

# Low-Voltage 16-Bit Bidirectional Transceiver with 3.6 V Tolerant Inputs and Outputs

## 74ALVC16245

### General Description

The ALVC16245 contains sixteen non-inverting bidirectional buffers with 3-STATE outputs and is intended for bus oriented applications. The device is byte controlled. Each byte has separate 3-STATE control inputs which can be shorted together for full 16-bit operation. The  $\overline{T/R}$  inputs determine the direction of data flow through the device. The  $\overline{OE}$  inputs disable both the A and B ports by placing them in a high impedance state.

The 74ALVC16245 is designed for low voltage (1.65 V to 3.6 V)  $V_{CC}$  applications with I/O capability up to 3.6 V.

The 74ALVC16245 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining low CMOS power dissipation.

### Features

- 1.65 V – 3.6 V  $V_{CC}$  Supply Operation
- 3.6 V Tolerant Inputs and Outputs
- $t_{PD}$ 
  - ♦ 3.0 ns max for 3.0 V to 3.6 V  $V_{CC}$
  - ♦ 3.5 ns max for 2.3 V to 2.7 V  $V_{CC}$
  - ♦ 6.0 ns max for 1.65 V to 1.95 V  $V_{CC}$
- Power-down High Impedance Inputs and Outputs
- Supports Live Insertion/Withdrawal\*
- Uses Patented Noise/EMI Reduction Circuitry
- Latch-up conforms to JEDEC JED78
- ESD Performance:
  - ♦ Human Body Model >2000 V
  - ♦ Machine Model >200 V
- These Devices are Pb-Free, Halide Free and are RoHS Compliant

\*To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pull-up resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

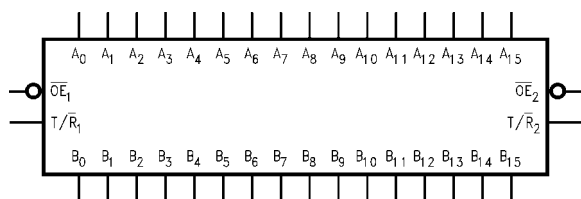
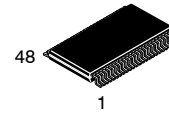
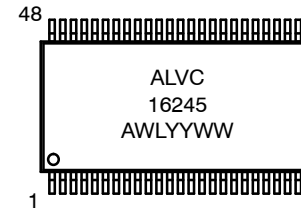


Figure 1. Logic Symbol



TSSOP48 12.5x6.1  
CASE 948BQ

### MARKING DIAGRAM



|    |                     |
|----|---------------------|
| A  | = Assembly Location |
| WL | = Wafer Lot         |
| YY | = Year              |
| WW | = Work Week         |

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

# 74ALVC16245

## Connection Diagram

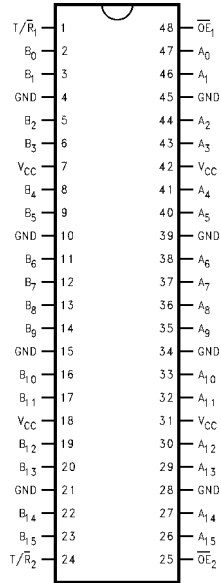


Figure 2. Pin Assignment of TSSOP

## PIN DESCRIPTION

| Pin Names          | Description                      |
|--------------------|----------------------------------|
| $\overline{OE}_n$  | Output Enable Input (Active LOW) |
| $T/\overline{R}_n$ | Transmit/Receive Input           |
| $A_0$ – $A_{15}$   | Side A Inputs of 3–STATE Outputs |
| $B_0$ – $B_{15}$   | Side B Inputs of 3–STATE Outputs |
| NC                 | No Connect                       |

