

LOW POWER QUAD OPERATIONAL AMPLIFIER

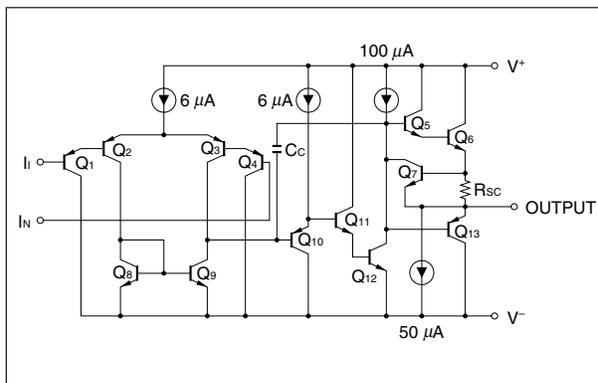
DESCRIPTION

The  $\mu$ PC324 is a quad operational amplifier which is designed to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the power supply current drain is very low. Further advantage, the input common-mode voltage can also swing to ground in the linear mode.

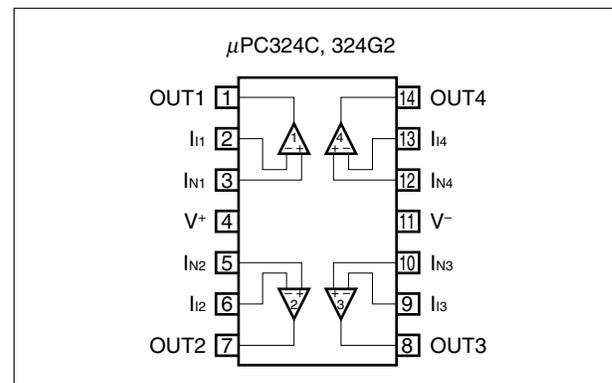
FEATURES

- Internal frequency compensation
- Wide output voltage swing  $V^-$  to  $V^+ - 1.5$  V
- Common Mode input voltage range includes  $V^-$
- Wide supply range  
 3 V to 30 V (Single)  
 $\pm 1.5$  V to  $\pm 15$  V (Split)
- Output short circuit protection

EQUIVALENT CIRCUIT (1/4 Circuit)



PIN CONFIGURATION (Top View)



★ ORDERING INFORMATION

| Part Number      | Package                            |
|------------------|------------------------------------|
| $\mu$ PC324C     | 14-pin plastic DIP (7.62 mm (300)) |
| $\mu$ PC324G2    | 14-pin plastic SOP (5.72 mm (225)) |
| $\mu$ PC324G2(5) | 14-pin plastic SOP (5.72 mm (225)) |

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**ABSOLUTE MAXIMUM RATINGS (TA = 25 °C)**

| Parameter                                   |                          | Symbol           | Ratings        | Unit |
|---|--------------------------|------------------|----------------|------|
| Voltage between V+ and V- <b>Note 1</b>     |                          | V+–V-            | –0.3 to +32    | V    |
| Differential Input Voltage                  |                          | V <sub>ID</sub>  | ±32            | V    |
| Input Voltage <b>Note 2</b>                 |                          | V <sub>I</sub>   | V–0.3 to V+32  | V    |
| Output Voltage <b>Note 3</b>                |                          | V <sub>O</sub>   | V–0.3 to V+0.3 | V    |
| Power Dissipation                           | C Package <b>Note 4</b>  | P <sub>T</sub>   | 570            | mW   |
|   | G2 Package <b>Note 5</b> |                  | 550            | mW   |
| Output Short Circuit Duration <b>Note 6</b> |                          |                  | Indefinite     | 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 independent of the magnitude of V+. Either input signal should not be allowed to go negative by more than 0.3 V. 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 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.
  - Thermal derating factor is –7.6 mW/°C when operating ambient temperature is higher than 50 °C.
  - Thermal derating factor is –5.5 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 (Split)    | V±     | ±1.5 |      | ±15  | V    |
| Supply Voltage (V– = GND) | V+     | 3    |      | 30   | V    |

