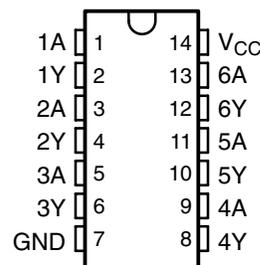


- Qualified for Automotive Applications
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- 2-V to 5.5-V  $V_{CC}$  Operation
- Max  $t_{pd}$  of 6.5 ns at 5 V
- Typical  $V_{OLP}$  (Output Ground Bounce) <0.8 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- 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
- $I_{off}$  Supports Partial-Power-Down Mode Operation

PW PACKAGE  
(TOP VIEW)



## description/ordering information

This hex inverter is designed for 2-V to 5.5-V  $V_{CC}$  operation.

The SN74LV04A contains six independent inverters. This device performs the Boolean function  $Y = \bar{A}$ .

The 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.

## ORDERING INFORMATION†

| $T_A$          | PACKAGE‡   |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|------------|---------------|-----------------------|------------------|
| -40°C to 105°C | TSSOP – PW | Tape and reel | SN74LV04ATPWRQ1       | LV04AT           |

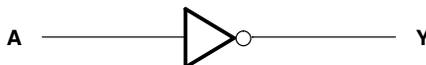
† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at <http://www.ti.com>.

‡ Package drawings, thermal data, and symbolization are available at <http://www.ti.com/packaging>.

FUNCTION TABLE  
(each inverter)

| INPUT<br>A | OUTPUT<br>Y |
|------------|-------------|
| H          | L           |
| L          | H           |

## logic diagram, each inverter (positive logic)



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
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# SN74LV04A-Q1 HEX INVERTER

SCLS514C – JULY 2003 – REVISED FEBRUARY 2008

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|  |                            |
|--|----------------------------|
| Supply voltage range, $V_{CC}$   | –0.5 V to 7 V              |
| Input voltage range, $V_I$ (see Note 1)  | –0.5 V to 7 V              |
| Voltage range applied to any output in the high-impedance or power-off state, $V_O$ (see Note 1) | –0.5 V to 7 V              |
| Output voltage range, $V_O$ (see Notes 1 and 2)  | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ )  | –20 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ )   | –50 mA                     |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )                                       | ±25 mA                     |
| Continuous current through $V_{CC}$ or GND   | ±50 mA                     |
| Package thermal impedance, $\theta_{JA}$ (see Note 3)  | 113°C/W                    |
| Storage temperature range, $T_{stg}$   | –65°C to 150°C             |

<sup>†</sup> 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.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. This value is limited to 5.5 V maximum.  
 3. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions (see Note 4)

|                     |                                    | MIN                       | MAX                 | UNIT |
|---------------------|------------------------------------|---------------------------|---------------------|------|
| $V_{CC}$            | Supply voltage                     | 2                         | 5.5                 | V    |
| $V_{IH}$            | High-level input voltage           | $V_{CC} = 2$ V            | 1.5                 | V    |
|                     |                                    | $V_{CC} = 2.3$ V to 2.7 V | $V_{CC} \times 0.7$ |      |
|                     |                                    | $V_{CC} = 3$ V to 3.6 V   | $V_{CC} \times 0.7$ |      |
|                     |                                    | $V_{CC} = 4.5$ V to 5.5 V | $V_{CC} \times 0.7$ |      |
| $V_{IL}$            | Low-level input voltage            | $V_{CC} = 2$ V            | 0.5                 | V    |
|                     |                                    | $V_{CC} = 2.3$ V to 2.7 V | $V_{CC} \times 0.3$ |      |
|                     |                                    | $V_{CC} = 3$ V to 3.6 V   | $V_{CC} \times 0.3$ |      |
|                     |                                    | $V_{CC} = 4.5$ V to 5.5 V | $V_{CC} \times 0.3$ |      |
| $V_I$               | Input voltage                      | 0                         | 5.5                 | V    |
| $V_O$               | Output voltage                     | 0                         | $V_{CC}$            | V    |
| $I_{OH}$            | High-level output current          | $V_{CC} = 2$ V            | –50                 | μA   |
|                     |                                    | $V_{CC} = 2.3$ V to 2.7 V | –2                  | mA   |
|                     |                                    | $V_{CC} = 3$ V to 3.6 V   | –6                  |      |
|                     |                                    | $V_{CC} = 4.5$ V to 5.5 V | –12                 |      |
| $I_{OL}$            | Low-level output current           | $V_{CC} = 2$ V            | 50                  | μA   |
|                     |                                    | $V_{CC} = 2.3$ V to 2.7 V | 2                   | mA   |
|                     |                                    | $V_{CC} = 3$ V to 3.6 V   | 6                   |      |
|                     |                                    | $V_{CC} = 4.5$ V to 5.5 V | 12                  |      |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | $V_{CC} = 2.3$ V to 2.7 V | 200                 | ns/V |
|                     |                                    | $V_{CC} = 3$ V to 3.6 V   | 100                 |      |
|                     |                                    | $V_{CC} = 4.5$ V to 5.5 V | 20                  |      |
| $T_A$               | Operating free-air temperature     | –40                       | 105                 | °C   |

