



## SN74LVC1G86 Single 2-Input Exclusive-OR Gate

### 1 Features

- Available in the Texas Instruments NanoFree™ Package
- Supports 5-V  $V_{CC}$  Operation
- Inputs Accept Voltages to 5.5 V
- Supports Down Translation to  $V_{CC}$
- Maximum  $t_{pd}$  of 4 ns at 3.3 V and 15-pF load
- Low Power Consumption, 10- $\mu$ A Maximum  $I_{CC}$
- $\pm 24$ -mA Output Drive at 3.3 V
- $I_{off}$  Supports Live Insertion, Partial-Power-Down Mode, and Back-Drive Protection
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 1000-V Charged-Device Model (C101)

### 2 Applications

- Cameras
- Programmable Logic Controllers
- Telecom Infrastructure
- Wireless Headsets
- Motor Drives and Controls
- TVs
- Set-Top Boxes
- Audio

### 3 Description

The SN74LVC1G86 device performs the Boolean function  $Y = A \times B$  or  $Y = \overline{A}B + A\overline{B}$  in positive logic. This single 2-input exclusive-OR gate is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

If the input is low, the other input is reproduced in true form at the output. If the input is high, the signal on the other input is reproduced inverted at the output. This device has low power consumption with maximum  $t_{pd}$  of 4 ns at 3.3 V and 15-pF capacitive load. The max output drive is  $\pm 32$ -mA at 4.5 V and  $\pm 24$ -mA at 3.3 V.

This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current back flow through the device when it is powered down.

**Device Information<sup>(1)</sup>**

| PART NUMBER    | PACKAGE    | BODY SIZE (NOM)   |
|----------------|------------|-------------------|
| SN74LVC1G86DBV | SOT-23 (5) | 2.90 mm × 1.60 mm |
| SN74LVC1G86DCK | SC70 (5)   | 2.00 mm × 1.25 mm |
| SN74LVC1G86DRL | SOT (5)    | 1.60 mm × 1.20 mm |
| SN74LVC1G86YZP | DSBGA (5)  | 1.44 mm × 0.94 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

### Functional Block Diagram



An exclusive-OR gate has many applications, some of which can be represented better by alternative logic symbols.

These are five equivalent exclusive-OR symbols valid for an SN74LVC1G86 gate in positive logic; negation may be shown at any two ports.



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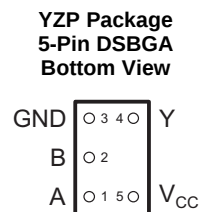
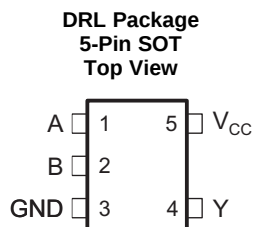
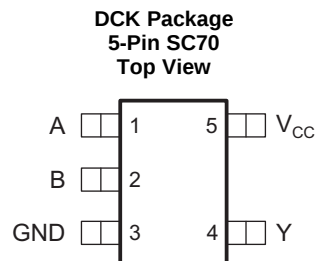
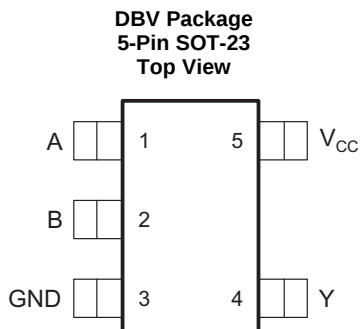
## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision O (December 2013) to Revision P                                                                                                                                                                                                                                                                                                                                                                                                                                        | Page |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| • Added <i>Applications</i> section, <i>Device Information</i> table, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Typical Characteristics</i> section, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section ..... | 1    |
| • .....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 5    |

| Changes from Revision N (January 2007) to Revision O | Page |
|------------------------------------------------------|------|
| • Updated document to new TI data sheet format ..... | 1    |
| • Removed <i>Ordering Information</i> table. ....    | 1    |
| • Updated $I_{off}$ in <i>Features</i> . ....        | 1    |
| • Updated operating temperature range. ....          | 4    |

## 5 Pin Configuration and Functions



**Pin Functions<sup>(1)</sup>**

| PIN |                 | I/O | DESCRIPTION |
|-----|-----------------|-----|-------------|
| NO. | NAME            |     |             |
| 1   | A               | I   | Input A     |
| 2   | B               | I   | Input B     |
| 3   | GND             | —   | Ground Pin  |
| 4   | Y               | O   | Output Y    |
| 5   | V <sub>CC</sub> | —   | Power Pin   |

(1) See mechanical drawings for dimensions.

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                  |                                                                                       |                    | MIN  | MAX                   | UNIT |
|------------------|---------------------------------------------------------------------------------------|--------------------|------|-----------------------|------|
| V <sub>CC</sub>  | Supply voltage                                                                        |                    | −0.5 | 6.5                   | V    |
| V <sub>I</sub>   | Input voltage <sup>(2)</sup>                                                          |                    | −0.5 | 6.5                   | V    |
| V <sub>O</sub>   | Voltage applied to any output in the high-impedance or power-off state <sup>(2)</sup> |                    | −0.5 | 6.5                   | V    |
| V <sub>O</sub>   | Voltage applied to any output in the high or low state <sup>(2)(3)</sup>              |                    | −0.5 | V <sub>CC</sub> + 0.5 | V    |
| I <sub>IK</sub>  | Input clamp current                                                                   | V <sub>I</sub> < 0 | −50  |                       | mA   |
| I <sub>OK</sub>  | Output clamp current                                                                  | V <sub>O</sub> < 0 | −50  |                       | mA   |
| I <sub>O</sub>   | Continuous output current                                                             |                    | ±50  |                       | mA   |
|                  | Continuous current through V <sub>CC</sub> or GND                                     |                    | ±100 |                       | mA   |
| T <sub>j</sub>   | Junction temperature                                                                  |                    | 150  |                       | °C   |
| T <sub>stg</sub> | Storage temperature                                                                   |                    | −65  | 150                   | °C   |

(1) Stresses beyond 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-rated conditions for extended periods may affect device reliability.

(2) The input negative-voltage and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

(3) The value of V<sub>CC</sub> is provided in the *Recommended Operating Conditions* table.

### 6.2 ESD Ratings

|                    |                         | VALUE                                                                                    | UNIT |
|--------------------|-------------------------|------------------------------------------------------------------------------------------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>              | 2000 |
|                    |                         | Charged-device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup> | 1000 |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                 |                           | MIN                                | MAX                    | UNIT |
|-----------------|---------------------------|------------------------------------|------------------------|------|
| V <sub>CC</sub> | Supply voltage            | Operating                          | 1.65                   | 5.5  |
|                 |                           | Data retention only                | 1.5                    |      |
| V <sub>IH</sub> | High-level input voltage  | V <sub>CC</sub> = 1.65 V to 1.95 V | 0.65 × V <sub>CC</sub> | V    |
|                 |                           | V <sub>CC</sub> = 2.3 V to 2.7 V   | 1.7                    |      |
|                 |                           | V <sub>CC</sub> = 3 V to 3.6 V     | 2                      |      |
|                 |                           | V <sub>CC</sub> = 4.5 V to 5.5 V   | 0.7 × V <sub>CC</sub>  |      |
| V <sub>IL</sub> | Low-level input voltage   | V <sub>CC</sub> = 1.65 V to 1.95 V | 0.35 × V <sub>CC</sub> | V    |
|                 |                           | V <sub>CC</sub> = 2.3 V to 2.7 V   | 0.7                    |      |
|                 |                           | V <sub>CC</sub> = 3 V to 3.6 V     | 0.8                    |      |
|                 |                           | V <sub>CC</sub> = 4.5 V to 5.5 V   | 0.3 × V <sub>CC</sub>  |      |
| V <sub>I</sub>  | Input voltage             | 0                                  | 5.5                    | V    |
| V <sub>O</sub>  | Output voltage            | 0                                  | V <sub>CC</sub>        | V    |
| I <sub>OH</sub> | High-level output current | V <sub>CC</sub> = 1.65 V           | −4                     | mA   |
|                 |                           | V <sub>CC</sub> = 2.3 V            | −8                     |      |
|                 |                           | V <sub>CC</sub> = 3 V              | −16                    |      |
|                 |                           |                                    | −24                    |      |
|                 |                           | V <sub>CC</sub> = 4.5 V            | −32                    |      |

(1) All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number [SCBA004](#).

