

## 74ALVC162240

### Low Voltage 16-Bit Inverting Buffer/Line Driver with 3.6V Tolerant Inputs and Outputs and 26Ω Series Resistors in Outputs

#### General Description

The ALVC162240 contains sixteen inverting buffers with 3-STATE outputs to be employed as a memory and address driver, clock driver, or bus oriented transmitter/receiver. The device is nibble (4-bit) controlled. Each nibble has separate 3-STATE control inputs which can be shorted together for full 16-bit operation.

The 74ALVC162240 is designed for low voltage (1.65V to 3.6V)  $V_{CC}$  applications with I/O capability up to 3.6V. The 74ALVC162240 is also designed with 26Ω series resistors in the outputs. This design reduces line noise in applications such as memory address drivers, clock drivers, and bus transceivers/transmitters.

The 74ALVC162240 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining low CMOS power dissipation.

#### Features

- 1.65V to 3.6V  $V_{CC}$  supply operation
- 3.6V tolerant inputs and outputs
- 26Ω series resistors in outputs
- $t_{PD}$ 
  - 3.8 ns max for 3.0V to 3.6V  $V_{CC}$
  - 4.3 ns max for 2.3V to 2.7V  $V_{CC}$
  - 7.6 ns max for 1.65V to 1.95V  $V_{CC}$
- Power-off high impedance inputs and outputs
- Supports live insertion and withdrawal (Note 1)
- Uses patented noise/EMI reduction circuitry
- Latchup conforms to JEDEC JED78
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V

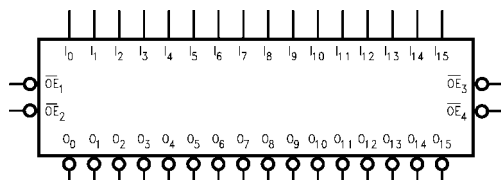
**Note 1:** To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pull-up resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

#### Ordering Code:

| Order Number  | Package Number | Package Descriptions                                                        |
|---------------|----------------|-----------------------------------------------------------------------------|
| 74ALVC162240T | 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.

#### Logic Symbol

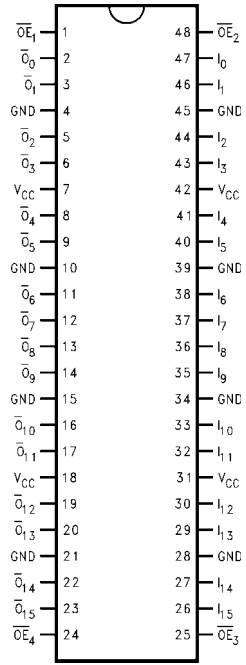


#### Pin Descriptions

| Pin Names         | Description                      |
|-------------------|----------------------------------|
| $\overline{OE}_n$ | Output Enable Input (Active LOW) |
| $I_0-I_{15}$      | Inputs                           |
| $O_0-O_{15}$      | Outputs                          |

74ALVC162240 Low Voltage 16-Bit Inverting Buffer/Line Driver with 3.6V Tolerant Inputs and Outputs and 26Ω Series Resistors in Outputs

Connection Diagram



Truth Tables

| Inputs            |                                | Outputs                             |
|-------------------|--------------------------------|-------------------------------------|
| $\overline{OE}_1$ | I <sub>0</sub> -I <sub>3</sub> | $\overline{O}_0$ - $\overline{O}_3$ |
| L                 | L                              | H                                   |
| L                 | H                              | L                                   |
| H                 | X                              | Z                                   |

| Inputs            |                                | Outputs                             |
|-------------------|--------------------------------|-------------------------------------|
| $\overline{OE}_2$ | I <sub>4</sub> -I <sub>7</sub> | $\overline{O}_4$ - $\overline{O}_7$ |
| L                 | L                              | H                                   |
| L                 | H                              | L                                   |
| H                 | X                              | Z                                   |

| Inputs            |                                 | Outputs                                |
|-------------------|---------------------------------|----------------------------------------|
| $\overline{OE}_3$ | I <sub>8</sub> -I <sub>11</sub> | $\overline{O}_8$ - $\overline{O}_{11}$ |
| L                 | L                               | H                                      |
| L                 | H                               | L                                      |
| H                 | X                               | Z                                      |

| Inputs            |                                  | Outputs                                   |
|-------------------|----------------------------------|-------------------------------------------|
| $\overline{OE}_4$ | I <sub>12</sub> -I <sub>15</sub> | $\overline{O}_{12}$ - $\overline{O}_{15}$ |
| L                 | L                                | H                                         |
| L                 | H                                | L                                         |
| H                 | X                                | Z                                         |

