

# SN5428, SN54LS28, SN7428, SN74LS28 QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS

SDLS094 – DECEMBER 1983 – REVISED MARCH 1988

- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers and Flat Packages, and Plastic and Ceramic DIPs
- Dependable Texas Instruments Quality and Reliability

## description

These devices contain four independent 2-input NOR buffer gates.

The SN5428, and SN54LS28 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7428, and SN74LS28 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

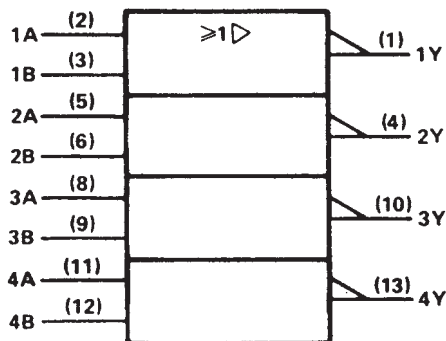
FUNCTION TABLE (each gate)

| INPUTS |   | OUTPUT |
|--------|---|--------|
| A      | B | Y      |
| H      | X | L      |
| X      | H | L      |
| L      | L | H      |

## positive logic

$$Y = \overline{A + B} \text{ or } Y = \overline{A} \cdot \overline{B}$$

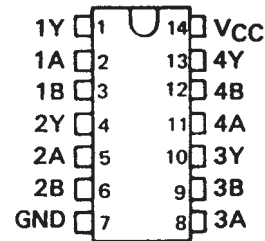
## logic symbol†



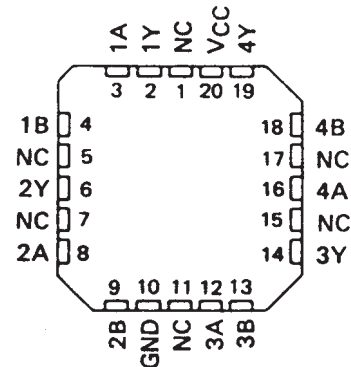
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers shown are for D, J, N, and W packages.

SN5428, SN54LS28 . . . J OR W PACKAGE  
SN7428 . . . N PACKAGE  
SN74LS28 . . . D OR N PACKAGE  
(TOP VIEW)

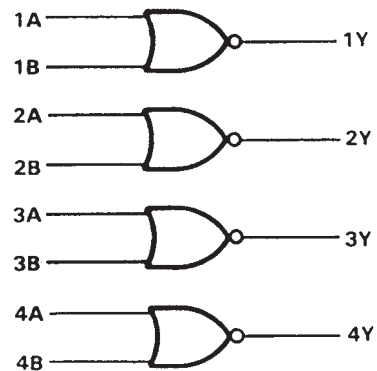


SN54LS28 . . . FK PACKAGE  
(TOP VIEW)



