NEC

# BIPOLAR ANALOG INTEGRATED CIRCUIT

# μPC4081

## J-FET INPUT OPERATIONAL AMPLIFIER

### DESCRIPTION

The μPC4081 is a single operational amplifier incorporating well matched ion implant P-channel J-FET on the same chip with standard bipolar transistors. The key features of this op amp is very low input bias current and high slew rate ten times faster than conventional general purpose op amps. By these features μPC4081 is excellent choice for wide variety of applications including integrator, active filter, pulse amp etc.

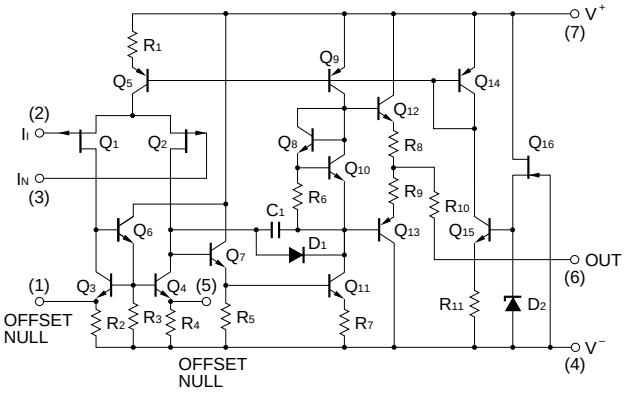
### FEATURES

- Low noise: $e_n$ = 25 nV/$\sqrt{Hz}$ (TYP.)
- Very low input bias and offset currents
- Output short circuit protection
- High input impedance...J-FET Input stage
- Internal frequency compensation
- High slew rate...13 V/μs (TYP.)

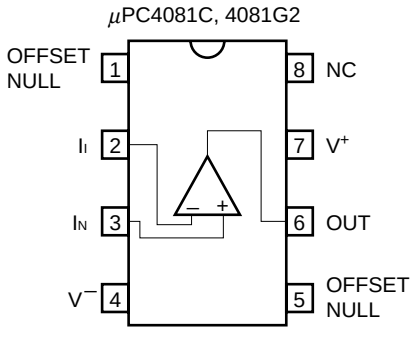
### ORDERING INFORMATION

| Part Number | Package |
|---|---|
| μPC4081C | 8-pin plastic DIP (7.62 mm (300)) |
| μPC4081G2 | 8-pin plastic SOP (5.72 mm (225)) |

### EQUIVALENT CIRCUIT




### PIN CONFIGURATION (Top View)




**Remark** NC : No Connection

**The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.**
**Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.**

Document No. G15343EJ3V0DS00 (3rd edition)
(Previous No. IC-1974)
Date Published February 2001 NS CP(K)
Printed in Japan

The mark ★ shows major revised points.

© NEC Corporation 1987

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C)

| Parameter | | Symbol | Ratings | Unit |
|---|---|---|---|---|
| Voltage between $V^+$ and $V^-$ Note 1 | | $V^+ - V^-$ | –0.3 to +36 | V |
| Differential Input Voltage | | $V_{ID}$ | ±30 | V |
| Input Voltage Note 2 | | $V_I$ | $V^-$–0.3 to $V^+$ +0.3 | V |
| Output Voltage Note 3 | | $V_O$ | $V^-$–0.3 to $V^+$ +0.3 | V |
| Power Dissipation | C Package Note 4 | $P_T$ | 350 | mW |
| | G2 Package Note 5 | | 440 | mW |
| Output Short Circuit Duration Note 6 | | | Indefinite | sec |
| Operating Ambient Temperature | | $T_A$ | –20 to +80 | °C |
| Storage Temperature | | $T_{stg}$ | –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 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.

**4.** Thermal derating factor is –5.0 mV/°C when operating ambient temperature is higher than 55°C.

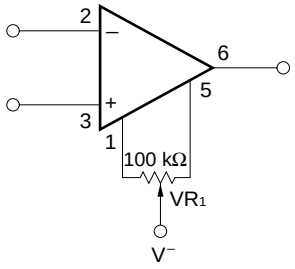
**5.** Thermal derating factor is –4.4 mV/°C when operating ambient temperature is higher than 25°C.

