

# BIPOLAR ANALOG INTEGRATED CIRCUIT

# $\mu$ PC4570

## ULTRA LOW-NOISE, WIDEBAND, DUAL OPERATIONAL AMPLIFIER

### DESCRIPTION

The  $\mu$ PC4570 is an ultra low-noise, wideband high slew-rate, dual operational amplifier. Input equivalent noise is three times better than the conventional 4558 type op-amps. The gain bandwidth products and the slew-rate are seven times better than 4558. In spite of fast AC performance, the  $\mu$ PC4570 is extremely stable under voltage-follower circuit conditions. Supply current is also improved compared with conventional wideband op-amps. The  $\mu$ PC4570 is an excellent choice for pre-amplifiers and active filters in audio, instrumentation, and communication circuits.

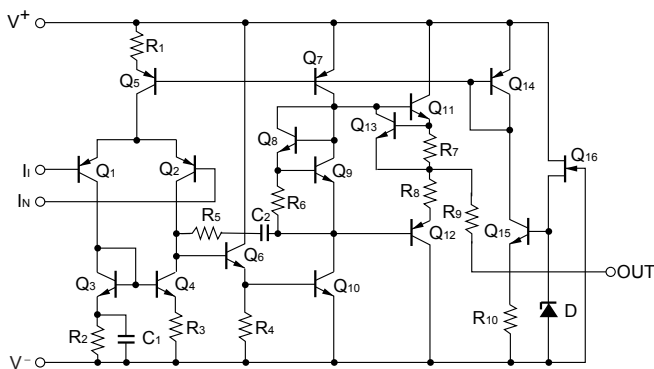
### FEATURES

- Ultra low noise :  $e_n = 4.5 \text{ nV}/\sqrt{\text{Hz}}$
- High slew rate :  $7 \text{ V}/\mu\text{s}$
- High gain bandwidth product :  $\text{GBW} = 15 \text{ MHz}$  at 100 kHz
- Internal frequency compensation

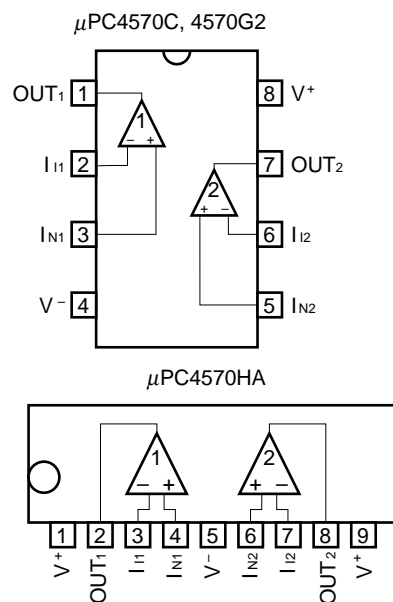
### ORDERING INFORMATION

Part Number	Package
$\mu$ PC4570C	8-pin plastic DIP (7.62 mm (300))
$\mu$ PC4570G2	8-pin plastic SOP (5.72 mm (225))
★ $\mu$ PC4570G2(5)	8-pin plastic SOP (5.72 mm (225))
$\mu$ PC4570HA	9-pin plastic slim SIP

### 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 Voltage <sup>Note 3</sup>		V <sub>O</sub>	V <sup>-</sup> -0.3 to V <sup>+</sup> +0.3	V
Power Dissipation	C Package <sup>Note 4</sup>	P <sub>T</sub>	350	mW
	G2 Package <sup>Note 5</sup>		440	mW
	HA Package <sup>Note 4</sup>		350	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**
- Reverse connection of supply voltage can cause destruction.
  - 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.
  - This specification is the voltage which should be allowed to supply to the output terminal from external without damage or destruction. Even during the transition period of supply voltage, power on/off etc., this specification should be kept. The output voltage of normal operation will be the Output Voltage Swing of electrical characteristics.
  - Thermal derating factor is -5.0 mW/°C when operating ambient temperature is higher than 55°C.
  - Thermal derating factor is -4.4 mW/°C when operating ambient temperature is higher than 25°C.
  - 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	V <sup>±</sup>	±4		±16	V
Output Current	I <sub>o</sub>			±10	mA
Source Resistance	R <sub>s</sub>			50	kΩ
Capacitive Load (A <sub>v</sub> = +1)	C <sub>L</sub>			100	pF

