

# SN5406, SN5416, SN7406, SN7416 HEX INVERTER BUFFERS/DRIVERS WITH OPEN-COLLECTOR HIGH-VOLTAGE OUTPUTS

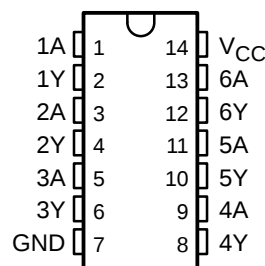
SDLS031A – DECEMBER 1983 – REVISED DECEMBER 2001

- Convert TTL Voltage Levels to MOS Levels
- High Sink-Current Capability
- Input Clamping Diodes Simplify System Design
- Open-Collector Drivers for Indicator Lamps and Relays
- Inputs Fully Compatible With Most TTL Circuits

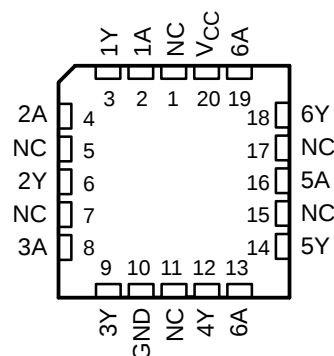
## description

These TTL hex inverter buffers/drivers feature high-voltage open-collector outputs for interfacing with high-level circuits (such as MOS) or for driving high-current loads (such as lamps or relays), and also are characterized for use as inverter buffers for driving TTL inputs. The SN5406 and SN7406 have minimum breakdown voltages of 30 V. The SN5416 and SN7416 have minimum breakdown voltages of 15 V. The maximum sink current is 30 mA for the SN5406 and SN5416, and 40 mA for the SN7406 and SN7416.

SN5406, SN5416 . . . J OR W PACKAGE  
SN7406 . . . D, N, OR NS PACKAGE  
SN7416 . . . D OR N PACKAGE  
(TOP VIEW)



SN5406 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## ORDERING INFORMATION

| T <sub>A</sub> | PACKAGE†  |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|-----------|---------------|-----------------------|------------------|
| 0°C to 70°C    | SOIC – D  | Tube          | SN7406D               | 7406             |
|                |           | Tape and reel | SN7406DR              |                  |
|                |           | Tube          | SN7416D               | 7416             |
|                |           | Tape and reel | SN7416DR              |                  |
|                | PDIP – N  | Tube          | SN7406N               | SN7406N          |
|                |           |               | SN7416N               | SN7416N          |
| –55°C to 125°C | SOP – NS  | Tape and reel | SN7406NSR             | SN7406           |
|                | CDIP – J  | Tube          | SNJ5406J              | SNJ5406J         |
|                |           | Tube          | SNJ5416J              | SNJ5416J         |
|                | CDIP – W  | Tube          | SNJ5406W              | SNJ5406W         |
|                |           | Tube          | SNJ5416W              | SNJ5416W         |
|                | LCCC – FK | Tube          | SNJ5406FK             | SNJ5406FK        |

† 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**

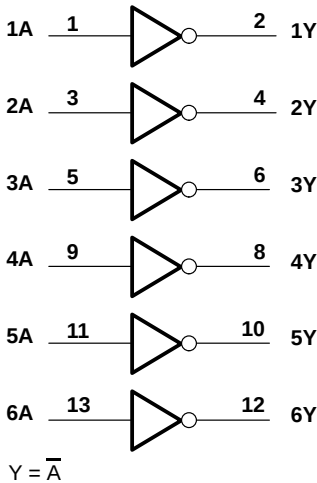
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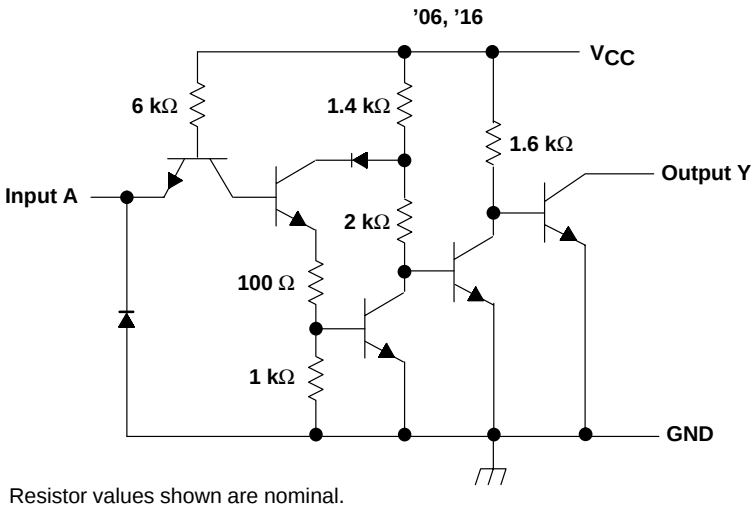
SN5406, SN5416, SN7406, SN7416  
 HEX INVERTER BUFFERS/DRIVERS  
 WITH OPEN-COLLECTOR HIGH-VOLTAGE OUTPUTS

