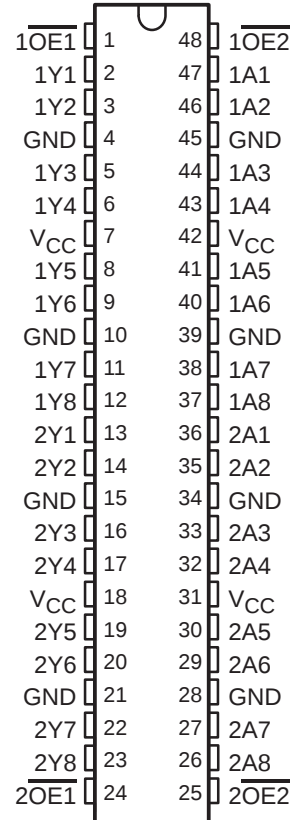


# SN54ABT16541, SN74ABT16541A 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS118C – FEBRUARY 1991 – REVISED JANUARY 1997

- Members of the Texas Instruments *Widebus™* Family
- State-of-the-Art *EPIC-II B™* BiCMOS Design Significantly Reduces Power Dissipation
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Typical  $V_{OLP}$  (Output Ground Bounce)  $< 0.8$  V at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$
- Distributed  $V_{CC}$  and GND Pin Configuration Minimizes High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- High-Drive Outputs ( $-32\text{-mA } I_{OH}$ ,  $64\text{-mA } I_{OL}$ )
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL), Thin Shrink Small-Outline (DGG), Thin Very Small-Outline (DGV) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Packages Using 25-mil Center-to-Center Spacings

SN54ABT16541 . . . WD PACKAGE  
SN74ABT16541A . . . DGG, DGV, OR DL PACKAGE  
(TOP VIEW)



## description

The SN54ABT16541 and SN74ABT16541A are noninverting 16-bit buffers composed of two 8-bit sections with separate output-enable signals. For either 8-bit buffer section, the two output-enable ( $\overline{1OE1}$  and  $\overline{1OE2}$  or  $\overline{2OE1}$  and  $\overline{2OE2}$ ) inputs must both be low for the corresponding Y outputs to be active. If either output-enable input is high, the outputs of that 8-bit buffer section are in the high-impedance state.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54ABT16541 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74ABT16541A is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

FUNCTION TABLE  
(each 8-bit section)

| INPUTS           |                  |   | OUTPUT<br>Y |
|------------------|------------------|---|-------------|
| $\overline{OE1}$ | $\overline{OE2}$ | A |             |
| L                | L                | L | L           |
| L                | L                | H | H           |
| H                | X                | X | Z           |
| X                | H                | X | Z           |



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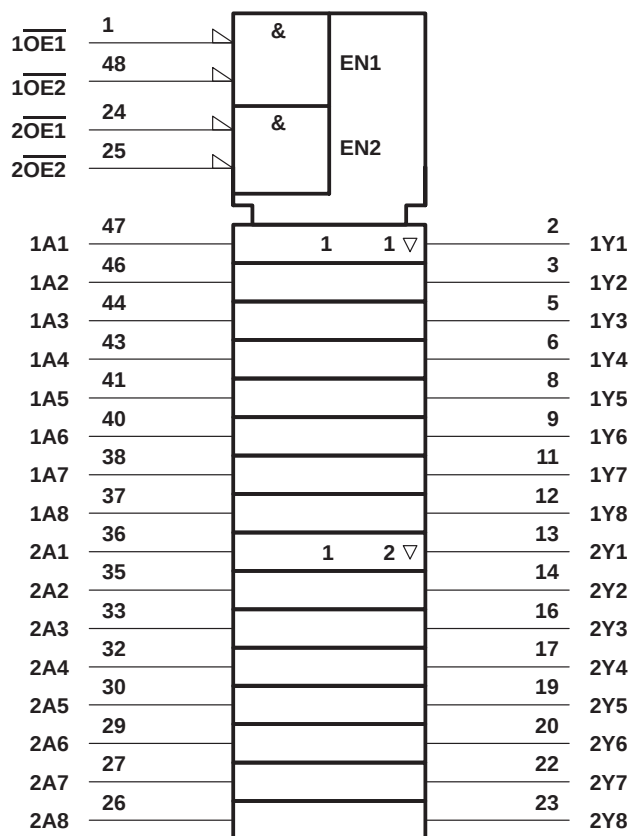
# SN54ABT16541, SN74ABT16541A

