

# SN74ALS1640A, SN74ALS1645A OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

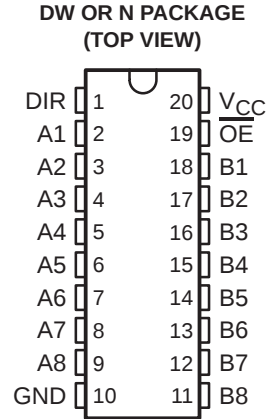
SDAS246B – DECEMBER 1982 – REVISED FEBRUARY 1997

- Bidirectional Bus Transceivers in High-Density 20-Pin Packages
- Lower-Power Versions of SN74ALS640B and SN74ALS645A
- Package Options Include Plastic Small-Outline (DW) Packages and Standard Plastic (N) 300-mil DIPs

## description

These octal bus transceivers are designed for asynchronous two-way communication between data buses. These devices transmit data from the A bus to the B bus or from the B bus to the A bus, depending on the level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so that the buses are effectively isolated. The SN74ALS1640A features inverting logic, while the SN74ALS1645A features noninverting logic.

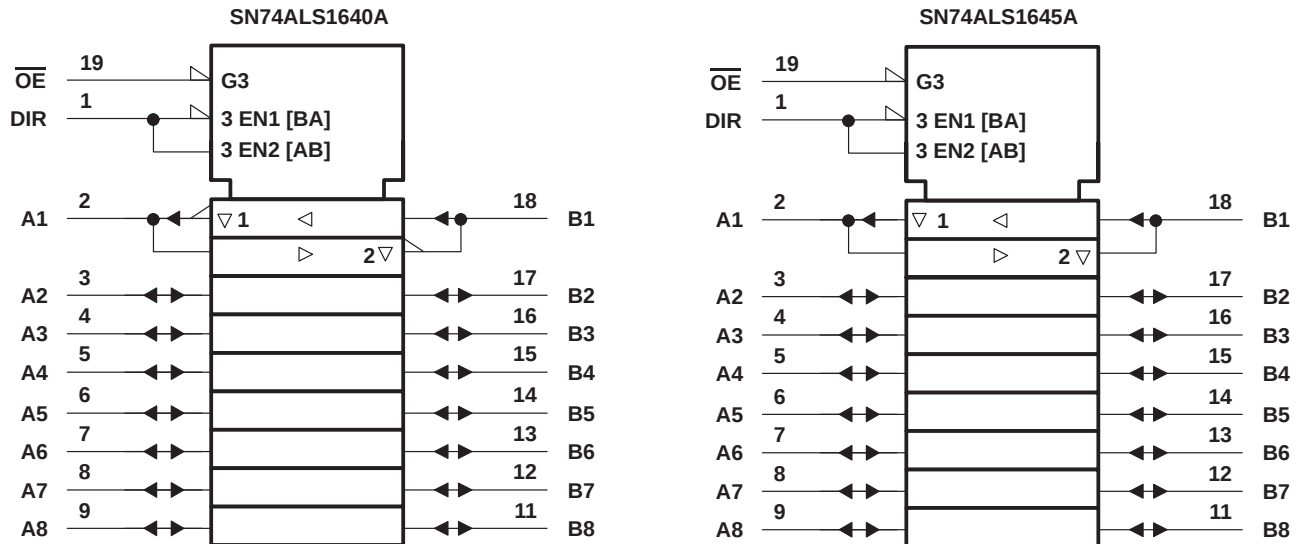
The SN74ALS1640A and SN74ALS1645A are characterized for operation from 0°C to 70°C.



FUNCTION TABLE

| INPUTS          |     | OPERATION                    |                 |
|-----------------|-----|------------------------------|-----------------|
| $\overline{OE}$ | DIR | SN74ALS1640A                 | SN74ALS1645A    |
| L               | L   | $\overline{B}$ data to A bus | B data to A bus |
| L               | H   | $\overline{A}$ data to B bus | A data to B bus |
| H               | X   | Isolation                    | Isolation       |

## logic symbols†



† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.



