



**THE DATASHEET OF  
74ALVT16652DL,512**



# DATA SHEET

## **74ALVT16652**

**2.5V/3.3V 16-bit bus transceiver/register  
(3-State)**

Product specification  
Supersedes data of 1996 Aug 13  
IC23 Data Handbook

1998 Feb 13

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

## 74ALVT16652

### FEATURES

- 16-bit bus interface
- 5V I/O Compatible
- 3-State buffers
- Output capability: +64mA/-32mA
- TTL input and output switching levels
- Input and output interface capability to systems at 5V supply
- Bus-hold data inputs eliminate the need for external pull-up resistors to hold unused inputs
- Live insertion/extraction permitted
- Power-up reset
- Power-up 3-State
- No bus current loading when output is tied to 5V bus
- Latch-up protection exceeds 500mA per JEDEC JC40.2 Std 17
- ESD protection exceeds 2000V per MIL STD 883 Method 3015 and 200V per Machine Model

### DESCRIPTION

The 74ALVT16652 is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 2.5V or 3.3V with I/O compatibility up to 5V. The device can be used as two 8-bit transceivers or one 16-bit transceiver.

Complimentary output-enable (OEAB and  $\overline{OEBA}$ ) inputs are provided to control the transceiver functions. Select-control (SAB and SBA) inputs are provided to select whether real-time or stored data is transferred. A Low-input level selects real-time data, and a High input level selects stored data. The circuitry used for select control eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data.

Data on the A or B bus, or both, can be stored in the internal flip-flops by Low-to-High transitions at the appropriate clock (CPAB or CPBA) inputs regardless of the levels on the select-control or output-enable inputs. When SAB and SBA are in real-time transfer mode, it is possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and OEBA. In this configuration, each output reinforces its input. Thus, when all other data sources to the two sets of bus lines are at high impedance, each set of bus lines remains at its last level configuration.

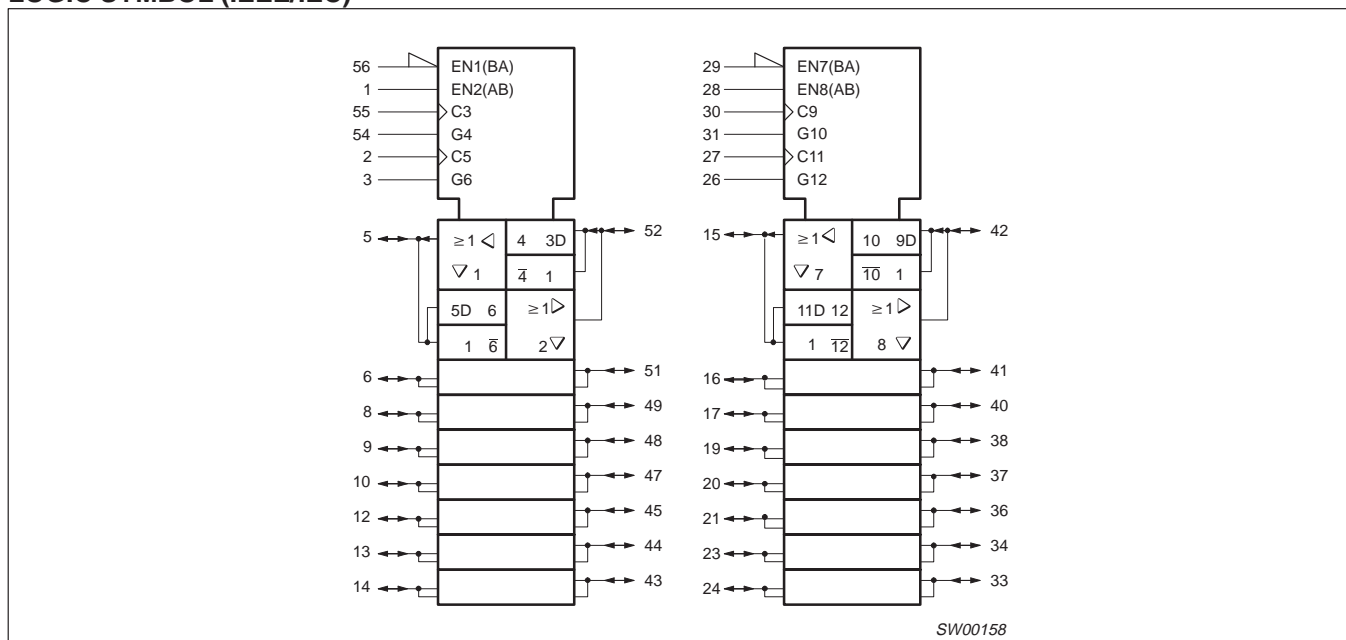
### QUICK REFERENCE DATA

| SYMBOL                 | PARAMETER                                     | CONDITIONS<br>$T_{amb} = 25^{\circ}C$ | TYPICAL    |            | UNIT    |
|------------------------|---|---------------------------------------|------------|------------|---------|
|                        |   |                                       | 2.5V       | 3.3V       |         |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nAx to nBx or nBx to nAx | $C_L = 50pF$                          | 2.0<br>2.1 | 1.5<br>1.6 | ns      |
| $C_{IN}$               | Input capacitance DIR, $\overline{OE}$        | $V_I = 0V$ or $V_{CC}$                | 3          | 3          | pF      |
| $C_{I/O}$              | I/O pin capacitance                           | $V_{I/O} = 0V$ or $V_{CC}$            | 9          | 9          | pF      |
| $I_{CCZ}$              | Total supply current                          | Outputs disabled                      | 40         | 70         | $\mu A$ |

### ORDERING INFORMATION

| PACKAGES                     | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | DWG NUMBER |
|------------------------------|-------------------|-----------------------|---------------|------------|
| 56-Pin Plastic SSOP Type III | -40°C to +85°C    | 74ALVT16652 DL        | AV16652 DL    | SOT371-1   |
| 56-Pin Plastic TSSOP Type II | -40°C to +85°C    | 74ALVT16652 DGG       | AV16652 DGG   | SOT364-1   |

