

# BIPOLAR ANALOG INTEGRATED CIRCUIT

# $\mu$ PC4560

## HIGH PERFORMANCE DUAL OPERATIONAL AMPLIFIER

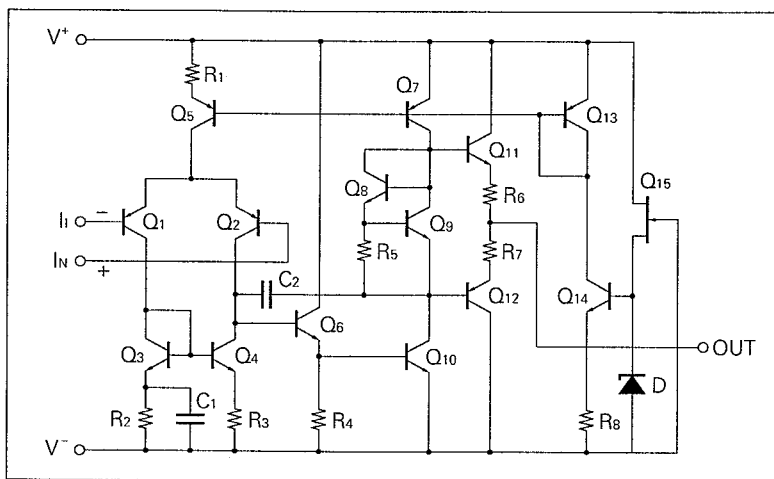
### DESCRIPTION

The  $\mu$ PC4560 is a dual operational amplifier which features more improved slew rate and G.B. products than that of  $\mu$ PC4559 with unity gain frequency compensation. Also very low input noise and high output current drive capability make this device the optimum choice for audio applications and active filters.

### FEATURES

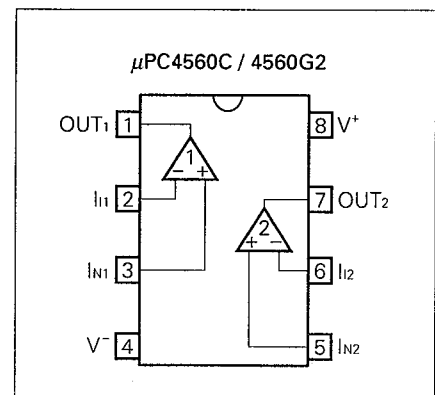
- Internal frequency compensation
- Gain bandwidth products: 10 MHz TYP.
- Low noise:  $6 \mu V_{p-p}$  TYP.
- High output current

### EQUIVALENT CIRCUIT (1/2 Circuit)



### CONNECTION DIAGRAM

(Top View)



### ORDERING INFORMATION

PART NUMBER	PACKAGE	QUALITY GRADE
$\mu$ PC4560C	8 PIN PLASTIC DIP (300 mil)	Standard
$\mu$ PC4560G2	8 PIN PLASTIC SOP (225 mil)	Standard

Please refer to "Quality grade on NEC Semiconductor Devices" (Document number IEI-1209) published by NEC Corporation to know the specifications of quality grade on the devices and its recommended applications.

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

PARAMETER		SYMBOL	μPC4060	UNIT
Voltage between V <sup>+</sup> and V <sup>-</sup> (Note 1)		V <sup>+</sup> - V <sup>-</sup>	-0.3 to +36	V
Differential Input Voltage		V <sub>ID</sub>	±30	V
Input Voltage (Note 2)		V <sub>I</sub>	V <sup>-</sup> -0.3 to V <sup>+</sup> +0.3	V
Output Voltage (Note 3)		V <sub>O</sub>	V <sup>-</sup> -0.3 to V <sup>+</sup> +0.3	V
Power Dissipation	C Package (Note 4)	P <sub>T</sub>	350	mW
	G2 Package (Note 5)		440	mW
Output Short Circuit Duration (Note 6)			0	sec
Operating Temperature Range		T <sub>opt</sub>	-20 to +80	°C
Storage Temperature Range		T <sub>stg</sub>	-55 to +125	°C

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

**Note 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.

**Note 3.** This specification is the voltage which should be allowed to supply to the output terminal from external without damage or destructive. 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.