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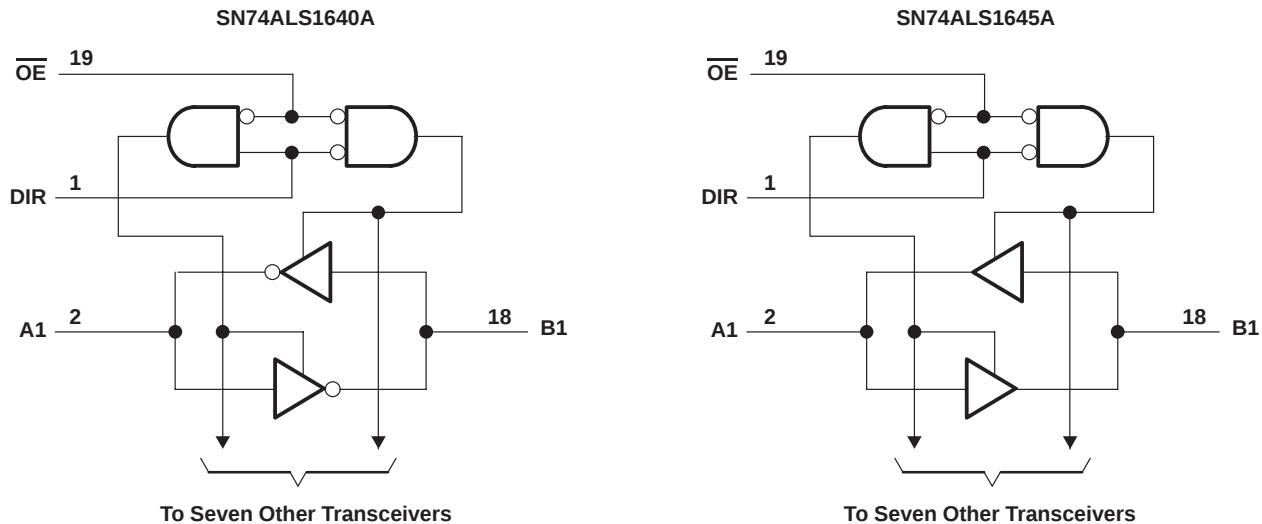
SN74ALS1640A, SN74ALS1645A

OCTAL BUS TRANSCEIVERS

WITH 3-STATE OUTPUTS

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logic diagrams (positive logic)



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

|                                                                   |                |
|-------------------------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$                                          | 7 V            |
| Input voltage, $V_I$ : All inputs                                 | 7 V            |
| I/O ports                                                         | 5.5 V          |
| Package thermal impedance, $\theta_{JA}$ (see Note 1): DW package | 97°C/W         |
| N package                                                         | 67°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.

NOTE 1: The package thermal impedance is calculated in accordance with EIA/JEDEC Std JESD51, except for through-hole packages, which use a trace length of zero.

recommended operating conditions

|          |                                | SN74ALS1640A<br>SN74ALS1645A |     |     | UNIT |
|----------|--------------------------------|------------------------------|-----|-----|------|
|          |                                | MIN                          | NOM | MAX |      |
| $V_{CC}$ | Supply voltage                 | 4.5                          | 5   | 5.5 | V    |
| $V_{IH}$ | High-level input voltage       | 2                            |     |     | V    |
| $V_{IL}$ | Low-level input voltage        |                              |     | 0.8 | V    |
| $I_{OH}$ | High-level output current      |                              |     | –15 | mA   |
| $I_{OL}$ | Low-level output current       |                              |     | 16  | mA   |
| $T_A$    | Operating free-air temperature | 0                            | 70  |     | °C   |

