

## DS9638 RS-422 Dual High Speed Differential Line Driver

Check for Samples: [DS9638](#)

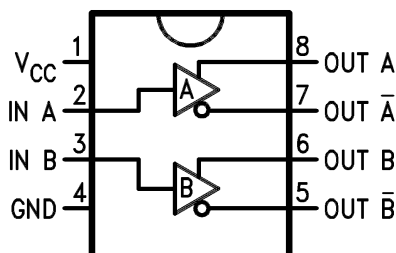
### FEATURES

- Single 5V Supply
- Schottky Technology
- TTL and CMOS Compatible Inputs
- Output Short Circuit Protection
- Input Clamp Diodes
- Complementary Outputs
- Minimum Output Skew (<1.0 ns typical)
- 50 mA Output Drive Capability for 50Ω Transmission Lines
- Meets EIA RS-422 Specifications
- Propagation Delay of Less Than 10 ns
- “Glitchless” Differential Output
- Delay Time Stable with  $V_{CC}$  and Temperature Variations (<2.0 ns typical) (See [Figure 4](#) )
- Extended Temperature Range

### DESCRIPTION

The DS9638 is a Schottky, TTL compatible, dual differential line driver designed specifically to meet the EIA Standard RS-422 specifications. It is designed to provide unipolar differential drive to twisted pair or parallel wire transmission lines. The inputs are TTL compatible. The outputs are similar to totem pole TTL outputs, with active pull-up and pull-down. The device features a short circuit protected active pull-up with low output impedance and is specified to drive 50Ω transmission lines at high speed. The mini-DIP provides high package density.

### Connection Diagram



**Figure 1. 8-Lead PDIP or CDIP or SOIC (Top View)**  
See P or NAB0008A or D Package



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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### Absolute Maximum Ratings<sup>(1)(2)</sup>

|                                                  |                           |                 |
|--------------------------------------------------|---------------------------|-----------------|
| Storage Temperature Range                        | Ceramic DIP               | –65°C to +175°C |
|                                                  | Molded DIP and SO-8       | –65°C to +150°C |
| Lead Temperature                                 | CDIP (Soldering, 60 sec.) | 300°C           |
|                                                  | PDIP (Soldering, 10 sec.) | 265°C           |
| Maximum Power Dissipation at 25°C <sup>(3)</sup> | CDIP Package              | 1300 mW         |
|                                                  | PDIP Package              | 930 mW          |
|                                                  | SOIC Package              | 810 mW          |
| V <sub>CC</sub> Lead Potential to Ground         |                           | –0.5V to 7V     |
| Input Voltage                                    |                           | –0.5V to +7V    |

- (1) “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be verified. They are not meant to imply that the devices should be operated at these limits. The tables of “Electrical Characteristics” provide conditions for actual device operation.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
- (3) Derate CDIP package 8.7 mW/°C above 25°C; derate PDIP package 7.5 mW/°C above 25°C; derate SOIC package 6.5 mW/°C above 25°C.

### Recommended Operating Conditions

|                                         | DS9638M |     |     | DS9638C |     |      | Units |
|-----------------------------------------|---------|-----|-----|---------|-----|------|-------|
|                                         | Min     | Typ | Max | Min     | Typ | Max  |       |
| Supply Voltage (V <sub>CC</sub> )       | 4.5     | 5.0 | 5.5 | 4.75    | 5.0 | 5.25 | V     |
| Output Current HIGH (I <sub>OH</sub> )  |         |     | –50 |         |     | –50  | mA    |
| Output Current LOW (I <sub>OL</sub> )   |         |     | 50  | 40      |     | 50   | mA    |
| Operating Temperature (T <sub>A</sub> ) | –55     | 25  | 125 | 0       | 25  | 70   | °C    |

