

## 74ALVC162245

### Low Voltage 16-Bit Bidirectional Transceiver with 3.6V Tolerant Inputs and Outputs and 26Ω Series Resistors in A Port Outputs

#### General Description

The ALVC162245 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 T/R inputs determine the direction of data flow through the device. The OE inputs disable both the A and B Ports by placing them in a high impedance state.

The 74ALVC162245 is designed for low voltage (1.65V to 3.6V) V<sub>CC</sub> applications with I/O compatibility up to 3.6V.

The 74ALVC162245 is also designed with 26Ω series resistance in the A Port outputs. This design reduces line noise in applications such as memory address drivers, clock drivers, and bus transceivers/transmitters.

The 74ALVC162245 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining low CMOS power dissipation.

#### Features

- 1.65V–3.6V V<sub>CC</sub> supply operation
- 3.6V tolerant inputs and outputs
- 26Ω series resistors in A Port outputs
- t<sub>PD</sub>
  - 3.9 ns max for 3.0V to 3.6V V<sub>CC</sub>
  - 4.8 ns max for 2.3V to 2.7V V<sub>CC</sub>
  - 8.6 ns max for 1.65V to 1.95V V<sub>CC</sub>
- Power-down high impedance inputs and outputs
- Supports live insertion/withdrawal (Note 1)
- Uses patented noise/EMI reduction circuitry
- Latchup conforms to JEDEC JED78
- ESD performance:
  - Human body model > 2000V
  - Machine model >200V

**Note 1:** To ensure the high-impedance state during power up or power down, OE should be tied to V<sub>CC</sub> through a pull-up resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

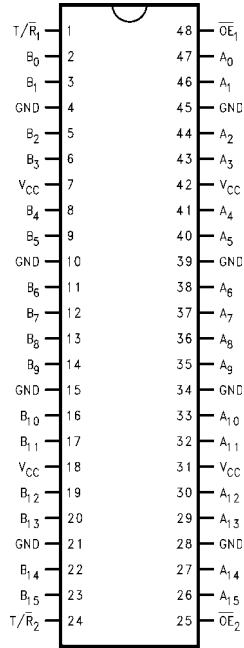
#### Ordering Code:

| Order Number  | Package Number | Package Description   |
|---------------|----------------|---|
| 74ALVC162245T | MTD48          | 48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide |

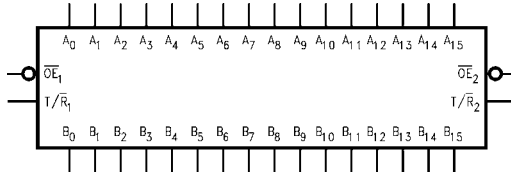
Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

74ALVC162245 Low Voltage 16-Bit Bidirectional Transceiver with 3.6V Tolerant Inputs and Outputs and 26Ω Series Resistors in A Port Outputs

### Connection Diagram



### Logic Symbol



### Pin Descriptions

| 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 or 3-STATE Outputs |
| $B_0-B_{15}$       | Side B Inputs or 3-STATE Outputs |

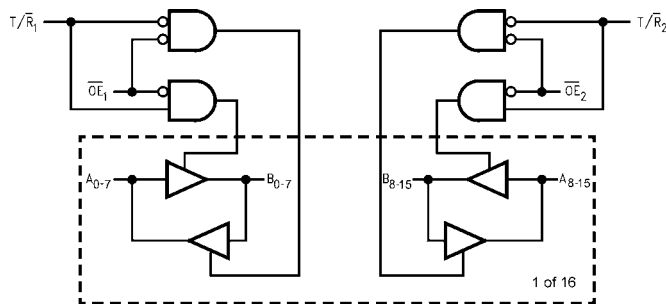
### Truth Tables

| 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

### Logic Diagram



**Absolute Maximum Ratings**(Note 2)

|  |                          |
|--|--------------------------|
| Supply Voltage ( $V_{CC}$ )                                  | -0.5V to +4.6V           |
| DC Input Voltage ( $V_I$ )                                   | -0.5V to 4.6V            |
| Output Voltage ( $V_O$ ) (Note 3)                            | -0.5V to $V_{CC} + 0.5V$ |
| DC Input Diode Current ( $I_{IK}$ )                          |                          |
| $V_I < 0V$   | -50 mA                   |
| DC Output Diode Current ( $I_{OK}$ )                         |                          |
| $V_O < 0V$   | -50 mA                   |
| DC Output Source/Sink Current ( $I_{OH}/I_{OL}$ )            | ±50 mA                   |
| DC $V_{CC}$ or GND Current per Supply Pin ( $I_{CC}$ or GND) | ±100 mA                  |
| Storage Temperature Range ( $T_{STG}$ )                      | -65°C to +150°C          |

