

# SN54HC148, SN74HC148 8-LINE TO 3-LINE PRIORITY ENCODERS

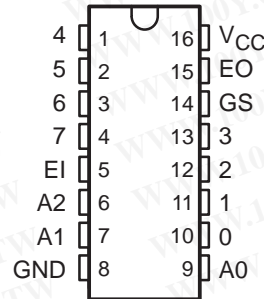
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- Wide Operating Voltage Range of 2 V to 6 V
- Outputs Can Drive Up To 10 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Max  $I_{CC}$
- Typical  $t_{pd} = 16$  ns
- $\pm 4$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Max
- Encode Eight Data Lines to 3-Line Binary (Octal)
- Applications Include:
  - n-Bit Encoding
  - Code Converters and Generators

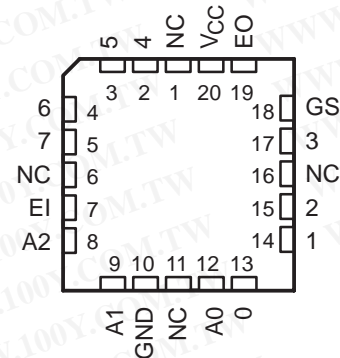
## description/ordering information

The 'HC148 devices feature priority decoding of the inputs to ensure that only the highest-order data line is encoded. These devices encode eight data lines to 3-line (4-2-1) binary (octal). Cascading circuitry (enable input EI and enable output EO) has been provided to allow octal expansion without the need for external circuitry. Data inputs and outputs are active at the low logic level.

SN54HC148 ... J OR W PACKAGE  
 SN74HC148 ... D, DW, N, OR NS PACKAGE  
 (TOP VIEW)



SN54HC148 ... FK PACKAGE  
 (TOP VIEW)



NC – No internal connection

## ORDERING INFORMATION

| T <sub>A</sub> | PACKAGE†  |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|-----------|--------------|-----------------------|------------------|
| –40°C to 85°C  | PDIP – N  | Tube of 25   | SN74HC148N            | HC148            |
|                |           | Tube of 40   | SN74HC148D            |                  |
|                | SOIC – D  | Reel of 2500 | SN74HC148DR           |                  |
|                |           | Reel of 250  | SN74HC148DT           |                  |
|                | SOIC – DW | Reel of 2000 | SN74HC148DWR          | HC148            |
| –55°C to 125°C | SOP – NS  | Reel of 2000 | SN74HC148NSR          | HC148            |
|                | CDIP – J  | Tube of 25   | SNJ54HC148J           | SNJ54HC148J      |
|                | CFP – W   | Tube of 150  | SNJ54HC148W           | SNJ54HC148W      |
|                | LCCC – FK | Tube of 55   | SNJ54HC148FK          | SNJ54HC148FK     |

† 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).



