

# DATA SHEET

**74ABT16541**

**74ABTH16541**

**16-bit buffer/line driver (3-State)**

Product specification  
Supersedes data of 1995 Sep 18  
IC23 Data Handbook

1998 Feb 25

# 16-bit buffer/line driver (3-State)

## 74ABT16541 74ABTH16541

### FEATURES

- Power-up 3-State
- Multiple  $V_{CC}$  and GND pins minimize switching noise
- Provides ideal interface and increases fan-out of MOS Microprocessors
- 3-State buffers sink 64mA and source 32mA
- 74ABTH16541 incorporates bus-hold data inputs which eliminate the need for external pull-up resistors to hold unused inputs
- Latch-up protection exceeds 500mA per Jedec Std 17
- ESD protection exceeds 2000 V per MIL STD 883 Method 3015 and 200 V per Machine Model
- Two 8-bit bus interfaces
- Bus-hold data inputs eliminate the need for external pull-up resistors to hold unused inputs

### DESCRIPTION

The 74ABT16541 high-performance BiCMOS device combines low static and dynamic power dissipation with high speed and high output drive.

The 74ABT16541 has two octal buffers that are ideal for driving bus lines. The outputs are all capable of sinking 64mA and sourcing 32mA.

Two options are available, 74ABT16541 which does not have the bus-hold feature and 74ABTH16541 which incorporates the bus-hold feature.

### QUICK REFERENCE DATA

| SYMBOL                 | PARAMETER                       | CONDITIONS<br>$T_{amb} = 25^{\circ}\text{C}; \text{GND} = 0\text{V}$ | TYPICAL    | UNIT          |
|------------------------|---------------------------------|--|------------|---------------|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nAx to nYx | $C_L = 50\text{pF}; V_{CC} = 5\text{V}$                              | 2.0<br>1.5 | ns            |
| $C_{IN}$               | Input capacitance               | $V_I = 0\text{V}$ or $V_{CC}$  | 4          | pF            |
| $C_{OUT}$              | Output capacitance              | $V_O = 0\text{V}$ or $V_{CC}$ ; 3-State                              | 6          | pF            |
| $I_{CCZ}$              | Quiescent supply current        | Outputs disabled; $V_{CC} = 5.5\text{V}$                             | 500        | $\mu\text{A}$ |
| $I_{CCL}$              |                                 | Outputs LOW; $V_{CC} = 5.5\text{V}$                                  | 8          | mA            |

### ORDERING INFORMATION

| PACKAGES                     | TEMPERATURE RANGE                              | OUTSIDE NORTH AMERICA | NORTH AMERICA | DWG NUMBER |
|------------------------------|--|-----------------------|---------------|------------|
| 48-Pin Plastic SSOP Type III | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 74ABT16541 DL         | BT16541 DL    | SOT370-1   |
| 48-Pin Plastic TSSOP Type II | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 74ABT16541 DGG        | BT16541 DGG   | SOT362-1   |
| 48-Pin Plastic SSOP Type III | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 74ABTH16541 DL        | BH16541 DL    | SOT370-1   |
| 48-Pin Plastic TSSOP Type II | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 74ABTH16541 DGG       | BH16541 DGG   | SOT362-1   |

