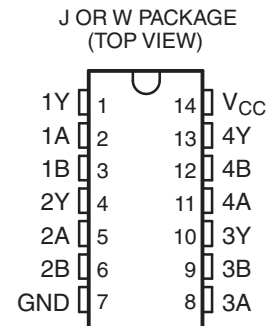


## RAD-TOLERANT CLASS V, QUADRUPLE 2-INPUT POSITIVE-NOR GATES

### FEATURES

- AC Types Feature 1.5-V to 5.5-V Operation
- Rad-Tolerant: 50 KRad(Si) TID <sup>(1)</sup>
  - TID Dose Rate < 2 mRad/sec
- QML-V Qualified, SMD 5962-87612

(1) Radiation tolerance is a typical value based upon initial device qualification. Radiation Lot Acceptance Testing is available - contact factory for details.



### DESCRIPTION

The 'AC02 devices contain four independent 2-input NOR gates that perform the Boolean function  $Y = \bar{A} \cdot \bar{B}$  or  $Y = A + B$  in positive logic.

### ORDERING INFORMATION<sup>(1)</sup>

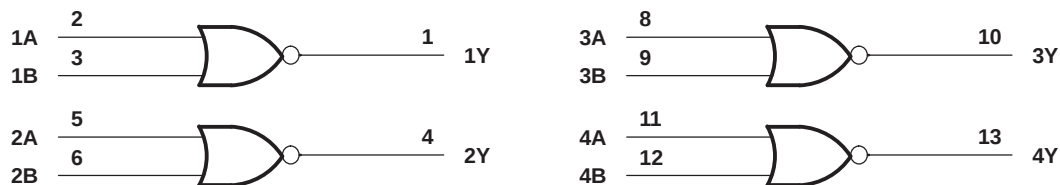
| T <sub>A</sub> | PACKAGE <sup>(2)</sup> |      | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|------------------------|------|-----------------------|------------------|
| –55°C to 125°C | J - package            | tube | 5962-8761203VCA       | 5962-8761203VCA  |
|                | W - package            |      | 5962-8761203VDA       | 5962-8761203VDA  |

- (1) 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 [www.ti.com](http://www.ti.com).  
(2) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

### FUNCTION TABLE (EACH GATE)

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

### LOGIC DIAGRAM (POSITIVE LOGIC)



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

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

|           |                                            |                             | MIN  | MAX  | UNIT |
|-----------|--------------------------------------------|-----------------------------|------|------|------|
| $V_{CC}$  | Supply voltage range                       |                             | –0.5 | 6    | V    |
| $I_{IK}$  | Input clamp current <sup>(2)</sup>         | $V_I < 0$ or $V_I > V_{CC}$ |      | ±20  | mA   |
| $I_{OK}$  | Output clamp current <sup>(2)</sup>        | $V_O < 0$                   |      | ±50  | mA   |
| $I_O$     | Continuous output current                  | $V_O = 0$ to $V_{CC}$       |      | ±50  | mA   |
|           | Continuous current through $V_{CC}$ or GND |                             |      | ±100 | mA   |
| $T_{stg}$ | Storage temperature range                  |                             | –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 and output voltage ratings may be exceeded provided the input and output current ratings are observed.