# SN74ALS1640A, SN74ALS1645A OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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

| PARAMETER  |                           | TEST CONDITIONS                                                         | SN74ALS1640A<br>SN74ALS1645A |                  |      | UNIT          |
|------------|---------------------------|-------------------------------------------------------------------------|------------------------------|------------------|------|---------------|
|            |                           |                                                                         | MIN                          | TYP <sup>†</sup> | MAX  |               |
| $V_{IK}$   |                           | $V_{CC} = 4.5\text{ V}$ ,<br>$I_I = -18\text{ mA}$                      |                              |                  | -1.5 | V             |
| $V_{OH}$   |                           | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ ,<br>$I_{OH} = -0.4\text{ mA}$ | $V_{CC}-2$                   |                  |      | V             |
|            |                           | $V_{CC} = 4.5\text{ V}$ ,<br>$I_{OH} = -3\text{ mA}$                    | 2.4                          | 3.2              |      |               |
|            |                           | $V_{CC} = 4.5\text{ V}$ ,<br>$I_{OH} = -15\text{ mA}$                   | 2                            |                  |      |               |
| $V_{OL}$   |                           | $V_{CC} = 4.5\text{ V}$ ,<br>$I_{OL} = 8\text{ mA}$                     |                              | 0.25             | 0.4  | V             |
|            |                           | $V_{CC} = 4.5\text{ V}$ ,<br>$I_{OL} = 16\text{ mA}$                    |                              | 0.35             | 0.5  |               |
|            |                           | $V_{CC} = 4.5\text{ V}$ ,<br>$I_{OL} = 16\text{ mA}$                    |                              |                  |      |               |
| $I_I$      | Control inputs            | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 7\text{ V}$                         |                              |                  | 0.1  | mA            |
|            | A or B ports              | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 5.5\text{ V}$                       |                              |                  | 0.1  |               |
| $I_{IH}$   | Control inputs            | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 2.7\text{ V}$                       |                              |                  | 20   | $\mu\text{A}$ |
|            | A or B ports <sup>‡</sup> | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 2.7\text{ V}$                       |                              |                  | 20   |               |
| $I_{IL}$   | Control inputs            | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 0.4\text{ V}$                       |                              |                  | -0.1 | mA            |
|            | A or B ports <sup>‡</sup> | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 0.4\text{ V}$                       |                              |                  | -0.1 |               |
| $I_O^{\S}$ |                           | $V_{CC} = 5.5\text{ V}$ ,<br>$V_O = 2.25\text{ V}$                      | -30                          |                  | -112 | mA            |
| $I_{CC}$   | SN74ALS1640A              | $V_{CC} = 5.5\text{ V}$                                                 |                              | 18               | 32   | mA            |
|            | SN74ALS1645A              | $V_{CC} = 5.5\text{ V}$                                                 |                              | 25               | 38   |               |

<sup>†</sup> All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

<sup>‡</sup> For I/O ports, the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

<sup>§</sup> The output conditions have been chosen to produce a current that closely approximates one-half of the true short-circuit output current,  $I_{OS}$ .

switching characteristics (see Figure 1)