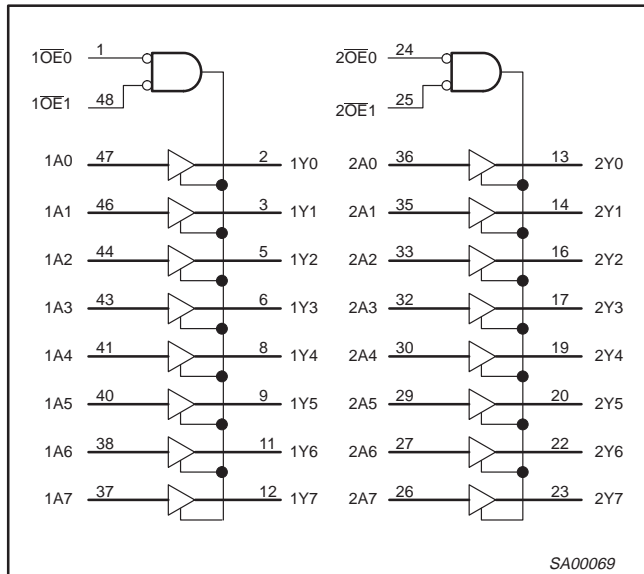
### PIN DESCRIPTION

| PIN NUMBER  | SYMBOL  | NAME AND FUNCTION       |
|---|---|-------------------------|
| 47, 46, 44, 43,<br>41, 40, 38, 37,<br>36, 35, 33, 32,<br>30, 29, 27, 26 | 1A0 - 1A7<br>2A0 - 2A7  | Data inputs             |
| 2, 3, 5, 6,<br>8, 9, 11, 12,<br>13, 14, 16, 17<br>19, 20, 22, 23        | 1Y0 - 1Y7,<br>2Y0 - 2Y7   | Data outputs            |
| 1, 48<br>24, 25   | $\overline{1OE0}, \overline{1OE1},$<br>$\overline{2OE0}, \overline{2OE1}$ | Output enables          |
| 4, 10, 15, 21<br>28, 34, 39, 45   | GND   | Ground (0V)             |
| 7, 18, 31, 42   | $V_{CC}$  | Positive supply voltage |

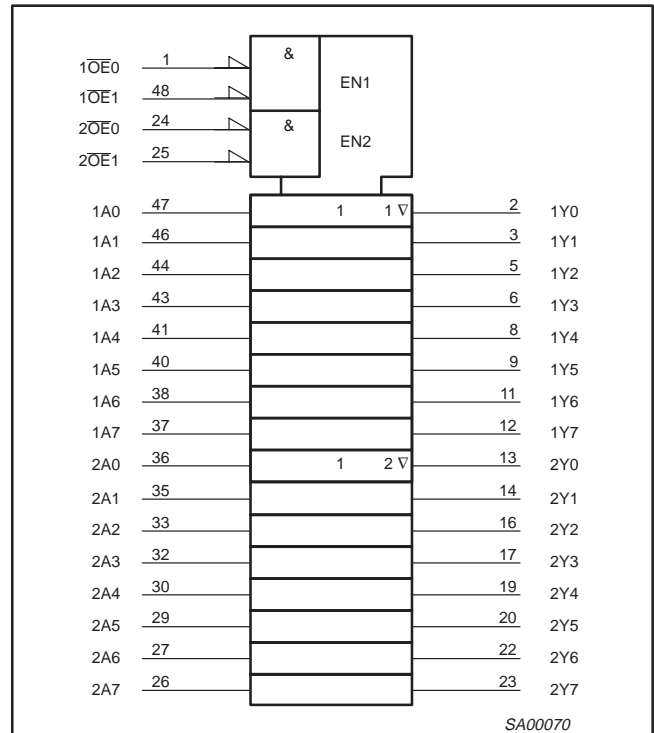
# 16-bit buffer/line driver (3-State)