## Recommended Operating Conditions (continued)

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                                                        |                                                                          | MIN | MAX | UNIT |
|--------------------------------------------------------|--------------------------------------------------------------------------|-----|-----|------|
| $I_{OL}$ Low-level output current                      | $V_{CC} = 1.65\text{ V}$                                                 |     | 4   | mA   |
|                                                        | $V_{CC} = 2.3\text{ V}$                                                  |     | 8   |      |
|                                                        | $V_{CC} = 3\text{ V}$                                                    |     | 16  |      |
|                                                        |                                                                          |     | 24  |      |
|                                                        | $V_{CC} = 4.5\text{ V}$                                                  |     | 32  |      |
| $\Delta t/\Delta v$ Input transition rise or fall rate | $V_{CC} = 1.8\text{ V} \pm 0.15\text{ V}, 2.5\text{ V} \pm 0.2\text{ V}$ |     | 20  | ns/V |
|                                                        | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$                                 |     | 10  |      |
|                                                        | $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$                                   |     | 5   |      |
| $T_A$ Operating free-air temperature                   | YZP Package                                                              | –40 | 85  | °C   |
|                                                        | DCK, DBV, and DRL Packages                                               | –40 | 125 |      |

## 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup>                          | SN74LVC1G86  |            |             | UNIT |
|--------------------------------------------------------|--------------|------------|-------------|------|
|                                                        | DBV (SOT-23) | DCK (SC70) | YZP (DSBGA) |      |
|                                                        | 5 PINS       | 5 PINS     | 5 PINS      |      |
| $R_{\theta JA}$ Junction-to-ambient thermal resistance | 206          | 252        | 132         | °C/W |

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#).

## 6.5 Electrical Characteristics

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER          | TEST CONDITIONS                                                        |                          | $V_{CC}$        | MIN            | TYP <sup>(1)</sup> | MAX      | UNIT          |
|--------------------|------------------------------------------------------------------------|--------------------------|-----------------|----------------|--------------------|----------|---------------|
| $V_{OH}$           | $I_{OH} = -100\text{ }\mu\text{A}$                                     |                          | 1.65 V to 5.5 V | $V_{CC} - 0.1$ |                    |          | V             |
|                    | $I_{OH} = -4\text{ mA}$                                                |                          | 1.65 V          | 1.2            |                    |          |               |
|                    | $I_{OH} = -8\text{ mA}$                                                |                          | 2.3 V           | 1.9            |                    |          |               |
|                    | $I_{OH} = -16\text{ mA}$                                               |                          | 3 V             | 2.4            |                    |          |               |
|                    | $I_{OH} = -24\text{ mA}$                                               |                          |                 | 2.3            |                    |          |               |
|                    | $I_{OH} = -32\text{ mA}$                                               |                          | 4.5 V           | 3.8            |                    |          |               |
| $V_{OL}$           | $I_{OL} = 100\text{ }\mu\text{A}$                                      |                          | 1.65 V to 5.5 V |                |                    | 0.1      | V             |
|                    | $I_{OL} = 4\text{ mA}$                                                 |                          | 1.65 V          |                |                    | 0.45     |               |
|                    | $I_{OL} = 8\text{ mA}$                                                 |                          | 2.3 V           |                |                    | 0.3      |               |
|                    | $I_{OL} = 16\text{ mA}$                                                |                          | 3 V             |                |                    | 0.4      |               |
|                    | $I_{OL} = 24\text{ mA}$                                                |                          |                 |                |                    | 0.55     |               |
|                    | $I_{OL} = 32\text{ mA}$                                                |                          | 4.5 V           |                |                    | 0.55     |               |
| $I_I$ A or B input | $V_I = 5.5\text{ V}$ or GND                                            |                          | 0 to 5.5 V      |                |                    | $\pm 5$  | $\mu\text{A}$ |
| $I_{off}$          | $V_I$ or $V_O = 5.5\text{ V}$                                          |                          | 0               |                |                    | $\pm 10$ | $\mu\text{A}$ |
| $I_{CC}$           | $V_I = V_{CC}$ or GND, $I_O = 0$                                       | –40°C to 85°C            | 1.65 V to 5.5 V |                |                    | 10       | $\mu\text{A}$ |
|                    |                                                                        | –40°C to 125°C           |                 |                |                    | 15       |               |
| $\Delta I_{CC}$    | One input at $V_{CC} - 0.6\text{ V}$ , Other inputs at $V_{CC}$ or GND |                          | 3 V to 5.5 V    |                |                    | 500      | $\mu\text{A}$ |
| $C_i$              | $V_I = V_{CC}$ or GND                                                  | –40°C to 85°C Temp Range | 3.3 V           |                |                    | 6        | pF            |

(1) All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

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### 6.6 Switching Characteristics, $C_L = 15 \text{ pF}$

over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 2](#))

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS          | $V_{CC} = 1.8 \text{ V} \pm 0.15 \text{ V}$ |     | $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$ |     | $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ |     | $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$ |     | UNIT |
|-----------|--------------|-------------|--------------------------|---------------------------------------------|-----|--------------------------------------------|-----|--------------------------------------------|-----|------------------------------------------|-----|------|
|           |              |             |                          | MIN                                         | MAX | MIN                                        | MAX | MIN                                        | MAX | MIN                                      | MAX |      |
| $t_{pd}$  | A or B       | Y           | –40°C to 85°C temp range | 2.1                                         | 9.1 | 1                                          | 4.5 | 0.6                                        | 4   | 0.8                                      | 3.3 | ns   |

### 6.7 Switching Characteristics, $C_L = 30 \text{ pF}$ or $50 \text{ pF}$

over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS                                         | $V_{CC} = 1.8 \text{ V} \pm 0.15 \text{ V}$ |     | $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$ |     | $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ |     | $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$ |     | UNIT |
|-----------|--------------|-------------|---------------------------------------------------------|---------------------------------------------|-----|--------------------------------------------|-----|--------------------------------------------|-----|------------------------------------------|-----|------|
|           |              |             |                                                         | MIN                                         | MAX | MIN                                        | MAX | MIN                                        | MAX | MIN                                      | MAX |      |
| $t_{pd}$  | A or B       | Y           | –40°C to 85°C temp range, see <a href="#">Figure 2</a>  | 3.5                                         | 9.9 | 1.8                                        | 5.5 | 1.3                                        | 5   | 1                                        | 4   | ns   |
|           |              |             | –40°C to 125°C temp range, see <a href="#">Figure 2</a> | 3.5                                         | 12  | 1.8                                        | 7   | 1.3                                        | 6   | 1                                        | 5   |      |

### 6.8 Operating Characteristics

$T_A = 25^\circ\text{C}$

| PARAMETER       |                               | TEST CONDITIONS | V <sub>CC</sub> = 1.8 V | V <sub>CC</sub> = 2.5 V | V <sub>CC</sub> = 3.3 V | V <sub>CC</sub> = 5 V | UNIT |
|-----------------|-------------------------------|-----------------|-------------------------|-------------------------|-------------------------|-----------------------|------|
|                 |                               |                 | TYP                     | TYP                     | TYP                     | TYP                   |      |
| C <sub>pd</sub> | Power dissipation capacitance | f = 10 MHz      | 22                      | 22                      | 22                      | 24                    | pF   |

### 6.9 Typical Characteristics

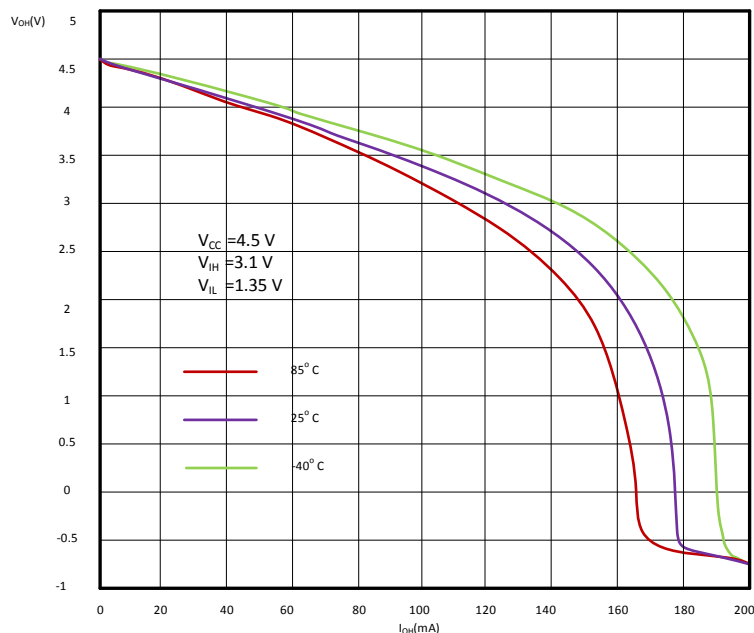
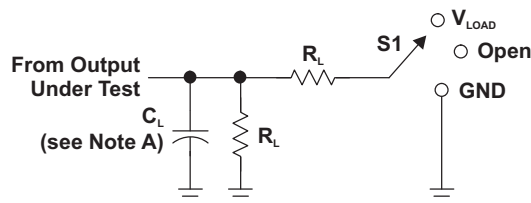