NC - No internal connection

## logic diagram

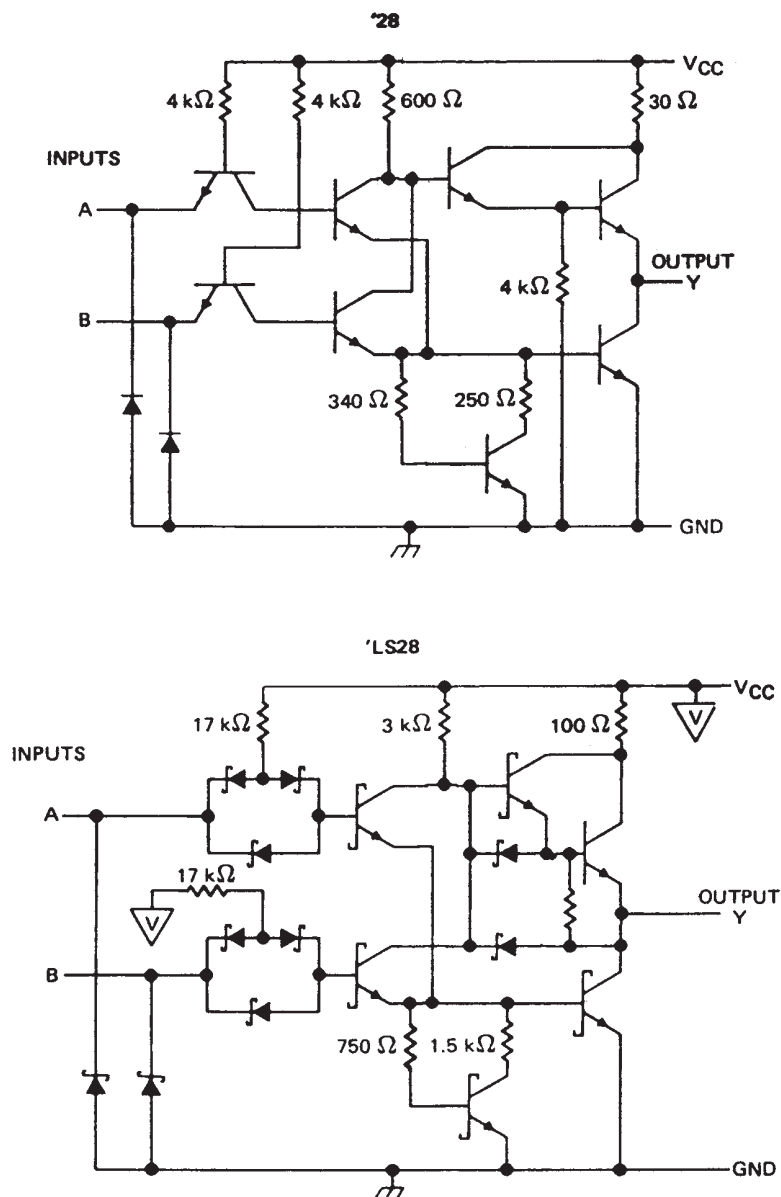


# SN5428, SN54LS28, SN7428, SN74LS28

## QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS

SDLS094 – DECEMBER 1983 – REVISED MARCH 1988

schematics (each gate)



Resistor values shown are nominal.

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

|                                       |                |
|---------------------------------------|----------------|
| Supply voltage, $V_{CC}$ (see Note 1) | 7 V            |
| Input voltage: '28                    | 5.5 V          |
| 'LS28                                 | 7 V            |
| Operating free-air temperature: SN54' | -55°C to 125°C |
| SN74'                                 | 0°C to 70°C    |
| Storage temperature range             | -65°C to 150°C |

NOTE 1: Voltage values are with respect to network ground terminal.



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# SN5428, SN54LS28, SN7428, SN74LS28 QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS

SDLS094 – DECEMBER 1983 – REVISED MARCH 1988

## recommended operating conditions

|                                               | SN5428 |     |       | SN7428 |     |       | UNIT |
|-----------------------------------------------|--------|-----|-------|--------|-----|-------|------|
|                                               | MIN    | NOM | MAX   | MIN    | NOM | MAX   |      |
| V <sub>CC</sub> Supply voltage                | 4.5    | 5   | 5.5   | 4.75   | 5   | 5.25  | V    |
| V <sub>IH</sub> High-level input voltage      | 2      |     |       | 2      |     |       | V    |
| V <sub>IL</sub> Low-level input voltage       |        |     | 0.8   |        |     | 0.8   | V    |
| I <sub>OH</sub> High-level output current     |        |     | – 2.4 |        |     | – 2.4 | mA   |
| I <sub>OL</sub> Low-level output current      |        |     | 48    |        |     | 48    | mA   |
| T <sub>A</sub> Operating free-air temperature | – 55   |     | 125   | 0      |     | 70    | °C   |

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

| PARAMETER         | TEST CONDITIONS †                                                          | MIN  | TYP ‡ | MAX   | UNIT |
|-------------------|----------------------------------------------------------------------------|------|-------|-------|------|
| V <sub>IK</sub>   | V <sub>CC</sub> = MIN, I <sub>I</sub> = – 12mA                             |      |       | – 1.5 | V    |
| V <sub>OH</sub>   | V <sub>CC</sub> = MIN, V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = – 2.4 mA | 2.4  | 3.4   |       | V    |
| V <sub>OL</sub>   | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 48 mA      |      | 0.2   | 0.4   | V    |
| I <sub>I</sub>    | V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V                              |      |       | 1     | mA   |
| I <sub>IH</sub>   | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.4 V                              |      |       | 40    | µA   |
| I <sub>IL</sub>   | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V                              |      |       | – 1.6 | mA   |
| I <sub>OS</sub> § | V <sub>CC</sub> = MAX                                                      | – 70 |       | – 180 | mA   |
| I <sub>CCH</sub>  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0 V                                |      | 12    | 21    | mA   |
| I <sub>CCL</sub>  | V <sub>CC</sub> = MAX, See Note 2                                          |      | 33    | 57    | mA   |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ Not more than one output should be shorted at a time and the duration of the short circuit should not exceed one second.

NOTE 2: One input at 4.5 V, all others at GND.

## switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see note 3)

| PARAMETER        | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS                                                      | MIN | TYP | MAX | UNIT |
|------------------|-----------------|----------------|----------------------------------------------------------------------|-----|-----|-----|------|
| t <sub>PLH</sub> | A or B          | Y              | R <sub>L</sub> = 133 Ω,                      C <sub>L</sub> = 50 pF  | 6   | 9   | ns  |      |
| t <sub>PHL</sub> |                 |                |                                                                      | 8   | 12  | ns  |      |
| t <sub>PLH</sub> |                 |                | R <sub>L</sub> = 133 Ω,                      C <sub>L</sub> = 150 pF | 10  | 15  | ns  |      |
| t <sub>PHL</sub> |                 |                |                                                                      | 12  | 18  | ns  |      |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



# SN5428, SN54LS28, SN7428, SN74LS28

## QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS

SDLS094 – DECEMBER 1983 – REVISED MARCH 1988

### recommended operating conditions

|                                      | SN54LS28 |     |       | SN74LS28 |     |       | UNIT |
|--------------------------------------|----------|-----|-------|----------|-----|-------|------|
|                                      | MIN      | NOM | MAX   | MIN      | NOM | MAX   |      |
| $V_{CC}$ Supply voltage              | 4.5      | 5   | 5.5   | 4.75     | 5   | 5.25  | V    |
| $V_{IH}$ High-level input voltage    | 2        |     |       | 2        |     |       | V    |
| $V_{IL}$ Low-level input voltage     |          |     | 0.7   |          |     | 0.8   | V    |
| $I_{OH}$ High-level output current   |          |     | – 1.2 |          |     | – 1.2 | mA   |
| $I_{OL}$ Low-level output current    |          |     | 12    |          |     | 24    | mA   |
| $T_A$ Operating free-air temperature | – 55     |     | 125   | 0        |     | 70    | °C   |

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

| PARAMETER  | TEST CONDITIONS †                                                          | SN54LS28 |       |       | SN74LS28 |       |       | UNIT |
|------------|----------------------------------------------------------------------------|----------|-------|-------|----------|-------|-------|------|
|            |                                                                            | MIN      | TYP ‡ | MAX   | MIN      | TYP ‡ | MAX   |      |
| $V_{IK}$   | $V_{CC} = \text{MIN}$ , $I_I = -18 \text{ mA}$                             |          |       | – 1.5 |          |       | – 1.5 | V    |
| $V_{OH}$   | $V_{CC} = \text{MIN}$ , $V_{IL} = \text{MAX}$ , $I_{OH} = -1.2 \text{ mA}$ | 2.5      | 3.4   |       | 2.7      | 3.4   |       | V    |
| $V_{OL}$   | $V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ , $I_{OL} = 12 \text{ mA}$  |          | 0.25  | 0.4   |          | 0.24  | 0.4   | V    |
|            | $V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ , $I_{OL} = 24 \text{ mA}$  |          |       |       |          | 0.35  | 0.5   |      |
| $I_I$      | $V_{CC} = \text{MAX}$ , $V_I = 7 \text{ V}$                                |          |       | 0.1   |          |       | 0.1   | mA   |
| $I_{IH}$   | $V_{CC} = \text{MAX}$ , $V_I = 2.7 \text{ V}$                              |          |       | 20    |          |       | 20    | μA   |
| $I_{IL}$   | $V_{CC} = \text{MAX}$ , $V_I = 0.4 \text{ V}$                              |          |       | – 0.4 |          |       | – 0.4 | mA   |
| $I_{OS} §$ | $V_{CC} = \text{MAX}$                                                      | – 30     |       | – 130 | – 30     |       | – 130 | mA   |
| $I_{CCH}$  | $V_{CC} = \text{MAX}$ , $V_I = 0 \text{ V}$                                |          | 1.8   | 3.6   |          | 1.8   | 3.6   | mA   |
| $I_{CCL}$  | $V_{CC} = \text{MAX}$ , See Note 2                                         |          | 6.9   | 13.8  |          | 6.9   | 13.8  | mA   |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time and the duration of the short circuit should not exceed one second.

NOTE 2: One input at 4.5 V, all others at GND.

### switching characteristics, $V_{CC} = 5 \text{ V}$ , $T_A = 25^\circ\text{C}$ (see note 3)

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS                            | MIN | TYP | MAX | UNIT |
|-----------|-----------------|----------------|--------------------------------------------|-----|-----|-----|------|
| $t_{PLH}$ | A or B          | Y              | $R_L = 667 \Omega$ , $C_L = 45 \text{ pF}$ |     | 12  | 24  | ns   |
| $t_{PHL}$ |                 |                |                                            |     | 12  | 24  | ns   |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



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## 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="#">SN5428J</a>  | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SN5428J             |
| SN5428J.A                | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SN5428J             |
| SN5428J.A                | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SN5428J             |
| <a href="#">SNJ5428J</a> | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SNJ5428J            |
| <a href="#">SNJ5428J</a> | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SNJ5428J            |
| SNJ5428J.A               | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SNJ5428J            |
| SNJ5428J.A               | Active        | Production           | CDIP (J)   14  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SNJ5428J            |