**RECOMMENDED OPERATING CONDITIONS<sup>(1)</sup>**

|                     |                                    |                                         | $T_A = 25^\circ\text{C}$ |          | –55°C TO 125°C |          | UNIT |
|---------------------|------------------------------------|-----------------------------------------|--------------------------|----------|----------------|----------|------|
|                     |                                    |                                         | MIN                      | MAX      | MIN            | MAX      |      |
| $V_{CC}$            | Supply voltage                     |                                         | 1.5                      | 5.5      | 1.5            | 5.5      | V    |
| $V_{IH}$            | High-level input voltage           | $V_{CC} = 1.5\text{ V}$                 | 1.2                      |          | 1.2            |          | V    |
|                     |                                    | $V_{CC} = 3\text{ V}$                   | 2.1                      |          | 2.1            |          |      |
|                     |                                    | $V_{CC} = 5.5\text{ V}$                 | 3.85                     |          | 3.85           |          |      |
| $V_{IL}$            | Low-level input voltage            | $V_{CC} = 1.5\text{ V}$                 |                          | 0.3      |                | 0.3      | V    |
|                     |                                    | $V_{CC} = 3\text{ V}$                   |                          | 0.9      |                | 0.9      |      |
|                     |                                    | $V_{CC} = 5.5\text{ V}$                 |                          | 1.65     |                | 1.65     |      |
| $V_I$               | Input voltage                      |                                         | 0                        | $V_{CC}$ | 0              | $V_{CC}$ | V    |
| $V_O$               | Output voltage                     |                                         | 0                        | $V_{CC}$ | 0              | $V_{CC}$ | V    |
| $I_{OH}$            | High-level output current          | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ |                          | –24      |                | –24      | mA   |
| $I_{OL}$            | Low-level output current           | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ |                          | 24       |                | 24       | mA   |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | $V_{CC} = 1.5\text{ V to }3\text{ V}$   |                          | 50       |                | 50       | ns/V |
|                     |                                    | $V_{CC} = 3.6\text{ V to }5.5\text{ V}$ |                          | 20       |                | 20       |      |

(1) 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 operating free-air temperature range (unless otherwise noted)

| PARAMETER       | TEST CONDITIONS                                             |                                         | V <sub>CC</sub> | T <sub>A</sub> = 25°C |      | –55°C TO 125°C |       | UNIT |
|-----------------|-------------------------------------------------------------|-----------------------------------------|-----------------|-----------------------|------|----------------|-------|------|
|                 |                                                             |                                         |                 | MIN                   | MAX  | MIN            | MAX   |      |
| V <sub>OH</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>         | I <sub>OH</sub> = –50 µA                | 1.5 V           | 1.4                   |      | 1.4            |       | V    |
|                 |                                                             |                                         | 3 V             | 2.9                   |      | 2.9            |       |      |
|                 |                                                             |                                         | 4.5 V           | 4.4                   |      | 4.4            |       |      |
|                 |                                                             | I <sub>OH</sub> = –4mA                  | 3 V             | 2.58                  |      | 2.4            |       |      |
|                 |                                                             | I <sub>OH</sub> = –24 mA                | 4.5 V           | 3.94                  |      | 3.7            |       |      |
|                 |                                                             | I <sub>OH</sub> = –50 mA <sup>(1)</sup> | 5.5 V           |                       |      | 3.85           |       |      |
| V <sub>OL</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>         | I <sub>OL</sub> = 50 µA                 | 1.5 V           |                       | 0.1  |                | 0.1   | V    |
|                 |                                                             |                                         | 3 V             |                       | 0.1  |                | 0.1   |      |
|                 |                                                             |                                         | 4.5 V           |                       | 0.1  |                | 0.1   |      |
|                 |                                                             | I <sub>OL</sub> = 12 mA                 | 3 V             |                       | 0.36 |                | 0.5   |      |
|                 |                                                             | I <sub>OL</sub> = 24 mA                 | 4.5 V           |                       | 0.36 |                | 0.525 |      |
|                 |                                                             | I <sub>OL</sub> = 50 mA <sup>(1)</sup>  | 5.5 V           |                       |      |                | 1.65  |      |
| I <sub>I</sub>  | V <sub>I</sub> = V <sub>CC</sub> or GND                     |                                         | 5.5 V           |                       | ±0.1 |                | ±1    | µA   |
| I <sub>CC</sub> | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 |                                         | 5.5 V           |                       | 4    |                | 80    | µA   |
| C <sub>I</sub>  |                                                             |                                         |                 |                       | 10   |                | 10    | pF   |

- (1) Test one output at a time, not exceeding 1-second duration. Measurement is made by forcing indicated current and measuring voltage to minimize power dissipation. Test verifies a minimum 50-Ω transmission-line drive capability at 85°C and 75-Ω transmission-line drive capability at 125°C.

