

To our customers,

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## Old Company Name in Catalogs and Other Documents

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On April 1<sup>st</sup>, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

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

April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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PRECISION VOLTAGE COMPARATOR

DESCRIPTION

The  $\mu$ PC311 is a voltage comparator that has input currents more than a hundred times lower than devices like conventional standard type of 710. It is also designed to operate over a wide range of supply voltages; from  $\pm 15$  V op amp supplies down to the single 5 V supply used for IC logic. Its output is compatible with HNIL, DTL and TTL as well as MOS circuits.

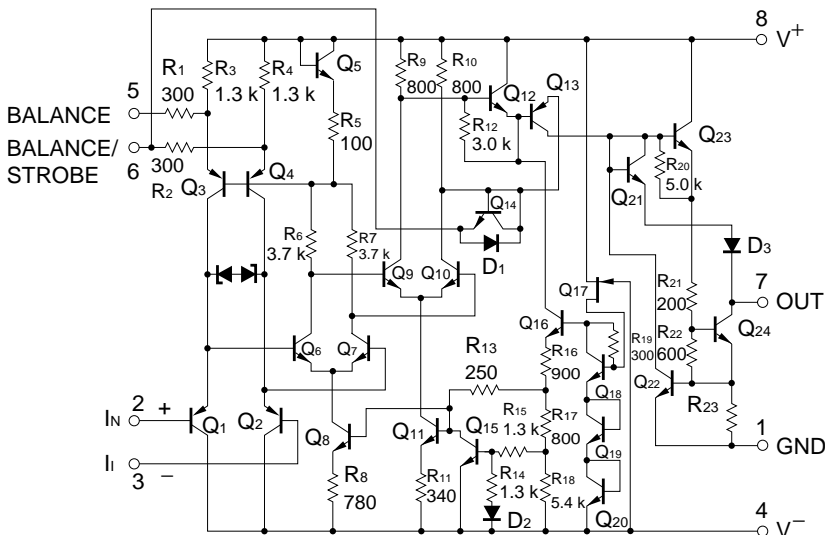
FEATURES

- Operate from single 5 V supply
- Maximum input current: 250 nA
- Maximum offset current: 50 nA
- Fast transient response: 200 ns TYP.

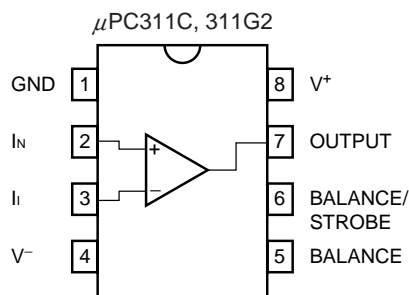
ORDERING INFORMATION

Part Number	Package
$\mu$ PC311C	8-pin plastic DIP (7.62 mm (300))
$\mu$ PC311G2	8-pin plastic SOP (5.72 mm (225))

EQUIVALENT CIRCUIT (1/2 Circuit)



PIN CONFIGURATION (Top View)



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**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C)**

Parameter		Symbol	Ratings	Unit
Voltage between V <sup>+</sup> and V <sup>-</sup> <sup>Note 1</sup>		V <sup>+</sup> - V <sup>-</sup>	-0.3 to +36	V
Differential Input Voltage		V <sub>ID</sub>	±30	V
Input Voltage <sup>Note 2</sup>		V <sub>I</sub>	V <sup>-</sup> -0.3 to V <sup>+</sup> +0.3	V
Output to Negative Supply Voltage <sup>Note 3</sup>		V <sub>O</sub> - V <sup>-</sup>	-0.3 to +40	V
Ground to Negative Supply Voltage <sup>Note 3</sup>		V <sub>GND</sub> - V <sup>-</sup>	-0.3 to +30	V
Power Dissipation	C Package <sup>Note 4</sup>	P <sub>T</sub>	350	mW
	G2 Package <sup>Note 5</sup>		440	mW
Output Short Circuit Duration <sup>Note 6</sup>			10	sec
Operating Ambient Temperature		T <sub>A</sub>	-20 to +80	°C
Storage Temperature		T <sub>stg</sub>	-55 to +125	°C

