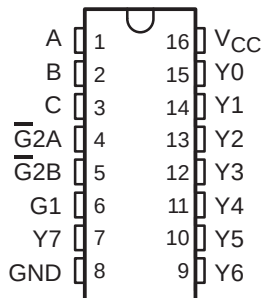


# SN54HCT138, SN74HCT138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

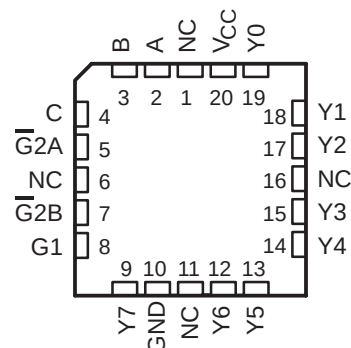
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- Operating Voltage Range of 4.5 V to 5.5 V
- Outputs Can Drive Up To 10 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Max  $I_{CC}$
- Typical  $t_{pd} = 17$  ns
- $\pm 4$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Max
- Inputs Are TTL-Voltage Compatible
- Designed Specifically for High-Speed Memory Decoders and Data Transmission Systems
- Incorporate Three Enable Inputs to Simplify Cascading and/or Data Reception

SN54HCT138 . . . J OR W PACKAGE  
SN74HCT138 . . . D, N, NS, OR PW PACKAGE  
(TOP VIEW)



SN54HCT138 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## description/ordering information

The 'HCT138 devices are designed for high-performance memory-decoding or data-routing applications requiring very short propagation delay times. In high-performance memory systems, these decoders can minimize the effects of system decoding. When employed with high-speed memories utilizing a fast enable circuit, the delay times of these decoders and the enable time of the memory usually are less than the typical access time of the memory. This means that the effective system delay introduced by the decoders is negligible.

## ORDERING INFORMATION

| T <sub>A</sub> | PACKAGE†   |               | ORDERABLE<br>PART NUMBER | TOP-SIDE<br>MARKING |
|----------------|------------|---------------|--------------------------|---------------------|
| –40°C to 85°C  | PDIP – N   | Tube of 25    | SN74HCT138N              | SN74HCT138N         |
|                | SOIC – D   | Tube of 40    | SN74HCT138D              | HCT138              |
|                |            | Reel of 2500  | SN74HCT138DR             |                     |
|                |            | Reel of 250   | SN74HCT138DT             |                     |
|                | SOP – NS   | Reel of 2000  | SN74HCT138NSR            | HCT138              |
|                | TSSOP – PW | Tube of 90    | SN74HCT138PW             | HT138               |
|                |            | Reel of 2000  | SN74HCT138PWR            |                     |
| Reel of 250    |            | SN74HCT138PWT |                          |                     |
| –55°C to 125°C | CDIP – J   | Tube of 25    | SNJ54HCT138J             | SNJ54HCT138J        |
|                | CFP – W    | Tube of 150   | SNJ54HCT138W             | SNJ54HCT138W        |
|                | LCCC – FK  | Tube of 55    | SNJ54HCT138FK            | SNJ54HCT138FK       |

<sup>†</sup> 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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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  
INSTRUMENTS**

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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

# SN54HCT138, SN74HCT138

## 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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### description/ordering information (continued)

The conditions at the binary-select inputs and the three enable inputs select one of eight output lines. Two active-low ( $\overline{G}$ ) and one active-high ( $G$ ) enable inputs reduce the need for external gates or inverters when expanding. A 24-line decoder can be implemented without external inverters, and a 32-line decoder requires only one inverter. An enable input can be used as a data input for demultiplexing applications.

