

# DATA SHEET

## **74ALVT16543**

**2.5 V/3.3 V ALVT 16-bit registered  
transceiver (3-State)**

Product data sheet  
Supersedes data of 1998 Feb 13

2004 Sep 14

# 2.5 V/3.3 V 16-bit registered transceiver (3-State)

# 74ALVT16543

## FEATURES

- 16-bit universal bus interface
- 5 V I/O Compatible
- 3-State buffers
- Output capability: +64 mA/-32 mA
- TTL input and output switching levels
- Input and output interface capability to systems at 5 V supply
- Bus-hold data inputs eliminate the need for external pull-up resistors to hold unused inputs
- Live insertion/extraction permitted
- Power-up 3-State
- Power-up reset
- No bus current loading when output is tied to 5 V bus
- 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

## DESCRIPTION

The 74ALVT16543 is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 2.5 V or 3.3 V with I/O compatibility up to 5 V. The device can be used as two 8-bit transceivers or one 16-bit transceiver.

The 74ALVT16543 contains two sets of eight D-type latches, with separate control pins for each set. Using data flow from A to B as an example, when the A-to-B Enable ( $\overline{nEAB}$ ) input and the A-to-B Latch Enable ( $\overline{nLEAB}$ ) input are LOW, the A-to-B path is transparent.

A subsequent LOW-to-HIGH transition of the  $\overline{nLEAB}$  signal puts the A data into the latches where it is stored and the B outputs no longer change with the A inputs. With  $\overline{nEAB}$  and  $\overline{nOEAB}$  both LOW, the 3-State B output buffers are active and display the data present at the outputs of the A latches.

Control of data flow from B to A is similar, but using the  $\overline{nEBA}$ ,  $\overline{nLEBA}$ , and  $\overline{nOEBA}$  inputs.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

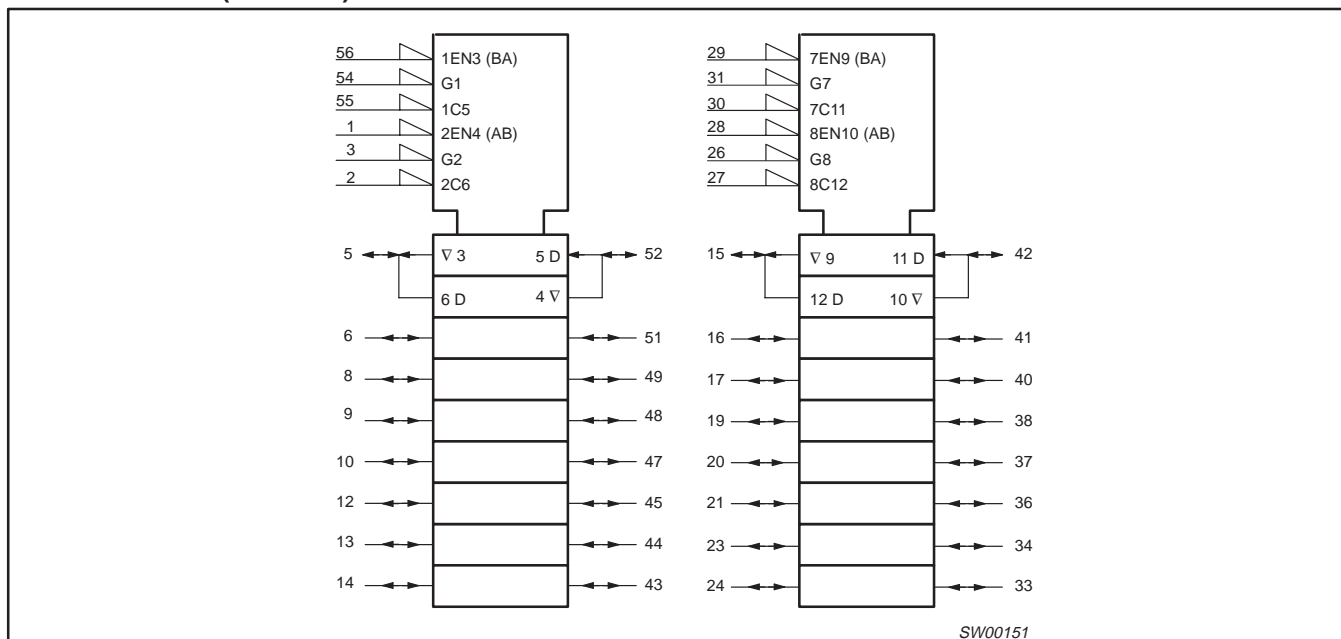
## QUICK REFERENCE DATA

| SYMBOL                 | PARAMETER                                     | CONDITIONS<br>$T_{amb} = 25\text{ }^\circ\text{C}; GND = 0\text{ V}$ | TYPICAL    |            | UNIT          |
|------------------------|---|--|------------|------------|---------------|
|                        |   |  | 2.5 V      | 3.3 V      |               |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nAx to nBx or nBx to nAx | $C_L = 50\text{ pF}$   | 1.8<br>2.7 | 1.6<br>1.8 | ns            |
| $C_{IN}$               | Input capacitance DIR, $\overline{OE}$        | $V_I = 0\text{ V or }V_{CC}$   | 3          | 3          | pF            |
| $C_{I/O}$              | I/O pin capacitance                           | Outputs disabled; $V_{I/O} = 0\text{ V or }V_{CC}$                   | 9          | 9          | pF            |
| $I_{CCZ}$              | Total supply current                          | Outputs disabled   | 40         | 70         | $\mu\text{A}$ |

## ORDERING INFORMATION

| PACKAGES                     | TEMPERATURE RANGE | TYPE NUMBER    | DWG NUMBER |
|------------------------------|-------------------|----------------|------------|
| 56-Pin Plastic SSOP Type III | -40 °C to +85 °C  | 74ALVT16543DL  | SOT371-1   |
| 56-Pin Plastic TSSOP Type II | -40 °C to +85 °C  | 74ALVT16543DGG | SOT364-1   |

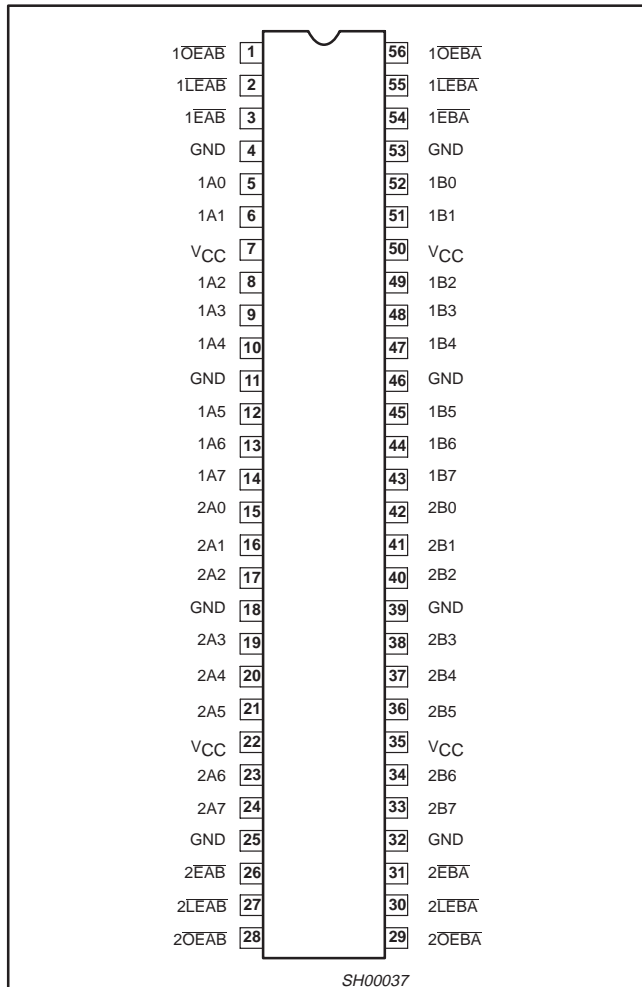
## LOGIC SYMBOL (IEEE/IEC)