**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 | $V^{\pm}$ | ±5 | | ±16 | V |
| ★ | Output Current | $I_O$ | | | ±10 | mA |
| ★ | Capacitive Load ($A_V$ = +1, $R_f$ = 0 Ω) | $C_L$ | | | 100 | pF |

## OFFSET VOLTAGE NULL CIRCUIT




★ **Remark** The OFFSET NULL pins should be left open or connected to $V^-$ via a resistor as shown in the left figure. Don't connect to any lines other than $V^-$, otherwise mulfunction, degradation, or failure may occur.

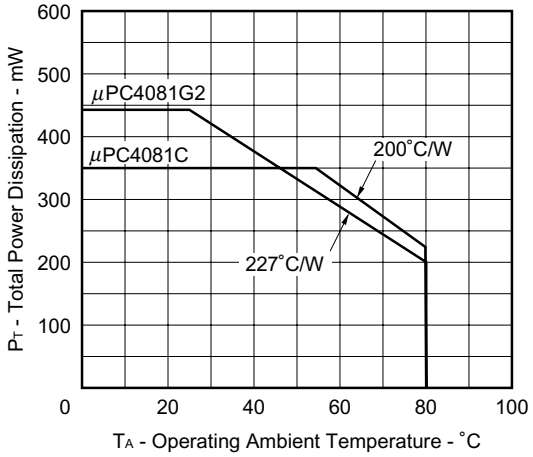
## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C, $V^{\pm}$ = ±15 V)

| Parameter | Symbol | Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | $R_S \leq 50\ \Omega$ | | ±5 | ±15 | mV |
| Input Offset Current Note 7 | $I_{IO}$ | | | ±5 | ±200 | pA |
| Input Bias Current Note 7 | $I_B$ | | | 30 | 400 | pA |
| Large Signal Voltage Gain | $A_V$ | $R_L \geq 2\ k\Omega$ , $V_O$ = ±10 V | 25000 | 200000 | | |
| Supply Current | $I_{CC}$ | $I_O$ = 0 A | | 2.0 | 2.8 | mA |
| Common Mode Rejection Ratio | CMR | | 70 | 76 | | dB |
| Supply Voltage Rejection Ratio | SVR | | 70 | 76 | | dB |
| Output Voltage Swing | $V_{om}$ | $R_L \geq 10\ k\Omega$ | ±12 | ±13.5 | | V |
| | | $R_L \geq 2\ k\Omega$ | ±10 | ±12 | | V |
| Common Model Input Voltage Range | $V_{ICM}$ | | ±10 | +15<br>–12.7 | | V |
| Slew Rate | SR | $A_V$ = 1 | | 13 | | V/μs |
| Unity Gain Frequency | $f_{unity}$ | | | 3 | | MHz |
| Input Equivalent Noise Voltage Density | $e_n$ | $R_S$ = 100 Ω, f = 1 kHz | | 25 | | nV/√Hz |
| Input Offset Voltage | $V_{IO}$ | $R_S \leq 50\ \Omega$, $T_A$ = –20 to +70°C | | | ±20 | mV |
| Average $V_{IO}$ Temperature Drift | $\Delta V_{IO}/\Delta T$ | $T_A$ = –20 to +70°C | | ±10 | | μV/°C |
| Input Offset Current Note 7 | $I_{IO}$ | $T_A$ = –20 to +70°C | | | ±5 | nA |
| Input Bias Current Note 7 | $I_B$ | $T_A$ = –20 to +70°C | | | 10 | nA |

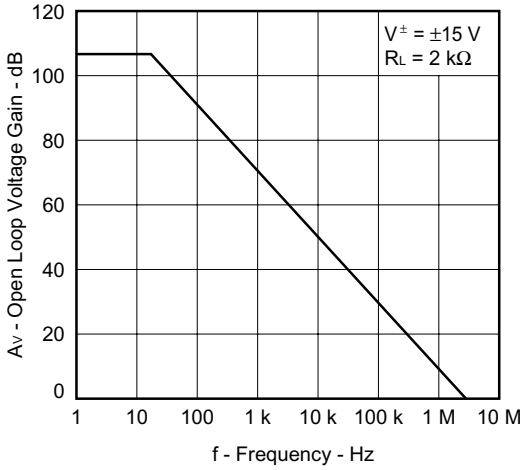
**Notes 7.** Input bias currents flow into IC. Because each currents are gate leak current of P-channel J-FET on input stage. And that are temperature sensitive. Short time measuring method is recommendable to maintain the junction temperature close to the operating ambient temperature.

