# DS90LV027AQ Automotive LVDS Dual Differential Driver

**Check for Samples: DS90LV027AQ**

## FEATURES

- **AECQ-100 Grade 1**
- **>600 Mbps (300MHz) Switching Rates**
- **0.3 ns Typical Differential Skew**
- **0.7 ns Maximum Differential Skew**
- **3.3V Power Supply Design**
- **Low Power Dissipation (46 mW @ 3.3V Static)**
- **Flow-Through Design Simplifies PCB Layout**
- **Power Off Protection (Outputs in High Impedance)**
- **Conforms to TIA/EIA-644 Standard**
- **8-Lead SOIC Package Saves Space**

## DESCRIPTION

The DS90LV027AQ is a dual LVDS driver device optimized for high data rate and low power applications. The device is designed to support data rates in excess of 600Mbps (300MHz) utilizing Low Voltage Differential Signaling (LVDS) technology. The DS90LV027AQ is a current mode driver allowing power dissipation to remain low even at high frequency. In addition, the short circuit fault current is also minimized.

The device is in a 8-lead SOIC package. The DS90LV027AQ has a flow-through design for easy PCB layout. The differential driver outputs provides low EMI with its typical low output swing of 360 mV. It is perfect for high speed transfer of clock and data. The DS90LV027AQ can be paired with its companion dual line receiver, the DS90LV028AQ, or with any of TI's LVDS receivers, to provide a high-speed point-to-point LVDS interface.

### Connection Diagram

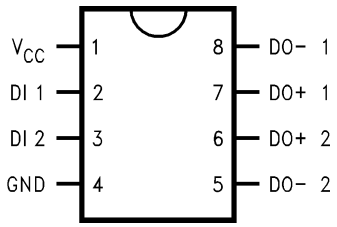
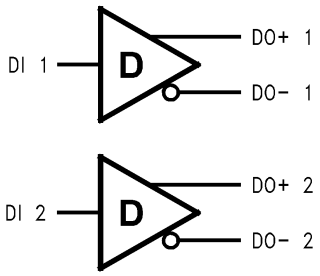



**Figure 1. Dual-In-Line**
**See Package Number D0008A**

### Functional Diagram



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(1)(2)

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | −0.3V to +4V |
| Input Voltage (DI) | −0.3V to ($V_{CC}$ + 0.3V) |
| Output Voltage (DO±) | −0.3V to +3.9V |
| Maximum Package Power Dissipation @ +25°C | |
| D Package | 1068 mW |
| Derate D Package | 9.71 mW/°C above +25°C |
| Package Thermal Resistance (4-Layer, 2 oz. Cu, JEDEC) | |
| $\theta_{JA}$ | 103.0°C/W |
| $\theta_{JC}$ | 50.0°C/W |
| Storage Temperature Range | −65°C to +150°C |
| Lead Temperature Range Soldering | |
| (4 sec.) | +260°C |
| Maximum Junction Temperature | +135°C |
| ESD Ratings | |
| HBM (3) | ≥ 8kV |
| MM (4) | ≥ 250V |
| CDM (5) | ≥ 1250V |

(1) Absolute Maximum Ratings are those values beyond which the safety of the device cannot be ensured. They are not meant to imply that the devices should be operated at these limits. Electrical Characteristics specifies conditions of device operation.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
(3) Human Body Model, applicable std. JESD22-A114C
(4) Machine Model, applicable std. JESD22-A115-A
(5) Field Induced Charge Device Model, applicable std. JESD22-C101-C

## Recommended Operating Conditions

| | Min | Typ | Max | Units |
|---|---|---|---|---|
| Supply Voltage ($V_{CC}$) | 3.0 | 3.3 | 3.6 | V |
| Temperature ($T_A$) | −40 | 25 | +125 | °C |

## Electrical Characteristics

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified.(1)(2)(3)

| Symbol | Parameter | Conditions | Pin | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **DIFFERENTIAL DRIVER CHARACTERISTICS** | | | | | | | |
| $V_{OD}$ | Output Differential Voltage | $R_L$ = 100Ω (Figure 2) | DO+, DO− | 250 | 360 | 450 | mV |
| $\Delta V_{OD}$ | $V_{OD}$ Magnitude Change | | | | 1 | 35 | mV |
| $V_{OH}$ | Output High Voltage | | | | 1.4 | 1.6 | V |
| $V_{OL}$ | Output Low Voltage | | | 0.9 | 1.1 | | V |
| $V_{OS}$ | Offset Voltage | | | 1.125 | 1.2 | 1.375 | V |
| $\Delta V_{OS}$ | Offset Magnitude Change | | | 0 | 3 | 25 | mV |
| $I_{OXD}$ | Power-off Leakage | $V_{OUT}$ = $V_{CC}$ or GND, $V_{CC}$ = 0V | | | ±1 | ±10 | µA |
| $I_{OSD}$ | Output Short Circuit Current | | | | −5.7 | −8 | mA |

(1) Current into device pins is defined as positive. Current out of device pins is defined as negative. All voltages are referenced to ground except $V_{OD}$.
(2) All typicals are given for: $V_{CC}$ = +3.3V and $T_A$ = +25°C.
(3) The DS90LV027AQ is a current mode device and only function with datasheet specification when a resistive load is applied to the drivers outputs.