## TRUTH TABLE

| Inputs            |                    | Outputs                                       |
|-------------------|--------------------|-----------------------------------------------|
| $\overline{OE}_1$ | $T/\overline{R}_1$ |                                               |
| L                 | L                  | Bus $B_0$ – $B_7$ Data to Bus $A_0$ – $A_7$   |
| L                 | H                  | Bus $A_0$ – $A_7$ Data to Bus $B_0$ – $B_7$   |
| H                 | X                  | HIGH Z State on $A_0$ – $A_7$ , $B_0$ – $B_7$ |

| Inputs            |                    | Outputs                                             |
|-------------------|--------------------|-----------------------------------------------------|
| $\overline{OE}_2$ | $T/\overline{R}_2$ |                                                     |
| L                 | L                  | Bus $B_8$ – $B_{15}$ Data to Bus $A_8$ – $A_{15}$   |
| L                 | H                  | Bus $A_8$ – $A_{15}$ Data to Bus $B_8$ – $B_{15}$   |
| H                 | X                  | HIGH Z State on $A_8$ – $A_{15}$ , $B_8$ – $B_{15}$ |

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial (HIGH or LOW, inputs and I/O's may not float)

Z = High Impedance

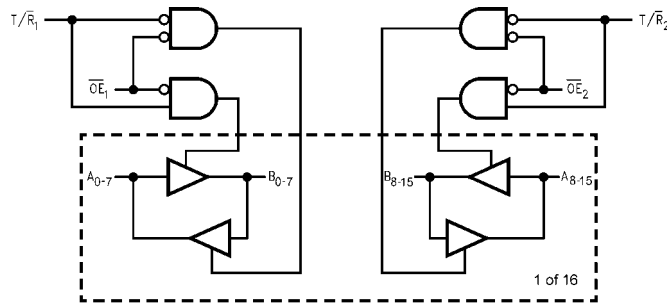


Figure 3. Logic Diagram

**ABSOLUTE MAXIMUM RATINGS**

| Parameter                                 | Symbol          | Value                  | Unit |
|-------------------------------------------|-----------------|------------------------|------|
| Supply Voltage                            | $V_{CC}$        | -0.5 to +4.6           | V    |
| DC Input Voltage                          | $V_I$           | -0.5 to +4.6           | V    |
| Output Voltage (Note 1)                   | $V_O$           | -0.5 to $V_{CC} + 0.5$ | V    |
| DC Input Diode Current, $V_I < 0$ V       | $I_{IK}$        | -50                    | mA   |
| DC Output Diode Current, $V_O < 0$ V      | $I_{OK}$        | -50                    | mA   |
| DC Output Source/Sink Current             | $I_{OH}/I_{OL}$ | $\pm 50$               | mA   |
| DC $V_{CC}$ or GND Current per Supply Pin | $I_{CC}$ or GND | $\pm 100$              | mA   |
| Storage Temperature Range                 | $T_{STG}$       | -65 to +150            | °C   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1.  $I_O$  Absolute Maximum Rating must be observed.

**RECOMMENDED OPERATING CONDITIONS** (Note 2)

| Symbol              | Parameter                                                    | Min  | Max      | Unit |
|---------------------|--------------------------------------------------------------|------|----------|------|
| $V_{CC}$            | Power Supply Operating Voltage                               | 1.65 | 3.6      | V    |
| $V_I$               | Input Voltage                                                | 0    | $V_{CC}$ | V    |
| $V_O$               | Output Voltage                                               | 0    | $V_{CC}$ | V    |
| $T_A$               | Free Air Operating Temperature                               | -40  | 85       | °C   |
| $\Delta t/\Delta V$ | Input Edge Rate, $V_{IN} = 0.8$ V to 2.0 V, $V_{CC} = 3.0$ V | 0    | 10       | ns/V |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

