

LOW POWER DUAL COMPARATORS

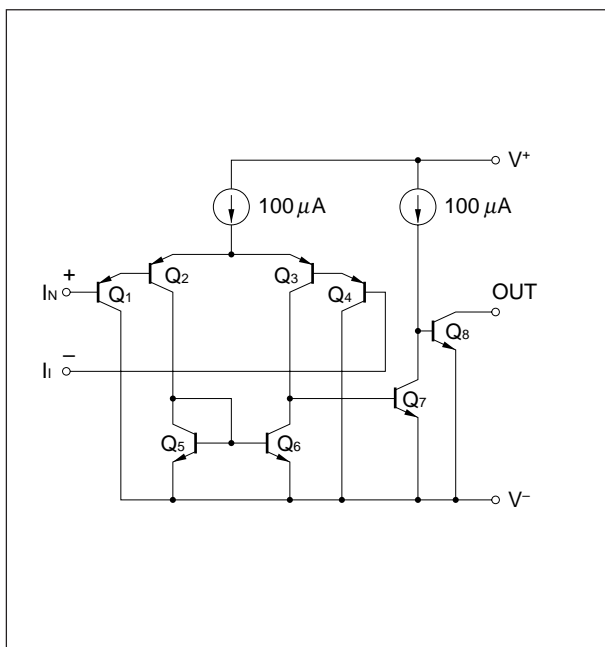
DESCRIPTION

The  $\mu$ PC393 is a dual comparator which is designed to operate from a single power supply over a wide range of voltage. Operation from split power supplies is also possible and the power supply current drain is very low. Further advantage, the input common-mode voltage includes ground, even though operated from a single power supply voltage.

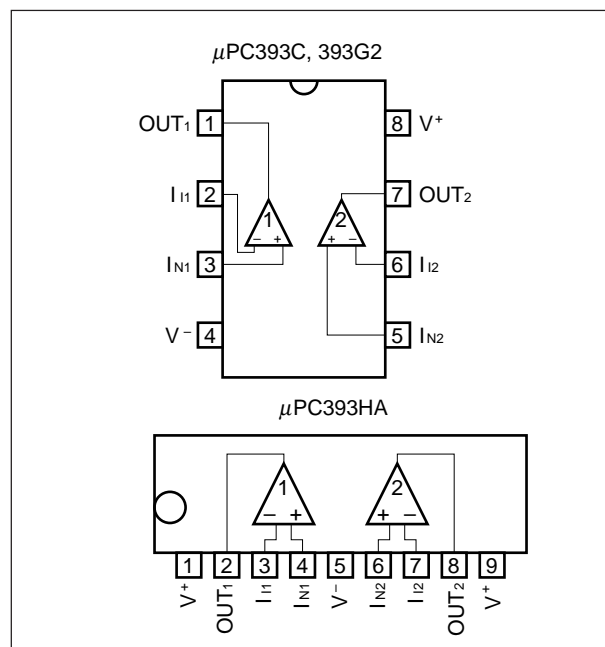
FEATURES

- Common-mode input voltage range includes  $V^-$
- Wide supply voltage range  
2 V to 32 V (Single)  
 $\pm 1$  V to  $\pm 16$  V (Split)
- Low supply current
- Open collector output

EQUIVALENT CIRCUIT (1/2 Circuit)



PIN CONFIGURATION (Top View)



ORDERING INFORMATION

| Part Number   | Package                     |
|---------------|-----------------------------|
| $\mu$ PC393C  | 8-pin plastic DIP (300 mil) |
| $\mu$ PC393G2 | 8-pin plastic SOP (225 mil) |
| $\mu$ PC393HA | 9-pin plastic slim SIP      |

The information in this document is subject to change without notice.