**Notes 1.** Reverse connection of supply voltage can cause destruction.

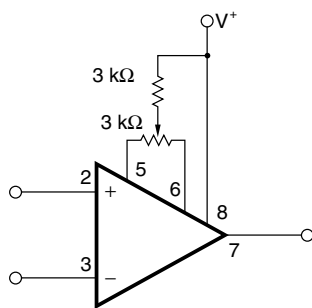
2. The input voltage should be allowed to input without damage or destruction. Even during the transition period of supply voltage, power on/off etc., this specification should be kept. The normal operation will establish when the both inputs are within the Common Mode Input Voltage Range of electrical characteristics.
3. This specification is the voltage which should be allowed to supply to the output and GND terminal from external without damage or destruction. Even during the transition period of supply voltage, power on/off etc., this specification should be kept.
4. Thermal derating factor is -5.0 mW/°C when operating ambient temperature is higher than 55°C.
5. Thermal derating factor is -4.4 mW/°C when operating ambient temperature is higher than 25°C.
6. Pay careful attention to the total power dissipation not to exceed the absolute maximum ratings, Note 4 and Note 5.

**RECOMMENDED OPERATING CONDITIONS**

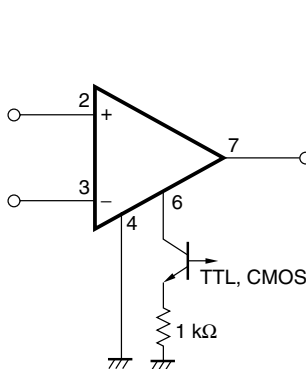
Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage (Split)	V <sup>±</sup>	±4		±16	V
Supply Voltage (V <sup>-</sup> = GND)	V <sup>+</sup>	+5		+32	V

**TYPICAL CONNECTIONS**

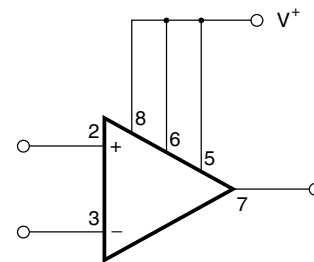
OFFSET VOLTAGE NULL CIRCUIT



STROBING CIRCUIT



FAST RESPONSE CIRCUIT  
(INCREASING INPUT STAGE CURRENT)

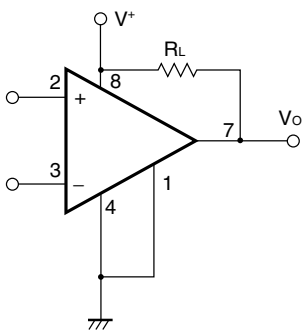


**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, V<sup>±</sup> = ±15 V)**

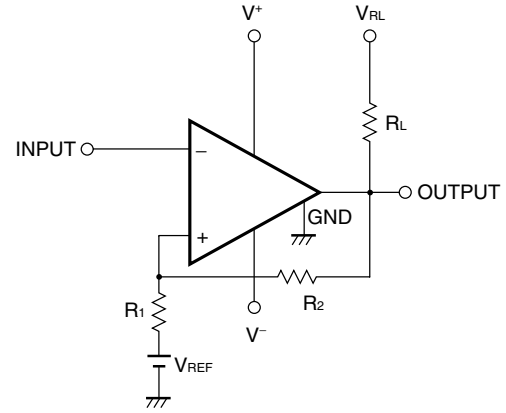