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**TEXAS  
INSTRUMENTS**

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# SN54HC148, SN74HC148

## 8-LINE TO 3-LINE PRIORITY ENCODERS

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FUNCTION TABLE

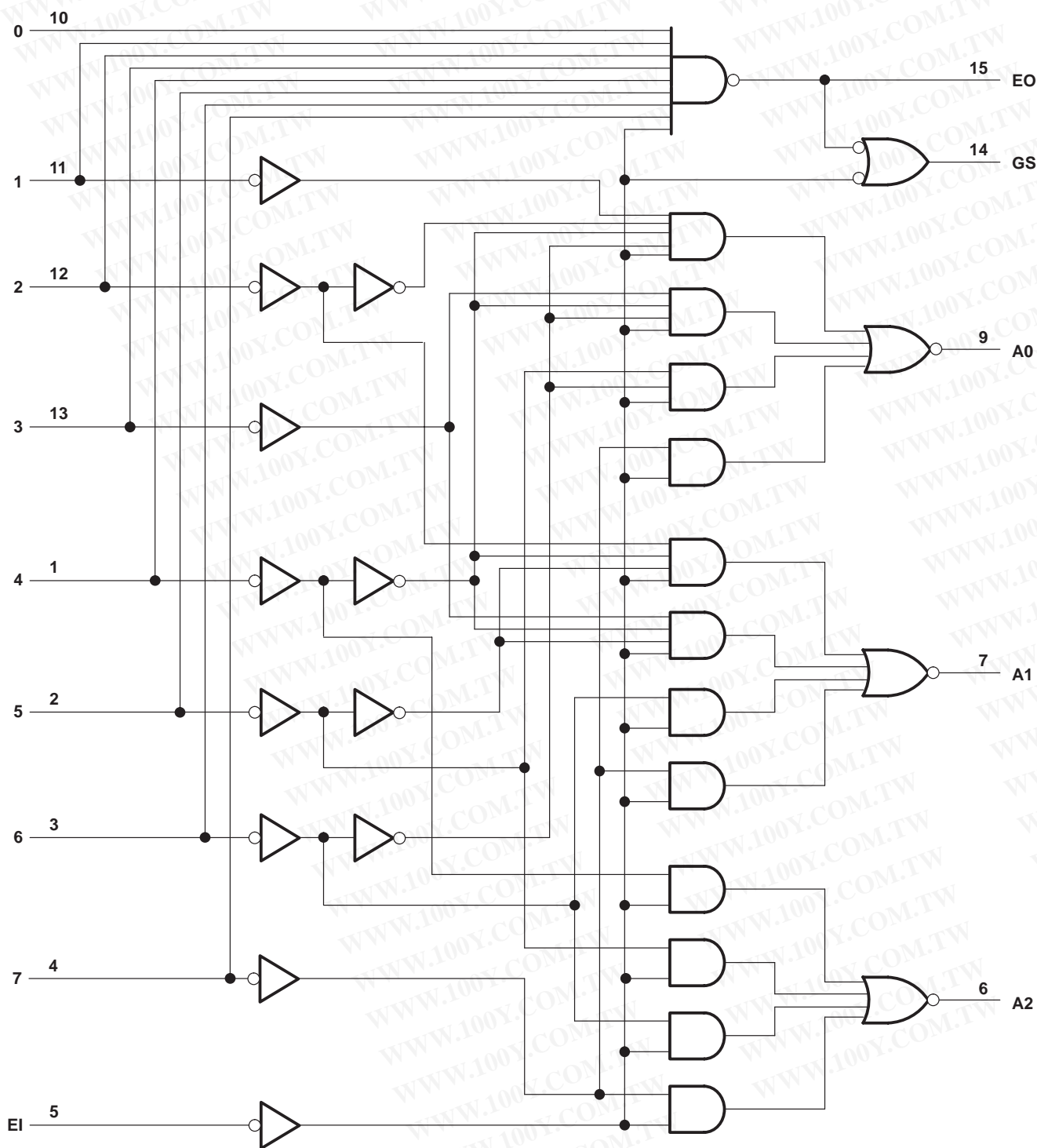
| INPUTS |   |   |   |   |   |   |   |   | OUTPUTS |    |    |    |    |
|--------|---|---|---|---|---|---|---|---|---------|----|----|----|----|
| EI     | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | A2      | A1 | A0 | GS | EO |
| H      | X | X | X | X | X | X | X | X | H       | H  | H  | H  | H  |
| L      | H | H | H | H | H | H | H | H | H       | H  | H  | H  | L  |
| L      | X | X | X | X | X | X | X | L | L       | L  | L  | L  | H  |
| L      | X | X | X | X | X | X | L | H | L       | L  | H  | L  | H  |
| L      | X | X | X | X | L | H | H | H | L       | H  | L  | L  | H  |
| L      | X | X | X | L | H | H | H | H | L       | H  | H  | L  | H  |
| L      | X | X | L | H | H | H | H | H | H       | L  | L  | L  | H  |
| L      | X | X | L | H | H | H | H | H | H       | L  | H  | L  | H  |
| L      | X | L | H | H | H | H | H | H | H       | H  | L  | L  | H  |
| L      | L | H | H | H | H | H | H | H | H       | H  | H  | L  | H  |

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logic diagram (positive logic)



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

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# SN54HC148, SN74HC148

## 8-LINE TO 3-LINE PRIORITY ENCODERS

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### 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 clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1)  | ±20 mA         |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1) | ±20 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 2): D package            | 73°C/W         |
| DW package  | 57°C/W         |
| N package   | 67°C/W         |
| NS package  | 64°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 voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.

### recommended operating conditions (see Note 3)

|                 |                                 |                         | SN54HC148 |                 |     | SN74HC148 |                 |     | UNIT |
|-----------------|---------------------------------|-------------------------|-----------|-----------------|-----|-----------|-----------------|-----|------|
|                 |                                 |                         | MIN       | NOM             | MAX | MIN       | NOM             | MAX |      |
| V <sub>CC</sub> | Supply voltage                  |                         | 2         | 5               | 6   | 2         | 5               | 6   | V    |
| V <sub>IH</sub> | High-level input voltage        | V <sub>CC</sub> = 2 V   | 1.5       |                 |     | 1.5       |                 |     | V    |
|                 |                                 | V <sub>CC</sub> = 4.5 V | 3.15      |                 |     | 3.15      |                 |     |      |
|                 |                                 | V <sub>CC</sub> = 6 V   | 4.2       |                 |     | 4.2       |                 |     |      |
| V <sub>IL</sub> | Low-level input voltage         | V <sub>CC</sub> = 2 V   | 0.5       |                 |     | 0.5       |                 |     | V    |
|                 |                                 | V <sub>CC</sub> = 4.5 V | 1.35      |                 |     | 1.35      |                 |     |      |
|                 |                                 | V <sub>CC</sub> = 6 V   | 1.8       |                 |     | 1.8       |                 |     |      |
| V <sub>I</sub>  | Input voltage                   |                         | 0         | V <sub>CC</sub> |     | 0         | V <sub>CC</sub> |     | V    |
| V <sub>O</sub>  | Output voltage                  |                         | 0         | V <sub>CC</sub> |     | 0         | V <sub>CC</sub> |     | V    |
| Δt/Δv           | Input transition rise/fall time | V <sub>CC</sub> = 2 V   | 1000      |                 |     | 1000      |                 |     | ns   |
|                 |                                 | V <sub>CC</sub> = 4.5 V | 500       |                 |     | 500       |                 |     |      |
|                 |                                 | V <sub>CC</sub> = 6 V   | 400       |                 |     | 400       |                 |     |      |
| T <sub>A</sub>  | Operating free-air temperature  |                         | −55       | 125             |     | −40       | 85              |     | °C   |

NOTE 3: 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.