74ABT16541  
74ABTH16541

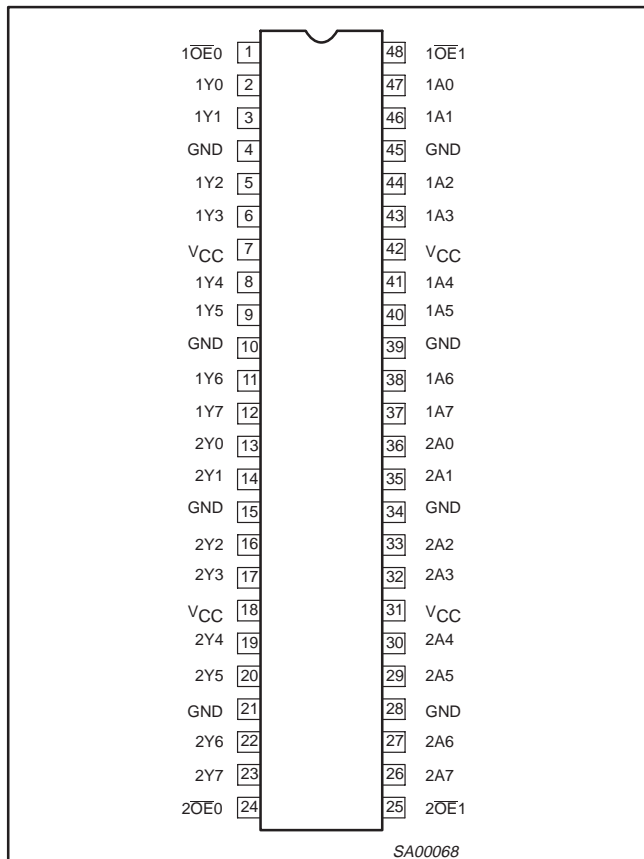
## LOGIC SYMBOL



## LOGIC SYMBOL (IEEE/IEC)



## PIN CONFIGURATION



## FUNCTION TABLE

| INPUTS |      |     | OUTPUTS |
|--------|------|-----|---------|
| nOE0   | nOE1 | nIx | nYx     |
| L      | L    | L   | L       |
| L      | L    | H   | H       |
| X      | H    | X   | Z       |
| H      | X    | X   | Z       |

H = HIGH voltage level  
L = LOW voltage level  
X = D0n't care  
Z = High impedance "off" state

## 16-bit buffer/line driver (3-State)

74ABT16541  
74ABTH16541**ABSOLUTE MAXIMUM RATINGS<sup>1, 2</sup>**

| SYMBOL           | PARAMETER                      | CONDITIONS                  | RATING       | UNIT |
|------------------|--------------------------------|-----------------------------|--------------|------|
| V <sub>CC</sub>  | DC supply voltage              |                             | -0.5 to +7.0 | V    |
| I <sub>IK</sub>  | DC input diode current         | V <sub>I</sub> < 0          | -18          | mA   |
| V <sub>I</sub>   | DC input voltage <sup>3</sup>  |                             | -1.2 to +7.0 | V    |
| I <sub>OK</sub>  | DC output diode current        | V <sub>O</sub> < 0          | -50          | mA   |
| V <sub>OUT</sub> | DC output voltage <sup>3</sup> | output in Off or High state | -0.5 to +5.5 | V    |
| I <sub>OUT</sub> | DC output current              | output in Low state         | 128          | mA   |
| T <sub>stg</sub> | Storage temperature range      |                             | -65 to 150   | °C   |

**NOTES:**

- Stresses beyond those listed 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.
- The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150°C.
- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

**RECOMMENDED OPERATING CONDITIONS**

| SYMBOL           | PARAMETER                            | LIMITS |                 | UNIT |
|------------------|--------------------------------------|--------|-----------------|------|
|                  |                                      | Min    | Max             |      |
| V <sub>CC</sub>  | DC supply voltage                    | 4.5    | 5.5             | V    |
| V <sub>I</sub>   | Input voltage                        | 0      | V <sub>CC</sub> | V    |
| V <sub>IH</sub>  | High-level input voltage             | 2.0    |                 | V    |
| V <sub>IL</sub>  | Low-level Input voltage              |        | 0.8             | V    |
| I <sub>OH</sub>  | High-level output current            |        | -32             | mA   |
| I <sub>OL</sub>  | Low-level output current             |        | 64              | mA   |
| Δt/Δv            | Input transition rise or fall rate   | 0      | 10              | ns/V |
| T <sub>amb</sub> | Operating free-air temperature range | -40    | +85             | °C   |