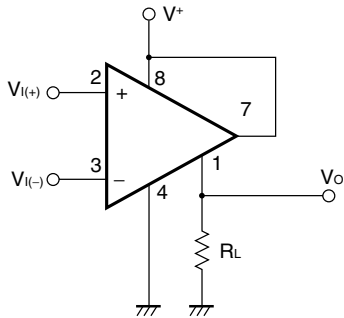
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input Offset Voltage	V <sub>IO</sub>	V <sup>+</sup> - V <sup>-</sup> = 5 to 30 V, R <sub>S</sub> ≤ 50 kΩ		±2.0	±7.5	mV
Input Offset Current	I <sub>IO</sub>	V <sup>+</sup> - V <sup>-</sup> = 5 to 30 V		±6.0	±50	nA
Input Bias Current	I <sub>B</sub>	V <sup>+</sup> - V <sup>-</sup> = 5 to 30 V		100	250	nA
Voltage Gain	A <sub>V</sub>	R <sub>L</sub> = 1.0 kΩ		200,000		
Response Time		Input step 100 mV, Overdrive 5 mV		200		ns
Output Saturation Voltage	V <sub>OL</sub>	V <sub>I</sub> ≤ 10 mV, I <sub>o</sub> = 50 mA		0.75	1.5	V
Strobe ON Current				3.0		mA
Output Leakage Current	I <sub>OLEAK</sub>	V <sub>I</sub> ≥ 10 mV, V <sub>O</sub> = 35 V		0.2	50	nA
Positive Supply Current	I <sup>+</sup>	I <sub>o</sub> = 0 A		5.1	7.5	mA
Negative Supply Current	I <sup>-</sup>	I <sub>o</sub> = 0 A		4.1	5.0	mA
Input Offset Voltage	V <sub>IO</sub>	V <sup>+</sup> - V <sup>-</sup> = 5 to 30 V, R <sub>S</sub> ≤ 50 kΩ, T <sub>A</sub> = 0 to 70°C			±10	mV
Input Offset Current	I <sub>IO</sub>	V <sup>+</sup> - V <sup>-</sup> = 5 to 30 V, T <sub>A</sub> = 0 to 70°C			±70	nA
Input Bias Current	I <sub>B</sub>	V <sup>+</sup> - V <sup>-</sup> = 5 to 30 V, T <sub>A</sub> = 0 to 70°C			300	nA
Common Mode Input Voltage Range	V <sub>ICM</sub>		±13.0 -14.5	±13.8 -14.7		V
Output Saturation Voltage	V <sub>OL</sub>	V <sup>+</sup> ≥ 4.5 V, V <sup>-</sup> = 0 V, V <sub>I</sub> ≤ -10 mV, I <sub>o</sub> = 8 mA		0.23	0.4	V