**μPC324C, μPC324G2**

**ELECTRICAL CHARACTERISTICS (TA = 25 °C, V+ = 5 V, V– = GND)**

| Parameter                        | Symbol                | Conditions   | MIN. | TYP. | MAX.     | Unit |
|----------------------------------|-----------------------|--|------|------|----------|------|
| Input Offset Voltage             | V <sub>IO</sub>       | R <sub>S</sub> = 0 Ω   |      | ±2   | ±7       | mV   |
| Input Offset Current             | I <sub>IO</sub>       |  |      | ±5   | ±50      | nA   |
| Input Bias Current <b>Note 7</b> | I <sub>B</sub>        |  |      | 45   | 250      | nA   |
| Large Single Voltage Gain        | A <sub>V</sub>        | R <sub>L</sub> ≥ 2 kΩ  | 25   | 100  |          | V/mV |
| ★ Supply Current <b>Note 8</b>   | I <sub>CC</sub>       | R <sub>L</sub> = ∞, I <sub>O</sub> = 0 A                                 |      | 1.0  | 2        | mA   |
| Common Mode Rejection Ratio      | CMR                   |  | 65   | 85   |          | dB   |
| Supply Voltage Rejection Ratio   | SVR                   |  | 65   | 100  |          | dB   |
| Output Voltage Swing             | V <sub>O</sub>        | R <sub>L</sub> = 2 kΩ (Connect to GND)                                   | 0    |      | V+ – 1.5 | V    |
| Common Mode Input Voltage Range  | V <sub>ICM</sub>      |  | 0    |      | V+ – 1.5 | V    |
| Output Current (SOURCE)          | I <sub>O SOURCE</sub> | V <sub>IN+</sub> = +1 V, V <sub>IN–</sub> = 0 V                          | 20   | 40   |          | mA   |
| Output Current (SINK)            | I <sub>O SINK</sub>   | V <sub>IN–</sub> = +1 V, V <sub>IN+</sub> = 0 V                          | 10   | 20   |          | mA   |
|                                  |                       | V <sub>IN–</sub> = +1 V, V <sub>IN+</sub> = 0 V, V <sub>O</sub> = 200 mV | 12   | 50   |          | μA   |
| Channel Separation               |                       | f = 1 kHz 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.

★ μPC324G2(5)