**Recommended Operating Conditions** (Note 4)

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

**Note 2:** The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 3:**  $I_O$  Absolute Maximum Rating must be observed.

**Note 4:** Floating or unused control inputs must be held HIGH or LOW.

**DC Electrical Characteristics**

| Symbol   | Parameter                              | Conditions                                       | $V_{CC}$<br>(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<br>A Outputs | $I_{OH} = -100 \mu A$                            | 1.65 - 3.6                            | $V_{CC} - 0.2$                     |                                    | V     |  |
|          |  | $I_{OH} = -2 \text{ mA}$                         | 1.65                                  | 1.2                                |                                    |       |  |
|          |  | $I_{OH} = -4 \text{ mA}$                         | 2.3                                   | 1.9                                |                                    |       |  |
|          |  | $I_{OH} = -6 \text{ mA}$                         | 2.3                                   | 1.7                                |                                    |       |  |
|          |  | $I_{OH} = -8 \text{ mA}$                         | 3.0                                   | 2.4                                |                                    |       |  |
|          |  | $I_{OH} = -12 \text{ mA}$                        | 2.7                                   | 2                                  |                                    |       |  |
|          | HIGH Level Output Voltage<br>B Outputs | $I_{OH} = -100 \mu A$                            | 1.65 - 3.6                            | $V_{CC} - 0.2$                     |                                    |       |  |
|          |  | $I_{OH} = -4 \text{ mA}$                         | 1.65                                  | 1.2                                |                                    |       |  |
|          |  | $I_{OH} = -6 \text{ mA}$                         | 2.3                                   | 2.0                                |                                    |       |  |
|          |  | $I_{OH} = -12 \text{ mA}$                        | 2.3                                   | 1.7                                |                                    |       |  |
|          |  |  | 2.7                                   | 2.2                                |                                    |       |  |
|          |  |  | 3.0                                   | 2.4                                |                                    |       |  |
| $V_{OL}$ | LOW Level Output Voltage<br>A Outputs  | $I_{OL} = 100 \mu A$                             | 1.65 - 3.6                            |                                    | 0.2                                | V     |  |
|          |  | $I_{OL} = 2 \text{ mA}$                          | 1.65                                  |                                    | 0.45                               |       |  |
|          |  | $I_{OL} = 4 \text{ mA}$                          | 2.3                                   |                                    | 0.4                                |       |  |
|          |  | $I_{OL} = 6 \text{ mA}$                          | 2.3                                   |                                    | 0.55                               |       |  |
|          |  | $I_{OL} = 8 \text{ mA}$                          | 3.0                                   |                                    | 0.55                               |       |  |
|          |  | $I_{OL} = 12 \text{ mA}$                         | 2.7                                   |                                    | 0.6                                |       |  |
|          | LOW Level Output Voltage<br>B Outputs  | $I_{OL} = 100 \mu A$                             | 1.65 - 3.6                            |                                    | 0.2                                |       |  |
|          |  | $I_{OL} = 4 \text{ mA}$                          | 1.65                                  |                                    | 0.45                               |       |  |
|          |  | $I_{OL} = 6 \text{ mA}$                          | 2.3                                   |                                    | 0.4                                |       |  |
|          |  | $I_{OL} = 12 \text{ mA}$                         | 2.3                                   |                                    | 0.7                                |       |  |
|          |  |  | 2.7                                   |                                    | 0.4                                |       |  |
|          |  |  | 3.0                                   |                                    | 0.55                               |       |  |
| $I_I$    | Input Leakage Current                  | $0 \leq V_I \leq 3.6V$                           | 1.65 - 3.6                            |                                    | ±5.0                               | μA    |  |
| $I_{OZ}$ | 3-STATE Output Leakage                 | $0 \leq V_O \leq 3.6V, V_I = V_{IH}$ or $V_{IL}$ | 1.65 - 3.6                            |                                    | ±10                                | μA    |  |