2. Floating or unused control inputs must be held HIGH or LOW.

**DC ELECTRICAL CHARACTERISTICS**

| Symbol          | Parameter                      | Conditions                       | $V_{CC}$ (V)                          | Min                                | Max                                | Units   |
|-----------------|--------------------------------|----------------------------------|---------------------------------------|------------------------------------|------------------------------------|---------|
| $V_{IH}$        | HIGH Level Input Voltage       |                                  | 1.65 – 1.95<br>2.3 – 2.7<br>2.7 – 3.6 | $0.65 \times V_{CC}$<br>1.7<br>2.0 |                                    | V       |
| $V_{IL}$        | LOW Level Input Voltage        |                                  | 1.65 – 1.95<br>2.3 – 2.7<br>2.7 – 3.6 |                                    | $0.35 \times V_{CC}$<br>0.7<br>0.8 | V       |
| $V_{OH}$        | HIGH Level Output Voltage      | $I_{OH} = -100 \mu A$            | 1.65 – 3.6                            | $V_{CC} - 0.2$                     |                                    | V       |
|                 |                                | $I_{OH} = -4 \text{ mA}$         | 1.65                                  | 1.2                                |                                    |         |
|                 |                                | $I_{OH} = -6 \text{ mA}$         | 2.3                                   | 2.0                                |                                    |         |
|                 |                                | $I_{OH} = -12 \text{ mA}$        | 2.3<br>2.7<br>3.0                     | 1.7<br>2.2<br>2.4                  |                                    |         |
|                 |                                | $I_{OH} = -24 \text{ mA}$        | 3.0                                   | 2                                  |                                    |         |
|                 |                                |                                  |                                       |                                    |                                    |         |
| $V_{OL}$        | LOW Level Output Voltage       | $I_{OL} = 100 \mu A$             | 1.65 – 3.6                            |                                    | 0.2                                | V       |
|                 |                                | $I_{OL} = 4 \text{ mA}$          | 1.65                                  |                                    | 0.45                               |         |
|                 |                                | $I_{OL} = 6 \text{ mA}$          | 2.3                                   |                                    | 0.4                                |         |
|                 |                                | $I_{OL} = 12 \text{ mA}$         | 2.3<br>2.7                            |                                    | 0.7<br>0.4                         |         |
|                 |                                | $I_{OL} = 24 \text{ mA}$         | 3.0                                   |                                    | 0.55                               |         |
|                 |                                |                                  |                                       |                                    |                                    |         |
| $I_I$           | Input Leakage Current          | $0 \leq V_I \leq 3.6$ V          | 3.6                                   |                                    | $\pm 5.0$                          | $\mu A$ |
| $I_{OZ}$        | 3-STATE Output Leakage         | $0 \leq V_O \leq 3.6$ V          | 3.6                                   |                                    | $\pm 10$                           | $\mu A$ |
| $I_{CC}$        | Quiescent Supply Current       | $V_I = V_{CC}$ or GND, $I_O = 0$ | 3.6                                   |                                    | 40                                 | $\mu A$ |
| $\Delta I_{CC}$ | Increase in $I_{CC}$ per Input | $V_{IH} = V_{CC} - 0.6$ V        | 3 – 3.6                               |                                    | 750                                | $\mu A$ |

# 74ALVC16245

## AC ELECTRICAL CHARACTERISTICS

| Symbol                              | Parameter           | T <sub>A</sub> = -40°C to +85°C, R <sub>L</sub> = 500 Ω |     |                         |     |                                |     |                                 |     | Units |
|-------------------------------------|---------------------|---------------------------------------------------------|-----|-------------------------|-----|--------------------------------|-----|---------------------------------|-----|-------|
|                                     |                     | C <sub>L</sub> = 50 pF                                  |     |                         |     | C <sub>L</sub> = 30 pF         |     |                                 |     |       |
|                                     |                     | V <sub>CC</sub> = 3.3 V ±0.3 V                          |     | V <sub>CC</sub> = 2.7 V |     | V <sub>CC</sub> = 2.5 V ±0.2 V |     | V <sub>CC</sub> = 1.8 V ±0.15 V |     |       |
|                                     |                     | Min                                                     | Max | Min                     | Max | Min                            | Max | Min                             | Max |       |
| t <sub>PHL</sub> , t <sub>PLH</sub> | Propagation Delay   | 1.3                                                     | 3   | 1.5                     | 3.5 | 1.0                            | 3.0 | 1.5                             | 6.0 | ns    |
| t <sub>PZL</sub> , t <sub>PZH</sub> | Output Enable Time  | 1.3                                                     | 4.3 | 1.5                     | 5.4 | 1.0                            | 4.9 | 1.5                             | 9.3 | ns    |
| t <sub>PLZ</sub> , t <sub>PHZ</sub> | Output Disable Time | 1.3                                                     | 4.2 | 1.5                     | 4.7 | 1.0                            | 4.2 | 1.5                             | 7.6 | ns    |