## TYPICAL PERFORMANCE CHARACTERISTICS ($T_A$ = 25°C, TYP.)

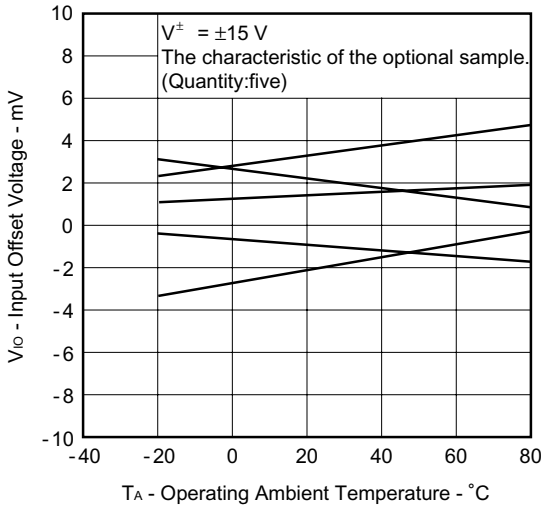
POWER DISSIPATION



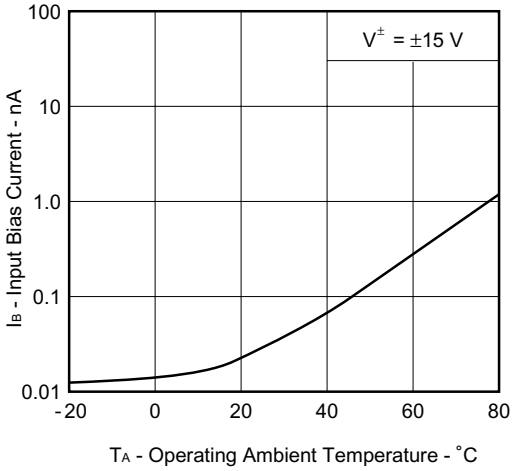

OPEN LOOP FREQUENCY RESPONSE



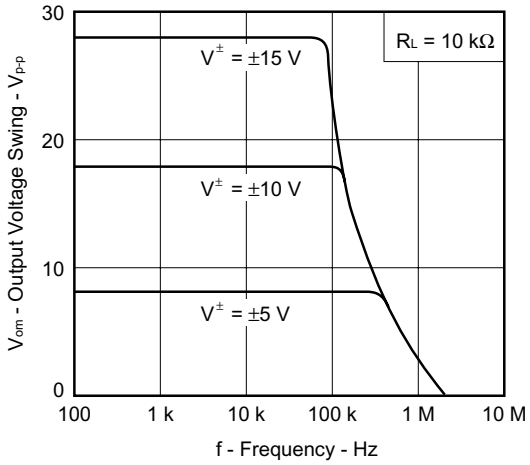

★INPUT OFFSET VOLTAGE



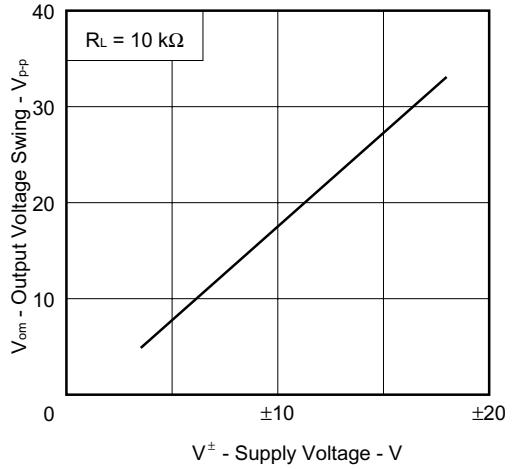

★INPUT BIAS CURRENT