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logic diagram (positive logic)



schematic (each buffer/driver)



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

|                                                                    |                |
|--------------------------------------------------------------------|----------------|
| Supply voltage, V <sub>CC</sub> (see Note 1)                       | 7 V            |
| Input voltage, V <sub>I</sub> (see Note 1)                         | 5.5 V          |
| Output voltage, V <sub>O</sub> (see Notes 1 and 2): SN5406, SN7406 | 30 V           |
| SN5416, SN7416                                                     | 15 V           |
| Package thermal impedance, θ <sub>JA</sub> (see Note 3): D package | 86°C/W         |
| N package                                                          | 80°C/W         |
| NS package                                                         | 76°C/W         |
| Storage temperature range, T <sub>stg</sub>                        | –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. Voltage values are with respect to network ground terminal.  
 2. This is the maximum voltage which should be applied to any output when it is in the off state.  
 3. The package thermal impedance is calculated in accordance with JESD 51-7.

**SN5406, SN5416, SN7406, SN7416**  
**HEX INVERTER BUFFERS/DRIVERS**  
**WITH OPEN-COLLECTOR HIGH-VOLTAGE OUTPUTS**

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**recommended operating conditions**

|                 |                                |     | SN5406<br>SN5416 |     |     | SN7406<br>SN7416 |     |      | 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     |
| V <sub>OH</sub> | High-level output voltage      | '06 | 30               |     |     | 30               |     |      | V     |
|                 |                                | '16 | 15               |     |     | 15               |     |      |       |
| I <sub>OL</sub> | Low-level output current       |     | 30               |     |     | 40               |     |      | mA    |
| T <sub>A</sub>  | Operating free-air temperature |     | −55              |     |     | 0                |     |      | 70 °C |

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

| PARAMETER        | TEST CONDITIONS†                                                    |  |                         | SN5406<br>SN5416 |      |     | SN7406<br>SN7416 |      |     | UNIT |
|------------------|---------------------------------------------------------------------|--|-------------------------|------------------|------|-----|------------------|------|-----|------|
|                  |                                                                     |  |                         | MIN              | TYP‡ | MAX | MIN              | TYP‡ | MAX |      |
| V <sub>IK</sub>  | V <sub>CC</sub> = MIN, I <sub>I</sub> = –12 mA                      |  |                         | –1.5             |      |     | –1.5             |      |     | V    |
| I <sub>OH</sub>  | V <sub>CC</sub> = MIN, V <sub>IL</sub> = 0.8 V, V <sub>OH</sub> = § |  |                         | 0.25             |      |     | 0.25             |      |     | mA   |
| V <sub>OL</sub>  | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V                        |  | I <sub>OL</sub> = 16 mA | 0.4              |      |     | 0.4              |      |     | V    |
|                  |                                                                     |  | I <sub>OL</sub> = ¶     | 0.7              |      |     | 0.7              |      |     |      |
| I <sub>I</sub>   | V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V                       |  |                         | 1                |      |     | 1                |      |     | mA   |
| I <sub>IH</sub>  | V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2.4 V                      |  |                         | 40               |      |     | 40               |      |     | µA   |
| I <sub>IL</sub>  | V <sub>CC</sub> = MAX, V <sub>IL</sub> = 0.4 V                      |  |                         | –1.6             |      |     | –1.6             |      |     | mA   |
| I <sub>CCH</sub> | V <sub>CC</sub> = MAX                                               |  |                         | 30 48            |      |     | 30 48            |      |     | mA   |
| I <sub>CCL</sub> | V <sub>CC</sub> = MAX                                               |  |                         | 32 51            |      |     | 32 51            |      |     | 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.

§ V<sub>OH</sub> = 30 V for '06 and 15 V for '16.

¶ I<sub>OL</sub> = 30 mA for SN54' and 40 mA for SN74'.