**SWITCHING CHARACTERISTICS**

over recommended operating free-air temperature range,  $V_{CC} = 1.5\text{ V}$ ,  $C_L = 50\text{ pF}$  (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | –55°C TO<br>125°C |     | UNIT |
|-----------|-----------------|----------------|-------------------|-----|------|
|           |                 |                | MIN               | MAX |      |
| $t_{PLH}$ | A or B          | Y              |                   | 144 | ns   |
| $t_{PHL}$ |                 |                |                   | 144 |      |

**SWITCHING CHARACTERISTICS**

over recommended operating free-air temperature range,  $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ ,  $C_L = 50\text{ pF}$  (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | –55°C TO<br>125°C |      | UNIT |
|-----------|-----------------|----------------|-------------------|------|------|
|           |                 |                | MIN               | MAX  |      |
| $t_{PLH}$ | A or B          | Y              | 4                 | 16.1 | ns   |
| $t_{PHL}$ |                 |                | 4                 | 16.1 |      |

**SWITCHING CHARACTERISTICS**

over recommended operating free-air temperature range,  $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ ,  $C_L = 50\text{ pF}$  (unless otherwise noted) (see [Figure 1](#))

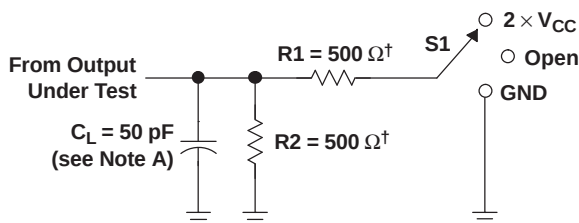
| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | –55°C TO<br>125°C |      | UNIT |
|-----------|-----------------|----------------|-------------------|------|------|
|           |                 |                | MIN               | MAX  |      |
| $t_{PLH}$ | A or B          | Y              | 2.9               | 11.5 | ns   |
| $t_{PHL}$ |                 |                | 2.9               | 11.5 |      |

**OPERATING CHARACTERISTICS**

$V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER |                               | TYP | UNIT |
|-----------|-------------------------------|-----|------|
| $C_{pd}$  | Power dissipation capacitance | 55  | pF   |

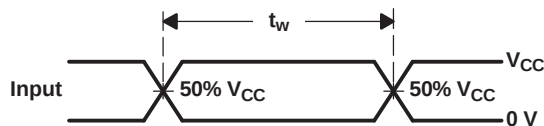
## PARAMETER MEASUREMENT INFORMATION



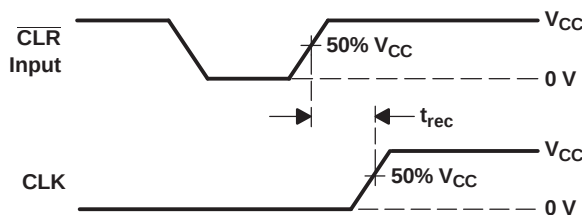
† When  $V_{CC} = 1.5\text{ V}$ ,  $R1 = R2 = 1\text{ k}\Omega$

**LOAD CIRCUIT**

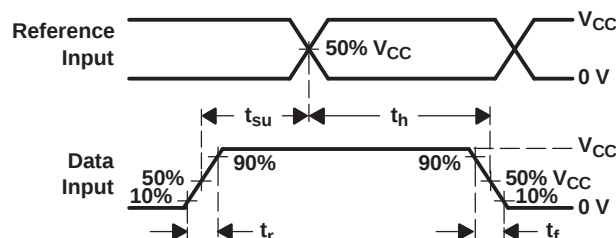
| TEST              | S1                |
|-------------------|-------------------|
| $t_{PLH}/t_{PHL}$ | Open              |
| $t_{PLZ}/t_{PZL}$ | $2 \times V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND               |