NOTE 4: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



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

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

**switching characteristics over recommended operating free-air temperature range, V<sub>CC</sub> = 2.5 V ± 0.2 V (unless otherwise noted) (see Figure 1)**

| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE       | T <sub>A</sub> = 25°C |      |     | MIN | MAX | UNIT |
|-----------------|--------------|-------------|------------------------|-----------------------|------|-----|-----|-----|------|
|                 |              |             |                        | MIN                   | TYP  | MAX |     |     |      |
| t <sub>pd</sub> | A            | Y           | C <sub>L</sub> = 50 pF | 10                    | 15.5 |     | 1   | 18  | ns   |

**switching characteristics over recommended operating free-air temperature range, V<sub>CC</sub> = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)**

| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE       | T <sub>A</sub> = 25°C |      |     | MIN | MAX | UNIT |
|-----------------|--------------|-------------|------------------------|-----------------------|------|-----|-----|-----|------|
|                 |              |             |                        | MIN                   | TYP  | MAX |     |     |      |
| t <sub>pd</sub> | A            | Y           | C <sub>L</sub> = 50 pF | 7.3                   | 10.6 |     | 1   | 12  | ns   |

**switching characteristics over recommended operating free-air temperature range, V<sub>CC</sub> = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)**

| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE       | T <sub>A</sub> = 25°C |     |     | MIN | MAX | UNIT |
|-----------------|--------------|-------------|------------------------|-----------------------|-----|-----|-----|-----|------|
|                 |              |             |                        | MIN                   | TYP | MAX |     |     |      |
| t <sub>pd</sub> | A            | Y           | C <sub>L</sub> = 50 pF | 5.1                   | 7.5 |     | 1   | 8.5 | ns   |

# SN74LV04A-Q1 HEX INVERTER

SCLS514C – JULY 2003 – REVISED FEBRUARY 2008

## noise characteristics, $V_{CC} = 3.3\text{ V}$ , $C_L = 50\text{ pF}$ , $T_A = 25^\circ\text{C}$ (see Note 5)

| PARAMETER   |  | MIN  | TYP  | MAX  | UNIT |
|-------------|--|------|------|------|------|
| $V_{OL(P)}$ | Quiet output, maximum dynamic $V_{OL}$ |      | 0.3  | 0.8  | V    |
| $V_{OL(V)}$ | Quiet output, minimum dynamic $V_{OL}$ |      | -0.1 | -0.8 | V    |
| $V_{OH(V)}$ | Quiet output, minimum dynamic $V_{OH}$ |      | 3.1  |      | V    |
| $V_{IH(D)}$ | High-level dynamic input voltage       | 2.31 |      |      | V    |
| $V_{IL(D)}$ | Low-level dynamic input voltage        |      |      | 0.99 | V    |