μPC4570C, μPC4570G2, μPC4570HA

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>	R <sub>S</sub> ≤ 50 Ω		±0.3	±5	mV
Input Offset Current <sup>Note 7</sup>	I <sub>IO</sub>			±10	±100	nA
Input Bias Current <sup>Note 7</sup>	I <sub>B</sub>			100	400	nA
Large Signal Voltage Gain	A <sub>V</sub>	R <sub>L</sub> ≥ 2 kΩ, V <sub>O</sub> = ±10 V	30,000	300,000		
★ Supply Current <sup>Note 8</sup>	I <sub>CC</sub>	I <sub>O</sub> = 0 A		5	8	mA
Common Mode Rejection Ratio	CMR		80	100		dB
Supply Voltage Rejection Ratio	SVR		80	100		dB
Output Voltage Swing	V <sub>OM</sub>	R <sub>L</sub> ≥ 10 kΩ	±12	±13.4		V
		R <sub>L</sub> ≥ 2 kΩ	±10	±12.8		V
Common Mode Input Voltage Range	V <sub>ICM</sub>		±12	±14		V
Slew Rate	SR	R <sub>L</sub> ≥ 2 kΩ	5	7		V/μs
Gain Bandwidth Product	GBW	f <sub>o</sub> = 100 kHz	10	15		MHz
Unity Gain Frequency	f <sub>unity</sub>	open loop		7		MHz
Phase Margin	φ <sub>unity</sub>	open loop		50		degree
Total Harmonic Distortion	THD	V <sub>O</sub> = 3 V <sub>r.m.s.</sub> , f = 20 Hz to 20 kHz (Figure1)		0.002		%
Input Equivalent Noise Voltage	V <sub>n</sub>	RIAA (Figure2)		0.9		μV <sub>r.m.s.</sub>
		FLAT+JIS A, R <sub>S</sub> = 100 Ω (Figure3)		0.53	0.65	μV <sub>r.m.s.</sub>
Input Equivalent Noise Voltage Density	e <sub>n</sub>	f <sub>o</sub> = 10 Hz, R <sub>S</sub> = 100 Ω		5.5		nV/√Hz
		f <sub>o</sub> = 1 kHz, R <sub>S</sub> = 100 Ω		4.5		nV/√Hz
Input Equivalent Noise Current Density	i <sub>n</sub>	f <sub>o</sub> = 1 kHz		0.7		pA/√Hz
Channel Separation		f = 20 Hz to 20 kHz		120		dB

**Notes 7.** Input bias currents flow out from IC. Because each currents are base current of PNP-transistor on input stage

★ **8.** This current flows irrespective of the existence of use.

★ μPC4570G2(5)

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>	R <sub>S</sub> ≤ 50 Ω		±0.3	±1	mV
Input Offset Current <sup>Note 7</sup>	I <sub>IO</sub>			±10	±50	nA
Input Bias Current <sup>Note 7</sup>	I <sub>B</sub>			100	200	nA
Large Signal Voltage Gain	A <sub>V</sub>	R <sub>L</sub> ≥ 2 kΩ, V <sub>O</sub> = ±10 V	50,000	300,000		
Supply Current <sup>Note 8</sup>	I <sub>CC</sub>	I <sub>O</sub> = 0 A		5	7	mA
Common Mode Rejection Ratio	CMR		85	100		dB
Supply Voltage Rejection Ratio	SVR		85	100		dB
Output Voltage Swing	V <sub>OM</sub>	R <sub>L</sub> ≥ 10 kΩ	±13	±13.4		V
		R <sub>L</sub> ≥ 2 kΩ	±12	±12.8		V
Common Mode Input Voltage Range	V <sub>ICM</sub>		±13.5	±14		V
Slew Rate	SR	R <sub>L</sub> ≥ 2 kΩ	5	7		V/μs
Gain Bandwidth Product	GBW	f <sub>o</sub> = 100 kHz	10	15		MHz
Unity Gain Frequency	f <sub>unity</sub>	open loop		7		MHz
Phase Margin	φ <sub>unity</sub>	open loop		50		degree
Total Harmonic Distortion	THD	V <sub>O</sub> = 3 V <sub>r.m.s.</sub> , f = 20 Hz to 20 kHz (Figure1)		0.002		%
Input Equivalent Noise Voltage	V <sub>n</sub>	RIAA (Figure2)		0.9		μV <sub>r.m.s.</sub>
		FLAT+JIS A, R <sub>S</sub> = 100 Ω (Figure3)		0.53	0.65	μV <sub>r.m.s.</sub>
Input Equivalent Noise Voltage Density	e <sub>n</sub>	f <sub>o</sub> = 10 Hz, R <sub>S</sub> = 100 Ω		5.5		nV/√Hz
		f <sub>o</sub> = 1 kHz, R <sub>S</sub> = 100 Ω		4.5		nV/√Hz
Input Equivalent Noise Current Density	i <sub>n</sub>	f <sub>o</sub> = 1 kHz		0.7		pA/√Hz
Channel Separation		f = 20 Hz to 20 kHz		120		dB