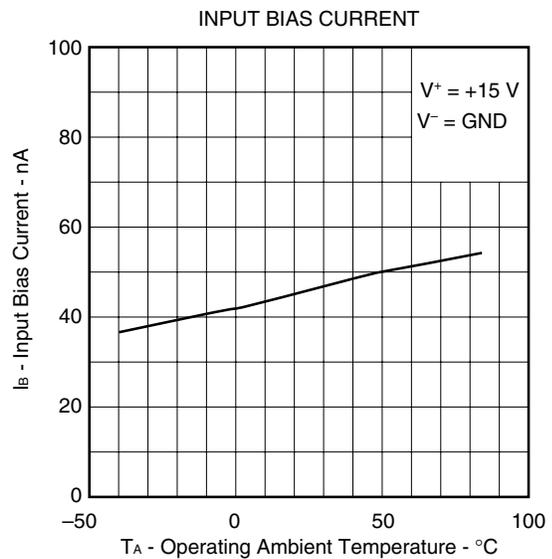
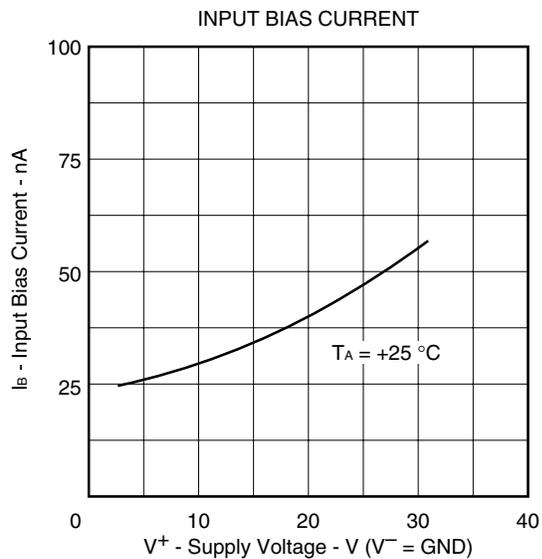
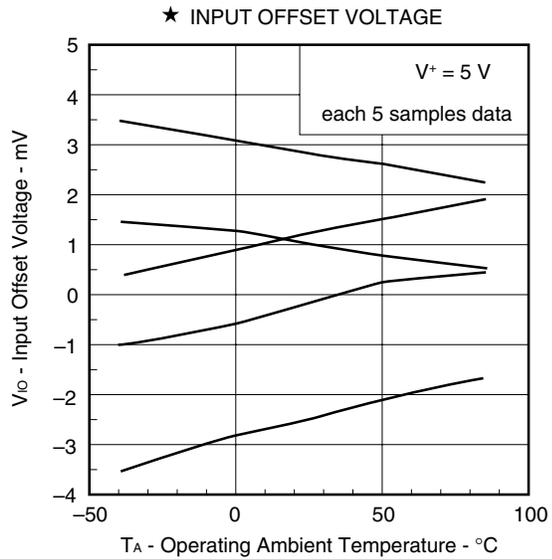
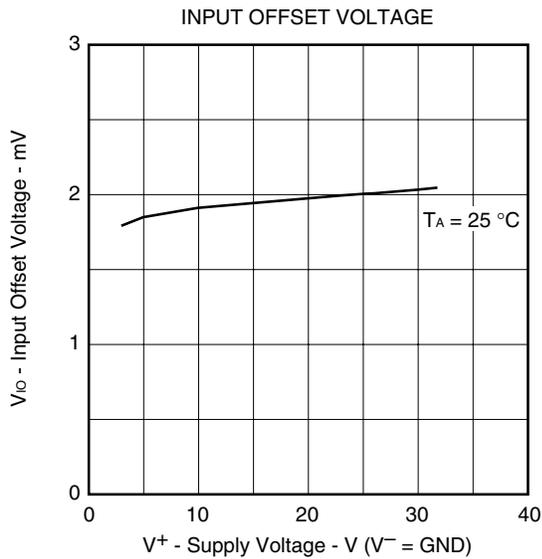
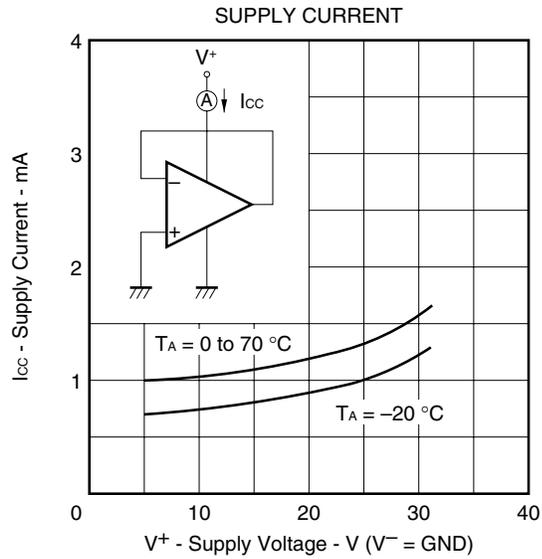
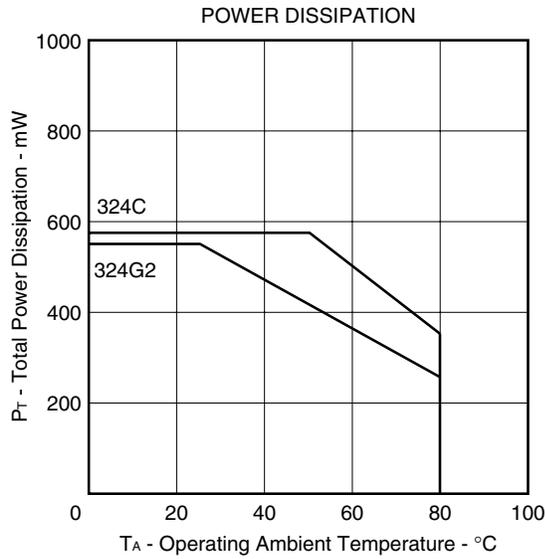
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, V<sup>+</sup> = 5 V, V<sup>-</sup> = GND)**

