

## SNx4LV86A Quadruple 2-Input Exclusive-OR Gates

### 1 Features

- 2-V to 5.5-V  $V_{CC}$  Operation
- Max  $t_{pd}$  of 8 ns at 5 V
- Typical  $V_{OLP}$  (Output Ground Bounce)  $<0.8$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot)  $>2.3$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Support Mixed-Mode Voltage Operation on All Ports
- Latch-Up Performance Exceeds 250 mA per JESD 17
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

### 2 Applications

- EPOS
- Programmable Logic Controller (PLC)
- DCS and PAC: Analog Input Module
- Medical Meters: Portable
- Server Motherboard
- Printer

### 4 Simplified Schematic



- A. These are five equivalent exclusive-OR symbols valid for an 'LV86A gate in positive logic; negation can be shown at any two ports. See [Functional Block Diagram](#) for more information.

### 3 Description

The 'LV86A devices are quadruple 2-input exclusive-OR gates designed for 2-V to 5.5-V  $V_{CC}$  operation.

These devices contain four independent 2-input exclusive-OR gates. They perform the Boolean function  $Y = A \oplus B$  or  $Y = \overline{A}B + A\overline{B}$  in positive logic.

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

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

| PART NUMBER | PACKAGE    | BODY SIZE (NOM)    |
|-------------|------------|--------------------|
| LV86A       | VQFN (14)  | 3.50 mm x 3.50 mm  |
|             | SOIC (14)  | 8.65 mm x 3.91 mm  |
|             | SOP (14)   | 10.30 mm x 5.30 mm |
|             | SSOP (14)  | 6.20 mm x 5.30 mm  |
|             | TSSOP (14) | 5.00 mm x 4.40 mm  |

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



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## 5 Revision History

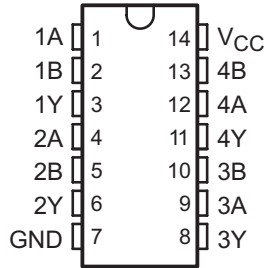
### Changes from Revision F (April 2005) to Revision G

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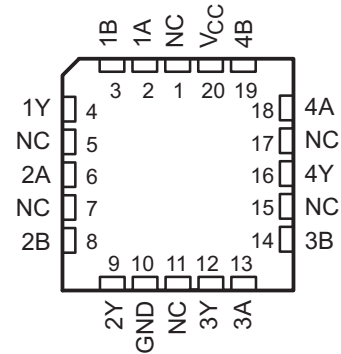
|   |  |          |
|---|--|----------|
| • | Added <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section ..... | <b>1</b> |
| • | Updated operating free-air temperature maximum from 85°C to 125°C for SN74LV86A .....  | <b>5</b> |

## 6 Pin Configuration and Functions

SN54LV86A: J or W Package  
SN74LV86A: D, DB, DGV, NS, or PW Package  
(Top View)



SN54LV86A: FK Package  
(Top View)



B. NC – No internal connection

### Pin Functions

| PIN | I/O             | DESCRIPTION |
|-----|-----------------|-------------|
| 1   | 1A              | A input 1   |
| 2   | 1B              | B input 1   |
| 3   | 1Y              | Output 1    |
| 4   | 2A              | A input 2   |
| 5   | 2B              | B input 2   |
| 6   | 2Y              | Output 2    |
| 7   | GND             | ground      |
| 8   | 3Y              | Output 3    |
| 9   | 3A              | A input 3   |
| 10  | 3B              | B input 3   |
| 11  | 4Y              | Output 4    |
| 12  | 4A              | A input 4   |
| 13  | 4B              | B input 4   |
| 14  | V <sub>CC</sub> | Power pin   |