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

| Parameter   |                          | Symbol                         | Ratings                                   | Unit |
|---|--------------------------|--------------------------------|---|------|
| Voltage between V <sup>+</sup> and V <sup>-</sup> | <b>Note 1</b>            | V <sup>+</sup> -V <sup>-</sup> | -0.3 to +36                               | V    |
| Differential Input Voltage                        |                          | V <sub>ID</sub>                | ±36                                       | V    |
| Input Voltage                                     | <b>Note 2</b>            | V <sub>I</sub>                 | V <sup>-</sup> -0.3 to V <sup>-</sup> +36 | V    |
| Output Voltage                                    | <b>Note 3</b>            | V <sub>O</sub>                 | V <sup>-</sup> -0.3 to V <sup>-</sup> +36 | V    |
| Power Dissipation                                 | C Package <b>Note 4</b>  | P <sub>T</sub>                 | 350                                       | mW   |
|   | G2 Package <b>Note 5</b> |                                | 440                                       | mW   |
|   | HA Package <b>Note 4</b> |                                | 350                                       | 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<sup>+</sup>. Either input signal should not be allowed to go negative by more than 0.3 V. The normal operation will establish when any input is 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 independent of the magnitude of V<sup>+</sup>. Even during the transition period of supply voltage, power on/off etc., this specification should be kept.
  - 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.
  - Short circuits from the output to V<sup>+</sup> can cause destruction. Pay careful attention to the total power dissipation not to exceed the absolute maximum ratings, Note 4 and Note 5.

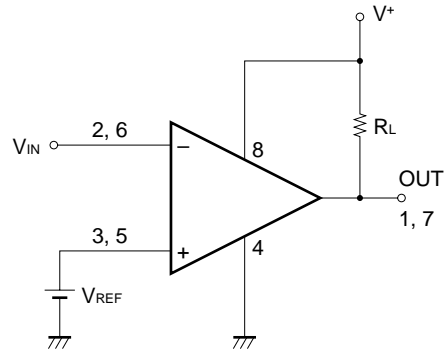
**RECOMMENDED OPERATING CONDITIONS**

| Parameter                             | Symbol         | MIN. | TYP. | MAX. | Unit |
|---------------------------------------|----------------|------|------|------|------|
| Supply Voltage (Split)                | V <sup>±</sup> | ±1   |      | ±16  | V    |
| Supply Voltage (V <sup>-</sup> = GND) | V <sup>+</sup> | +2   |      | +32  | V    |

ELECTRICAL CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ ,  $V^+ = 5\text{ V}$ ,  $V^- = \text{GND}$ )

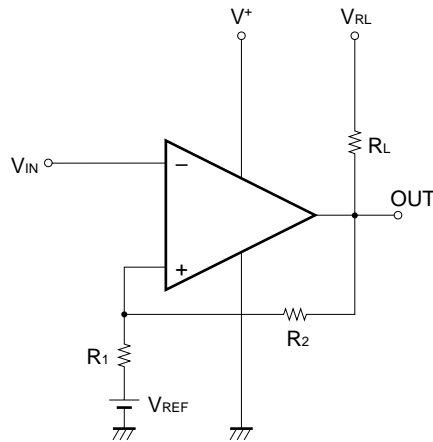
| Parameter                       | Symbol              | Conditions  | MIN. | TYP.    | MAX.        | Unit          |
|---------------------------------|---------------------|---|------|---------|-------------|---------------|
| Input Offset Voltage            | $V_{IO}$            | $V_O = 1.4\text{ V}$ , $V_{REF} = 1.4\text{ V}$ , $R_S = 0\ \Omega$                     |      | $\pm 2$ | $\pm 5$     | mV            |
| Input Offset Current            | $I_{IO}$            | $V_O \doteq 1.4\text{ V}$   |      | $\pm 5$ | $\pm 50$    | nA            |
| Input Bias Current              | $I_B$               | $V_O \doteq 1.4\text{ V}$   |      | 25      | 250         | nA            |
| Voltage Gain                    | $A_V$               | $R_L = 15\text{ k}\Omega$   |      | 200     |             | V/mV          |
| Supply Current                  | $I_{CC}$            | $R_L = \infty$ , $I_O = 0\text{ A}$ , Both Comparators                                  |      | 0.6     | 1           | mA            |
| Common Mode Input Voltage Range | $V_{ICM}$           |   | 0    |         | $V^+ - 1.5$ | V             |
| Output Saturation Voltage       | $V_{OL}$            | $V_{IN(-)} = 1\text{ V}$ , $V_{IN(+)} = 0\text{ V}$ , $I_{O\text{ SINK}} = 4\text{ mA}$ |      | 0.2     | 0.4         | V             |
| Output Sink Current             | $I_{O\text{ SINK}}$ | $V_{IN(-)} = 1\text{ V}$ , $V_{IN(+)} = 0\text{ V}$ , $V_O \leq 1.5\text{ V}$           | 6    | 16      |             | mA            |
| Output Leakage Current          | $I_{O\text{ LEAK}}$ | $V_{IN(+)} = 1\text{ V}$ , $V_{IN(-)} = 0\text{ V}$ , $V_O = 5\text{ V}$                |      | 0.1     |             | nA            |
| Response Time                   |                     | $R_L = 5.1\text{ k}\Omega$ , $V_{RL} = 5\text{ V}$                                      |      | 1.3     |             | $\mu\text{s}$ |