## 16-BIT BUFFERS/DRIVERS

### WITH 3-STATE OUTPUTS

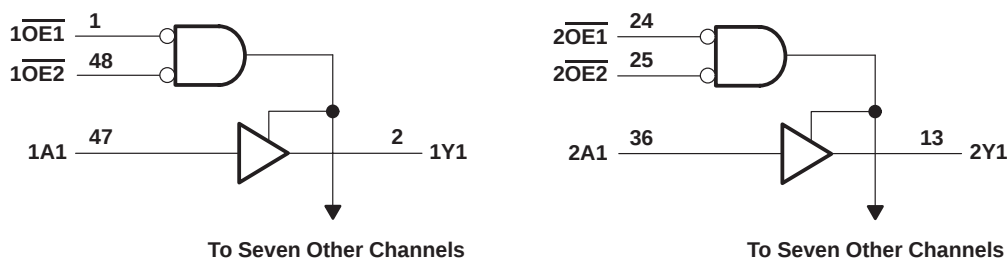
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logic symbol†



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

logic diagram (positive logic)



## SCBS118C – FEBRUARY 1991 – REVISED JANUARY 1997

## 3

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

| PARAMETER          |                | TEST CONDITIONS                                                                      |                          | T <sub>A</sub> = 25°C |      |       | SN54ABT16541 |      | SN74ABT16541A |      | UNIT |
|--------------------|----------------|--------------------------------------------------------------------------------------|--------------------------|-----------------------|------|-------|--------------|------|---------------|------|------|
|                    |                |                                                                                      |                          | MIN                   | TYP† | MAX   | MIN          | MAX  | MIN           | MAX  |      |
| V <sub>IK</sub>    |                | V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = –18 mA                                     |                          |                       |      | –1.2  |              | –1.2 |               | –1.2 | V    |
| V <sub>OH</sub>    |                | V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = –3 mA                                     |                          | 2.5                   |      |       | 2.5          |      | 2.5           |      | V    |
|                    |                | V <sub>CC</sub> = 5 V, I <sub>OH</sub> = –3 mA                                       |                          | 3                     |      |       | 3            |      | 3             |      |      |
|                    |                | V <sub>CC</sub> = 4.5 V                                                              | I <sub>OH</sub> = –24 mA | 2                     |      |       | 2            |      |               |      |      |
|                    |                |                                                                                      | I <sub>OH</sub> = –32 mA | 2*                    |      |       |              |      | 2             |      |      |
| V <sub>OL</sub>    |                | V <sub>CC</sub> = 4.5 V                                                              | I <sub>OL</sub> = 48 mA  |                       |      | 0.55  |              | 0.55 |               |      | V    |
|                    |                |                                                                                      | I <sub>OL</sub> = 64 mA  |                       |      | 0.55* |              |      |               | 0.55 |      |
| V <sub>hys</sub>   |                |                                                                                      |                          |                       | 100  |       |              |      |               |      | mV   |
| I <sub>I</sub>     |                | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND                     |                          |                       |      | ±1    |              | ±1   |               | ±1   | μA   |
| I <sub>OZH</sub>   |                | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.7 V                                      |                          |                       |      | 10    |              | 50   |               | 10   | μA   |
| I <sub>OZL</sub>   |                | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0.5 V                                      |                          |                       |      | –10   |              | –50  |               | –10  | μA   |
| I <sub>off</sub>   |                | V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> ≤ 4.5 V                        |                          |                       |      | ±100  |              |      |               | ±100 | μA   |
| I <sub>CEX</sub>   |                | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V                                      | Outputs high             |                       |      | 50    |              | 50   |               | 50   | μA   |
| I <sub>O‡</sub>    |                | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.5 V                                      |                          | –50                   | –100 | –180  | –50          | –180 | –50           | –180 | mA   |
| I <sub>CC</sub>    |                | V <sub>CC</sub> = 5.5 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND | Outputs high             |                       |      | 3     |              | 2    |               | 3    | mA   |
|                    |                |                                                                                      | Outputs low              |                       |      | 34    |              | 32   |               | 34   |      |
|                    |                |                                                                                      | Outputs disabled         |                       |      | 3     |              | 2    |               | 3    |      |
| ΔI <sub>CC</sub> § | Data inputs    | V <sub>CC</sub> = 5.5 V, One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND  | Outputs enabled          |                       |      | 1     |              | 1.5  |               | 1    | mA   |
|                    |                |                                                                                      | Outputs disabled         |                       |      | 0.05  |              | 0.05 |               | 0.05 |      |
|                    | Control inputs | V <sub>CC</sub> = 5.5 V, One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND  |                          |                       |      | 1.5   |              | 1.5  |               | 1.5  |      |
| C <sub>i</sub>     |                | V <sub>I</sub> = 2.5 V or 0.5 V                                                      |                          |                       |      | 3.5   |              |      |               |      | pF   |
| C <sub>O</sub>     |                | V <sub>O</sub> = 2.5 V or 0.5 V                                                      |                          |                       |      | 3.5   |              |      |               |      | pF   |