**Notes 7.** Input bias currents flow out from IC. Because each currents are base current of PNP-transistor on input stage

**8.** This current flows irrespective of the existence of use.

MEASUREMENT CIRCUIT

Figure1 Total Harmonic Distortion Measurement Circuit

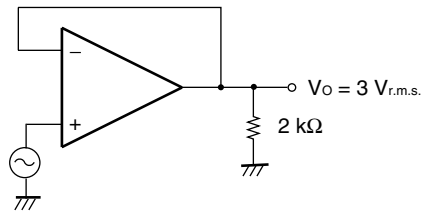


Figure2 Noise Measurement Circuit (RIAA)

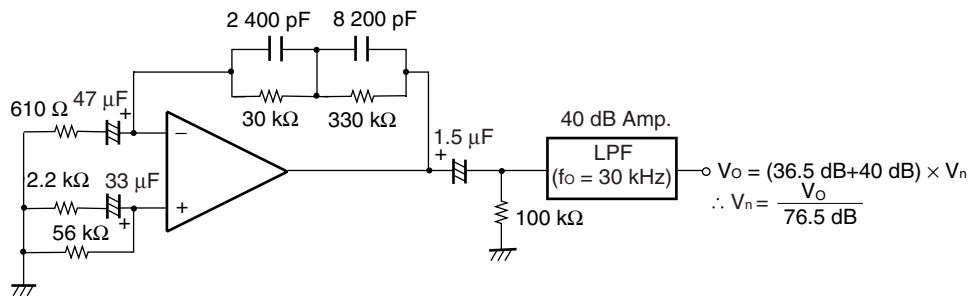
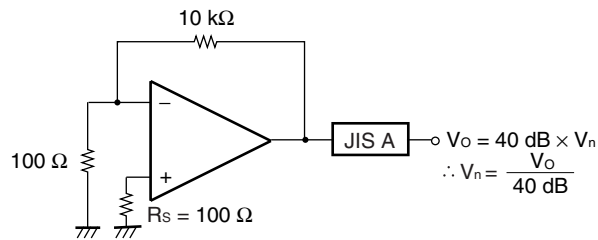
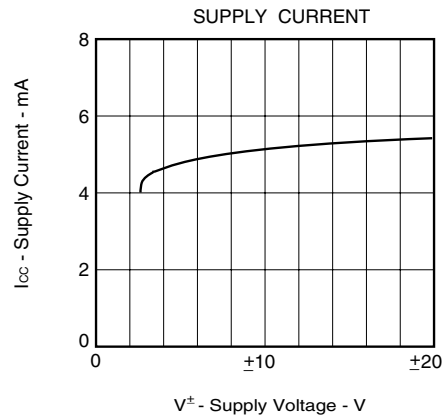
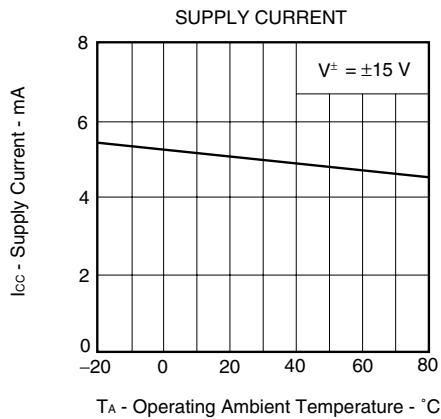
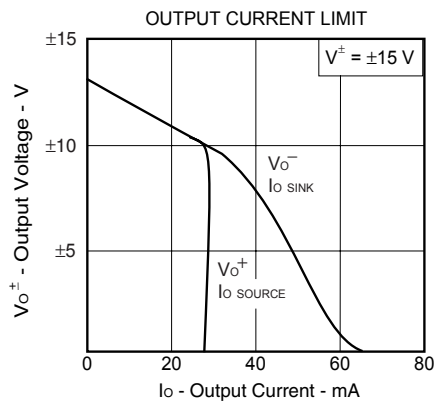
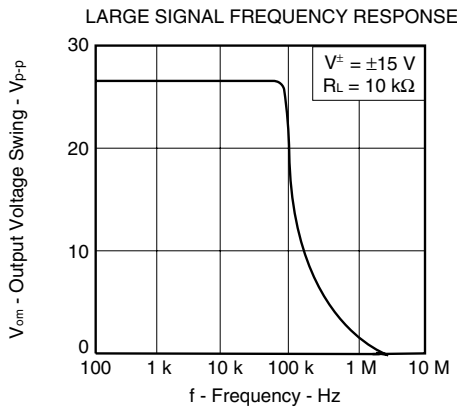
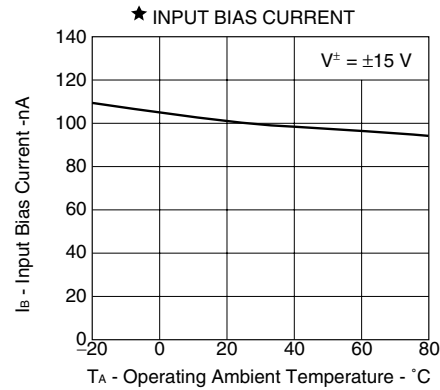