### LOGIC SYMBOL (IEEE/IEC)

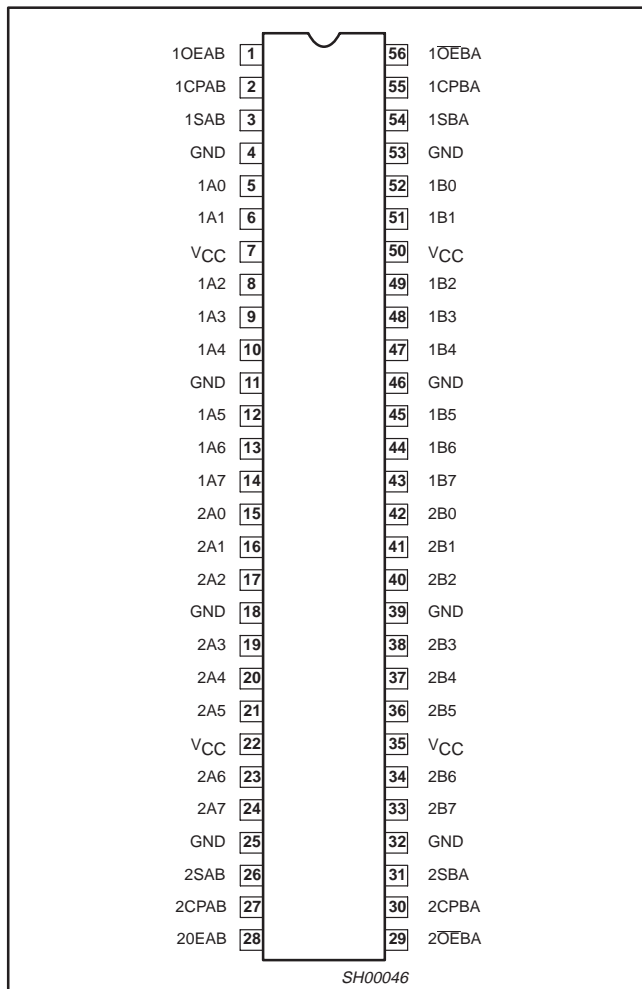


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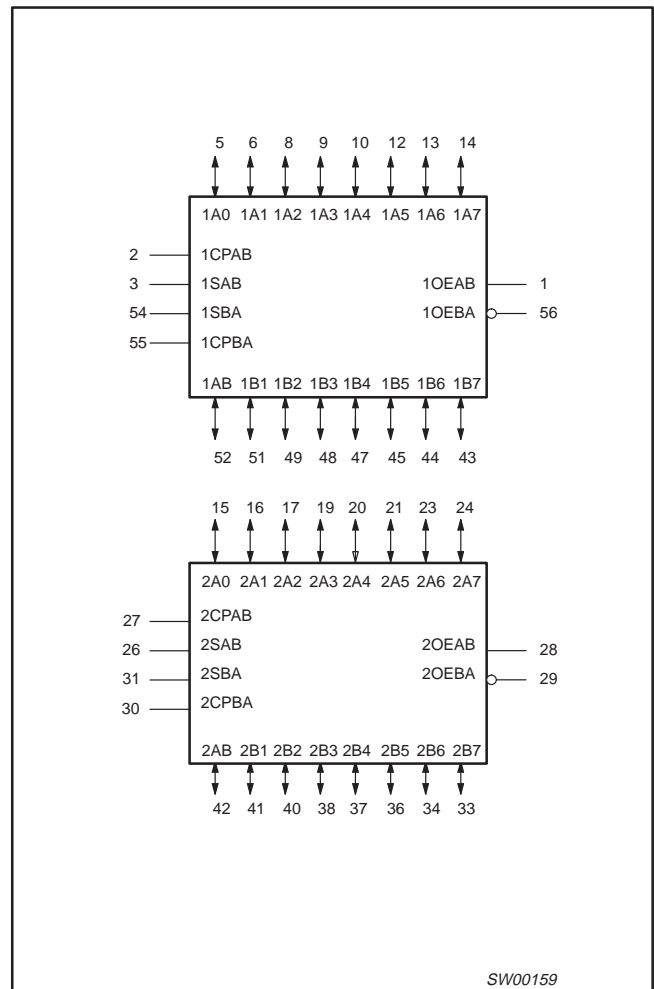
# 2.5V/3.3V 16-bit bus transceiver/register (3-State)