## 7 Specifications

### 7.1 Absolute Maximum Ratings

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

|           |   | MIN  | MAX              | UNIT |
|-----------|---|------|------------------|------|
| $V_{CC}$  | Supply voltage  | -0.5 | 7                | V    |
| $V_I$     | Input voltage <sup>(2)</sup>  | -0.5 | 7                | V    |
| $V_O$     | Voltage applied to any output in the high-impedance or power-off state <sup>(2)</sup> | -0.5 | 7                | V    |
| $V_O$     | Output voltage <sup>(2)(3)</sup>  | -0.5 | $V_{CC} + 0.5$ V | V    |
| $I_{IK}$  | Input clamp current, $V_I < 0$  |      | -20              | mA   |
| $I_{OK}$  | Output clamp current, $V_O < 0$   |      | -50              | mA   |
| $I_O$     | Continuous output current, $V_O = 0$ to $V_{CC}$                                      | -25  | 25               | mA   |
|           | Continuous current through $V_{CC}$ or GND  | -50  | 50               | mA   |
| $T_{stg}$ | 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, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This value is limited to 5.5-V maximum.

### 7.2 ESD Ratings

|             |                         |  | VALUE | UNIT |
|-------------|-------------------------|--|-------|------|
| $V_{(ESD)}$ | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | 2000  | V    |
|             |                         | Charged-device model (CDM), per JEDEC specification JESD22-C101 <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.

### 7.3 Recommended Operating Conditions

 see <sup>(1)</sup>

|                 |                                    | MIN                              | MAX                   | UNIT |
|-----------------|------------------------------------|----------------------------------|-----------------------|------|
| V <sub>CC</sub> | Supply voltage                     | 2                                | 5.5                   | V    |
| V <sub>IH</sub> | High-level input voltage           | V <sub>CC</sub> = 2 V            | 1.5                   | V    |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V | V <sub>CC</sub> × 0.7 |      |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V   | V <sub>CC</sub> × 0.7 |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V | V <sub>CC</sub> × 0.7 |      |
| V <sub>IL</sub> | Low-level input voltage            | V <sub>CC</sub> = 2 V            | 0.5                   | V    |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V | V <sub>CC</sub> × 0.3 |      |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V   | V <sub>CC</sub> × 0.3 |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V | V <sub>CC</sub> × 0.3 |      |
| 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> = 2 V            | –50                   | μA   |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V | –2                    |      |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V   | –6                    |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V | –12                   |      |
| I <sub>OL</sub> | Low-level output current           | V <sub>CC</sub> = 2 V            | 50                    | μA   |
|                 |                                    | V <sub>CC</sub> = 2.3 V to 2.7 V | 2                     |      |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V   | 6                     |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V | 12                    |      |
| Δt/Δv           | Input transition rise or fall rate | V <sub>CC</sub> = 2.3 V to 2.7 V | 200                   | ns/V |
|                 |                                    | V <sub>CC</sub> = 3 V to 3.6 V   | 100                   |      |
|                 |                                    | V <sub>CC</sub> = 4.5 V to 5.5 V | 20                    |      |
| T <sub>A</sub>  | Operating free-air temperature     | –55                              | 125                   | °C   |

(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*, [SCBA004](#).

### 7.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> | D   | DB   | DGV   | NS    | PW   | UNIT  |      |
|-------------------------------|---|------|-------|-------|------|-------|------|
|                               | 14 PINS   |      |       |       |      |       |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance <sup>(2)</sup> | 90.6 | 107.1 | 129.0 | 90.7 | 122.6 | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance             | 50.9 | 59.6  | 52.1  | 48.3 | 51.4  |      |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance                  | 44.8 | 54.4  | 62.0  | 49.4 | 64.4  |      |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter            | 14.7 | 20.5  | 6.5   | 14.6 | 6.7   |      |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter          | 44.5 | 53.8  | 61.3  | 49.1 | 63.8  |      |

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

(2) The package thermal impedance is calculated in accordance with JESD 51-7.

