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## Description

The AS393/393A consist of two independent precision voltage comparators with a typical offset voltage of 1.0mV and high gain. They are specifically designed to operate from a single power supply over wide range of voltages. Operation from split power supply is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

The AS393/393A series are compatible with industry standard 393. AS393A has more stringent input offset voltage than AS393.

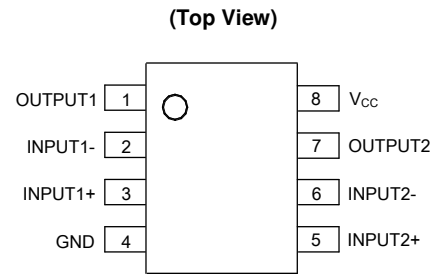
The AS393 is available in standard PDIP-8, SO-8, TSSOP-8 and MSOP-8 packages, AS393A is available in standard PDIP-8 and SO-8 packages.

## Features

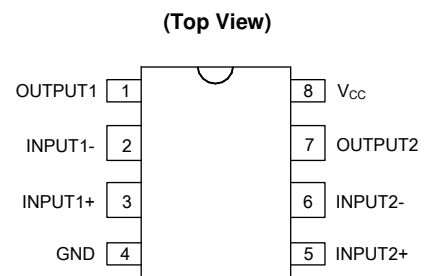
- Wide Supply Voltage Range
  - Single Supply: 2V to 36V
  - Dual Supplies:  $\pm 1.0V$  to  $\pm 18V$
- Low Supply Current Drain: 0.6mA
- Low Input Bias Current: 25nA (Typical)
- Low Input Offset Current:  $\pm 5.0nA$  (Typical)
- Low Input Offset Voltage: 1.0mV (Typical)
- Input Common Mode Voltage Range Includes Ground
- Differential Input Voltage Range Equals to the Power Supply Voltage
- Low Output Saturation Voltage: 200mV at 4mA
- Open Collector Output
- Lead-Free Packages: SO-8, TSSOP-8, PDIP-8
  - **Totally Lead-Free; RoHS Compliant (Notes 1 & 2)**
- Lead-Free Packages, Available in "Green" Molding Compound: SO-8, TSSOP-8, MSOP-8
  - **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
  - **Halogen and Antimony Free. "Green" Device (Note 3)**

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
  2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

## Pin Assignments



SO-8/TSSOP-8/MSOP-8

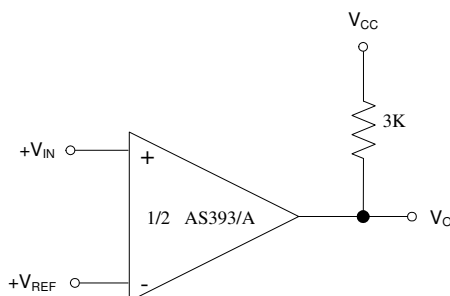


PDIP-8

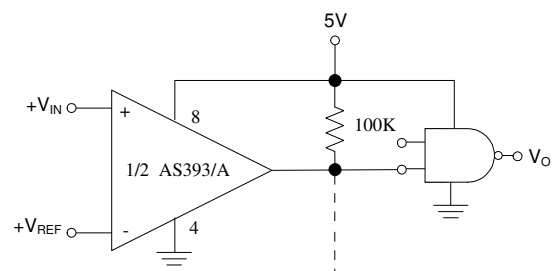
## Applications

- Battery Charger
- Cordless Telephone
- Switching Power Supply
- DC-DC Module
- PC Motherboard
- Communication Equipment

## Typical Applications Circuit



Basic Comparator



Driving CMOS

## Absolute Maximum Ratings (Note 4)

| Symbol            | Parameter  | Rating      | Unit |    |
|-------------------|--|-------------|------|----|
| V <sub>CC</sub>   | Supply Voltage                                   | 40          | V    |    |
| V <sub>ID</sub>   | Differential Input Voltage                       | 40          | V    |    |
| V <sub>IN</sub>   | Input Voltage                                    | -0.3 to 40  | V    |    |
| I <sub>IN</sub>   | Input Current (V <sub>IN</sub> < -0.3V) (Note 5) | 50          | mA   |    |
| —                 | Output Short-Circuit Current to Ground           | Continuous  | —    |    |
| P <sub>D</sub>    | Power Dissipation (T <sub>A</sub> = +25°C)       | PDIP-8      | 780  | mW |
|                   |  | SOIC-8      | 660  |    |
|                   |  | TSSOP-8     | 570  |    |
|                   |  | MSOP-8      | 450  |    |
| T <sub>J</sub>    | Operating Junction Temperature                   | +150        | °C   |    |
| T <sub>STG</sub>  | Storage Temperature                              | -65 to +150 | °C   |    |
| T <sub>LEAD</sub> | Lead Temperature (Soldering, 10 Seconds)         | +260        | °C   |    |

- Notes: 4. Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.
5. This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the comparators to go to the V<sub>+</sub> voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than -0.3 V<sub>DC</sub> (at +25°C).