**Note 4.** Thermal derating factor is -7.0 mW / °C when ambient temperature is higher than 55 °C.

**Note 5.** Thermal derating factor is -4.4 mW / °C when ambient temperature is higher than 25 °C.

**Note 6.** Must not short to GND, V<sup>+</sup>, V<sup>-</sup>, and other Voltage source. Pay careful attention to the total power dissipation not to exceed the absolute maximum ratings, Note 4 and Note 5.

**RECOMMENDED OPERATING CONDITIONS**

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V <sup>±</sup>	± 4		± 16	V

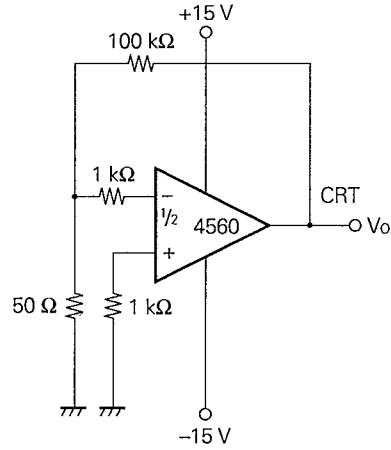
**ELECTRICAL CHARACTERISTICS (T<sub>a</sub> = 25 °C, V<sup>±</sup> = ±15 V)**

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Input Offset Voltage	V <sub>IO</sub>		±0.5	±6.0	mV	R <sub>s</sub> ≤ 10 kΩ
Input Offset Current (Note 7)	I <sub>IO</sub>		±5	±200	nA	
Input Bias Current (Note 7)	I <sub>B</sub>		60	500	nA	
Large Signal Voltage Gain	A <sub>v</sub>	20000	180000			R <sub>L</sub> ≥ 2 kΩ, V <sub>O</sub> = ±10 V
Power Consumption	P <sub>d</sub>		120	170	mW	I <sub>O</sub> = 0 A, Both Amplifiers
Common Mode Rejection Ratio	CMR	70	100		dB	R <sub>s</sub> ≤ 10 kΩ
Supply Voltage Rejection Ratio	SVR		10	150	μV/V	R <sub>s</sub> ≤ 10 kΩ
Output Voltage Swing	V <sub>om</sub>	±12	±14		V	R <sub>L</sub> ≥ 2 kΩ
		±10	±13		V	I <sub>O</sub> = ±25 mA
Common Mode Input Voltage Range	V <sub>ICM</sub>	±12	±14		V	
Slew Rate	SR		2.8		V/μs	A <sub>v</sub> = 1
Input Equivalent Noise Voltage	V <sub>n</sub>		6		μVp-p	R <sub>s</sub> = 1 kΩ, f = 1 Hz to 1 kHz (Fig.1)
Channel Separation			105		dB	f = 1 kHz (Fig.2)