\* On products compliant to MIL-PRF-38535, this parameter does not apply.

† All typical values are at V<sub>CC</sub> = 5 V.

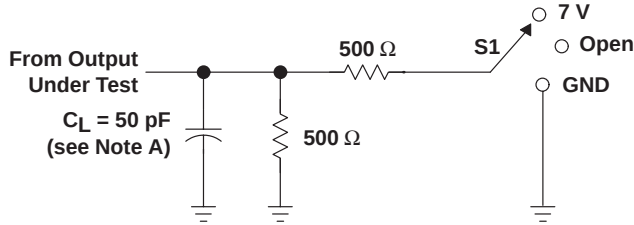
‡ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

§ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V<sub>CC</sub> or GND.

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

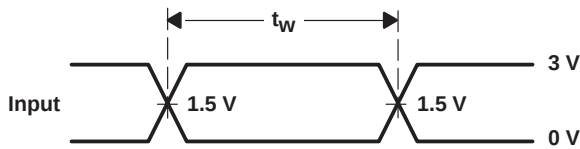
| PARAMETER        | FROM (INPUT)           | TO (OUTPUT) | V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C |     |     | SN54ABT16541 |     | SN74ABT16541A |     | UNIT |
|------------------|------------------------|-------------|----------------------------------------------|-----|-----|--------------|-----|---------------|-----|------|
|                  |                        |             | MIN                                          | TYP | MAX | MIN          | MAX | MIN           | MAX |      |
| t <sub>PLH</sub> | A                      | Y           | 1                                            | 2.1 | 3   | 1            | 3.5 | 1             | 3.4 | ns   |
| t <sub>PHL</sub> |                        |             | 1                                            | 2.5 | 3.6 | 1            | 4.3 | 1             | 4.2 |      |
| t <sub>PZH</sub> | $\overline{\text{OE}}$ | Y           | 1.3                                          | 3.2 | 4.3 | 1.3          | 5.3 | 1.3           | 5.2 | ns   |
| t <sub>PZL</sub> |                        |             | 1.6                                          | 3.8 | 4.7 | 1.6          | 6.2 | 1.6           | 6   |      |
| t <sub>PHZ</sub> | $\overline{\text{OE}}$ | Y           | 1.3                                          | 4.1 | 4.8 | 1.3          | 5.4 | 1.3           | 5.4 | ns   |
| t <sub>PLZ</sub> |                        |             | 1                                            | 3.3 | 4   | 1            | 4.3 | 1             | 4.3 |      |