Figure 1.  $V_{OH}$  vs  $I_{OH}$  at 4.5 V

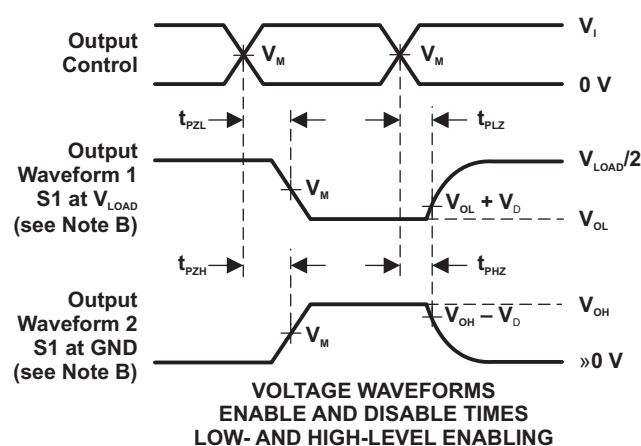
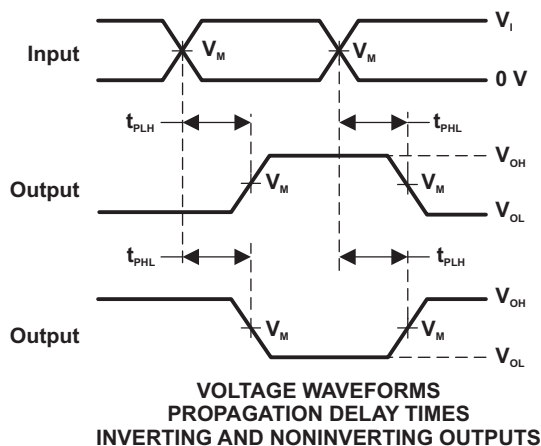
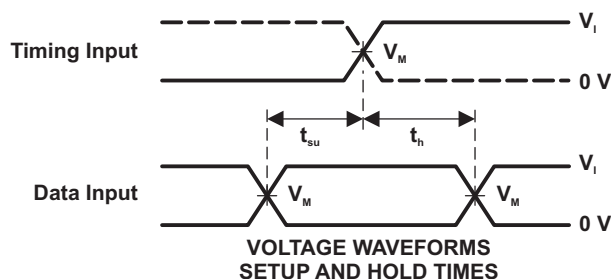
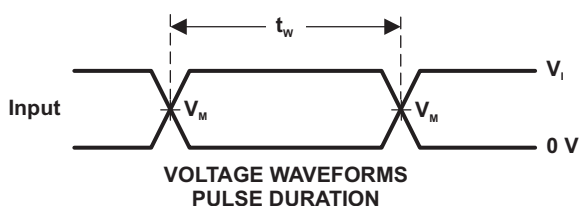
## 7 Parameter Measurement Information



LOAD CIRCUIT

| TEST              | S1         |
|-------------------|------------|
| $t_{PLH}/t_{PHL}$ | Open       |
| $t_{PLZ}/t_{PZL}$ | $V_{LOAD}$ |
| $t_{PHZ}/t_{PZH}$ | GND        |

| $V_{CC}$                         | INPUTS   |                      | $V_M$      | $V_{LOAD}$        | $C_L$ | $R_L$        | $V_D$  |
|----------------------------------|----------|----------------------|------------|-------------------|-------|--------------|--------|
|                                  | $V_I$    | $t/t_i$              |            |                   |       |              |        |
| $1.8\text{ V} \pm 0.15\text{ V}$ | $V_{CC}$ | $\leq 2\text{ ns}$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 15 pF | 1 M $\Omega$ | 0.15 V |
| $2.5\text{ V} \pm 0.2\text{ V}$  | $V_{CC}$ | $\leq 2\text{ ns}$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 15 pF | 1 M $\Omega$ | 0.15 V |
| $3.3\text{ V} \pm 0.3\text{ V}$  | 3 V      | $\leq 2.5\text{ ns}$ | 1.5 V      | 6 V               | 15 pF | 1 M $\Omega$ | 0.3 V  |
| $5\text{ V} \pm 0.5\text{ V}$    | $V_{CC}$ | $\leq 2.5\text{ ns}$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 15 pF | 1 M $\Omega$ | 0.3 V  |



- NOTES:
- $C_L$  includes probe and jig capacitance.
  - Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
  - All input pulses are supplied by generators having the following characteristics: PRR  $\leq 10\text{ MHz}$ ,  $Z_o = 50\ \Omega$ .
  - The outputs are measured one at a time, with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - All parameters and waveforms are not applicable to all devices.

Figure 2. Load Circuit and Voltage Waveforms

## 8 Detailed Description

### 8.1 Overview

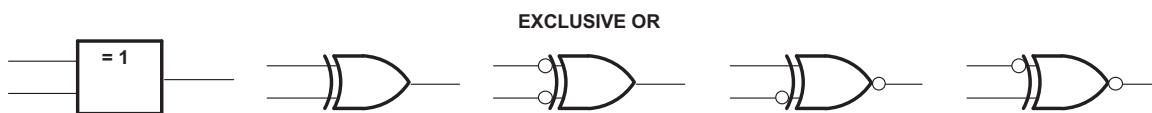
The SN74LVC1G86 device performs the Boolean function  $Y = A \times B$  or  $Y = \overline{A}B + A\overline{B}$  in positive logic. This single 2-input exclusive-OR gate is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

A common application is as a true/complement element. If the input is low, the other input is reproduced in true form at the output. If the input is high, the signal on the other input is reproduced inverted at the output.

NanoFree package technology is a major breakthrough in IC packaging concepts, using the die as the package.

This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

### 8.2 Functional Block Diagram



These are five equivalent exclusive-OR symbols valid for an SN74LVC1G86 gate in positive logic; negation may be shown at any two ports.

### 8.3 Feature Description

SN74LVC1G86 has a wide operating voltage range from 1.65 V to 5.5 V. This allows down voltage translation and also accepts inputs voltages to 5.5 V. The maximum propagation delay is 4n s at 3.3 V at 15-pF capacitor load. Power consumption is low with 10  $\mu$ A maximum  $I_{CC}$  current. It supports  $\pm 24$ -mA output drive at 3.3 V. The SN74LVC1G86 is specified for partial power down applications using  $I_{off}$  supporting Live insertion and Back-Drive protection.

### 8.4 Function Table

[Table 1](#) lists the functional modes of the SN74LVC1G86.

**Table 1. Function Table**

| INPUTS |   | OUTPUT<br>Y |
|--------|---|-------------|
| A      | B |             |
| L      | L | L           |
| L      | H | H           |
| H      | L | H           |
| H      | H | L           |

## 9 Application and Implementation

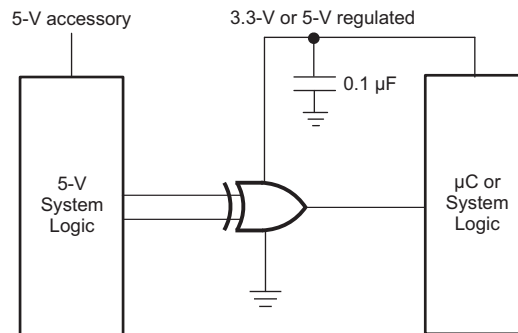
### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

SN74LVC1G86 can accept input voltages to 5.5 V at any valid  $V_{CC}$  which makes it suitable for down translation. This feature of SN74LVC1G86 makes it ideal for various bus interface applications.