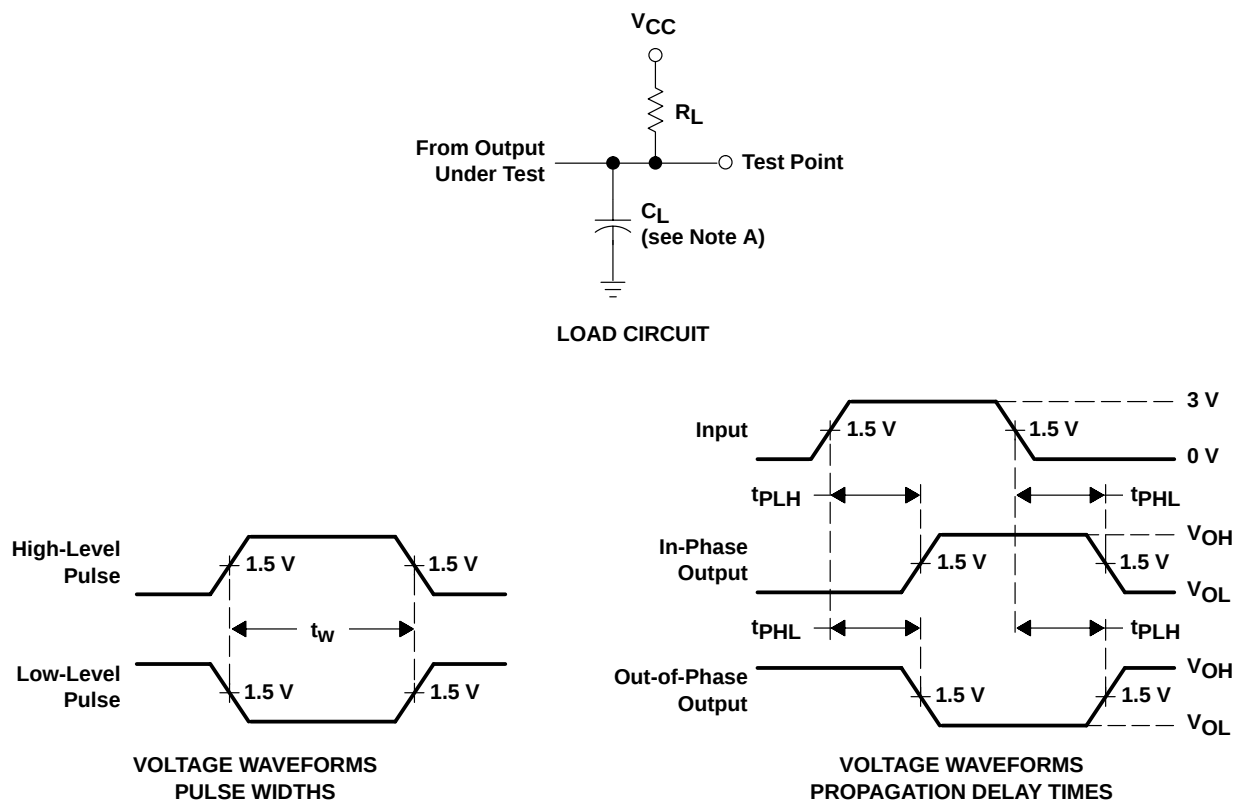
**switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see Figure 1)**

| PARAMETER        | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS                                | MIN | TYP | MAX | UNIT |
|------------------|-----------------|----------------|------------------------------------------------|-----|-----|-----|------|
| t <sub>PLH</sub> | A               | Y              | R <sub>L</sub> = 110 Ω, C <sub>L</sub> = 15 pF |     | 10  | 15  | ns   |
| t <sub>PHL</sub> |                 |                |                                                |     | 15  | 23  |      |

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## PARAMETER MEASUREMENT INFORMATION



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. In the examples above, the phase relationships between inputs and outputs have been chosen arbitrarily.  
 C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 7$  ns,  $t_f \leq 7$  ns.  
 D. The outputs are measured one at a time with one input transition per measurement.