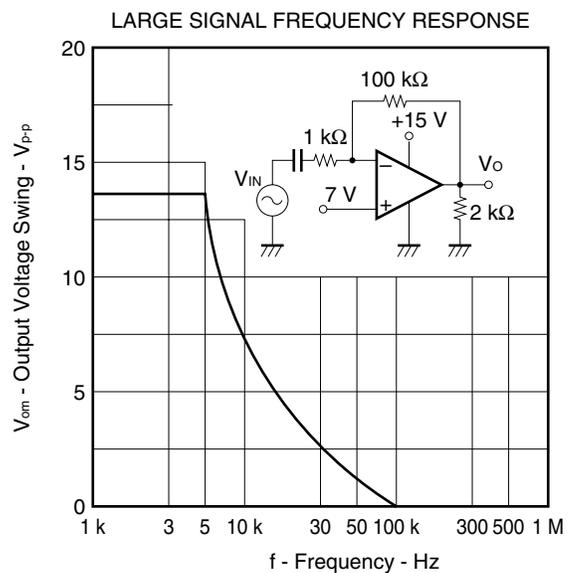
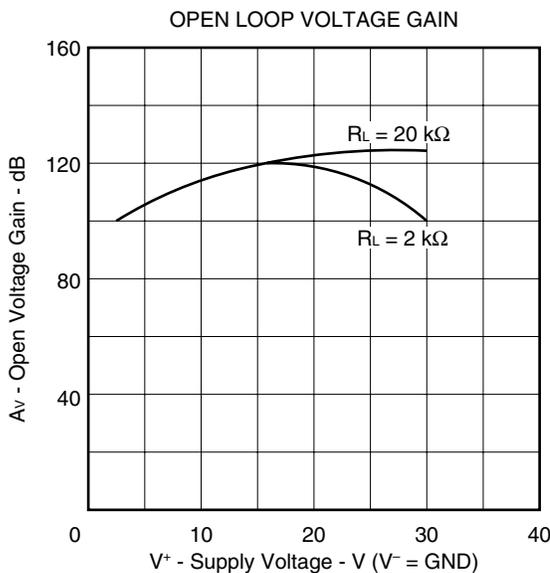
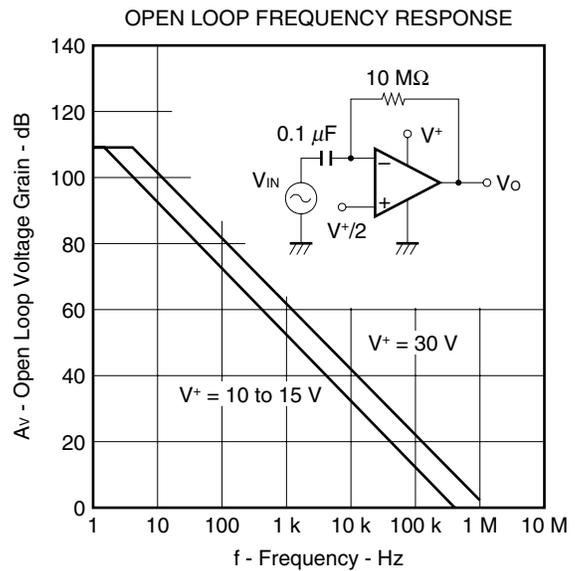
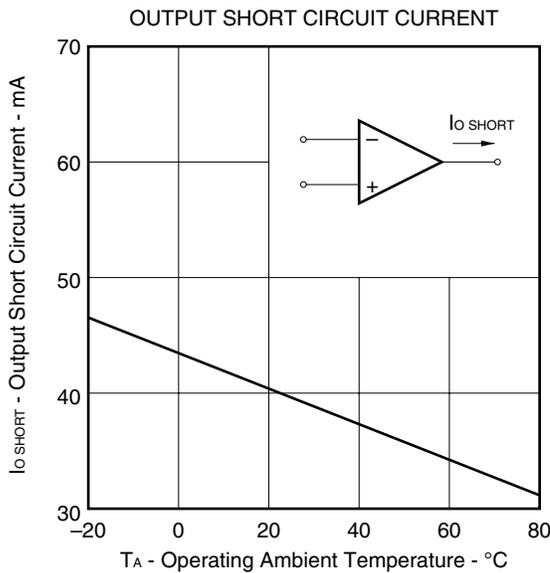
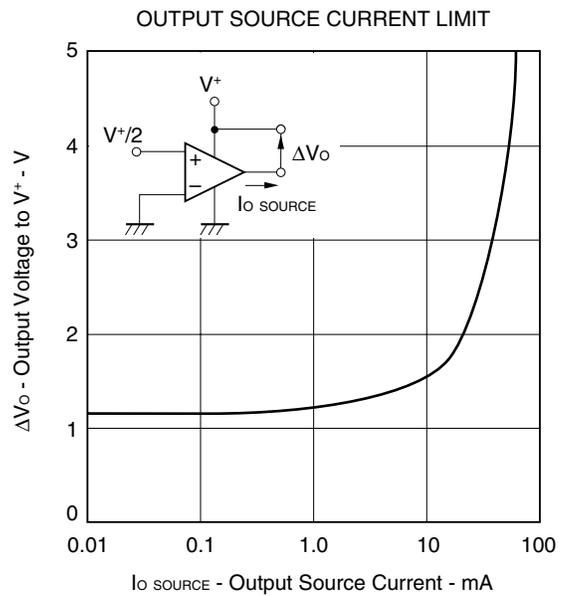
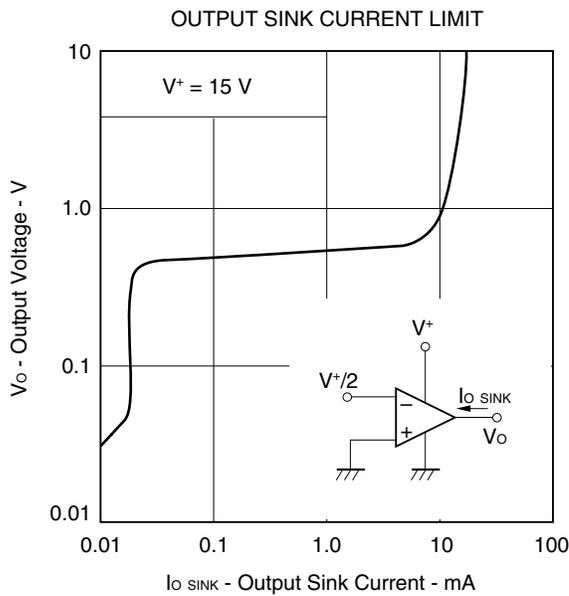
| Parameter                        | Symbol                | Conditions   | MIN. | TYP. | MAX.                 | Unit |
|----------------------------------|-----------------------|--|------|------|----------------------|------|
| Input Offset Voltage             | V <sub>IO</sub>       | R <sub>S</sub> = 0 Ω   |      | ±2   | ±3                   | mV   |
| Input Offset Current             | I <sub>IO</sub>       |  |      | ±5   | ±50                  | nA   |
| Input Bias Current <b>Note 7</b> | I <sub>B</sub>        |  |      | 45   | 60                   | nA   |
| Large Single Voltage Gain        | A <sub>V</sub>        | R <sub>L</sub> ≥ 2 kΩ  | 50   | 100  |                      | V/mV |
| Supply Current <b>Note 8</b>     | I <sub>CC</sub>       | R <sub>L</sub> = ∞, I <sub>O</sub> = 0 A   |      | 1.0  | 1.5                  | mA   |