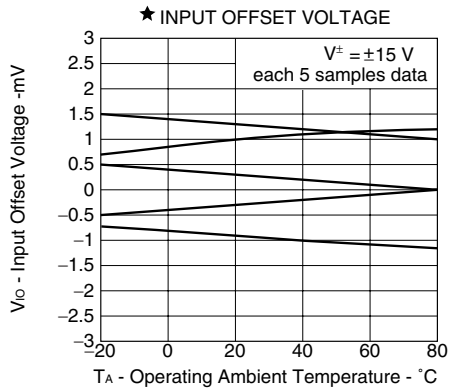
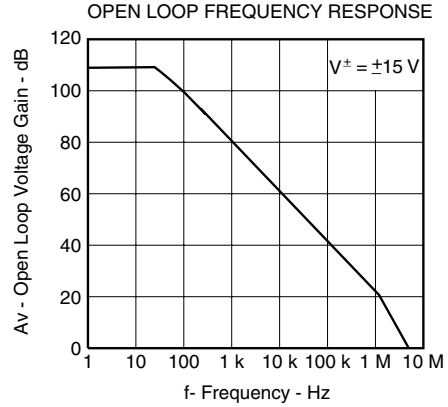
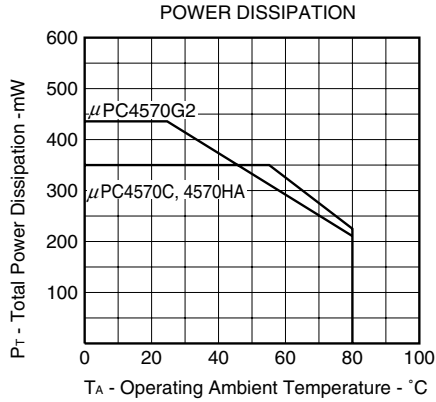
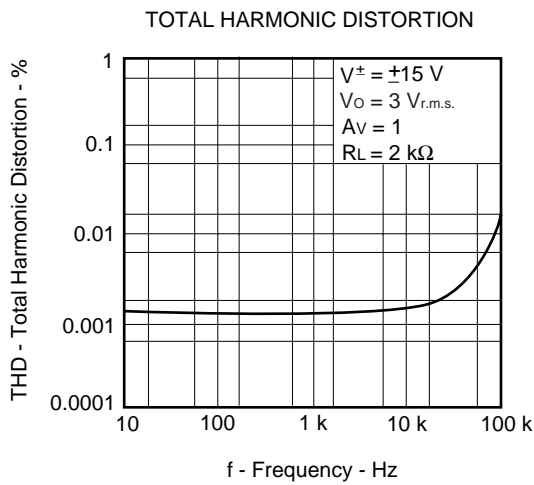
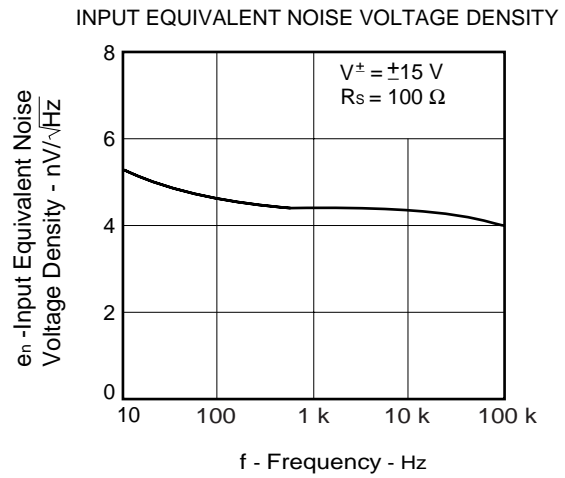
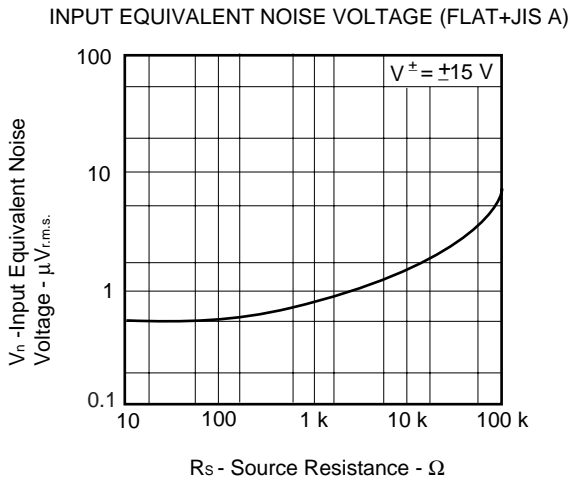
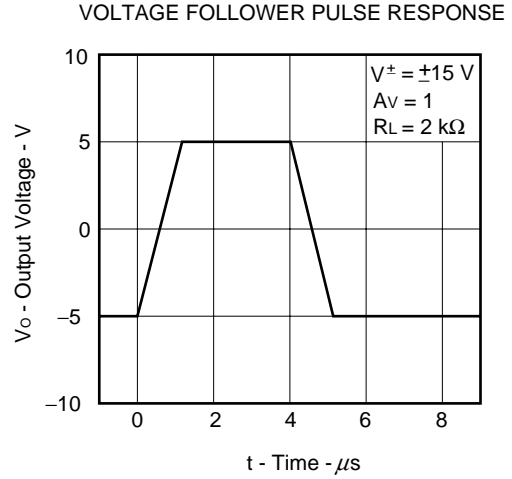
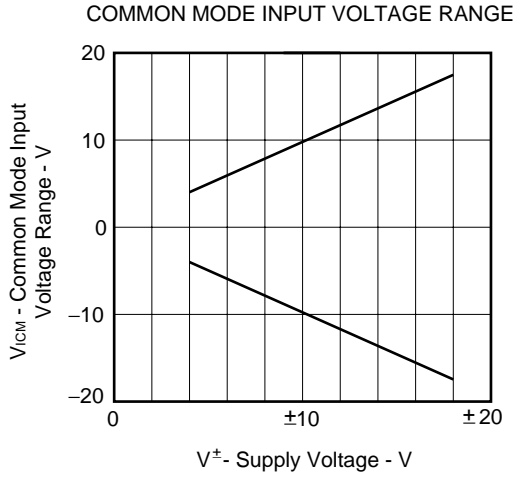