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

**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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| JM38510/00801BCA | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| JM38510/00801BDA | ACTIVE                | CFP          | W               | 14   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| SN5406J          | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| SN5416J          | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| SN7406D          | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7406DE4        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7406DG4        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7406DR         | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7406DRE4       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7406DRG4       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7406J          | OBSOLETE              | CDIP         | J               | 14   |             | TBD                     | Call TI          | Call TI                      |
| SN7406N          | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN7406N3         | OBSOLETE              | PDIP         | N               | 14   |             | TBD                     | Call TI          | Call TI                      |
| SN7406NE4        | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN7406NSR        | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7406NSRE4      | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7416D          | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7416DE4        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7416DR         | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7416DRE4       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7416N          | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN7416N3         | OBSOLETE              | PDIP         | N               | 14   |             | TBD                     | Call TI          | Call TI                      |
| SN7416NE4        | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN7416NSR        | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN7416NSRE4      | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SNJ5406FK        | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | POST-PLATE       | N / A for Pkg Type           |
| SNJ5406J         | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |
| SNJ5406W         | ACTIVE                | CFP          | W               | 14   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| SNJ5416J         | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42 SNPB         | N / A for Pkg Type           |

| 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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SNJ5416W         | ACTIVE                | CFP          | W               | 14   | 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.

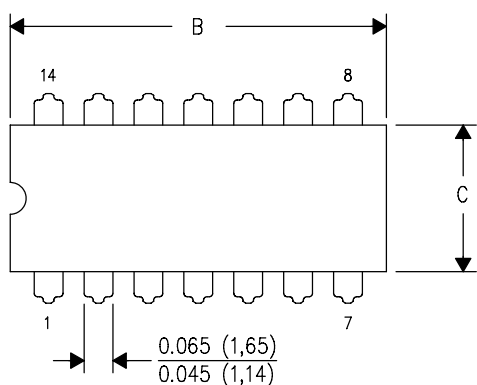
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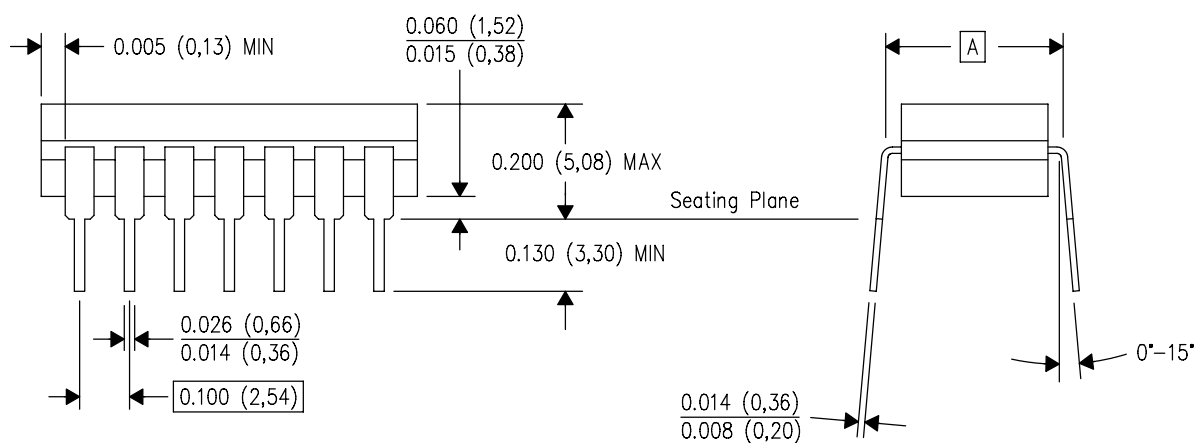
J (R-GDIP-T\*\*)