## Electrical Characteristics<sup>(1)(2)</sup>

Over recommended operating temperature and supply voltage ranges, unless otherwise specified

| Symbol                  | Parameter                              | Conditions                                                                                                          | Min | Typ  | Max  | Units         |
|-------------------------|----------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----|------|------|---------------|
| $V_{IH}$                | Input Voltage HIGH                     |                                                                                                                     | 2.0 |      |      | V             |
| $V_{IL}$                | Input Voltage LOW                      | 0°C to +70°C                                                                                                        |     |      | 0.8  | V             |
|                         |                                        | –55°C to +125°C                                                                                                     |     |      | 0.5  |               |
| $V_{IC}$                | Input Clamp Voltage                    | $V_{CC} = \text{Min}$ , $I_I = -18 \text{ mA}$                                                                      |     | –1.0 | –1.2 | V             |
| $V_{OH}$                | Output Voltage HIGH                    | $V_{CC} = \text{Min}$ ,<br>$V_{IH} = V_{IH \text{ Min}}$ ,<br>$V_{IL} = V_{IL \text{ Max}}$                         | 2.5 | 3.5  |      | V             |
|                         |                                        | $I_{OH} = -10 \text{ mA}$<br>$I_{OH} = -40 \text{ mA}$                                                              | 2.0 |      |      |               |
| $V_{OL}$                | Output Voltage LOW                     | $V_{CC} = \text{Min}$ , $V_{IH} = V_{IH \text{ Min}}$ ,<br>$V_{IL} = V_{IL \text{ Max}}$ , $I_{OL} = 40 \text{ mA}$ |     |      | 0.5  | V             |
| $I_I$                   | Input Current at Maximum Input Voltage | $V_{CC} = \text{Max}$ , $V_I \text{ Max} = 5.5 \text{ V}$                                                           |     |      | 50   | $\mu\text{A}$ |
| $I_{IH}$                | Input Current HIGH                     | $V_{CC} = \text{Max}$ , $V_{IH} = 2.7 \text{ V}$                                                                    |     |      | 25   | $\mu\text{A}$ |
| $I_{IL}$                | Input Current LOW                      | $V_{CC} = \text{Max}$ , $V_{IL} = 0.5 \text{ V}$                                                                    |     |      | –200 | $\mu\text{A}$ |
| $I_{OS}$                | Output Short Circuit Current           | $V_{CC} = \text{Max}$ , $V_O = 0 \text{ V}^{(2)}$                                                                   | –50 |      | –150 | mA            |
| $V_T, \bar{V}_T$        | Terminated Output Voltage              | See Figure 2                                                                                                        | 2.0 |      |      | V             |
| $V_T - \bar{V}_T$       | Output Balance                         |                                                                                                                     |     |      | 0.4  | V             |
| $V_{OS}, \bar{V}_{OS}$  | Output Offset Voltage                  |                                                                                                                     |     |      | 3.0  | V             |
| $V_{OS} - \bar{V}_{OS}$ | Output Offset Balance                  |                                                                                                                     |     |      | 0.4  | V             |
| $I_X$                   | Output Leakage Current                 | $T_A = 25^\circ\text{C}$<br>$-0.25 \text{ V} < V_X < 5.5 \text{ V}$                                                 |     |      | 100  | $\mu\text{A}$ |
| $I_{CC}$                | Supply Current (Both Drivers)          | $V_{CC} = 5.5 \text{ V}$ ,<br>All input at 0V,<br>No Load                                                           |     | 45   | 65   | mA            |

- (1) Unless otherwise specified min/max limits apply across the –55°C to +125°C temperature range for the DS9638M and across the 0°C to +70°C range for the DS9638C. All typicals are given for  $V_{CC} = 5 \text{ V}$  and  $T_A = 25^\circ\text{C}$ .
- (2) All currents into the device pins are positive; all currents out of the device pins are negative. All voltages are referenced to ground unless otherwise specified.

## Switching Characteristics

$V_{CC} = 5.0 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

| Symbol                  | Parameter                                          | Conditions                                                 | Min | Typ | Max | Units |
|-------------------------|----------------------------------------------------|------------------------------------------------------------|-----|-----|-----|-------|
| $t_{PHL}$               | Propagation Delay                                  | $C_L = 15 \text{ pF}$<br>$R_L = 100 \Omega$ , See Figure 3 |     | 10  | 20  | ns    |
| $t_{PLH}$               |                                                    |                                                            |     | 10  | 20  | ns    |
| $t_f$                   | Fall Time, 90%–10%                                 |                                                            |     | 10  | 20  | ns    |
| $t_r$                   | Rise Time, 10%–90%                                 |                                                            |     | 10  | 20  | ns    |
| $t_{PO} - \bar{t}_{PO}$ | Skew Between Outputs A/ $\bar{A}$ and B/ $\bar{B}$ |                                                            |     | 1.0 |     | ns    |