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## PIN CONFIGURATION



## LOGIC SYMBOL



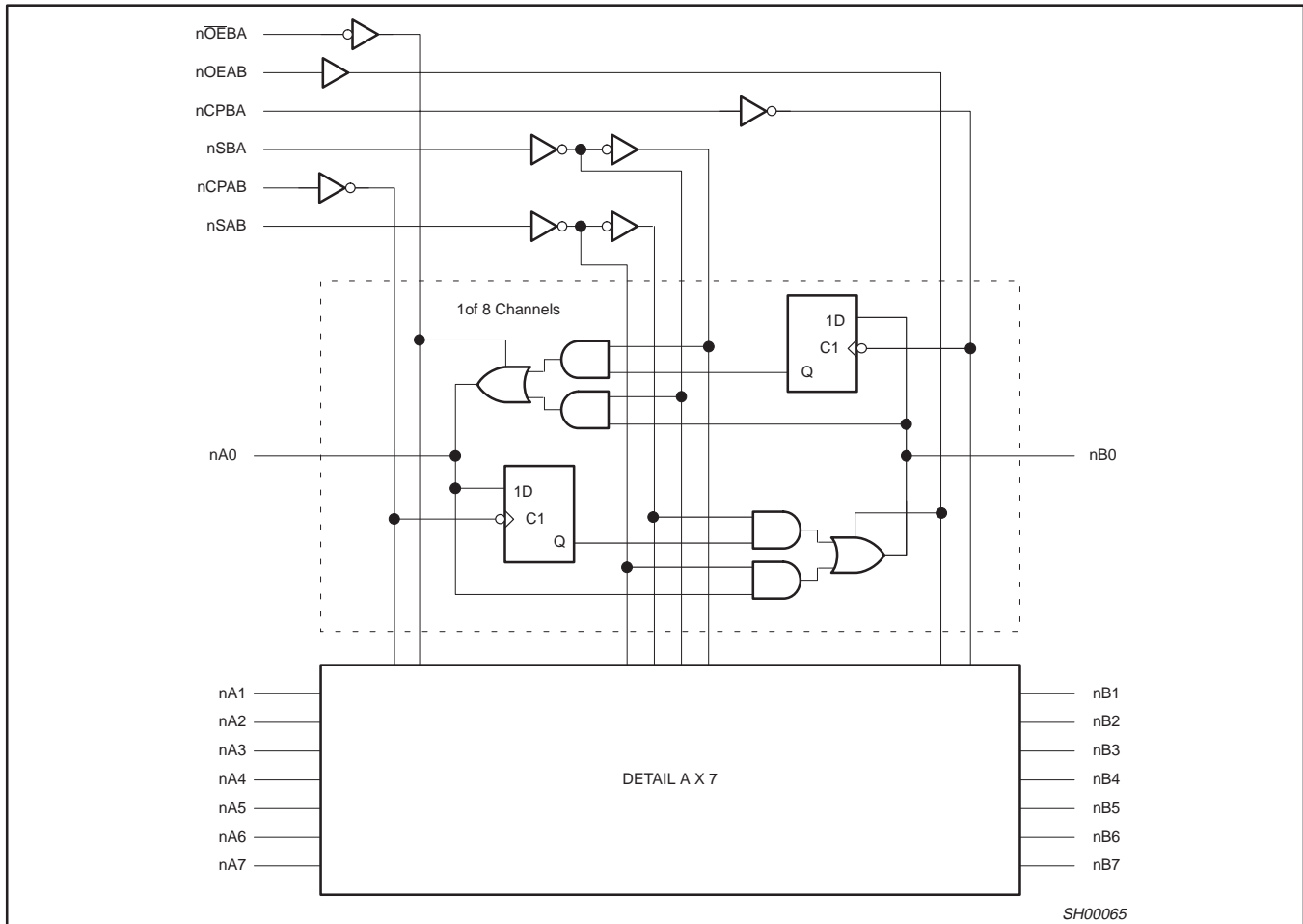
## PIN DESCRIPTION

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

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

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## LOGIC DIAGRAM



SH00065

## FUNCTION TABLE

| INPUTS |       |        |        |      |      | DATA I/O               |                        | OPERATING MODE                                      |
|--------|-------|--------|--------|------|------|------------------------|------------------------|---|
| nOEAB  | nOEBA | nCPAB  | nCPBA  | nSAB | nSBA | nAx                    | nBx                    |   |
| L      | H     | H or L | H or L | X    | X    | Input                  | Input                  | Isolation<br>Store A and B data                     |
| X      | H     | ↑      | H or L | X    | X    | Input                  | Unspecified<br>output* | Store A, Hold B<br>Store A in both registers        |
| L      | X     | H or L | ↑      | X    | X    | Unspecified<br>output* | Input                  | Hold A, Store B<br>Store B in both registers        |
| L      | L     | X      | X      | X    | L    | Output                 | Input                  | Real time B data to A bus<br>Stored B data to A bus |
| H      | H     | X      | X      | L    | X    | Input                  | Output                 | Real time A data to B bus<br>Store A data to B bus  |
| H      | L     | H or L | H or L | H    | H    | Output                 | Output                 | Stored A data to B bus<br>Stored B data to A bus    |

H = High voltage level

L = Low voltage level

X = Don't care

↑ = Low-to-High clock transition

\* The data output function may be enabled or disabled by various signals at the nOEBA and nOEAB inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every Low-to-High transition of the clock.

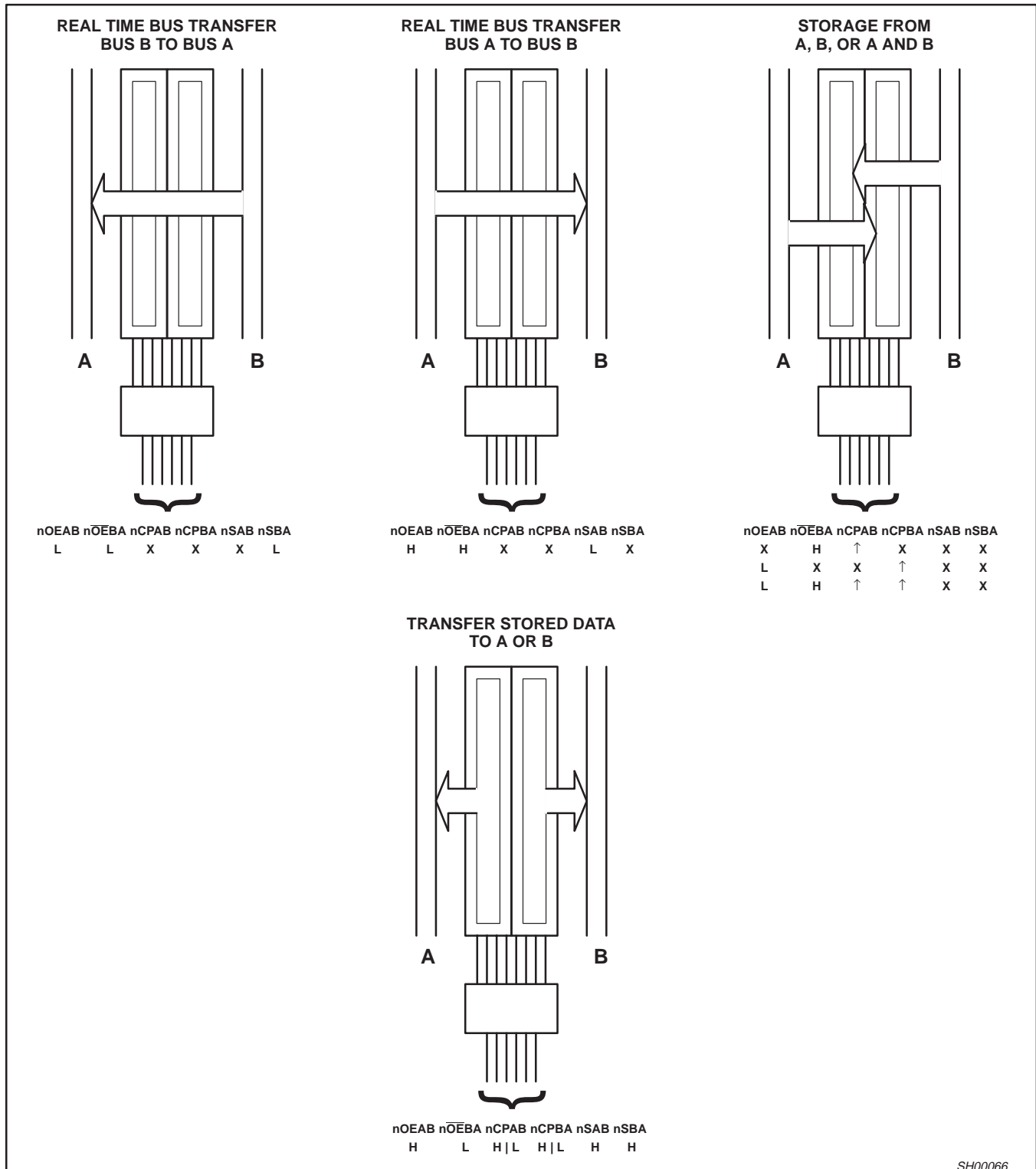
\*\* If both Select controls (nSAB and nSBA) are Low, then clocks can occur simultaneously. If either Select control is High, the clocks must be staggered in order to load both registers.

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

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The following examples demonstrate the four fundamental bus-management functions that can be performed with the 74ALVT16652. The select pins determine whether data is stored or

transferred through the device in real time. The output enable pins determine the direction of the data flow.