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

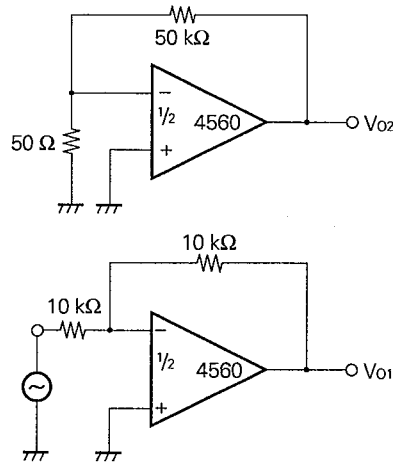
MEASUREMENT CIRCUIT

Fig. 1 Noise Measurement Circuit



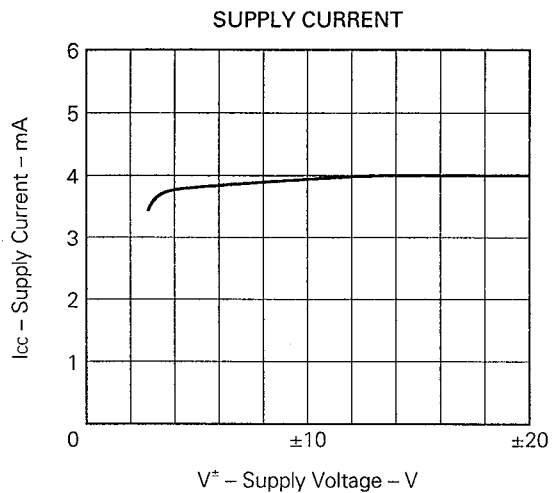
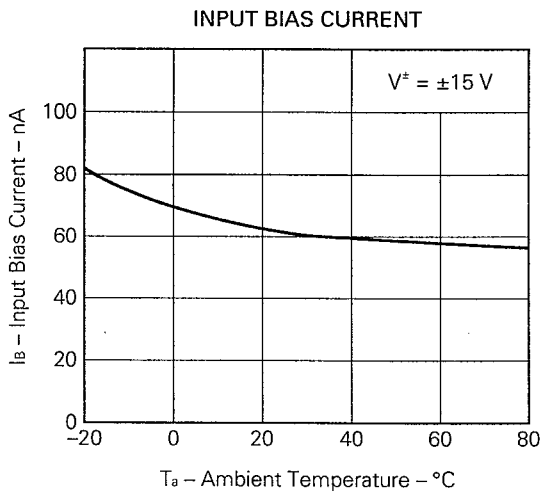
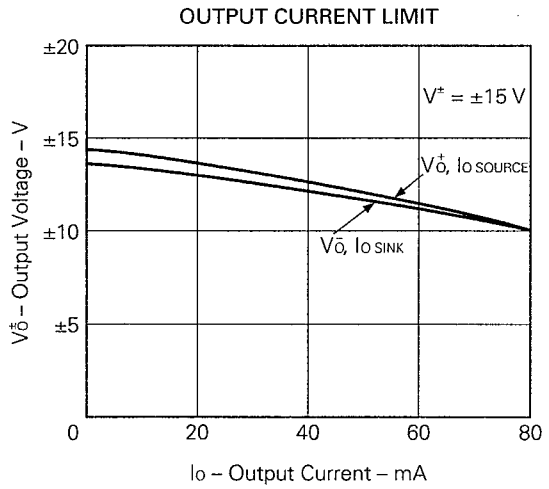
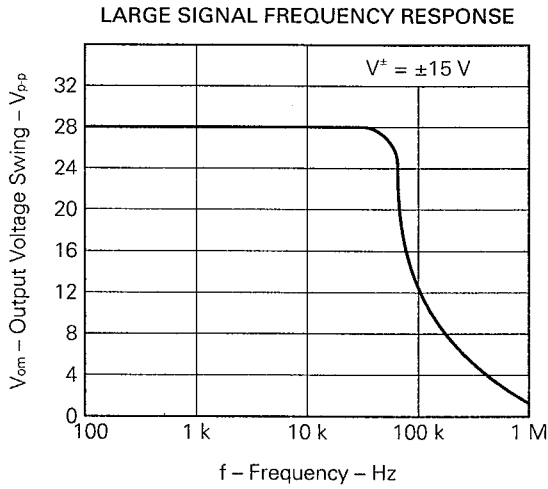
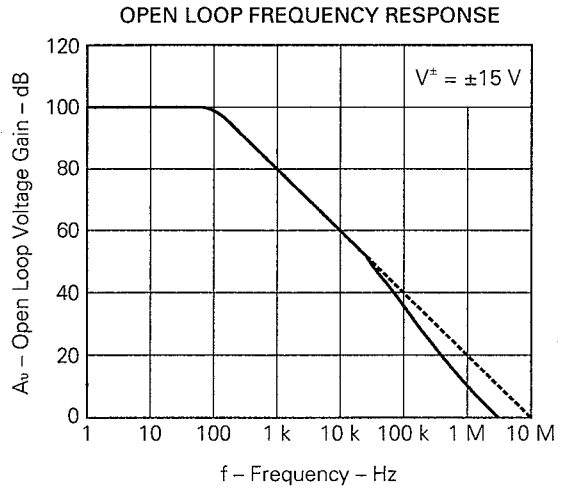
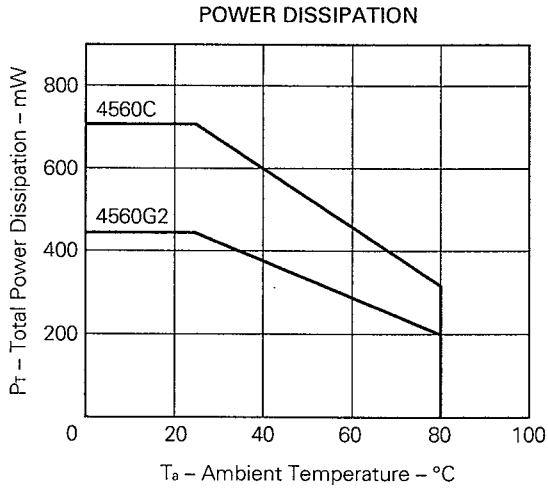
$$V_n = \frac{V_o}{2000}$$