## Electrical Characteristics (continued)

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified.(1)(2)(3)

| Symbol | Parameter | Conditions | | Pin | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|---|
| **DIFFERENTIAL DRIVER CHARACTERISTICS** | | | | | | | | |
| $V_{IH}$ | Input High Voltage | | | DI | 2.0 | | $V_{CC}$ | V |
| $V_{IL}$ | Input Low Voltage | | | | GND | | 0.8 | V |
| $I_{IH}$ | Input High Current | $V_{IN}$ = 3.3V or 2.4V | | | | ±2 | ±10 | µA |
| $I_{IL}$ | Input Low Current | $V_{IN}$ = GND or 0.5V | | | | ±1 | ±10 | µA |
| $V_{CL}$ | Input Clamp Voltage | $I_{CL}$ = −18 mA | | | −1.5 | −0.6 | | V |
| $I_{CC}$ | Power Supply Current | No Load | $V_{IN}$ = $V_{CC}$ or GND | $V_{CC}$ | | 8 | 14 | mA |
| | | $R_L$ = 100Ω | | | | 14 | 20 | mA |

## Switching Characteristics

Over Supply Voltage and Operating Temperature Ranges, unless otherwise specified.(1)(2)(3)(4)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **DIFFERENTIAL DRIVER CHARACTERISTICS** | | | | | | |
| $t_{PHLD}$ | Differential Propagation Delay High to Low | $R_L$ = 100Ω, $C_L$ = 15 pF | 0.3 | 0.8 | 2.0 | ns |
| $t_{PLHD}$ | Differential Propagation Delay Low to High | (Figure 3 and Figure 4) | 0.3 | 1.1 | 2.0 | ns |
| $t_{SKD1}$ | Differential Pulse Skew $\|t_{PHLD} - t_{PLHD}\|$ (5) | | 0 | 0.3 | 0.7 | ns |
| $t_{SKD2}$ | Channel to Channel Skew (6) | | 0 | 0.4 | 0.8 | ns |
| $t_{SKD3}$ | Differential Part to Part Skew (7) | | 0 | | 1.0 | ns |
| $t_{SKD4}$ | Differential Part to Part Skew (8) | | 0 | | 1.7 | ns |
| $t_{TLH}$ | Transition Low to High Time | | 0.2 | 0.5 | 1.0 | ns |
| $t_{THL}$ | Transition High to Low Time | | 0.2 | 0.5 | 1.0 | ns |
| $f_{MAX}$ | Maximum Operating Frequency (9) | | | 350 | | MHz |

(1) All typicals are given for: $V_{CC}$ = +3.3V and $T_A$ = +25°C.
(2) These parameters are ensured by design. The limits are based on statistical analysis of the device over PVT (process, voltage, temperature) ranges.
(3) $C_L$ includes probe and fixture capacitance.
(4) Generator waveform for all tests unless otherwise specified: f = 1 MHz, $Z_O$ = 50Ω, $t_r$ ≤ 1 ns, $t_f$ ≤ 1 ns (10%-90%).
(5) $t_{SKD1}$, $|t_{PHLD} - t_{PLHD}|$, is the magnitude difference in differential propagation delay time between the positive going edge and the negative going edge of the same channel.
(6) $t_{SKD2}$ is the Differential Channel to Channel Skew of any event on the same device.
(7) $t_{SKD3}$, Differential Part to Part Skew, is defined as the difference between the minimum and maximum specified differential propagation delays. This specification applies to devices at the same $V_{CC}$ and within 5°C of each other within the operating temperature range.
(8) $t_{SKD4}$, part to part skew, is the differential channel to channel skew of any event between devices. This specification applies to devices over recommended operating temperature and voltage ranges, and across process distribution. $t_{SKD4}$ is defined as |Max − Min| differential propagation delay.
(9) $f_{MAX}$ generator input conditions: $t_r$ = $t_f$ < 1 ns (0% to 100%), 50% duty cycle, 0V to 3V. Output criteria: duty cycle = 45%/55%, $V_{OD}$ > 250mV, all channels switching.