SH00066

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

| SYMBOL    | PARAMETER                      | CONDITIONS                  | RATING       | UNIT |
|-----------|--------------------------------|-----------------------------|--------------|------|
| $V_{CC}$  | DC supply voltage              |                             | -0.5 to +4.6 | V    |
| $I_{IK}$  | DC input diode current         | $V_I < 0$                   | -50          | mA   |
| $V_I$     | DC input voltage <sup>3</sup>  |                             | -0.5 to +7.0 | V    |
| $I_{OK}$  | DC output diode current        | $V_O < 0$                   | -50          | mA   |
| $V_{OUT}$ | DC output voltage <sup>3</sup> | Output in Off or High state | -0.5 to +7.0 | V    |
| $I_{OUT}$ | DC output current              | Output in Low state         | 128          | mA   |
|           |                                | Output in High state        | -64          |      |
| $T_{stg}$ | 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   | 2.5V RANGE LIMITS |     | 3.3V RANGE LIMITS |     | UNIT |
|---------------------|---|-------------------|-----|-------------------|-----|------|
|                     |   | MIN               | MAX | MIN               | MAX |      |
| $V_{CC}$            | DC supply voltage   | 2.3               | 2.7 | 3.0               | 3.6 | V    |
| $V_I$               | Input voltage   | 0                 | 5.5 | 0                 | 5.5 | V    |
| $V_{IH}$            | High-level input voltage  | 1.7               |     | 2.0               |     | V    |
| $V_{IL}$            | Input voltage   |                   | 0.7 |                   | 0.8 | V    |
| $I_{OH}$            | High-level output current   |                   | -8  |                   | -32 | mA   |
| $I_{OL}$            | Low-level output current  |                   | 8   |                   | 32  | mA   |
|                     | Low-level output current; current duty cycle $\leq 50\%$ ; $f \geq 1$ kHz |                   | 24  |                   | 64  |      |
| $\Delta t/\Delta v$ | Input transition rise or fall rate; Outputs enabled                       |                   | 10  |                   | 10  | ns/V |
| $T_{amb}$           | Operating free-air temperature range                                      | -40               | +85 | -40               | +85 | °C   |

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

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## DC ELECTRICAL CHARACTERISTICS (3.3V ± 0.3V RANGE)

GND = 0V;  $t_R = t_F = 2.5\text{ns}$ ;  $C_L = 50\text{pF}$ ;  $R_L = 500\Omega$ ;  $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ .

| SYMBOL          | PARAMETER  | TEST CONDITIONS  | LIMITS  |                  |           | UNIT          |
|-----------------|--|--|---|------------------|-----------|---------------|
|                 |  |  | Temp = $-40^\circ\text{C}$ to $+85^\circ\text{C}$ |                  |           |               |
|                 |  |  | MIN   | TYP <sup>1</sup> | MAX       |               |
| $V_{IK}$        | Input clamp voltage  | $V_{CC} = 3.0\text{V}$ ; $I_{IK} = -18\text{mA}$   |   | -0.85            | -1.2      | V             |
| $V_{OH}$        | High-level output voltage                                    | $V_{CC} = 3.0$ to $3.6\text{V}$ ; $I_{OH} = -100\mu\text{A}$   | $V_{CC}-0.2$                                      | $V_{CC}$         |           | V             |
|                 |  | $V_{CC} = 3.0\text{V}$ ; $I_{OH} = -32\text{mA}$   | 2.0   | 2.3              |           |               |
| $V_{OL}$        | Low-level output voltage                                     | $V_{CC} = 3.0\text{V}$ ; $I_{OL} = 100\mu\text{A}$   |   | 0.07             | 0.2       | V             |
|                 |  | $V_{CC} = 3.0\text{V}$ ; $I_{OL} = 16\text{mA}$  |   | 0.25             | 0.4       |               |
|                 |  | $V_{CC} = 3.0\text{V}$ ; $I_{OL} = 32\text{mA}$  |   | 0.3              | 0.5       |               |
|                 |  | $V_{CC} = 3.0\text{V}$ ; $I_{OL} = 64\text{mA}$  |   | 0.4              | 0.55      |               |
| $V_{RST}$       | Power-up output low voltage <sup>6</sup>                     | $V_{CC} = 3.6\text{V}$ ; $I_O = 1\text{mA}$ ; $V_I = V_{CC}$ or GND  |   |                  | 0.55      | V             |
| $I_I$           | Input leakage current  | $V_{CC} = 3.6\text{V}$ ; $V_I = V_{CC}$ or GND   | Control pins                                      | 0.1              | $\pm 1$   | $\mu\text{A}$ |
|                 |  | $V_{CC} = 0$ or $3.6\text{V}$ ; $V_I = 5.5\text{V}$  |   | 0.1              | 10        |               |
|                 |  | $V_{CC} = 3.6\text{V}$ ; $V_I = 5.5\text{V}$   | I/O Data pins <sup>4</sup>                        | 0.1              | 20        |               |
|                 |  | $V_{CC} = 3.6\text{V}$ ; $V_I = V_{CC}$  |   | 0.5              | 10        |               |
|                 |  | $V_{CC} = 3.6\text{V}$ ; $V_I = 0$   |   | 0.1              | -5        |               |
| $I_{OFF}$       | Off current  | $V_{CC} = 0\text{V}$ ; $V_I$ or $V_O = 0$ to $4.5\text{V}$   |   | 0.1              | $\pm 100$ | $\mu\text{A}$ |
| $I_{HOLD}$      | Bus Hold current<br>Data inputs <sup>7</sup>                 | $V_{CC} = 3\text{V}$ ; $V_I = 0.8\text{V}$   | 75  | 130              |           | $\mu\text{A}$ |
|                 |  | $V_{CC} = 3\text{V}$ ; $V_I = 2.0\text{V}$   | -75   | -140             |           | $\mu\text{A}$ |
|                 |  | $V_{CC} = 3.0\text{V}$ ; $V_I = 0\text{V}$ to $3.6\text{V}$  | $\pm 500$   |                  |           | $\mu\text{A}$ |
| $I_{EX}$        | Current into an output in the High state when $V_O > V_{CC}$ | $V_O = 5.5\text{V}$ ; $V_{CC} = 3.0\text{V}$   |   | 50               | 125       | $\mu\text{A}$ |
| $I_{PU/PD}$     | Power up/down 3-State output current <sup>3</sup>            | $V_{CC} \leq 1.2\text{V}$ ; $V_O = 0.5\text{V}$ to $V_{CC}$ ; $V_I = \text{GND}$ or $V_{CC}$<br>OE/OE = Don't care |   | 40               | $\pm 100$ | $\mu\text{A}$ |
| $I_{CCH}$       | Quiescent supply current                                     | $V_{CC} = 3.6\text{V}$ ; Outputs High, $V_I = \text{GND}$ or $V_{CC}$ , $I_O = 0$                                  |   | 0.07             | 0.14      | mA            |
| $I_{CCL}$       |  | $V_{CC} = 3.6\text{V}$ ; Outputs Low, $V_I = \text{GND}$ or $V_{CC}$ , $I_O = 0$                                   |   | 3.2              | 7         |               |
| $I_{CCZ}$       |  | $V_{CC} = 3.6\text{V}$ ; Outputs Disabled; $V_I = \text{GND}$ or $V_{CC}$ , $I_O = 0^5$                            |   | 0.07             | 0.14      |               |
| $\Delta I_{CC}$ | Additional supply current per input pin <sup>2</sup>         | $V_{CC} = 3\text{V}$ to $3.6\text{V}$ ; One input at $V_{CC}-0.6\text{V}$ ,<br>Other inputs at $V_{CC}$ or GND     |   | 0.04             | 0.4       | mA            |

### NOTES:

- All typical values are at  $V_{CC} = 3.3\text{V}$  and  $T_{\text{amb}} = 25^\circ\text{C}$ .
- This is the increase in supply current for each input at the specified voltage level other than  $V_{CC}$  or GND
- This parameter is valid for any  $V_{CC}$  between 0V and 1.2V with a transition time of up to 10msec. From  $V_{CC} = 1.2\text{V}$  to  $V_{CC} = 3.3\text{V} \pm 0.3\text{V}$  a transition time of 100 $\mu\text{sec}$  is permitted. This parameter is valid for  $T_{\text{amb}} = 25^\circ\text{C}$  only.
- Unused pins at  $V_{CC}$  or GND.
- $I_{CCZ}$  is measured with outputs pulled up to  $V_{CC}$  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.