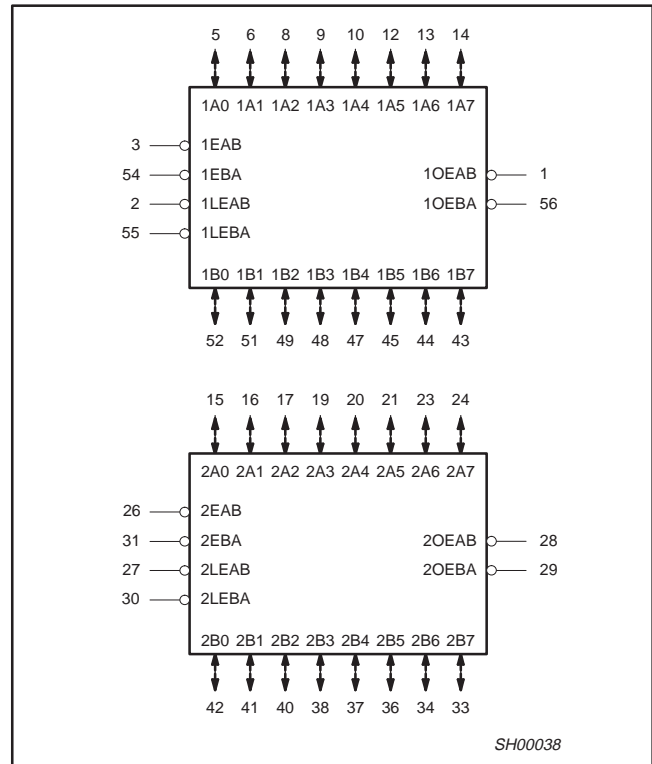
# 2.5 V/3.3 V 16-bit registered transceiver (3-State)

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## PIN CONFIGURATION



## LOGIC SYMBOL



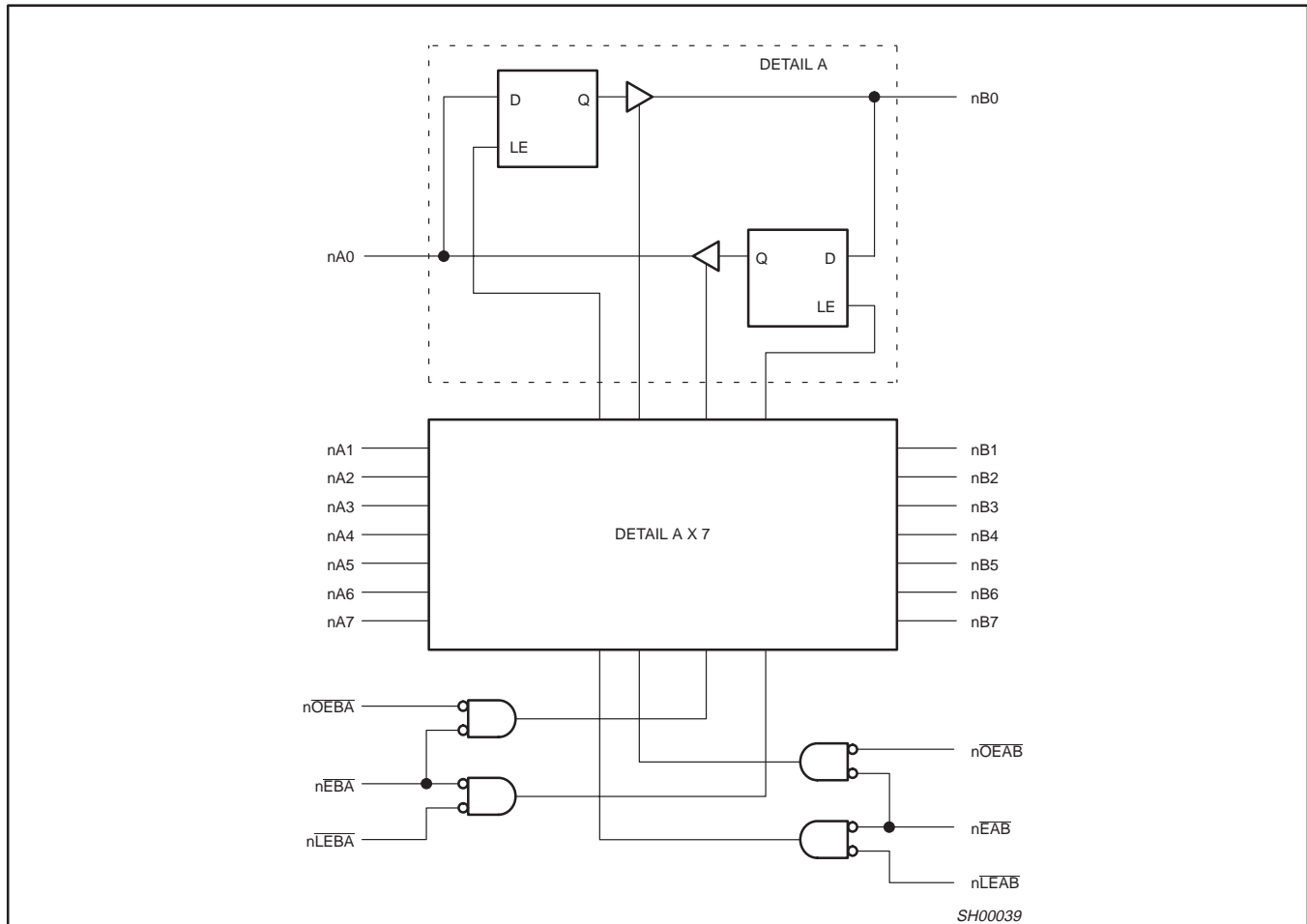
## PIN DESCRIPTION

| PIN NUMBER   | SYMBOL                        | NAME AND FUNCTION                                 |
|--|-------------------------------|---|
| 5, 6, 8, 9, 10, 12, 13, 14<br>15, 16, 17, 19, 20, 21, 23, 24     | 1A0 – 1A7,<br>2A0 – 2A7       | A Data inputs/outputs                             |
| 52, 51, 49, 48, 47, 45, 44, 43<br>42, 41, 40, 38, 37, 36, 34, 33 | 1B0 – 1B7,<br>2B0 – 2B7       | B Data inputs/outputs                             |
| 1, 56<br>28, 29  | 1OEAB, 1OEBA,<br>2OEAB, 2OEBA | A to B / B to A Output Enable inputs (active-LOW) |
| 3, 54<br>26, 31  | 1EAB, 1EBA,<br>2EAB, 2EBA     | A to B / B to A Enable inputs (active-LOW)        |
| 2, 55<br>27, 30  | 1LEAB, 1LEBA,<br>2LEAB, 2LEBA | A to B / B to A Latch Enable inputs (active-LOW)  |
| 4, 11, 18, 25, 32, 39, 46, 53                                    | GND                           | Ground (0 V)                                      |
| 7, 22, 35, 50  | V <sub>CC</sub>               | Positive supply voltage                           |