## Parameter Measurement Information

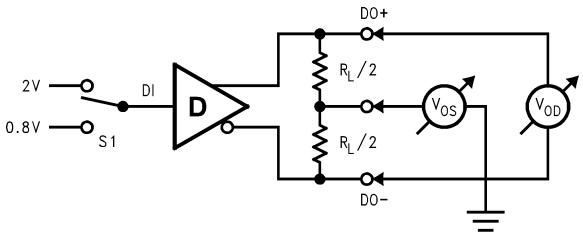



**Figure 2. Differential Driver DC Test Circuit**

## Parameter Measurement Information (continued)

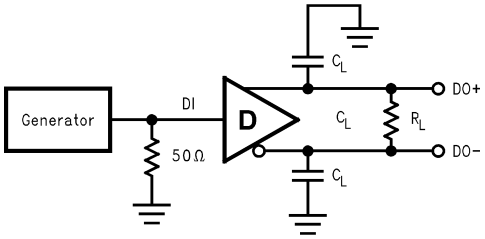



**Figure 3. Differential Driver Propagation Delay and Transition Time Test Circuit**

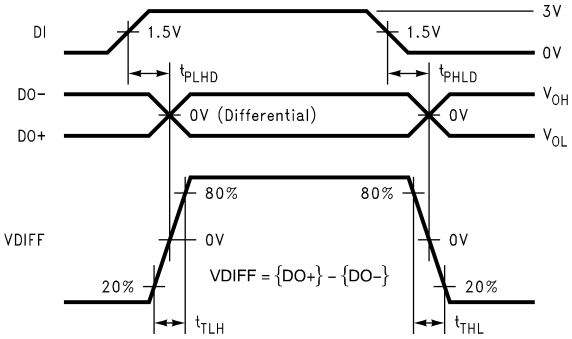



**Figure 4. Differential Driver Propagation Delay and Transition Time Waveforms**

# APPLICATION INFORMATION

## DEVICE PIN DESCRIPTIONS

| Pin # | Name | Description |
|---|---|---|
| 2, 3 | DI | TTL/CMOS driver input pins |
| 6, 7 | DO+ | Non-inverting driver output pin |
| 5, 8 | DO− | Inverting driver output pin |
| 4 | GND | Ground pin |
| 1 | $V_{CC}$ | Positive power supply pin, +3.3V ± 0.3V |