## 16-bit buffer/line driver (3-State)

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## DC ELECTRICAL CHARACTERISTICS

| SYMBOL                           | PARAMETER  | TEST CONDITIONS  | LIMITS                   |       |      |                                   |      | UNIT |
|----------------------------------|--|--|--------------------------|-------|------|-----------------------------------|------|------|
|                                  |  |  | T <sub>amb</sub> = +25°C |       |      | T <sub>amb</sub> = -40°C to +85°C |      |      |
|                                  |  |  | Min                      | Typ   | Max  | Min                               | Max  |      |
| V <sub>IK</sub>                  | Input clamp voltage  | V <sub>CC</sub> = 4.5V; I <sub>IK</sub> = -18mA  |                          | -0.9  | -1.2 |                                   | -1.2 | V    |
| V <sub>OH</sub>                  | High-level output voltage  | V <sub>CC</sub> = 4.5V; I <sub>OH</sub> = -3mA; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                        | 2.5                      | 2.9   |      | 2.5                               |      | V    |
|                                  |  | V <sub>CC</sub> = 5.0V; I <sub>OH</sub> = -3mA; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                        | 3.0                      | 3.4   |      | 3.0                               |      | V    |
|                                  |  | V <sub>CC</sub> = 4.5V; I <sub>OH</sub> = -32mA; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                       | 2.0                      | 2.4   |      | 2.0                               |      | V    |
| V <sub>OL</sub>                  | Low-level output voltage   | V <sub>CC</sub> = 4.5V; I <sub>OL</sub> = 64mA; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                        |                          | 0.42  | 0.55 |                                   | 0.55 | V    |
| I <sub>I</sub>                   | Input leakage current  | V <sub>CC</sub> = 5.5V; V <sub>I</sub> = GND or 5.5V   |                          | ±0.01 | ±1.0 |                                   | ±1.0 | µA   |
| I <sub>I</sub>                   | Input leakage current<br>74ABTH16541                             | V <sub>CC</sub> = 5.5V; V <sub>I</sub> = V <sub>CC</sub> or GND  |                          | ±0.01 | ±1   |                                   | ±1   | µA   |
|                                  |  | V <sub>CC</sub> = 5.5V; V <sub>I</sub> = V <sub>CC</sub>   |                          | 0.01  | 1    |                                   | 1    | µA   |
|                                  |  | V <sub>CC</sub> = 5.5V; V <sub>I</sub> = 0   |                          | -2    | -3   |                                   | -5   | µA   |
| I <sub>HOLD</sub>                | Bus Hold current A inputs <sup>3</sup><br>74ABTH16541            | V <sub>CC</sub> = 4.5V; V <sub>I</sub> = 0.8V  | 50                       |       |      | 50                                |      | µA   |
|                                  |  | V <sub>CC</sub> = 4.5V; V <sub>I</sub> = 2.0V  | -75                      |       |      | -75                               |      |      |
|                                  |  | V <sub>CC</sub> = 5.5V; V <sub>I</sub> = 0 to 5.5V   | ±500                     |       |      |                                   |      |      |
| I <sub>OFF</sub>                 | Power-off leakage current  | V <sub>CC</sub> = 0.0V; V <sub>O</sub> or V <sub>I</sub> ≤ 4.5V  |                          | ±5.0  | ±100 |                                   | ±100 | µA   |
| I <sub>PU</sub> /I <sub>PD</sub> | Power-up/down 3-State output current                             | V <sub>CC</sub> = 2.0V; V <sub>O</sub> = 0.5V; V <sub>I</sub> = GND or V <sub>CC</sub> ; V <sub>OE</sub> = V <sub>CC</sub> |                          | ±5.0  | ±50  |                                   | ±50  | µA   |
| I <sub>OZH</sub>                 | 3-State output High current                                      | V <sub>CC</sub> = 5.5V; V <sub>O</sub> = 2.7V; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                         |                          | 1.0   | 10   |                                   | 10   | µA   |
| I <sub>OZL</sub>                 | 3-State output Low current                                       | V <sub>CC</sub> = 5.5V; V <sub>O</sub> = 0.5V; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                         |                          | -1.0  | -10  |                                   | -10  | µA   |
| I <sub>CEX</sub>                 | Output high leakage current                                      | V <sub>CC</sub> = 5.5V; V <sub>O</sub> = 5.5V; V <sub>I</sub> = GND or V <sub>CC</sub>                                     |                          | 1.0   | 50   |                                   | 50   | µA   |
| I <sub>O</sub>                   | Output current <sup>1</sup>                                      | V <sub>CC</sub> = 5.5V; V <sub>O</sub> = 2.5V  | -50                      | -70   | -180 | -50                               | -180 | mA   |
| I <sub>CCH</sub>                 | Quiescent supply current   | V <sub>CC</sub> = 5.5V; Outputs High, V <sub>I</sub> = GND or V <sub>CC</sub>  |                          | 0.5   | 1.0  |                                   | 1.0  | mA   |
| I <sub>CCL</sub>                 |  | V <sub>CC</sub> = 5.5V; Outputs Low, V <sub>I</sub> = GND or V <sub>CC</sub>   |                          | 8     | 19   |                                   | 19   | mA   |
| I <sub>CCZ</sub>                 |  | V <sub>CC</sub> = 5.5V; Outputs 3-State; V <sub>I</sub> = GND or V <sub>CC</sub>   |                          | 0.5   | 1.0  |                                   | 1.0  | mA   |
| ΔI <sub>CC</sub>                 | Additional supply current per input pin <sup>2</sup> 74ABT16541  | Outputs enabled, one input at 3.4V, other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5V                         |                          | 100   | 250  |                                   | 250  | µA   |
| ΔI <sub>CC</sub>                 | Additional supply current per input pin <sup>2</sup> 74ABTH16541 | Outputs enabled, one input at 3.4V, other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5V                         |                          | 0.2   | 1.0  |                                   | 1.0  | mA   |