**TYPICAL APPLICATION CIRCUIT**

OPEN COLLECTOR OUTPUT    EMITTER FOLLOWER OUTPUT    COMPARATOR with HYSTERESIS CIRCUIT



Input polarity is reversed when 1pin (GND) is used as an output  
V<sub>N</sub> > V<sub>I</sub> → V<sub>O</sub> : Low

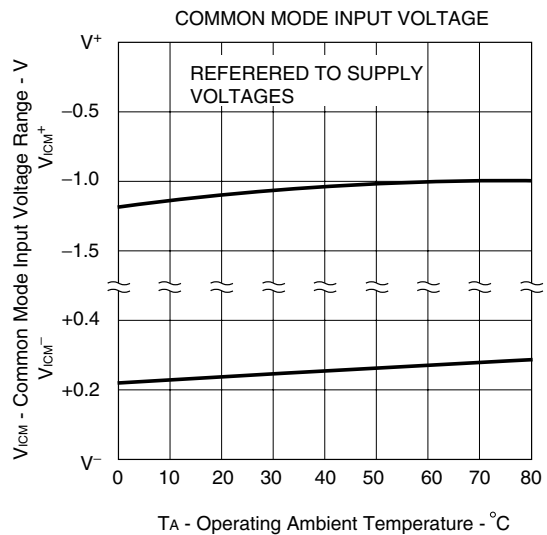
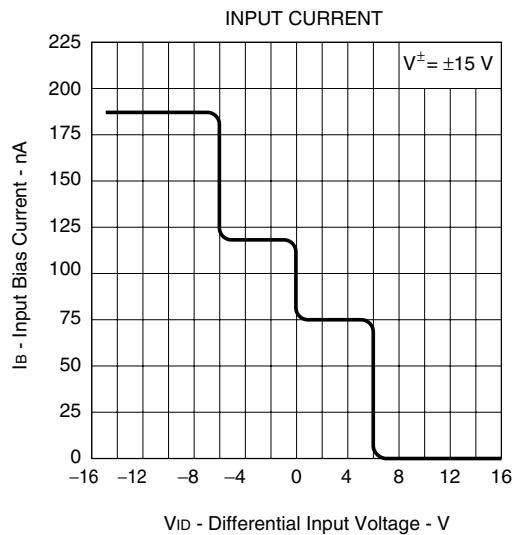
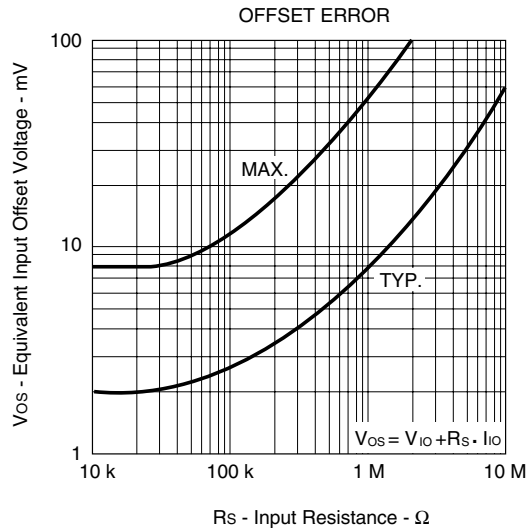
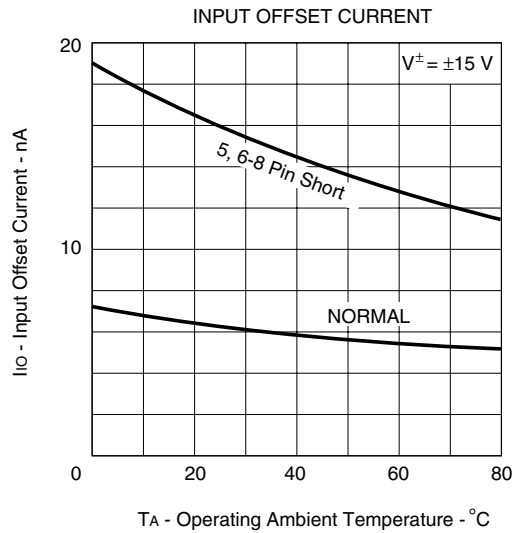
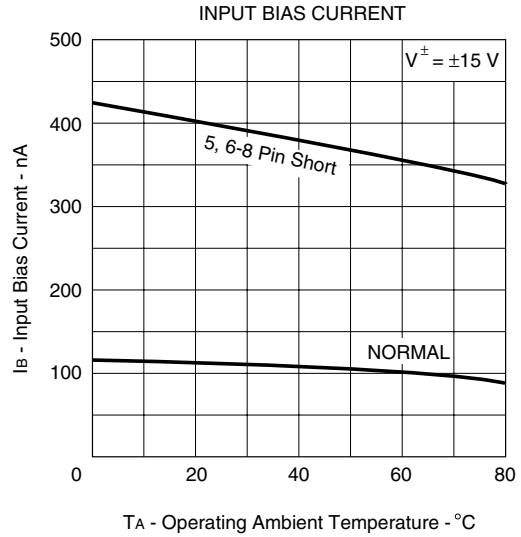
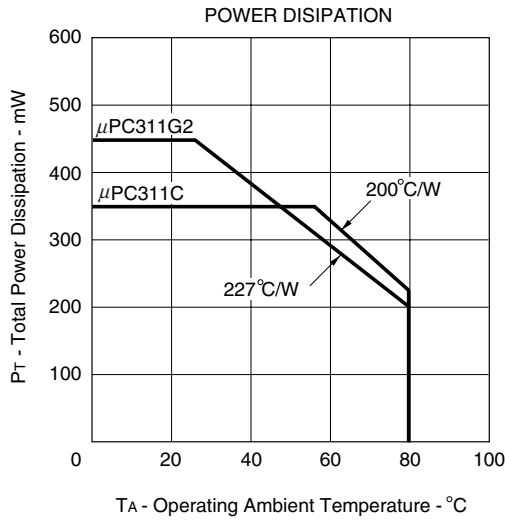