## Typical Performance Curves

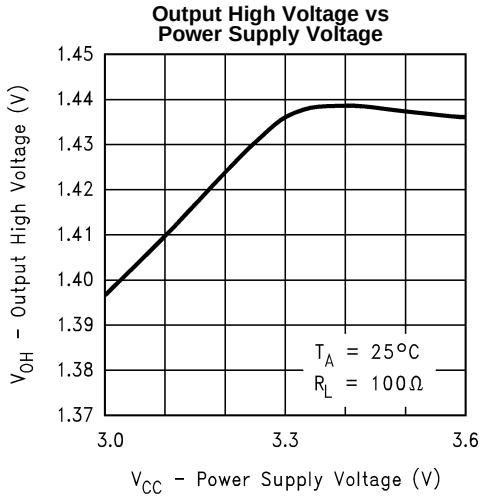



**Figure 5.**

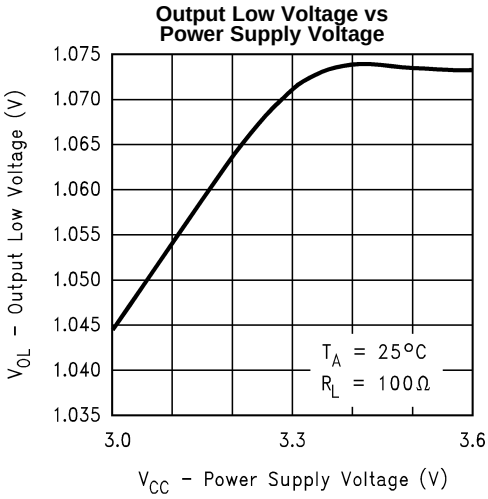



**Figure 6.**

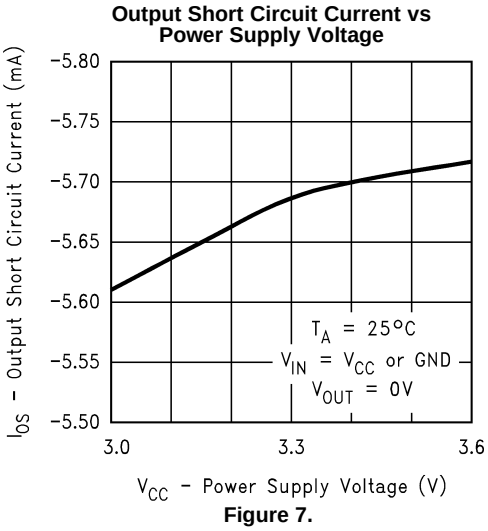



**Figure 7.**

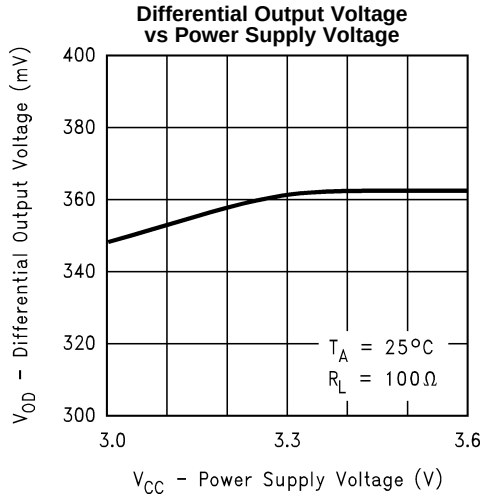



**Figure 8.**

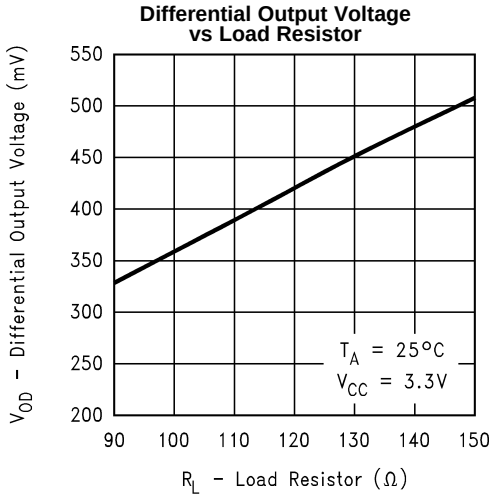



**Figure 9.**

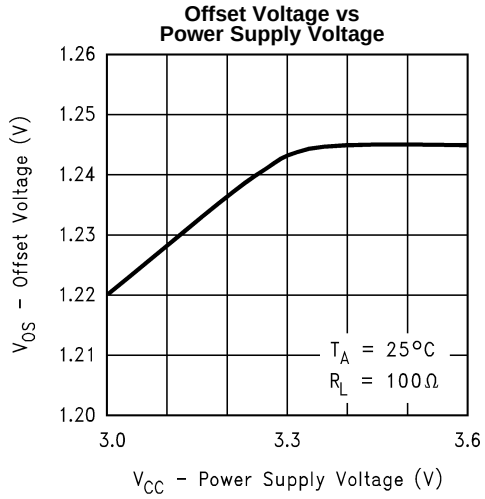



**Figure 10.**

## Typical Performance Curves (continued)

**Power Supply Current vs Frequency**

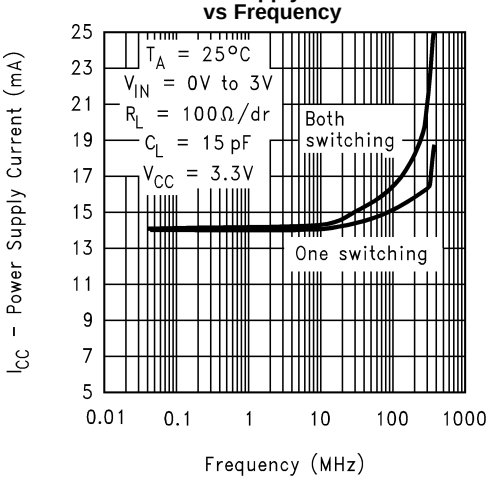



**Figure 11.**

**Power Supply Current vs Power Supply Voltage**

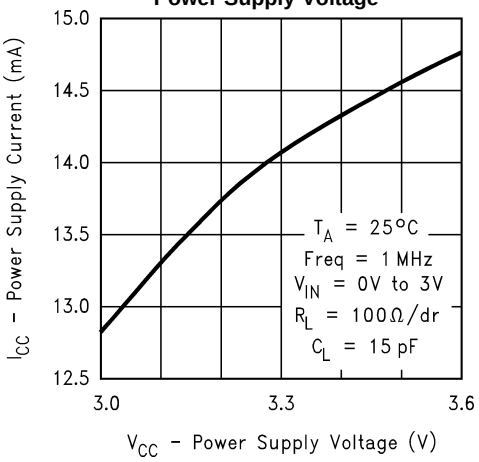



**Figure 12.**

**Power Supply Current vs Ambient Temperature**

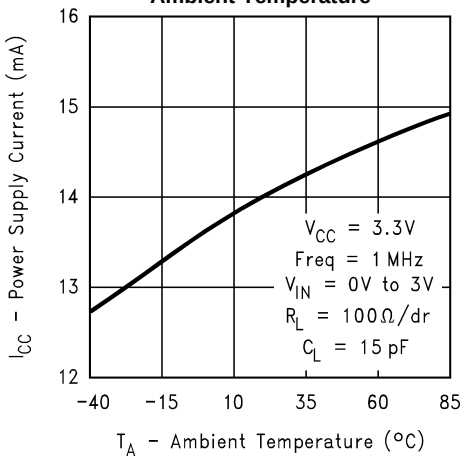



**Figure 13.**

**Differential Propagation Delay vs Power Supply Voltage**

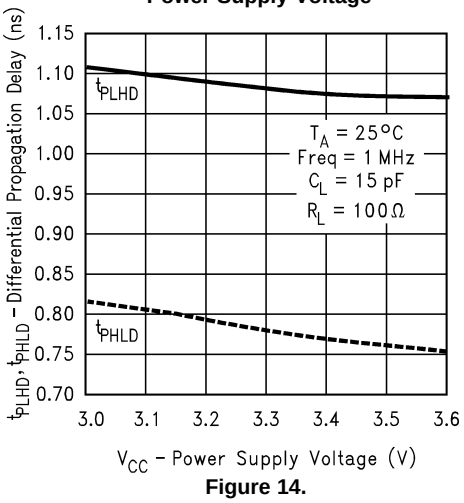