APPLICATION CIRCUIT EXAMPLE



$V_{REF}$ :  $V^-$  to  $V^+ - 1.5$  (V)

COMPARATOR with HYSTERESIS CIRCUIT



- Threshold voltage

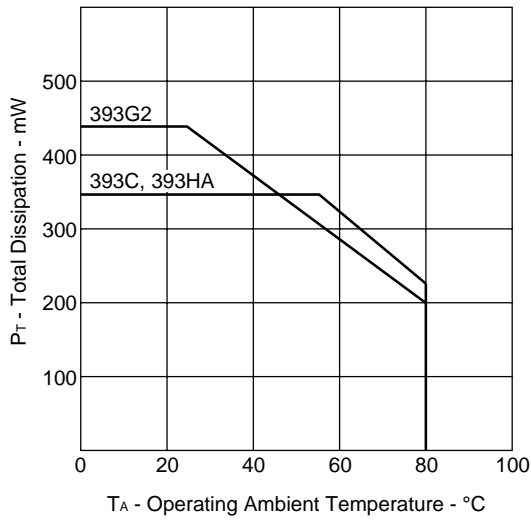
$$V_{TH(High)} \cong V_{REF} + \frac{R_1}{R_L + R_2 + R_1} (V_{RL} - V_{REF})$$