## Recommended Operating Conditions

| Symbol          | Parameter                   | Min | Max | Unit |
|-----------------|-----------------------------|-----|-----|------|
| V <sub>CC</sub> | Supply Voltage              | 2   | 36  | V    |
| T <sub>A</sub>  | Operating Temperature Range | -40 | +85 | °C   |

**Electrical Characteristics** (Limits in standard typeface are for  $T_A = +25^\circ\text{C}$ , **bold** typeface applies over  $T_A = -40$  to  $+85^\circ\text{C}$  (Note 6),  $V_{CC} = 5\text{V}$ ,  $\text{GND} = 0\text{V}$ , unless otherwise specified.)

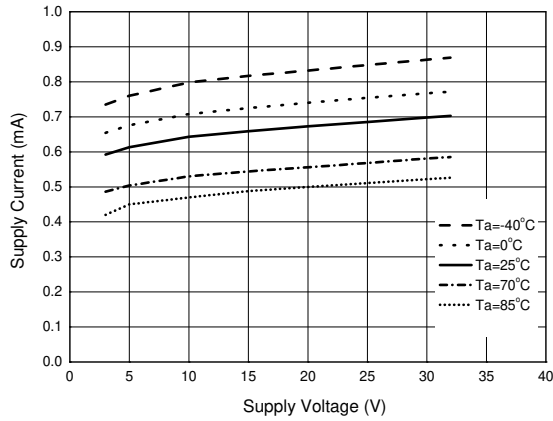
| Parameter                                | Conditions  |                       | Min | Typ        | Max            | Unit               |
|--|---|-----------------------|-----|------------|----------------|--------------------|
| Input Offset Voltage                     | $V_O = 1.4\text{V}$ , $R_S = 0\Omega$ ,<br>$V_{CC} = 5$ to $30\text{V}$                                     | AS393                 | —   | 1.0        | 5.0            | mV                 |
|  |   |                       | —   | —          | <b>7</b>       |                    |
|  |   | AS393A                | —   | 1.0        | 3.0            |                    |
|  |   |                       | —   | —          | <b>5</b>       |                    |
| Input Bias Current                       | $I_{IN+}$ or $I_{IN-}$ with output in linear range,<br>$V_{CM} = 0\text{V}$                                 | —                     | 25  | 250        | nA             |                    |
|  |   | —                     | —   | <b>400</b> |                |                    |
| Input Offset Current                     | $I_{IN+} - I_{IN-}$ , $V_{CM} = 0\text{V}$  | —                     | 5.0 | 50         | nA             |                    |
|  |   | —                     | —   | <b>200</b> |                |                    |
| Input Common Mode Voltage Range (Note 7) | $V_{CC} = 30\text{V}$   |                       | 0   | —          | $V_{CC} - 1.5$ | V                  |
| Supply Current                           | $R_L = \infty$  | $V_{CC} = 5\text{V}$  | —   | 0.4        | 1.0            | mA                 |
|  |   |                       | —   | —          | <b>2</b>       |                    |
|  |   | $V_{CC} = 30\text{V}$ | —   | 0.7        | 1.7            |                    |
|  |   |                       | —   | —          | <b>3</b>       |                    |
| Voltage Gain                             | $V_{CC} = 15\text{V}$ , $R_L \geq 15\text{k}\Omega$ , $V_O = 1\text{V}$ to $11\text{V}$                     |                       | 50  | 200        | —              | V/mV               |
| Large Signal Response Time               | $V_{IN} = \text{TTL Logic Swing}$ , $V_{REF} = 1.4\text{V}$ ,<br>$V_{RL} = 5\text{V}$ , $R_L = 5.1\text{k}$ |                       | —   | 200        | —              | ns                 |
| Response Time                            | $V_{RL} = 5\text{V}$ , $R_L = 5.1\text{k}$  |                       | —   | 1.3        | —              | $\mu\text{s}$      |
| Output Sink Current                      | $V_{IN-} = 1\text{V}$ , $V_{IN+} = 0\text{V}$ , $V_O = 1.5\text{V}$   |                       | 6.0 | 16         | —              | mA                 |
| Output Leakage Current                   | $V_{IN-} = 0\text{V}$ , $V_{IN+} = 1\text{V}$ , $V_O = 5\text{V}$   |                       | —   | 0.1        | —              | nA                 |
|  | $V_{IN-} = 0\text{V}$ , $V_{IN+} = 1\text{V}$ , $V_O = 30\text{V}$  |                       | —   | —          | <b>1</b>       | $\mu\text{A}$      |
| Saturation Voltage                       | $V_{IN-} = 1\text{V}$ , $V_{IN+} = 0$ , $I_{SINK} \leq 4\text{mA}$  |                       | —   | 200        | 400            | mV                 |
|  |   |                       | —   | —          | <b>500</b>     |                    |
| Thermal Resistance (Junction to Case)    | SO-8  |                       | —   | 9          | —              | $^\circ\text{C/W}$ |
|  | TSSOP-8   |                       | —   | 15         | —              |                    |
|  | MSOP-8  |                       | —   | 24         | —              |                    |
| Thermal Resistance (Junction to Ambient) | SO-8  |                       | —   | 108        | —              |                    |
|  | TSSOP-8   |                       | —   | 179        | —              |                    |
|  | MSOP-8  |                       | —   | 151        | —              |                    |

Notes: 6. These specifications are limited to  $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ . Limits over temperature are guaranteed by design, but not tested in production.

