



## 3.3V CMOS 16-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS

**IDT74ALVC16245**

### FEATURES:

- 0.5 MICRON CMOS Technology
- Typical  $t_{sk(o)}$  (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- $V_{CC} = 3.3V \pm 0.3V$ , Normal Range
- $V_{CC} = 2.7V$  to  $3.6V$ , Extended Range
- $V_{CC} = 2.5V \pm 0.2V$
- CMOS power levels (0.4 $\mu$  W typ. static)
- Rail-to-Rail output swing for increased noise margin
- Available in TSSOP package

### DRIVE FEATURES:

- High Output Drivers:  $\pm 24mA$
- Suitable for heavy loads

### DESCRIPTION:

This 16-bit bus transceiver is built using advanced dual metal CMOS technology. The ALVC16245 is designed for asynchronous communication between data buses. The control-function implementation minimizes external timing requirements.

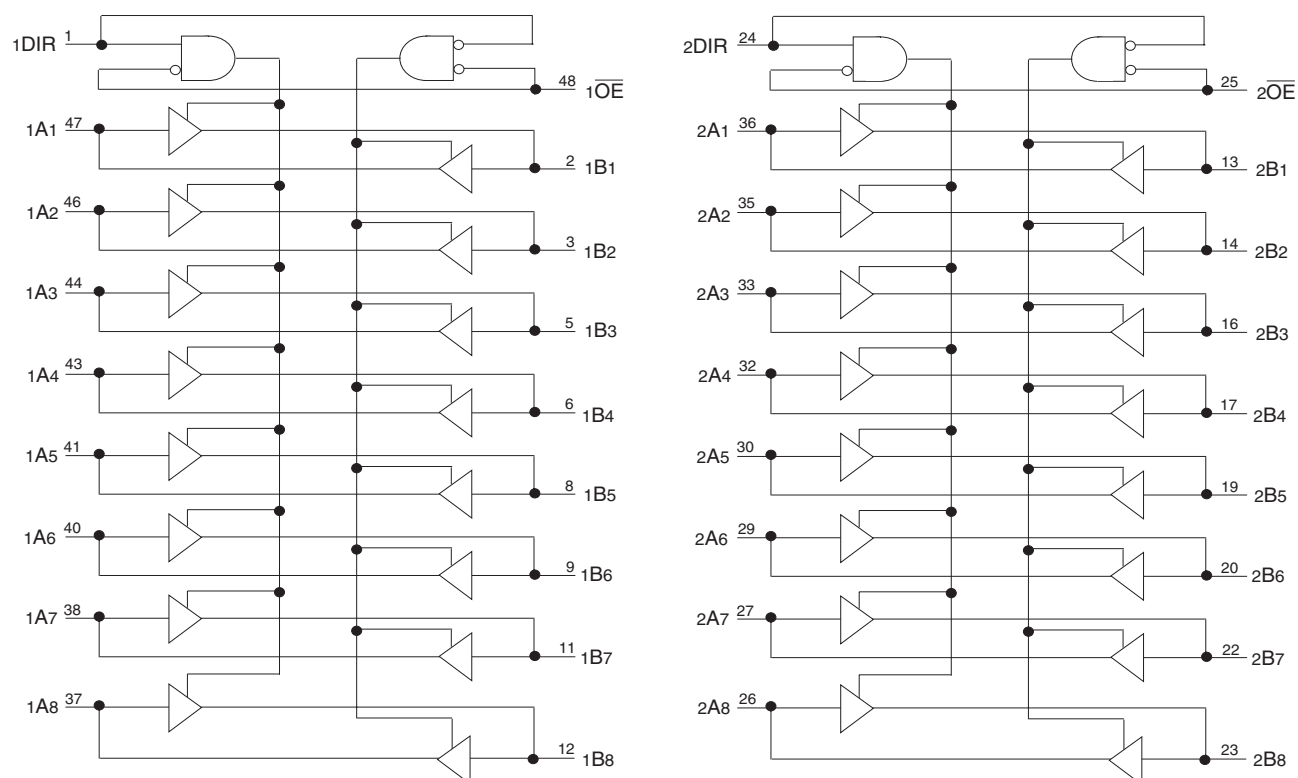
This device can be used as two 8-bit transceivers or one 16-bit transceiver. It allows data transmission from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so that the buses are effectively isolated.