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

| PARAMETER       | TEST CONDITIONS   |                           | V <sub>CC</sub> | T <sub>A</sub> = 25°C |       |      | SN54HC148 |       | SN74HC148 |       | UNIT |
|-----------------|---|---------------------------|-----------------|-----------------------|-------|------|-----------|-------|-----------|-------|------|
|                 |   |                           |                 | MIN                   | TYP   | MAX  | 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> = –20 µA  | 2 V             | 1.9                   | 1.998 |      | 1.9       |       | 1.9       |       | V    |
|                 |   |                           | 4.5 V           | 4.4                   | 4.499 |      | 4.4       |       | 4.4       |       |      |
|                 |   |                           | 6 V             | 5.9                   | 5.999 |      | 5.9       |       | 5.9       |       |      |
|                 |   | I <sub>OH</sub> = –4 mA   | 4.5 V           | 3.98                  | 4.3   |      | 3.7       |       | 3.84      |       |      |
|                 |   | I <sub>OH</sub> = –5.2 mA | 6 V             | 5.48                  | 5.8   |      | 5.2       |       | 5.34      |       |      |
| V <sub>OL</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>       | I <sub>OL</sub> = 20 µA   | 2 V             |                       | 0.002 | 0.1  |           | 0.1   |           | 0.1   | V    |
|                 |   |                           | 4.5 V           |                       | 0.001 | 0.1  |           | 0.1   |           | 0.1   |      |
|                 |   |                           | 6 V             |                       | 0.001 | 0.1  |           | 0.1   |           | 0.1   |      |
|                 |   | I <sub>OL</sub> = 4 mA    | 4.5 V           |                       | 0.17  | 0.26 |           | 0.4   |           | 0.33  |      |
|                 |   | I <sub>OL</sub> = 5.2 mA  | 6 V             |                       | 0.15  | 0.26 |           | 0.4   |           | 0.33  |      |
| I <sub>I</sub>  | V <sub>I</sub> = V <sub>CC</sub> or 0                     |                           | 6 V             |                       | ±0.1  | ±100 |           | ±1000 |           | ±1000 | nA   |
| I <sub>CC</sub> | V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0 |                           | 6 V             |                       |       | 8    |           | 160   |           | 80    | µA   |
| C <sub>i</sub>  |   |                           | 2 V to 6 V      |                       | 3     | 10   |           | 10    |           | 10    | pF   |

switching characteristics over recommended operating free-air temperature range, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

| PARAMETER       | FROM (INPUT) | TO (OUTPUT)   | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | SN54HC148 |     | SN74HC148 |     | UNIT |
|-----------------|--------------|---------------|-----------------|-----------------------|-----|-----|-----------|-----|-----------|-----|------|
|                 |              |               |                 | MIN                   | TYP | MAX | MIN       | MAX | MIN       | MAX |      |
| t <sub>pd</sub> | 1–7          | A0, A1, or A2 | 2 V             |                       | 69  | 180 |           | 270 |           | 225 | ns   |
|                 |              |               | 4.5 V           |                       | 23  | 36  |           | 54  |           | 45  |      |
|                 |              |               | 6 V             |                       | 21  | 31  |           | 46  |           | 38  |      |
|                 | 0–7          | EO            | 2 V             |                       | 60  | 150 |           | 225 |           | 190 |      |
|                 |              |               | 4.5 V           |                       | 20  | 30  |           | 45  |           | 38  |      |
|                 |              |               | 6 V             |                       | 17  | 26  |           | 38  |           | 33  |      |
|                 |              | GS            | 2 V             |                       | 75  | 190 |           | 285 |           | 240 |      |
|                 |              |               | 4.5 V           |                       | 25  | 38  |           | 57  |           | 48  |      |
|                 |              |               | 6 V             |                       | 21  | 32  |           | 48  |           | 41  |      |
|                 | EI           | A0, A1, or A2 | 2 V             |                       | 78  | 195 |           | 295 |           | 245 |      |
|                 |              |               | 4.5 V           |                       | 26  | 39  |           | 59  |           | 49  |      |
|                 |              |               | 6 V             |                       | 22  | 33  |           | 50  |           | 42  |      |
|                 |              | GS            | 2 V             |                       | 57  | 145 |           | 220 |           | 180 |      |
|                 |              |               | 4.5 V           |                       | 19  | 29  |           | 44  |           | 36  |      |
|                 |              |               | 6 V             |                       | 16  | 25  |           | 38  |           | 31  |      |
|                 |              | EO            | 2 V             |                       | 66  | 165 |           | 250 |           | 205 |      |
|                 |              |               | 4.5 V           |                       | 22  | 33  |           | 50  |           | 41  |      |
|                 |              |               | 6 V             |                       | 19  | 28  |           | 43  |           | 35  |      |
| t <sub>t</sub>  |              | Any           | 2 V             |                       | 28  | 75  |           | 110 |           | 95  | ns   |
|                 |              |               | 4.5 V           |                       | 8   | 15  |           | 22  |           | 19  |      |
|                 |              |               | 6 V             |                       | 6   | 13  |           | 19  |           | 16  |      |