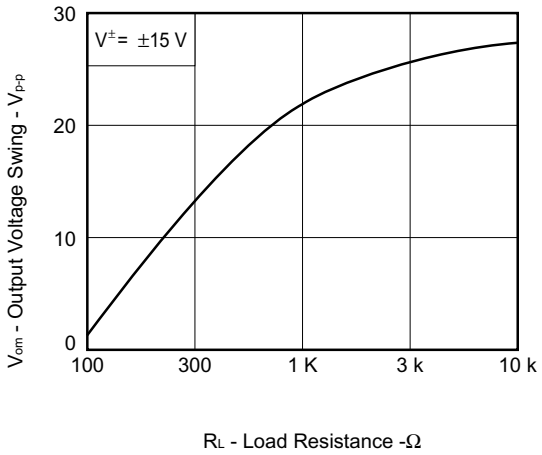

LARGE SIGNAL FREQUENCY RESPONSE



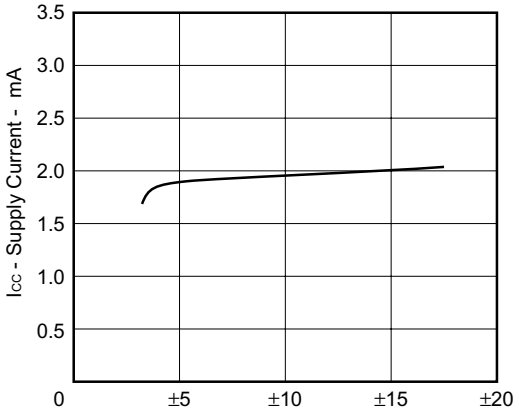

OUTPUT VOLTAGE SWING



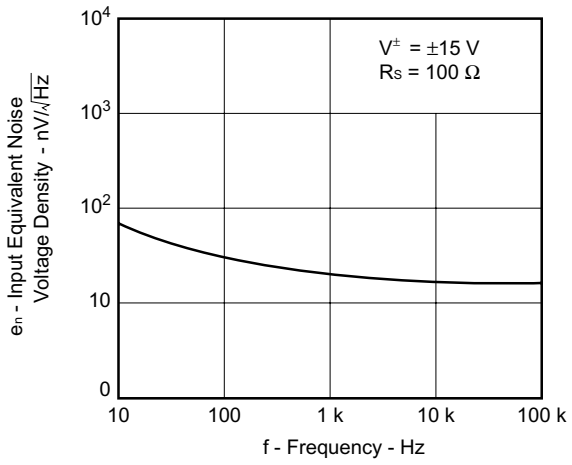
OUTPUT VOLTAGE SWING



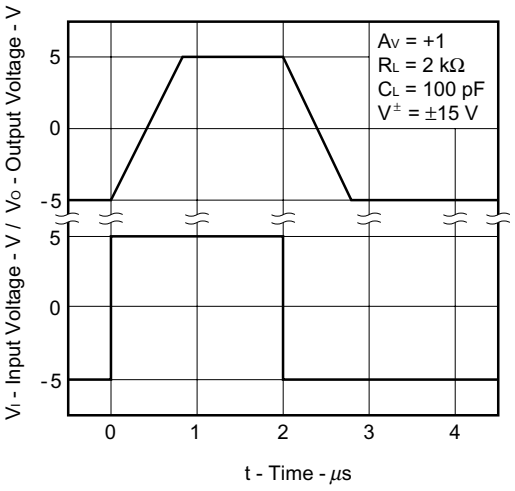

★ SUPPLY CURRENT




★ INPUT EQUIVALENT NOISE VOLTAGE DENSITY