<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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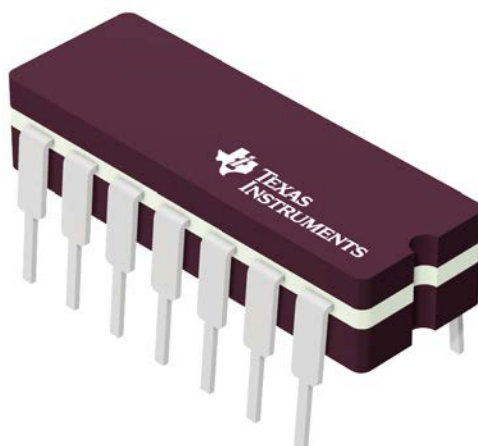


**J 14**

## GENERIC PACKAGE VIEW

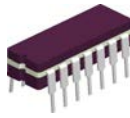
**CDIP - 5.08 mm max height**

CERAMIC DUAL IN LINE PACKAGE

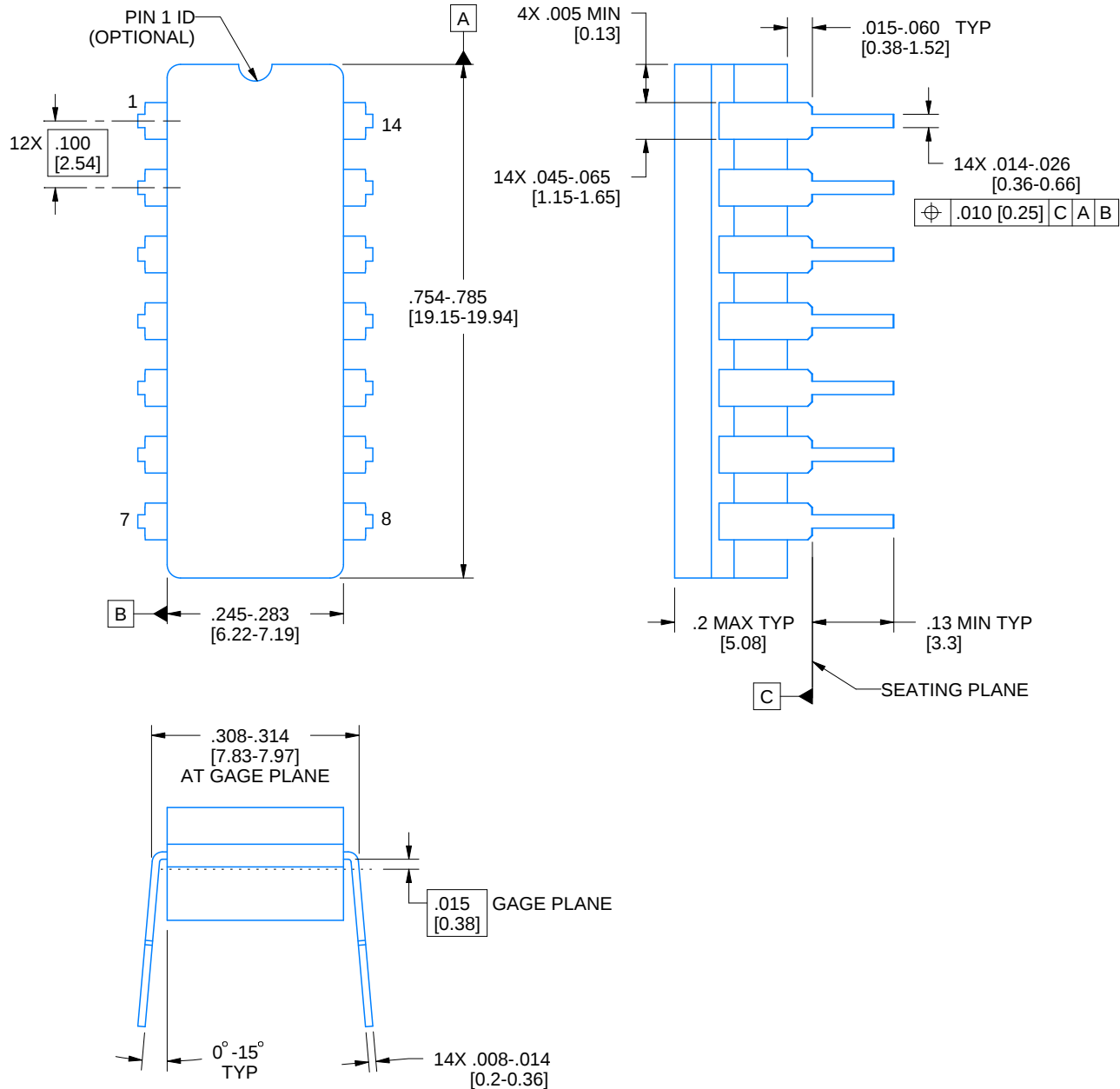


Images above are just a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.

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.



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