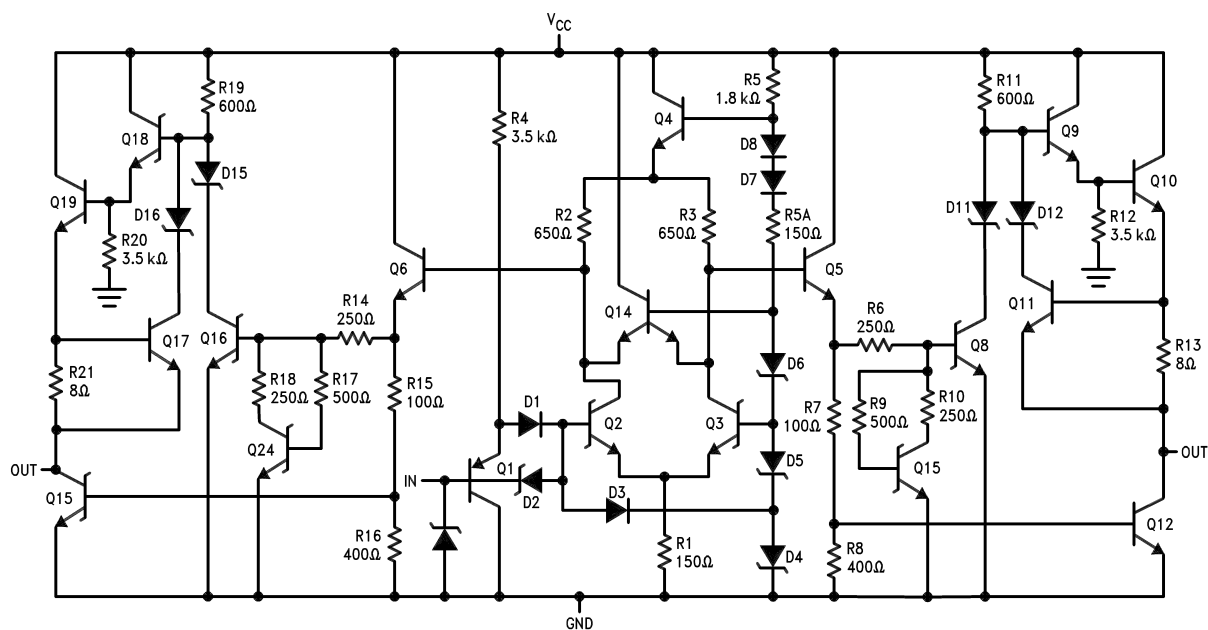


Figure 2. Equivalent Circuit

### DC Test Circuit

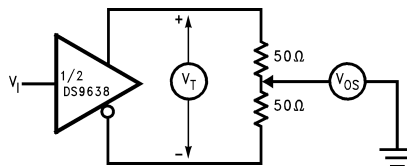
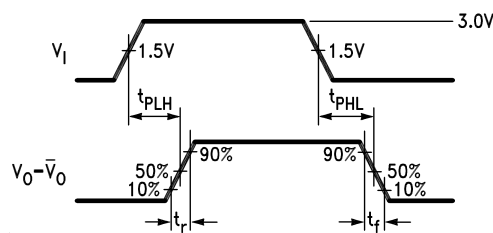
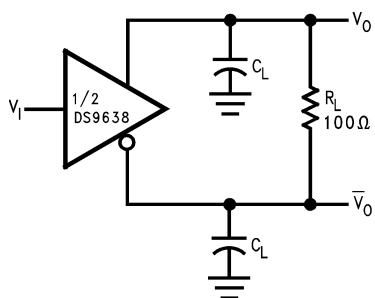


Figure 3. Terminated Output Voltage and Output Balance



(1) The pulse generator has the following characteristics:

$C_L$  includes probe and jig capacitance.