## 7.5 Electrical Characteristics

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

| PARAMETER        | TEST CONDITIONS   | V <sub>CC</sub> | SN54LV86A             |     |     | SN74LV86A<br>–40°C to 125°C |     |     | UNIT |
|------------------|---|-----------------|-----------------------|-----|-----|-----------------------------|-----|-----|------|
|                  |   |                 | MIN                   | TYP | MAX | MIN                         | TYP | MAX |      |
| V <sub>OH</sub>  | I <sub>OH</sub> = –50 μA                                    | 2 to 5.5 V      | V <sub>CC</sub> – 0.1 |     |     | V <sub>CC</sub> – 0.1       |     |     | V    |
|                  | I <sub>OH</sub> = –2 mA                                     | 2.3 V           | 2                     |     |     | 2                           |     |     |      |
|                  | I <sub>OH</sub> = –6 mA                                     | 3 V             | 2.48                  |     |     | 2.48                        |     |     |      |
|                  | I <sub>OH</sub> = –12 mA                                    | 4.5 V           | 3.8                   |     |     | 3.8                         |     |     |      |
| V <sub>OL</sub>  | I <sub>OL</sub> = 50 μA                                     | 2 to 5.5 V      | 0.1                   |     |     | 0.1                         |     |     | V    |
|                  | I <sub>OL</sub> = 2 mA                                      | 2.3 V           | 0.4                   |     |     | 0.4                         |     |     |      |
|                  | I <sub>OL</sub> = 6 mA                                      | 3 V             | 0.44                  |     |     | 0.44                        |     |     |      |
|                  | I <sub>OL</sub> = 12 mA                                     | 4.5 V           | 0.55                  |     |     | 0.55                        |     |     |      |
| I <sub>I</sub>   | V <sub>I</sub> = 5.5 V or GND                               | 0 to 5.5 V      | ±1                    |     |     | ±1                          |     |     | μA   |
| I <sub>CC</sub>  | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 | 5.5 V           | 20                    |     |     | 20                          |     |     | μA   |
| I <sub>off</sub> | V <sub>I</sub> or V <sub>O</sub> = 0 to 5.5 V               | 0               | 5                     |     |     | 5                           |     |     | μA   |
| C <sub>i</sub>   | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 3.3 V           | 1.4                   |     |     | 1.4                         |     |     | pF   |

## 7.6 Switching Characteristics, V<sub>CC</sub> = 2.5 V ±0.2 V

 over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 3](#))

| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE       | T <sub>A</sub> = 25°C                  |     |     | MIN              | MAX               | UNIT |
|-----------------|--------------|-------------|------------------------|--|-----|-----|------------------|-------------------|------|
|                 |              |             |                        | MIN                                    | TYP | MAX |                  |                   |      |
| t <sub>pd</sub> | A or B       | Y           | C <sub>L</sub> = 15 pF | 7.9 <sup>(1)</sup> 17.6 <sup>(1)</sup> |     |     | 1 <sup>(2)</sup> | 21 <sup>(2)</sup> | ns   |
|                 |              |             | C <sub>L</sub> = 50 pF | 10.5 22.6                              |     |     |                  |                   |      |

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

(2) This note applies to SN54LV86A only: On products compliant to MIL-PRF-38535, this parameter is not production tested.

## 7.7 Switching Characteristics, V<sub>CC</sub> = 3.3 V ±0.3 V

 over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 3](#))

| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE       | T <sub>A</sub> = 25°C                |     |     | MIN              | MAX               | UNIT |
|-----------------|--------------|-------------|------------------------|--------------------------------------|-----|-----|------------------|-------------------|------|
|                 |              |             |                        | MIN                                  | TYP | MAX |                  |                   |      |
| t <sub>pd</sub> | A or B       | Y           | C <sub>L</sub> = 15 pF | 5.5 <sup>(1)</sup> 11 <sup>(1)</sup> |     |     | 1 <sup>(2)</sup> | 13 <sup>(2)</sup> | ns   |
|                 |              |             | C <sub>L</sub> = 50 pF | 7.4 14.5                             |     |     |                  |                   |      |

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

(2) This note applies to SN54LV86A only: On products compliant to MIL-PRF-38535, this parameter is not production tested.