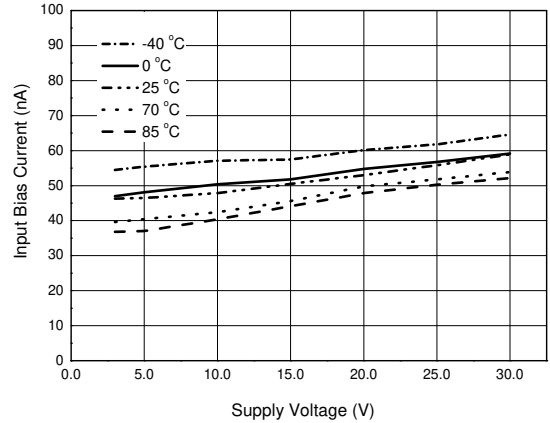
7. The input common-mode voltage of either input signal voltage should not be allowed to go negatively by more than 0.3V (at  $+25^\circ\text{C}$ ). The upper end of the common-mode voltage range is  $V_{CC} - 1.5\text{V}$  (at  $+25^\circ\text{C}$ ), but either or both inputs can go to  $+36\text{V}$  without damages, independent of the magnitude of the  $V_{CC}$ .

**Performance Characteristics**

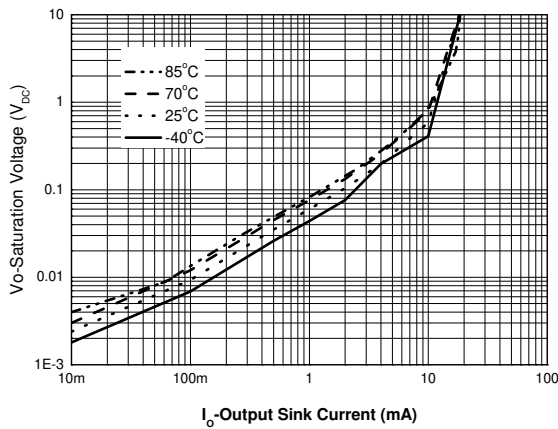
**Supply Voltage vs. Supply Current**



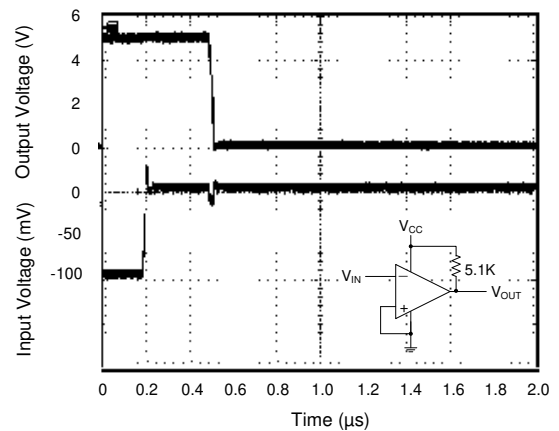
**Supply Voltage vs. Input Bias Current**



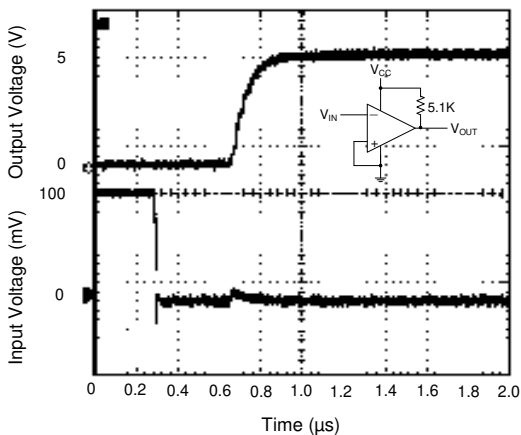
**Output Sink Current vs. Saturation Voltage**



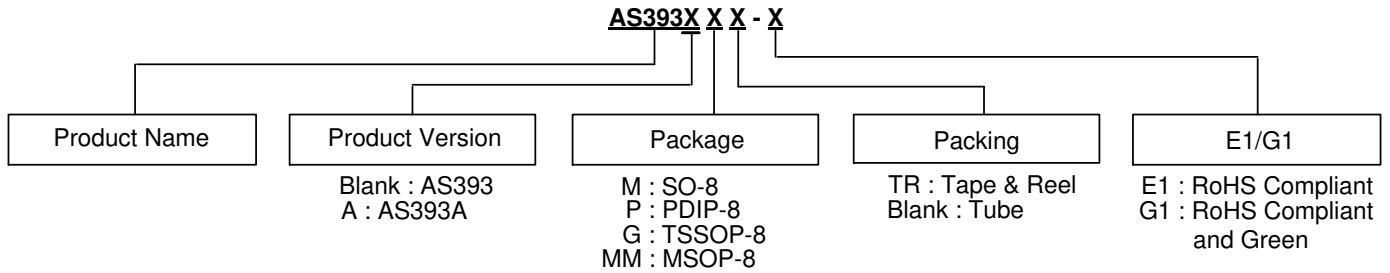
**Response Time for 5mV Input Overdrive – Negative Transition**