FUNCTION TABLE

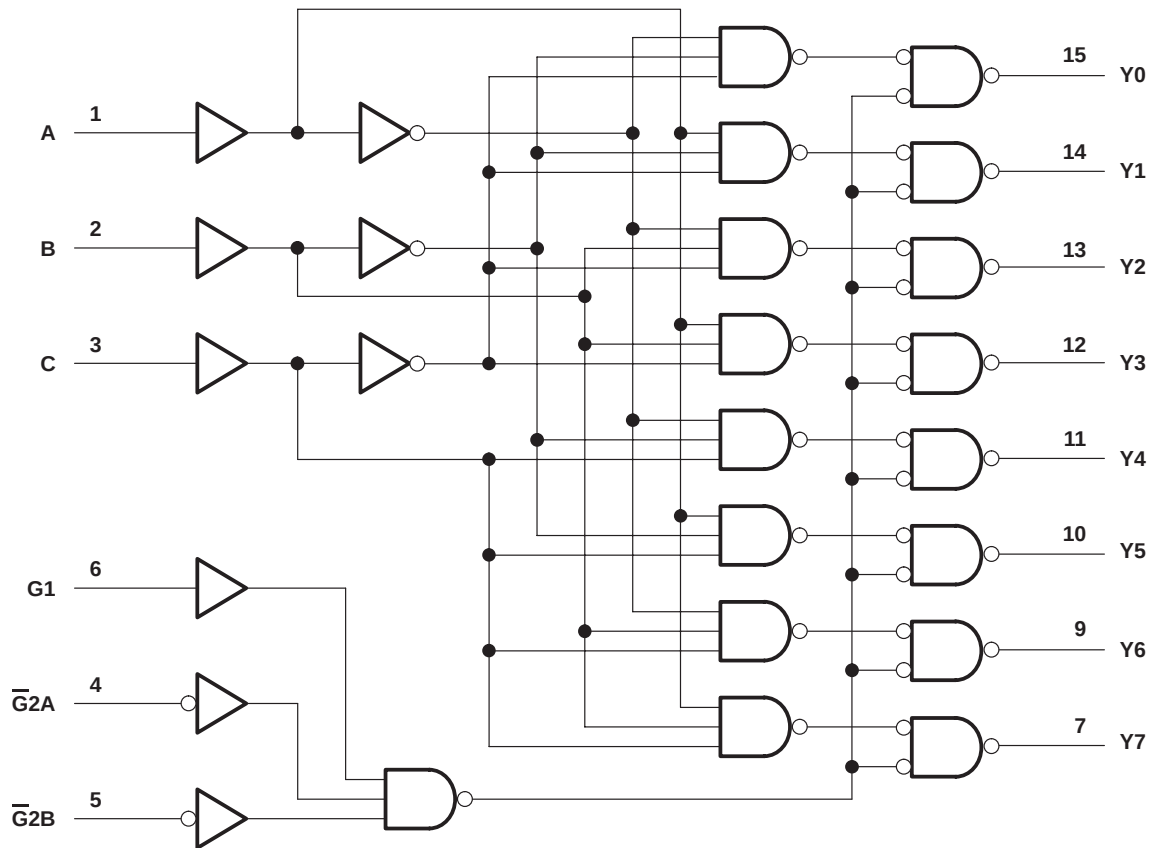
| INPUTS |                  |                  |        |   |   | OUTPUTS |    |    |    |    |    |    |    |
|--------|------------------|------------------|--------|---|---|---------|----|----|----|----|----|----|----|
| ENABLE |                  |                  | SELECT |   |   |         |    |    |    |    |    |    |    |
| G1     | $\overline{G2A}$ | $\overline{G2B}$ | C      | B | A | Y0      | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
| X      | H                | X                | X      | X | X | H       | H  | H  | H  | H  | H  | H  | H  |
| X      | X                | H                | X      | X | X | H       | H  | H  | H  | H  | H  | H  | H  |
| L      | X                | X                | X      | X | X | H       | H  | H  | H  | H  | H  | H  | H  |
| H      | L                | L                | L      | L | L | L       | H  | H  | H  | H  | H  | H  | H  |
| H      | L                | L                | L      | L | H | H       | L  | H  | H  | H  | H  | H  | H  |
| H      | L                | L                | L      | H | L | H       | H  | L  | H  | H  | H  | H  | H  |
| H      | L                | L                | L      | H | H | H       | H  | H  | L  | H  | H  | H  | H  |
| H      | L                | L                | H      | L | L | H       | H  | H  | H  | L  | H  | H  | H  |
| H      | L                | L                | H      | L | H | H       | H  | H  | H  | H  | L  | H  | H  |
| H      | L                | L                | H      | H | L | H       | H  | H  | H  | H  | H  | L  | H  |
| H      | L                | L                | H      | H | H | H       | H  | H  | H  | H  | H  | H  | L  |

# SN54HCT138, SN74HCT138

## 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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### logic diagram (positive logic)



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

### 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)  | $\pm 20$ mA    |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1) | $\pm 20$ mA    |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )                  | $\pm 25$ mA    |
| Continuous current through $V_{CC}$ or GND                                  | $\pm 50$ mA    |
| Package thermal impedance, $\theta_{JA}$ (see Note 2): D package            | 73°C/W         |
| N package                                                                   | 67°C/W         |
| NS package                                                                  | 64°C/W         |
| PW package                                                                  | 108°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.

# SN54HCT138, SN74HCT138

## 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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### recommended operating conditions (see Note 3)

|                     |                                 | SN54HCT138                              |     |     | SN74HCT138 |     |     | UNIT |
|---------------------|---------------------------------|-----------------------------------------|-----|-----|------------|-----|-----|------|
|                     |                                 | MIN                                     | NOM | MAX | MIN        | NOM | MAX |      |
| $V_{CC}$            | Supply voltage                  | 4.5                                     | 5   | 5.5 | 4.5        | 5   | 5.5 | V    |
| $V_{IH}$            | High-level input voltage        | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ |     |     | 2          |     |     | V    |
| $V_{IL}$            | Low-level input voltage         | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ |     |     | 0.8        |     |     | V    |
| $V_I$               | Input voltage                   | 0                                       |     |     | $V_{CC}$   |     |     | V    |
| $V_O$               | Output voltage                  | 0                                       |     |     | $V_{CC}$   |     |     | V    |
| $\Delta t/\Delta v$ | Input transition rise/fall time | 500                                     |     |     | 500        |     |     | ns   |
| $T_A$               | Operating free-air temperature  | -55                                     |     |     | 125        |     |     | °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.