## 7.8 Switching Characteristics, V<sub>CC</sub> = 5 V ±0.5 V

 over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 3](#))

| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE       | T <sub>A</sub> = 25°C                 |     |     | MIN              | MAX              | UNIT |
|-----------------|--------------|-------------|------------------------|---------------------------------------|-----|-----|------------------|------------------|------|
|                 |              |             |                        | MIN                                   | TYP | MAX |                  |                  |      |
| t <sub>pd</sub> | A or B       | Y           | C <sub>L</sub> = 15 pF | 3.7 <sup>(1)</sup> 6.8 <sup>(1)</sup> |     |     | 1 <sup>(2)</sup> | 8 <sup>(2)</sup> | ns   |
|                 |              |             | C <sub>L</sub> = 50 pF | 5.3 8.8                               |     |     |                  |                  |      |

(1) On products compliant to MIL-PRF-38535, this parameter is not production tested.

(2) This note applies to SN54LV86A only: On products compliant to MIL-PRF-38535, this parameter is not production tested.

## 7.9 Noise Characteristics for SN74LV86A

 $V_{CC} = 3.3\text{ V}$ ,  $C_L = 50\text{ pF}$ ,  $T_A = 25^\circ\text{C}$  (see <sup>(1)</sup>)

| PARAMETER   |  | MIN  | TYP  | MAX  | UNIT |
|-------------|--|------|------|------|------|
| $V_{OL(P)}$ | Quiet output, maximum dynamic $V_{OL}$ |      | 0.2  | 0.8  | V    |
| $V_{OL(V)}$ | Quiet output, minimum dynamic $V_{OL}$ |      | -0.1 | -0.8 |      |
| $V_{OH(V)}$ | Quiet output, minimum dynamic $V_{OH}$ |      | 3.1  |      |      |
| $V_{IH(D)}$ | High-level dynamic input voltage       | 2.31 |      |      |      |
| $V_{IL(D)}$ | Low-level dynamic input voltage        |      |      | 0.99 |      |

(1) Characteristics are for surface-mount packages only.

## 7.10 Operating Characteristics

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

| PARAMETER |                               | TEST CONDITIONS                            | $V_{CC}$ | TYP | UNIT |
|-----------|-------------------------------|--|----------|-----|------|
| $C_{pd}$  | Power dissipation capacitance | $C_L = 50\text{ pF}$ , $f = 10\text{ MHz}$ | 3.3 V    | 8.4 | pF   |
|           |                               |  | 5 V      | 8.8 |      |