## PARAMETER MEASUREMENT INFORMATION

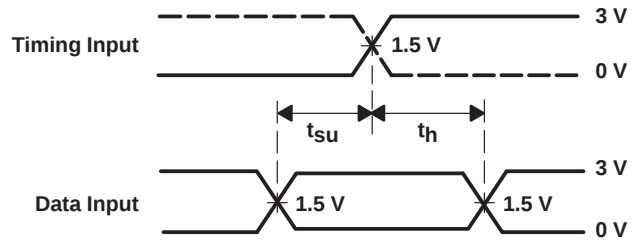


LOAD CIRCUIT

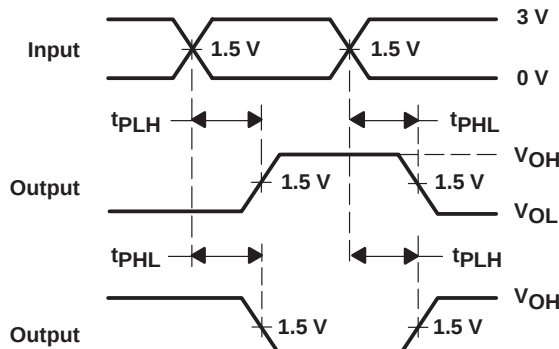
| TEST              | S1   |
|-------------------|------|
| $t_{PLH}/t_{PHL}$ | Open |
| $t_{PLZ}/t_{PZL}$ | 7 V  |
| $t_{PHZ}/t_{PZH}$ | Open |



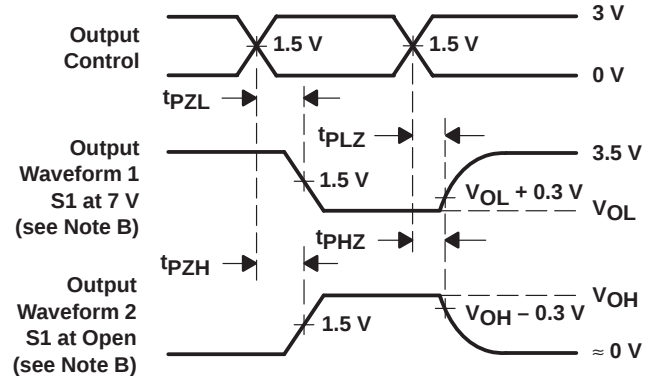
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- 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. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .  
D. The outputs are measured one at a time with one 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> |
|--------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 74ABT16541ADGGRE4  | ACTIVE                | TSSOP        | DGG             | 48   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| 74ABT16541ADGGRG4  | ACTIVE                | TSSOP        | DGG             | 48   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| 74ABT16541ADGVRE4  | ACTIVE                | TVSOP        | DGV             | 48   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| 74ABT16541ADGVRG4  | ACTIVE                | TVSOP        | DGV             | 48   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ABT16541ADGGR  | ACTIVE                | TSSOP        | DGG             | 48   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ABT16541ADGVR  | ACTIVE                | TVSOP        | DGV             | 48   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ABT16541ADL    | ACTIVE                | SSOP         | DL              | 48   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ABT16541ADLG4  | ACTIVE                | SSOP         | DL              | 48   | 25          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ABT16541ADLR   | ACTIVE                | SSOP         | DL              | 48   | 1000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ABT16541ADLRG4 | ACTIVE                | SSOP         | DL              | 48   | 1000        | 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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**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

| Device            | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74ABT16541ADGGR | TSSOP        | DGG             | 48   | 2000 | 330.0              | 24.4               | 8.6     | 15.8    | 1.8     | 12.0    | 24.0   | Q1            |
| SN74ABT16541ADGVR | TVSOP        | DGV             | 48   | 2000 | 330.0              | 16.4               | 7.1     | 10.2    | 1.6     | 12.0    | 16.0   | Q1            |
| SN74ABT16541ADLR  | SSOP         | DL              | 48   | 1000 | 330.0              | 32.4               | 11.35   | 16.2    | 3.1     | 16.0    | 32.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