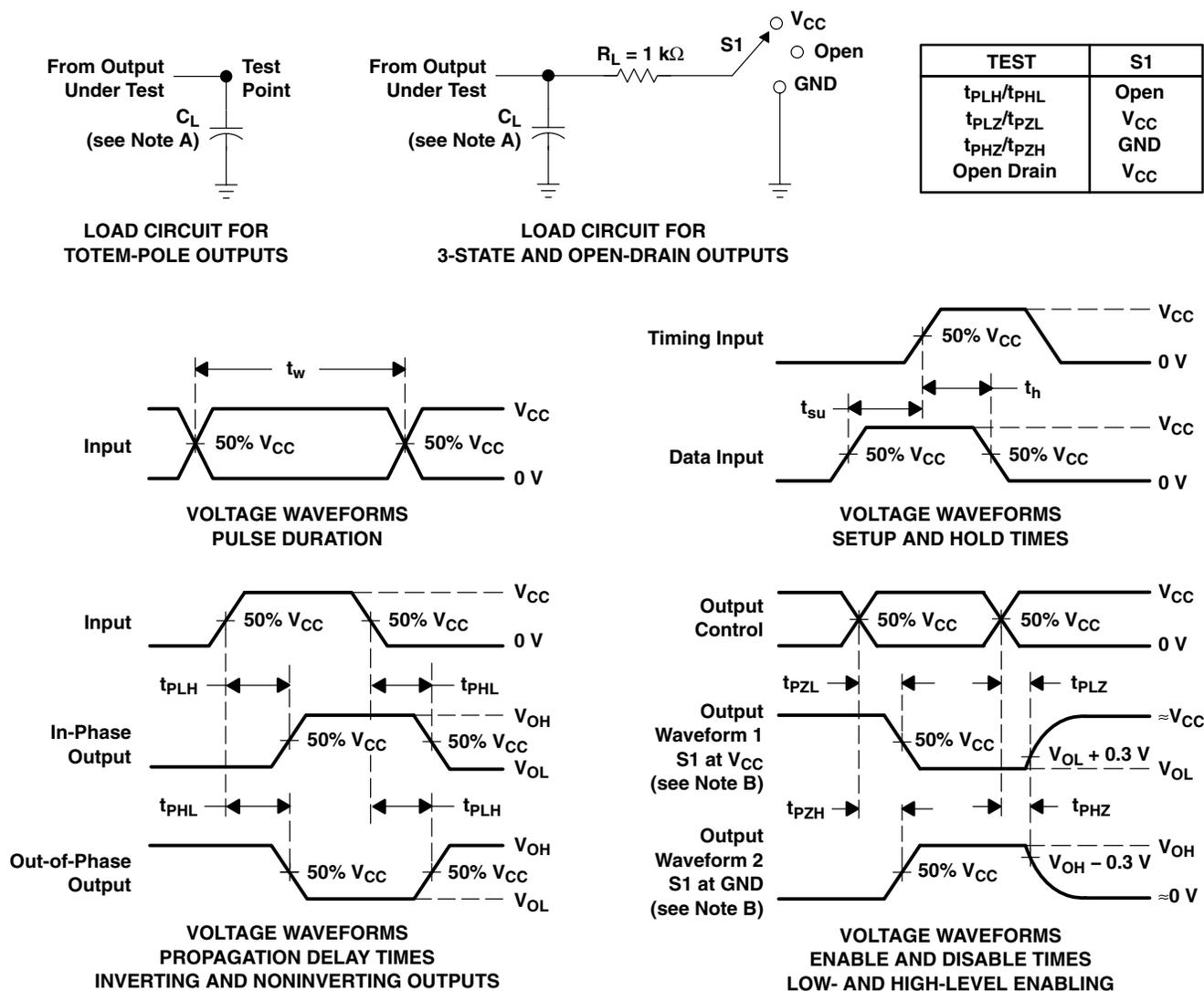
NOTE 5: Characteristics are for surface-mount packages only.

## 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    | 9.6  | pF   |
|           |                               |  | 5 V      | 11.4 |      |



## PARAMETER MEASUREMENT INFORMATION



- NOTES:
- 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:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 3$  ns,  $t_f \leq 3$  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 1. Load Circuit and Voltage Waveforms

**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 |
|-------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---------|
| SN74LV04ATPWRG4Q1 | ACTIVE        | TSSOP        | PW              | 14   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 105   | LV04AT                  | Samples |

(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.