| Common Mode Rejection Ratio      | CMR                   |  | 65   | 85   |                      | dB   |
| Supply Voltage Rejection Ratio   | SVR                   |  | 65   | 100  |                      | dB   |
| Output Voltage Swing             | V <sub>O</sub>        | R <sub>L</sub> = 2 kΩ (Connect to GND)   | 0    |      | V <sup>+</sup> - 1.5 | V    |
| Common Mode Input Voltage Range  | V <sub>ICM</sub>      |  | 0    |      | V <sup>+</sup> - 1.4 | V    |
| Output Current (SOURCE)          | I <sub>O SOURCE</sub> | V <sub>IN<sup>+</sup></sub> = +1 V, V <sub>IN<sup>-</sup></sub> = 0 V                          | 30   | 40   |                      | mA   |
| Output Current (SINK)            | I <sub>O SINK</sub>   | V <sub>IN<sup>-</sup></sub> = +1 V, V <sub>IN<sup>+</sup></sub> = 0 V                          | 15   | 20   |                      | mA   |
|                                  |                       | V <sub>IN<sup>-</sup></sub> = +1 V, V <sub>IN<sup>+</sup></sub> = 0 V, V <sub>O</sub> = 200 mV | 30   | 50   |                      | μA   |
| Channel Separation               |                       | f = 1 kHz to 20 kHz  |      | 120  |                      | dB   |