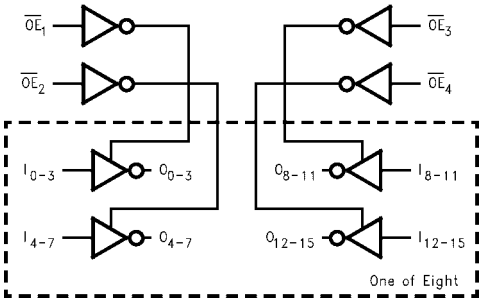
H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Immaterial (HIGH or LOW, inputs may not float)  
Z = High Impedance

Functional Description

The 74ALVC162240 contains sixteen inverting buffers with 3-STATE outputs. The device is nibble (4 bits) controlled with each nibble functioning identically, but independent of each other. The control pins may be shorted together to obtain full 16-bit operation. The 3-STATE outputs are con-

trolled by an Output Enable ( $\overline{OE}_n$ ) input. When  $\overline{OE}_n$  is LOW, the outputs are in the 2-state mode. When  $\overline{OE}_n$  is HIGH, the standard outputs are in the high impedance mode but this does not interfere with entering new data into the inputs.

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      | $I_{OH} = -100 \mu A$            | 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<br>3                              | 1.7<br>2.4                         |                                    |       |
|                 |                                | $I_{OH} = -8 \text{ mA}$         | 2.7                                   | 2                                  |                                    |       |
|                 |                                | $I_{OH} = -12 \text{ mA}$        | 3.0                                   | 2                                  |                                    |       |
| $V_{OL}$        | LOW Level Output Voltage       | $I_{OL} = 100 \mu A$             | 1.65 - 3.6                            |                                    | 0.2                                | V     |
|                 |                                | $I_{OL} = 2 \text{ mA}$          | 1.65                                  |                                    | 0.45                               |       |
|                 |                                | $I_{OL} = 4 \text{ mA}$          | 2.3                                   |                                    | 0.4                                |       |
|                 |                                | $I_{OL} = 6 \text{ mA}$          | 2.3<br>3                              |                                    | 0.55<br>0.55                       |       |
|                 |                                | $I_{OL} = 8 \text{ mA}$          | 2.7                                   |                                    | 0.6                                |       |
|                 |                                | $I_{OL} = 12 \text{ mA}$         | 3                                     |                                    | 0.8                                |       |
| $I_I$           | Input Leakage Current          | $0 \leq V_I \leq 3.6V$           | 3.6                                   |                                    | ±5.0                               | μA    |
| $I_{OZ}$        | 3-STATE Output Leakage         | $0 \leq V_O \leq 3.6V$           | 3.6                                   |                                    | ±10                                | μA    |
| $I_{CC}$        | Quiescent Supply Current       | $V_I = V_{CC}$ or GND, $I_O = 0$ | 3.6                                   |                                    | 40                                 | μA    |
| $\Delta I_{CC}$ | Increase in $I_{CC}$ per Input | $V_{IH} = V_{CC} - 0.6V$         | 3 - 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> = 2.5V ± 0.2V |     | V <sub>CC</sub> = 1.8V ± 0.15V |     |       |
|                                     |                                 | Min                                                    | Max | Min                    | Max | Min                           | Max | Min                            | Max |       |
| t <sub>PHL</sub> , t <sub>PL</sub>  | Propagation Delay<br>Bus to Bus | 1.3                                                    | 3.8 | 1.5                    | 4.3 | 1.0                           | 3.8 | 1.5                            | 7.6 | ns    |
| t <sub>PZL</sub> , t <sub>PZH</sub> | Output Enable Time              | 1.3                                                    | 4.3 | 1.5                    | 5.6 | 1.0                           | 5.1 | 1.5                            | 9.8 | ns    |
| t <sub>PLZ</sub> , t <sub>PHZ</sub> | Output Disable Time             | 1.3                                                    | 4.1 | 1.5                    | 4.5 | 1.0                           | 4.0 | 1.5                            | 7.2 | 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    |
| $C_{OUT}$ | Output Capacitance            |                 | $V_I = 0\text{V or } V_{CC}$            | 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      |       |