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

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### AC CHARACTERISTICS (3.3V ± 0.3V RANGE)

GND = 0V;  $t_R = t_F = 2.5\text{ns}$ ;  $C_L = 50\text{pF}$ ;  $R_L = 500\Omega$ ;  $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ .

| SYMBOL                               | PARAMETER   | WAVEFORM | LIMITS                   |                  |            | UNIT |
|--------------------------------------|---|----------|--------------------------|------------------|------------|------|
|                                      |   |          | $V_{CC} = 3.3V \pm 0.3V$ |                  |            |      |
|                                      |   |          | MIN                      | TYP <sup>1</sup> | MAX        |      |
| $f_{\text{MAX}}$                     | Maximum clock frequency                           | 1        | 150                      | 300              |            | MHz  |
| $t_{\text{PLH}}$<br>$t_{\text{PHL}}$ | Propagation delay<br>nCPAB to nBx or nCPBA to nAx | 1        | 1.0<br>1.0               | 2.4<br>2.1       | 3.6<br>3.2 | ns   |
| $t_{\text{PLH}}$<br>$t_{\text{PHL}}$ | Propagation delay<br>nAx to nBx or nBx to nAx     | 2        | 0.5<br>0.5               | 1.5<br>1.6       | 2.5<br>2.7 | ns   |
| $t_{\text{PLH}}$<br>$t_{\text{PHL}}$ | Propagation delay<br>nSAB to nBx or nSBA to nAx   | 3        | 0.5<br>0.5               | 2.4<br>2.1       | 3.9<br>3.9 | ns   |
| $t_{\text{PZH}}$<br>$t_{\text{PZL}}$ | Output enable time<br>nOEBA to nAx                | 5<br>6   | 0.5<br>0.5               | 2.3<br>1.5       | 3.6<br>2.5 | ns   |
| $t_{\text{PHZ}}$<br>$t_{\text{PLZ}}$ | Output disable time<br>nOEBA to nAx               | 5<br>6   | 1.5<br>1.0               | 3.4<br>2.6       | 5.0<br>3.8 | ns   |
| $t_{\text{PZH}}$<br>$t_{\text{PZL}}$ | Output enable time<br>nOEAB to nBx                | 5<br>6   | 0.5<br>0.5               | 2.4<br>1.7       | 3.6<br>2.6 | ns   |
| $t_{\text{PHZ}}$<br>$t_{\text{PLZ}}$ | Output disable time<br>nOEAB to nBx               | 5<br>6   | 1.5<br>1.5               | 3.8<br>3.1       | 5.8<br>4.5 | ns   |

#### NOTE:

1. All typical values are at  $V_{CC} = 3.3V$  and  $T_{\text{amb}} = 25^\circ\text{C}$ .

### AC SETUP REQUIREMENTS (3.3V ± 0.3V RANGE)

GND = 0V,  $t_R = 2.5\text{ns}$ ,  $t_F = 2.5\text{ns}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 500\Omega$ ,  $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

| SYMBOL                             | PARAMETER                                  | WAVEFORM | LIMITS                   |              | UNIT |
|------------------------------------|--|----------|--------------------------|--------------|------|
|                                    |  |          | $V_{CC} = 3.3V \pm 0.3V$ |              |      |
|                                    |  |          | MIN                      | TYP          |      |
| $t_s(\text{H})$<br>$t_s(\text{L})$ | Setup time<br>nAx to nCPAB, nBx to nCPBA   | 4        | 1.6<br>1.6               | 0.8<br>0.6   | ns   |
| $t_h(\text{H})$<br>$t_h(\text{L})$ | Hold time<br>nAx to nCPAB, nBx to nCPBA    | 4        | 0.5<br>0                 | -0.5<br>-0.8 | ns   |
| $t_w(\text{H})$<br>$t_w(\text{L})$ | Pulse width, High or Low<br>nCPAB or nCPBA | 1        | 1.5<br>1.5               |              | ns   |

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

74ALVT16652

## DC ELECTRICAL CHARACTERISTICS (2.5V ± 0.2V RANGE)

GND = 0V;  $t_R = t_F = 2.5\text{ns}$ ;  $C_L = 50\text{pF}$ ;  $R_L = 500\Omega$ ;  $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ .

| SYMBOL          | PARAMETER  | TEST CONDITIONS  | LIMITS  |                  |      | UNIT |
|-----------------|--|--|---|------------------|------|------|
|                 |  |  | Temp = $-40^\circ\text{C}$ to $+85^\circ\text{C}$ |                  |      |      |
|                 |  |  | MIN   | TYP <sup>1</sup> | MAX  |      |
| $V_{IK}$        | Input clamp voltage  | $V_{CC} = 2.3\text{V}$ ; $I_{IK} = -18\text{mA}$   |   | -0.85            | -1.2 | V    |
| $V_{OH}$        | High-level output voltage                                    | $V_{CC} = 2.3$ to $3.6\text{V}$ ; $I_{OH} = -100\mu\text{A}$   | $V_{CC}-0.2$                                      | $V_{CC}$         |      | V    |
|                 |  | $V_{CC} = 2.3\text{V}$ ; $I_{OH} = -8\text{mA}$  | 1.8   | 2.1              |      |      |
| $V_{OL}$        | Low-level output voltage                                     | $V_{CC} = 2.3\text{V}$ ; $I_{OL} = 100\mu\text{A}$   |   | 0.07             | 0.2  | V    |
|                 |  | $V_{CC} = 2.3\text{V}$ ; $I_{OL} = 24\text{mA}$  |   | 0.3              | 0.5  |      |
|                 |  | $V_{CC} = 2.3\text{V}$ ; $I_{OL} = 8\text{mA}$   |   |                  | 0.4  |      |
| $V_{RST}$       | Power-up output low voltage <sup>7</sup>                     | $V_{CC} = 2.7\text{V}$ ; $I_O = 1\text{mA}$ ; $V_I = V_{CC}$ or GND  |   |                  | 0.55 | V    |
| $I_I$           | Input leakage current  | $V_{CC} = 2.7\text{V}$ ; $V_I = \text{GND}$  | Control pins                                      | 0.1              | ±1   | μA   |
|                 |  | $V_{CC} = 0$ or $2.7\text{V}$ ; $V_I = 5.5\text{V}$  |   | 0.1              | 10   |      |
|                 |  | $V_{CC} = 2.7\text{V}$ ; $V_I = 5.5\text{V}$   | I/O Data pins <sup>4</sup>                        | 0.1              | 20   |      |
|                 |  | $V_{CC} = 2.7\text{V}$ ; $V_I = V_{CC}$  |   | 0.1              | 10   |      |
|                 |  | $V_{CC} = 2.7\text{V}$ ; $V_I = 0$   |   | 0.1              | -5   |      |
| $I_{OFF}$       | Off current  | $V_{CC} = 0\text{V}$ ; $V_I$ or $V_O = 0$ to $4.5\text{V}$   |   | 0.1              | ±100 | μA   |
| $I_{HOLD}$      | Bus Hold current<br>A or B inputs <sup>6</sup>               | $V_{CC} = 2.3\text{V}$ ; $V_I = 0.7\text{V}$   |   | 90               |      | μA   |
|                 |  | $V_{CC} = 2.3\text{V}$ ; $V_I = 1.7\text{V}$   |   | -10              |      | μA   |
| $I_{EX}$        | Current into an output in the High state when $V_O > V_{CC}$ | $V_O = 5.5\text{V}$ ; $V_{CC} = 2.3\text{V}$   |   | 50               | 125  | μA   |
| $I_{PU/PD}$     | Power up/down 3-State output current <sup>3</sup>            | $V_{CC} \leq 1.2\text{V}$ ; $V_O = 0.5\text{V}$ to $V_{CC}$ ; $V_I = \text{GND}$ or $V_{CC}$<br>OE/OE = Don't care |   | 40               | 100  | μA   |
| $I_{CCH}$       | Quiescent supply current                                     | $V_{CC} = 2.7\text{V}$ ; Outputs High, $V_I = \text{GND}$ or $V_{CC}$ , $I_O = 0$                                  |   | 0.04             | 0.1  | mA   |
| $I_{CCL}$       |  | $V_{CC} = 2.7\text{V}$ ; Outputs Low, $V_I = \text{GND}$ or $V_{CC}$ , $I_O = 0$                                   |   | 2.5              | 4.5  |      |
| $I_{CCZ}$       |  | $V_{CC} = 2.7\text{V}$ ; Outputs Disabled; $V_I = \text{GND}$ or $V_{CC}$ , $I_O = 0^5$                            |   | 0.04             | 0.1  |      |
| $\Delta I_{CC}$ | Additional supply current per input pin <sup>2</sup>         | $V_{CC} = 2.3\text{V}$ to $2.7\text{V}$ ; One input at $V_{CC}-0.6\text{V}$ ,<br>Other inputs at $V_{CC}$ or GND   |   | 0.01             | 0.4  | mA   |

### NOTES:

- All typical values are at  $V_{CC} = 2.5\text{V}$  and  $T_{\text{amb}} = 25^\circ\text{C}$ .
- This is the increase in supply current for each input at the specified voltage level other than  $V_{CC}$  or GND
- This parameter is valid for any  $V_{CC}$  between 0V and 1.2V with a transition time of up to 10msec. From  $V_{CC} = 1.2\text{V}$  to  $V_{CC} = 2.5\text{V} \pm 0.2\text{V}$  a transition time of 100μsec is permitted. This parameter is valid for  $T_{\text{amb}} = 25^\circ\text{C}$  only.
- Unused pins at  $V_{CC}$  or GND.
- $I_{CCZ}$  is measured with outputs pulled up to  $V_{CC}$  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.

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

74ALVT16652

## AC CHARACTERISTICS (2.5V ± 0.2V RANGE)

GND = 0V;  $t_R = t_F = 2.5\text{ns}$ ;  $C_L = 50\text{pF}$ ;  $R_L = 500\Omega$ ;  $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ .

| SYMBOL                               | PARAMETER   | WAVEFORM | LIMITS                   |                  |            | UNIT |
|--------------------------------------|---|----------|--------------------------|------------------|------------|------|
|                                      |   |          | $V_{CC} = 2.5V \pm 0.2V$ |                  |            |      |
|                                      |   |          | MIN                      | TYP <sup>1</sup> | MAX        |      |
| $f_{\text{MAX}}$                     | Maximum clock frequency                           | 1        | 150                      | 200              |            | MHz  |
| $t_{\text{PLH}}$<br>$t_{\text{PHL}}$ | Propagation delay<br>nCPAB to nBx or nCPBA to nAx | 1        | 1.0<br>1.0               | 3.0<br>2.7       | 4.9<br>4.2 | ns   |
| $t_{\text{PLH}}$<br>$t_{\text{PHL}}$ | Propagation delay<br>nAx to nBx or nBx to nAx     | 2        | 0.5<br>0.5               | 2.0<br>2.1       | 3.2<br>3.5 | ns   |
| $t_{\text{PLH}}$<br>$t_{\text{PHL}}$ | Propagation delay<br>nSAB to nBx or nSBA to nAx   | 3        | 1.5<br>1.5               | 3.4<br>3.2       | 5.2<br>5.8 | ns   |
| $t_{\text{PZH}}$<br>$t_{\text{PZL}}$ | Output enable time<br>nOEBA to nAx                | 5<br>6   | 1.5<br>0.5               | 3.2<br>2.0       | 4.7<br>3.2 | ns   |
| $t_{\text{PHZ}}$<br>$t_{\text{PLZ}}$ | Output disable time<br>nOEBA to nAx               | 5<br>6   | 1.5<br>1.8               | 3.2<br>2.3       | 4.8<br>3.5 | ns   |
| $t_{\text{PZH}}$<br>$t_{\text{PZL}}$ | Output enable time<br>nOEAB to nBx                | 5<br>6   | 1.5<br>1.0               | 3.3<br>2.5       | 4.9<br>3.6 | ns   |
| $t_{\text{PHZ}}$<br>$t_{\text{PLZ}}$ | Output disable time<br>nOEAB to nBx               | 5<br>6   | 2.0<br>1.0               | 3.9<br>2.3       | 5.9<br>6.0 | ns   |

**NOTE:**

1. All typical values are at  $V_{CC} = 3.3V$  and  $T_{\text{amb}} = 25^\circ\text{C}$ .

## AC SETUP REQUIREMENTS (2.5V ± 0.2V RANGE)

GND = 0V,  $t_R = 2.5\text{ns}$ ,  $t_F = 2.5\text{ns}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 500\Omega$ ,  $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