## NOTES:

- 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 at 3.4V.
- This is the bus hold overdrive current required to force the input to the opposite logic state.

## AC CHARACTERISTICS

GND = 0V; t<sub>R</sub> = t<sub>F</sub> = 2.5ns; C<sub>L</sub> = 50pF, R<sub>L</sub> = 500Ω

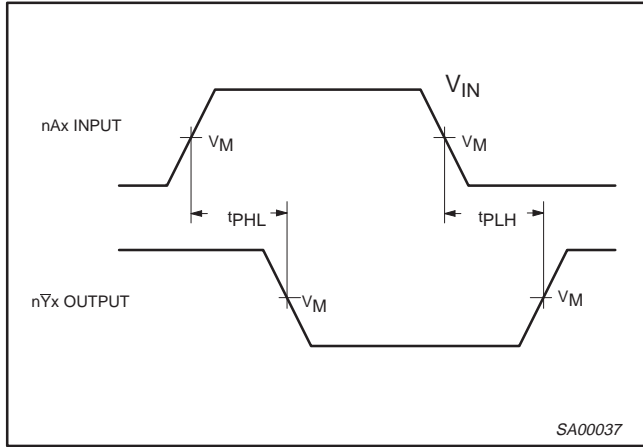
| SYMBOL                               | PARAMETER                                      | WAVEFORM | LIMITS  |            |            |  |            | UNIT |
|--------------------------------------|--|----------|---|------------|------------|--|------------|------|
|                                      |  |          | T <sub>amb</sub> = +25°C<br>V <sub>CC</sub> = +5.0V |            |            | T <sub>amb</sub> = -40°C to +85°C<br>V <sub>CC</sub> = +5.0V ±0.5V |            |      |
|                                      |  |          | Min   | Typ        | Max        | Min  | Max        |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation delay<br>nIx to nYx                | 1        | 1.0<br>1.0  | 2.0<br>1.5 | 3.0<br>3.6 | 1.0<br>1.0   | 3.4<br>4.2 | ns   |
| t <sub>PZH</sub><br>t <sub>PZL</sub> | Output enable time<br>to High and Low level    | 2        | 1.3<br>1.6  | 2.9<br>3.1 | 4.3<br>4.7 | 1.3<br>1.6   | 5.2<br>6.0 | ns   |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Output disable time<br>from High and Low level | 2        | 1.3<br>1.0  | 3.5<br>2.8 | 4.4<br>3.6 | 1.3<br>1.0   | 5.1<br>3.9 | ns   |