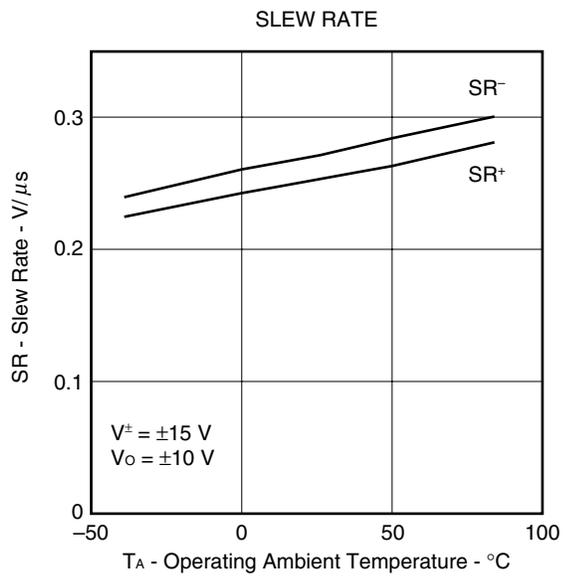
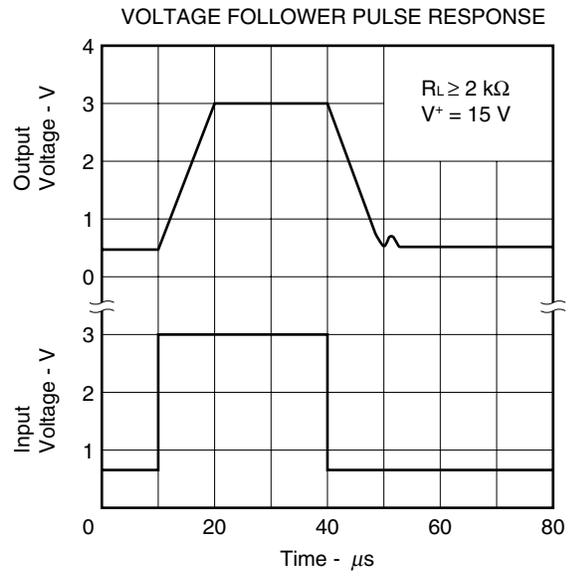
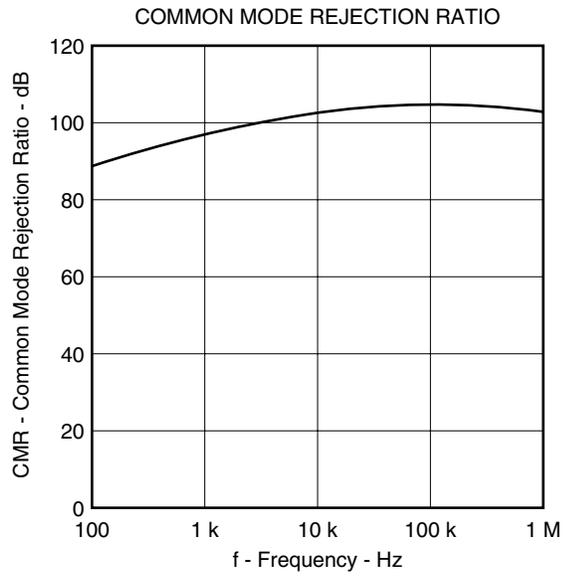
**Notes 7.** Input bias currents flow out from IC. Because each currents are base current of PNP-transistor on input stage.