**Figure 14.**

**Differential Propagation Delay vs Ambient Temperature**

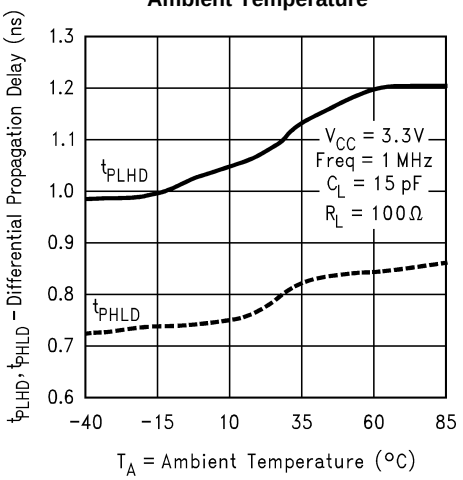



**Figure 15.**

**Differential Skew vs Power Supply Voltage**

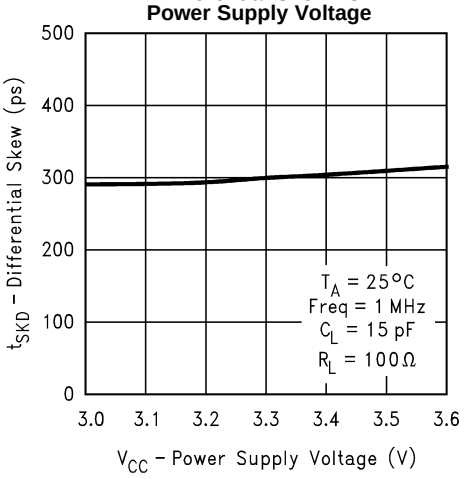



**Figure 16.**

## Typical Performance Curves (continued)

**Differential Skew vs Ambient Temperature**

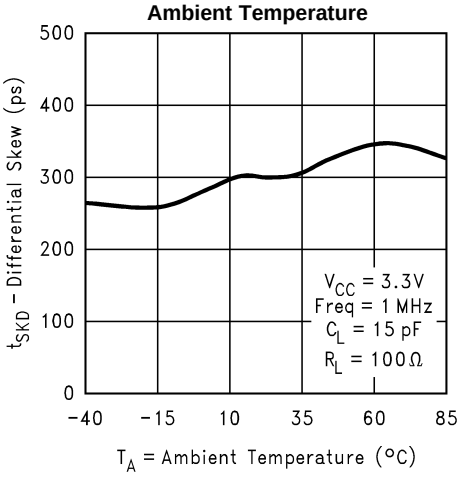



**Figure 17.**

**Transition Time vs Power Supply Voltage**

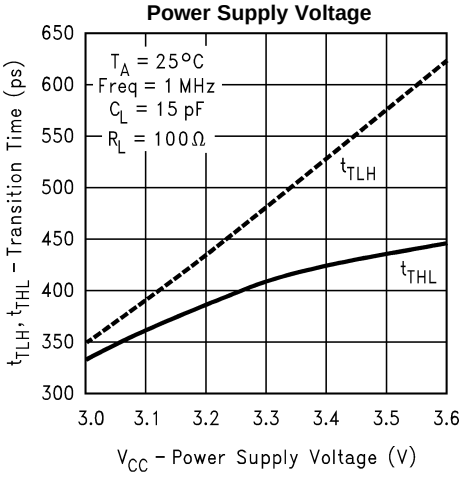



**Figure 18.**

**Transition Time vs Ambient Temperature**

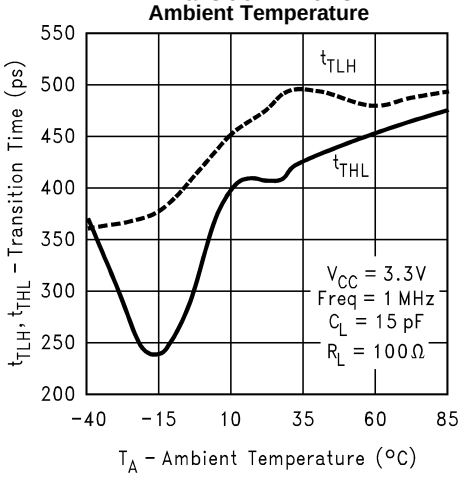



**Figure 19.**

## REVISION HISTORY

| Changes from Revision C (April 2013) to Revision D | Page |
|---|---|
| • Changed layout of National Data Sheet to TI format | 7 |

## PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package \| Pins | Package qty \| Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---|---|---|---|---|---|---|---|---|---|
| DS90LV027AQMA/NOPB | Active | Production | SOIC (D) \| 8 | 95 \| TUBE | Yes | SN | Level-1-260C-UNLIM | -40 to 125 | 90LV0<br>27AQM |
| DS90LV027AQMA/NOPB.A | Active | Production | SOIC (D) \| 8 | 95 \| TUBE | Yes | SN | Level-1-260C-UNLIM | -40 to 125 | 90LV0<br>27AQM |
| DS90LV027AQMA/NOPB.B | Active | Production | SOIC (D) \| 8 | 95 \| TUBE | Yes | SN | Level-1-260C-UNLIM | -40 to 125 | 90LV0<br>27AQM |
| DS90LV027AQMAX/NO.A | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 125 | 90LV0<br>27AQM |
| DS90LV027AQMAX/NOPB | Active | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 125 | 90LV0<br>27AQM |

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

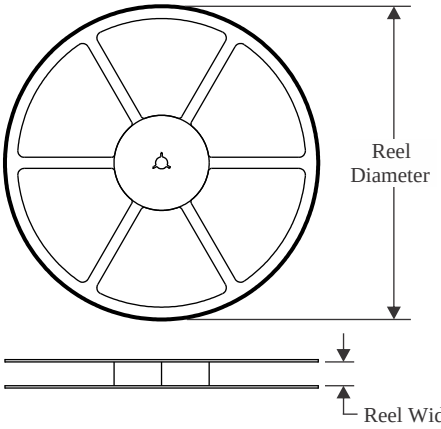
(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

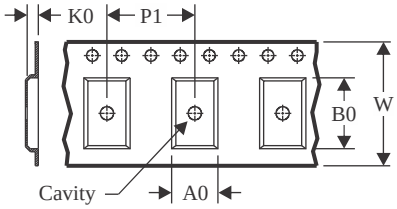
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

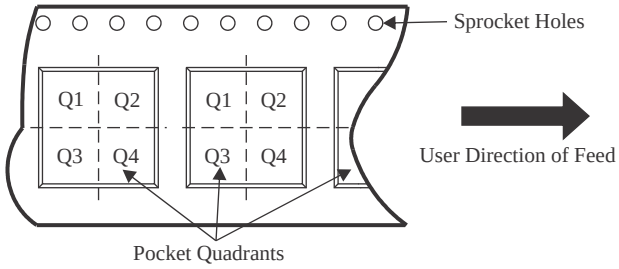



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

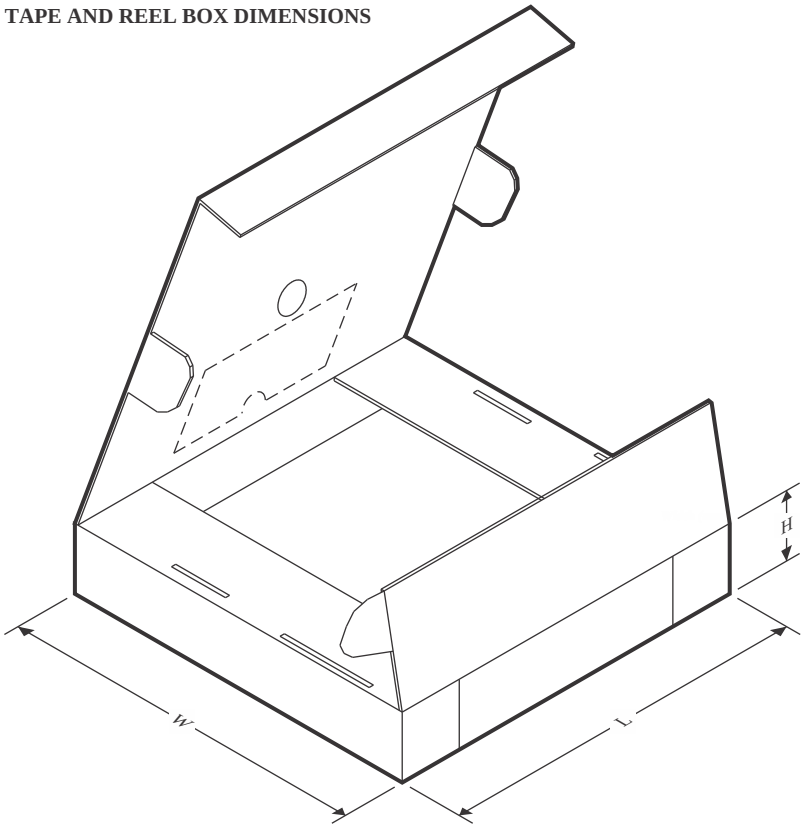
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DS90LV027AQMAX/ NOPB | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.5 | 5.4 | 2.0 | 8.0 | 12.0 | Q1 |