Fig. 2 Channel Separation Measurement Circuit

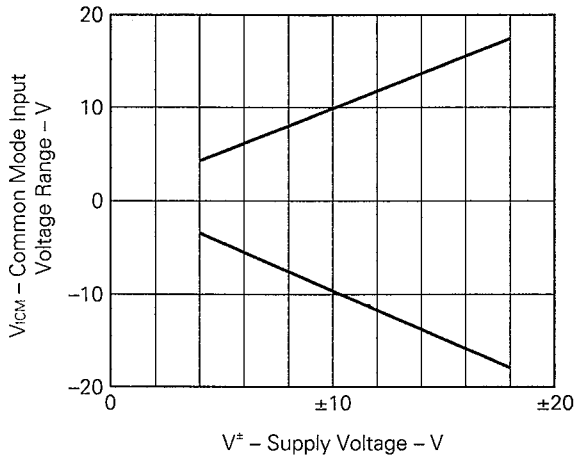


$$\text{Channel separation} = \left| 20 \cdot \log \left( \frac{1}{1000} \cdot \frac{V_{o2}}{V_{o1}} \right) \right|$$

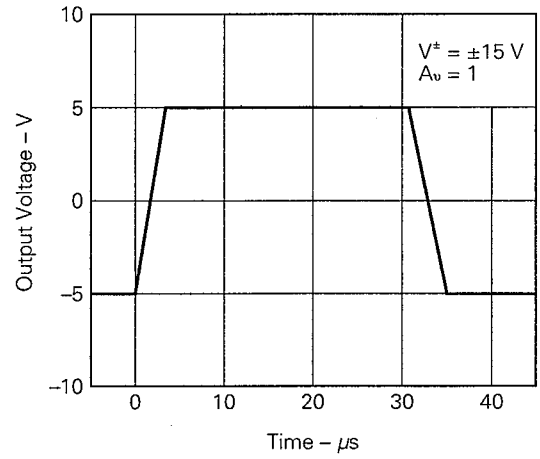
TYPICAL PERFORMANCE CHARACTERISTICS ( $T_a = 25^\circ\text{C}$ , TYP.)