## 7.11 Typical Characteristics

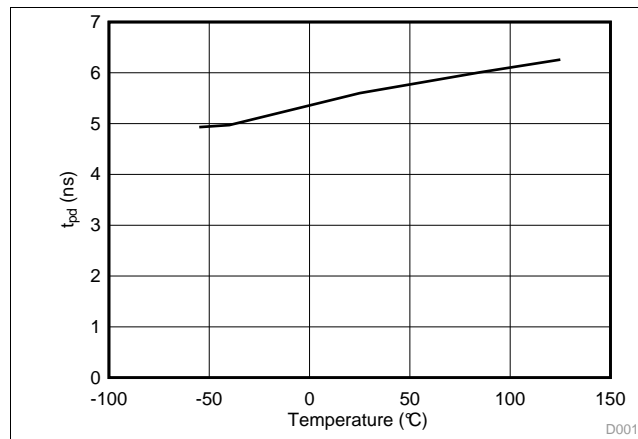


Figure 1.  $t_{pd}$  vs Temperature at 3.3 V

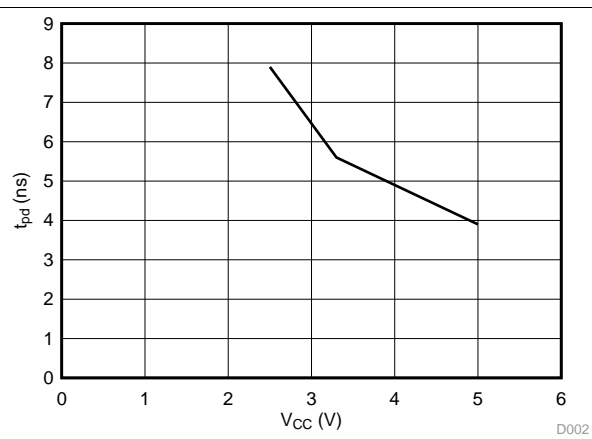
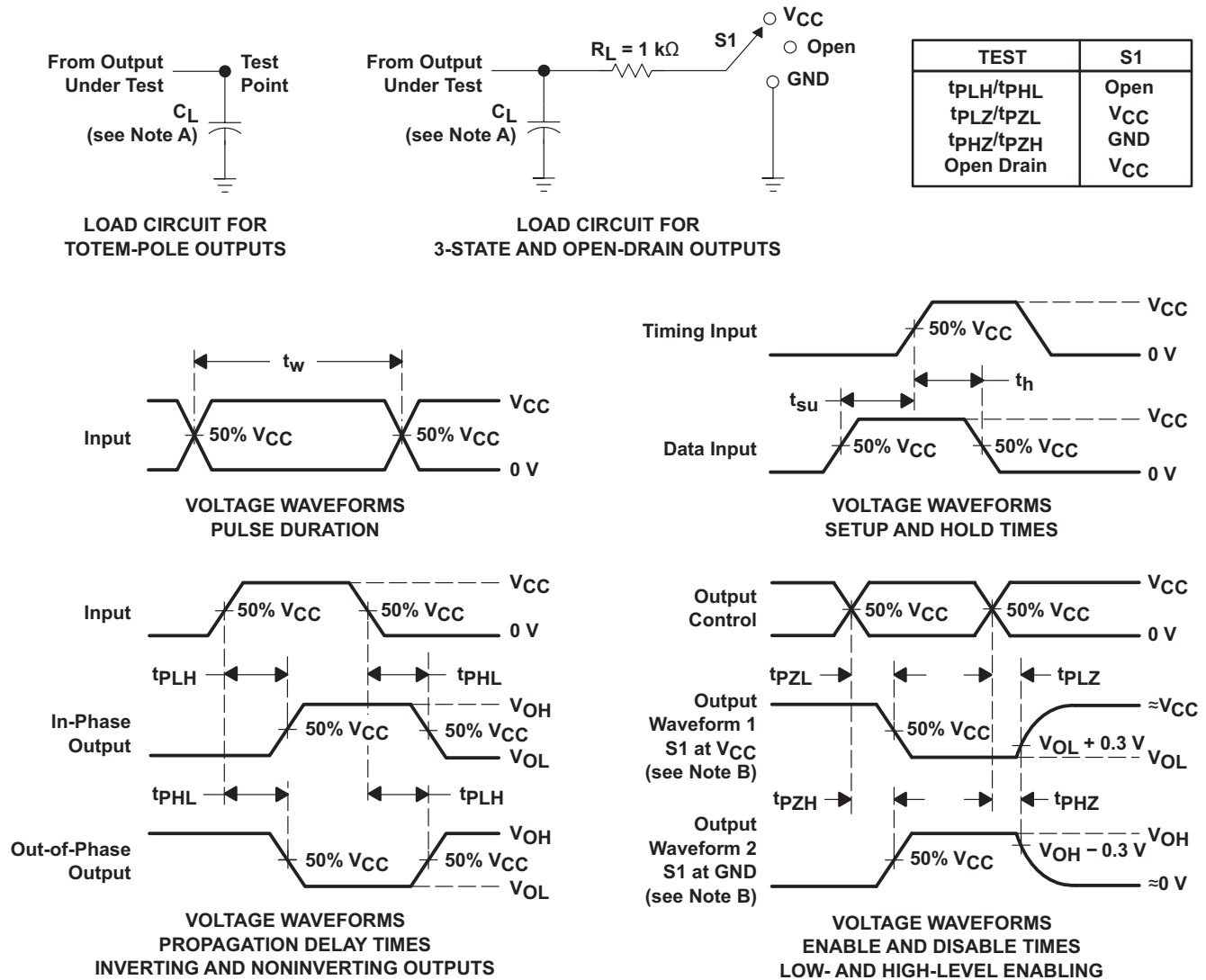