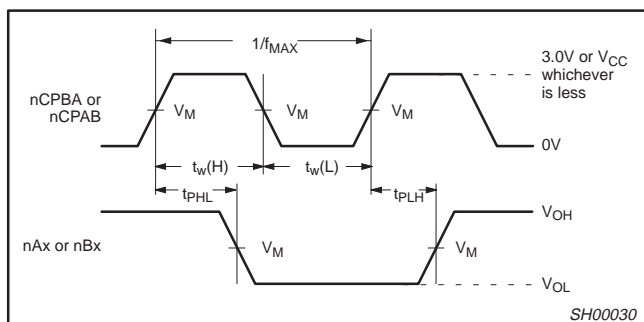
| SYMBOL                             | PARAMETER   | WAVEFORM | LIMITS                   |              | UNIT |
|------------------------------------|---|----------|--------------------------|--------------|------|
|                                    |   |          | $V_{CC} = 2.5V \pm 0.2V$ |              |      |
|                                    |   |          | MIN                      | TYP          |      |
| $t_s(\text{H})$<br>$t_s(\text{L})$ | Setup time <sup>1</sup><br>nAx to nCPAB, nBx to nCPBA | 4        | 1.8<br>2.0               | 0.9<br>1.0   | ns   |
| $t_h(\text{H})$<br>$t_h(\text{L})$ | Hold time <sup>1</sup><br>nAx to nCPAB, nBx to nCPBA  | 4        | 0.0<br>0.0               | -1.0<br>-1.0 | ns   |
| $t_w(\text{H})$<br>$t_w(\text{L})$ | Pulse width, High or Low<br>nCPAB or nCPBA            | 1        | 1.5<br>1.5               |              | ns   |

**NOTE:**

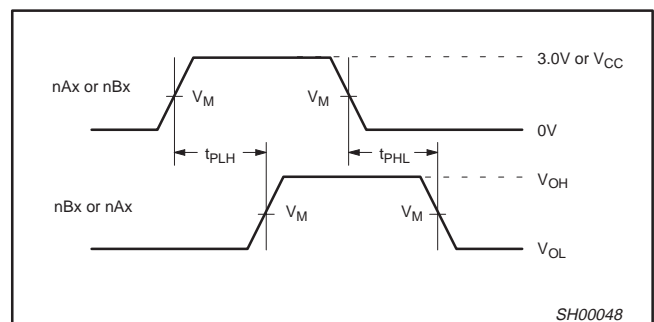
1. This data sheet limit may vary among suppliers.

## AC WAVEFORMS

$V_M = 1.5V$  at  $V_{CC} \geq 3.0V$ ;  $V_M = V_{CC}/2$  at  $V_{CC} \leq 2.7V$   
 $V_X = V_{OL} + 0.3V$  at  $V_{CC} \geq 3.0V$ ;  $V_X = V_{OL} + 0.15V$  at  $V_{CC} \leq 2.7V$   
 $V_Y = V_{OH} - 0.3V$  at  $V_{CC} \geq 3.0V$ ;  $V_Y = V_{OH} - 0.15V$  at  $V_{CC} \leq 2.7V$



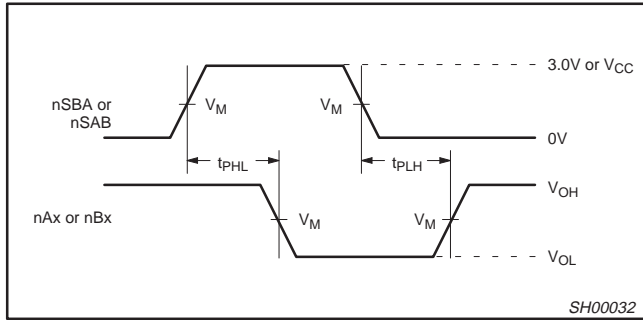
Waveform 1. Propagation Delay, Clock Input to Output, Clock Pulse Width, and Maximum Clock Frequency



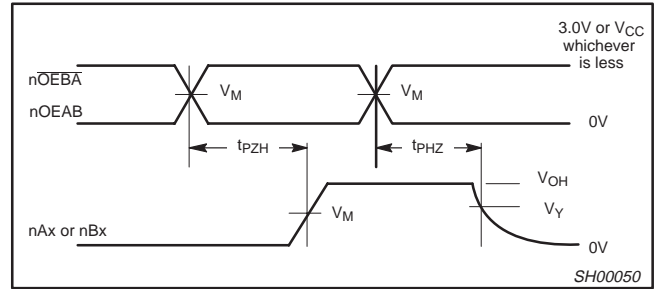
Waveform 2. Propagation Delay, nAx to nBx or nBx to nAx

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

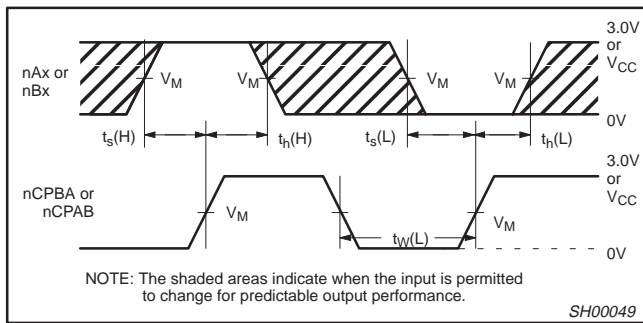
74ALVT16652



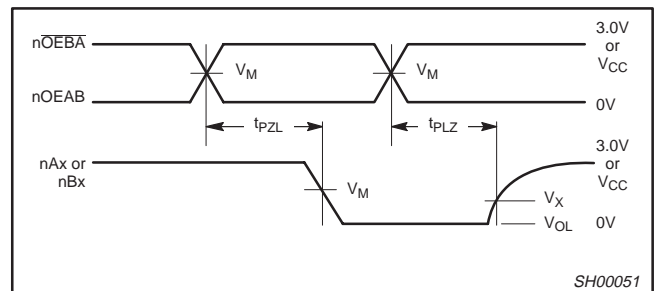
Waveform 3. Propagation Delay, SBA to nAx or SAB to nBx



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



Waveform 4. Data Setup and Hold Times



Waveform 6. 3-State Output Enable Time to Low Level and Output Disable Time from Low Level

