

# 54ACT16541, 74ACT16541 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUPUTS

SCAS208A – JUNE 1992 – REVISED APRIL 1996

- Members of the Texas Instruments *Widebus*™ Family
- Inputs Are TTL-Voltage Compatible
- Flow-Through Architecture Optimizes PCB Layout
- Distributed V<sub>CC</sub> and GND Pin Configuration Minimizes High-Speed Switching Noise
- *EPIC*™ (Enhanced-Performance Implanted CMOS) 1-μm Process
- 500-mA Typical Latch-Up Immunity at 125°C
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL) Packages Using 25-mil Center-to-Center Pin Spacings and 380-mil Fine-Pitch Ceramic Flat (WD) Packages Using 25-mil Center-to-Center Pin Spacings

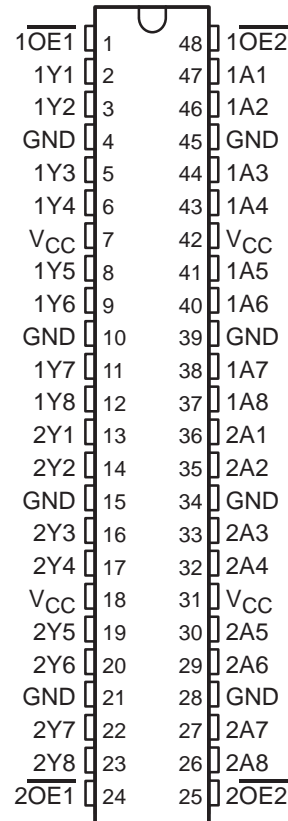
## description

The 'ACT16541 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.

The 74ACT16541 is packaged in TI's shrink small-outline package, which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The 54ACT16541 is characterized for operation over the full military temperature range of –55°C to 125°C. The 74ACT16541 is characterized for operation from –40°C to 85°C.

54ACT16541 . . . WD PACKAGE  
74ACT16541 . . . DL PACKAGE  
(TOP VIEW)



FUNCTION TABLE  
(each 8-bit section)

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



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 **TEXAS  
INSTRUMENTS**

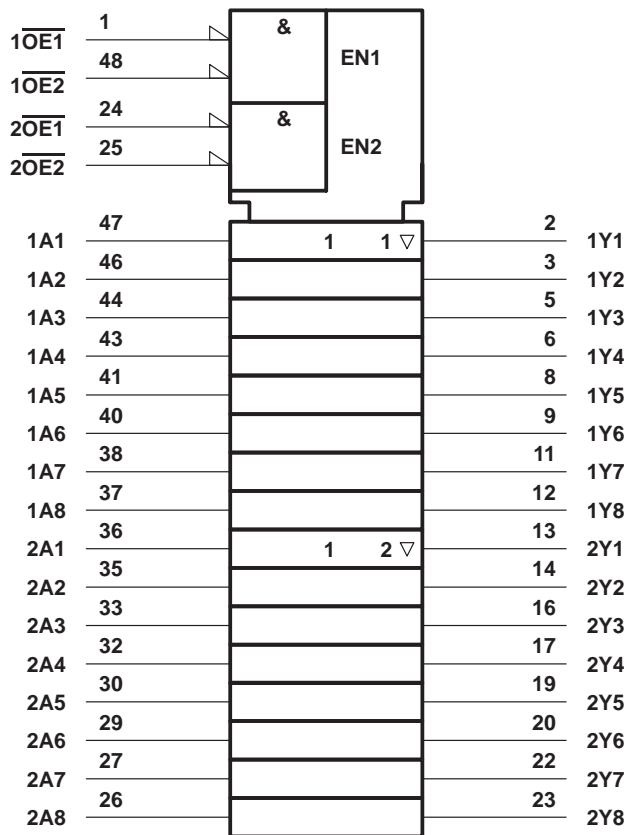
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# 54ACT16541, 74ACT16541 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUPUTS

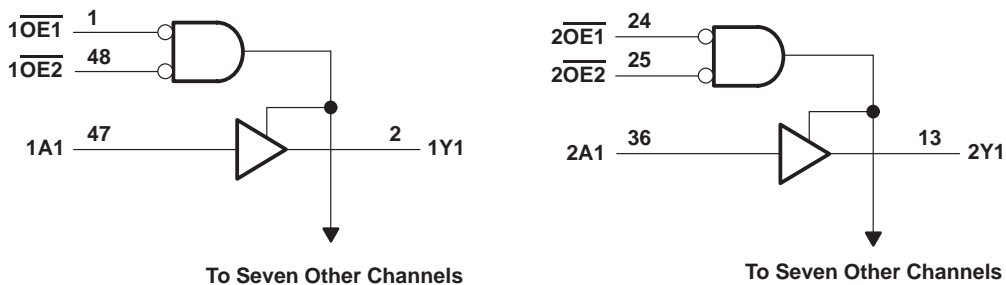
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## logic symbol†



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

## logic diagram (positive logic)



54ACT16541, 74ACT16541  
16-BIT BUFFERS/DRIVERS  
WITH 3-STATE OUPUTS

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**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

|                                                                                                       |                            |
|-------------------------------------------------------------------------------------------------------|----------------------------|
| Supply voltage range, $V_{CC}$                                                                        | –0.5 V to 7 V              |
| Input voltage range, $V_I$ (see Note 1)                                                               | –0.5 V to $V_{CC} + 0.5$ V |
| Output voltage range, $V_O$ (see Note 1)                                                              | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ )                                         | ±20 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ )                                        | ±50 mA                     |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )                                            | ±50 mA                     |
| Continuous current through $V_{CC}$ or GND                                                            | ±400 mA                    |
| Maximum package power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DL package | 1.2 W                      |
| Storage temperature range, $T_{stg}$                                                                  | –65°C to 150°C             |

† 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 maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

**recommended operating conditions (see Note 3)**

|                                                        | 54ACT16541 |     |          | 74ACT16541 |     |          | 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                      | 2          |     |          | 2          |     |          | V    |
| $V_{IL}$ Low-level input voltage                       |            |     | 0.8      |            |     | 0.8      | V    |
| $V_I$ Input voltage                                    | 0          |     | $V_{CC}$ | 0          |     | $V_{CC}$ | V    |
| $V_O$ Output voltage                                   | 0          |     | $V_{CC}$ | 0          |     | $V_{CC}$ | V    |
| $I_{OH}$ High-level output current                     |            |     | –24      |            |     | –24      | mA   |
| $I_{OL}$ Low-level output current                      |            |     | 24       |            |     | 24       | mA   |
| $\Delta t/\Delta v$ Input transition rise or fall rate | 0          |     | 10       | 0          |     | 10       | ns/V |
| $T_A$ Operating free-air temperature                   | –55        |     | 125      | –40        |     | 85       | °C   |

NOTE 3: Unused inputs must be held high or low to prevent them from floating.