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

| PARAMETER               | TEST CONDITIONS                                               |                                   | $V_{CC}$          | $T_A = 25^\circ\text{C}$ |           |      | SN54HCT138 |     | SN74HCT138 |      | UNIT          |
|-------------------------|---------------------------------------------------------------|-----------------------------------|-------------------|--------------------------|-----------|------|------------|-----|------------|------|---------------|
|                         |                                                               |                                   |                   | MIN                      | TYP       | MAX  | MIN        | MAX | MIN        | MAX  |               |
| $V_{OH}$                | $V_I = V_{IH}\text{ or }V_{IL}$                               | $I_{OH} = -20\text{ }\mu\text{A}$ | 4.5 V             | 4.4                      | 4.499     |      | 4.4        |     | 4.4        |      | V             |
|                         |                                                               | $I_{OH} = -4\text{ mA}$           |                   | 3.98                     | 4.3       |      | 3.7        |     | 3.84       |      |               |
| $V_{OL}$                | $V_I = V_{IH}\text{ or }V_{IL}$                               | $I_{OL} = 20\text{ }\mu\text{A}$  | 4.5 V             |                          | 0.001     | 0.1  |            | 0.1 |            | 0.1  | V             |
|                         |                                                               | $I_{OL} = 4\text{ mA}$            |                   |                          | 0.17      | 0.26 |            | 0.4 |            | 0.33 |               |
| $I_I$                   | $V_I = V_{CC}\text{ or }0$                                    |                                   | 5.5 V             | $\pm 0.1$                | $\pm 100$ |      | $\pm 1000$ |     | $\pm 1000$ |      | nA            |
| $I_{CC}$                | $V_I = V_{CC}\text{ or }0$ , $I_O = 0$                        |                                   | 5.5 V             |                          |           | 8    | 160        |     | 80         |      | $\mu\text{A}$ |
| $\Delta I_{CC}^\dagger$ | One input at 0.5 V or 2.4 V,<br>Other inputs at 0 or $V_{CC}$ |                                   | 5.5 V             |                          | 1.4       | 2.4  | 3          |     | 2.9        |      | mA            |
| $C_i$                   |                                                               |                                   | 4.5 V<br>to 5.5 V |                          | 3         | 10   | 10         |     | 10         |      | pF            |

<sup>†</sup> This is the increase in supply current for each input that is at one of the specified TTL voltage levels, rather than 0 V or  $V_{CC}$ .

### switching characteristics over recommended operating free-air temperature range, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     |     | SN54HCT138 |     | SN74HCT138 |     | UNIT |
|-----------|--------------|-------------|----------|--------------------------|-----|-----|------------|-----|------------|-----|------|
|           |              |             |          | MIN                      | TYP | MAX | MIN        | MAX | MIN        | MAX |      |
| $t_{pd}$  | A, B, or C   | Any Y       | 4.5 V    |                          | 23  | 36  |            | 54  |            | 45  | ns   |
|           |              |             | 5.5 V    |                          | 17  | 32  |            | 49  |            | 34  |      |
|           | Enable       | Any Y       | 4.5 V    |                          | 22  | 33  |            | 50  |            | 42  |      |
|           |              |             | 5.5 V    |                          | 18  | 30  |            | 45  |            | 38  |      |
| $t_t$     |              | Y           | 4.5 V    |                          | 12  | 15  |            | 22  |            | 19  | ns   |
|           |              |             | 5.5 V    |                          | 11  | 14  |            | 20  |            | 17  |      |

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

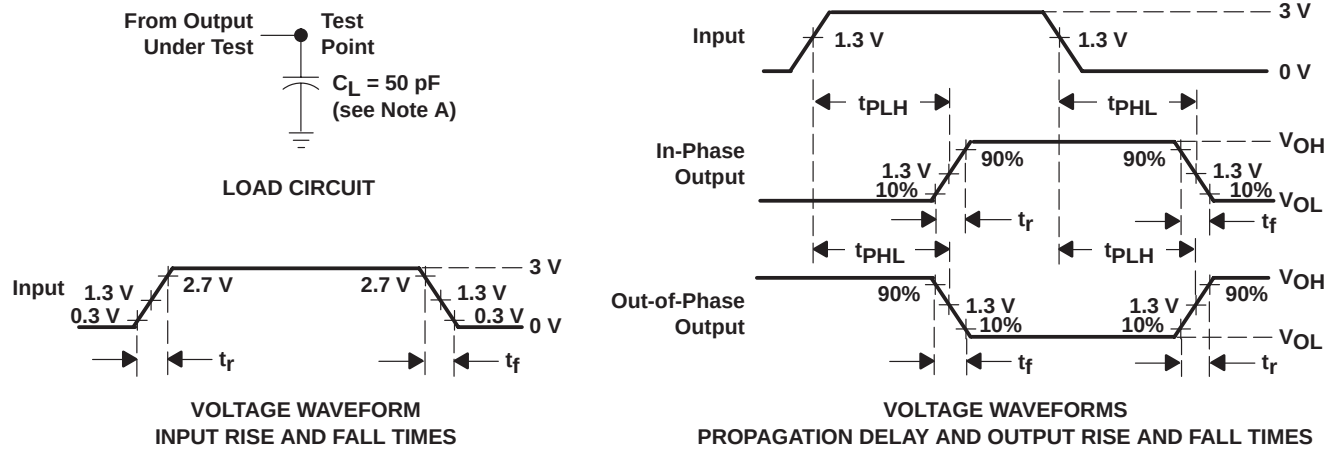
| PARAMETER                              | TEST CONDITIONS | TYP | UNIT |
|----------------------------------------|-----------------|-----|------|
| $C_{pd}$ Power dissipation capacitance | No load         | 85  | pF   |



# SN54HCT138, SN74HCT138 3-LINE TO 8-LINE DECODERS/DEMULTIPLEXERS

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## PARAMETER MEASUREMENT INFORMATION