**Response Time for 5mV Input Overdrive – Positive Transition**



## Ordering Information

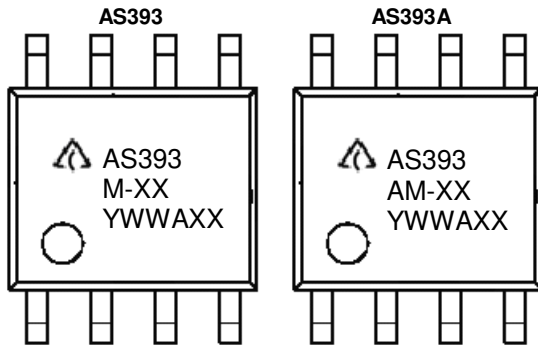


| Part Number  | Package (Note 9) | RoHS Compliant Lead Free / Green | Marking ID | Packing     | Quantity | Status (Note 8) | Alternative   |           |
|--------------|------------------|----------------------------------|------------|-------------|----------|-----------------|---------------|-----------|
| AS393M-E1    | SO-8             | Lead Free                        | AS393M-E1  | Tube        | 100      | End of Life     | AS393MTR-G1   |           |
| AS393M-G1    |                  | Green                            | AS393M-G1  | Tube        | 100      | End of Life     | AS393MTR-G1   |           |
| AS393MTR-E1  |                  | Lead Free                        | AS393M-E1  | Tape & Reel | 4000     | NRND            | AS393MTR-G1   |           |
| AS393MTR-G1  |                  | Green                            | AS393M-G1  | Tape & Reel | 4000     | In Production   | —             |           |
| AS393AM-E1   |                  | Lead Free                        | AS393AM-E1 | Tube        | 100      | End of Life     | AS393MTR-G1   |           |
| AS393AM-G1   |                  | Green                            | AS393AM-G1 | Tube        | 100      | End of Life     | AS393MTR-G1   |           |
| AS393AMTR-E1 |                  | Lead Free                        | AS393AM-E1 | Tape & Reel | 4000     | NRND            | AS393AMTR-G1  |           |
| AS393AMTR-G1 |                  | Green                            | AS393AM-G1 | Tape & Reel | 4000     | In Production   | —             |           |
| AS393P-E1    |                  | PDIP-8                           | Lead Free  | AS393P-E1   | Tube     | 50              | In Production | —         |
| AS393P-G1    |                  |                                  | Green      | AS393P-G1   | Tube     | 50              | End of Life   | AS393P-E1 |
| AS393AP-E1   | Lead Free        |                                  | AS393AP-E1 | Tube        | 50       | In Production   | —             |           |
| AS393AP-G1   | Green            |                                  | AS393AP-G1 | Tube        | 50       | End of Life     | AS393AP-E1    |           |
| AS393GTR-E1  | TSSOP-8          | Lead Free                        | EG3C       | Tape & Reel | 4000     | NRND            | AS393GTR-G1   |           |
| AS393GTR-G1  |                  | Green                            | GG3C       | Tape & Reel | 4000     | In Production   | —             |           |
| AS393MMTR-G1 | MSOP-8           | Green                            | AS393MM-G1 | Tape & Reel | 2500     | In Production   | —             |           |

- Notes:
- All variants in TDIP-8 package are End of life without replacements.  
NRND: Not Recommended for New Design.
  - For packaging details, go to our website at: <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

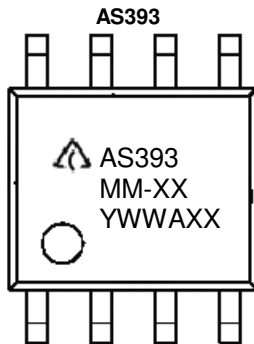
**Marking Information**

(1) SO-8



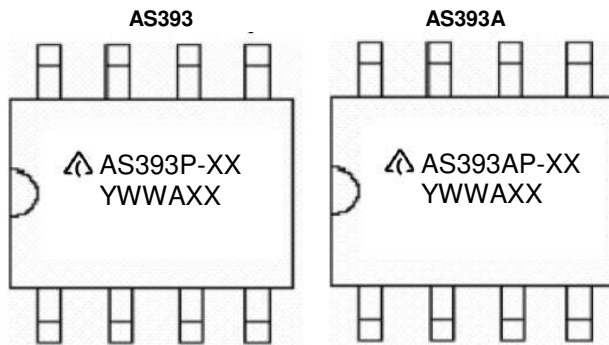
First and Second Lines: Logo and Marking ID  
(See Ordering Information)  
Third Line: Date Code  
Y: Year  
WW: Work Week of Molding  
A: Assembly House Code  
XX: Internal Code

(2) MSOP-8



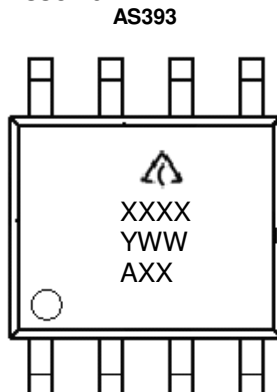
First and Second Lines: Logo and Marking ID  
(See Ordering Information)  
Third Line: Date Code  
Y: Year  
WW: Work Week of Molding  
A: Assembly House Code  
XX: Internal Code

(3) PDIP-8



First Line: Logo and Marking ID (See Ordering Information)  
Second Line: Date Code  
Y: Year  
WW: Work Week of Molding  
A: Assembly House Code  
XX: Internal Code