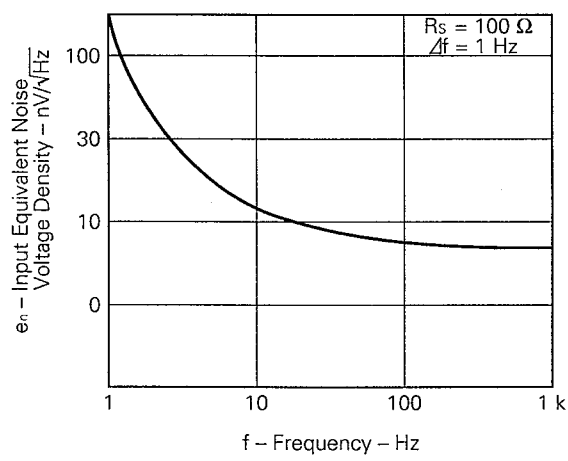
COMMON MODE INPUT VOLTAGE RANGE



PULSE RESPONSE

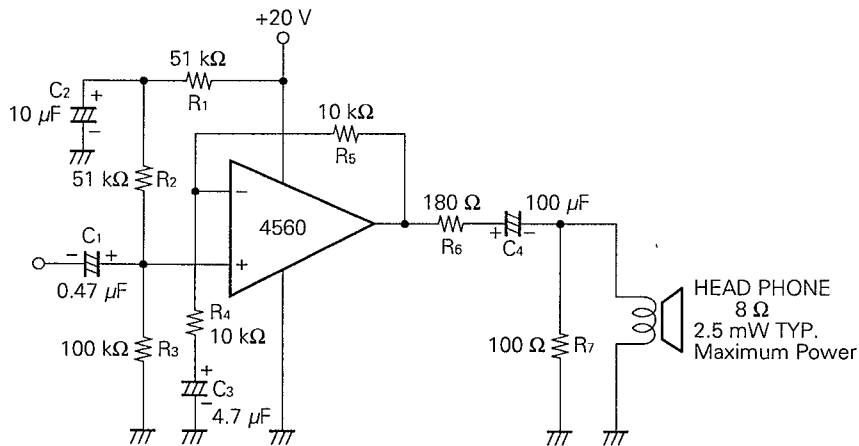


INPUT EQUIVALENT NOISE VOLTAGE DENSITY

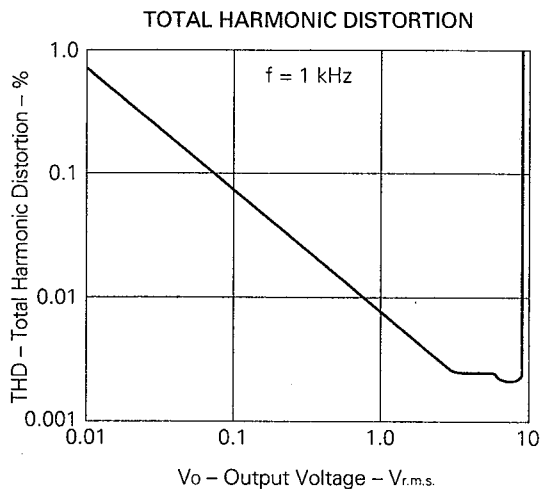
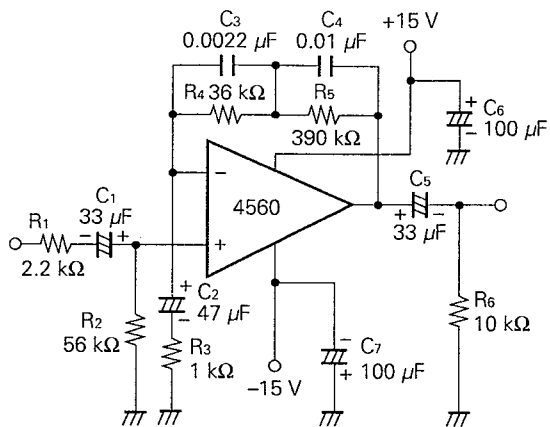