The ALVC16245 has been designed with a  $\pm 24mA$  output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

### APPLICATIONS:

- 3.3V high speed systems
- 3.3V and lower voltage computing systems

### FUNCTIONAL BLOCK DIAGRAM

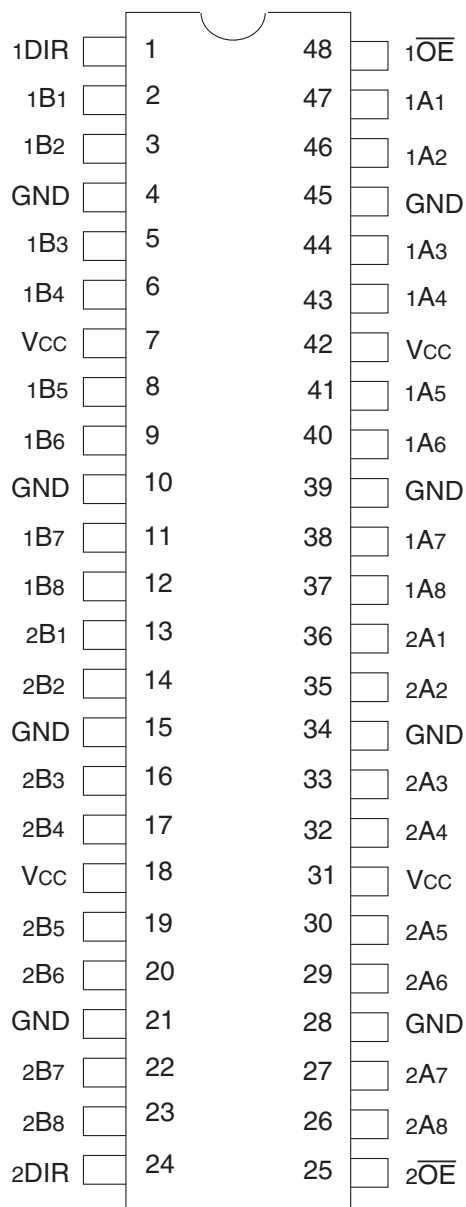


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**INDUSTRIAL TEMPERATURE RANGE**

**JUNE 2009**

## PIN CONFIGURATION



TSSOP  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol                             | Description                                                                         | Max                          | Unit |
|------------------------------------|-------------------------------------------------------------------------------------|------------------------------|------|
| V <sub>TERM</sub> <sup>(2)</sup>   | Terminal Voltage with Respect to GND                                                | -0.5 to +4.6                 | V    |
| V <sub>TERM</sub> <sup>(3)</sup>   | Terminal Voltage with Respect to GND                                                | -0.5 to V <sub>CC</sub> +0.5 | V    |
| T <sub>STG</sub>                   | Storage Temperature                                                                 | -65 to +150                  | °C   |
| I <sub>OUT</sub>                   | DC Output Current                                                                   | -50 to +50                   | mA   |
| I <sub>IK</sub>                    | Continuous Clamp Current,<br>V <sub>I</sub> < 0 or V <sub>I</sub> > V <sub>CC</sub> | ±50                          | mA   |
| I <sub>OK</sub>                    | Continuous Clamp Current, V <sub>O</sub> < 0                                        | -50                          | mA   |
| I <sub>CC</sub><br>I <sub>SS</sub> | Continuous Current through each<br>V <sub>CC</sub> or GND                           | ±100                         | mA   |

### NOTES:

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
- V<sub>CC</sub> terminals.
- All terminals except V<sub>CC</sub>.