**54ACT16541, 74ACT16541**  
**16-BIT BUFFERS/DRIVERS**  
**WITH 3-STATE OUPUTS**

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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 |     |      | 54ACT16541 |      | 74ACT16541 |     | UNIT |
|--------------------|-------------------------------------------------------------|-----------------|-----------------------|-----|------|------------|------|------------|-----|------|
|                    |                                                             |                 | MIN                   | TYP | MAX  | MIN        | MAX  | MIN        | MAX |      |
| V <sub>OH</sub>    | I <sub>OH</sub> = -50 μA                                    | 4.5 V           | 4.4                   |     |      | 4.4        |      | 4.4        | V   |      |
|                    |                                                             | 5.5 V           | 5.4                   |     |      | 5.4        |      | 5.4        |     |      |
|                    | I <sub>OH</sub> = -24 mA                                    | 5.5 V           | 3.9                   |     |      | 3.8        |      | 3.8        |     |      |
|                    |                                                             | 5.5 V           | 4.94                  |     |      | 4.8        |      | 4.8        |     |      |
|                    |                                                             | 5.5 V           |                       |     |      | 3.85       |      | 3.85       |     |      |
| V <sub>OL</sub>    | I <sub>OL</sub> = 50 μA                                     | 4.5 V           |                       |     | 0.1  |            | 0.1  | 0.1        | V   |      |
|                    |                                                             | 5.5 V           |                       |     | 0.1  |            | 0.1  | 0.1        |     |      |
|                    | I <sub>OL</sub> = 24 mA                                     | 4.5 V           |                       |     | 0.36 |            | 0.44 | 0.44       |     |      |
|                    |                                                             | 5.5 V           |                       |     | 0.36 |            | 0.44 | 0.44       |     |      |
|                    |                                                             | 5.5 V           |                       |     |      |            | 1.65 | 1.65       |     |      |
| I <sub>I</sub>     | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 5.5 V           |                       |     | ±0.1 |            | ±1   | ±1         | μA  |      |
| I <sub>OZ</sub>    | V <sub>O</sub> = V <sub>CC</sub> or GND                     | 5.5 V           |                       |     | ±0.5 |            | ±5   | ±5         | μA  |      |
| I <sub>CC</sub>    | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 | 5.5 V           |                       |     | 8    |            | 80   | 80         | μA  |      |
| ΔI <sub>CC</sub> ‡ | One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND  | 5.5 V           |                       |     | 0.9  |            | 1    | 1          | mA  |      |
| C <sub>i</sub>     | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 5.5 V           |                       |     | 4    |            |      |            | pF  |      |
| C <sub>o</sub>     | V <sub>O</sub> = V <sub>CC</sub> or GND                     | 5 V             |                       |     | 13   |            |      |            | pF  |      |

† Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

‡ 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<sub>CC</sub>.

**switching characteristics over recommended operating free-air temperature range, V<sub>CC</sub> = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)**

| PARAMETER        | FROM (INPUT)    | TO (OUTPUT) | T <sub>A</sub> = 25°C |     |      | 54ACT16541 |      | 74ACT16541 |      | UNIT |
|------------------|-----------------|-------------|-----------------------|-----|------|------------|------|------------|------|------|
|                  |                 |             | MIN                   | TYP | MAX  | MIN        | MAX  | MIN        | MAX  |      |
| t <sub>PLH</sub> | A               | Y           | 3.1                   | 5.9 | 7.9  | 3.1        | 9    | 3.1        | 9    | ns   |
| t <sub>PHL</sub> |                 |             | 2.7                   | 6.3 | 8.3  | 2.7        | 9.2  | 2.7        | 9.2  |      |
| t <sub>PZH</sub> | $\overline{OE}$ | Y           | 2.8                   | 6.5 | 8.9  | 2.8        | 9.7  | 2.8        | 9.7  | ns   |
| t <sub>PZL</sub> |                 |             | 3.5                   | 7.5 | 9.9  | 3.5        | 11   | 3.5        | 11   |      |
| t <sub>PHZ</sub> | $\overline{OE}$ | Y           | 4.5                   | 8.5 | 10.3 | 4.5        | 11.3 | 4.5        | 11.3 | ns   |
| t <sub>PLZ</sub> |                 |             | 4.9                   | 8   | 9.9  | 4.9        | 10.7 | 4.9        | 10.7 |      |

**operating characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C**

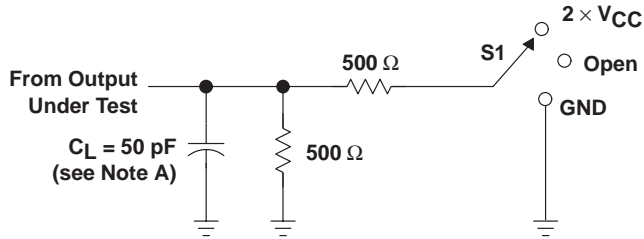
| PARAMETER       |                                                 | TEST CONDITIONS                   | TYP | UNIT |
|-----------------|-------------------------------------------------|-----------------------------------|-----|------|
| C <sub>pd</sub> | Power dissipation capacitance per buffer/driver | C <sub>L</sub> = 50 pF, f = 1 MHz | 40  | pF   |
|                 |                                                 |                                   | 9.5 |      |