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)        |

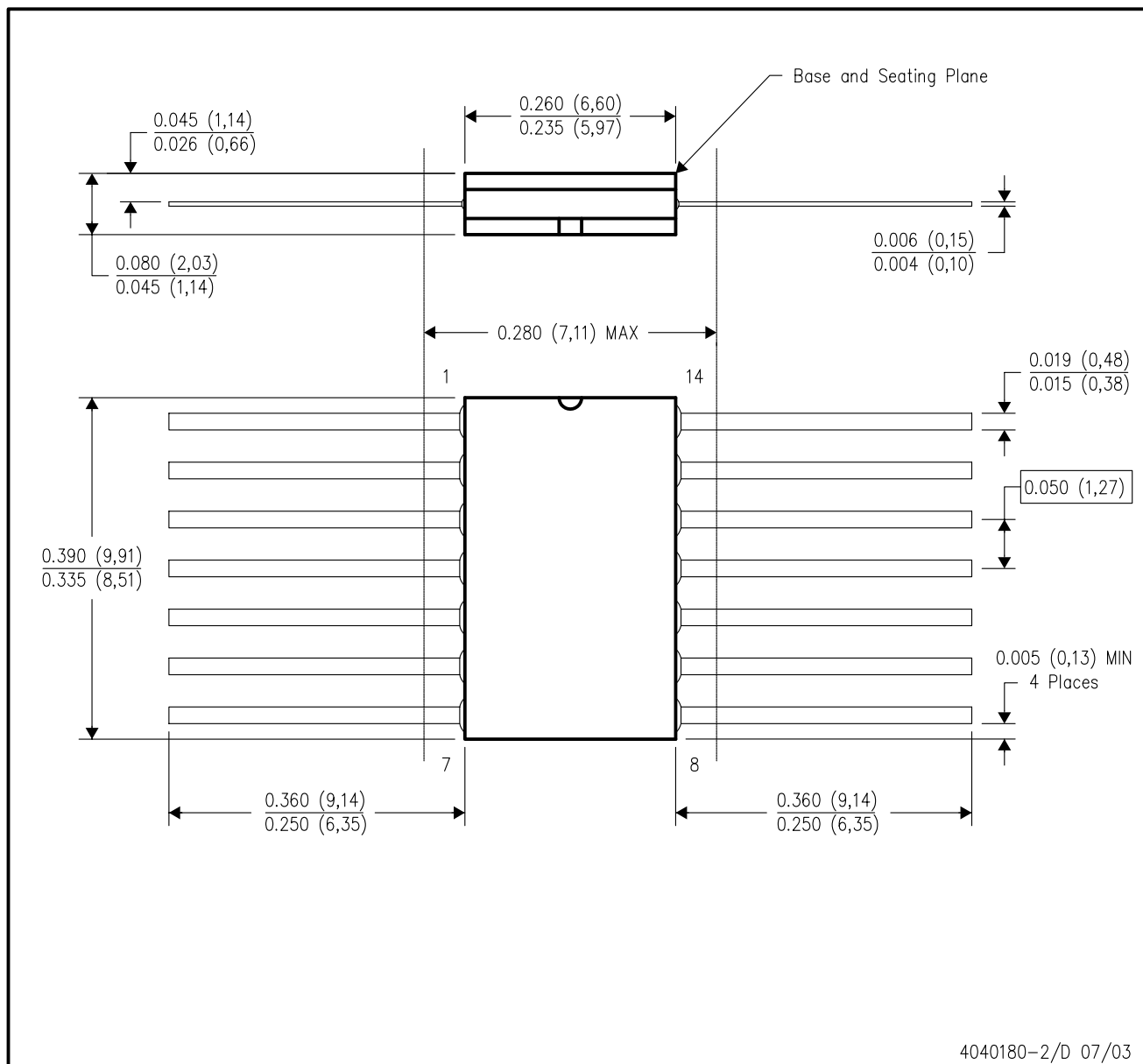


4040083/F 03/03

- 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-F14)