Figure 2.  $t_{pd}$  vs  $V_{CC}$  at 25°C

## 8 Parameter Measurement Information



- A.  $C_L$  includes probe and jig capacitance.
- B. 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.
- C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 3\text{ ns}$ ,  $t_f \leq 3\text{ ns}$ .
- D. The outputs are measured one at a time, with one input transition per measurement.
- E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
- F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
- G.  $t_{PHL}$  and  $t_{PLH}$  are the same as  $t_{pd}$ .
- H. All parameters and waveforms are not applicable to all devices.

**Figure 3. Load Circuit and Voltage Waveforms**



## 9 Detailed Description

### 9.1 Overview

The 'LV86A devices are quadruple 2-input exclusive-OR gates designed for 2-V to 5.5-V  $V_{CC}$  operation.

These devices contain four independent 2-input exclusive-OR gates. They perform the Boolean function  $Y = A \oplus B$  or  $Y = \overline{A}B + A\overline{B}$  in positive logic.

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

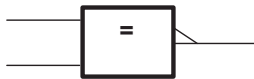
### 9.2 Functional Block Diagram

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



A. These are five equivalent exclusive-OR symbols valid for an 'LV86A gate in positive logic; negation can be shown at any two ports.

**Figure 4. Exclusive OR**



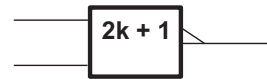
The output is active (low) if all inputs stand at the same logic level (that is,  $A = B$ ).

**Figure 5. Logic-Identity Element**



The output is active (low) if an even number of inputs (that is, 0 or 2) are active.

**Figure 6. Even-Parity Element**



The output is active (high) if an odd number of inputs (that is, only 1 of the 2) are active.

**Figure 7. Odd-Parity Element**

### 9.3 Feature Description

- Wide operating voltage range, operates from 2 to 5.5 V
- Allows down voltage translation, inputs accept voltages to 5.5 V

### 9.4 Device Functional Modes

**Table 1. Function Table (Each Gate)**

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

## 10 Application and Implementation

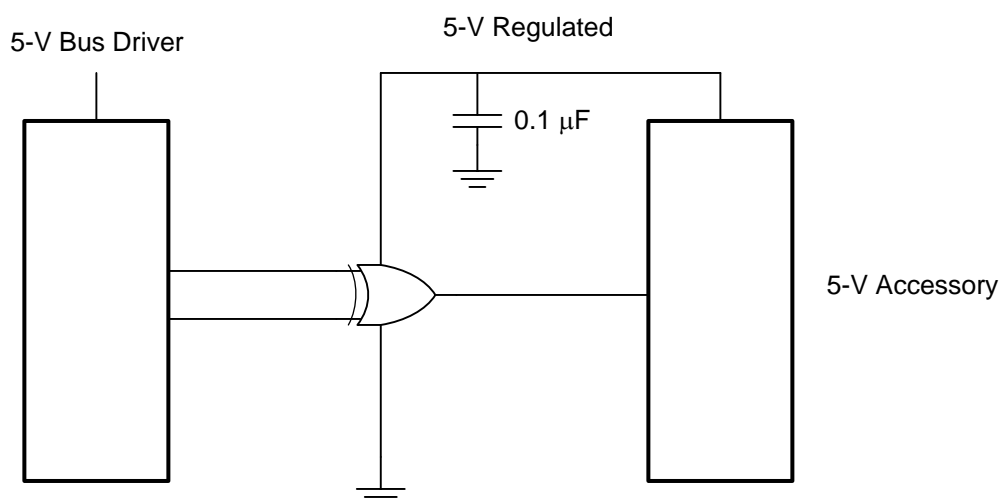
### NOTE

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.