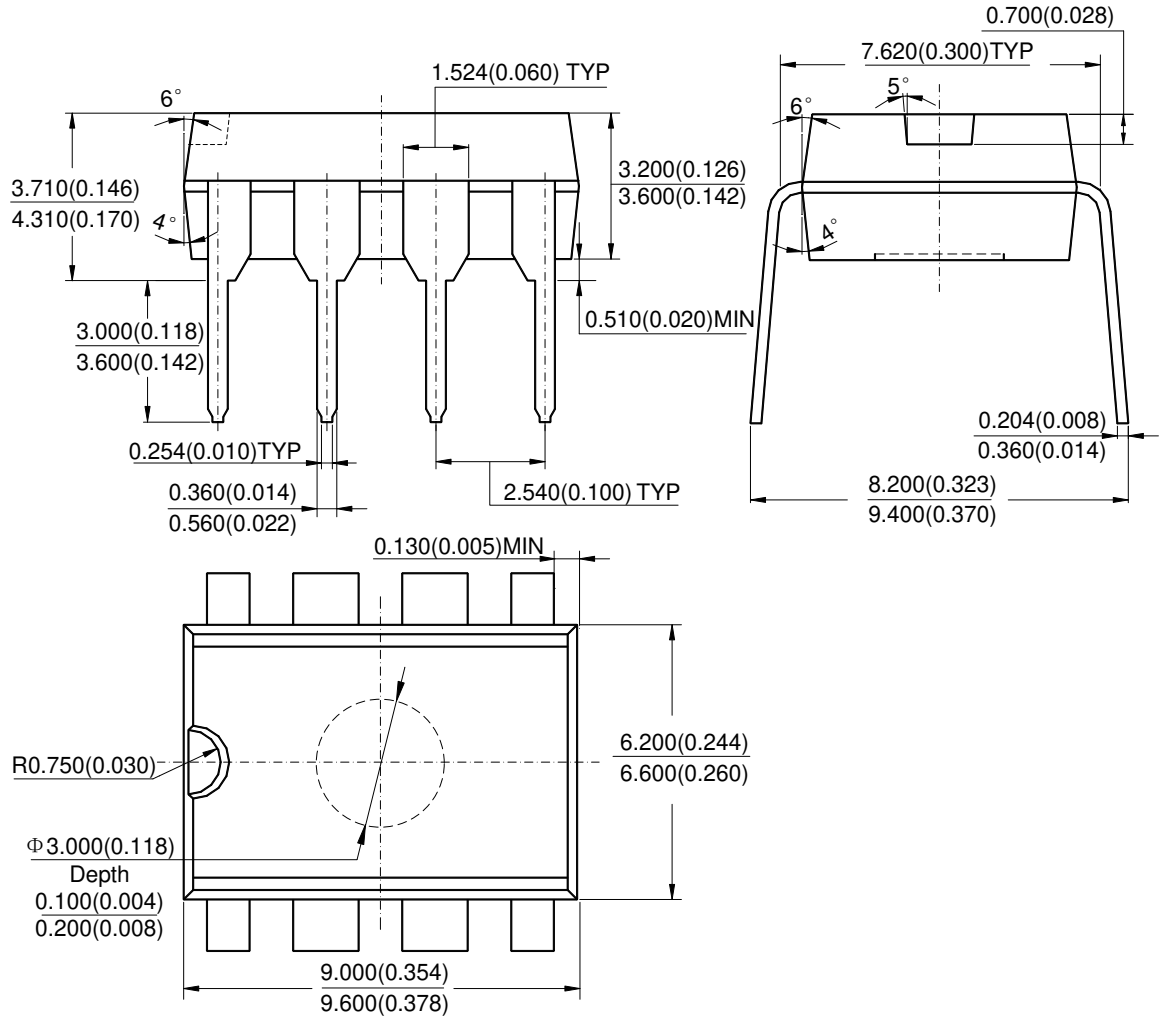
(4) TSSOP-8



First Line: Logo  
Second Line: Marking ID (See Ordering Information)  
Third and Fourth Lines: Date Code  
Y: Year  
WW: Work Week of Molding  
A: Assembly House Code  
XX: Internal Code