### 9.2 Typical Application



**Figure 3. Typical Application Schematic**

#### 9.2.1 Design Requirements

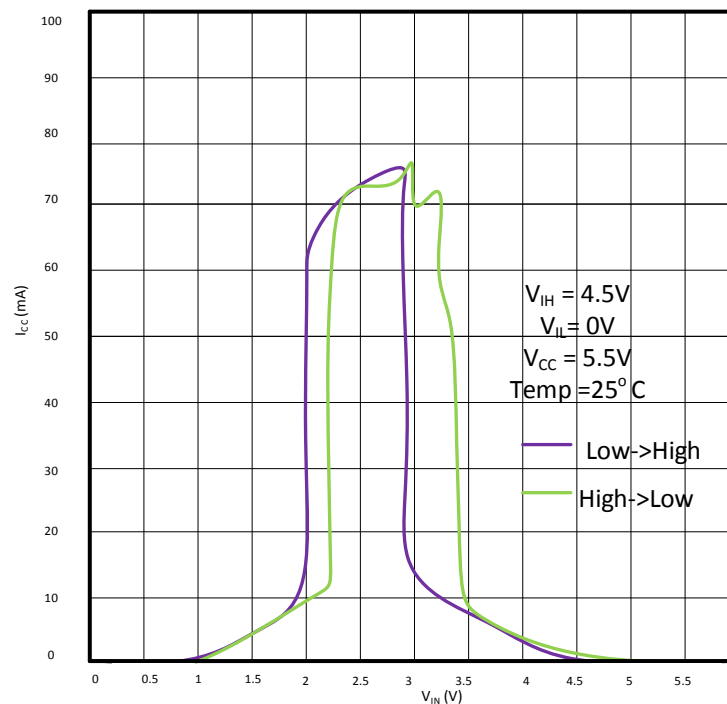
This device uses CMOS technology and has balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits. The high drive will also create fast edges into light loads, so routing and load conditions should be considered to prevent ringing.

#### 9.2.2 Detailed Design Procedure

1. Recommended Input Conditions
  - For rise time and fall time specifications, see  $\Delta t/\Delta V$  in the [Recommended Operating Conditions](#) table.
  - For specified High and low levels, see  $V_{IH}$  and  $V_{IL}$  in the [Recommended Operating Conditions](#) table.
  - Inputs are overvoltage tolerant allowing them to go as high as 5.5 V at any valid  $V_{CC}$ .
2. Recommend Output Conditions
  - Load currents should not exceed 32 mA per output and 50 mA total for the part.
  - Outputs should not be pulled above  $V_{CC}$ .

## Typical Application (continued)

### 9.2.3 Application Curve



**Figure 4. ICC vs. VIN**

## 10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Recommended Operating Conditions](#) table.

Each  $V_{CC}$  pin should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, 0.1  $\mu F$  is recommended. If there are multiple  $V_{CC}$  pins, 0.01  $\mu F$  or 0.022  $\mu F$  is recommended for each power pin. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. A 0.1- $\mu F$  and 1- $\mu F$  are commonly used in parallel. The bypass capacitor should be installed as close to the power pin as possible for best results.

## 11 Layout

### 11.1 Layout Guidelines

When using multiple bit logic devices, inputs should not float. In many cases, functions or parts of functions of digital logic devices are unused. Some examples are when only two inputs of a triple-input AND gate are used, or when only 3 of the 4-buffer gates are used. Such input pins should not be left unconnected because the undefined voltages at the outside connections result in undefined operational states.

Specified in [Figure 5](#) are rules that must be observed under all circumstances. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that should be applied to any particular unused input depends on the function of the device. Generally they will be tied to GND or  $V_{CC}$ , whichever makes more sense or is more convenient. It is acceptable to float outputs unless the part is a transceiver. If the transceiver has an output enable pin, it will disable the outputs section of the part when asserted. This will not disable the input section of the I/Os so they also cannot float when disabled.

### 11.2 Layout Example

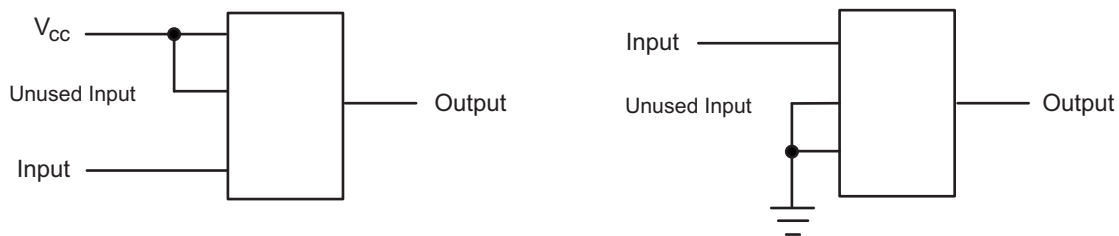


Figure 5. Layout Diagram

## 12 Device and Documentation Support

### 12.1 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 12.2 Trademarks

NanoFree, E2E are trademarks of Texas Instruments.  
All other trademarks are the property of their respective owners.

### 12.3 Electrostatic Discharge Caution



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.

### 12.4 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

## PACKAGING INFORMATION

| Orderable Device  | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)        | Samples                 |
|-------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|--------------------------------|-------------------------|
| SN74LVC1G86DBVR   | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | -40 to 125   | (C865 ~ C86F ~<br>C86K ~ C86R) | <a href="#">Samples</a> |
| SN74LVC1G86DBVRE4 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | C86F                           | <a href="#">Samples</a> |
| SN74LVC1G86DBVRG4 | ACTIVE        | SOT-23       | DBV                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | C86F                           | <a href="#">Samples</a> |
| SN74LVC1G86DBVT   | ACTIVE        | SOT-23       | DBV                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | -40 to 125   | (C865 ~ C86F ~<br>C86K ~ C86R) | <a href="#">Samples</a> |
| SN74LVC1G86DCKR   | ACTIVE        | SC70         | DCK                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (CH5 ~ CHF ~ CHK ~<br>CHR)     | <a href="#">Samples</a> |
| SN74LVC1G86DCKRE4 | ACTIVE        | SC70         | DCK                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (CH5 ~ CHF ~ CHK ~<br>CHR)     | <a href="#">Samples</a> |
| SN74LVC1G86DCKRG4 | ACTIVE        | SC70         | DCK                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (CH5 ~ CHF ~ CHK ~<br>CHR)     | <a href="#">Samples</a> |
| SN74LVC1G86DCKT   | ACTIVE        | SC70         | DCK                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (CH5 ~ CHF ~ CHK ~<br>CHR)     | <a href="#">Samples</a> |
| SN74LVC1G86DCKTG4 | ACTIVE        | SC70         | DCK                | 5    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (CH5 ~ CHF ~ CHK ~<br>CHR)     | <a href="#">Samples</a> |
| SN74LVC1G86DRLR   | ACTIVE        | SOT          | DRL                | 5    | 4000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (CH7 ~ CHR)                    | <a href="#">Samples</a> |
| SN74LVC1G86DRLRG4 | ACTIVE        | SOT          | DRL                | 5    | 4000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | (CH7 ~ CHR)                    | <a href="#">Samples</a> |
| SN74LVC1G86YZPR   | ACTIVE        | DSBGA        | YZP                | 5    | 3000           | Green (RoHS<br>& no Sb/Br) | SNAGCU                  | Level-1-260C-UNLIM   | -40 to 85    | (CH7 ~ CHN)                    | <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)

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

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

<sup>(5)</sup> 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.