## CAPACITANCE (T<sub>A</sub> = +25°C, F = 1.0MHz)

| Symbol           | Parameter <sup>(1)</sup> | Conditions            | Typ. | Max. | Unit |
|------------------|--------------------------|-----------------------|------|------|------|
| C <sub>IN</sub>  | Input Capacitance        | V <sub>IN</sub> = 0V  | 5    | 7    | pF   |
| C <sub>OUT</sub> | Output Capacitance       | V <sub>OUT</sub> = 0V | 7    | 9    | pF   |
| C <sub>OUT</sub> | I/O Port Capacitance     | V <sub>IN</sub> = 0V  | 7    | 9    | pF   |

### NOTE:

- As applicable to the device type.

## PIN DESCRIPTION

| Pin Names         | Description                       |
|-------------------|-----------------------------------|
| x $\overline{OE}$ | Output Enable Inputs (Active LOW) |
| xDIR              | Direction Control Inputs          |
| xAx               | Side A Inputs or 3-State Outputs  |
| xBx               | Side B Inputs or 3-State Outputs  |

## FUNCTION TABLE (EACH 8-BIT SECTION)<sup>(1)</sup>

| Inputs            |      | Outputs             |
|-------------------|------|---------------------|
| x $\overline{OE}$ | xDIR |                     |
| L                 | L    | Bus B Data to Bus A |
| L                 | H    | Bus A Data to Bus B |
| H                 | X    | Z                   |

### NOTE:

- H = HIGH Voltage Level  
X = Don't Care  
L = LOW Voltage Level  
Z = High-Impedance

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

| Symbol                              | Parameter                                              | Test Conditions                                                                |                    | Min. | Typ. <sup>(1)</sup> | Max.     | Unit          |
|-------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------------------|--------------------|------|---------------------|----------|---------------|
| $V_{IH}$                            | Input HIGH Voltage Level                               | $V_{CC} = 2.3\text{V}$ to $2.7\text{V}$                                        |                    | 1.7  | —                   | —        | V             |
|                                     |                                                        | $V_{CC} = 2.7\text{V}$ to $3.6\text{V}$                                        |                    | 2    | —                   | —        |               |
| $V_{IL}$                            | Input LOW Voltage Level                                | $V_{CC} = 2.3\text{V}$ to $2.7\text{V}$                                        |                    | —    | —                   | 0.7      | V             |
|                                     |                                                        | $V_{CC} = 2.7\text{V}$ to $3.6\text{V}$                                        |                    | —    | —                   | 0.8      |               |
| $I_{IH}$                            | Input HIGH Current                                     | $V_{CC} = 3.6\text{V}$                                                         | $V_I = V_{CC}$     | —    | —                   | $\pm 5$  | $\mu\text{A}$ |
| $I_{IL}$                            | Input LOW Current                                      | $V_{CC} = 3.6\text{V}$                                                         | $V_I = \text{GND}$ | —    | —                   | $\pm 5$  | $\mu\text{A}$ |
| $I_{OZH}$                           | High Impedance Output Current<br>(3-State Output pins) | $V_{CC} = 3.6\text{V}$                                                         | $V_O = V_{CC}$     | —    | —                   | $\pm 10$ | $\mu\text{A}$ |
| $I_{OZL}$                           |                                                        |                                                                                | $V_O = \text{GND}$ | —    | —                   | $\pm 10$ |               |
| $V_{IK}$                            | Clamp Diode Voltage                                    | $V_{CC} = 2.3\text{V}$ , $I_{IN} = -18\text{mA}$                               |                    | —    | -0.7                | -1.2     | V             |
| $V_H$                               | Input Hysteresis                                       | $V_{CC} = 3.3\text{V}$                                                         |                    | —    | 100                 | —        | mV            |
| $I_{CCL}$<br>$I_{CCH}$<br>$I_{CCZ}$ | Quiescent Power Supply Current                         | $V_{CC} = 3.6\text{V}$<br>$V_{IN} = \text{GND}$ or $V_{CC}$                    |                    | —    | 0.1                 | 40       | $\mu\text{A}$ |
| $\Delta I_{CC}$                     | Quiescent Power Supply Current Variation               | One input at $V_{CC} - 0.6\text{V}$ , other inputs at $V_{CC}$ or $\text{GND}$ |                    | —    | —                   | 750      | $\mu\text{A}$ |