**Package Outline Dimensions** (All dimensions in mm(inch).)

(1) Package Type: PDIP-8

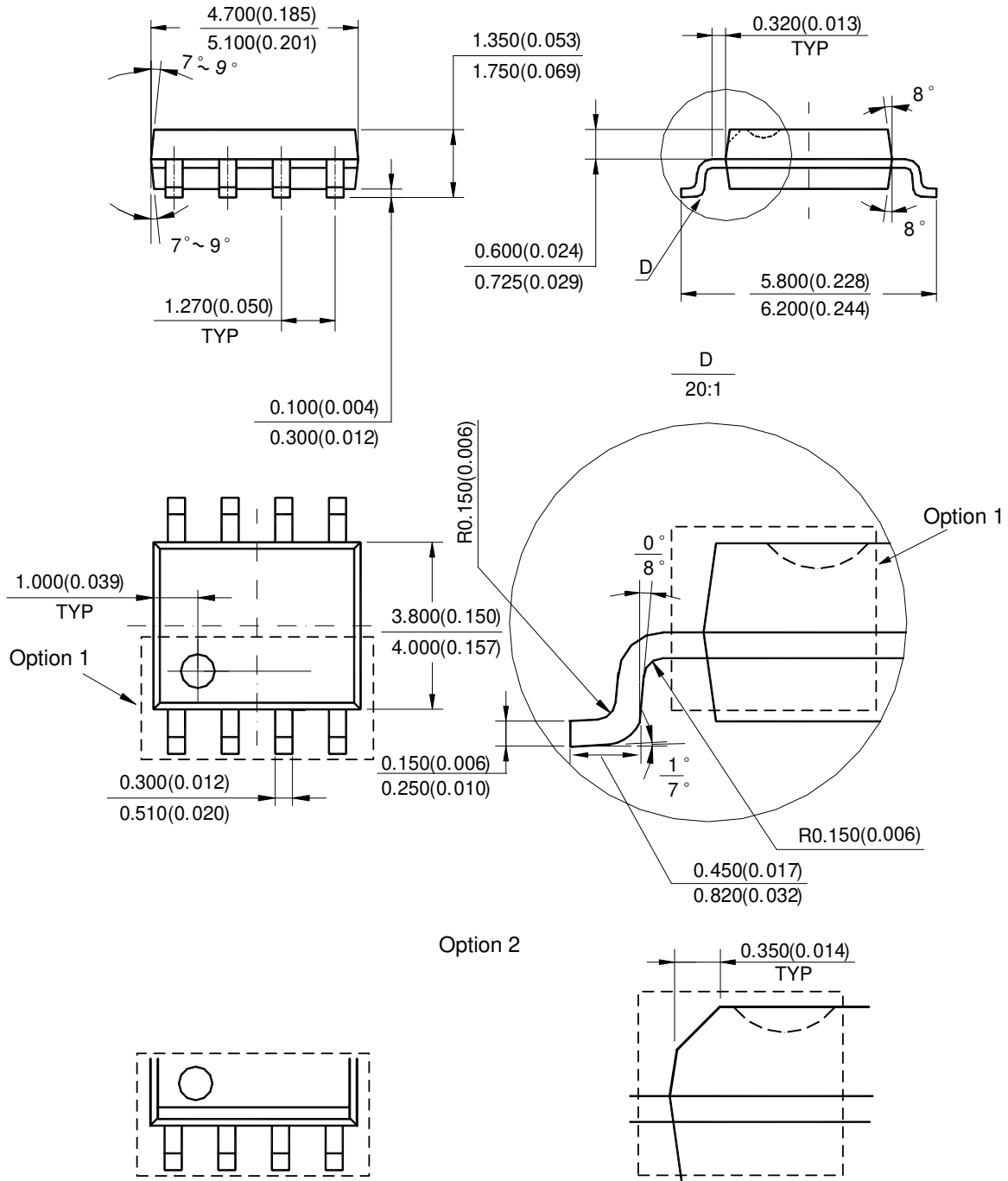


Note: Eject hole, oriented hole and mold mark is optional.