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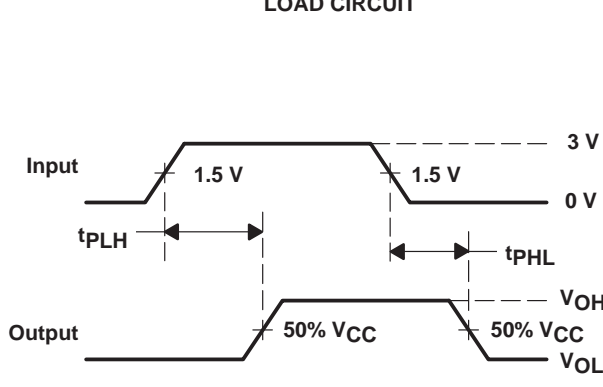
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PARAMETER MEASUREMENT INFORMATION

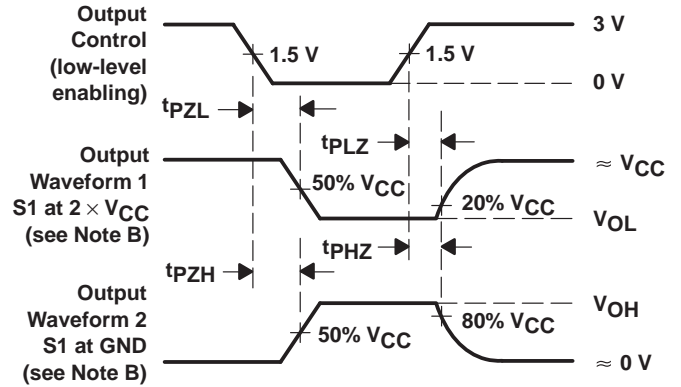


| TEST              | S1                |
|-------------------|-------------------|
| $t_{PLH}/t_{PHL}$ | Open              |
| $t_{PLZ}/t_{PZL}$ | $2 \times V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND               |

LOAD CIRCUIT



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS

- 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:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 3$  ns,  $t_f = 3$  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<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| 74ACT16541DL     | ACTIVE        | SSOP         | DL              | 48   | 25          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | ACT16541                | <a href="#">Samples</a> |
| 74ACT16541DLG4   | ACTIVE        | SSOP         | DL              | 48   | 25          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | ACT16541                | <a href="#">Samples</a> |
| 74ACT16541DLR    | ACTIVE        | SSOP         | DL              | 48   | 1000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 85    | ACT16541                | <a href="#">Samples</a> |

(1) 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.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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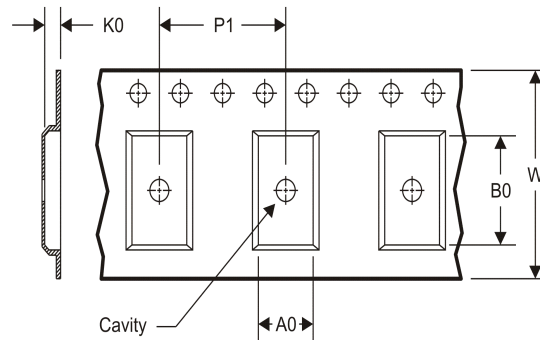
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**TAPE AND REEL INFORMATION**

**REEL DIMENSIONS**



**TAPE DIMENSIONS**



|    |                                                           |
|----|-----------------------------------------------------------|
| A0 | Dimension designed to accommodate the component width     |
| B0 | Dimension designed to accommodate the component length    |
| K0 | Dimension designed to accommodate the component thickness |
| W  | Overall width of the carrier tape                         |
| P1 | Pitch between successive cavity centers                   |

**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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| 74ACT16541DLR | 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) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| 74ACT16541DLR | SSOP         | DL              | 48   | 1000 | 367.0       | 367.0      | 55.0        |

# MECHANICAL DATA

DL (R-PDSO-G48)

PLASTIC SMALL-OUTLINE PACKAGE



- 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 MO-118

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