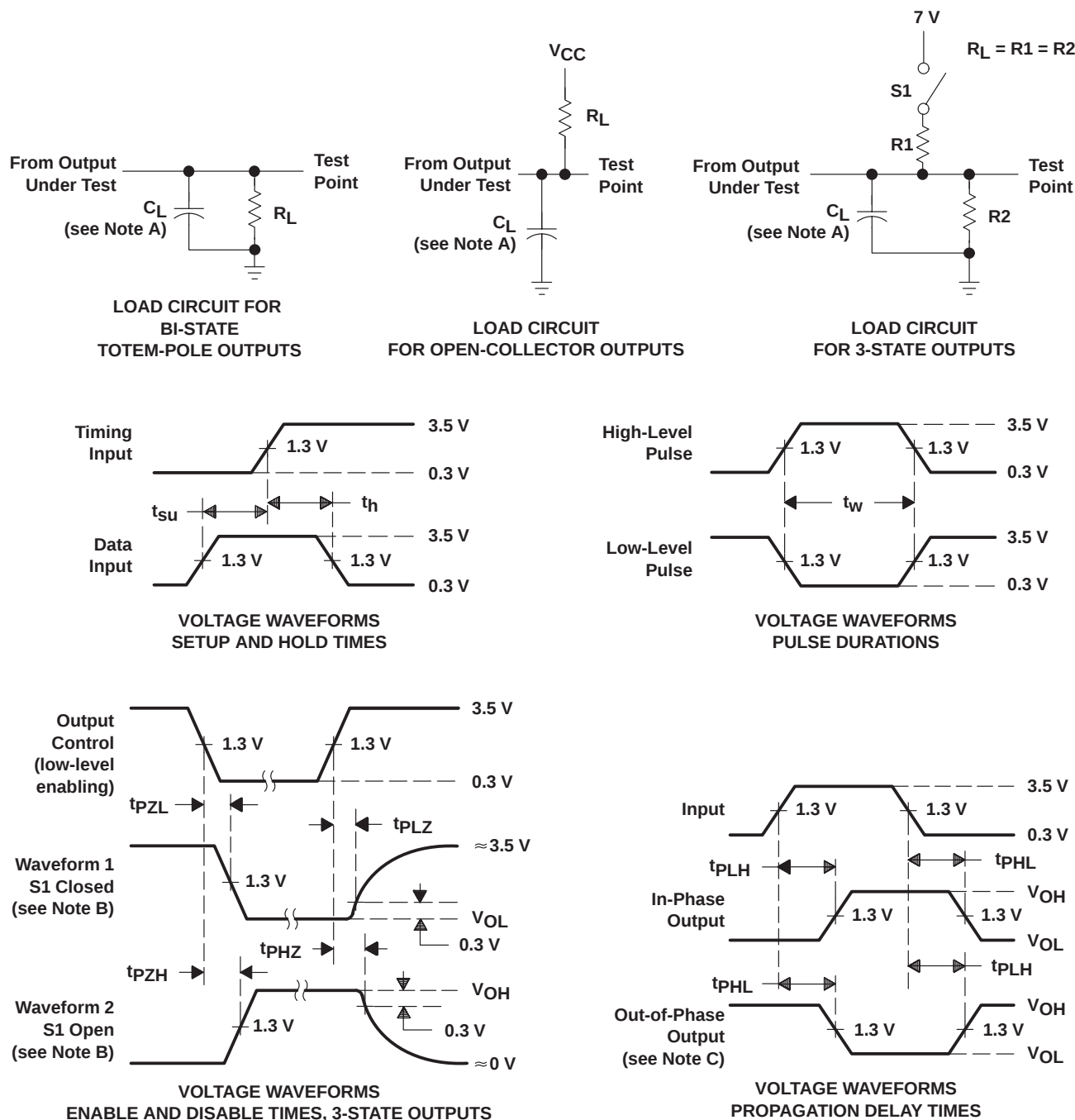
| PARAMETER        | FROM<br>(INPUT)        | TO<br>(OUTPUT) | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>1</sub> = 500 Ω,<br>R <sub>2</sub> = 500 Ω,<br>T <sub>A</sub> = MIN to MAX† |     |              |     | UNIT |
|------------------|------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------|-----|------|
|                  |                        |                | SN74ALS1640A                                                                                                                                       |     | SN74ALS1645A |     |      |
|                  |                        |                | MIN                                                                                                                                                | MAX | MIN          | MAX |      |
| t <sub>PLH</sub> | A or B                 | B or A         | 4                                                                                                                                                  | 15  | 2            | 13  | ns   |
| t <sub>PHL</sub> |                        |                | 2                                                                                                                                                  | 10  | 2            | 13  |      |
| t <sub>PZH</sub> | $\overline{\text{OE}}$ | A or B         | 5                                                                                                                                                  | 20  | 8            | 25  | ns   |
| t <sub>PZL</sub> |                        |                | 5                                                                                                                                                  | 22  | 8            | 25  |      |
| t <sub>PHZ</sub> | $\overline{\text{OE}}$ | A or B         | 2                                                                                                                                                  | 10  | 2            | 12  | ns   |
| t <sub>PLZ</sub> |                        |                | 5                                                                                                                                                  | 13  | 3            | 18  |      |