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## LOGIC DIAGRAM



## FUNCTION TABLE

| INPUTS            |                  |                   |                                    | OUTPUTS                            | STATUS           |
|-------------------|------------------|-------------------|------------------------------------|------------------------------------|------------------|
| nOE <sub>XX</sub> | nE <sub>XX</sub> | nLE <sub>XX</sub> | nA <sub>x</sub> or nB <sub>x</sub> | nB <sub>x</sub> or nA <sub>x</sub> |                  |
| H                 | X                | X                 | X                                  | Z                                  | Disabled         |
| X                 | H                | X                 | X                                  | Z                                  | Disabled         |
| L                 | ↑                | L                 | h                                  | Z                                  | Disabled + Latch |
| L                 | ↑                | L                 | l                                  | Z                                  |                  |
| L                 | L                | ↑                 | h                                  | H                                  | Latch + Display  |
| L                 | L                | ↑                 | l                                  | L                                  |                  |
| L                 | L                | L                 | H                                  | H                                  | Transparent      |
| L                 | L                | L                 | L                                  | L                                  |                  |
| L                 | L                | H                 | X                                  | NC                                 | Hold             |

H = HIGH voltage level  
 h = HIGH voltage level one setup time prior to the LOW-to-HIGH transition of nLE<sub>XX</sub> or nE<sub>XX</sub> (XX = AB or BA)  
 L = LOW voltage level  
 l = LOW voltage level one setup time prior to the LOW-to-HIGH transition of nLE<sub>XX</sub> or nE<sub>XX</sub> (XX = AB or BA)  
 X = Don't care  
 ↑ = LOW-to-HIGH transition of nLE<sub>XX</sub> or nE<sub>XX</sub> (XX = AB or BA)  
 NC = No change  
 Z = High-impedance or "off" state

## 2.5 V/3.3 V 16-bit registered transceiver (3-State)

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**ABSOLUTE MAXIMUM RATINGS<sup>1, 2</sup>**

| SYMBOL           | PARAMETER                      | CONDITIONS                  | RATING       | UNIT |
|------------------|--------------------------------|-----------------------------|--------------|------|
| V <sub>CC</sub>  | DC supply voltage              |                             | -0.5 to +4.6 | V    |
| I <sub>IK</sub>  | DC input diode current         | V <sub>I</sub> < 0 V        | -50          | mA   |
| V <sub>I</sub>   | DC input voltage <sup>3</sup>  |                             | -0.5 to +7.0 | V    |
| I <sub>OK</sub>  | DC output diode current        | V <sub>O</sub> < 0 V        | -50          | mA   |
| V <sub>OUT</sub> | DC output voltage <sup>3</sup> | Output in Off or HIGH state | -0.5 to +7.0 | V    |
| I <sub>OUT</sub> | DC output current              | Output in LOW state         | 128          | mA   |
|                  |                                | Output in HIGH state        | -64          |      |
| 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 negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

**RECOMMENDED OPERATING CONDITIONS**

| SYMBOL           | PARAMETER  | 2.5 V RANGE LIMITS |     | 3.3 V RANGE LIMITS |     | UNIT |
|------------------|--|--------------------|-----|--------------------|-----|------|
|                  |  | MIN                | MAX | MIN                | MAX |      |
| V <sub>CC</sub>  | DC supply voltage  | 2.3                | 2.7 | 3.0                | 3.6 | V    |
| V <sub>I</sub>   | Input voltage  | 0                  | 5.5 | 0                  | 5.5 | V    |
| V <sub>IH</sub>  | HIGH-level input voltage                                       | 1.7                |     | 2.0                |     | V    |
| V <sub>IL</sub>  | Input voltage  |                    | 0.7 |                    | 0.8 | V    |
| I <sub>OH</sub>  | HIGH-level output current                                      |                    | -8  |                    | -32 | mA   |
| I <sub>OL</sub>  | LOW-level output current                                       |                    | 8   |                    | 32  | mA   |
|                  | LOW-level output current; current duty cycle ≤ 50 %; f ≥ 1 kHz |                    | 24  |                    | 64  |      |
| Δt/Δv            | Input transition rise or fall rate; Outputs enabled            |                    | 10  |                    | 10  | ns/V |
| T <sub>amb</sub> | Operating free-air temperature range                           | -40                | +85 | -40                | +85 | °C   |

## 2.5 V/3.3 V 16-bit registered transceiver (3-State)

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DC ELECTRICAL CHARACTERISTICS (3.3 V  $\pm$  0.3 V RANGE)