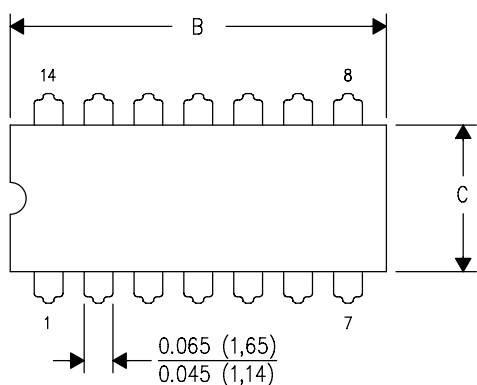
- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = 6 \text{ ns}$ ,  $t_f = 6 \text{ ns}$ .
  - 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

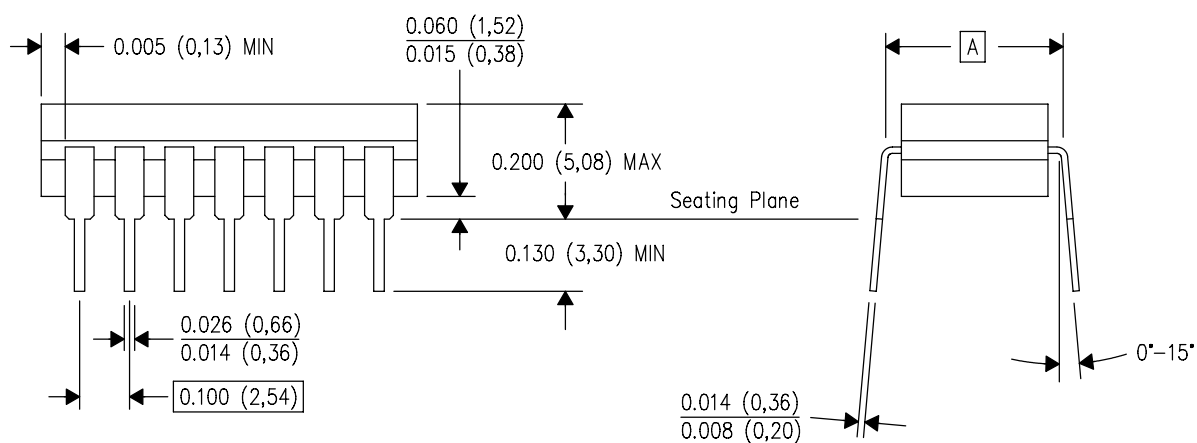
J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



| PINS **<br>DIM | 14                     | 16                     | 18                     | 20                     |
|----------------|------------------------|------------------------|------------------------|------------------------|
| 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)        |