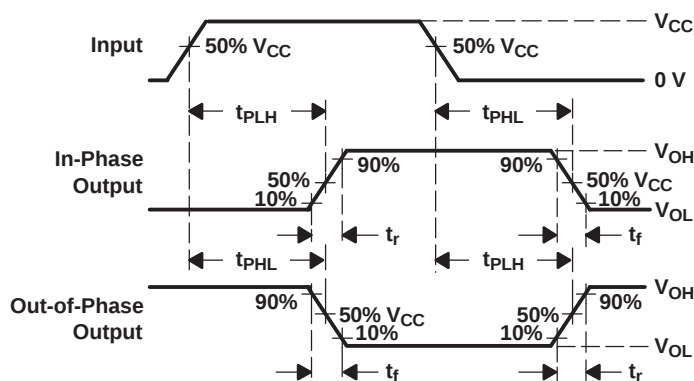
**VOLTAGE WAVEFORMS  
PULSE DURATION**



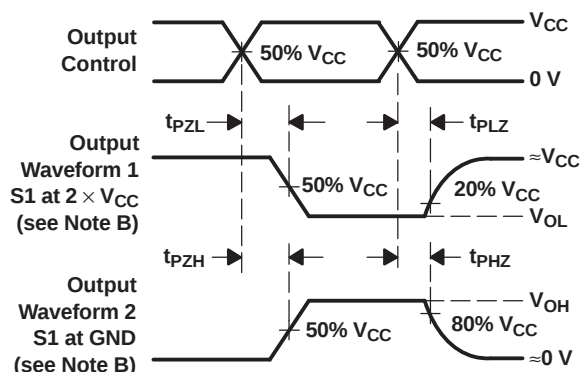
**VOLTAGE WAVEFORMS  
RECOVERY TIME**



**VOLTAGE WAVEFORMS  
SETUP AND HOLD AND INPUT RISE AND FALL TIMES**



**VOLTAGE WAVEFORMS  
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES**



**VOLTAGE WAVEFORMS  
OUTPUT ENABLE AND DISABLE TIMES**

- NOTES:
- A.  $C_L$  includes probe and test-fixture 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:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r = 3\text{ ns}$ ,  $t_f = 3\text{ ns}$ . Phase relationships between waveforms are arbitrary.
  - D. For clock inputs,  $f_{max}$  is measured with the input duty cycle at 50%.
  - E. The outputs are measured one at a time with one input transition per measurement.
  - F.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - G.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - H.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .

**Figure 1. Load Circuit and Voltage Waveforms**

## PACKAGING INFORMATION

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6)               |
|---------------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|-----------------------------------|
| <a href="#">5962-8761203VCA</a> | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-8761203VC<br>A<br>SNV54AC02J |
| 5962-8761203VCA.A               | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-8761203VC<br>A<br>SNV54AC02J |
| <a href="#">5962-8761203VDA</a> | Active        | Production           | CFP (W)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-8761203VD<br>A<br>SNV54AC02W |
| 5962-8761203VDA.A               | Active        | Production           | CFP (W)   14   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-8761203VD<br>A<br>SNV54AC02W |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

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

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

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

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

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

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

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**OTHER QUALIFIED VERSIONS OF SN54AC02-SP :**

