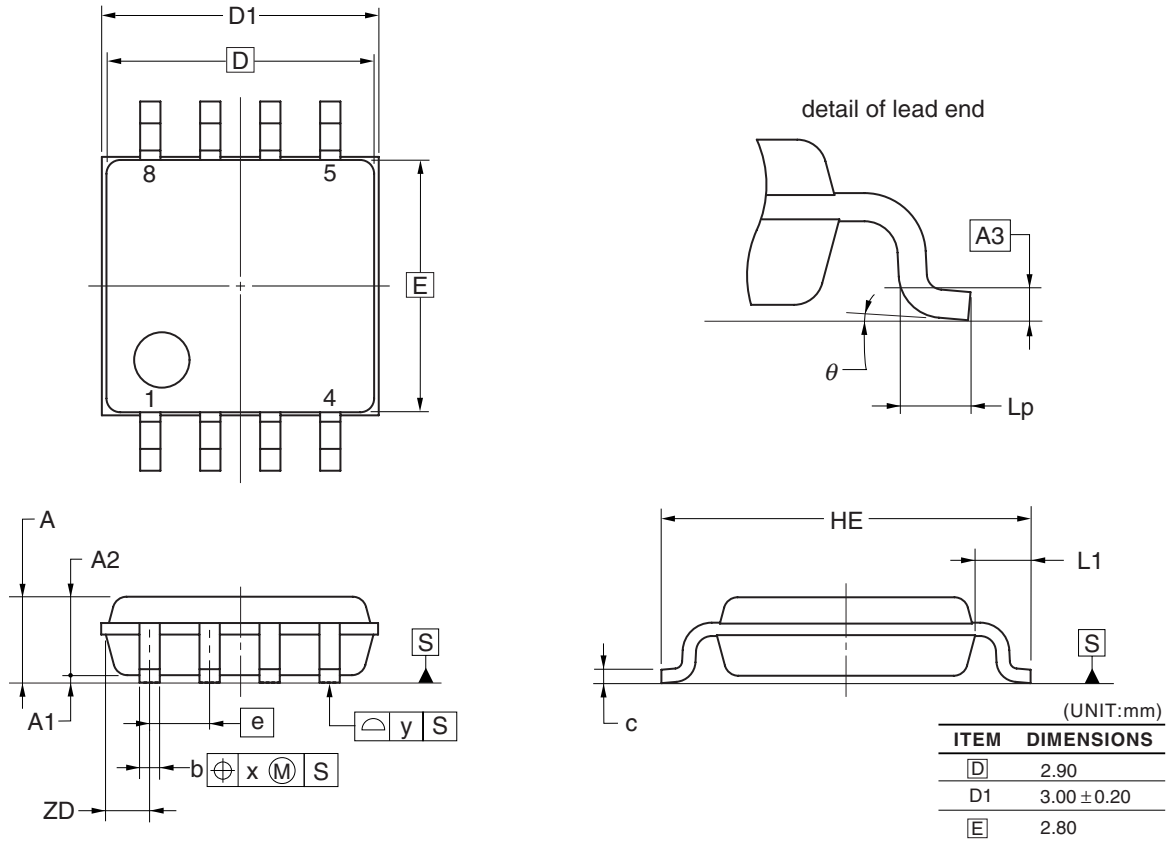
P8GR-65-9LG

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

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<R> 8-PIN PLASTIC TSSOP(2.8x2.9)



(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

P8MP-65-KAA

NOTE

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

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<R> RECOMMENDED SOLDERING CONDITIONS

The μPC277GR-9LG, μPC277MP-KAA, μPC393GR-9LG should be soldered and mounted under the following recommended conditions.

For soldering methods and conditions other than those recommended below, contact an NEC Electronics sales representative.

For technical information, see the following website.

Semiconductor Device Mount Manual (http://www.necel.com/pkg/en/mount/index.html)

Type of Surface Mount Device

μPC277GR-9LG-A Note, μPC277GR(5)-9LG-A Note,
μPC393GR-9LG-A Note, μPC393GR(5)-9LG-A Note: 8-pin plastic TSSOP (5.72 mm (225))
μPC277MP-KAA-A Note, μPC277MP(5)-KAA-A Note: 8-pin plastic TSSOP (2.8 x 2.9)

Process	Conditions	Symbol
Infrared ray reflow	Peak temperature: 260°C, Reflow time: 60 seconds or less (at 220°C or higher), Maximum number of reflow processes: 3 times.	IR60-00-3
Wave soldering	Solder temperature: 260°C or below, Flow time: 10 seconds or less, Maximum number of flow processes: 1 time, Pre-heating temperature: 120°C or below (Package surface temperature).	WS60-00-1
Partial heating method	Pin temperature: 350°C or below, Heat time: 3 seconds or less (Per each side of the device).	P350

Note Pb-free (This product does not contain Pb in external electrode and other parts.)

Caution Apply only one kind of soldering condition to a device, except for "partial heating method", or the device will be damaged by heat stress.

Remark Flux: Rosin flux with low chlorine (0.2 Wt% or below) recommended.

<R> REFERENCE DOCUMENTS

Document Name	Document No.
QUALITY GRADES ON NEC SEMICONDUCTOR DEVICES	C11531E
SEMICONDUCTOR DEVICE MOUNT MANUAL	http://www.necel.com/pkg/en/mount/index.html
NEC SEMICONDUCTOR DEVICE RELIABILITY/QUALITY CONTROL SYSTEM-STANDARD LINEAR IC	IEI-1212
REVIEW OF QUALITY AND RELIABILITY HANDBOOK	C12769E
NEC SEMICONDUCTOR DEVICE RELIBIALITY/QUALITY CONTROL SYSTEM	C10983E

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  "Special": Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support).

  "Specific": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.

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