| SYMBOL                   | PARAMETER  | TEST CONDITIONS  | LIMITS                  |                  |           | UNIT    |         |
|--------------------------|--|--|-------------------------|------------------|-----------|---------|---------|
|                          |  |  | Temp = -40 °C to +85 °C |                  |           |         |         |
|                          |  |  | MIN                     | TYP <sup>1</sup> | MAX       |         |         |
| V <sub>IK</sub>          | Input clamp voltage  | V <sub>CC</sub> = 3.0 V; I <sub>IK</sub> = -18 mA  | -                       | -0.85            | -1.2      | V       |         |
| V <sub>OH</sub>          | HIGH-level output voltage  | V <sub>CC</sub> = 3.0 V to 3.6 V; I <sub>OH</sub> = -100 $\mu$ A   | V <sub>CC</sub> - 0.2   | V <sub>CC</sub>  | -         | V       |         |
|                          |  | V <sub>CC</sub> = 3.0 V; I <sub>OH</sub> = -32 mA  | 2.0                     | 2.3              | -         |         |         |
| V <sub>OL</sub>          | LOW-level output voltage   | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 100 $\mu$ A   | -                       | 0.07             | 0.2       | V       |         |
|                          |  | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 16 mA   | -                       | 0.25             | 0.4       |         |         |
|                          |  | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 32 mA   | -                       | 0.3              | 0.5       |         |         |
|                          |  | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 64 mA   | -                       | 0.4              | 0.55      |         |         |
| V <sub>RST</sub>         | Power-up output low voltage <sup>6</sup>                                       | V <sub>CC</sub> = 3.6 V; I <sub>O</sub> = 1 mA; V <sub>I</sub> = V <sub>CC</sub> or GND  | -                       | -                | 0.55      | V       |         |
| I <sub>I</sub>           | Input leakage current  | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND   | Control pins            | -                | 0.1       | $\pm$ 1 | $\mu$ A |
|                          |  | V <sub>CC</sub> = 0 V or 3.6 V; V <sub>I</sub> = 5.5 V   |                         | -                | 0.1       | 10      |         |
|                          |  | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub>  | Data pins <sup>4</sup>  | -                | 0.5       | 1       |         |
|                          |  | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 0 V  |                         | -                | 0.1       | -5      |         |
|                          |  | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 5.5 V  |                         | -                | 0.1       | 20      |         |
| I <sub>OFF</sub>         | Off current  | V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 0 V to 4.5 V   | -                       | 0.1              | $\pm$ 100 | $\mu$ A |         |
| I <sub>HOLD</sub>        | Bus Hold current<br>Data inputs <sup>7</sup>                                   | V <sub>CC</sub> = 3 V; V <sub>I</sub> = 0.8 V  | 75                      | 130              | -         | $\mu$ A |         |
|                          |  | V <sub>CC</sub> = 3 V; V <sub>I</sub> = 2.0 V  | -75                     | -140             | -         |         |         |
|                          |  | V <sub>CC</sub> = 0 V to 3.6 V; V <sub>CC</sub> = 3.6 V  | $\pm$ 500               | -                | -         |         |         |
| I <sub>EX</sub>          | Current into an output in the High state when V <sub>O</sub> > V <sub>CC</sub> | V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 3.0 V  | -                       | 50               | 125       | $\mu$ A |         |
| I <sub>PU/PD</sub>       | Power-up/down 3-State output current <sup>3</sup>                              | V <sub>CC</sub> $\leq$ 1.2 V; V <sub>O</sub> = 0.5 V to V <sub>CC</sub> ; V <sub>I</sub> = GND or V <sub>CC</sub> ; OE/OE = Don't care | -                       | 40               | $\pm$ 100 | $\mu$ A |         |
| I <sub>CCH</sub>         | Quiescent supply current   | V <sub>CC</sub> = 3.6 V; Outputs HIGH; V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 mA                                 | -                       | 0.07             | 0.1       | mA      |         |
| I <sub>CCL</sub>         |  | V <sub>CC</sub> = 3.6 V; Outputs LOW; V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 mA                                  | -                       | 3.6              | 5         |         |         |
| I <sub>CCZ</sub>         |  | V <sub>CC</sub> = 3.6 V; Outputs disabled; V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 mA <sup>5</sup>                | -                       | 0.07             | 0.1       |         |         |
| $\Delta$ I <sub>CC</sub> | Additional supply current per input pin <sup>2</sup>                           | V <sub>CC</sub> = 3 V to 3.6 V; One input at V <sub>CC</sub> - 0.6 V; Other inputs at V <sub>CC</sub> or GND                           | -                       | 0.04             | 0.4       | mA      |         |

## NOTES:

- All typical values are at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C.
- This is the increase in supply current for each input at the specified voltage level other than V<sub>CC</sub> or GND.
- This parameter is valid for any V<sub>CC</sub> between 0 V and 1.2 V with a transition time of up to 10 msec. From V<sub>CC</sub> = 1.2 V to V<sub>CC</sub> = 3.3 V  $\pm$  0.3 V a transition time of 100  $\mu$ sec is permitted. This parameter is valid for T<sub>amb</sub> = 25 °C only.
- Unused pins at V<sub>CC</sub> or GND.
- I<sub>CCZ</sub> is measured with outputs pulled up to V<sub>CC</sub> or pulled down to ground.
- For valid test results, data must not be loaded into the flip-flops (or latches) after applying power.
- This is the bus hold overdrive current required to force the input to the opposite logic state.

## 2.5 V/3.3 V 16-bit registered transceiver (3-State)

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DC ELECTRICAL CHARACTERISTICS (2.5 V  $\pm$  0.2 V RANGE)

| SYMBOL                   | PARAMETER  | TEST CONDITIONS  | LIMITS                  |                  |           | UNIT    |         |
|--------------------------|--|--|-------------------------|------------------|-----------|---------|---------|
|                          |  |  | Temp = -40 °C to +85 °C |                  |           |         |         |
|                          |  |  | MIN                     | TYP <sup>1</sup> | MAX       |         |         |
| V <sub>IK</sub>          | Input clamp voltage  | V <sub>CC</sub> = 2.3 V; I <sub>IK</sub> = -18 mA  | -                       | -0.85            | -1.2      | V       |         |
| V <sub>OH</sub>          | HIGH-level output voltage  | V <sub>CC</sub> = 2.3 V to 3.6 V; I <sub>OH</sub> = -100 $\mu$ A   | V <sub>CC</sub> - 0.2   | V <sub>CC</sub>  | -         | V       |         |
|                          |  | V <sub>CC</sub> = 2.3 V; I <sub>OH</sub> = -8 mA   | 1.8                     | 2.1              | -         |         |         |
| V <sub>OL</sub>          | LOW-level output voltage   | V <sub>CC</sub> = 2.3 V; I <sub>OL</sub> = 100 $\mu$ A   | -                       | 0.07             | 0.2       | V       |         |
|                          |  | V <sub>CC</sub> = 2.3 V; I <sub>OL</sub> = 24 mA   | -                       | 0.3              | 0.5       |         |         |
|                          |  | V <sub>CC</sub> = 2.3 V; I <sub>OL</sub> = 8 mA  | -                       | -                | 0.4       |         |         |
| V <sub>RST</sub>         | Power-up output low voltage <sup>7</sup>                                       | V <sub>CC</sub> = 2.7 V; I <sub>O</sub> = 1 mA; V <sub>I</sub> = V <sub>CC</sub> or GND  | -                       | -                | 0.55      | V       |         |
| I <sub>I</sub>           | Input leakage current  | V <sub>CC</sub> = 2.7 V; V <sub>I</sub> = V <sub>CC</sub> or GND   | Control pins            | -                | 0.1       | $\pm$ 1 | $\mu$ A |
|                          |  | V <sub>CC</sub> = 0 V or 2.7 V; V <sub>I</sub> = 5.5 V   |                         | -                | 0.1       | 10      |         |
|                          |  | V <sub>CC</sub> = 2.7 V; V <sub>I</sub> = 5.5 V  | Data pins <sup>4</sup>  | -                | 0.1       | 20      |         |
|                          |  | V <sub>CC</sub> = 2.7 V; V <sub>I</sub> = V <sub>CC</sub>  |                         | -                | 0.1       | 10      |         |
|                          |  | V <sub>CC</sub> = 2.7 V; V <sub>I</sub> = 0 V  |                         | -                | 0.1       | -5      |         |
| I <sub>OFF</sub>         | Off current  | V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 0 V to 4.5 V   | -                       | 0.1              | $\pm$ 100 | $\mu$ A |         |
| I <sub>HOLD</sub>        | Bus Hold current   | V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 0.7 V  | -                       | 120              | -         | $\mu$ A |         |
|                          | Data inputs <sup>6</sup>   | V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 1.7 V  | -                       | -6               | -         |         |         |
| I <sub>EX</sub>          | Current into an output in the HIGH state when V <sub>O</sub> > V <sub>CC</sub> | V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 2.3 V  | -                       | 50               | 125       | $\mu$ A |         |
| I <sub>PU/PD</sub>       | Power-up/down 3-State output current <sup>3</sup>                              | V <sub>CC</sub> $\leq$ 1.2 V; V <sub>O</sub> = 0.5 V to V <sub>CC</sub> ; V <sub>I</sub> = GND or V <sub>CC</sub> ; OE/OE = Don't care | -                       | 40               | 100       | $\mu$ A |         |
| I <sub>CCH</sub>         | Quiescent supply current   | V <sub>CC</sub> = 2.7 V; Outputs HIGH, V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 mA                                 | -                       | 0.04             | 0.1       | mA      |         |
| I <sub>CCL</sub>         |  | V <sub>CC</sub> = 2.7 V; Outputs LOW, V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 mA                                  | -                       | 2.6              | 4.5       |         |         |
| I <sub>CCZ</sub>         |  | V <sub>CC</sub> = 2.7 V; Outputs disabled; V <sub>I</sub> = GND or V <sub>CC</sub> ; I <sub>O</sub> = 0 mA <sup>5</sup>                | -                       | 0.04             | 0.1       |         |         |
| $\Delta$ I <sub>CC</sub> | Additional supply current per input pin <sup>2</sup>                           | V <sub>CC</sub> = 2.3 V to 2.7 V; One input at V <sub>CC</sub> - 0.6 V; Other inputs at V <sub>CC</sub> or GND                         | -                       | 0.01             | 0.4       | mA      |         |