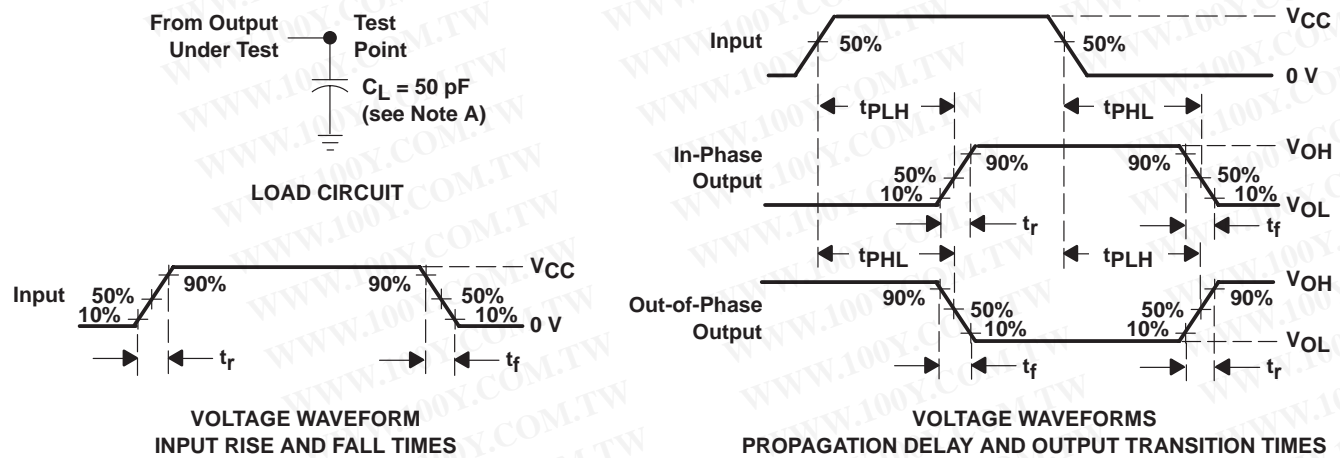
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operating characteristics,  $T_A = 25^{\circ}\text{C}$

| PARAMETER |                               | TEST CONDITIONS | TYP | UNIT |
|-----------|-------------------------------|-----------------|-----|------|
| $C_{pd}$  | Power dissipation capacitance | No load         | 35  | pF   |

PARAMETER MEASUREMENT INFORMATION

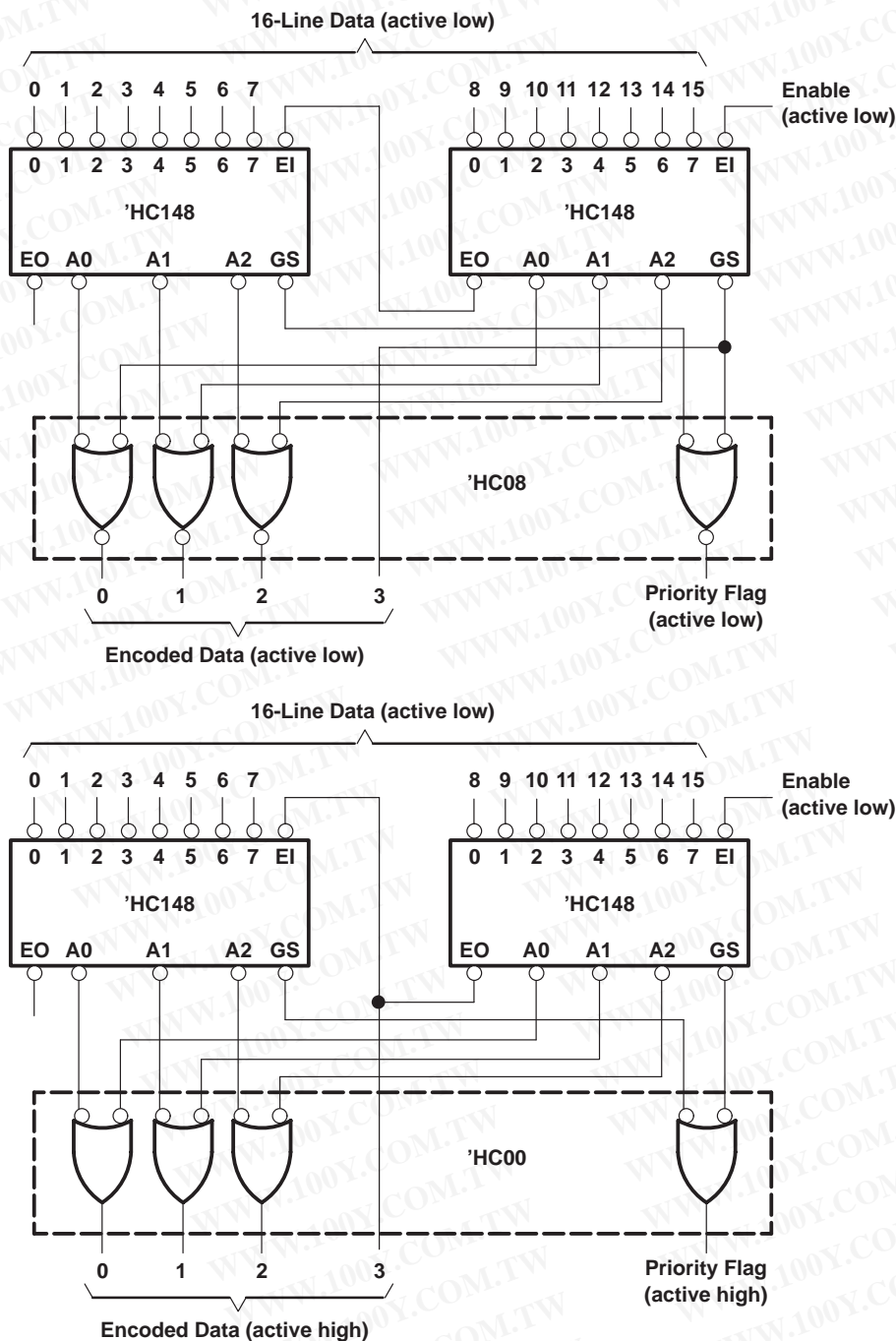


- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = 6 \text{ ns}$ ,  $t_f = 6 \text{ ns}$ .
  - C. The outputs are measured one at a time, with one input transition per measurement.
  - D.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