**NOTE:**

1. Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.

## OUTPUT DRIVE CHARACTERISTICS

| Symbol   | Parameter           | Test Conditions <sup>(1)</sup>          |                          | Min.           | Max. | Unit |
|----------|---------------------|-----------------------------------------|--------------------------|----------------|------|------|
| $V_{OH}$ | Output HIGH Voltage | $V_{CC} = 2.3\text{V}$ to $3.6\text{V}$ | $I_{OH} = -0.1\text{mA}$ | $V_{CC} - 0.2$ | —    | V    |
|          |                     | $V_{CC} = 2.3\text{V}$                  | $I_{OH} = -6\text{mA}$   | 2              | —    |      |
|          |                     | $V_{CC} = 2.3\text{V}$                  | $I_{OH} = -12\text{mA}$  | 1.7            | —    |      |
|          |                     | $V_{CC} = 2.7\text{V}$                  |                          | 2.2            | —    |      |
|          |                     | $V_{CC} = 3\text{V}$                    |                          | 2.4            | —    |      |
|          |                     | $V_{CC} = 3\text{V}$                    | $I_{OH} = -24\text{mA}$  | 2              | —    |      |
| $V_{OL}$ | Output LOW Voltage  | $V_{CC} = 2.3\text{V}$ to $3.6\text{V}$ | $I_{OL} = 0.1\text{mA}$  | —              | 0.2  | V    |
|          |                     | $V_{CC} = 2.3\text{V}$                  | $I_{OL} = 6\text{mA}$    | —              | 0.4  |      |
|          |                     |                                         | $I_{OL} = 12\text{mA}$   | —              | 0.7  |      |
|          |                     | $V_{CC} = 2.7\text{V}$                  | $I_{OL} = 12\text{mA}$   | —              | 0.4  |      |
|          |                     | $V_{CC} = 3\text{V}$                    | $I_{OL} = 24\text{mA}$   | —              | 0.55 |      |

**NOTE:**

1.  $V_{IH}$  and  $V_{IL}$  must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate  $V_{CC}$  range.  
 $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

## OPERATING CHARACTERISTICS, $T_A = 25^\circ\text{C}$

| Symbol | Parameter                                      | Test Conditions                         | $V_{CC} = 2.5V \pm 0.2V$ | $V_{CC} = 3.3V \pm 0.3V$ | Unit |
|--------|------------------------------------------------|-----------------------------------------|--------------------------|--------------------------|------|
|        |                                                |                                         | Typical                  | Typical                  |      |
| CPD    | Power Dissipation Capacitance Outputs enabled  | $C_L = 0\text{pF}$ , $f = 10\text{MHz}$ | 22                       | 29                       | pF   |
| CPD    | Power Dissipation Capacitance Outputs disabled |                                         | 4                        | 5                        |      |