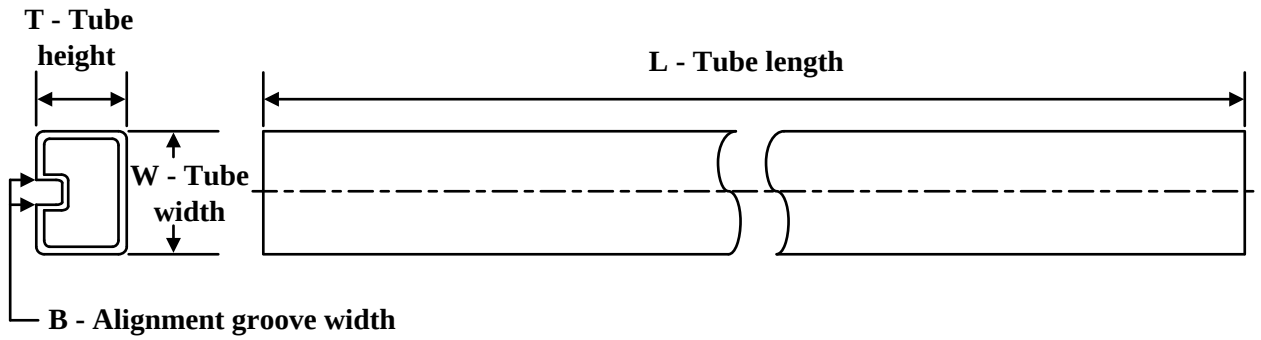
TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

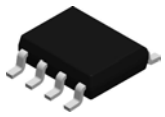
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| DS90LV027AQMAX/NOPB | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |

## TUBE




*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (µm) | B (mm) |
|---|---|---|---|---|---|---|---|---|
| DS90LV027AQMA/NOPB | D | SOIC | 8 | 95 | 495 | 8 | 4064 | 3.05 |
| DS90LV027AQMA/ NOPB.A | D | SOIC | 8 | 95 | 495 | 8 | 4064 | 3.05 |
| DS90LV027AQMA/ NOPB.B | D | SOIC | 8 | 95 | 495 | 8 | 4064 | 3.05 |