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

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

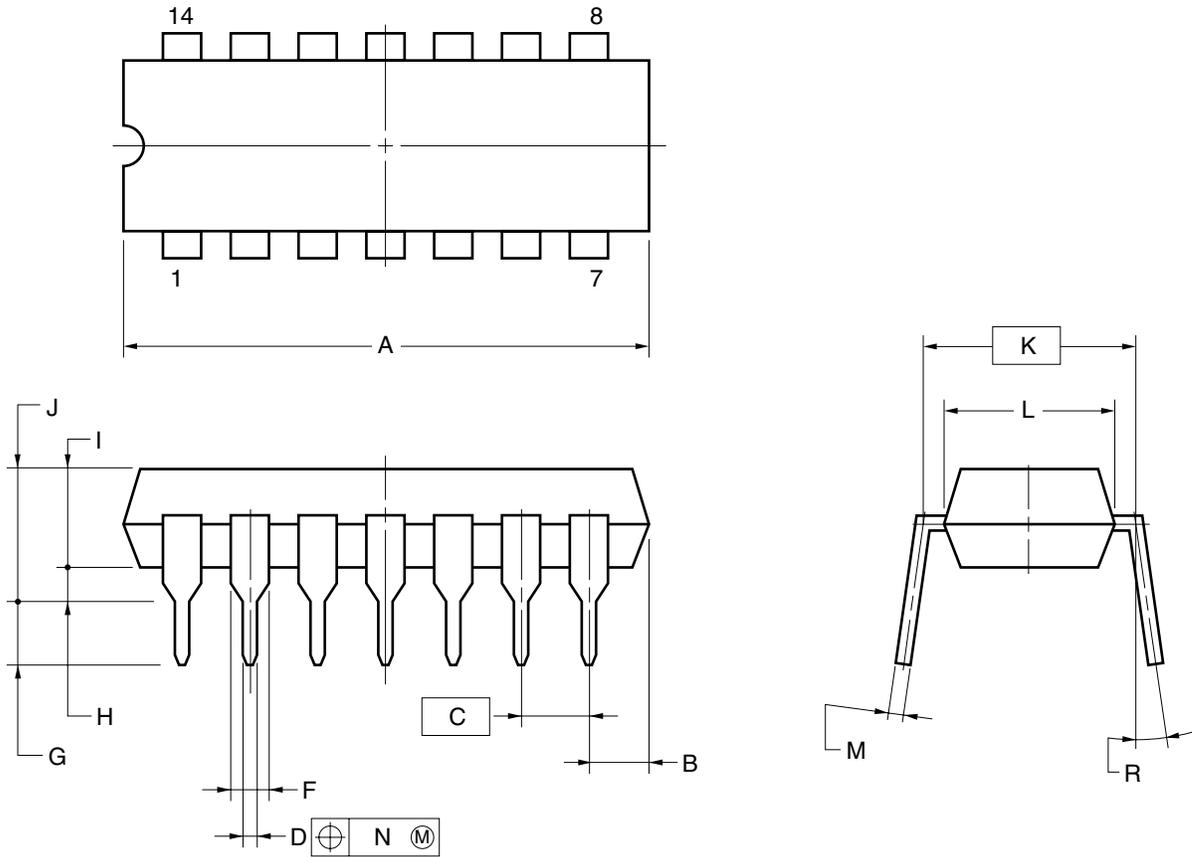






★ PACKAGE DRAWINGS

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



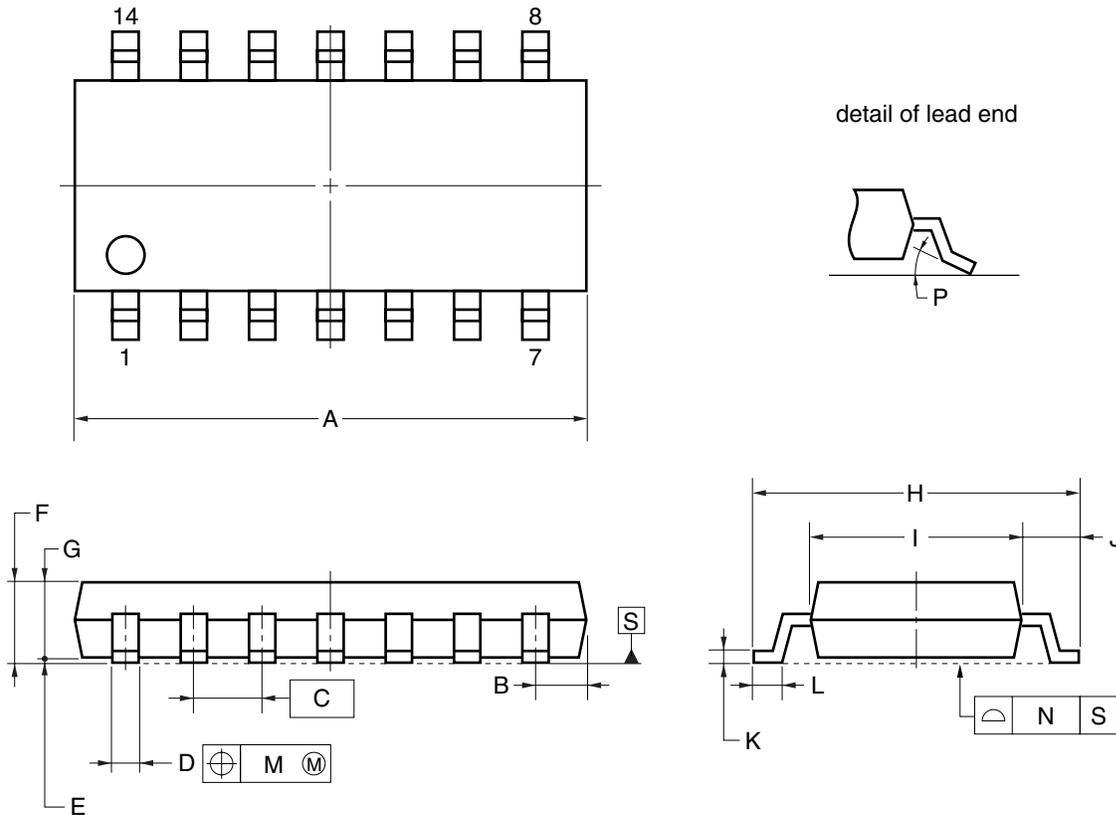
NOTES

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    | 19.22±0.2                              |
| B    | 2.14 MAX.                              |
| C    | 2.54 (T.P.)                            |
| D    | 0.50±0.10                              |
| F    | 1.32±0.12                              |
| G    | 3.6±0.3                                |
| H    | 0.51 MIN.                              |
| I    | 3.55                                   |
| J    | 4.3±0.2                                |
| K    | 7.62 (T.P.)                            |
| L    | 6.4±0.2                                |
| M    | 0.25 <sup>+0.10</sup> <sub>-0.05</sub> |
| N    | 0.25                                   |
| R    | 0~15°                                  |

P14C-100-300B1-3

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



**NOTE**

Each lead centerline is located within 0.1 mm of its true position (T.P.) at maximum material condition.

| ITEM | MILLIMETERS                            |
|------|--|
| A    | 10.2±0.26                              |
