

# 3.3V 16-bit inverting buffer/driver with 30Ω termination resistors (3-State)

## 74LVT162240A

### FEATURES

- 16-bit bus interface
- 3-State buffers
- Output capability: +12mA/-12mA
- 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
- Outputs include series resistance of 30Ω making external termination resistors unnecessary
- Power-up 3-State
- No bus current loading when output is tied to 5V bus
- Latch-up protection exceeds 500mA per JEDEC Std 17
- ESD protection exceeds 2000V per MIL STD 883 Method 3015 and 200V per Machine Model
- Same part as 74LVT16240A-1

### DESCRIPTION

The 74LVT162240A is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3V.

This device is an inverting 16-bit buffer that is ideal for driving bus lines. The device features four Output Enables ( $1\overline{OE}$ ,  $2\overline{OE}$ ,  $3\overline{OE}$ ,  $4\overline{OE}$ ), each controlling four of the 3-State outputs.

The 74LVT162240A is designed with 30Ω series resistance in both the pull-up and pull-down output structures. This design reduces line noise in applications such as memory address drivers, clock drivers, and bus receivers/transmitters.

The 74LVT162240A is the same as the 74LVT16240A-1. The part number has been changed to reflect industry standards.

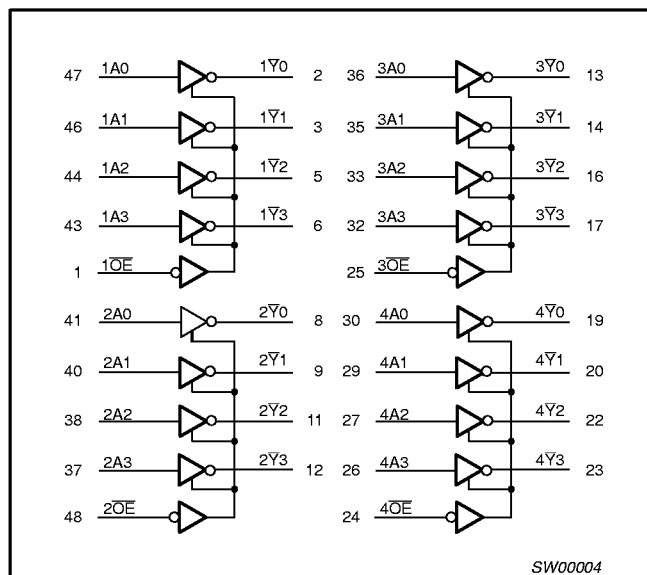
### QUICK REFERENCE DATA

| SYMBOL                 | PARAMETER                             | CONDITIONS<br>$T_{amb} = 25^{\circ}\text{C}$    | TYPICAL | UNIT |
|------------------------|---------------------------------------|-------------------------------------------------|---------|------|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>$nA_x$ to $nY_x$ | $C_L = 50\text{pF}$ ;<br>$V_{CC} = 3.3\text{V}$ | 2.6     | ns   |
| $C_{IN}$               | Input capacitance $n\overline{OE}$    | $V_I = 0\text{V}$ or $3.0\text{V}$              | 3       | pF   |
| $C_{OUT}$              | Output capacitance                    | $V_O = 0\text{V}$ or $3.0\text{V}$              | 9       | pF   |
| $I_{CCZ}$              | Total supply current                  | Outputs disabled; $V_{CC} = 3.6\text{V}$        | 70      | μA   |

### ORDERING INFORMATION

| PACKAGES                     | TEMPERATURE RANGE                              | OUTSIDE NORTH AMERICA | NORTH AMERICA | DWG NUMBER |
|------------------------------|------------------------------------------------|-----------------------|---------------|------------|
| 48-Pin Plastic SSOP Type III | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 74LVT162240A DL       | VT162240A DL  | SOT370-1   |
| 48-Pin Plastic TSSOP Type II | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 74LVT162240A DGG      | VT162240A DGG | SOT362-1   |