- Catalog : [SN54AC02-DIE](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

## TUBE

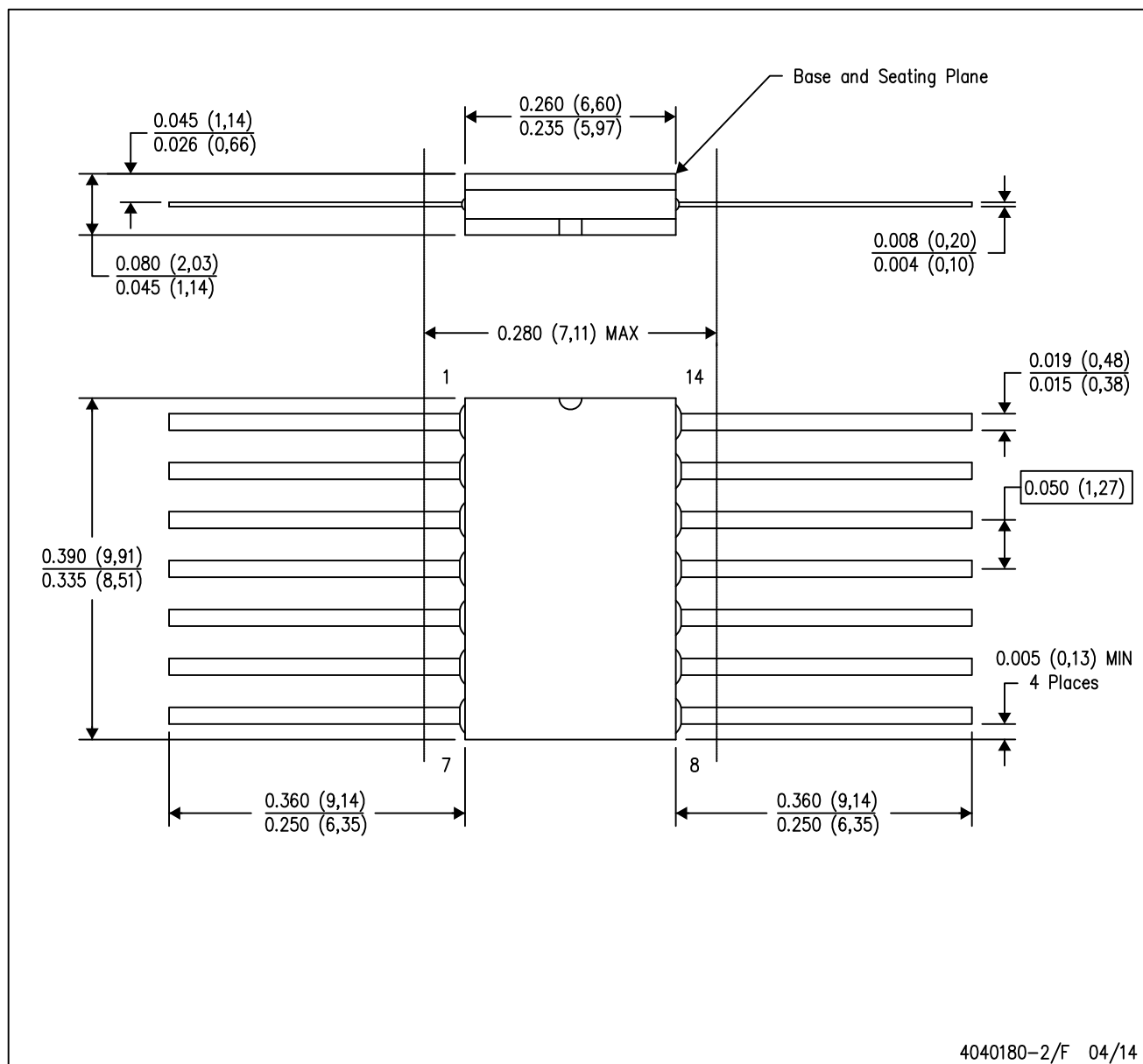


\*All dimensions are nominal

| Device            | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 5962-8761203VDA   | W            | CFP          | 14   | 25  | 506.98 | 26.16  | 6220   | NA     |
| 5962-8761203VDA.A | W            | CFP          | 14   | 25  | 506.98 | 26.16  | 6220   | NA     |