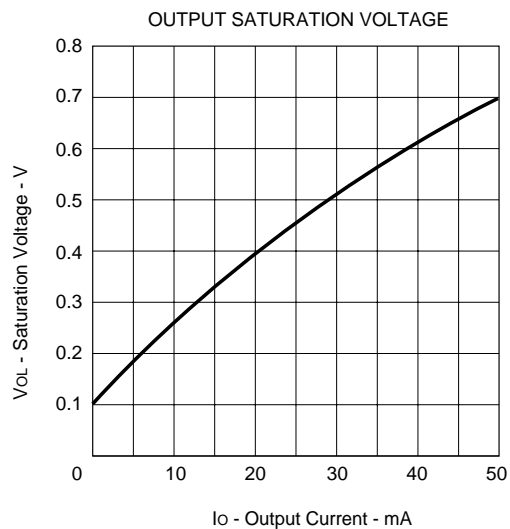
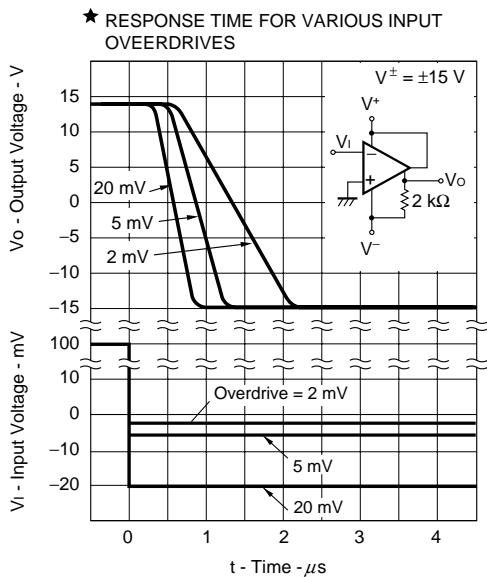
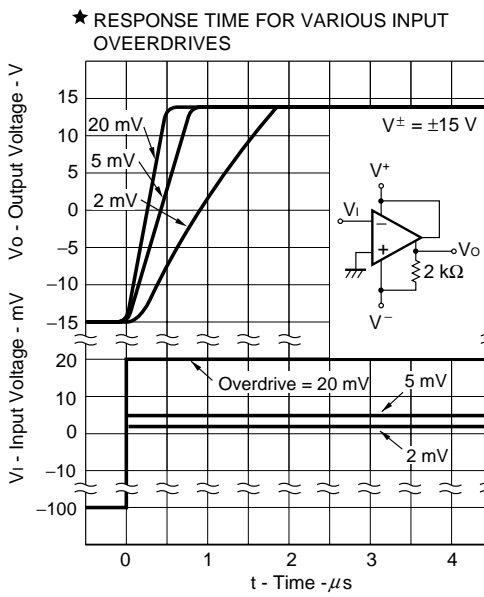
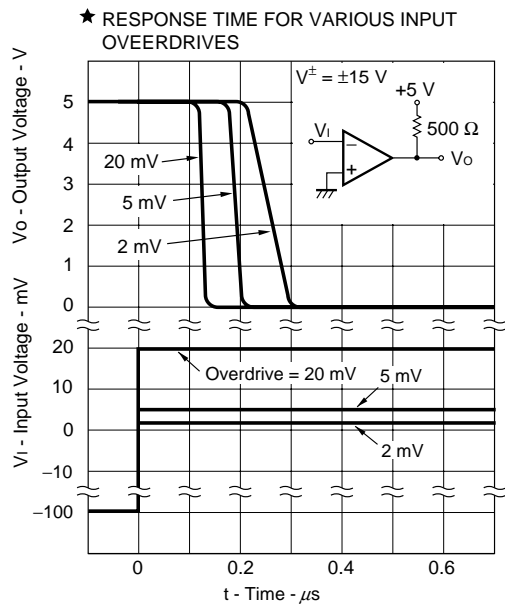
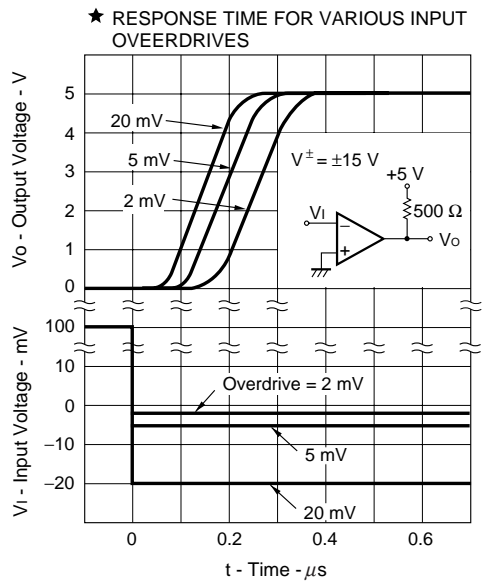
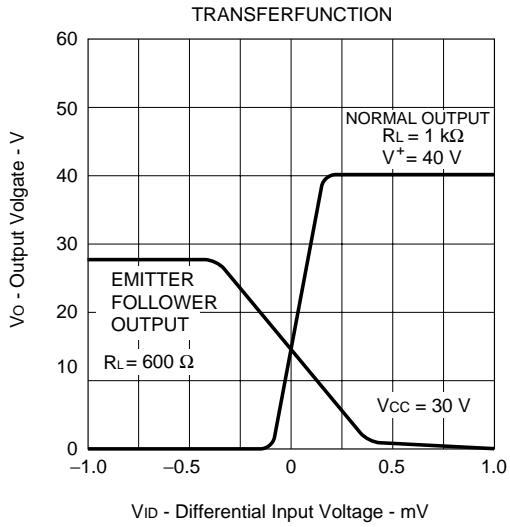
Threshold Voltage  