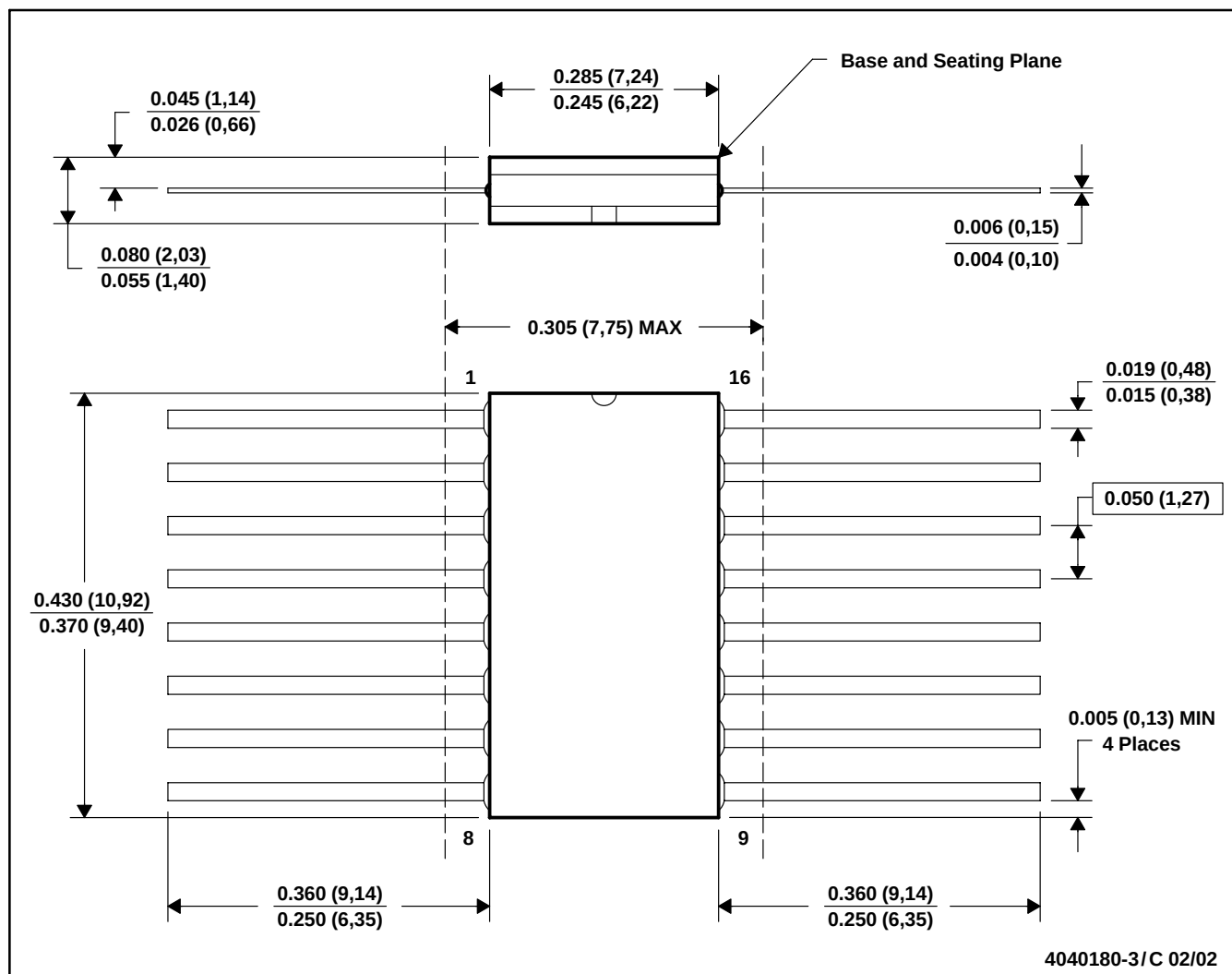


4040083/F 03/03

- 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

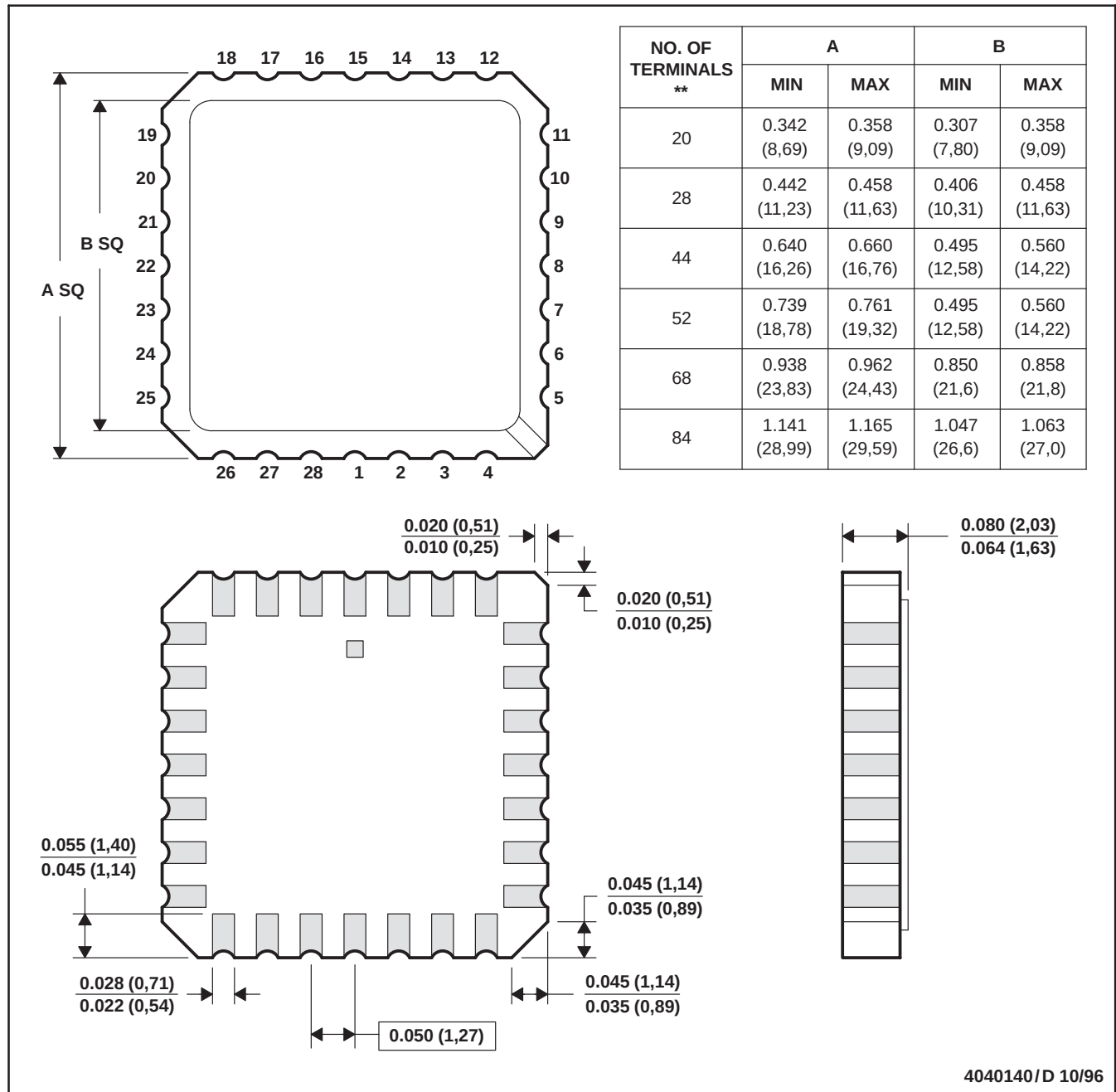


- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification only.  
 E. Falls within MIL STD 1835 GDFP-1F16 and JEDEC MO-092AC