# 16-bit buffer/line driver (3-State)

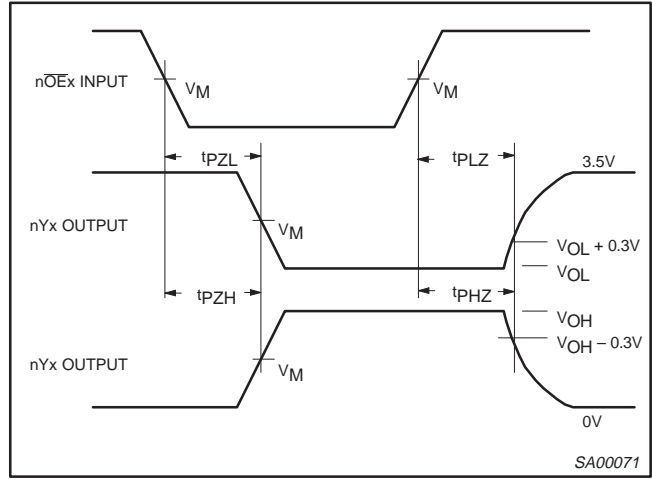
74ABT16541  
74ABTH16541

## AC WAVEFORMS

$V_M = 1.5V, V_{IN} = GND \text{ to } 3.0V$



Waveform 1. Input (An) to Output (Yn) Propagation Delays



Waveform 2. 3-State Output Enable and Disable Times

## TEST CIRCUIT AND WAVEFORMS

**Test Circuit for 3-State Outputs**

$V_M = 1.5V$

**Input Pulse Definition**

**SWITCH POSITION**

| TEST      | SWITCH |
|-----------|--------|
| $t_{PLZ}$ | closed |
| $t_{PZL}$ | closed |
| All other | open   |

**DEFINITIONS**

$R_L$  = Load resistor; see AC CHARACTERISTICS for value.

$C_L$  = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

$R_T$  = Termination resistance should be equal to  $Z_{OUT}$  of pulse generators.

| FAMILY | INPUT PULSE REQUIREMENTS |           |       |       |       |
|--------|--------------------------|-----------|-------|-------|-------|
|        | Amplitude                | Rep. Rate | $t_W$ | $t_R$ | $t_F$ |
| 74ABT  | 3.0V                     | 1MHz      | 500ns | 2.5ns | 2.5ns |