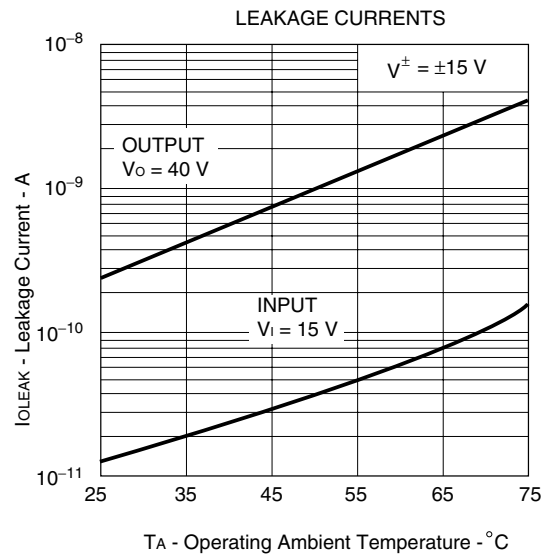
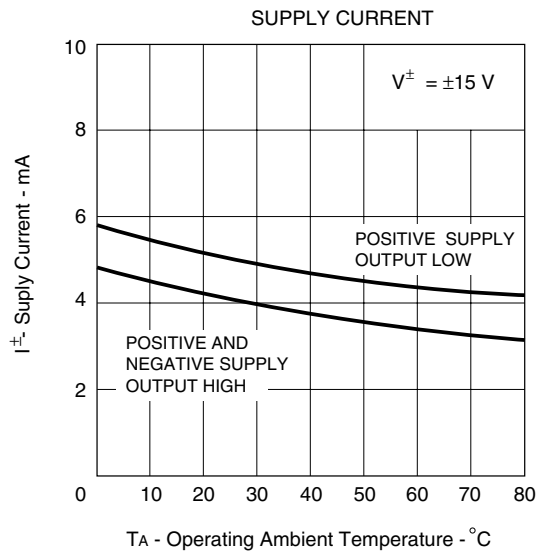
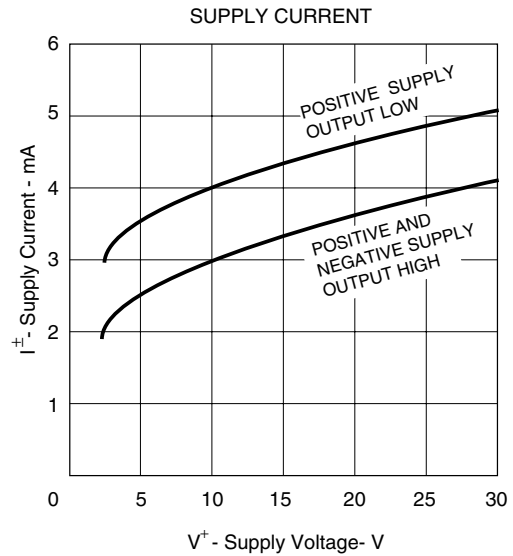
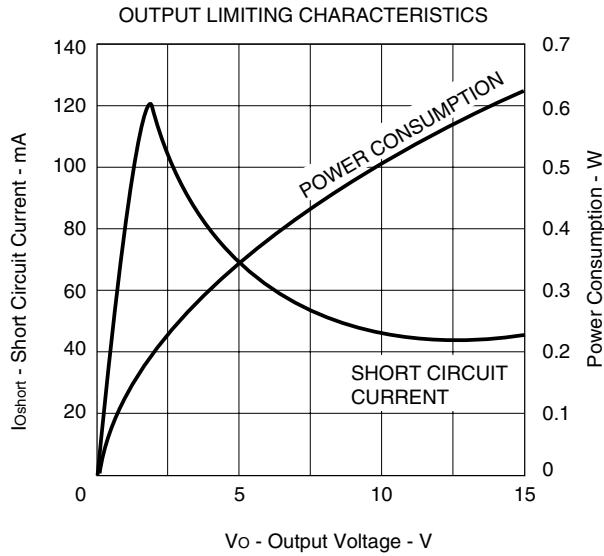
$$V_{TH(High)} = V_{REF} + \frac{R_1}{R_L + R_2 + R_1} (V_{RL} - V_{REF})$$

$$V_{TH(Low)} = V_{REF} - \frac{R_1}{R_1 + R_2} (V_{REF} - V_{OL})$$
 (V<sub>RL</sub> > V<sub>REF</sub> > V<sub>OL</sub>)

TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C, TYP.)