APPLICATION CIRCUITS

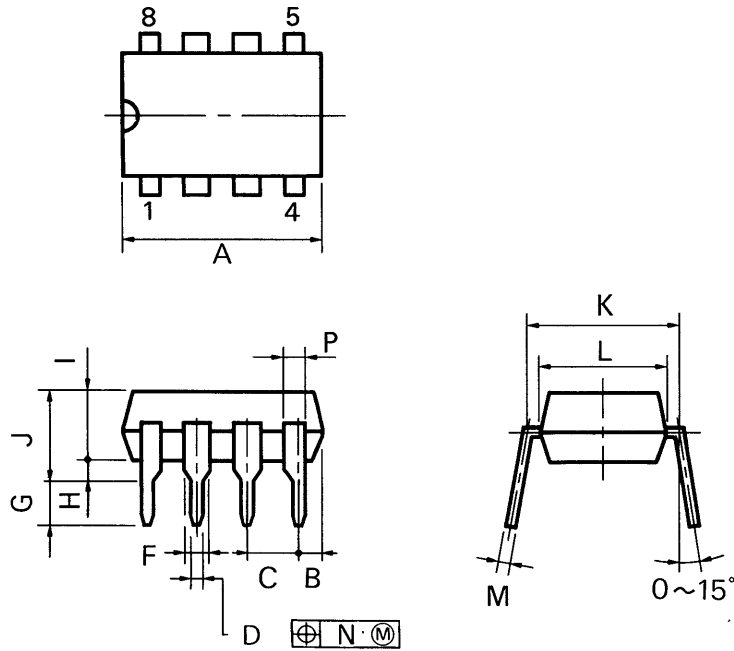
Head Phone Amp



RIAA Amp



8PIN PLASTIC DIP (300 mil)



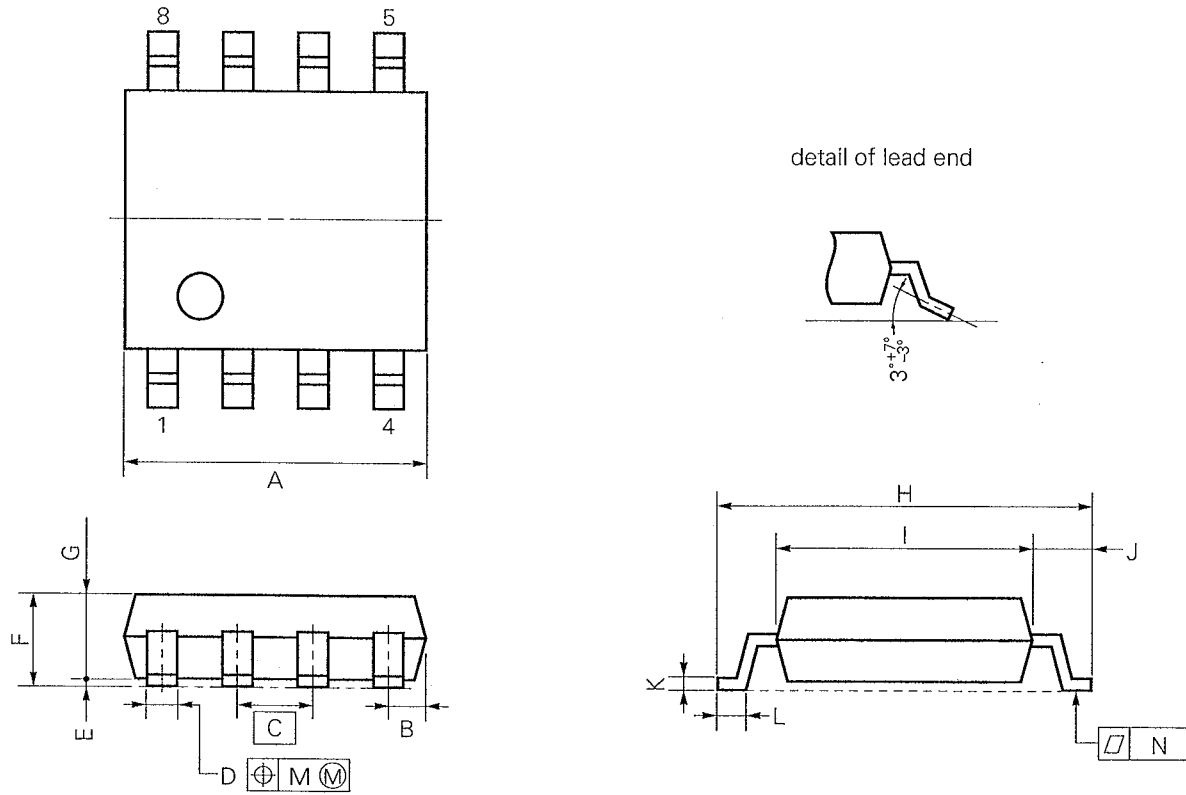
P8C-100-300B,C

NOTES

- 1) Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.
- 2) Item "K" to center of leads when formed parallel.