## AC Loading and Waveforms

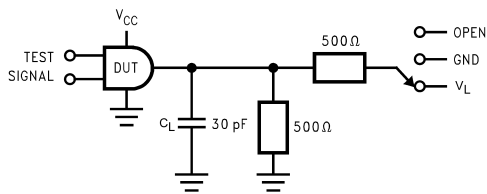


FIGURE 1. AC Test Circuit

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

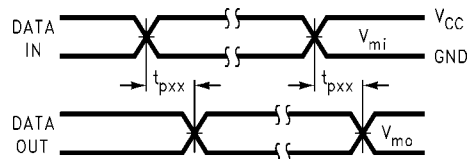


FIGURE 2. Waveform for Inverting and Non-Inverting Functions

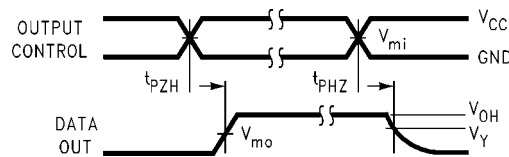


FIGURE 3. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

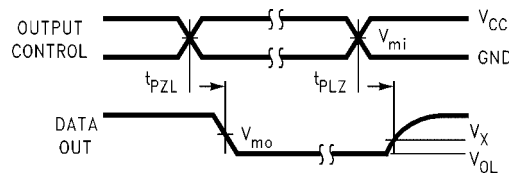
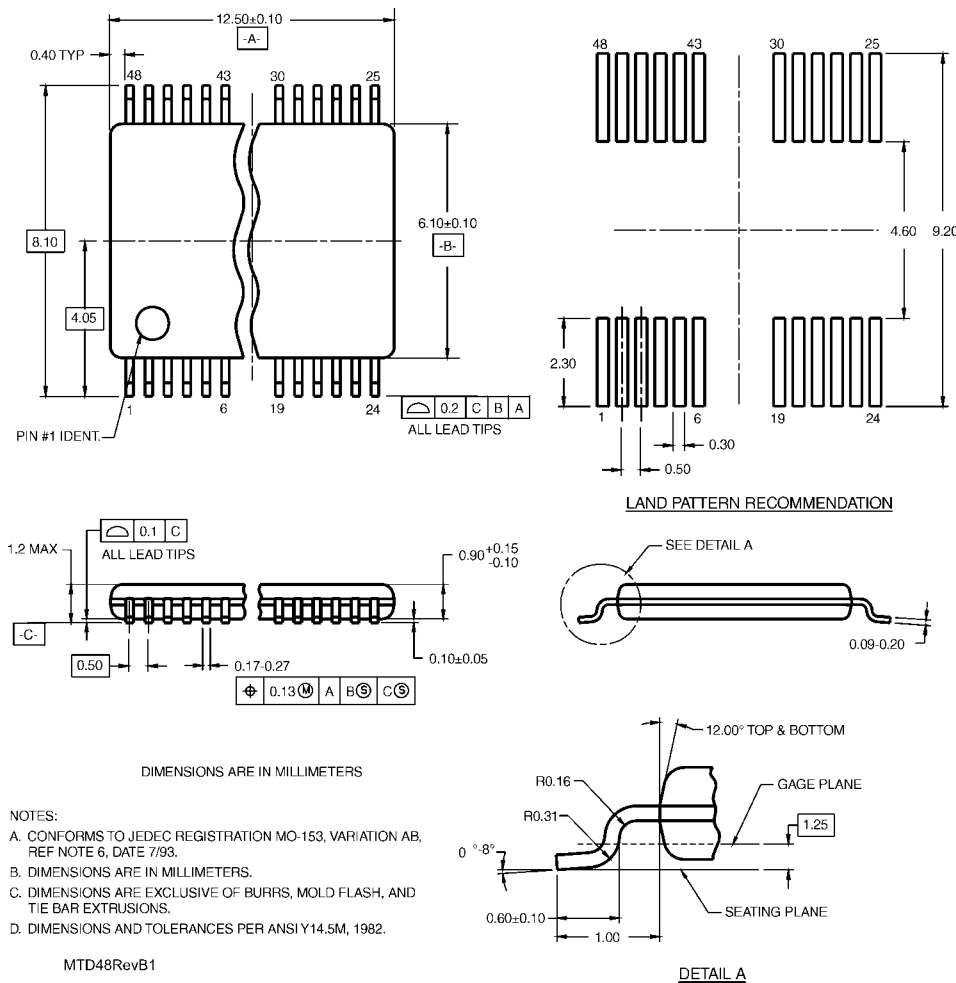


FIGURE 4. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

## Physical Dimensions inches (millimeters) unless otherwise noted



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

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