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

# SN74ALS1640A, SN74ALS1645A OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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## PARAMETER MEASUREMENT INFORMATION SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



- NOTES: A.  $C_L$  includes probe and jig 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. When measuring propagation delay items of 3-state outputs, switch S1 is open.  
 D. All input pulses have the following characteristics:  $PRR \leq 1$  MHz,  $t_r = t_f = 2$  ns, duty cycle = 50%.  
 E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits 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> |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74ALS1640AN     | OBSOLETE              | PDIP         | N               | 20   |             | TBD                     | Call TI          | Call TI                      |
| SN74ALS1645ADW    | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALS1645ADWE4  | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALS1645ADWG4  | ACTIVE                | SOIC         | DW              | 20   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALS1645AN     | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74ALS1645ANE4   | ACTIVE                | PDIP         | N               | 20   | 20          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74ALS1645ANSR   | ACTIVE                | SO           | NS              | 20   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALS1645ANSRE4 | ACTIVE                | SO           | NS              | 20   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALS1645ANSRG4 | ACTIVE                | SO           | NS              | 20   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

<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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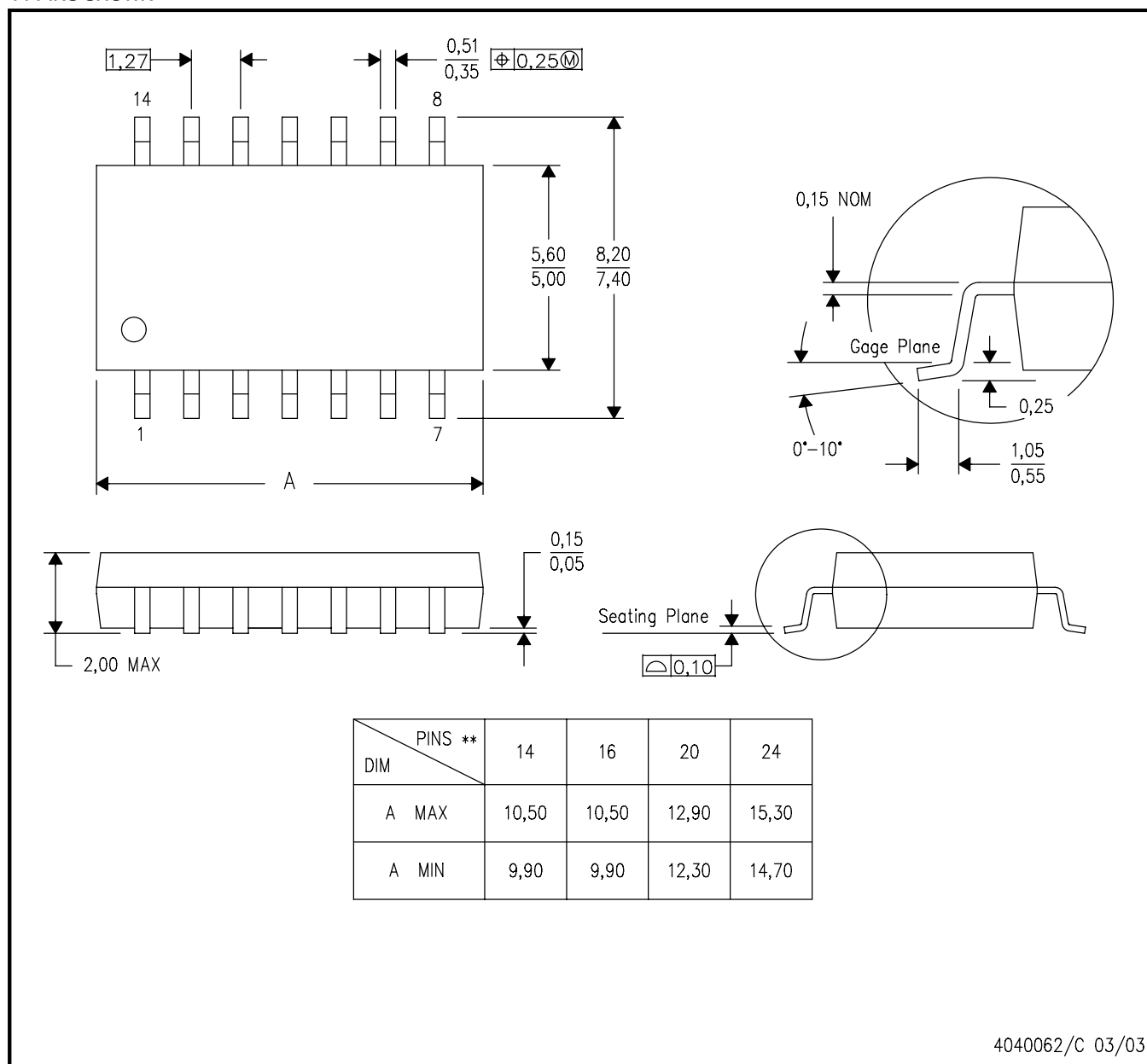
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# MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