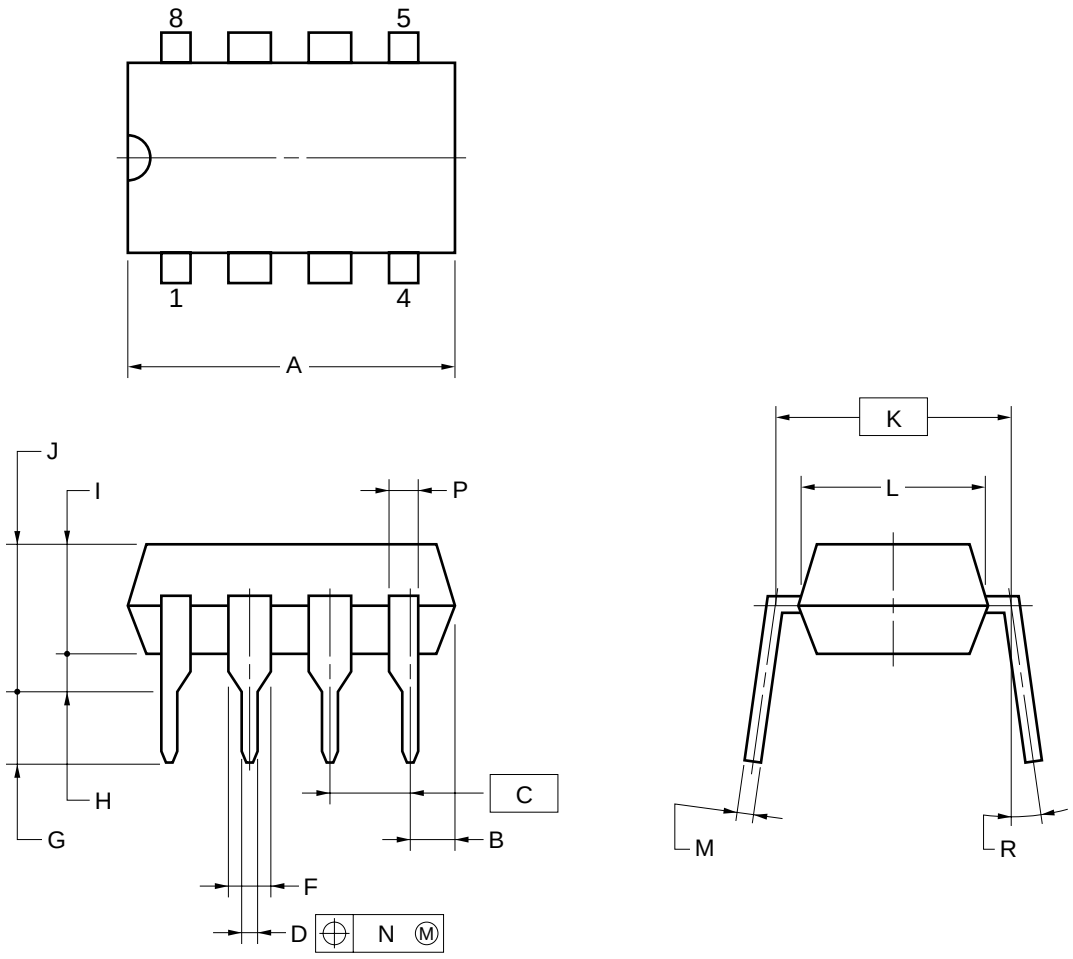



VOLTAGE FOLLOWER PULSE RESPONSE



★ **PACKAGE DRAWINGS (Unit : mm)**

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




**NOTES**

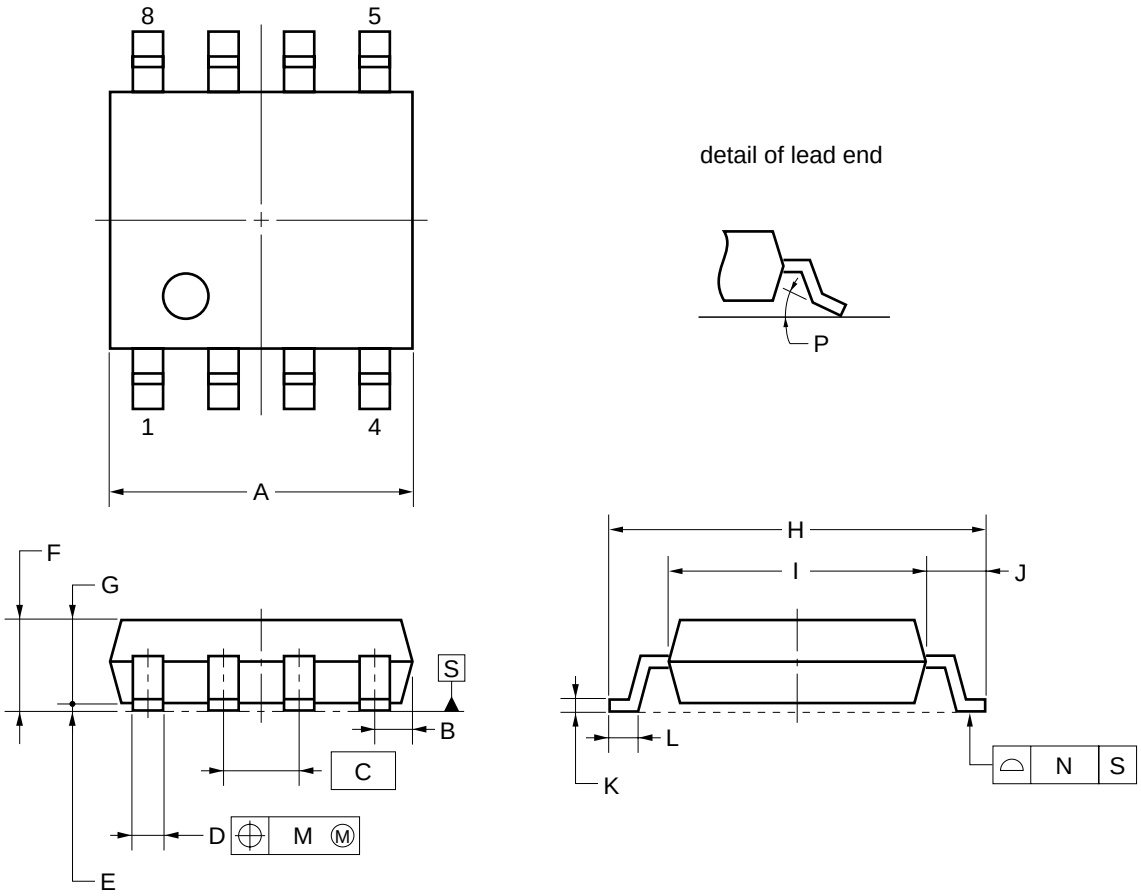
1. Each lead centerline is located within 0.25 mm of its true position (T.P.) at maximum material condition.