### LOGIC SYMBOL



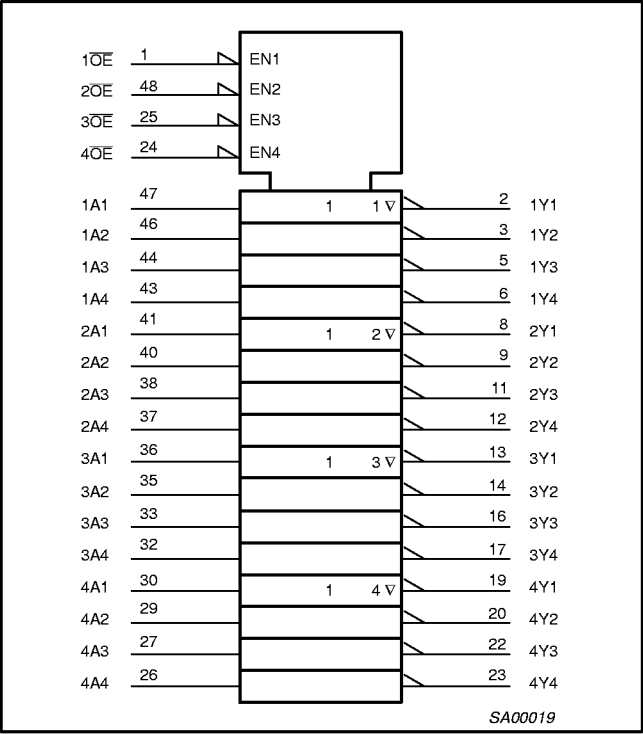
### PIN DESCRIPTION

| PIN NUMBER                                                              | SYMBOL                                           | NAME AND FUNCTION       |
|-------------------------------------------------------------------------|--------------------------------------------------|-------------------------|
| 47, 46, 44, 43,<br>41, 40, 38, 37,<br>36, 35, 33, 32,<br>30, 29, 27, 26 | 1A0 - 1A3<br>2A0 - 2A3<br>3A0 - 3A3<br>4A0 - 4A3 | Data inputs             |
| 2, 3, 5, 6,<br>8, 9, 11, 12,<br>13, 14, 16, 17,<br>19, 20, 22, 23       | 1Y0 - 1Y3<br>2Y0 - 2Y3<br>3Y0 - 3Y3<br>4Y0 - 4Y3 | Data outputs            |
| 1, 48<br>25, 24                                                         | 1OE, 2OE,<br>3OE, 4OE                            | Output enables          |
| 4, 10, 15, 21,<br>28, 34, 39, 45                                        | GND                                              | Ground (0V)             |
| 7, 18, 31, 42                                                           | $V_{CC}$                                         | Positive supply voltage |

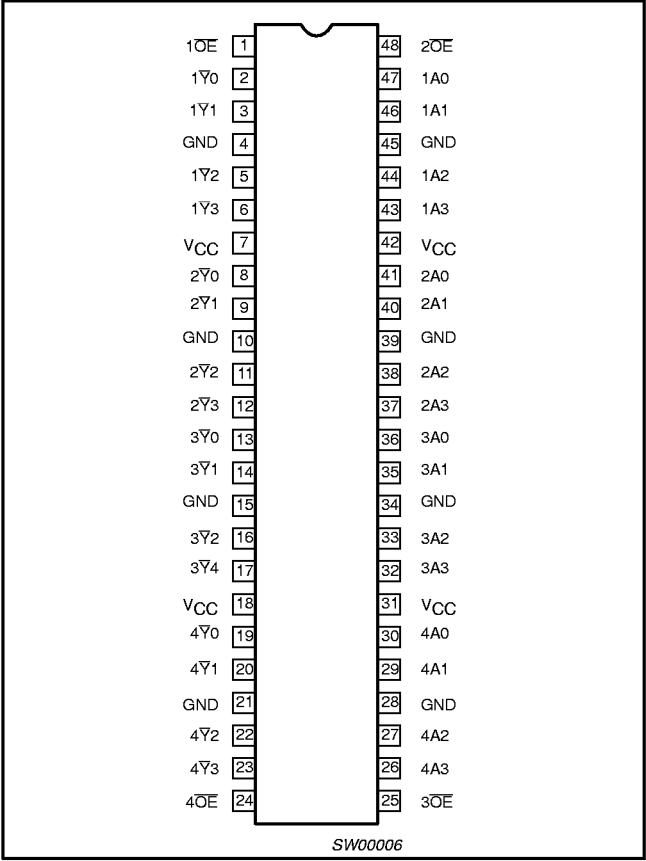
3.3V 16-bit inverting buffer/driver with 30Ω termination resistors (3-State)