## DC Electrical Characteristics (Continued)

| Symbol           | Parameter                             | Conditions  | V <sub>CC</sub><br>(V) | Min | Max | Units |
|------------------|---------------------------------------|---|------------------------|-----|-----|-------|
| I <sub>OFF</sub> | Power Off Leakage Current             | 0V ≤ (V <sub>I</sub> , V <sub>O</sub> ) ≤ 3.6V              | 0                      |     | 10  | mA    |
| I <sub>CC</sub>  | Quiescent Supply Current              | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 | 3.6                    |     | 40  | μA    |
| ΔI <sub>CC</sub> | Increase in I <sub>CC</sub> per Input | V <sub>IH</sub> = V <sub>CC</sub> - 0.6V                    | 2.7 - 3.6              |     | 750 | μA    |

## AC Electrical Characteristics

| Symbol                              | Parameter                     | T <sub>A</sub> = -40°C to +85°C, R <sub>L</sub> = 500Ω |     |                        |     |                              |     |                                |     | Units |
|-------------------------------------|-------------------------------|--|-----|------------------------|-----|------------------------------|-----|--------------------------------|-----|-------|
|                                     |                               | C <sub>L</sub> = 50 pF                                 |     |                        |     | C <sub>L</sub> = 30 pF       |     |                                |     |       |
|                                     |                               | V <sub>CC</sub> = 3.3V ± 0.3V                          |     | V <sub>CC</sub> = 2.7V |     | V <sub>CC</sub> = 2.5 ± 0.2V |     | V <sub>CC</sub> = 1.8V ± 0.15V |     |       |
|                                     |                               | Min  | Max | Min                    | Max | Min                          | Max | Min                            | Max |       |
| t <sub>PHL</sub> , t <sub>PLH</sub> | Propagation Delay<br>A to B   | 1.3  | 3.0 | 1.5                    | 3.5 | 1                            | 3.0 | 1.5                            | 6.0 | ns    |
|                                     | Propagation Delay<br>B to A   | 1.3  | 3.9 | 1.5                    | 4.8 | 1                            | 4.3 | 1.5                            | 8.6 |       |
| t <sub>PZL</sub> , t <sub>PZH</sub> | Output Enable Time<br>A to B  | 1.3  | 4.3 | 1.5                    | 5.4 | 1.0                          | 4.9 | 1.5                            | 9.3 | ns    |
|                                     | Output Enable Time<br>B to A  | 1.3  | 4.7 | 1.5                    | 6.2 | 1.0                          | 5.7 | 1.5                            | 9.8 |       |
| t <sub>PLZ</sub> , t <sub>PHZ</sub> | Output Disable Time<br>A to B | 1.3  | 4.2 | 1.5                    | 4.7 | 1.0                          | 4.2 | 1.5                            | 7.6 | ns    |
|                                     | Output Disable Time<br>B to A | 1.3  | 4.6 | 1.5                    | 5.3 | 1.0                          | 4.8 | 1.5                            | 8.6 |       |

## Capacitance

| Symbol          | Parameter                     | Conditions                             | T <sub>A</sub> = +25°C             |         | Units |
|-----------------|-------------------------------|--|------------------------------------|---------|-------|
|                 |                               |  | V <sub>CC</sub>                    | Typical |       |
| C <sub>IN</sub> | Input Capacitance             | V <sub>I</sub> = 0V or V <sub>CC</sub> | 3.3                                | 6       | pF    |
| C <sub>IO</sub> | Input, Output Capacitance     | V <sub>O</sub> = 0V or V <sub>CC</sub> | 3.3                                | 7       | pF    |
| C <sub>PD</sub> | Power Dissipation Capacitance | Outputs Enabled                        | f = 10 MHz, C <sub>L</sub> = 50 pF |         | pF    |
|                 |                               |  | 3.3                                | 20      |       |
|                 |                               |  | 2.5                                | 20      |       |