## NOTES:

- All typical values are at V<sub>CC</sub> = 2.5 V and T<sub>amb</sub> = 25 °C.
- This is the increase in supply current for each input at the specified voltage level other than V<sub>CC</sub> or GND.
- This parameter is valid for any V<sub>CC</sub> between 0 V and 1.2 V with a transition time of up to 10 msec. From V<sub>CC</sub> = 1.2 V to V<sub>CC</sub> = 2.5 V  $\pm$  0.2 V a transition time of 100  $\mu$ sec is permitted. This parameter is valid for T<sub>amb</sub> = 25 °C only.
- Unused pins at V<sub>CC</sub> or GND.
- I<sub>CCZ</sub> is measured with outputs pulled up to V<sub>CC</sub> or pulled down to ground.
- Not guaranteed.
- For valid test results, data must not be loaded into the flip-flops (or latches) after applying power.

## 2.5 V/3.3 V 16-bit registered transceiver (3-State)

74ALVT16543

**AC CHARACTERISTICS (3.3 V ± 0.3 V RANGE)**GND = 0 V;  $t_R = t_F = 2.5$  ns;  $C_L = 50$  pF;  $R_L = 500$   $\Omega$ ;  $T_{amb} = -40$  °C to +85 °C.

| SYMBOL                 | PARAMETER   | WAVEFORM | LIMITS                   |                  |            | UNIT |
|------------------------|---|----------|--------------------------|------------------|------------|------|
|                        |   |          | $V_{CC} = 3.3$ V ± 0.3 V |                  |            |      |
|                        |   |          | MIN                      | TYP <sup>1</sup> | MAX        |      |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nAx to nBx or nBx to nAx     | 2        | 0.5<br>0.5               | 1.6<br>1.8       | 2.6<br>3.0 | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nLEBA to nAx, nLEAB to nBx   | 1<br>2   | 1.0<br>1.0               | 2.4<br>2.4       | 4.0<br>4.0 | ns   |
| $t_{PZH}$<br>$t_{PZL}$ | Output enable time<br>nOEBA to nAx, nOEAB to nBx  | 4<br>5   | 1.0<br>1.0               | 2.3<br>1.8       | 4.0<br>3.1 | ns   |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output disable time<br>nOEBA to nAx, nOEAB to nBx | 4<br>5   | 1.0<br>1.0               | 3.1<br>2.7       | 4.8<br>4.2 | ns   |
| $t_{PZH}$<br>$t_{PZL}$ | Output enable time<br>nEBA to nAx, nEAB to nBx    | 4<br>5   | 1.0<br>1.0               | 2.5<br>1.9       | 4.2<br>3.1 | ns   |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output disable time<br>nEBA to nAx, nEAB to nBx   | 4<br>5   | 1.0<br>1.0               | 2.9<br>2.4       | 4.9<br>4.2 | ns   |

**NOTE:**1. All typical values are at  $V_{CC} = 3.3$  V and  $T_{amb} = 25$  °C.**AC SETUP REQUIREMENTS (3.3 V ± 0.3 V RANGE)**GND = 0 V;  $t_R = t_F = 2.5$  ns;  $C_L = 50$  pF;  $R_L = 500$   $\Omega$ ;  $T_{amb} = -40$  °C to +85 °C.

| SYMBOL               | PARAMETER                                | WAVEFORM | LIMITS                   |              | UNIT |
|----------------------|--|----------|--------------------------|--------------|------|
|                      |  |          | $V_{CC} = 3.3$ V ± 0.3 V |              |      |
|                      |  |          | MIN                      | TYP          |      |
| $t_s(H)$<br>$t_s(L)$ | Setup time<br>nAx to nLEAB, nBx to nLEBA | 3        | 0.5<br>0.7               | 0<br>-0.4    | ns   |
| $t_h(H)$<br>$t_h(L)$ | Hold time<br>nAx to nLEAB, nBx to nLEBA  | 3        | 1.5<br>1.5               | 0.2<br>-0.3  | ns   |
| $t_s(H)$<br>$t_s(L)$ | Setup time<br>nAx to nEAB, nBx to nEBA   | 3        | 0.5<br>1.1               | -0.3<br>-0.6 | ns   |
| $t_h(H)$<br>$t_h(L)$ | Hold time<br>nAx to nEAB, nBx to nEBA    | 3        | 1.2<br>2.0               | 0.6<br>0.1   | ns   |
| $t_W(L)$             | Latch enable pulse width, LOW            | 3        | 1.5                      | -            | ns   |

## 2.5 V/3.3 V 16-bit registered transceiver (3-State)

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**AC CHARACTERISTICS (2.5 V ± 0.2 V RANGE)**GND = 0 V;  $t_R = t_F = 2.5$  ns;  $C_L = 50$  pF;  $R_L = 500$   $\Omega$ ;  $T_{amb} = -40$  °C to +85 °C.

| SYMBOL                 | PARAMETER   | WAVEFORM | LIMITS                                     |                  |            | UNIT |
|------------------------|---|----------|--|------------------|------------|------|
|                        |   |          | $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$ |                  |            |      |
|                        |   |          | MIN  | TYP <sup>1</sup> | MAX        |      |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nAx to nBx or nBx to nAx     | 2        | 1.0<br>1.0                                 | 1.8<br>2.7       | 5.1<br>4.5 | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nLEBA to nAx, nLEAB to nBx   | 1<br>2   | 1.5<br>1.5                                 | 3.9<br>3.6       | 6.4<br>5.9 | ns   |
| $t_{PZH}$<br>$t_{PZL}$ | Output enable time<br>nOEBA to nAx, nOEAB to nBx  | 4<br>5   | 1.5<br>1.5                                 | 4.0<br>2.7       | 6.5<br>4.6 | ns   |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output disable time<br>nOEBA to nAx, nOEAB to nBx | 4<br>5   | 1.5<br>1.5                                 | 3.7<br>2.6       | 5.6<br>4.0 | ns   |
| $t_{PZH}$<br>$t_{PZL}$ | Output enable time<br>nEBA to nAx, nEAB to nBx    | 4<br>5   | 1.5<br>1.5                                 | 4.2<br>2.8       | 7.0<br>5.0 | ns   |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output disable time<br>nEBA to nAx, nEAB to nBx   | 4<br>5   | 1.5<br>1.5                                 | 3.6<br>2.4       | 5.6<br>3.9 | ns   |