**Package Outline Dimensions** (Cont. All dimensions in mm(inch).)

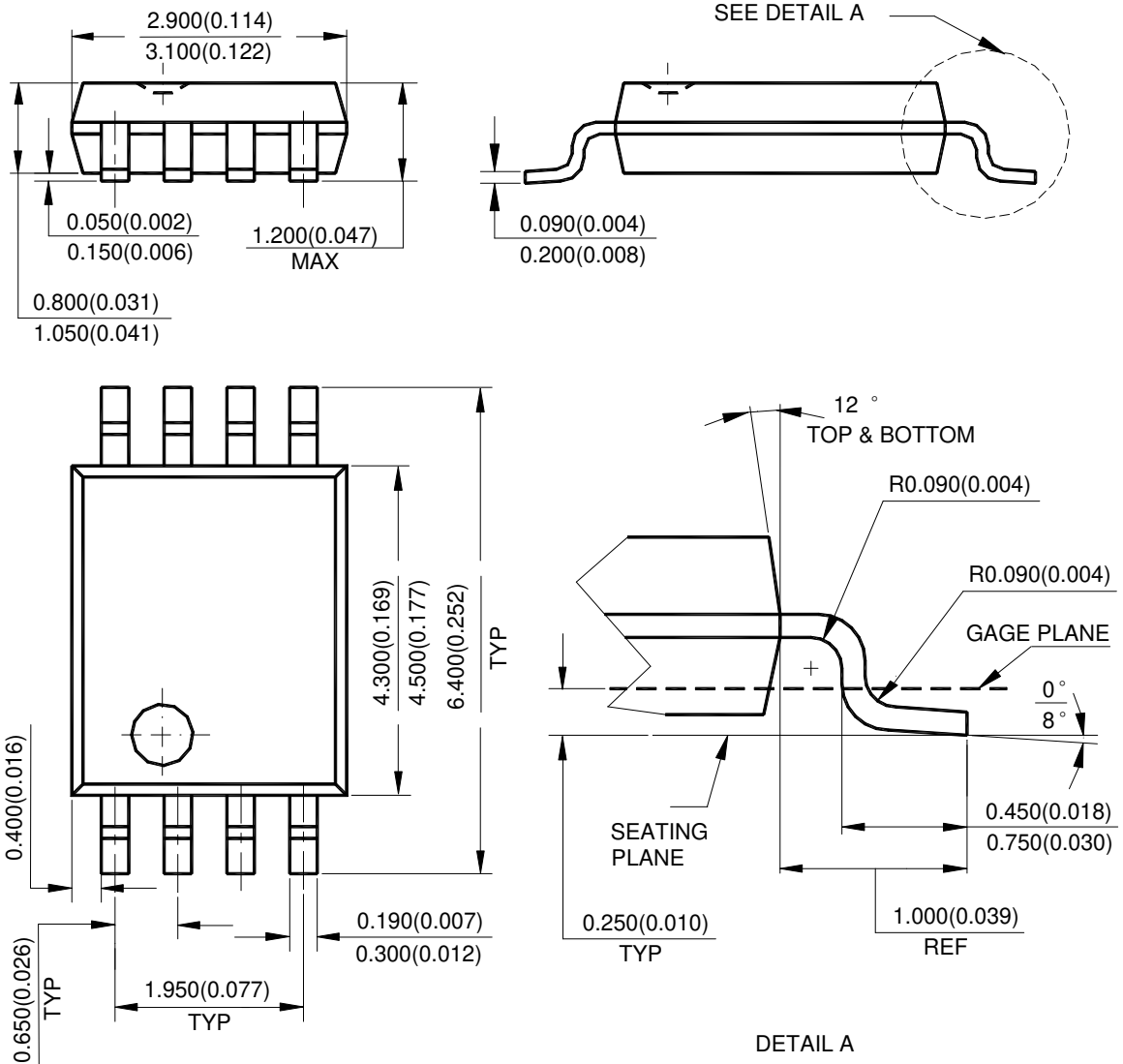
(2) Package Type: SO-8



Note: Eject hole, oriented hole and mold mark is optional.

**Package Outline Dimensions** (Cont. All dimensions in mm(inch).)

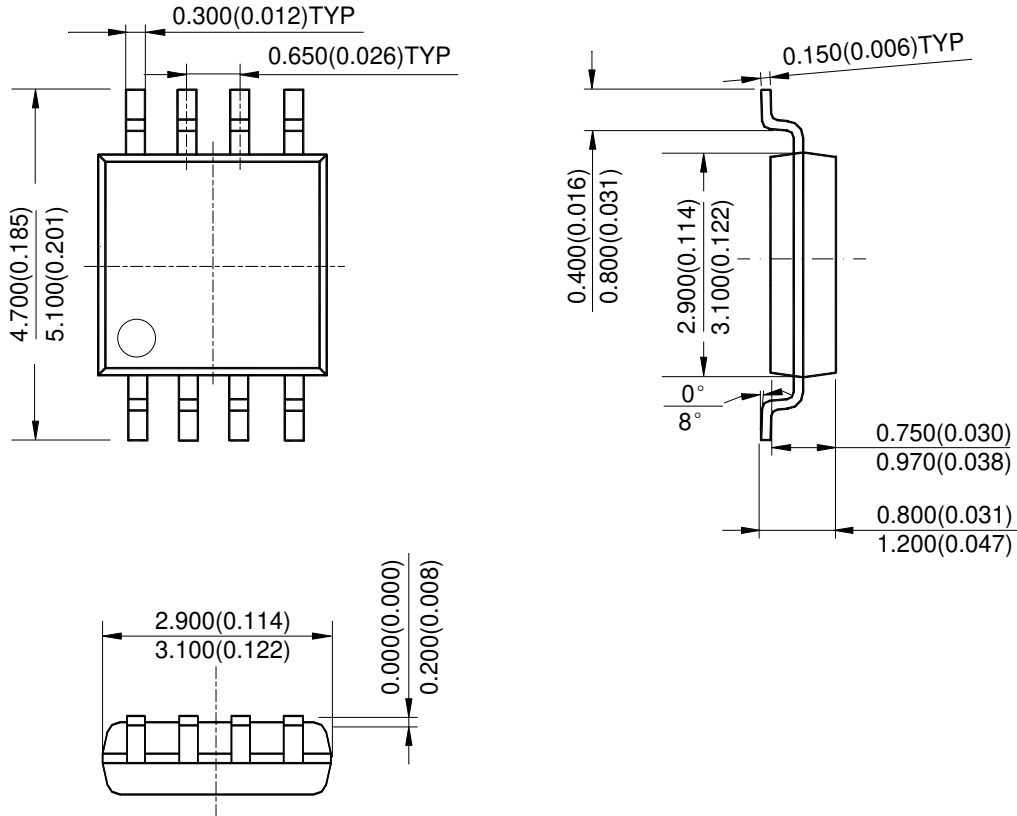
(3) Package Type: TSSOP-8



Note: Eject hole, oriented hole and mold mark is optional.