CERAMIC DUAL FLATPACK

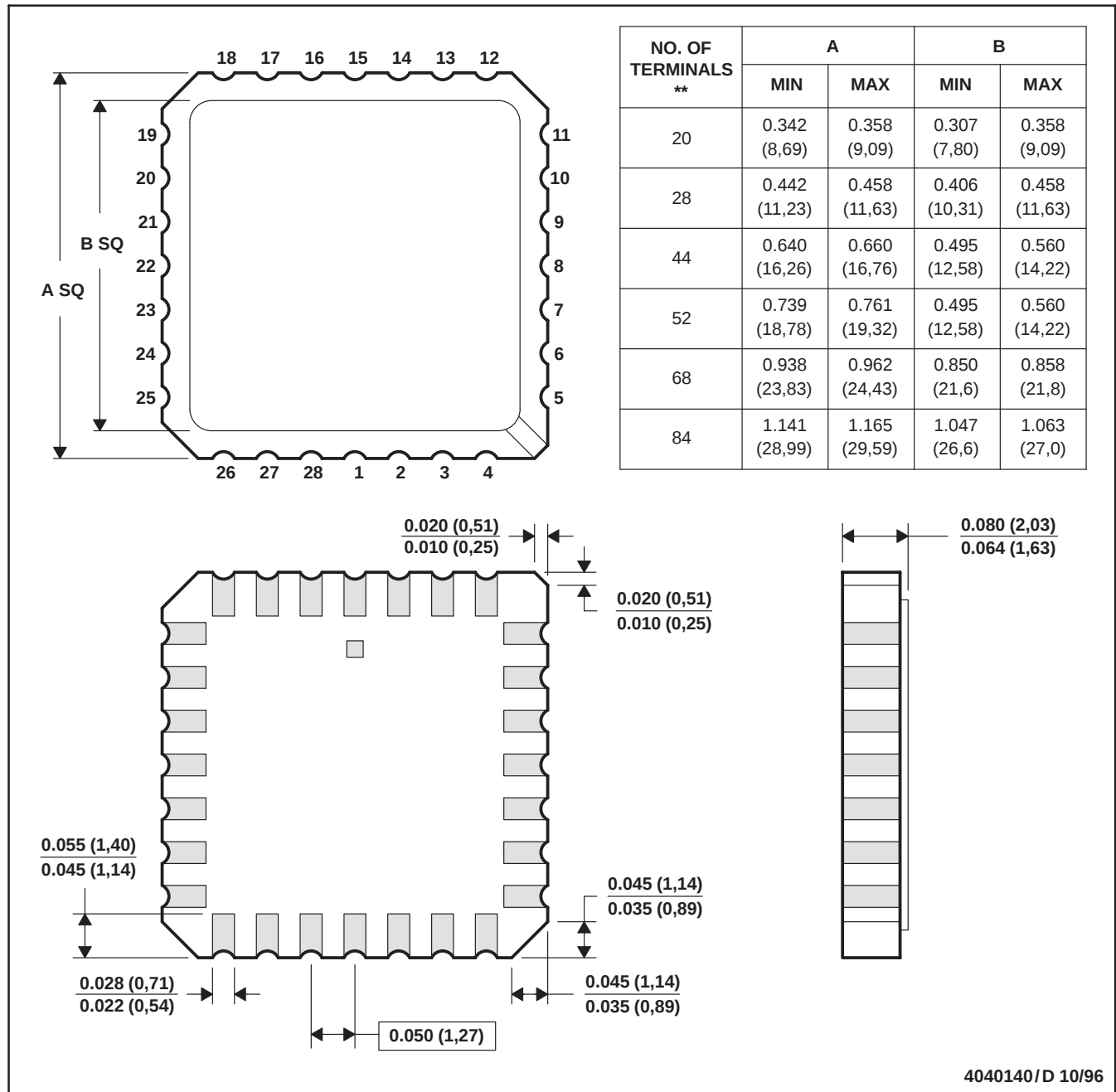


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP1-F14 and JEDEC MO-092AB

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

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN

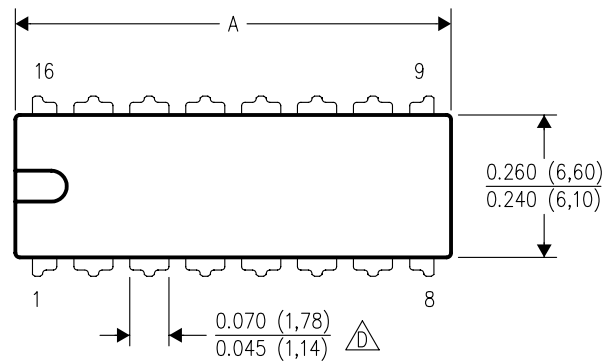


- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - The terminals are gold plated.
  - Falls within JEDEC MS-004

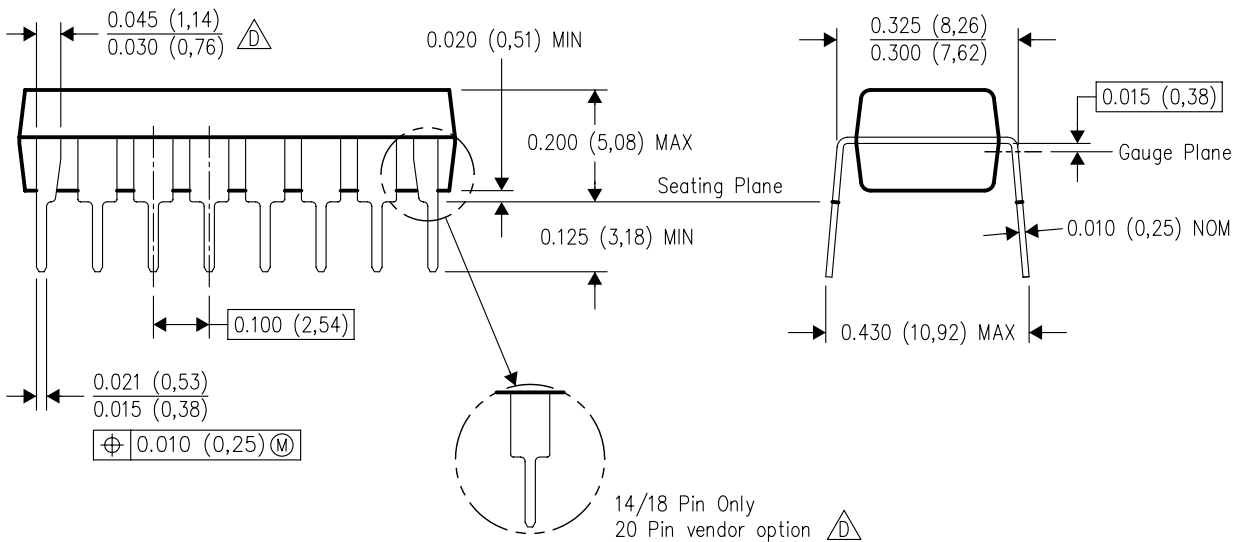
## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