$$V_{TH(Low)} \cong V_{REF} - \frac{R_1}{R_1 + R_2} (V_{REF} - V_{OL})$$

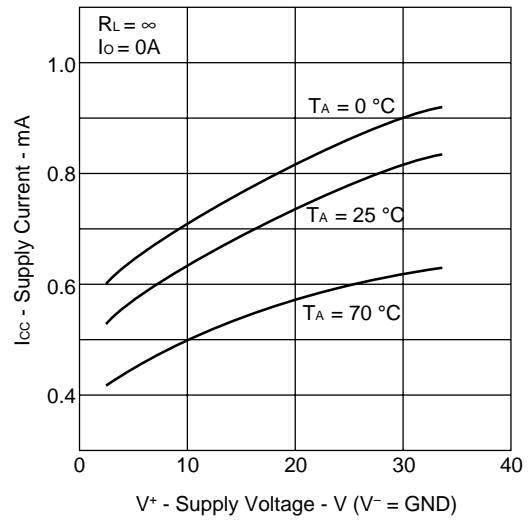
$$(V_{RL} > V_{REF} > V_{OL})$$

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

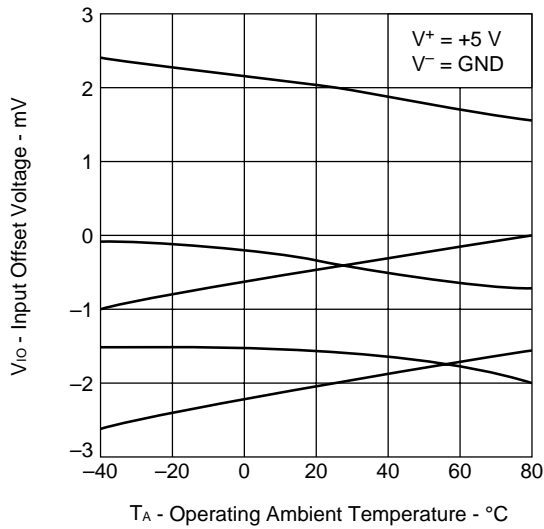
POWER DISSIPATION



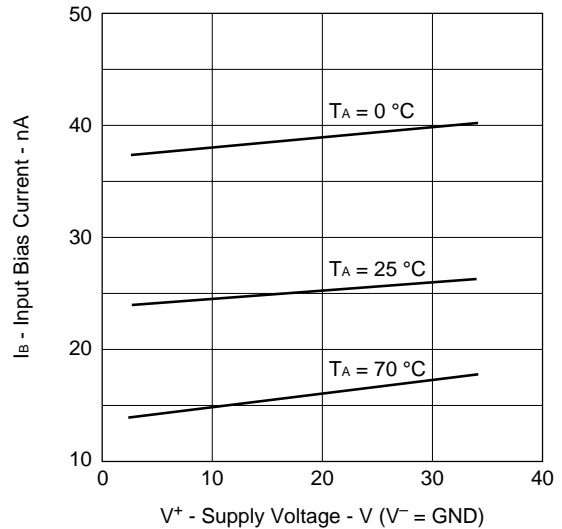
SUPPLY CURRENT



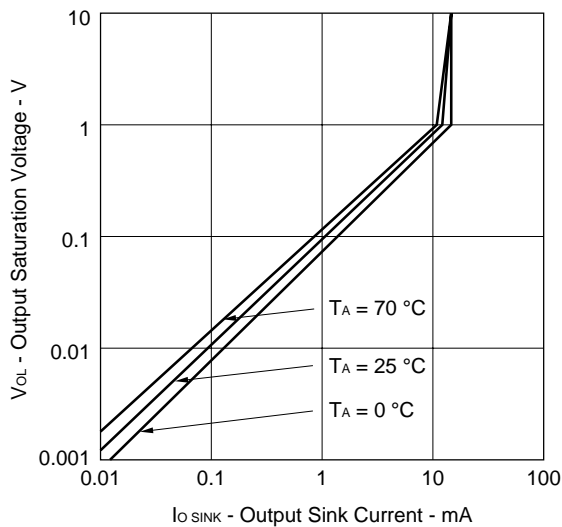
★ INPUT OFFSET VOLTAGE



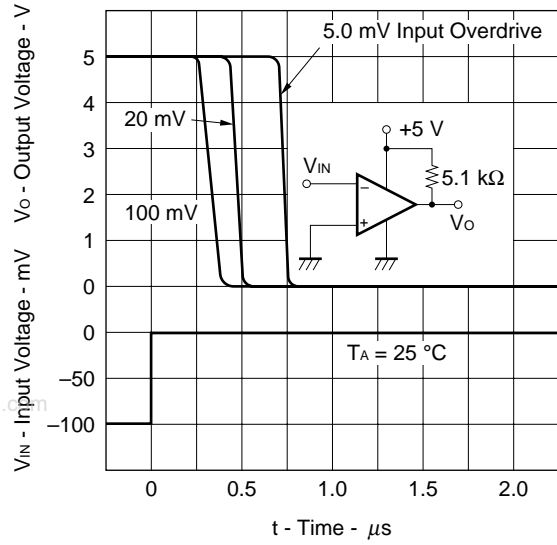
INPUT BIAS CURRENT



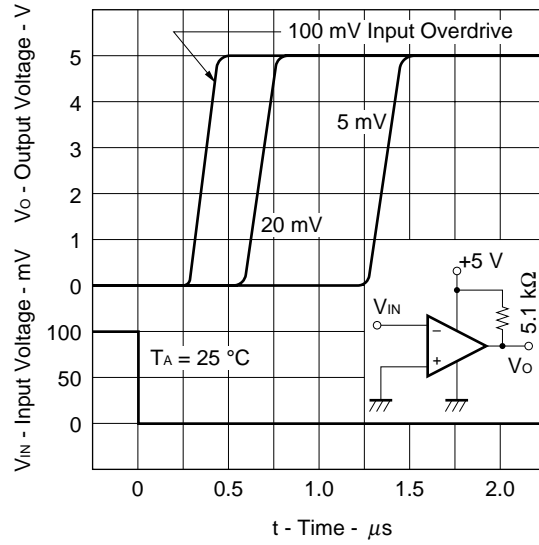
OUTPUT SATURATION VOLTAGE



RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES I



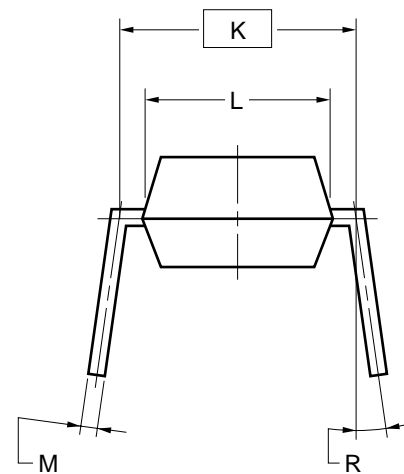
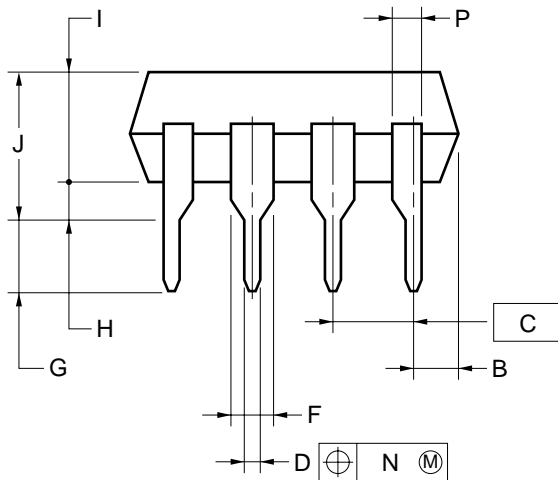
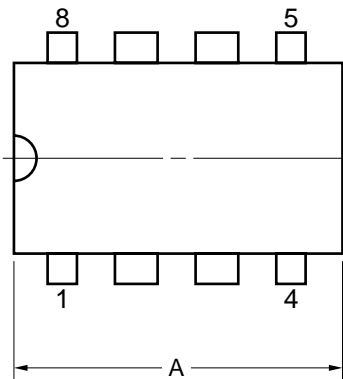
RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES II



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PACKAGE DRAWINGS

8PIN PLASTIC DIP (300 mil)



NOTES

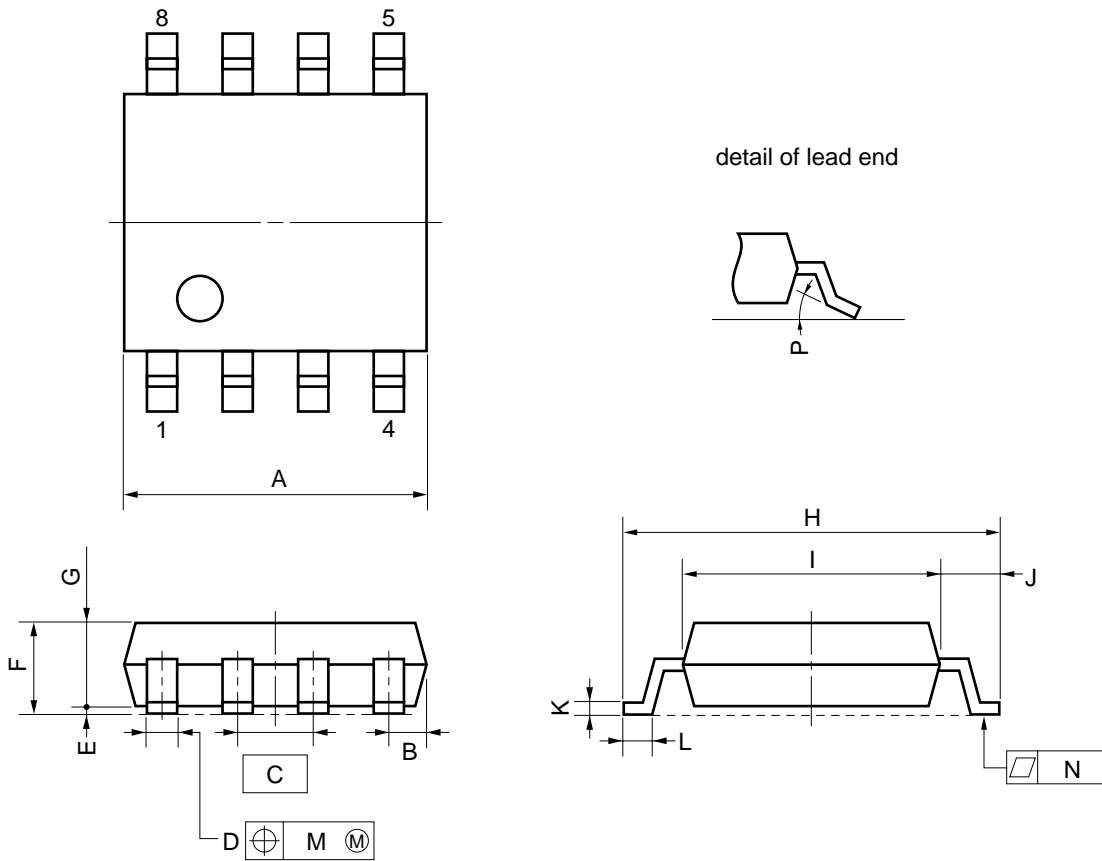
- 1) Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.
- 2) Item "K" to center of leads when formed parallel.