### 10.1 Application Information

The SN74LV86A is a low drive CMOS device that can be used for a multitude of bus interface type applications where output ringing is a concern. The low drive and slow edge rates will minimize overshoot and undershoot on the outputs. The inputs can accept voltages to 5.5 V at any valid  $V_{CC}$  making it ideal for down translation.

### 10.2 Typical Application



**Figure 8. Typical Application Schematic**

#### 10.2.1 Design Requirements

This device uses CMOS technology and has balanced output drive. Care should be taken 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.

#### 10.2.2 Detailed Design Procedure

1. Recommended Input conditions
  - Rise time and fall time specs see  $(\Delta t/\Delta V)$  in [Recommended Operating Conditions](#).
  - Specified High and low levels. See  $(V_{IH}$  and  $V_{IL})$  in [Recommended Operating Conditions](#).
2. Recommend output conditions
  - Load currents should not exceed 25 mA per output and 50 mA total for the part
  - Outputs should not be pulled above  $V_{CC}$

## Typical Application (continued)

### 10.2.3 Application Curve

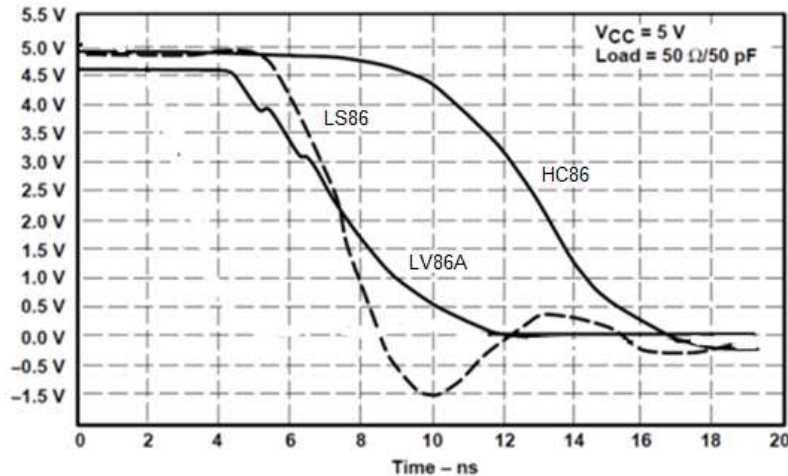


Figure 9. Switching Characteristics Comparison

## 11 Power Supply Recommendations

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

Each  $V_{CC}$  terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, TI recommends 0.1  $\mu\text{F}$  and if there are multiple  $V_{CC}$  terminals then .01 or .022  $\mu\text{F}$  is recommended for each power terminal. It is okay to parallel multiple bypass capacitors to reject different frequencies of noise. A 0.1  $\mu\text{F}$  and 1  $\mu\text{F}$  are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results.

## 12 Layout

### 12.1 Layout Guidelines

When using multiple bit logic devices inputs should not ever float.

In many cases, functions or parts of functions of digital logic devices are unused, for example, when only two inputs of a triple-input AND gate are used or 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 below are the 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 make more sense or is more convenient. It is generally okay 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 IOs so they also cannot float when disabled.