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 | $0.25^{+0.10}_{-0.05}$ |
| 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 | $5.2^{+0.17}_{-0.20}$ |
| B | 0.78 MAX. |
| C | 1.27 (T.P.) |
| D | $0.42^{+0.08}_{-0.07}$ |
| 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 | $0.17^{+0.08}_{-0.07}$ |
| L | 0.6±0.2 |
| M | 0.12 |
| N | 0.10 |
| P | $3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$ |

**S8GM-50-225B-6**

## ★ RECOMMENDED SOLDERING CONDITIONS

When soldering this product, it is highly recommended to observe the conditions as shown below. If other soldering processes are used, or if the soldering is performed under different conditions, please make sure to consult with our sales offices.

For more details, refer to our document "**SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL"(C10535E)**.

**Type of Surface Mount Device**

**μPC4081G2: 8-pin plastic SOP (5.72 mm (225))**

| Process | Conditions | Symbol |
|---|---|---|
| Infrared Ray Reflow | Peak temperature: 230°C or below (Package surface temperature),<br>Reflow time: 30 seconds or less (at 210°C or higher),<br>Maximum number of reflow processes: 1 time. | IR30-00-1 |
| Vapor Phase Soldering | Peak temperature: 215°C or below (Package surface temperature),<br>Reflow time: 40 seconds or less (at 200°C or higher),<br>Maximum number of reflow processes: 1 time. | VP15-00-1 |
| Wave Soldering | Solder temperature: 260°C or below, Flow time: 10 seconds or less,<br>Maximum number of flow processes: 1 time,<br>Pre-heating temperature: 120°C or below (Package surface temperature). | WS60-00-1 |
| Partial Heating Method | Pin temperature: 300°C or below,<br>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**

**μPC4081C: 8-pin plastic DIP (7.62 mm (300))**

| Process | Conditions |
|---|---|
| Wave Soldering<br>(only to leads) | Solder temperature: 260°C or below,<br>Flow time: 10 seconds or less. |
| Partial Heating Method | Pin temperature: 300°C or below,<br>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.**

**[MEMO]**

**[MEMO]**

**[MEMO]**

- **The information in this document is current as of February, 2001. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC's data sheets or data books, etc., for the most up-to-date specifications of NEC semiconductor products. Not all products and/or types are available in every country. Please check with an NEC sales representative for availability and additional information.**
- No part of this document may be copied or reproduced in any form or by any means without prior written consent of NEC. NEC assumes no responsibility for any errors that may appear in this document.
- NEC does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from the use of NEC semiconductor products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC or others.
- Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of customer's equipment shall be done under the full responsibility of customer. NEC assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
- While NEC endeavours to enhance the quality, reliability and safety of NEC semiconductor products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC semiconductor products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment, and anti-failure features.
- NEC semiconductor products are classified into the following three quality grades:
  "Standard", "Special" and "Specific". The "Specific" quality grade applies only to semiconductor products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of a semiconductor product depend on its quality grade, as indicated below. Customers must check the quality grade of each semiconductor product before using it in a particular application.

  "Standard": Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

  "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.

  The quality grade of NEC semiconductor products is "Standard" unless otherwise expressly specified in NEC's data sheets or data books, etc. If customers wish to use NEC semiconductor products in applications not intended by NEC, they must contact an NEC sales representative in advance to determine NEC's willingness to support a given application.

  (Note)

  (1) "NEC" as used in this statement means NEC Corporation and also includes its majority-owned subsidiaries.

  (2) "NEC semiconductor products" means any semiconductor product developed or manufactured by or for NEC (as defined above).

M8E 00.4