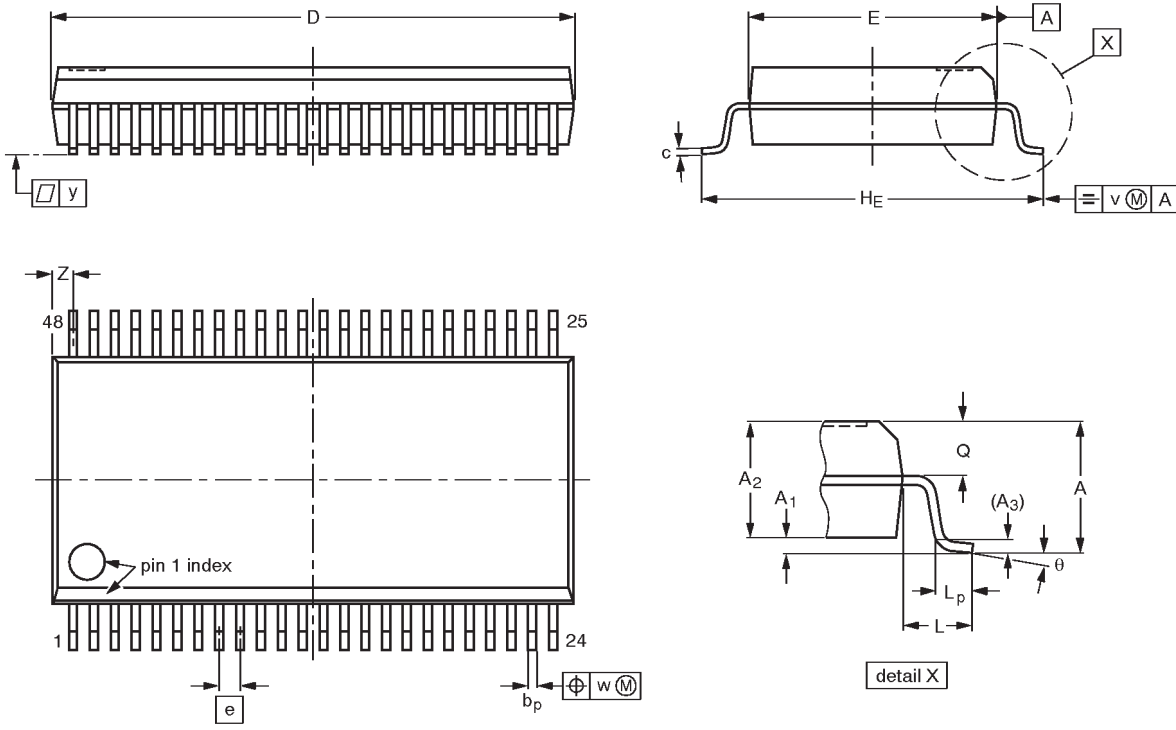
SA00012

16-bit buffer/line driver (3-State)

74ABT16541  
74ABTH16541

SSOP48: plastic shrink small outline package; 48 leads; body width 7.5 mm

SOT370-1



**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c            | D <sup>(1)</sup> | E <sup>(1)</sup> | e     | H <sub>E</sub> | L   | L <sub>p</sub> | Q          | v    | w    | y   | Z <sup>(1)</sup> | θ        |
|------|--------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|-------|----------------|-----|----------------|------------|------|------|-----|------------------|----------|
| mm   | 2.8    | 0.4<br>0.2     | 2.35<br>2.20   | 0.25           | 0.3<br>0.2     | 0.22<br>0.13 | 16.00<br>15.75   | 7.6<br>7.4       | 0.635 | 10.4<br>10.1   | 1.4 | 1.0<br>0.6     | 1.2<br>1.0 | 0.25 | 0.18 | 0.1 | 0.85<br>0.40     | 8°<br>0° |