**NOTE:**1. All typical values are at  $V_{CC} = 2.5$  V and  $T_{amb} = 25$  °C.**AC SETUP REQUIREMENTS (2.5 V ± 0.2 V RANGE)**GND = 0 V;  $t_R = t_F = 2.5$  ns;  $C_L = 50$  pF;  $R_L = 500$   $\Omega$ ;  $T_{amb} = -40$  °C to +85 °C.

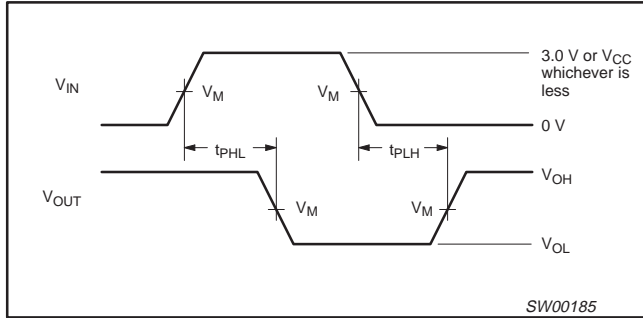
| SYMBOL               | PARAMETER                                | WAVEFORM | LIMITS                                     |              | UNIT |
|----------------------|--|----------|--|--------------|------|
|                      |  |          | $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$ |              |      |
|                      |  |          | MIN  | TYP          |      |
| $t_s(H)$<br>$t_s(L)$ | Setup time<br>nAx to nLEAB, nBx to nLEBA | 3        | 0.5<br>1.0                                 | -0.2<br>-0.5 | ns   |
| $t_h(H)$<br>$t_h(L)$ | Hold time<br>nAx to nLEAB, nBx to nLEBA  | 3        | 1.0<br>1.0                                 | 0.2<br>-0.2  | ns   |
| $t_s(H)$<br>$t_s(L)$ | Setup time<br>nAx to nEAB, nBx to nEBA   | 3        | 0.5<br>1.5                                 | -0.3<br>-0.6 | ns   |
| $t_h(H)$<br>$t_h(L)$ | Hold time<br>nAx to nEAB, nBx to nEBA    | 3        | 1.2<br>1.5                                 | 0<br>0.2     | ns   |
| $t_W(L)$             | Latch enable pulse width, LOW            | 3        | 1.5  | -            | ns   |

2.5 V/3.3 V 16-bit registered transceiver (3-State)

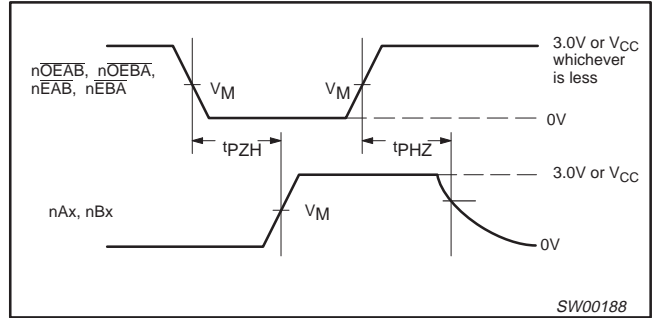
74ALVT16543

**AC WAVEFORMS**

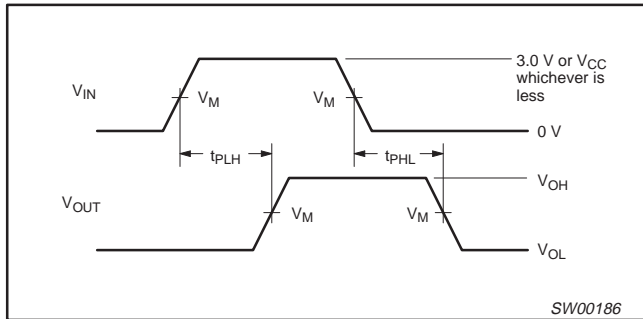
For all waveforms  $V_M = 1.5\text{ V}$  or  $V_{CC}/2$ , whichever is less.



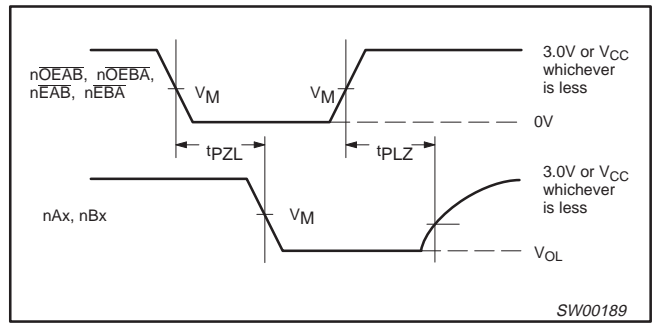
**Waveform 1. Propagation Delay For Inverting Output**



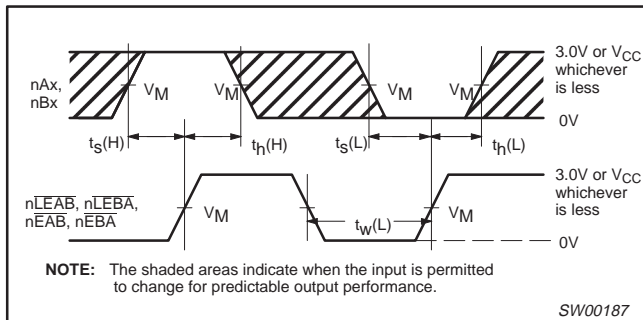
**Waveform 4. 3-State Output Enable Time to High Level and Output Disable Time from High Level**



**Waveform 2. Propagation Delay For Non-Inverting Output**



**Waveform 5. 3-State Output Enable Time to Low Level and Output Disable Time from Low Level**

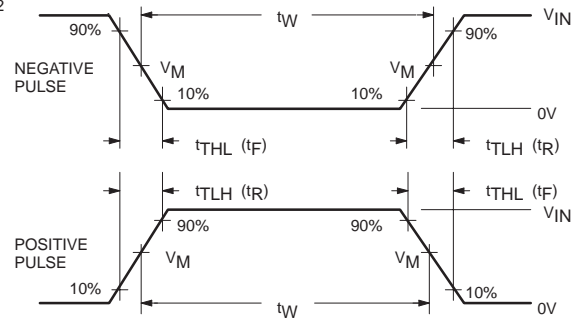
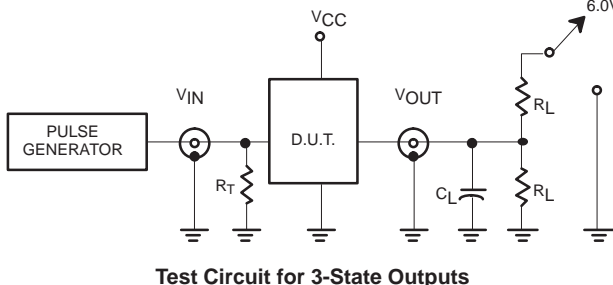