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

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



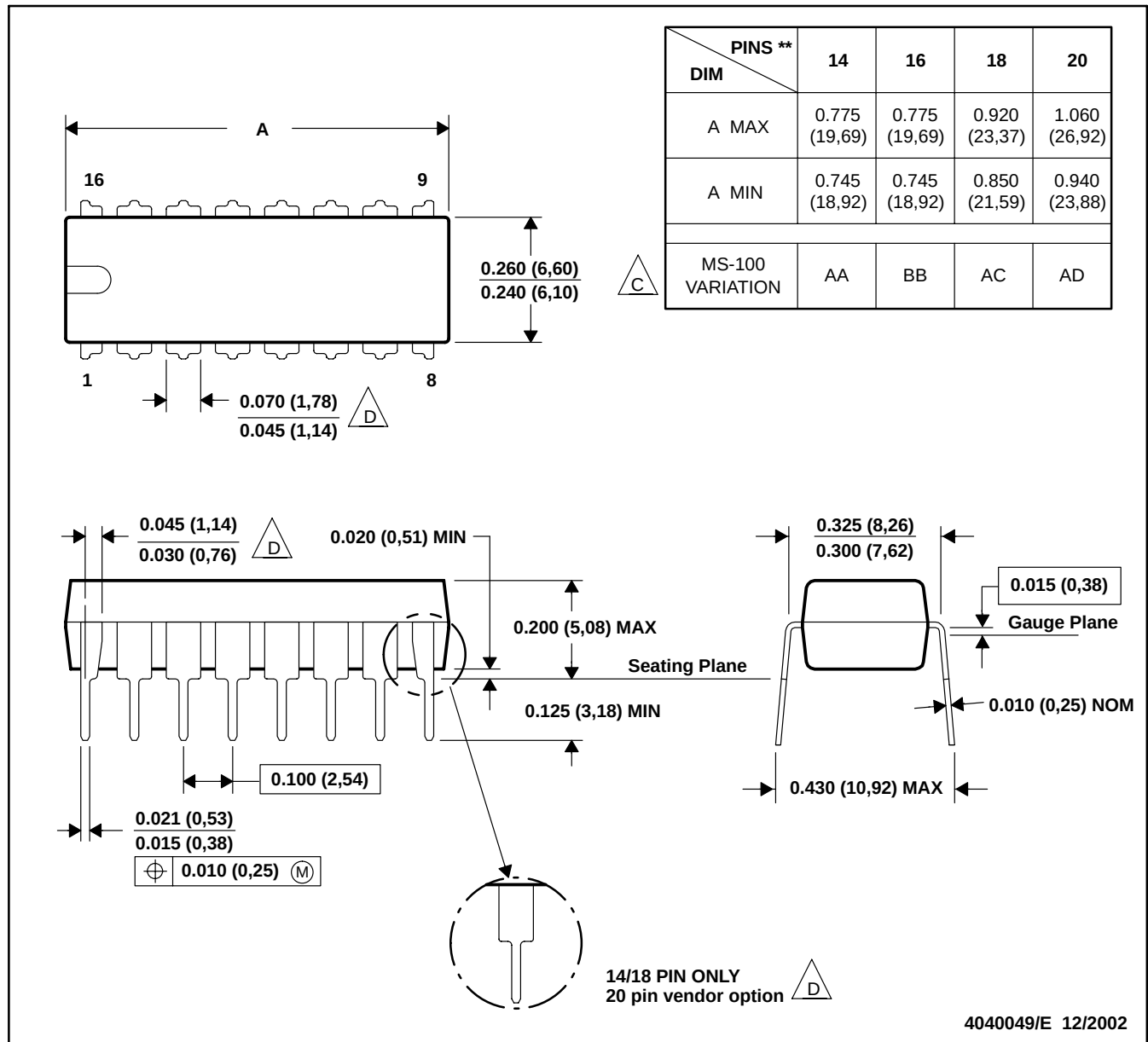
- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - The terminals are gold plated.
  - Falls within JEDEC MS-004



## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



NOTES: A. All linear dimensions are in inches (millimeters).