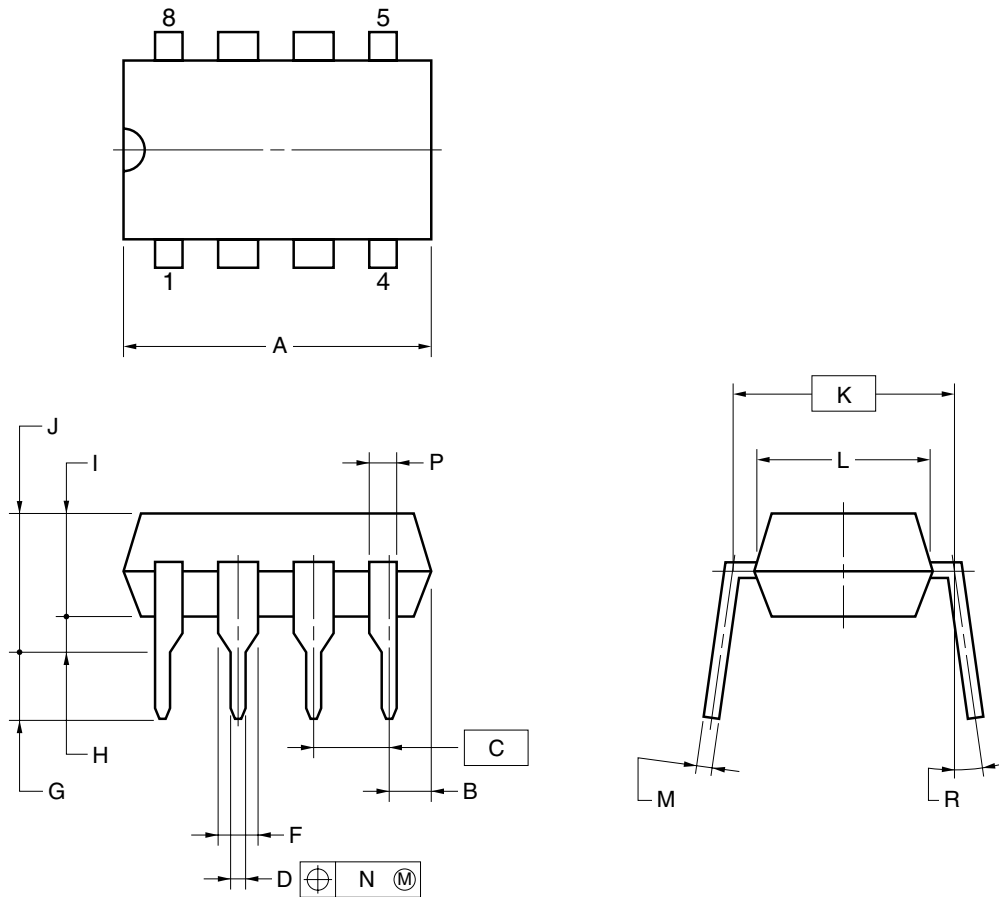






PACKAGE DRAWINGS (Unit : mm)

8-PIN PLASTIC DIP (7.62mm(300))