| 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>-0.005</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>-0.05</sub> | 0.010 <sup>+0.004</sup> <sub>-0.003</sub> |
| N    | 0.25                                   | 0.01                                      |
| P    | 0.9 MIN.                               | 0.035 MIN.                                |
| R    | 0~15°                                  | 0~15°                                     |

P8C-100-300B,C-1

8 PIN PLASTIC SOP (225 mil)

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**NOTE**

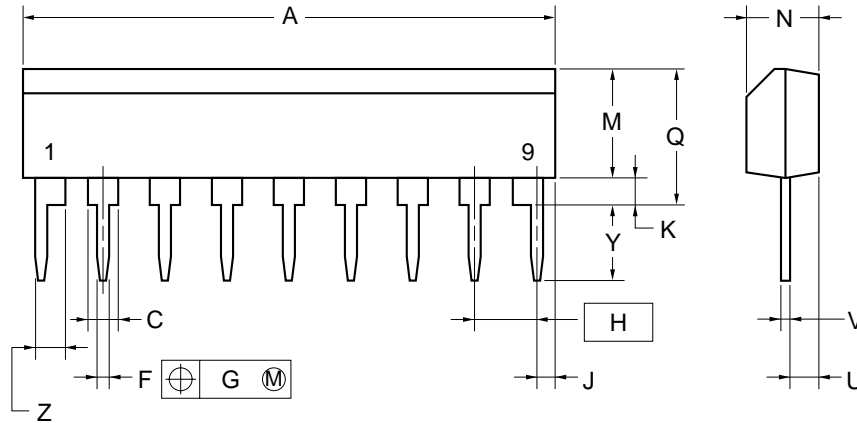
Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

| 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.                               | 0.071 MAX.                                |
| 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    | 0.10                                   | 0.004                                     |
| P    | 3° <sup>+7°</sup> <sub>-3°</sub>       | 3° <sup>+7°</sup> <sub>-3°</sub>          |

S8GM-50-225B-4



9 PIN PLASTIC SLIM SIP



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**NOTE**

Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.

| ITEM | MILLIMETERS                            | INCHES                                   |
|------|--|--|
| A    | 22.86 MAX.                             | 0.900 MAX.                               |
| C    | 1.1 MIN.                               | 0.043 MIN.                               |
| F    | 0.5±0.1                                | 0.02 <sup>+0.004</sup> <sub>-0.005</sub> |
| G    | 0.25                                   | 0.010                                    |
| H    | 2.54                                   | 0.100                                    |
| J    | 1.27 MAX.                              | 0.050 MAX.                               |
| K    | 0.51 MIN.                              | 0.020 MIN.                               |
| M    | 5.08 MAX.                              | 0.200 MAX.                               |
| N    | 2.8±0.2                                | 0.11 <sup>+0.009</sup> <sub>-0.008</sub> |
| Q    | 5.75 MAX.                              | 0.227 MAX.                               |
| U    | 1.5 MAX.                               | 0.059 MAX.                               |
| V    | 0.25 <sup>+0.10</sup> <sub>-0.05</sub> | 0.01 <sup>+0.004</sup> <sub>-0.003</sub> |
| Y    | 3.2±0.5                                | 0.126±0.02                               |
| Z    | 1.1 MIN.                               | 0.043 MIN.                               |

P9HA-254B-1

**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**

μPC393G2: 8-pin plastic SOP (225 mil)

| 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**

μPC393C : 8-pin plastic DIP (300 mil)

μPD393HA: 9-pin plastic slim SIP

| 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 MOUNTING TECHNOLOGY MANUAL       | C10535E  |
| IC PACKAGE MANUAL                                     | C10943X  |
| GUIDE TO QUALITY ASSUARANCE FOR SEMICONDUCTOR DEVICES | MEI-1202 |
| SEMICONDUCTORS SELECTION GUIDE                        | X10679E  |
| NEC SEMICONDUCTOR DEVICE RELIABILITY/                 | IEI-1212 |
| QUALITY CONTROL SYSTEM - STANDARD LINEAR IC           |          |

## [MEMO]

The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

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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)

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Anti-radioactive design is not implemented in this product.

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