## TEST CIRCUIT AND WAVEFORMS

**Test Circuit for 3-State Outputs**

**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.

SW00025

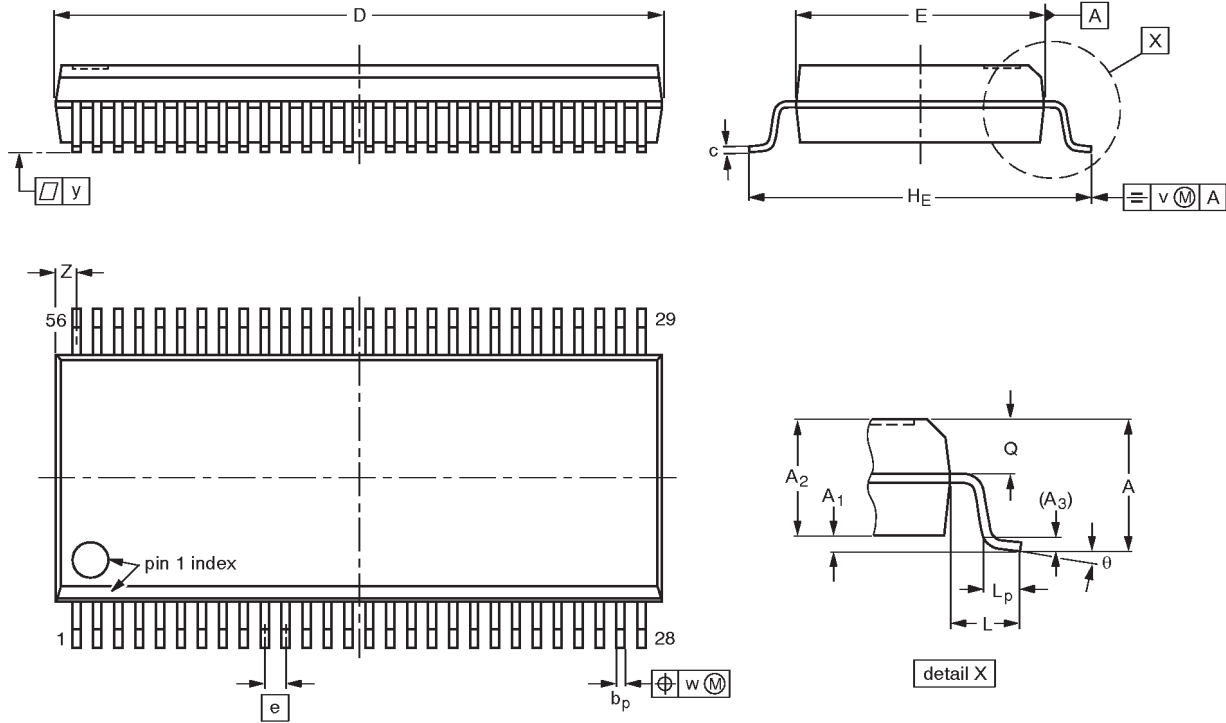
| FAMILY   | INPUT PULSE REQUIREMENTS           |                     |       |                     |                     |
|----------|------------------------------------|---------------------|-------|---------------------|---------------------|
|          | Amplitude                          | Rep. Rate           | $t_w$ | $t_R$               | $t_F$               |
| 74ALVT16 | 3.0V or $V_{CC}$ whichever is less | $\leq 10\text{MHz}$ | 500ns | $\leq 2.5\text{ns}$ | $\leq 2.5\text{ns}$ |

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

74ALVT16652

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.

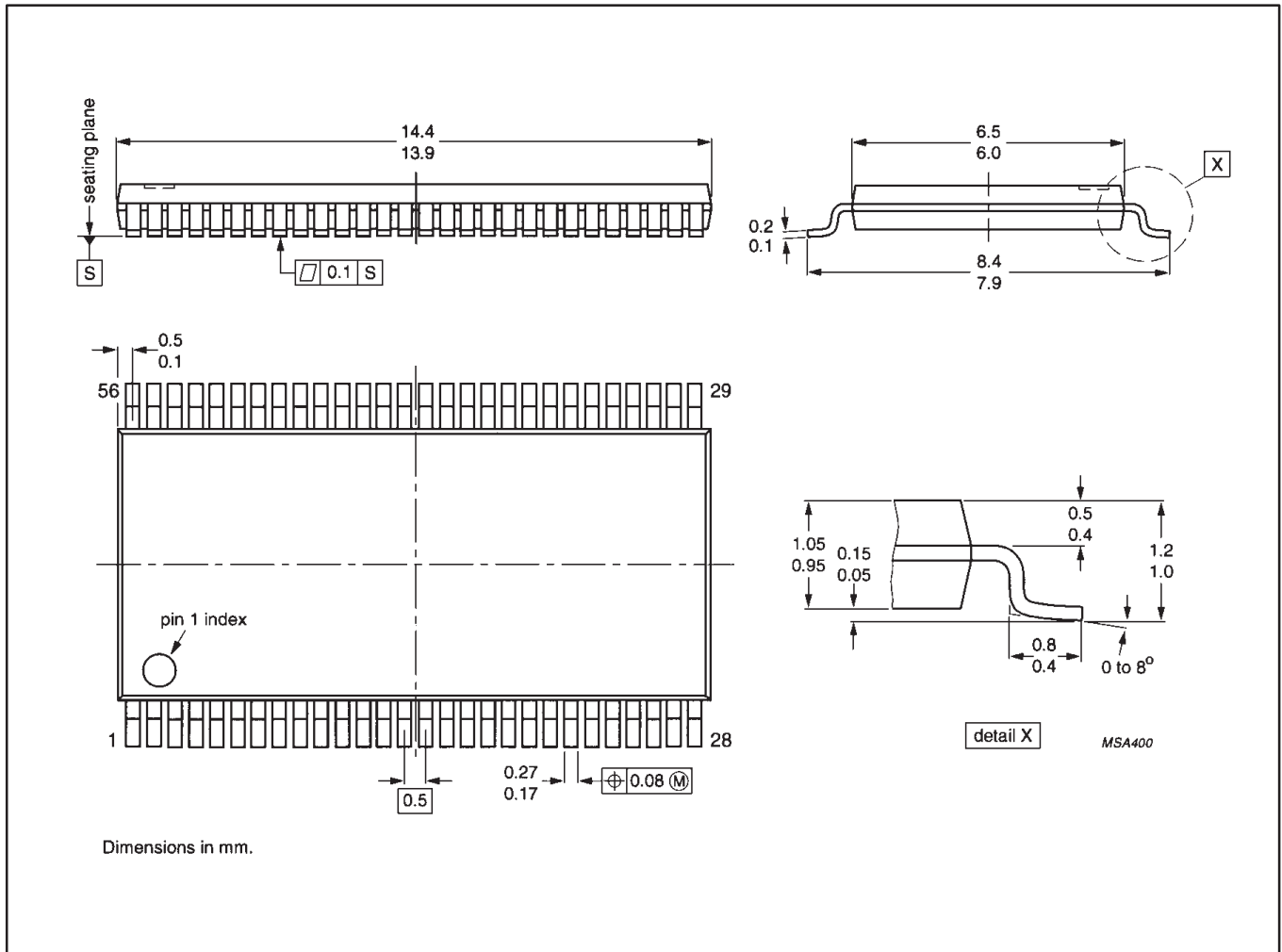
| OUTLINE VERSION | REFERENCES |          |      |  | EUROPEAN PROJECTION | ISSUE DATE           |
|-----------------|------------|----------|------|--|---------------------|----------------------|
|                 | IEC        | JEDEC    | EIAJ |  |                     |                      |
| SOT371-1        |            | MO-118AB |      |  |                     | 93-11-02<br>95-02-04 |

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

## 74ALVT16652

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

**SOT364-1**



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

74ALVT16652

**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.

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print code

Date of release: 05-96

Document order number:

9397-750-03573

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