<sup>(6)</sup> Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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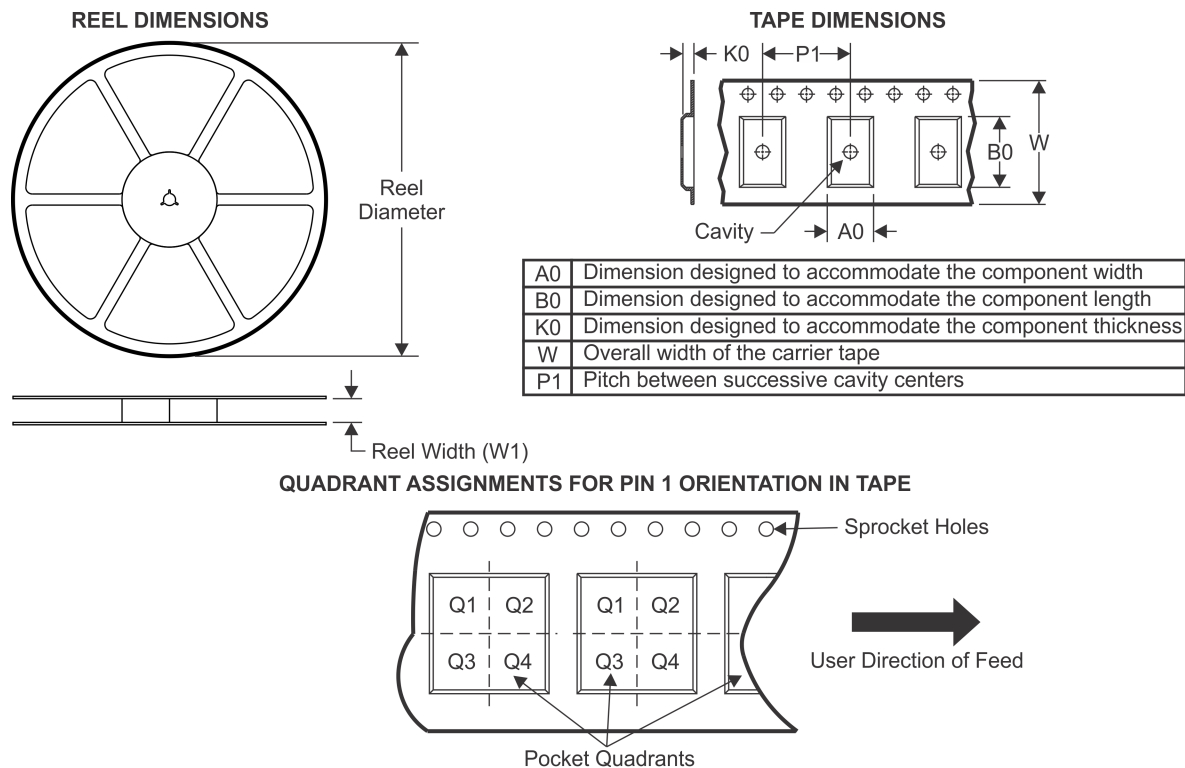
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

#### **OTHER QUALIFIED VERSIONS OF SN74LVC1G86 :**

- Enhanced Product: [SN74LVC1G86-EP](#)

NOTE: Qualified Version Definitions:

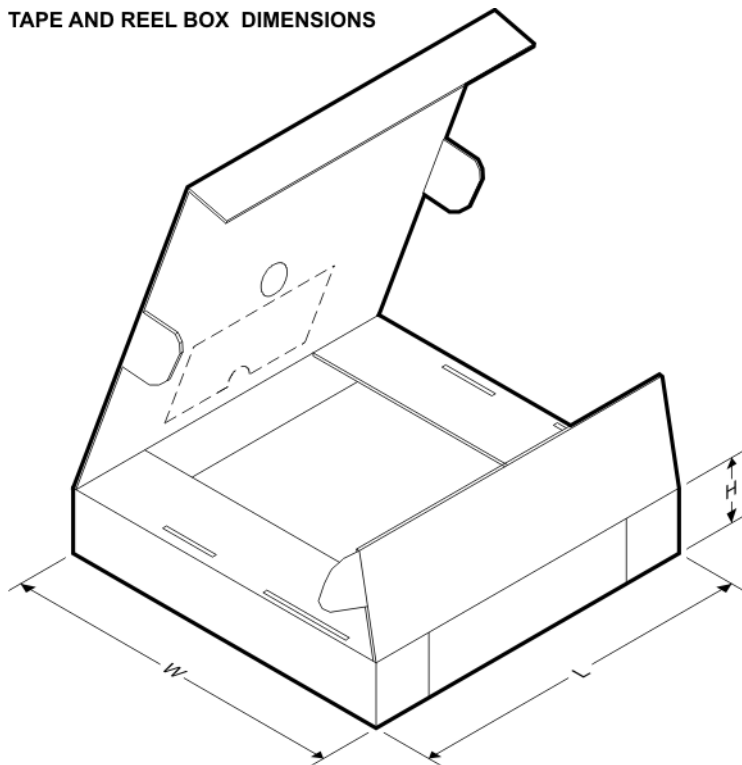
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

**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 |
|-------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LVC1G86DBVR   | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| SN74LVC1G86DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 8.4                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| SN74LVC1G86DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0              | 9.2                | 3.17    | 3.23    | 1.37    | 4.0     | 8.0    | Q3            |
| SN74LVC1G86DBVRG4 | SOT-23       | DBV             | 5    | 3000 | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| SN74LVC1G86DBVT   | SOT-23       | DBV             | 5    | 250  | 178.0              | 9.0                | 3.23    | 3.17    | 1.37    | 4.0     | 8.0    | Q3            |
| SN74LVC1G86DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0              | 9.2                | 3.17    | 3.23    | 1.37    | 4.0     | 8.0    | Q3            |
| SN74LVC1G86DCKR   | SC70         | DCK             | 5    | 3000 | 178.0              | 9.2                | 2.4     | 2.4     | 1.22    | 4.0     | 8.0    | Q3            |
| SN74LVC1G86DCKT   | SC70         | DCK             | 5    | 250  | 180.0              | 9.2                | 2.3     | 2.55    | 1.2     | 4.0     | 8.0    | Q3            |
| SN74LVC1G86DCKT   | SC70         | DCK             | 5    | 250  | 178.0              | 9.2                | 2.4     | 2.4     | 1.22    | 4.0     | 8.0    | Q3            |
| SN74LVC1G86DRLR   | SOT          | DRL             | 5    | 4000 | 180.0              | 8.4                | 1.98    | 1.78    | 0.69    | 4.0     | 8.0    | Q3            |
| SN74LVC1G86DRLR   | SOT          | DRL             | 5    | 4000 | 180.0              | 9.5                | 1.78    | 1.78    | 0.69    | 4.0     | 8.0    | Q3            |
| SN74LVC1G86YZPR   | DSBGA        | YZP             | 5    | 3000 | 178.0              | 9.2                | 1.02    | 1.52    | 0.63    | 4.0     | 8.0    | Q1            |