**Waveform 3. Data Setup and Hold Times and Latch Enable Pulse Width**

# 2.5 V/3.3 V 16-bit registered transceiver (3-State)

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## TEST CIRCUIT AND WAVEFORMS



### SWITCH POSITION

| TEST              | SWITCH                  |
|-------------------|-------------------------|
| $t_{PLZ}/t_{PZL}$ | 6V or $V_{CC} \times 2$ |
| $t_{PLH}/t_{PHL}$ | Open                    |
| $t_{PHZ}/t_{PZH}$ | GND                     |

### 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           | $t_W$ | $t_R$               | $t_F$               |
| 74ALVT16 | 3.0V or $V_{CC}$ whichever is less | $\leq 10\text{MHz}$ | 500ns | $\leq 2.5\text{ns}$ | $\leq 2.5\text{ns}$ |

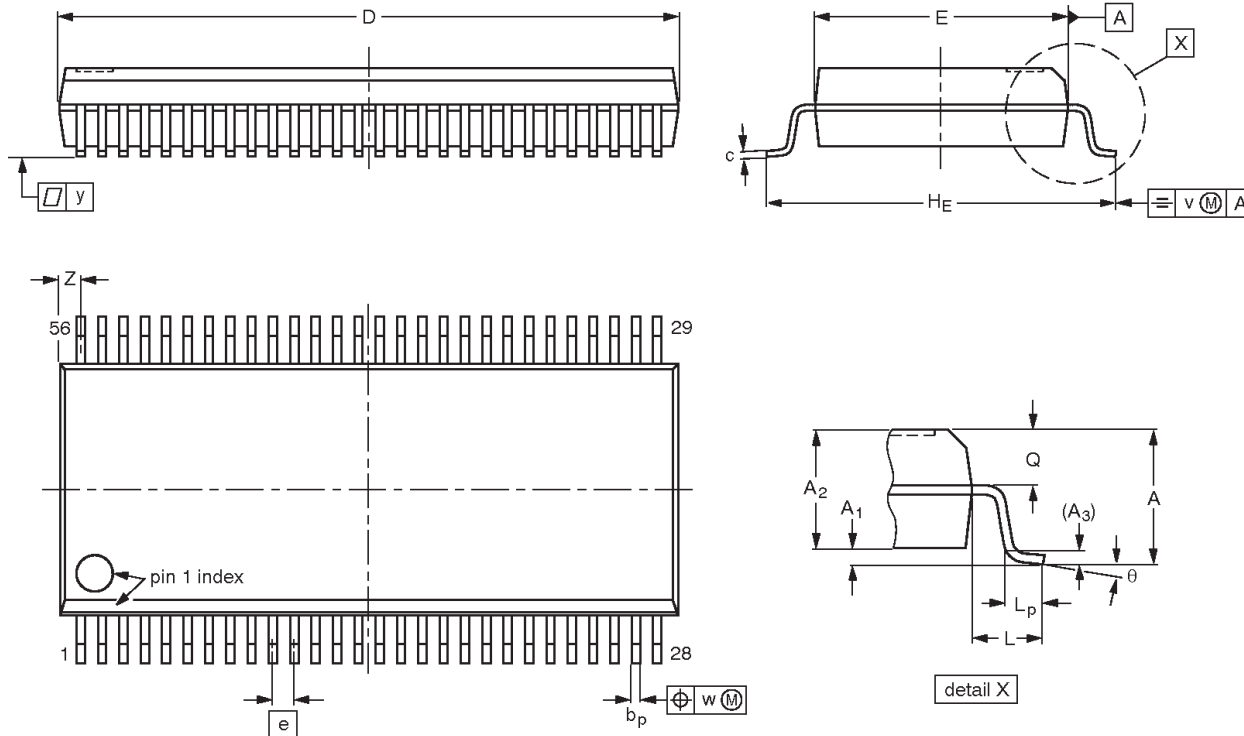
SW00025

2.5 V/3.3 V 16-bit registered transceiver (3-State)

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SSOP56: plastic shrink small outline package; 56 leads; body width 7.5 mm

SOT371-1



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 | 18.55<br>18.30   | 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.

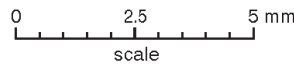
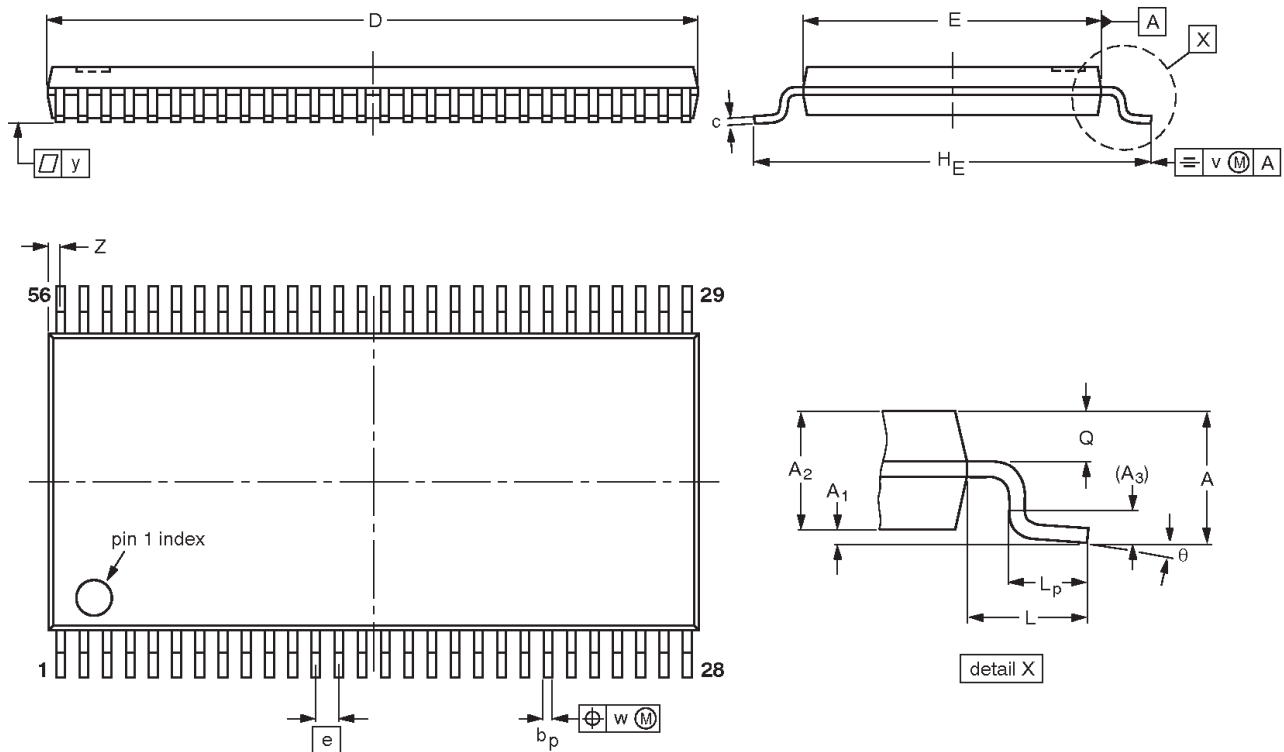
| OUTLINE VERSION | REFERENCES |        |       |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|--------|-------|--|---------------------|----------------------|
|                 | IEC        | JEDEC  | JEITA |  |                     |                      |
| SOT371-1        |            | MO-118 |       |  |                     | 99-12-27<br>03-02-18 |