| PINS **             | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| DIM                 |                  |                  |                  |                  |
| 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               |



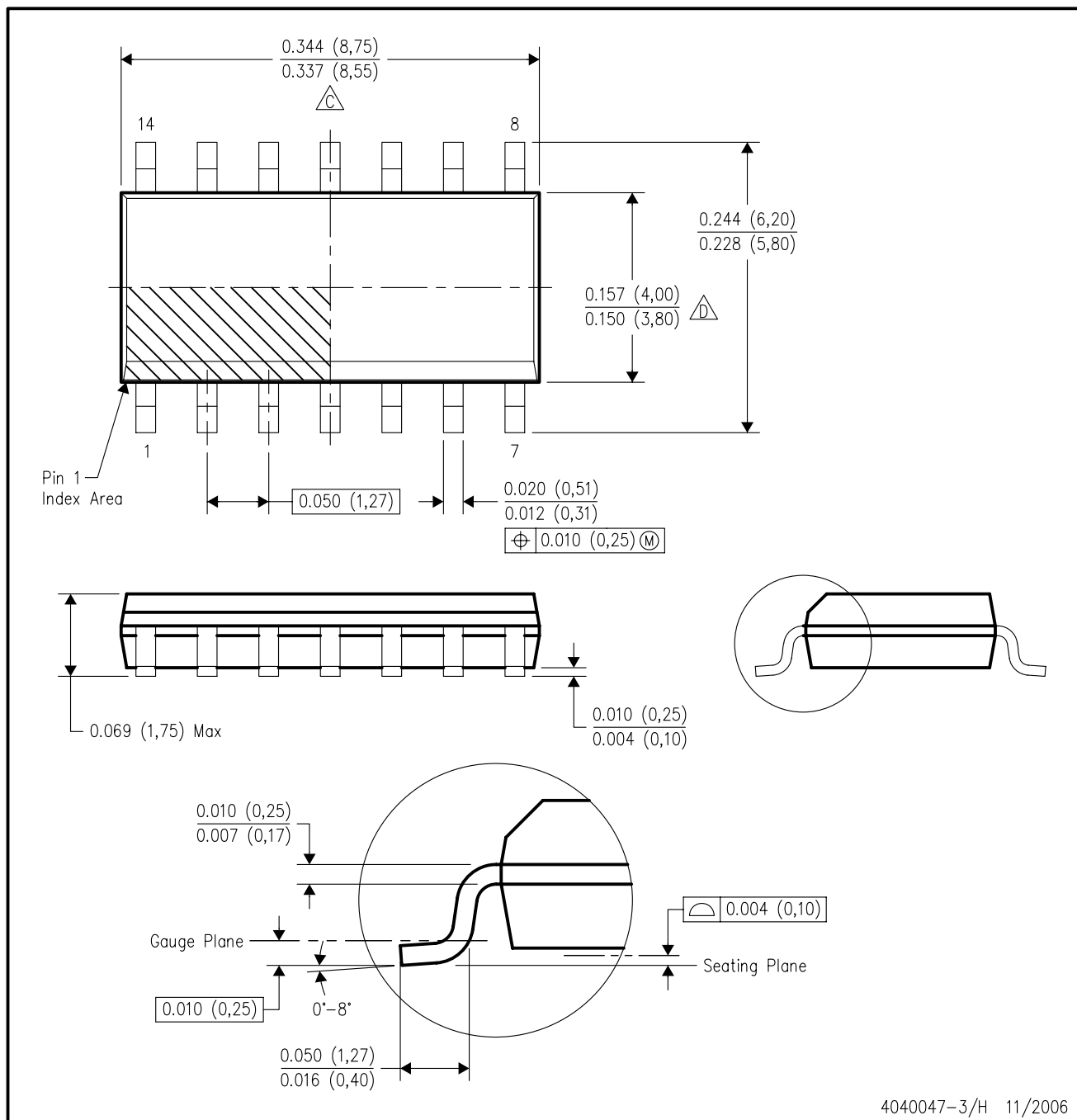
14/18 Pin Only  
20 Pin vendor option

4040049/E 12/2002

- 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.