## TAPE AND REEL BOX DIMENSIONS

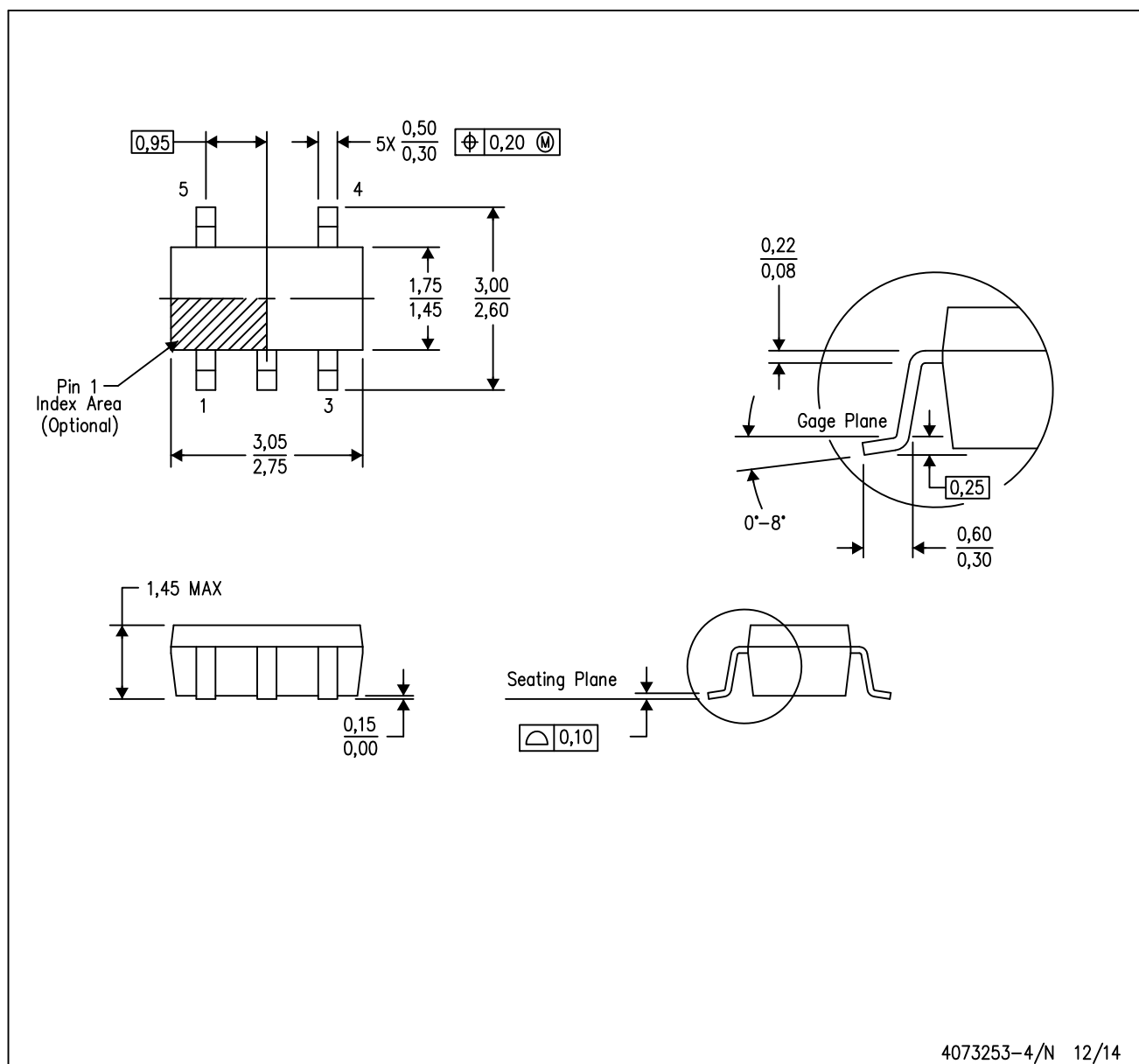


\*All dimensions are nominal

| Device            | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LVC1G86DBVR   | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| SN74LVC1G86DBVR   | SOT-23       | DBV             | 5    | 3000 | 202.0       | 201.0      | 28.0        |
| SN74LVC1G86DBVR   | SOT-23       | DBV             | 5    | 3000 | 205.0       | 200.0      | 33.0        |
| SN74LVC1G86DBVRG4 | SOT-23       | DBV             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| SN74LVC1G86DBVT   | SOT-23       | DBV             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| SN74LVC1G86DBVT   | SOT-23       | DBV             | 5    | 250  | 205.0       | 200.0      | 33.0        |
| SN74LVC1G86DCKR   | SC70         | DCK             | 5    | 3000 | 180.0       | 180.0      | 18.0        |
| SN74LVC1G86DCKT   | SC70         | DCK             | 5    | 250  | 205.0       | 200.0      | 33.0        |
| SN74LVC1G86DCKT   | SC70         | DCK             | 5    | 250  | 180.0       | 180.0      | 18.0        |
| SN74LVC1G86DRLR   | SOT          | DRL             | 5    | 4000 | 202.0       | 201.0      | 28.0        |
| SN74LVC1G86DRLR   | SOT          | DRL             | 5    | 4000 | 184.0       | 184.0      | 19.0        |
| SN74LVC1G86YZPR   | DSBGA        | YZP             | 5    | 3000 | 220.0       | 220.0      | 35.0        |

DBV (R-PDSO-G5)

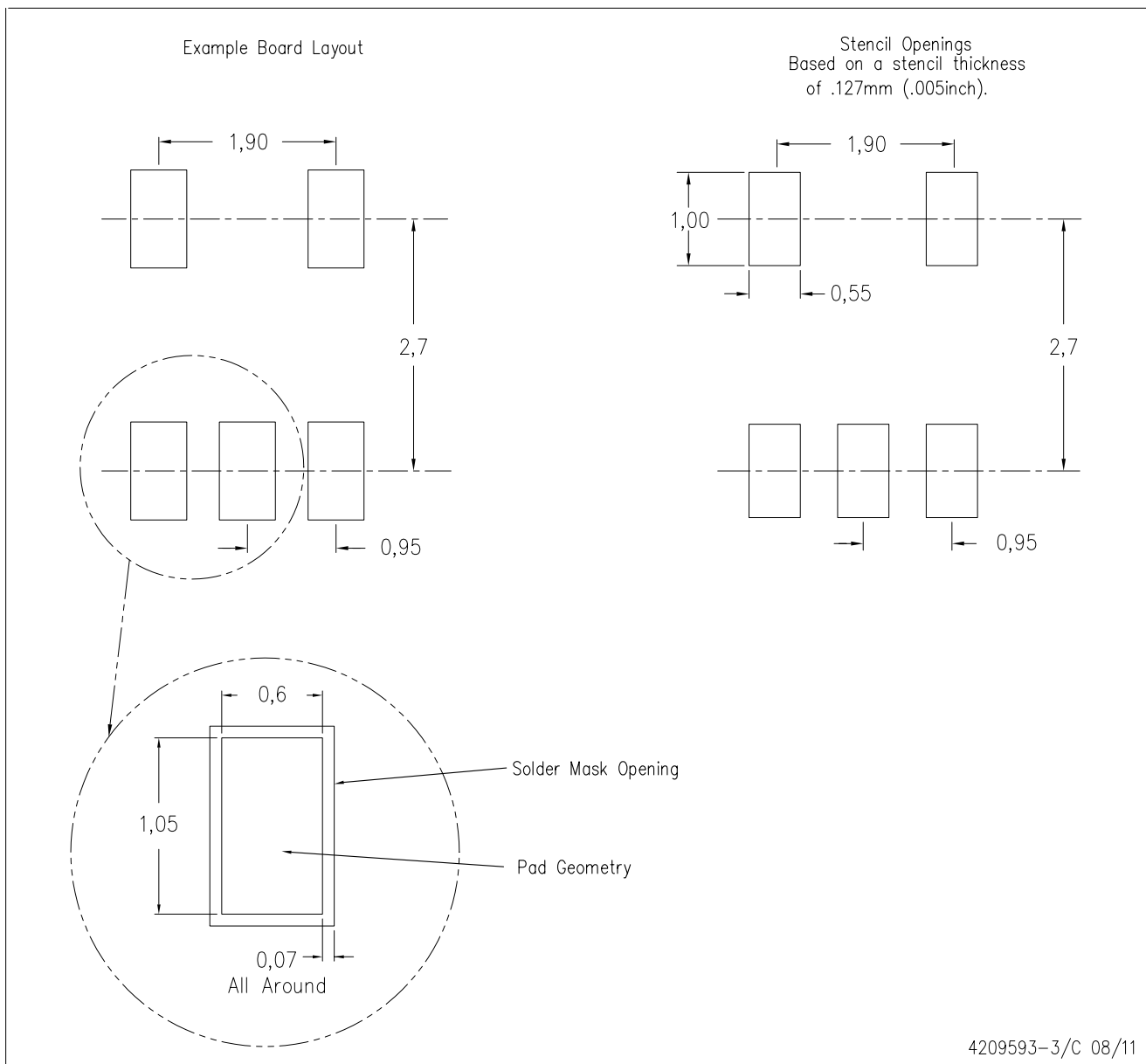
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Falls within JEDEC MO-178 Variation AA.

DBV (R-PDSO-G5)

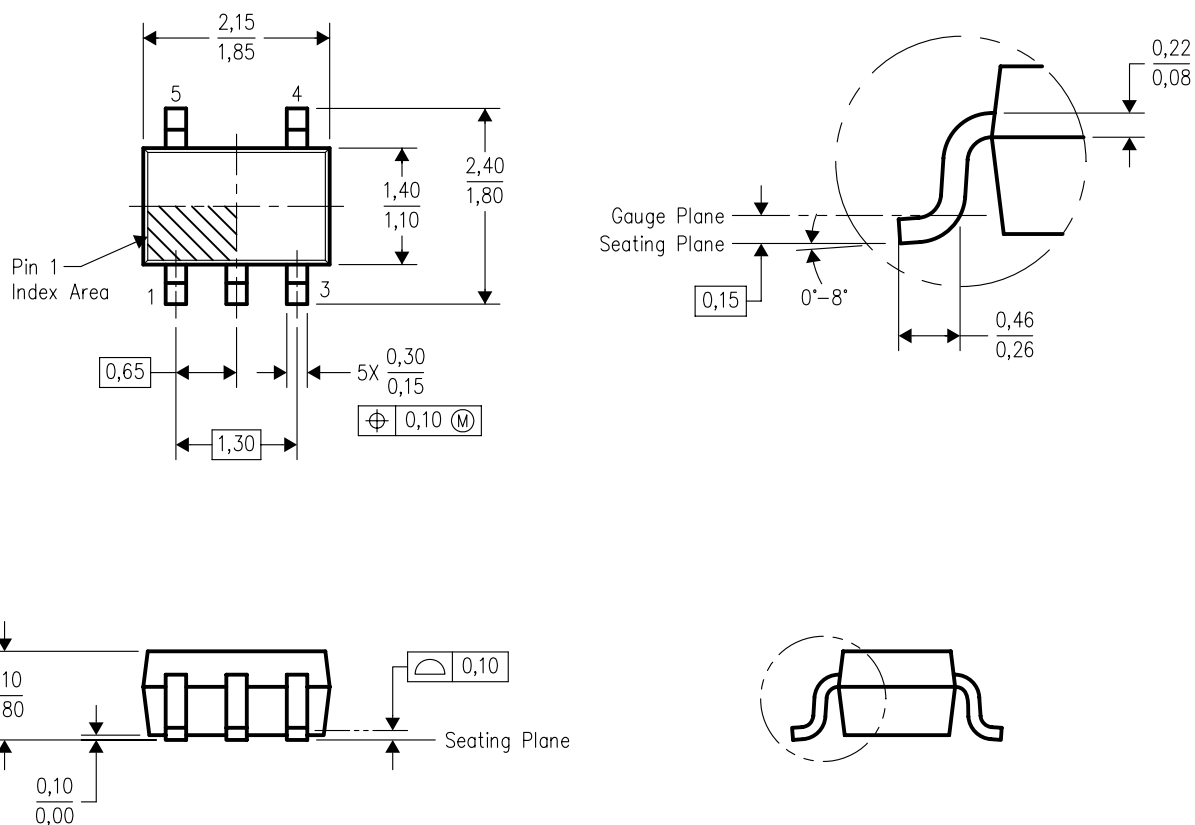
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