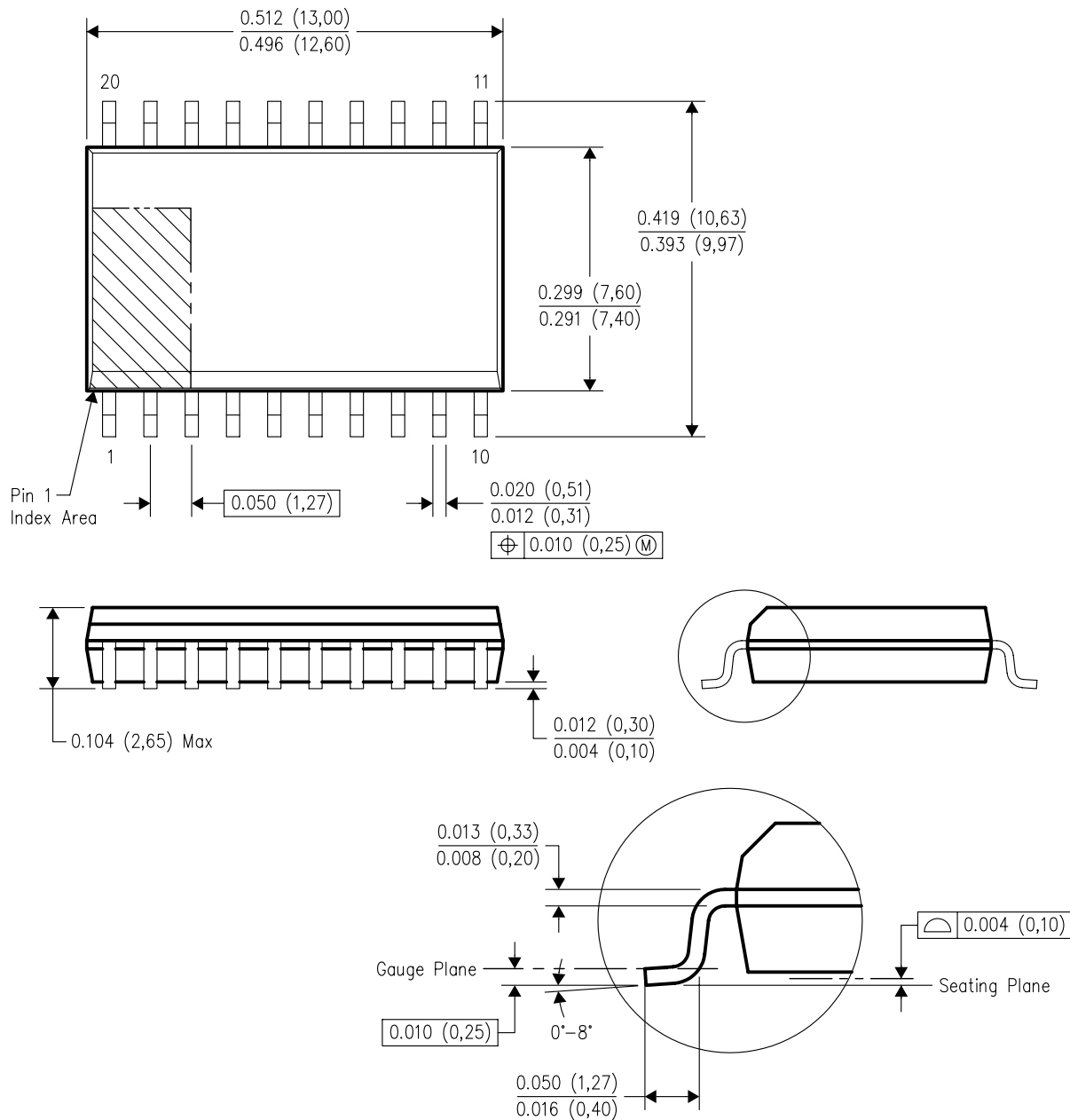
14-PINS SHOWN



- 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.

## DW (R-PDSO-G20)

## PLASTIC SMALL-OUTLINE PACKAGE



4040000-4/F 06/2004

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - Falls