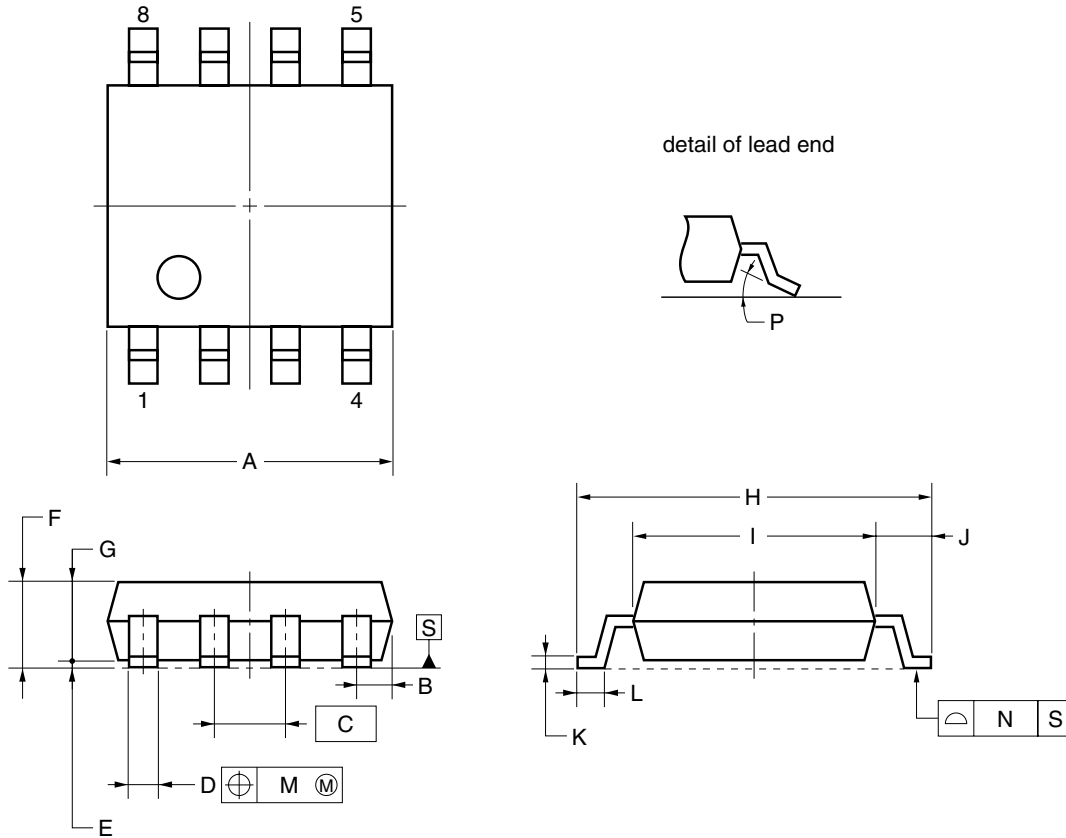
NOTES

1. Each lead centerline is located within 0.25 mm of its true position (T.P.) at maximum material condition.
2. Item "K" to center of leads when formed parallel.

ITEM	MILLIMETERS
A	10.16 MAX.
B	1.27 MAX.
C	2.54 (T.P.)
D	0.50±0.10
F	1.4 MIN.
G	3.2±0.3
H	0.51 MIN.
I	4.31 MAX.
J	5.08 MAX.
K	7.62 (T.P.)
L	6.4
M	0.25 <sup>+0.10</sup> <sub>-0.05</sub>
N	0.25
P	0.9 MIN.
R	0~15°

P8C-100-300B,C-2

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



**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 <sup>+0.17</sup> / <sub>-0.20</sub>
B	0.78 MAX.
C	1.27 (T.P.)
D	0.42 <sup>+0.08</sup> / <sub>-0.07</sub>
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 <sup>+0.08</sup> / <sub>-0.07</sub>
L	0.6±0.2
M	0.12
N	0.10
P	3° <sup>+7°</sup> / <sub>-3°</sub>

S8GM-50-225B-6

★ **RECOMMENDED SOLDERING CONDITIONS**

The μPC311 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**

**μPC311G2: 8-pin plastic SOP (5.72 mm (225))**

Process	Conditions	Symbol
Infrared Ray Reflow	Peak temperature: 230°C or below (Package surface temperature), Reflow time: 30 seconds or less (at 210°C or higher), Maximum number of reflow processes: 1 time.	IR30-00-1
Vapor Phase Soldering	Peak temperature: 215°C or below (Package surface temperature), Reflow time: 40 seconds or less (at 200°C or higher), Maximum number of reflow processes: 1 time.	VP15-00-1
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: 300°C or below, Heat time: 3 seconds or less (Per each side of the device).	—

**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.

**Type of Through-hole Device**

**μPC311C: 8-pin plastic DIP (7.62 mm (300))**

Process	Conditions
Wave Soldering (only to leads)	Solder temperature: 260°C or below, Flow time: 10 seconds or less.
Partial Heating Method	Pin temperature: 300°C or below, Heat time: 3 seconds or less (per each lead).

**Caution** For through-hole device, the wave soldering process must be applied only to leads, and make sure that the package body does not get jet soldered.

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