| B    | 1.42 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 <sup>+0.21</sup> <sub>-0.2</sub>  |
| G    | 1.49                                   |
| H    | 6.5±0.2                                |
| I    | 4.4±0.1                                |
| J    | 1.1±0.16                               |
| K    | 0.17 <sup>+0.08</sup> <sub>-0.07</sub> |
| L    | 0.6±0.2                                |
| M    | 0.1                                    |
| N    | 0.10                                   |
| P    | 3° <sup>+7°</sup> <sub>-3°</sub>       |

S14GM-50-225B, C-6

★ **RECOMMENDED SOLDERING CONDITIONS**

The μPC324 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>)**

**Surface mount device**

**μPC324G2: 14-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.

**Through-hole device**

**μPC324C: 14-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.

## REFERENCE DOCUMENTS

|   |  |   |
|---|--|---|
|   | QUALITY GRADES ON NEC SEMICONDUCTOR DEVICES  | C11531E   |
| ★ | SEMICONDUCTOR DEVICE MOUNT MANUAL  | <a href="http://www.necel.com/pkg/en/mount/index.html">http://www.necel.com/pkg/en/mount/index.html</a> |
|   | NEC SEMICONDUCTOR DEVICE RELIABILITY/<br>QUALITY CONTROL SYSTEM - STANDARD LINEAR IC | IEI-1212  |

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