B. This drawing is subject to change without notice.

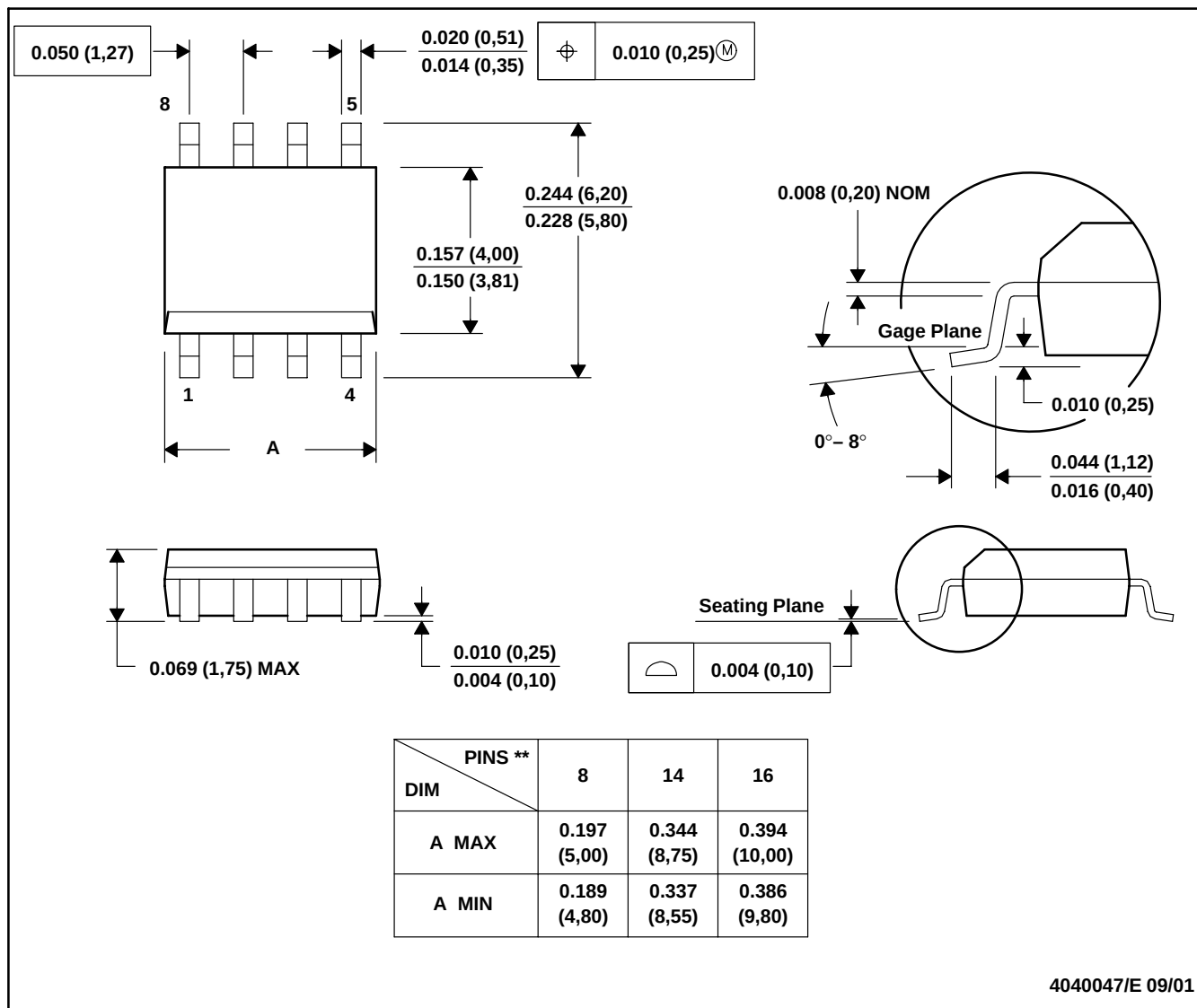
C Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).

D The 20 pin end lead shoulder width is a vendor option, either half or full width.

## D (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE PACKAGE

8 PINS SHOWN



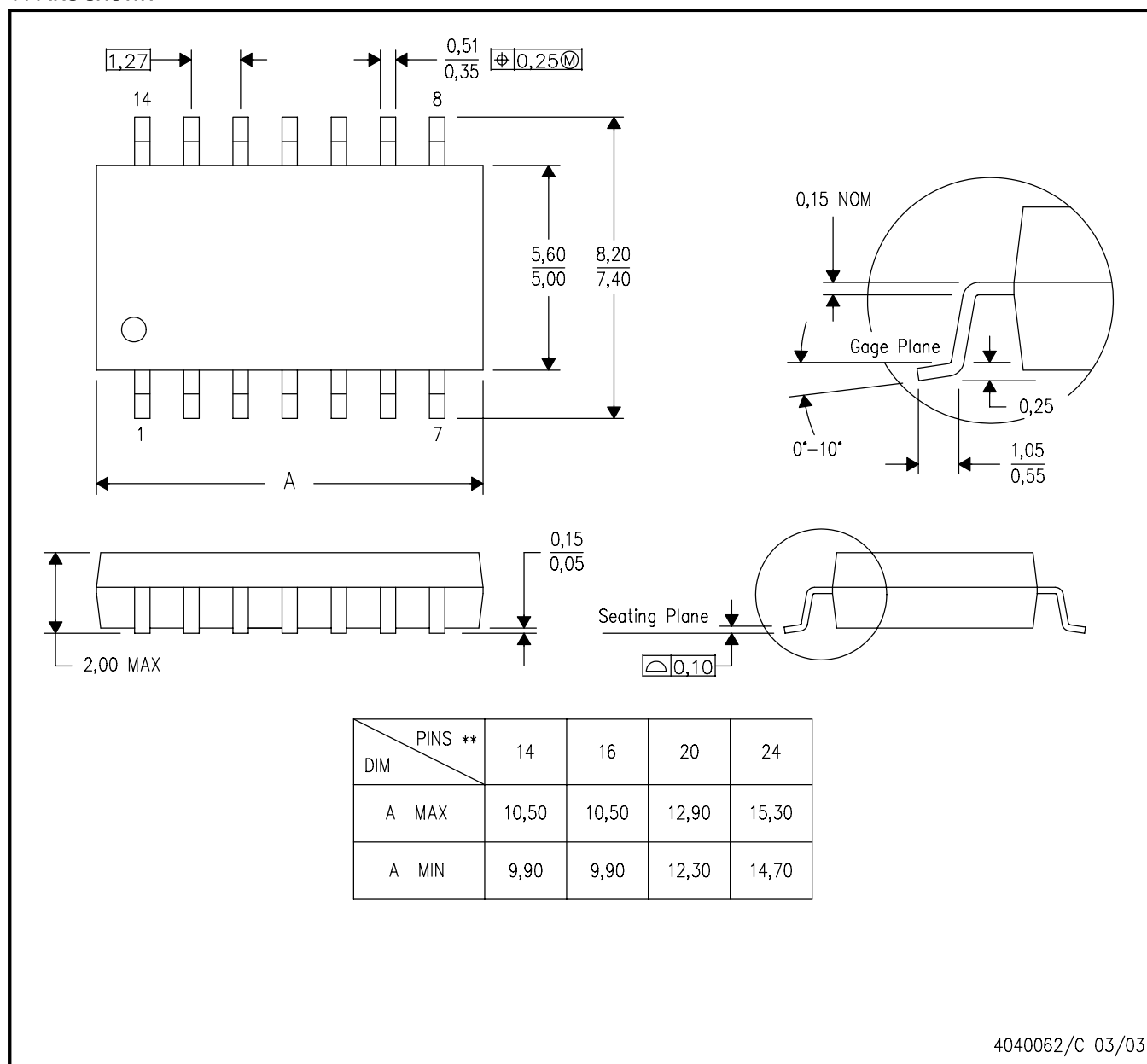
- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).  
 D. Falls within JEDEC MS-012

# MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN

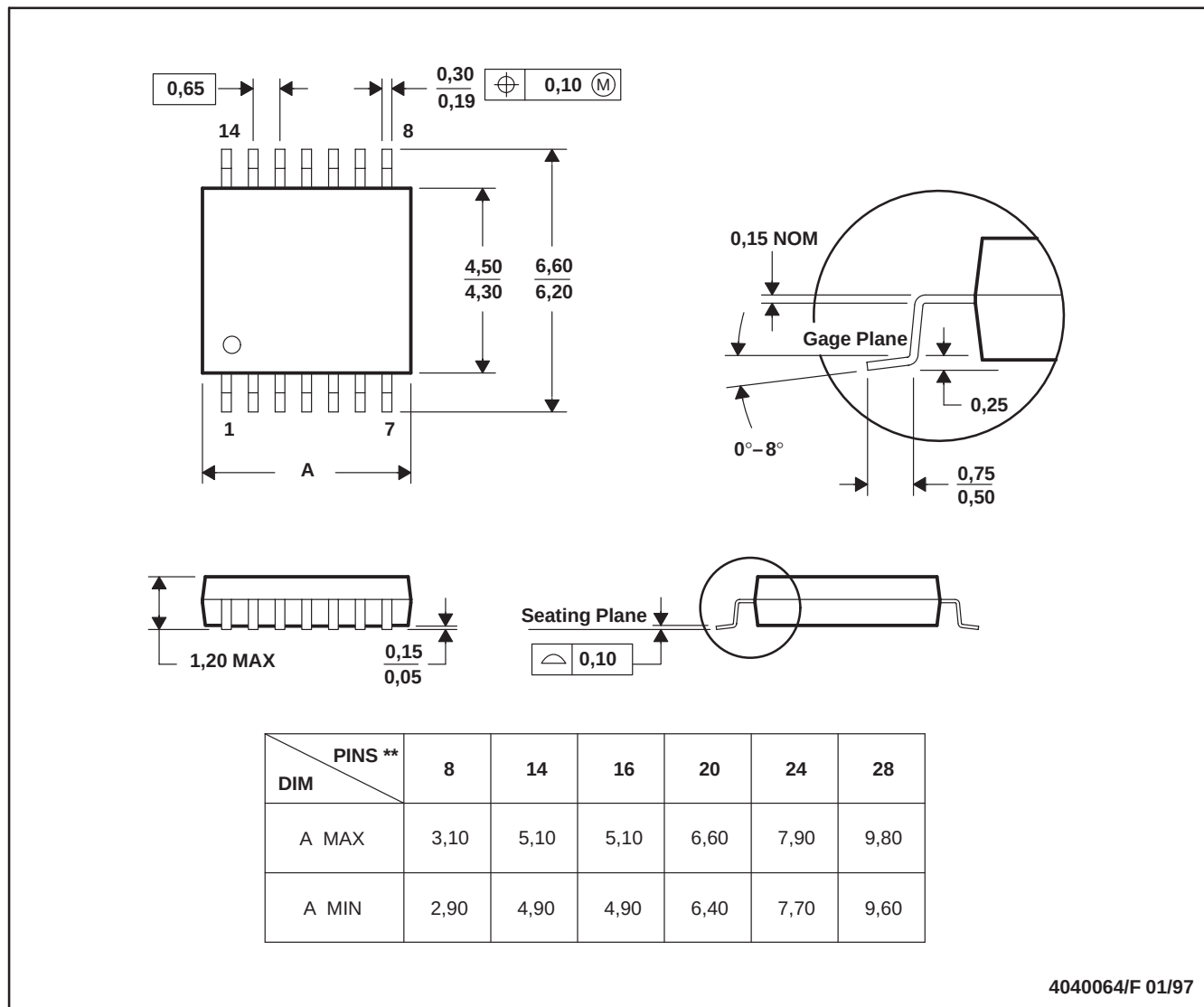


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

## PW (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.  
 D. Falls within JEDEC MO-153

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