74LVT162240A

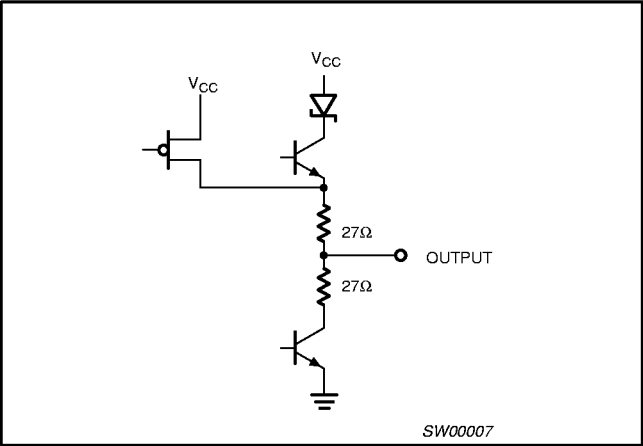
LOGIC SYMBOL (IEEE/IEC)



PIN CONFIGURATION



SCHEMATIC OF EACH OUTPUT



FUNCTION TABLE

| INPUTS |     | OUTPUTS |
|--------|-----|---------|
| nOE    | nAx | nYx     |
| L      | L   | H       |
| L      | H   | L       |
| H      | X   | Z       |

H = High voltage level  
L = Low voltage level  
X = Don't care  
Z = High Impedance "off" state

# 3.3V 16-bit inverting buffer/driver with 30Ω termination resistors (3-State)

74LVT162240A

## 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                                           | LIMITS |     | UNIT |
|---------------------|-----------------------------------------------------|--------|-----|------|
|                     |                                                     | MIN    | MAX |      |
| $V_{CC}$            | DC supply voltage                                   | 2.7    | 3.6 | V    |
| $V_I$               | Input voltage                                       | 0      | 5.5 | V    |
| $V_{IH}$            | High-level input voltage                            | 2.0    |     | V    |
| $V_{IL}$            | Input voltage                                       |        | 0.8 | V    |
| $I_{OH}$            | High-level output current                           |        | -12 | mA   |
| $I_{OL}$            | Low-level output current                            |        | 12  | mA   |
| $\Delta t/\Delta v$ | Input transition rise or fall rate; Outputs enabled |        | 10  | ns/V |
| $T_{amb}$           | Operating free-air temperature range                | -40    | +85 | °C   |

# 3.3V 16-bit inverting buffer/driver with 30Ω termination resistors (3-State)

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## DC ELECTRICAL CHARACTERISTICS