within JEDEC MS-013 variation AC.

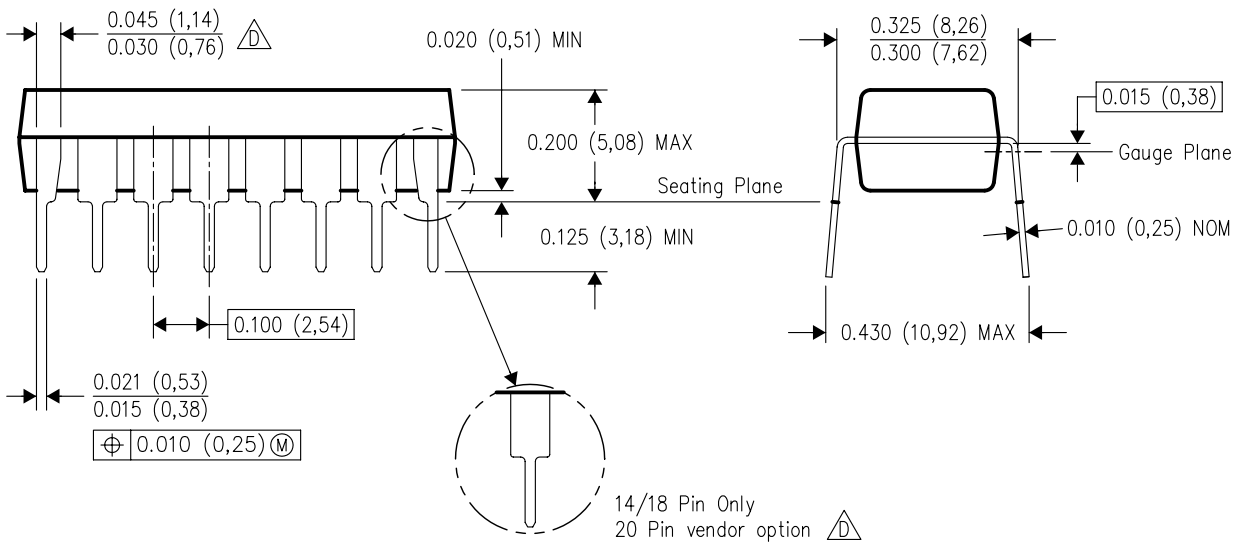
## N (R-PDIP-T\*\*)

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.

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