PRR = 500 kHz,  $t_W$  = 100 ns,

$t_r \leq 5.0$  ns,  $Z_O = 50\Omega$ .

Figure 4. AC Test Circuit and Voltage Waveform

## Typical Characteristics

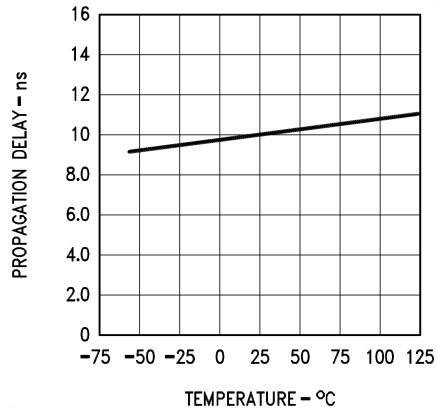


Figure 5. Typical Delay Characteristics (a)

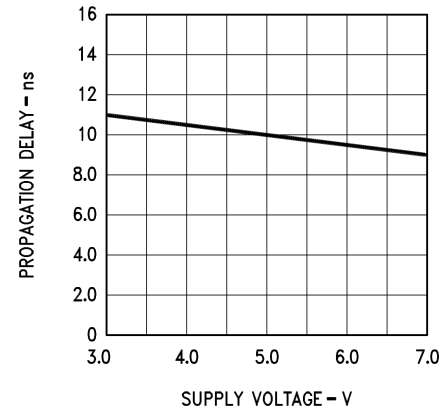


Figure 6. Typical Delay Characteristics (b)

REVISION HISTORY

| Changes from Revision C (April 2013) to Revision D         | Page              |
|------------------------------------------------------------|-------------------|
| • Changed layout of National Data Sheet to TI format ..... | <a href="#">5</a> |

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|-------------------------|-------------------------|
| DS9638CM         | ACTIVE        | SOIC         | D                  | 8    | 95             | TBD                        | Call TI          | Call TI              | 0 to 70      | DS963<br>8CM            | <a href="#">Samples</a> |
| DS9638CM/NOPB    | ACTIVE        | SOIC         | D                  | 8    | 95             | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | 0 to 70      | DS963<br>8CM            | <a href="#">Samples</a> |
| DS9638CMX/NOPB   | ACTIVE        | SOIC         | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | 0 to 70      | DS963<br>8CM            | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "--" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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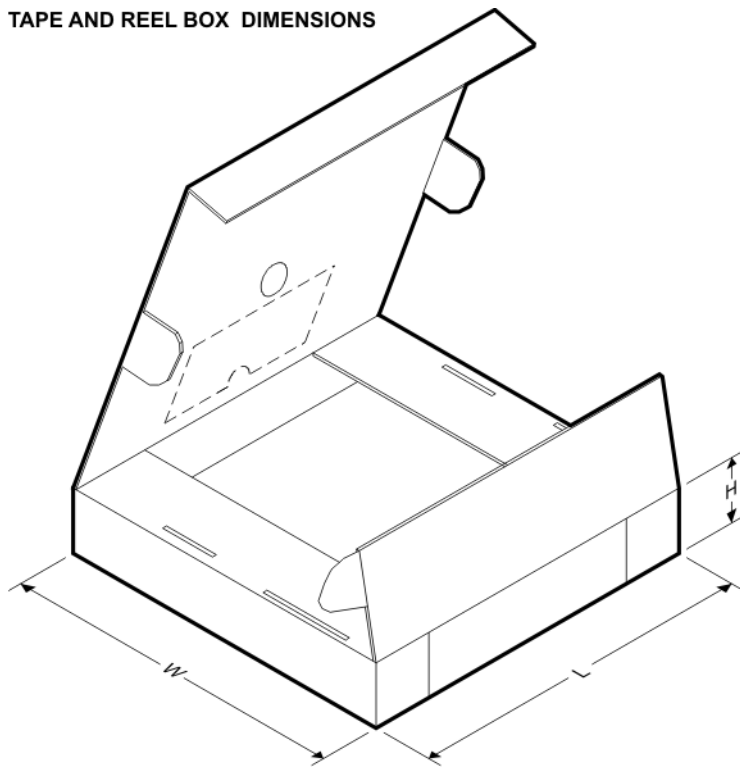
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**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| DS9638CMX/NOPB | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS

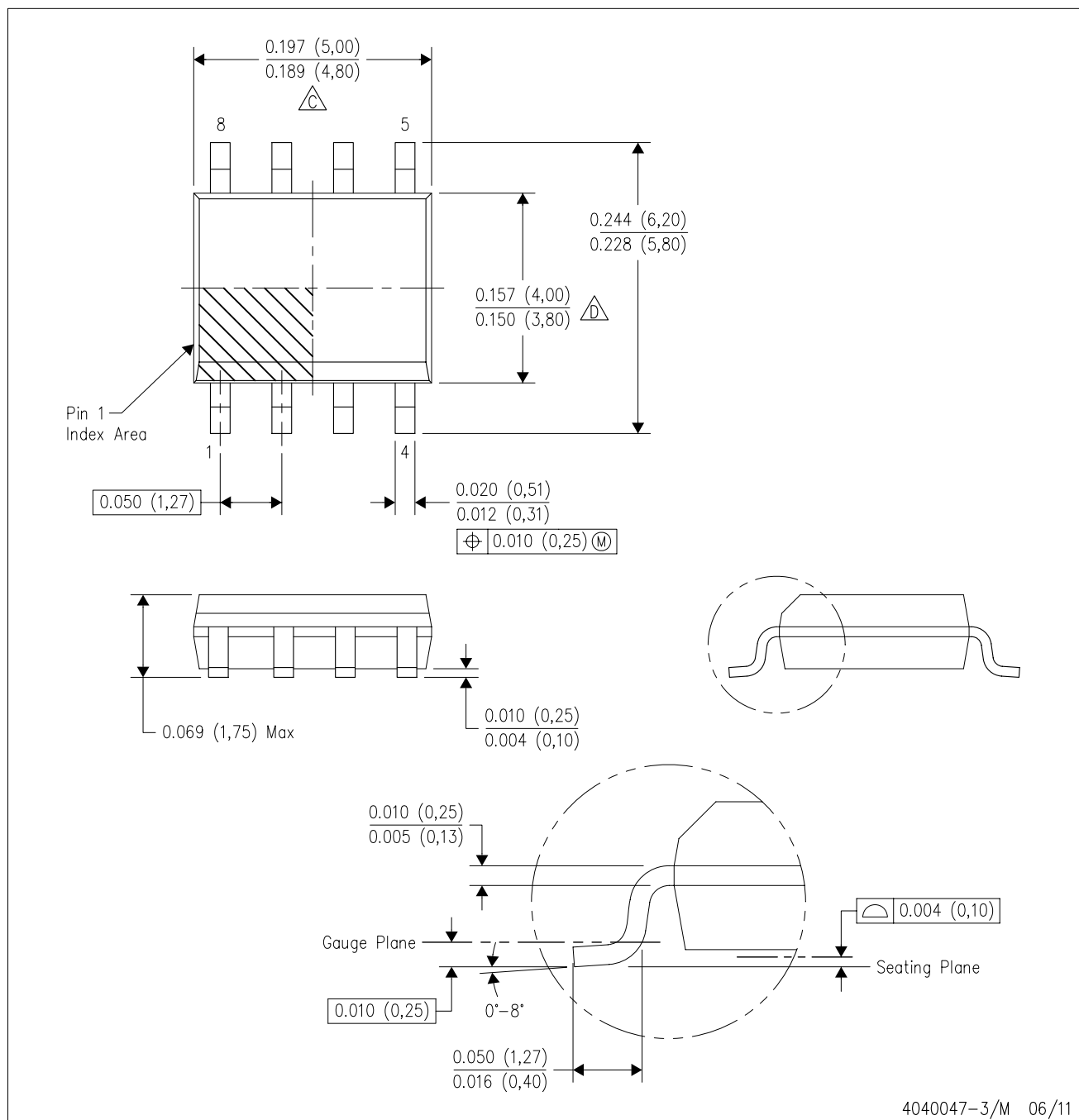


\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| DS9638CMX/NOPB | SOIC         | D               | 8    | 2500 | 349.0       | 337.0      | 45.0        |

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AA.

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