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK

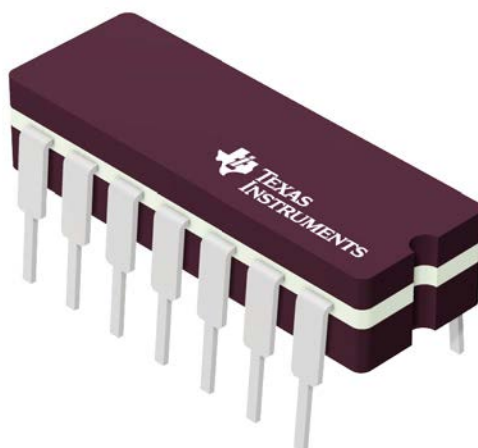


**J 14**

## GENERIC PACKAGE VIEW

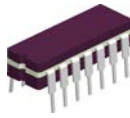
**CDIP - 5.08 mm max height**

CERAMIC DUAL IN LINE PACKAGE

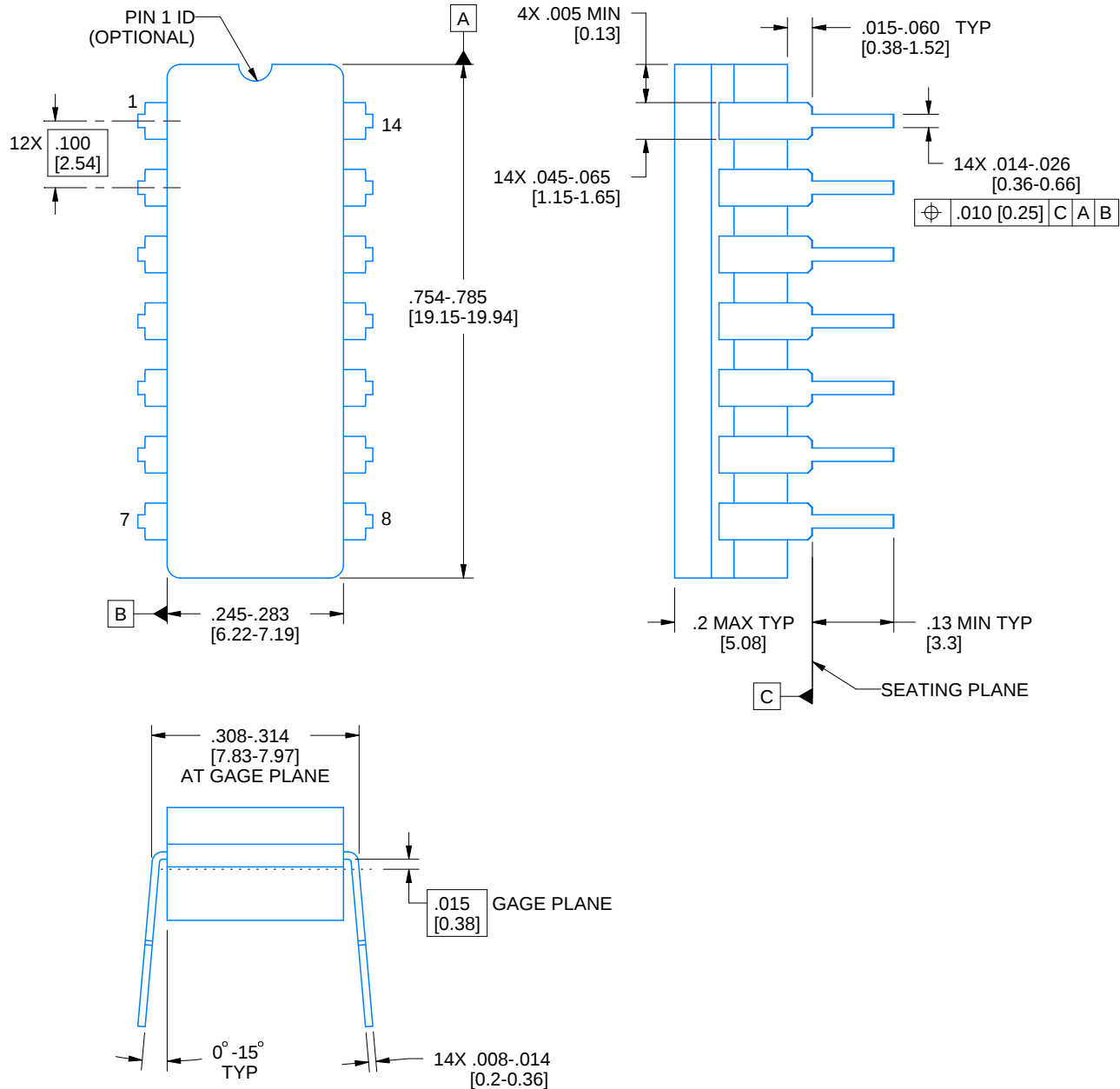


Images above are just a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.