### 12.2 Layout Example

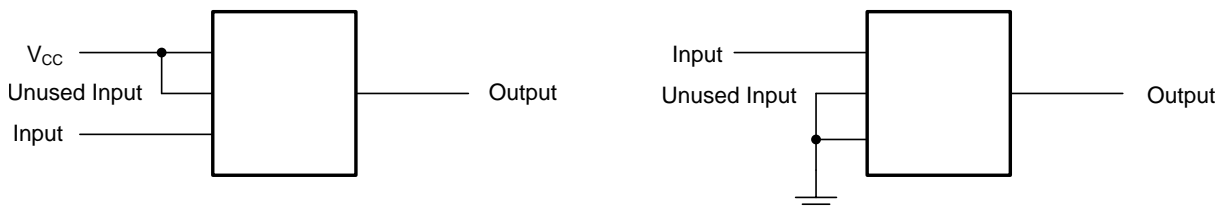


Figure 10. Layout Recommendation

## 13 Device and Documentation Support

### 13.1 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 2. Related Links

| PARTS     | PRODUCT FOLDER             | SAMPLE & BUY               | TECHNICAL DOCUMENTS        | TOOLS & SOFTWARE           | SUPPORT & COMMUNITY        |
|-----------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| SN54LV86A | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| SN74LV86A | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |

### 13.2 Trademarks

All trademarks are the property of their respective owners.

### 13.3 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.

### 13.4 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 14 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 Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LV86AD       | ACTIVE        | SOIC         | D               | 14   | 50          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LV86A                   | <a href="#">Samples</a> |
| SN74LV86ADBR     | ACTIVE        | SSOP         | DB              | 14   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LV86A                   | <a href="#">Samples</a> |
| SN74LV86ADGVR    | ACTIVE        | TVSOP        | DGV             | 14   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LV86A                   | <a href="#">Samples</a> |
| SN74LV86ADR      | ACTIVE        | SOIC         | D               | 14   | 2500        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LV86A                   | <a href="#">Samples</a> |
| SN74LV86ANSR     | ACTIVE        | SO           | NS              | 14   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | 74LV86A                 | <a href="#">Samples</a> |
| SN74LV86APW      | ACTIVE        | TSSOP        | PW              | 14   | 90          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LV86A                   | <a href="#">Samples</a> |
| SN74LV86APWR     | ACTIVE        | TSSOP        | PW              | 14   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LV86A                   | <a href="#">Samples</a> |
| SN74LV86APWRG4   | ACTIVE        | TSSOP        | PW              | 14   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LV86A                   | <a href="#">Samples</a> |
| SN74LV86APWT     | ACTIVE        | TSSOP        | PW              | 14   | 250         | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | LV86A                   | <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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(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.

(6) Lead finish/Ball material - Orderable Devices 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.

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**OTHER QUALIFIED VERSIONS OF SN74LV86A :**

- Automotive : [SN74LV86A-Q1](#)
- Enhanced Product : [SN74LV86A-EP](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

**TAPE AND REEL INFORMATION**

**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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LV86ADBR  | SSOP         | DB              | 14   | 2000 | 330.0              | 16.4               | 8.35    | 6.6     | 2.4     | 12.0    | 16.0   | Q1            |
| SN74LV86ADGVR | TVSOP        | DGV             | 14   | 2000 | 330.0              | 12.4               | 6.8     | 4.0     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74LV86ADR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| SN74LV86ANSR  | SO           | NS              | 14   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| SN74LV86APWR  | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74LV86APWT  | TSSOP        | PW              | 14   | 250  | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 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) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LV86ADBR  | SSOP         | DB              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74LV86ADGVR | TVSOP        | DGV             | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74LV86ADR   | SOIC         | D               | 14   | 2500 | 356.0       | 356.0      | 35.0        |
| SN74LV86ANSR  | SO           | NS              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74LV86APWR  | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74LV86APWT  | TSSOP        | PW              | 14   | 250  | 356.0       | 356.0      | 35.0        |



**TUBE**


\*All dimensions are nominal

| Device      | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| SN74LV86AD  | D            | SOIC         | 14   | 50  | 506.6  | 8      | 3940   | 4.32   |
| SN74LV86APW | PW           | TSSOP        | 14   | 90  | 530    | 10.2   | 3600   | 3.5    |

DGV (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



- 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, not to exceed 0,15 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - 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.
  - Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- 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. 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 other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211284-2/G 08/15

- 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. 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 other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DB (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- 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 not to exceed 0,15.  
 D. Falls within JEDEC MO-150

## MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- 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, not to exceed 0,15.



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