**OBSELETE:** 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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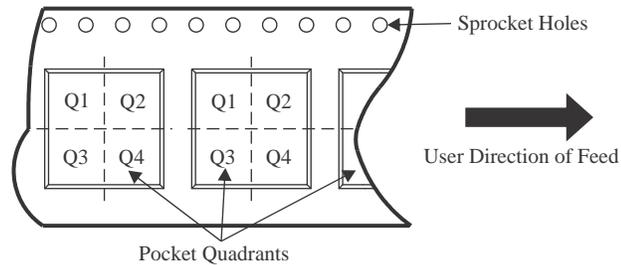
**OTHER QUALIFIED VERSIONS OF SN74LV04A-Q1 :**

- Catalog : [SN74LV04A](#)
- Enhanced Product : [SN74LV04A-EP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- 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 |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LV04ATPWG4Q1 | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**

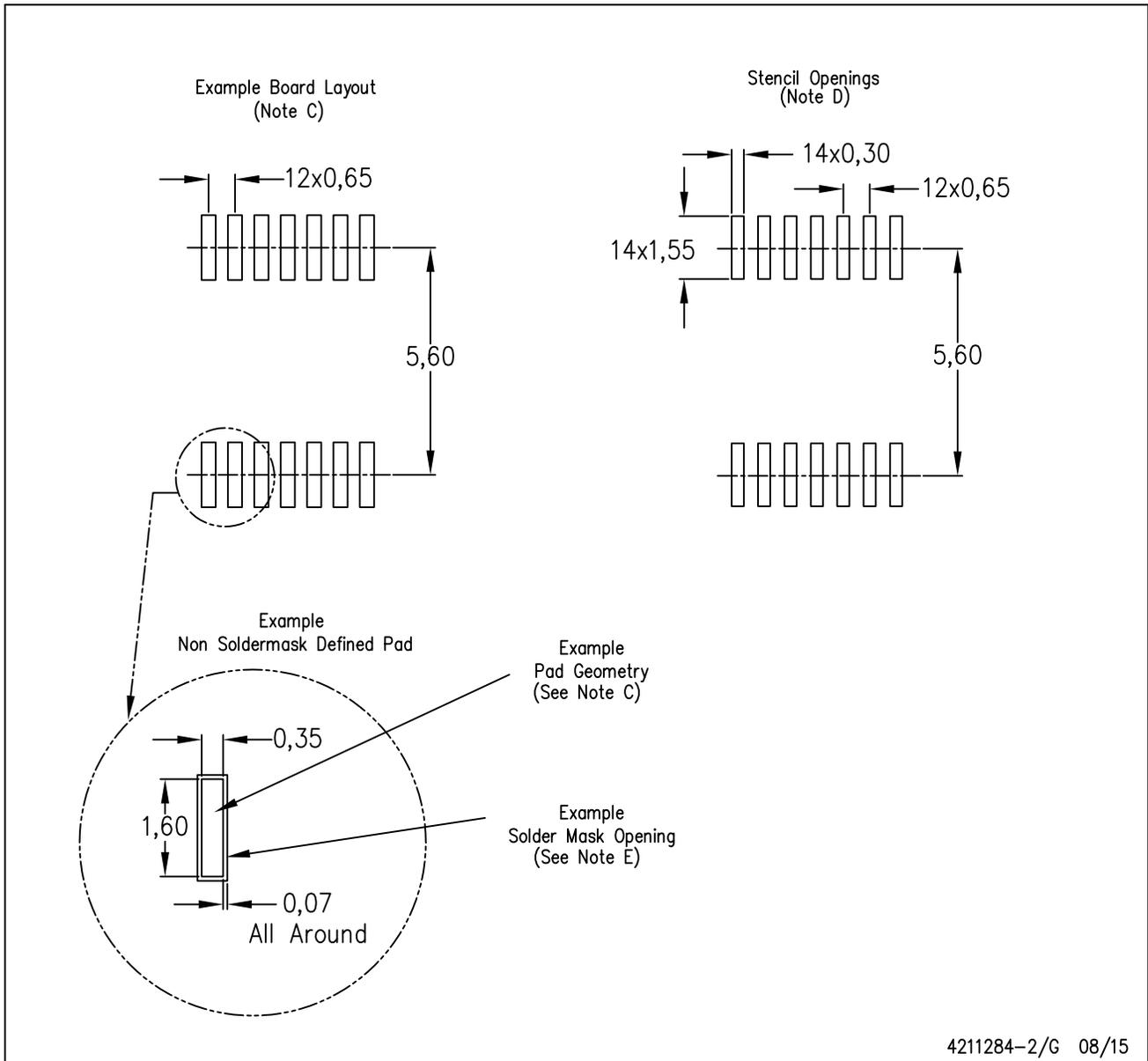

\*All dimensions are nominal

| Device            | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LV04ATPWRG4Q1 | TSSOP        | PW              | 14   | 2000 | 356.0       | 356.0      | 35.0        |



PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - 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.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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