Figure3 Noise Measurement Circuit (FLAT+JIS A)



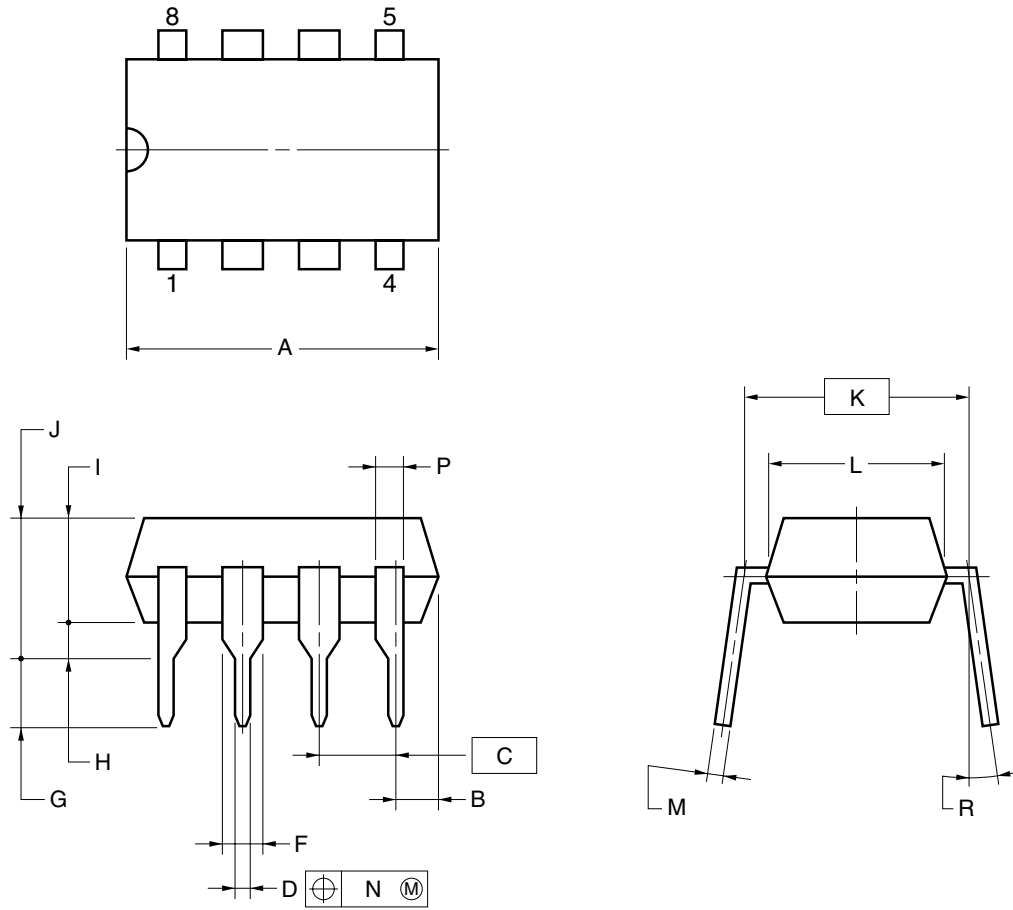
TYPICAL PERFORMANCE CHARACTERISTICS (T<sub>A</sub> = 25°C, TYP.)





PACKAGE DRAWINGS (Unit: mm)

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



NOTES

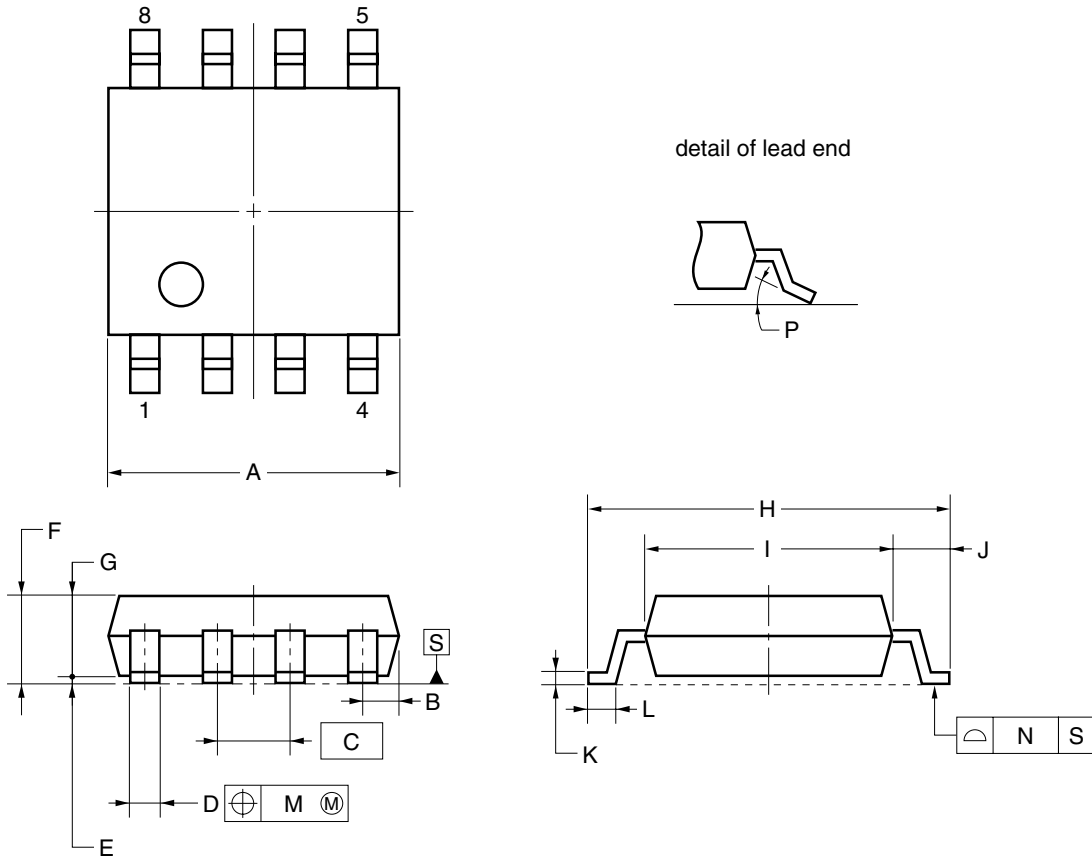
1. Each lead centerline is located within 0.25 mm of its true position (T.P.) at maximum material condition.
2. Item "K" to center of leads when formed parallel.