**Package Outline Dimensions** (Cont. All dimensions in mm(inch).)

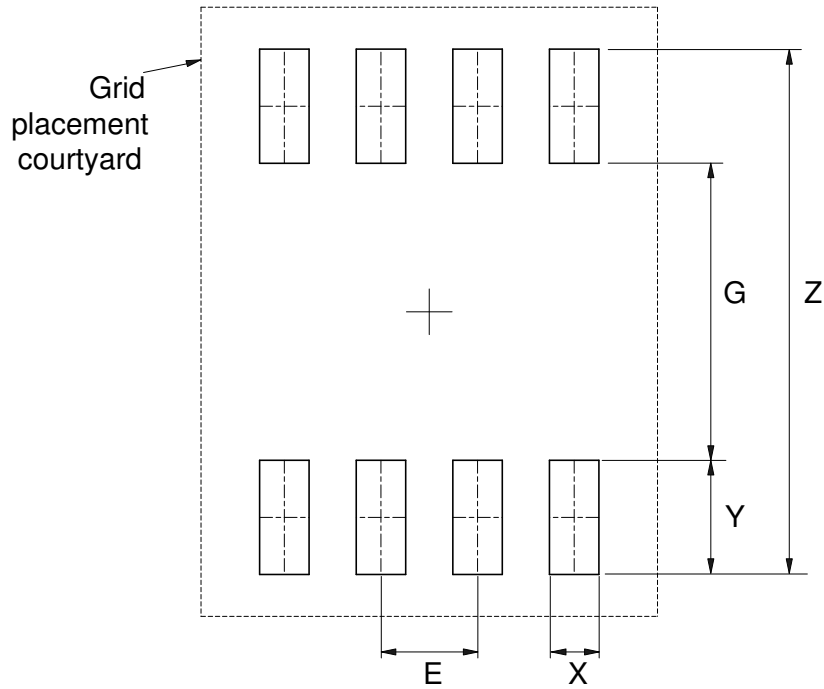
(4) Package Type: MSOP-8



Note: Eject hole, oriented hole and mold mark is optional.

**Suggested Pad Layout**

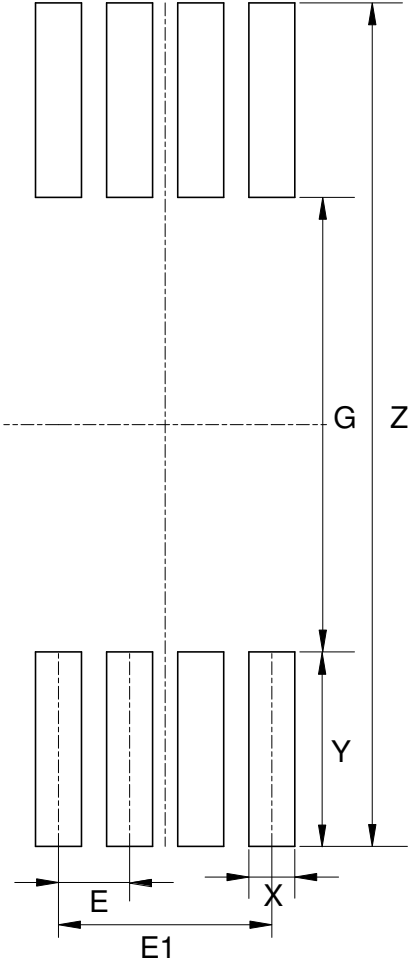
(1) Package Type: SO-8



| Dimensions | Z<br>(mm)/(inch) | G<br>(mm)/(inch) | X<br>(mm)/(inch) | Y<br>(mm)/(inch) | E<br>(mm)/(inch) |
|------------|------------------|------------------|------------------|------------------|------------------|
| Value      | 6.900/0.272      | 3.900/0.154      | 0.650/0.026      | 1.500/0.059      | 1.270/0.050      |

**Suggested Pad Layout** (Cont.)

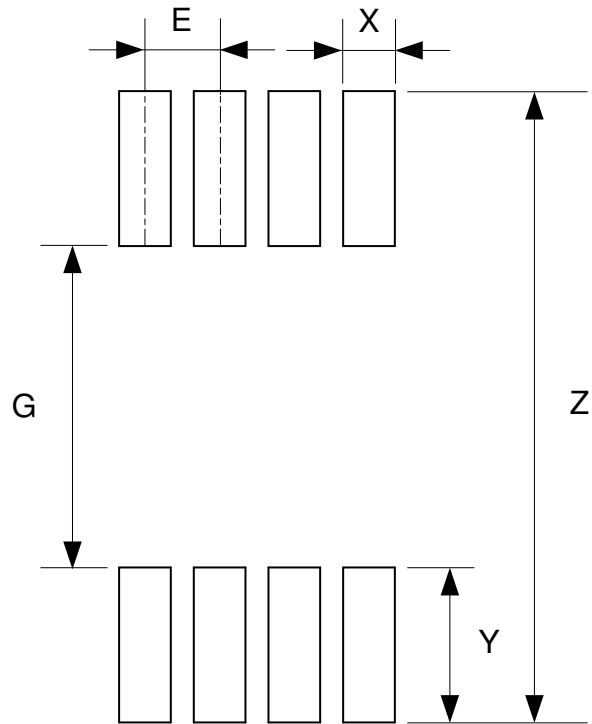
(2) Package Type: TSSOP-8



| Dimensions | Z<br>(mm)/(inch) | G<br>(mm)/(inch) | X<br>(mm)/(inch) | Y<br>(mm)/(inch) | E<br>(mm)/(inch) | E1<br>(mm)/(inch) |
|------------|------------------|------------------|------------------|------------------|------------------|-------------------|
| Value      | 7.720/0.304      | 4.160/0.164      | 0.420/0.017      | 1.780/0.070      | 0.650/0.026      | 1.950/0.077       |

**Suggested Pad Layout** (Cont.)

(3) Package Type: MSOP-8



| Dimensions | Z<br>(mm)/(inch) | G<br>(mm)/(inch) | X<br>(mm)/(inch) | Y<br>(mm)/(inch) | E<br>(mm)/(inch) |
|------------|------------------|------------------|------------------|------------------|------------------|
| Value      | 5.500/0.217      | 2.800/0.110      | 0.450/0.018      | 1.350/0.053      | 0.650/0.026      |

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