## CAPACITANCE

| Symbol   | Parameter                     |                 | Conditions                                | $T_A = +25^{\circ}\text{C}$ |         | Units |
|----------|-------------------------------|-----------------|-------------------------------------------|-----------------------------|---------|-------|
|          |                               |                 |                                           | $V_{CC}$                    | Typical |       |
| $C_{IN}$ | Input Capacitance             |                 | $V_I = 0\ \text{V or } V_{CC}$            | 3.3                         | 6       | pF    |
| $C_{IO}$ | Input, Output Capacitance     |                 | $V_O = 0\ \text{V or } V_{CC}$            | 3.3                         | 7       | pF    |
| $C_{PD}$ | Power Dissipation Capacitance | Outputs Enabled | $f = 10\ \text{MHz}, C_L = 50\ \text{pF}$ | 3.3                         | 20      | pF    |
|          |                               |                 |                                           | 2.5                         | 20      |       |

# 74ALVC16245

## AC Loading and Waveforms

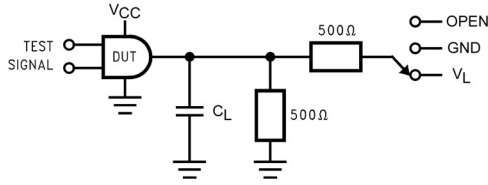


Figure 4. AC Test Circuit

Values for Figure 4

| Test                  | Switch |
|-----------------------|--------|
| $t_{PLH}$ , $t_{PHL}$ | Open   |
| $t_{PZL}$ , $t_{PLZ}$ | $V_L$  |
| $t_{PZH}$ , $t_{PHZ}$ | GND    |

## VARIABLE MATRIX

(Input Characteristics:  $f = 1 \text{ MHz}$ ;  $t_r = t_f = 2 \text{ ns}$ ;  $Z_0 = 50 \Omega$ )

| Symbol   | $V_{CC}$                          |                          |                                   |                                    |
|----------|-----------------------------------|--------------------------|-----------------------------------|------------------------------------|
|          | $3.3 \text{ V} \pm 0.3 \text{ V}$ | $2.7 \text{ V}$          | $2.5 \text{ V} \pm 0.2 \text{ V}$ | $1.8 \text{ V} \pm 0.15 \text{ V}$ |
| $V_{mi}$ | $1.5 \text{ V}$                   | $1.5 \text{ V}$          | $V_{CC} / 2$                      | $V_{CC} / 2$                       |
| $V_{mo}$ | $1.5 \text{ V}$                   | $1.5 \text{ V}$          | $V_{CC} / 2$                      | $V_{CC} / 2$                       |
| $V_X$    | $V_{OL} + 0.3 \text{ V}$          | $V_{OL} + 0.3 \text{ V}$ | $V_{OL} + 0.15 \text{ V}$         | $V_{OL} + 0.15 \text{ V}$          |
| $V_Y$    | $V_{OH} - 0.3 \text{ V}$          | $V_{OH} - 0.3 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$         | $V_{OH} - 0.15 \text{ V}$          |
| $V_L$    | $6 \text{ V}$                     | $6 \text{ V}$            | $V_{CC} * 2$                      | $V_{CC} * 2$                       |