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))



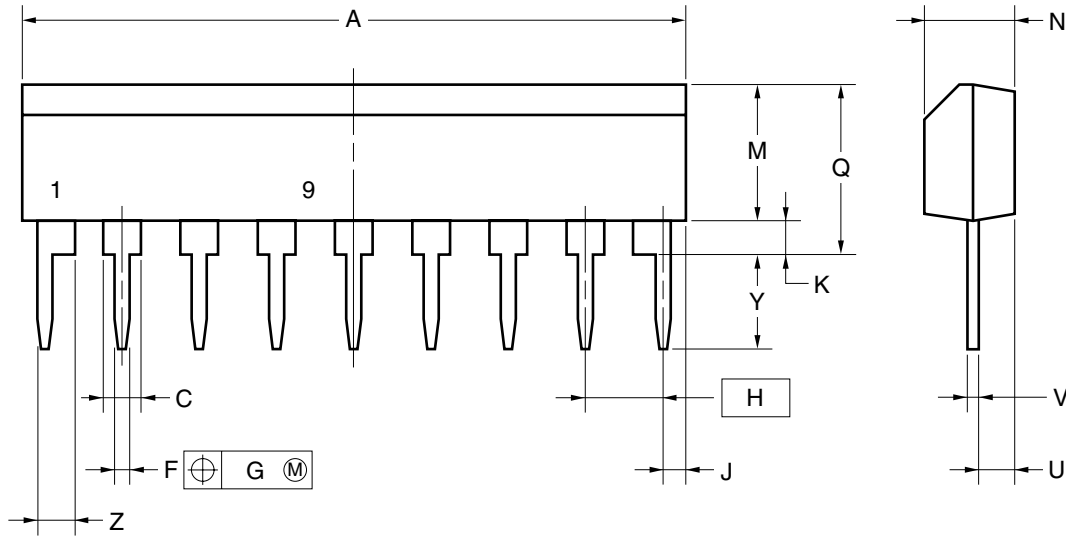
**NOTE**

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

9-PIN PLASTIC SLIM SIP



**NOTE**

Each lead centerline is located within 0.25 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	22.86 MAX.
C	1.1 MIN.
F	0.5±0.1
G	0.25
H	2.54
J	1.27 MAX.
K	0.51 MIN.
M	5.08 MAX.
N	2.8±0.2
Q	5.75 MAX.
U	1.5 MAX.
V	0.25 <sup>+0.10</sup> <sub>-0.05</sub>
Y	3.2±0.5
Z	1.1 MIN.

P9HA-254B-2

★ **RECOMMENDED SOLDERING CONDITIONS**

The μPC4570 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**

**μPC4570G2, μPC4570G2(5): 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**

**μPC4570C: 8-pin plastic DIP (7.62 mm (300)) , μPC4570HA: 9-pin plastic slim SIP**

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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