4040083-5/G

**J0014A****PACKAGE OUTLINE****CDIP - 5.08 mm max height**

CERAMIC DUAL IN LINE PACKAGE



4214771/A 05/2017

**NOTES:**

1. All controlling linear dimensions are in inches. Dimensions in brackets are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This package is hermetically sealed with a ceramic lid using glass frit.
4. Index point is provided on cap for terminal identification only and on press ceramic glass frit seal only.
5. Falls within MIL-STD-1835 and GDIP1-T14.



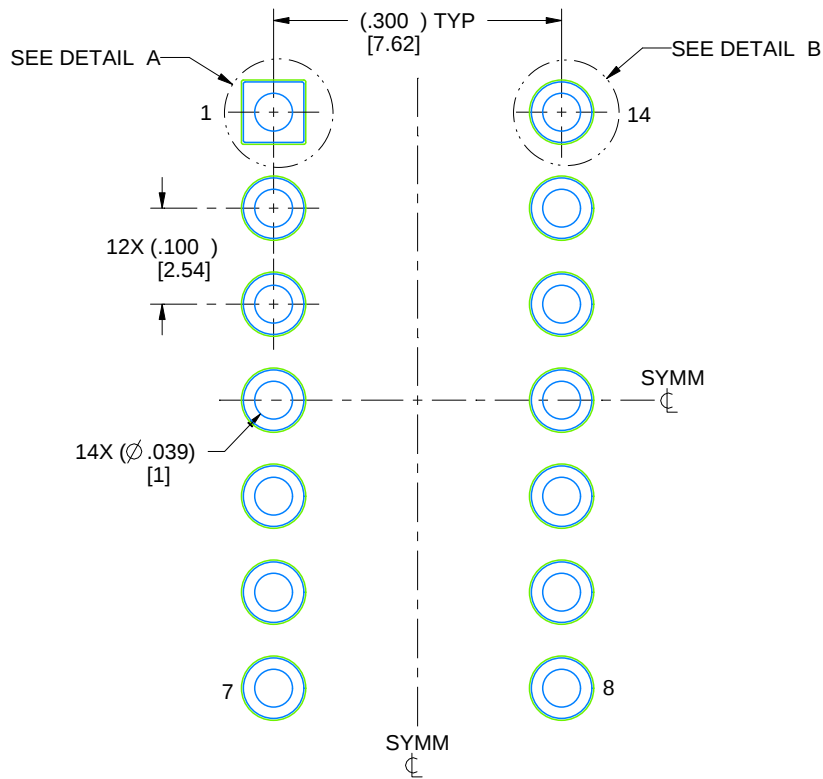
**TEXAS  
INSTRUMENTS**  
www.ti.com

# EXAMPLE BOARD LAYOUT

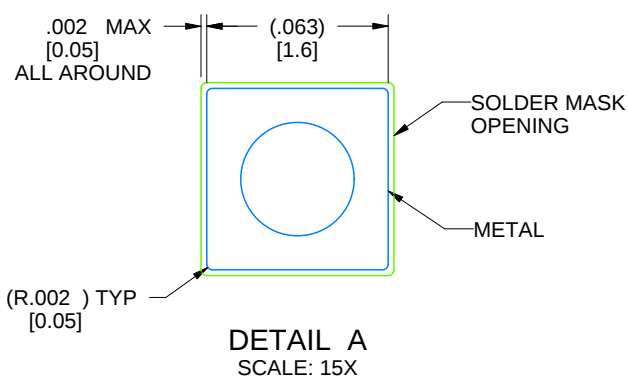
J0014A

CDIP - 5.08 mm max height

CERAMIC DUAL IN LINE PACKAGE



LAND PATTERN EXAMPLE  
NON-SOLDER MASK DEFINED  
SCALE: 5X



4214771/A 05/2017

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