## DCK (R-PDSO-G5)

## PLASTIC SMALL-OUTLINE PACKAGE

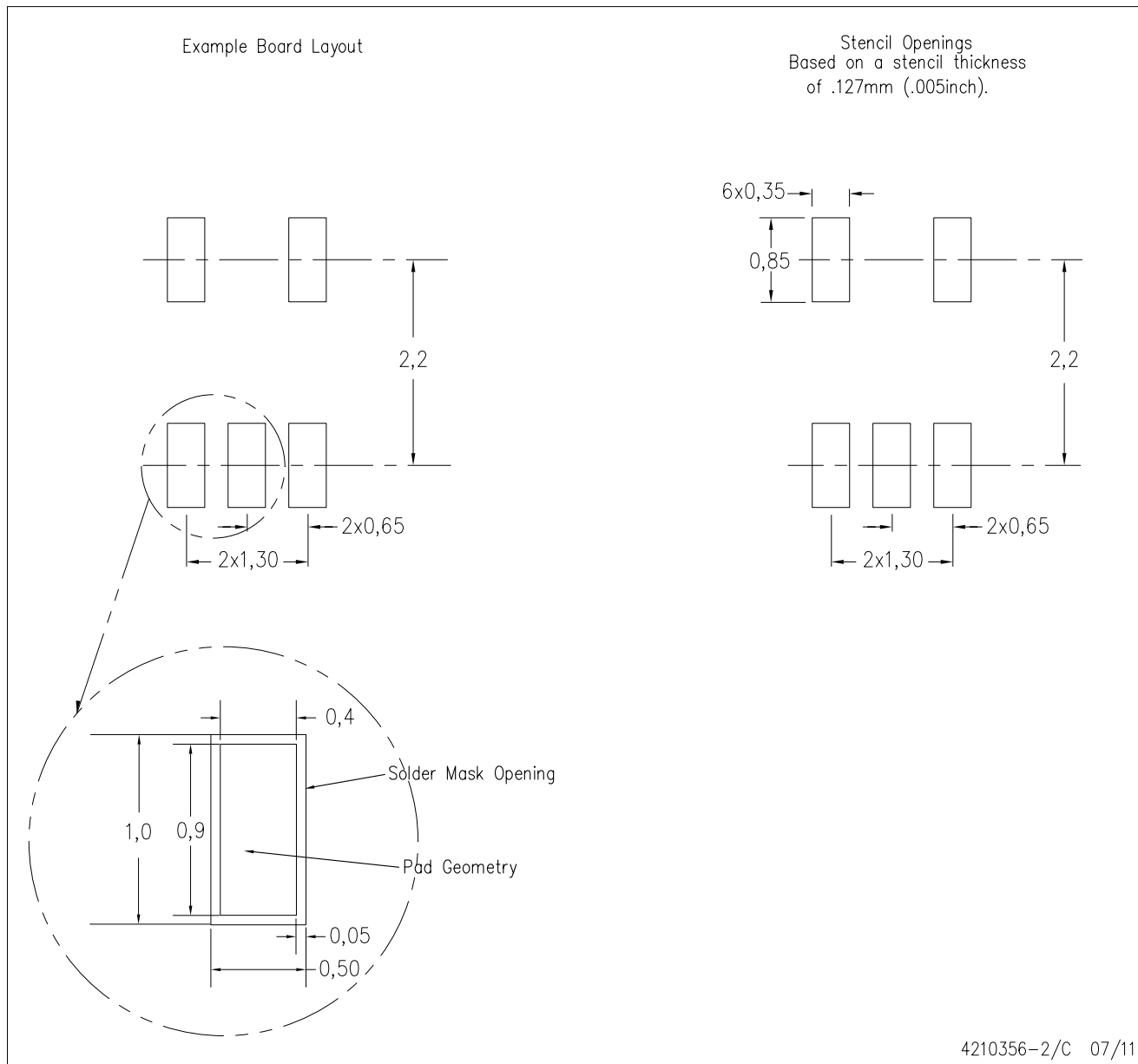


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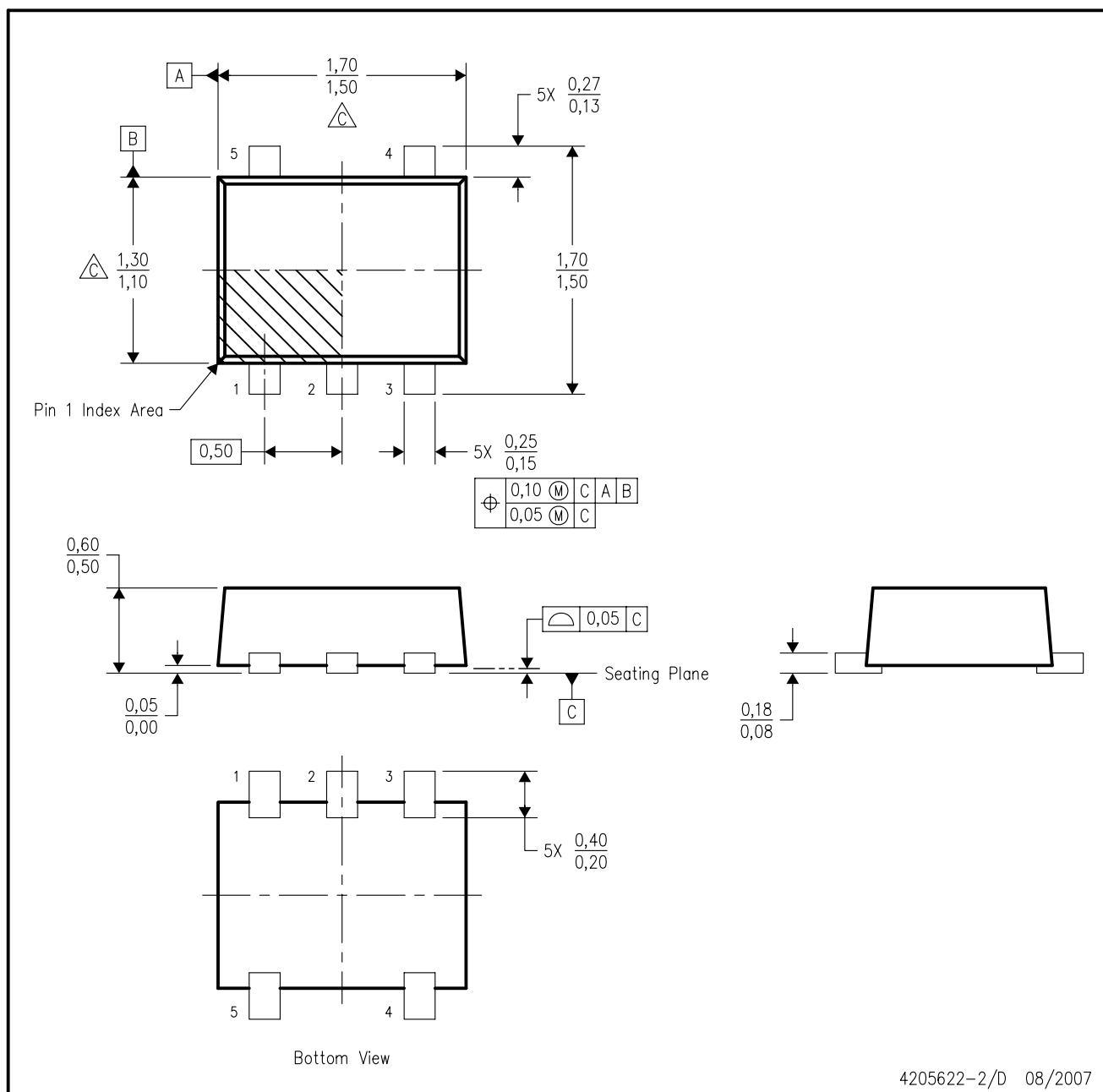
- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - Falls within JEDEC MO-203 variation AA.