**Note**

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

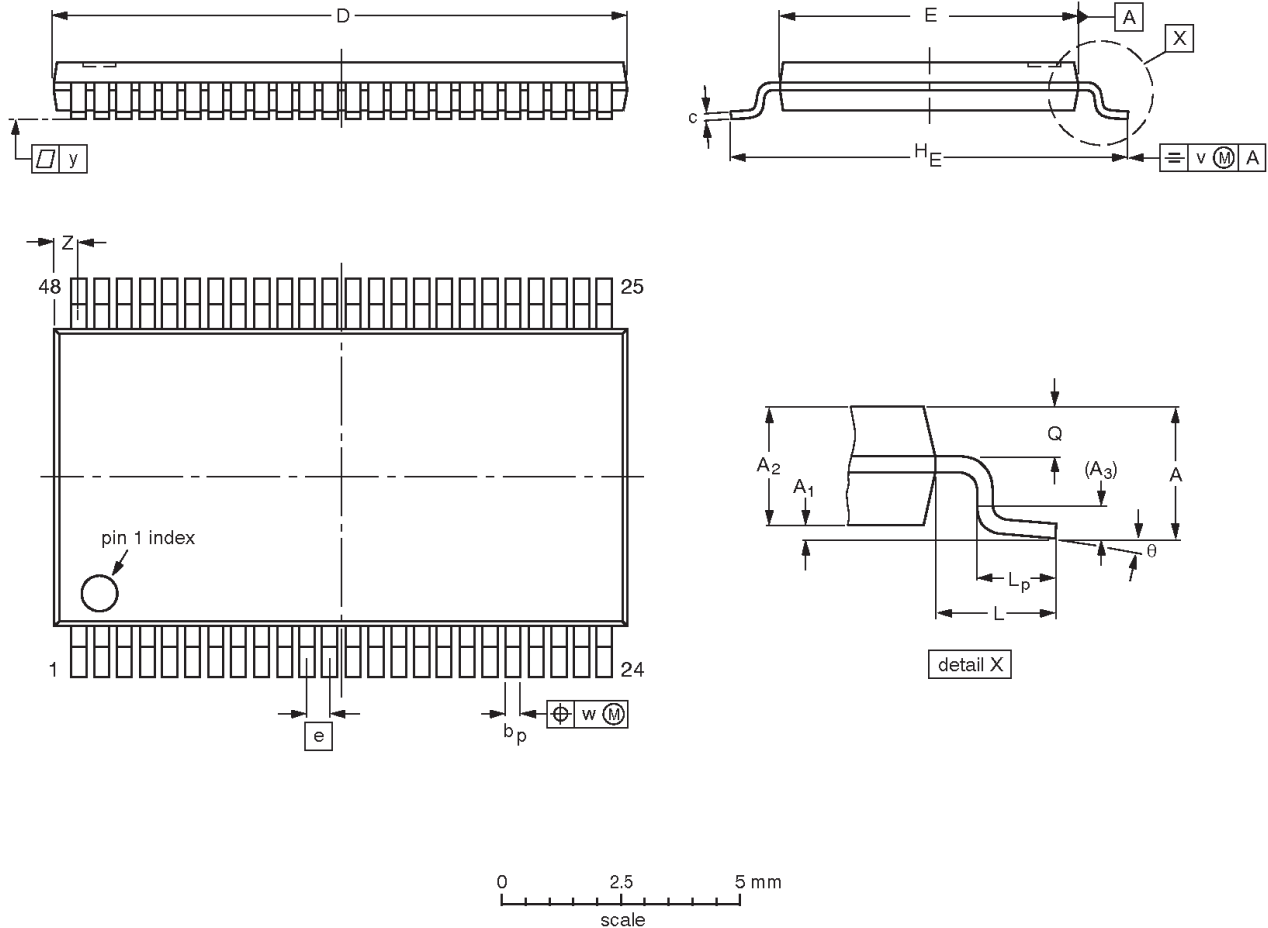
| OUTLINE VERSION | REFERENCES |          |      |  | EUROPEAN PROJECTION | ISSUE DATE            |
|-----------------|------------|----------|------|--|---------------------|-----------------------|
|                 | IEC        | JEDEC    | EIAJ |  |                     |                       |
| SOT370-1        |            | MO-118AA |      |  |                     | 93-11-02-<br>95-02-04 |

# 16-bit buffer/line driver (3-State)

74ABT16541  
74ABTH16541

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1mm

SOT362-1



**DIMENSIONS (mm are the original dimensions).**

| UNIT | A max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c          | D <sup>(1)</sup> | E <sup>(2)</sup> | e   | H <sub>E</sub> | L | L <sub>p</sub> | Q            | v    | w    | y   | Z          | θ        |
|------|--------|----------------|----------------|----------------|----------------|------------|------------------|------------------|-----|----------------|---|----------------|--------------|------|------|-----|------------|----------|
| mm   | 1.2    | 0.15<br>0.05   | 1.05<br>0.85   | 0.25           | 0.28<br>0.17   | 0.2<br>0.1 | 12.6<br>12.4     | 6.2<br>6.0       | 0.5 | 8.3<br>7.9     | 1 | 0.8<br>0.4     | 0.50<br>0.35 | 0.25 | 0.08 | 0.1 | 0.8<br>0.4 | 8°<br>0° |

**Notes**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES |          |      |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|----------|------|--|---------------------|----------------------|
|                 | IEC        | JEDEC    | EIAJ |  |                     |                      |
| SOT362-1        |            | MO-153ED |      |  |                     | 93-02-09<br>95-02-10 |



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16-bit buffer/line driver (3-State)

74ABT16541  
74ABTH16541

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**NOTES**

## 16-bit buffer/line driver (3-State)

74ABT16541  
74ABTH16541

## Data sheet status

| Data sheet status         | Product status | Definition [1]   |
|---------------------------|----------------|--|
| Objective specification   | Development    | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.  |
| Preliminary specification | Qualification  | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
| Product specification     | Production     | This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.   |

[1] Please consult the most recently issued datasheet before initiating or completing a design.

## Definitions

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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