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### APPLICATION INFORMATION



**Figure 2. Priority Encoder for 16 Bits**

Because the 'HC148 devices are combinational logic circuits, wrong addresses can appear during input transients. Moreover, a change from high to low at EI can cause a transient low on GS when all inputs are high. This must be considered when strobing the outputs.

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN54HC148J       | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| SN74HC148D       | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74HC148DE4     | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74HC148DR      | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74HC148DRE4    | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74HC148DT      | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74HC148DTE4    | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74HC148DW      | OBSOLETE              | SOIC         | DW              | 16   |             | TBD                     | Call TI          | Call TI                      |
| SN74HC148DWR     | ACTIVE                | SOIC         | DW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74HC148DWRE4   | ACTIVE                | SOIC         | DW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74HC148N       | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74HC148NE4     | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74HC148NSR     | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74HC148NSRE4   | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SNJ54HC148FK     | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | POST-PLATE       | N / A for Pkg Type           |
| SNJ54HC148J      | ACTIVE                | CDIP         | J               | 16   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| SNJ54HC148W      | ACTIVE                | CFP          | W               | 16   | 1           | TBD                     | A42              | N / A for Pkg Type           |

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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



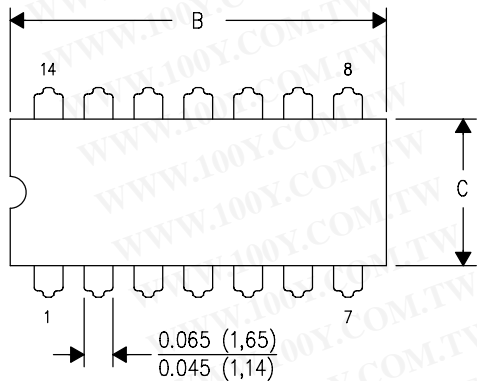
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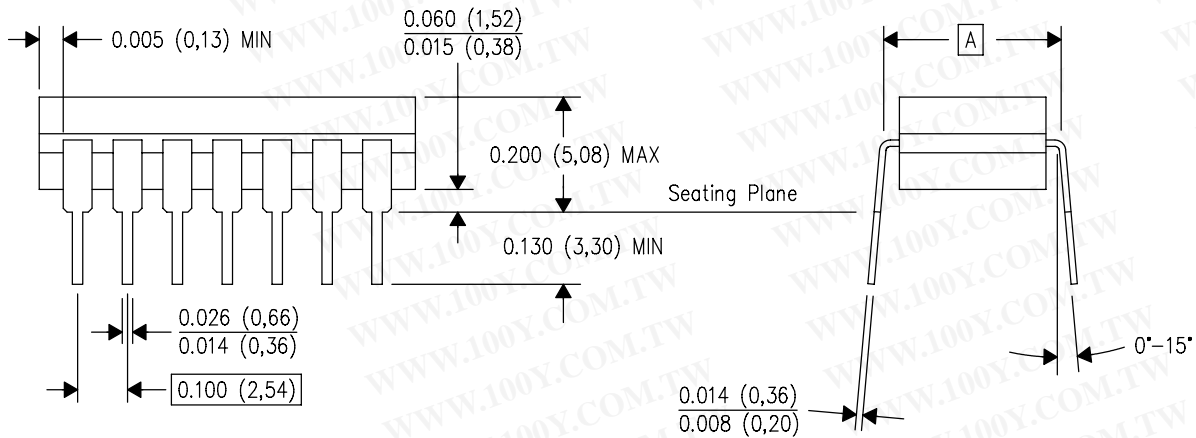
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J (R-GDIP-T\*\*)  
14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| PINS ** | 14                     | 16                     | 18                     | 20                     |
|---------|------------------------|------------------------|------------------------|------------------------|
| DIM     |                        |                        |                        |                        |
| A       | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC |
| B MAX   | 0.785<br>(19,94)       | .840<br>(21,34)        | 0.960<br>(24,38)       | 1.060<br>(26,92)       |
| B MIN   | —                      | —                      | —                      | —                      |
| C MAX   | 0.300<br>(7,62)        | 0.300<br>(7,62)        | 0.310<br>(7,87)        | 0.300<br>(7,62)        |
| C MIN   | 0.245<br>(6,22)        | 0.245<br>(6,22)        | 0.220<br>(5,59)        | 0.245<br>(6,22)        |