## SWITCHING CHARACTERISTICS<sup>(1)</sup>

| Symbol      | Parameter                                    | $V_{CC} = 2.5V \pm 0.2V$ |      | $V_{CC} = 2.7V$ |      | $V_{CC} = 3.3V \pm 0.3V$ |      | Unit |
|-------------|----------------------------------------------|--------------------------|------|-----------------|------|--------------------------|------|------|
|             |                                              | Min.                     | Max. | Min.            | Max. | Min.                     | Max. |      |
| $t_{PLH}$   | Propagation Delay                            | 1                        | 3.7  | —               | 3.6  | 1                        | 3    | ns   |
| $t_{PHL}$   | $x_{Ax}$ to $x_{Bx}$ or $x_{Bx}$ to $x_{Ax}$ |                          |      |                 |      |                          |      |      |
| $t_{PZH}$   | Output Enable Time                           | 1                        | 5.7  | —               | 5.4  | 1                        | 4.4  | ns   |
| $t_{PZL}$   | $\overline{xOE}$ to $x_{Ax}$ or $x_{Bx}$     |                          |      |                 |      |                          |      |      |
| $t_{PHZ}$   | Output Disable Time                          | 1                        | 5.2  | —               | 4.6  | 1                        | 4.1  | ns   |
| $t_{PLZ}$   | $\overline{xOE}$ to $x_{Ax}$ or $x_{Bx}$     |                          |      |                 |      |                          |      |      |
| $t_{SK(0)}$ | Output Skew <sup>(2)</sup>                   | —                        | —    | —               | —    | —                        | 500  | ps   |

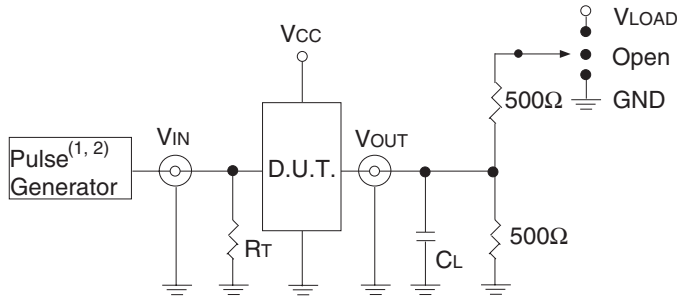
### NOTES:

- See TEST CIRCUITS AND WAVEFORMS.  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ .
- Skew between any two outputs of the same package and switching in the same direction.

## TEST CIRCUITS AND WAVEFORMS

### TEST CONDITIONS

| Symbol            | V <sub>CC</sub> <sup>(1)</sup> =3.3V±0.3V | V <sub>CC</sub> <sup>(1)</sup> =2.7V | V <sub>CC</sub> <sup>(2)</sup> =2.5V±0.2V | Unit |
|-------------------|-------------------------------------------|--------------------------------------|-------------------------------------------|------|
| V <sub>LOAD</sub> | 6                                         | 6                                    | 2 x V <sub>CC</sub>                       | V    |
| V <sub>IH</sub>   | 2.7                                       | 2.7                                  | V <sub>CC</sub>                           | V    |
| V <sub>T</sub>    | 1.5                                       | 1.5                                  | V <sub>CC</sub> / 2                       | V    |
| V <sub>LZ</sub>   | 300                                       | 300                                  | 150                                       | mV   |
| V <sub>HZ</sub>   | 300                                       | 300                                  | 150                                       | mV   |
| C <sub>L</sub>    | 50                                        | 50                                   | 30                                        | pF   |



Test Circuit for All Outputs

#### DEFINITIONS:

C<sub>L</sub> = Load capacitance: includes jig and probe capacitance.

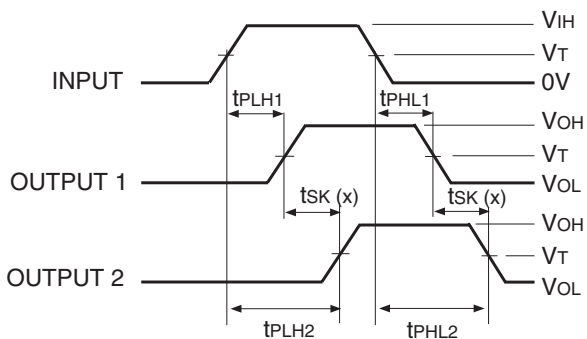
R<sub>T</sub> = Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

#### NOTES:

1. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t<sub>r</sub> ≤ 2.5ns; t<sub>r</sub> ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t<sub>r</sub> ≤ 2ns; t<sub>r</sub> ≤ 2ns.