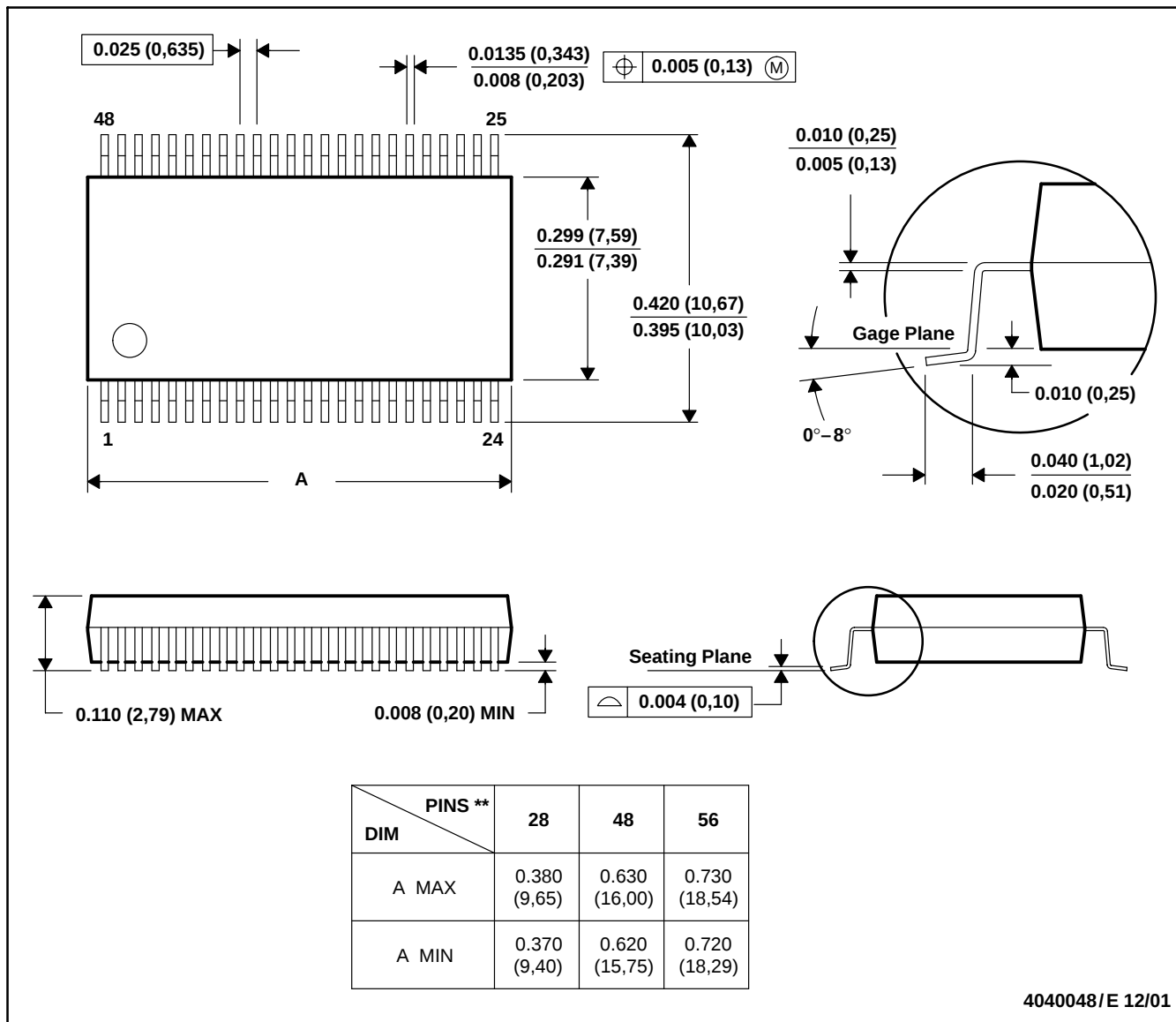
\*All dimensions are nominal

| Device            | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74ABT16541ADGGR | TSSOP        | DGG             | 48   | 2000 | 346.0       | 346.0      | 41.0        |
| SN74ABT16541ADGVR | TVSOP        | DGV             | 48   | 2000 | 346.0       | 346.0      | 33.0        |
| SN74ABT16541ADLR  | SSOP         | DL              | 48   | 1000 | 346.0       | 346.0      | 49.0        |

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

## PLASTIC SMALL-OUTLINE PACKAGE

48 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 MO-118

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

## PLASTIC SMALL-OUTLINE PACKAGE

48 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 protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

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

## PLASTIC SMALL-OUTLINE

24 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 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

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|                    |                                                                          |
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| Broadband          | <a href="http://www.ti.com/broadband">www.ti.com/broadband</a>           |
| Digital Control    | <a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a> |
| Medical            | <a href="http://www.ti.com/medical">www.ti.com/medical</a>               |
| Military           | <a href="http://www.ti.com/military">www.ti.com/military</a>             |
| Optical Networking | <a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a> |
| Security           | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
| Telephony          | <a href="http://www.ti.com/telephony">www.ti.com/telephony</a>           |
| Video & Imaging    | <a href="http://www.ti.com/video">www.ti.com/video</a>                   |
| Wireless           | <a href="http://www.ti.com/wireless">www.ti.com/wireless</a>             |

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