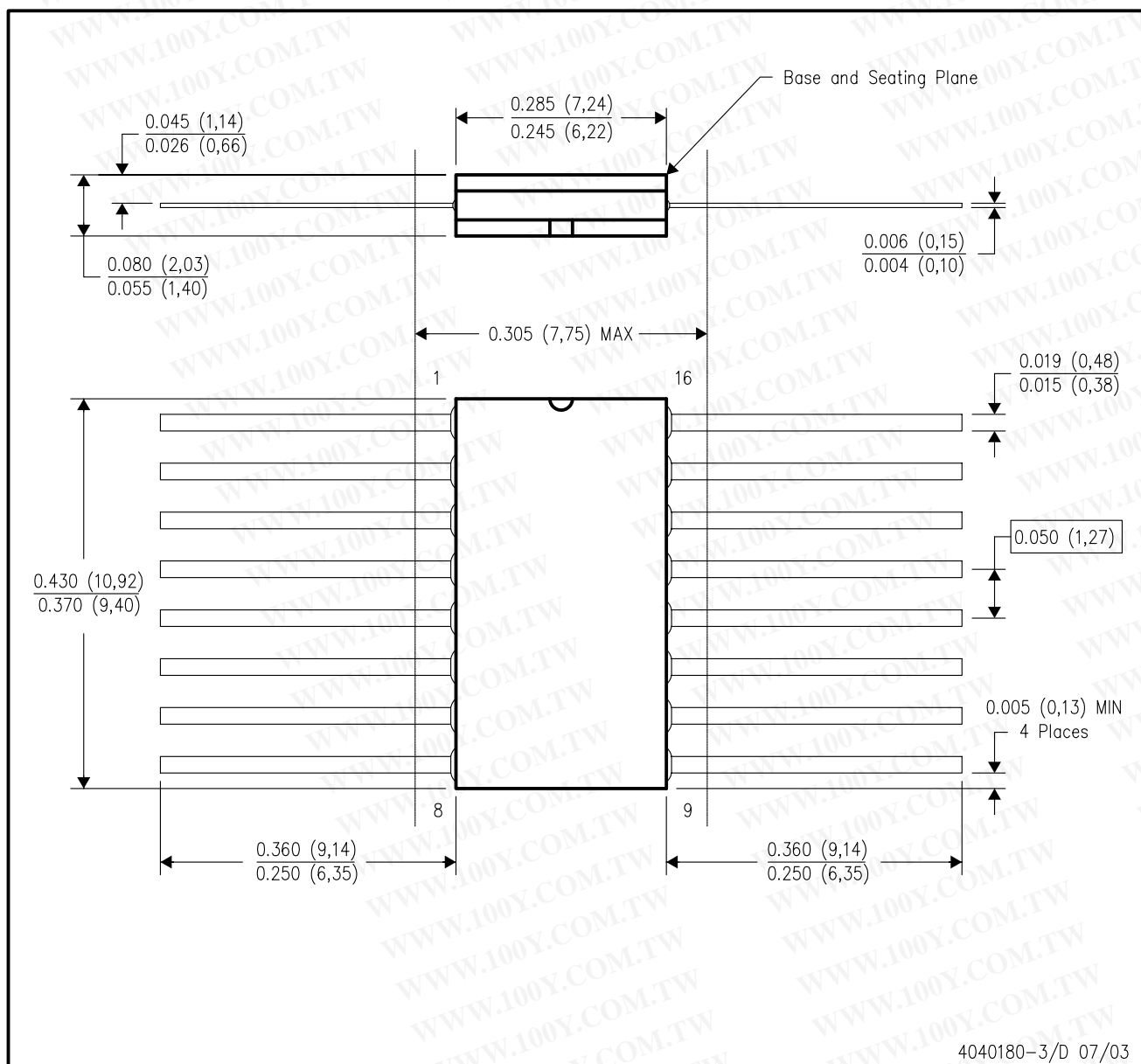


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- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK