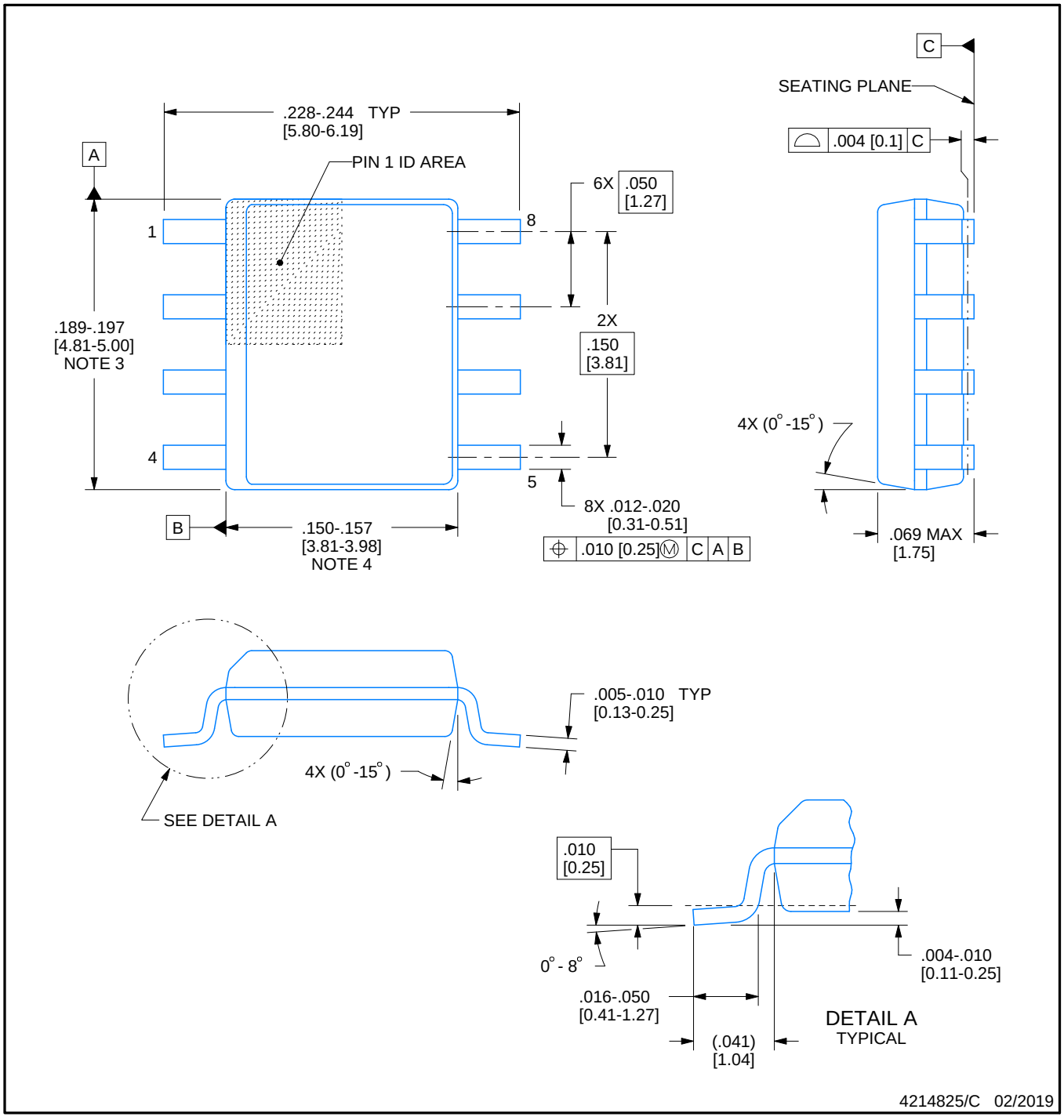


# PACKAGE OUTLINE

## D0008A

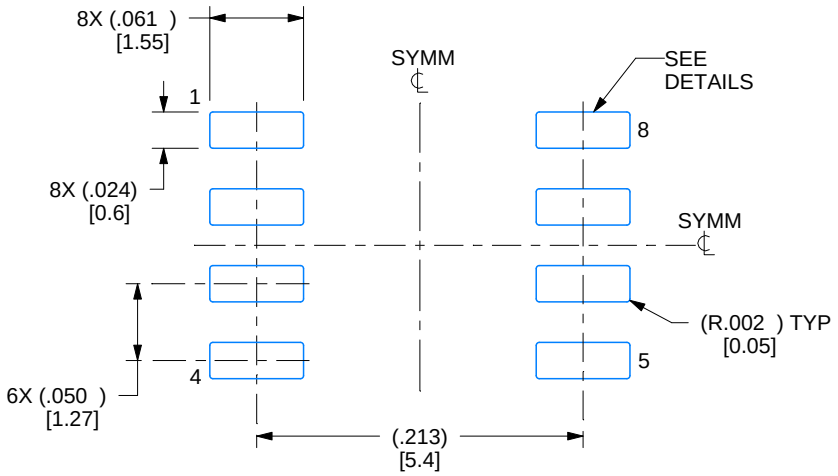
## SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

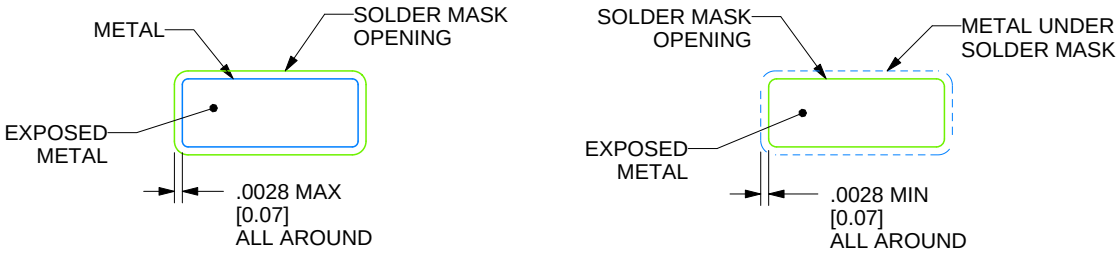



NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X




SOLDER MASK DETAILS

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NOTES: (continued)

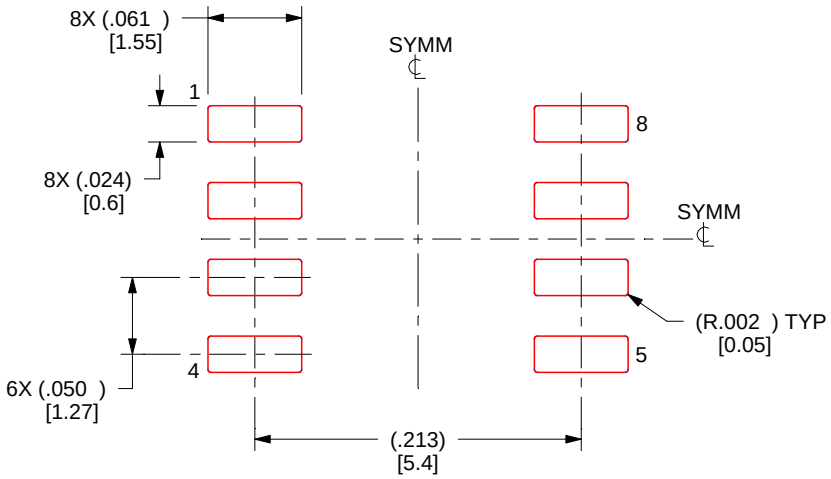
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

## D0008A

## SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT




SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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