## D (R-PDSO-G14)

## PLASTIC SMALL-OUTLINE PACKAGE



## NOTES:

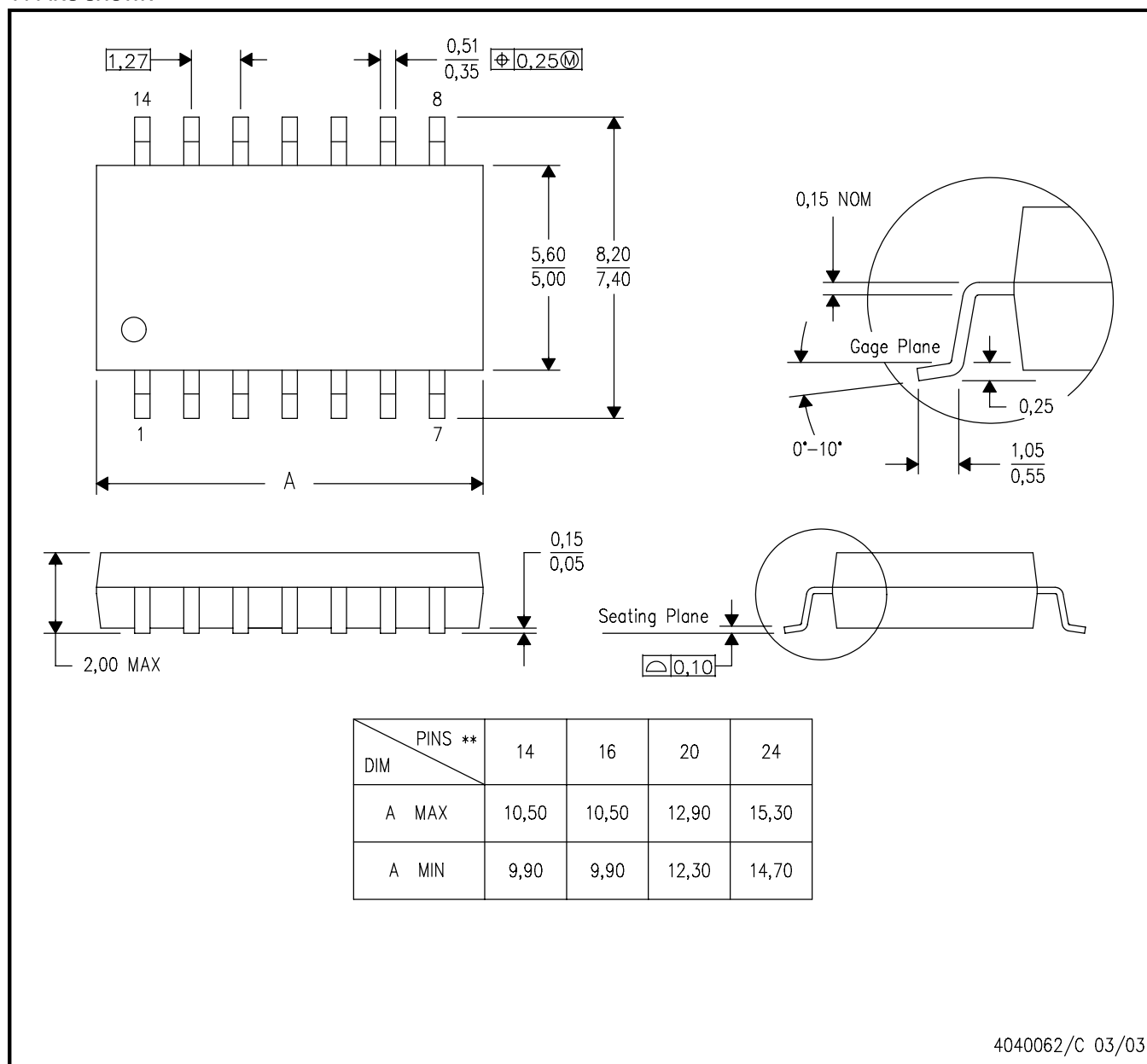
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
- D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
- E. Reference JEDEC MS-012 variation AB.

# MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



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

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