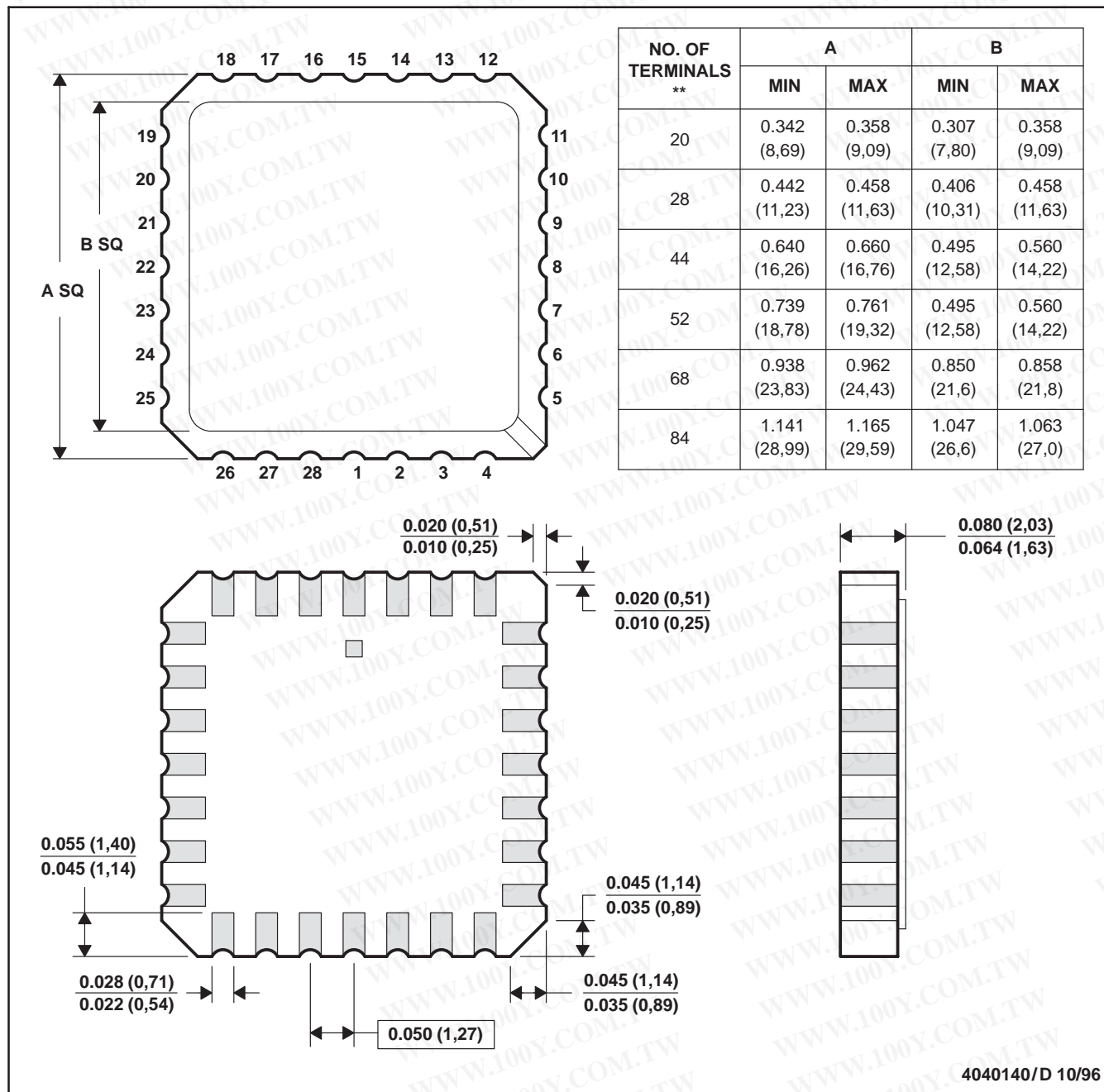


- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only.
  - Falls within MIL STD 1835 GDFP1-F16 and JEDEC MO-092AC

FK (S-CQCC-N\*\*)