2.5 V/3.3 V 16-bit registered transceiver (3-State)

74ALVT16543

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 6.1 mm

SOT364-1



**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 | 14.1<br>13.9     | 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 | 0.5<br>0.1 | 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  | JEITA |  |                     |                       |
| SOT364-1        |            | MO-153 |       |  |                     | -99-12-27<br>03-02-19 |

## 2.5 V/3.3 V 16-bit registered transceiver (3-State)

74ALVT16543

## REVISION HISTORY

| Rev | Date     | Description  |
|-----|----------|--|
| _3  | 20040914 | <p><b>Product data sheet (9397 750 14059). Supersedes data of 1998 Feb 13 (9397 750 03568).</b></p> <p>Modifications:</p> <ul style="list-style-type: none"> <li>● Ordering information table on page 2: <ul style="list-style-type: none"> <li>– remove “North America” column; rename third column from “Outside North America” to “Type Number”.</li> </ul> </li> <li>● DC Electrical Characteristics (3.3 V ± 0.3 V range) table on page 6: <ul style="list-style-type: none"> <li>– I<sub>I</sub> on Data pins: add condition ‘V<sub>CC</sub> = 3.6 V; V<sub>I</sub> = 5.5 V’ and values 0.1 μA (typ) and 20 μA (max).</li> </ul> </li> <li>● AC Characteristics (3.3 V ± 0.3 V range) table on page 8: <ul style="list-style-type: none"> <li>– change propagation delay nAx to nBx t<sub>PLH</sub> Max. time from 2.5 ns to 2.6 ns</li> <li>– change output disable time nOEBA to nAx, nOEAB to nBx t<sub>PHZ</sub> (Max.) time from 4.7 ns to 4.8 ns</li> <li>– change output disable time nOEB̄A to nAx, nOEB̄B to nBx t<sub>PLZ</sub> (Max.) time from 4.0 ns to 4.2 ns</li> <li>– change output disable time nEB̄A to nAx, nEB̄B to nBx t<sub>PHZ</sub> (Max.) time from 4.5 ns to 4.9 ns</li> <li>– change output disable time nEB̄A to nAx, nEB̄B to nBx t<sub>PLZ</sub> (Max.) time from 3.8 ns to 4.2 ns</li> </ul> </li> <li>● AC Setup Requirements (3.3 V ± 0.3 V range) table on page 8: <ul style="list-style-type: none"> <li>– change setup time nAx to nLEAB, nBx to nLEB̄A t<sub>s</sub>(H) (Min.) from 0.0 ns to 0.5 ns; (Typ.) from –0.8 ns to 0 ns</li> <li>– change setup time nAx to nLEAB, nBx to nLEB̄A t<sub>s</sub>(L) (Typ.) from –0.3 ns to –0.4 ns</li> <li>– change hold time nAx to nLEAB, nBx to nLEB̄A t<sub>h</sub>(H) (Typ.) from 0.4 ns to 0.2 ns</li> <li>– change hold time nAx to nLEAB, nBx to nLEB̄A t<sub>h</sub>(L) (Typ.) from 0.8 ns to –0.3 ns</li> <li>– change setup time nAx to nEAB, nBx to nEB̄A t<sub>s</sub>(H) (Typ.) from –0.8 ns to –0.3 ns</li> <li>– change setup time nAx to nEAB, nBx to nEB̄A t<sub>s</sub>(L) (Typ.) from –0.2 ns to –0.6 ns</li> <li>– change hold time nAx to nEAB, nBx to nEB̄A t<sub>h</sub>(H) (Typ.) from 0.3 ns to 0.6 ns</li> <li>– change hold time nAx to nEAB, nBx to nEB̄A t<sub>h</sub>(L) (Typ.) from 1.1 ns to 0.1 ns</li> </ul> </li> <li>● AC Setup Requirements (2.5 V ± 0.2 V range) table on page 9: <ul style="list-style-type: none"> <li>– change setup time nAx to nLEAB, nBx to nLEB̄A t<sub>s</sub>(H) (Min.) from 0 ns to 0.5 ns; (Typ.) from –0.9 ns to –0.2 ns</li> <li>– change setup time nAx to nLEAB, nBx to nLEB̄A t<sub>s</sub>(L) (Typ.) from 0.2 ns to –0.5 ns</li> <li>– change hold time nAx to nLEAB, nBx to nLEB̄A t<sub>h</sub>(H) (Min.) from 0.8 ns to 1.0 ns; (Typ.) from –0.2 ns to 0.2 ns</li> <li>– change hold time nAx to nLEAB, nBx to nLEB̄A t<sub>h</sub>(L) (Min.) from 1.7 ns to 1.0 ns; (Typ.) from 1.0 ns to –0.2 ns</li> <li>– change setup time nAx to nEAB, nBx to nEB̄A t<sub>s</sub>(H) (Min.) from 0 ns to 0.5 ns; (Typ.) from –1.0 ns to –0.3 ns</li> <li>– change setup time nAx to nEAB, nBx to nEB̄A t<sub>s</sub>(L) (Typ.) from 0.4 ns to –0.6 ns</li> <li>– change hold time nAx to nEAB, nBx to nEB̄A t<sub>h</sub>(H) (Min.) from 0.5 ns to 1.2 ns; (Typ.) from 0.2 ns to 0 ns</li> <li>– change hold time nAx to nEAB, nBx to nEB̄A t<sub>h</sub>(L) (Min.) from 2.0 ns to 1.5 ns; (Typ.) from 1.3 ns to 0.2 ns</li> </ul> </li> </ul> |
| _2  | 19980213 | <p><b>Product specification (9397 750 03568). ECN 853-1823 18958 of 13 February 1998.</b></p> <p><b>Supersedes data of 1995 Dec 21.</b></p>  |
| _1  | 19951221 |  |

## 2.5 V/3.3 V 16-bit registered transceiver (3-State)

74ALVT16543

## Data sheet status

| Level | Data sheet status <sup>[1]</sup> | Product status <sup>[2] [3]</sup> | Definitions  |
|-------|----------------------------------|-----------------------------------|--|
| I     | Objective data sheet             | Development                       | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.  |
| II    | Preliminary data sheet           | Qualification                     | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.             |
| III   | Product data sheet               | Production                        | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). |

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

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

## 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 60134). 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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Document number:

9397 750 14059

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