### SWITCH POSITION

| Test                                    | Switch            |
|-----------------------------------------|-------------------|
| Open Drain<br>Disable Low<br>Enable Low | V <sub>LOAD</sub> |
| Disable High<br>Enable High             | GND               |
| All Other Tests                         | Open              |

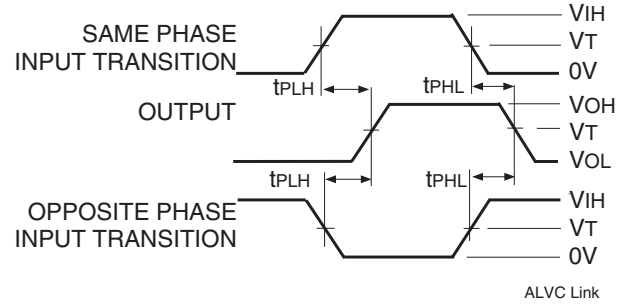


$$t_{SK}(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

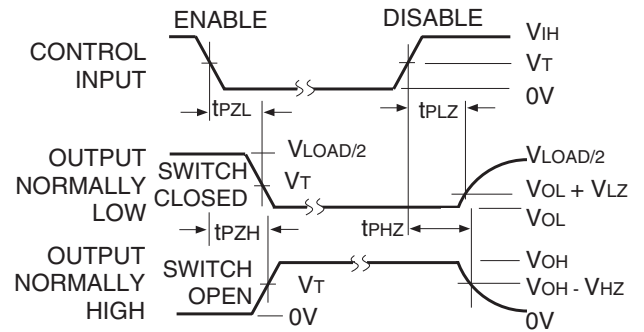
Output Skew - t<sub>SK</sub>(x)

#### NOTES:

1. For t<sub>SK</sub>(0) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t<sub>SK</sub>(b) OUTPUT1 and OUTPUT2 are in the same bank.



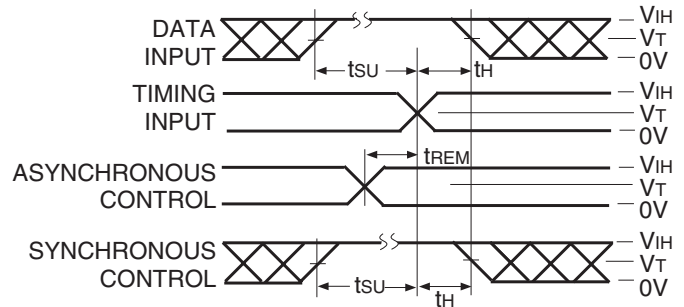
Propagation Delay



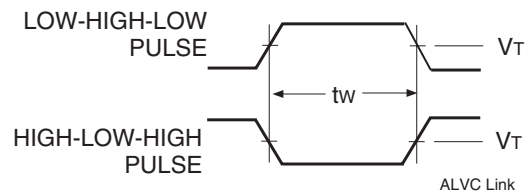
Enable and Disable Times

#### NOTE:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.



Set-up, Hold, and Release Times



Pulse Width

## ORDERING INFORMATION

| XX          | ALVC     | X      | XX          | XXX     | XX    |                                                |
|-------------|----------|--------|-------------|---------|-------|------------------------------------------------|
| Temp. Range | Bus-Hold | Family | Device Type | Package |       |                                                |
|             |          |        |             |         | PA    | Thin Shrink Small Outline Package - Green      |
|             |          |        |             | 245     |       | 16-Bit Bus Transceiver with 3-State Outputs    |
|             |          |        | 16          |         |       | Double-Density, $\pm 24\text{mA}$              |
|             |          |        |             |         | Blank | No Bus-Hold                                    |
|             |          |        |             |         | 74    | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ |



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