ITEM	MILLIMETERS	INCHES
A	10.16 MAX.	0.400 MAX.
B	1.27 MAX.	0.050 MAX.
C	2.54 (T.P.)	0.100 (T.P.)
D	0.50 ±0.10	0.020 <sup>+0.004</sup> / <sub>-0.006</sub>
F	1.4 MIN.	0.055 MIN.
G	3.2 ±0.3	0.126 ±0.012
H	0.51 MIN.	0.020 MIN.
I	4.31 MAX.	0.170 MAX.
J	5.08 MAX.	0.200 MAX.
K	7.62 (T.P.)	0.300 (T.P.)
L	6.4	0.252
M	0.25 <sup>+0.10</sup> / <sub>-0.08</sub>	0.010 <sup>+0.004</sup> / <sub>-0.003</sub>
N	0.25	0.01
P	0.9 MIN.	0.035 MIN.

8 PIN PLASTIC SOP (225 mil)



**NOTE**

Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

S8GM-50-225B-2

ITEM	MILLIMETERS	INCHES
A	5.37 MAX.	0.212 MAX.
B	0.78 MAX.	0.031 MAX.
C	1.27 (T.P.)	0.050 (T.P.)
D	0.40 <sup>+0.10</sup> <sub>-0.05</sub>	0.016 <sup>+0.004</sup> <sub>-0.003</sub>
E	0.1±0.1	0.004±0.004
F	1.8 MAX.	0.071MAX.
G	1.49	0.059
H	6.5±0.3	0.256±0.012
I	4.4	0.173
J	1.1	0.043
K	0.15 <sup>+0.10</sup> <sub>-0.05</sub>	0.006 <sup>+0.004</sup> <sub>-0.002</sub>
L	0.6±0.2	0.024 <sup>+0.008</sup> <sub>-0.009</sub>
M	0.12	0.005
N	0.15	0.006



**RECOMMENDED SOLDERING CONDITIONS**

The following conditions (see table below) must be met when soldering this product.  
Please consult with our sales offices in case other soldering process is used, or in case soldering is done under different conditions.

**TYPES OF SURFACE MOUNT DEVICE**

For more details, refer to our document "SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL" (IEI-1207).

[ μPC4560G2 ]

Soldering method	Soldering conditions	Recommended condition symbol
Infrared ray reflow	Peak package's surface temperature: 230 °C or below, Reflow time: 30 seconds or below (210 °C or higher), Number of reflow process: 1, Exposure limit*: None	IR30-00-1
VPS	Peak package's surface temperature: 215 °C or below, Reflow time: 40 seconds or below (200 °C or higher), Number of reflow process: 1, Exposure limit*: None	VP15-00-1
Wave soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or below Number of flow process: 1, Exposure limit*: None	WS15-00-1
Partial heating method	Terminal temperature: 300 °C or below, Flow time: 10 seconds or below, Exposure limit*: None	

\*: Exposure limit before soldering after dry-pack package is opened.  
Storage conditions: 25 °C and relative humidity at 65 % or less.

**Note:** Do not apply more than a single process at once, except for "Partial heating method".

**TYPES OF THROUGH HOLE DEVICE**

[ μPC4560C ]

Soldering method	Soldering conditions	Recommended condition symbol
Wave soldering	Solder temperature: 260 °C or below, Flow time: 10 seconds or below	

[MEMO]

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Application examples recommended by NEC Corporation.

Standard: Computer, Office equipment, Communication equipment, Test and Measurement equipment, Machine tools, Industrial robots, Audio and Visual equipment, Other consumer products, etc.

Special: Automotive and Transportation equipment, Traffic control systems, Antidisaster systems, Anticrime systems, etc.