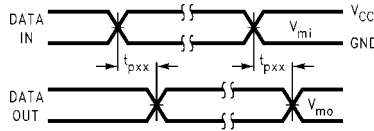


Figure 5. Waveform for Inverting and Non-Inverting Functions

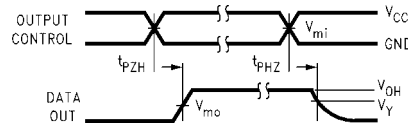


Figure 6. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

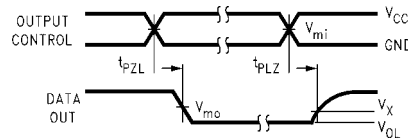


Figure 7. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

## ORDERING INFORMATION

| Device          | Package                    | Shipping <sup>†</sup>    |
|-----------------|----------------------------|--------------------------|
| 74ALVC16245MTDX | TSSOP48 12.5x6.1 (Pb-Free) | 1000 Units / Tape & Reel |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

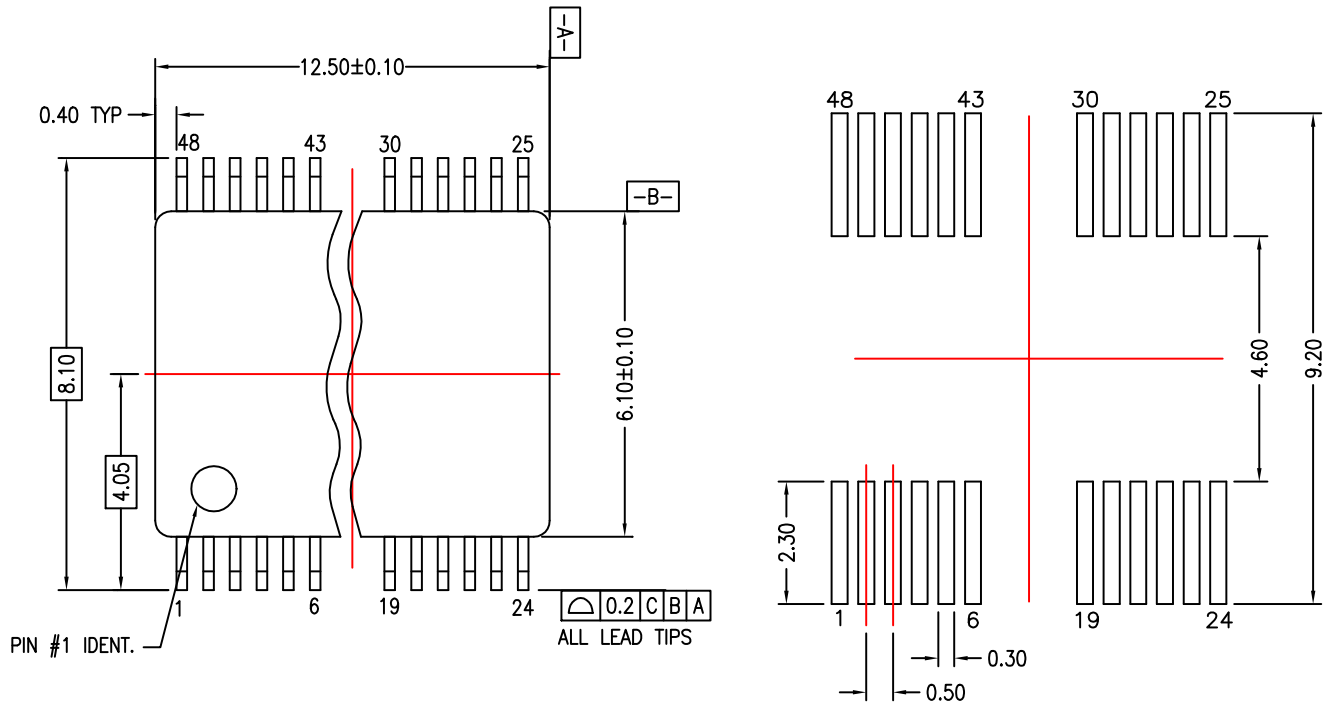
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®

ON

TSSOP48 12.5x6.1  
CASE 948BQ  
ISSUE O

DATE 30 SEP 2016



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