28 TERMINAL SHOWN

LEADLESS CERAMIC CHIP CARRIER

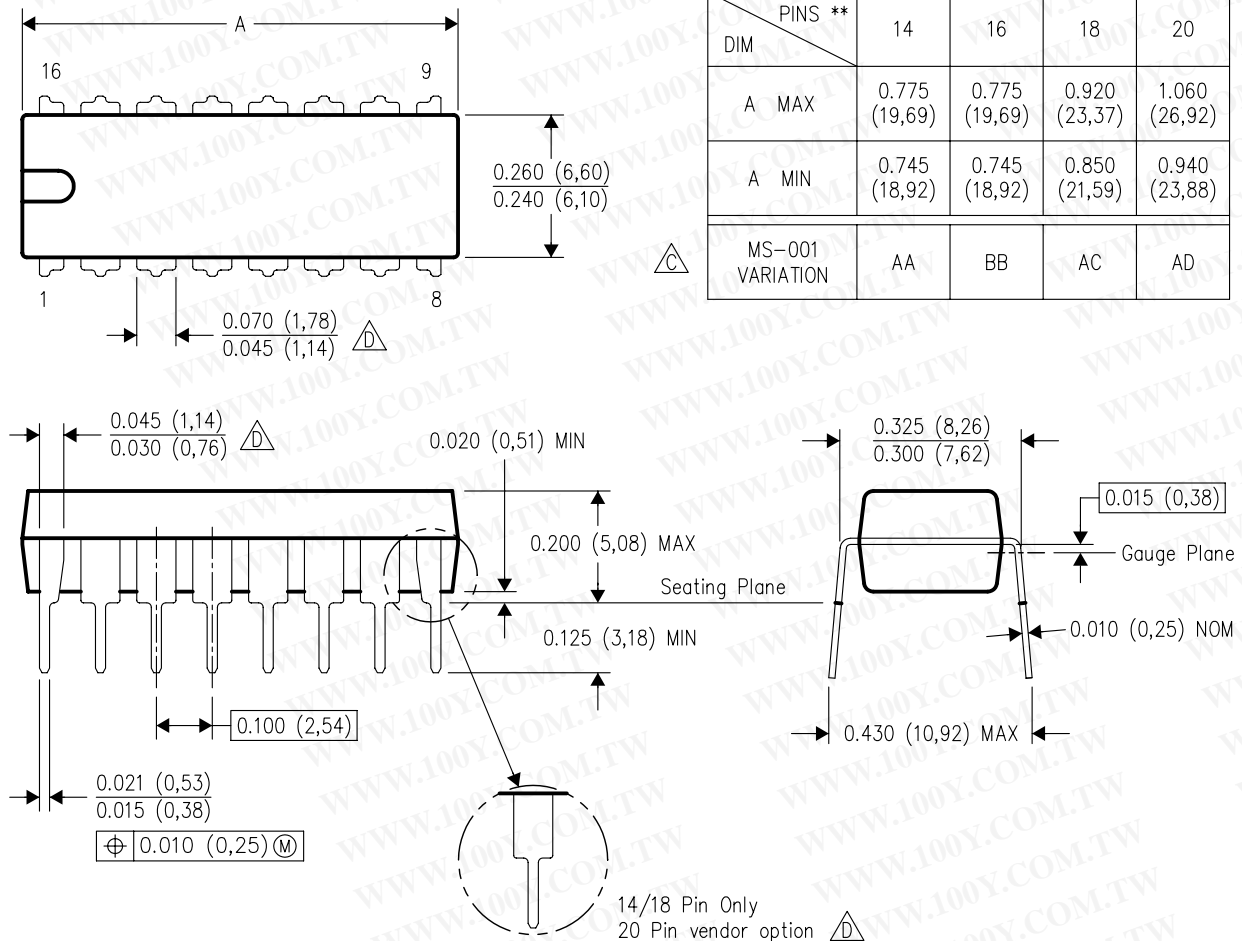


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a metal lid.
  - D. The terminals are gold plated.
  - E. Falls within JEDEC MS-004





## PLASTIC DUAL-IN-LINE PACKAGE

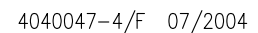
| PINS **<br>DIM      | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | AA               | BB               | AC               | AD               |



NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
-  The 20 pin end lead shoulder width is a vendor option, either half or full width.

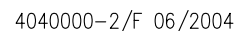
# PLASTIC SMALL-OUTLINE PACKAGE



- NOTES: A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.  
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).  
D. Falls within JEDEC MS-012 variation AC.

## MECHANICAL DATA

# PLASTIC SMALL-OUTLINE PACKAGE



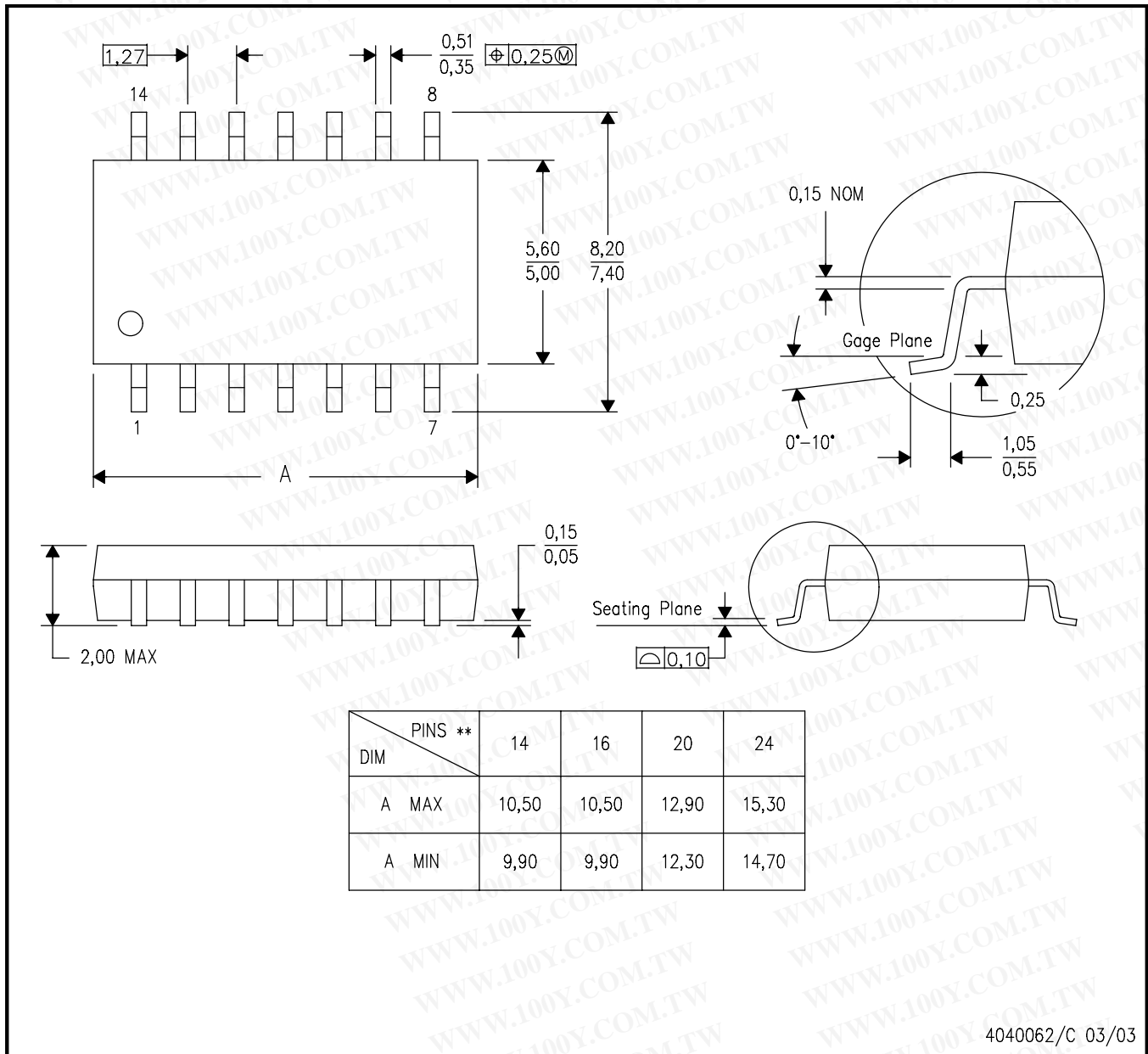
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# MECHANICAL DATA

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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