## AC Loading and Waveforms

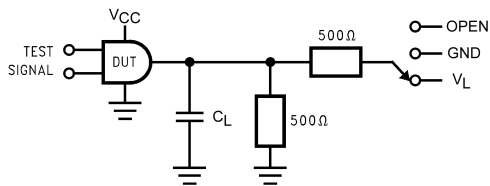


FIGURE 1. AC Test Circuit

TABLE 1. Values for Figure 1

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

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

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

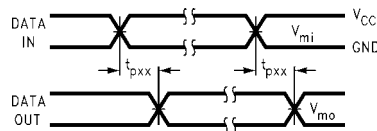


FIGURE 2. Waveform for Inverting and Non-inverting Functions

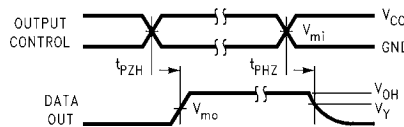


FIGURE 3. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

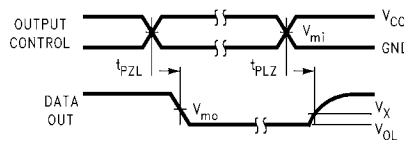
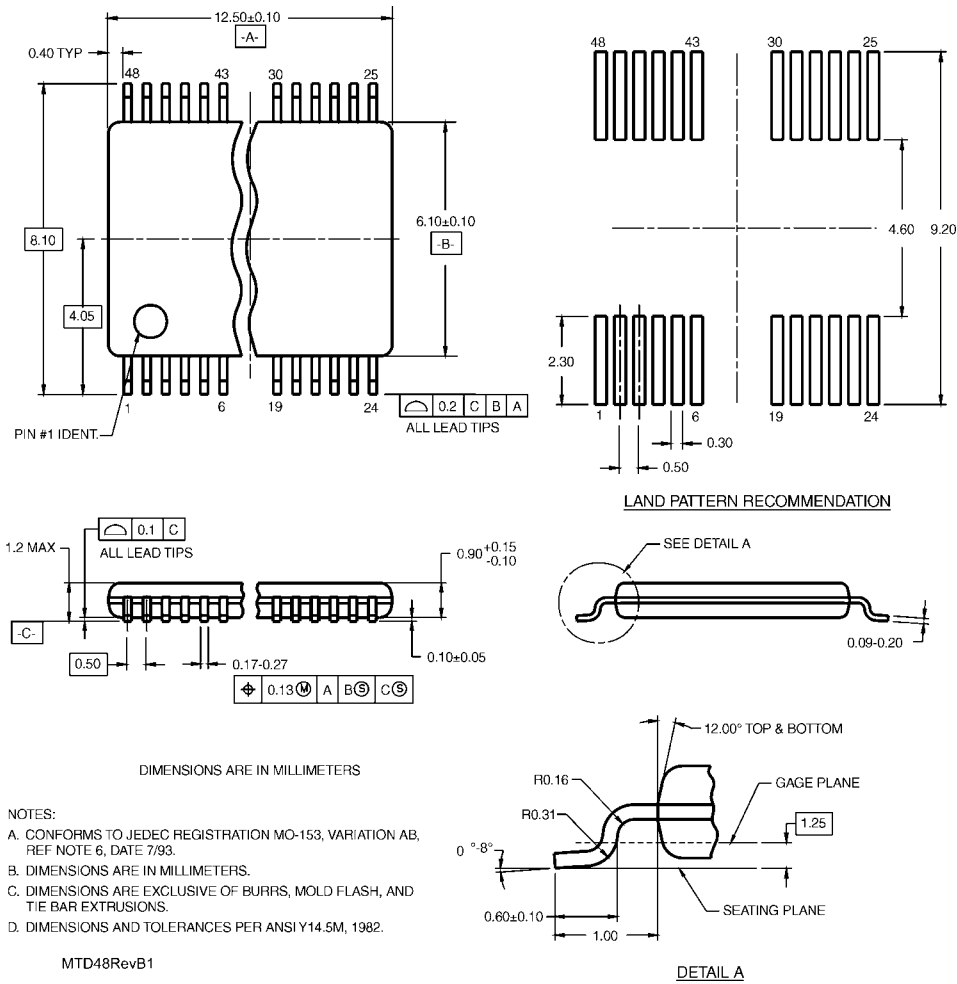


FIGURE 4. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

**Physical Dimensions** inches (millimeters) unless otherwise noted



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