DCK (R-PDSO-G5)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.



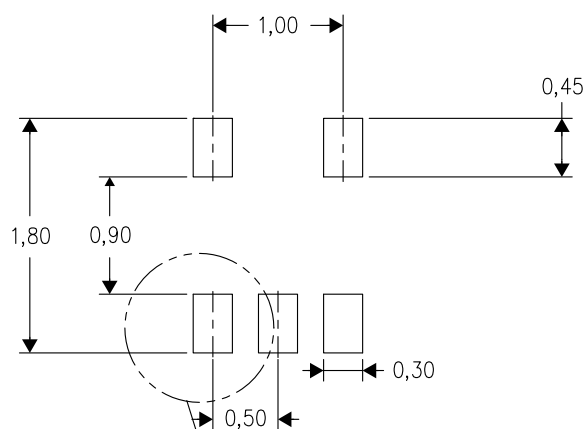
4205622-2/D 08/2007

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash, interlead flash, protrusions, or gate burrs. Mold flash, interlead flash, protrusions, or gate burrs shall not exceed 0,15 per end or side.
  - D. JEDEC package registration is pending.

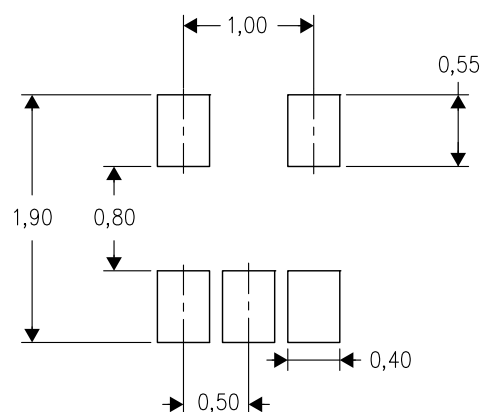
DRL (R-PDSO-N5)

PLASTIC SMALL OUTLINE

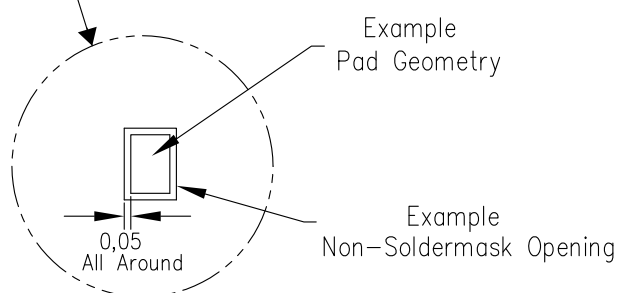
Example Board Layout



Example Stencil Design  
(Note E)



Example  
Non-Soldermask Defined Pad

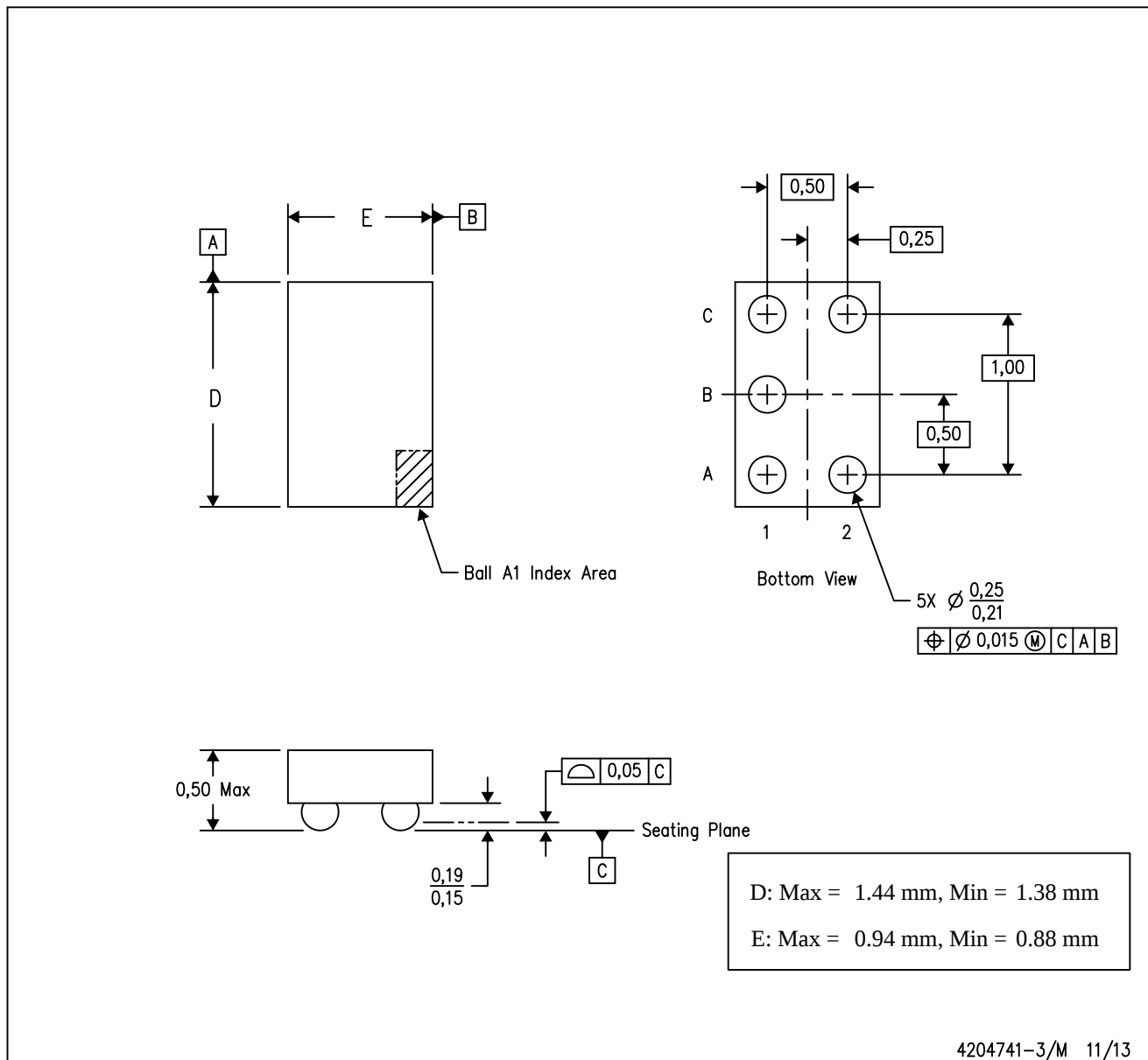


4208207-2/E 06/12

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.
  - E. Maximum stencil thickness 0,127 mm (5 mils). All linear dimensions are in millimeters.
  - F. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
  - G. Side aperture dimensions over-print land for acceptable area ratio > 0.66. Customer may reduce side aperture dimensions if stencil manufacturing process allows for sufficient release at smaller opening.

YZP (R-XBGA-N5)

DIE-SIZE BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. NanoFree™ package configuration.

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No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

|                              |                                                                                      |
|------------------------------|--------------------------------------------------------------------------------------|
| Audio                        | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                               |
| Amplifiers                   | <a href="http://amplifier.ti.com">amplifier.ti.com</a>                               |
| Data Converters              | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>                       |
| DLP® Products                | <a href="http://www.dlp.com">www.dlp.com</a>                                         |
| DSP                          | <a href="http://dsp.ti.com">dsp.ti.com</a>                                           |
| Clocks and Timers            | <a href="http://www.ti.com/clocks">www.ti.com/clocks</a>                             |
| Interface                    | <a href="http://interface.ti.com">interface.ti.com</a>                               |
| Logic                        | <a href="http://logic.ti.com">logic.ti.com</a>                                       |
| Power Mgmt                   | <a href="http://power.ti.com">power.ti.com</a>                                       |
| Microcontrollers             | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a>                   |
| RFID                         | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
| OMAP Applications Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
| Wireless Connectivity        | <a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a> |

### Applications

|                               |                                                                                          |
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