| SYMBOL             | PARAMETER                                                                      | TEST CONDITIONS                                                                                                                  |                        | LIMITS                |                  |      | UNIT |
|--------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------|------------------|------|------|
|                    |                                                                                |                                                                                                                                  |                        | Temp = -40°C to +85°C |                  |      |      |
|                    |                                                                                |                                                                                                                                  |                        | MIN                   | TYP <sup>1</sup> | MAX  |      |
| V <sub>IK</sub>    | Input clamp voltage                                                            | V <sub>CC</sub> = 2.7V; I <sub>IK</sub> = -18mA                                                                                  |                        |                       | -0.85            | 1.2  | V    |
| V <sub>OH</sub>    | High-level output voltage                                                      | V <sub>CC</sub> = 3.0V; I <sub>OH</sub> = -12mA                                                                                  |                        | 2.0                   |                  |      | V    |
| V <sub>OL</sub>    | Low-level output voltage                                                       | V <sub>CC</sub> = 3.0V; I <sub>OL</sub> = 12mA                                                                                   |                        |                       |                  | 0.8  | V    |
| I <sub>I</sub>     | Input leakage current                                                          | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub> or GND                                                                  | Control pins           |                       | 0.1              | ±1   | μA   |
|                    |                                                                                | V <sub>CC</sub> = 0 or 3.6V; V <sub>I</sub> = 5.5V                                                                               |                        |                       | 0.4              | 10   |      |
|                    |                                                                                | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub>                                                                         | Data pins <sup>4</sup> |                       | 0.1              | 1    |      |
|                    |                                                                                | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = 0                                                                                       |                        |                       | -0.4             | -5   |      |
| I <sub>OFF</sub>   | Output off current                                                             | V <sub>CC</sub> = 0V; V <sub>I</sub> or V <sub>O</sub> = 0 to 4.5V                                                               |                        |                       | 0.1              | ±100 | μA   |
| I <sub>HOLD</sub>  | Bus Hold current A outputs <sup>6</sup>                                        | V <sub>CC</sub> = 3V; V <sub>I</sub> = 0.8V                                                                                      |                        | 75                    | 135              |      | μA   |
|                    |                                                                                | V <sub>CC</sub> = 3V; V <sub>I</sub> = 2.0V                                                                                      |                        | -75                   | -135             |      |      |
|                    |                                                                                | V <sub>CC</sub> = 0V to 3.6V; V <sub>CC</sub> = 3.6V                                                                             |                        | ±500                  |                  |      |      |
| I <sub>EX</sub>    | Current into an output in the High state when V <sub>O</sub> > V <sub>CC</sub> | V <sub>O</sub> = 5.5V; V <sub>CC</sub> = 3.0V                                                                                    |                        |                       | 50               | 125  | μA   |
| I <sub>PU/PD</sub> | Power up/down 3-State output current <sup>3</sup>                              | V <sub>CC</sub> ≤ 1.2V; V <sub>O</sub> = 0.5V to V <sub>CC</sub> ; V <sub>I</sub> = GND or V <sub>CC</sub><br>OE/OE = Don't care |                        |                       | 1                | ±100 | μA   |
| I <sub>OZH</sub>   | 3-State output High current                                                    | V <sub>CC</sub> = 3.6V; V <sub>O</sub> = 3.0V; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                               |                        |                       | 0.5              | 5    | μA   |
| I <sub>OZL</sub>   | 3-State output Low current                                                     | V <sub>CC</sub> = 3.6V; V <sub>O</sub> = 0.5V; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                               |                        |                       | 0.5              | -5   | μA   |
| I <sub>CCH</sub>   | Quiescent supply current                                                       | V <sub>CC</sub> = 3.6V; Outputs High, V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0                               |                        |                       | 0.07             | 0.12 | mA   |
| I <sub>CCL</sub>   |                                                                                | V <sub>CC</sub> = 3.6V; Outputs Low, V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0                                |                        |                       | 4.0              | 6    |      |
| I <sub>CCZ</sub>   |                                                                                | V <sub>CC</sub> = 3.6V; Outputs Disabled; V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0 <sup>5</sup>              |                        |                       | 0.07             | 0.12 |      |
| ΔI <sub>CC</sub>   | Additional supply current per input pin <sup>2</sup>                           | V <sub>CC</sub> = 3V to 3.6V; One input at V <sub>CC</sub> -0.6V,<br>Other inputs at V <sub>CC</sub> or GND                      |                        |                       | 0.1              | 0.20 | mA   |

### NOTES:

- All typical values are at  $V_{CC} = 3.3V$  and  $T_{amb} = 25^\circ C$ .
- 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  $V_{CC} = 1.2V$  to  $V_{CC} = 3.3V \pm 0.3V$  a transition time of 100μsec is permitted. This parameter is valid for  $T_{amb} = 25^\circ C$  only.
- Unused pins at  $V_{CC}$  or GND.
- $I_{CCZ}$  is measured with outputs pulled to  $V_{CC}$  or GND.
- This is the bus hold overdrive current required to force the input to the opposite logic state.

## AC CHARACTERISTICS

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

| SYMBOL                 | PARAMETER                                      | WAVEFORM | LIMITS                   |                  |            |                 | UNIT |
|------------------------|------------------------------------------------|----------|--------------------------|------------------|------------|-----------------|------|
|                        |                                                |          | $V_{CC} = 3.3V \pm 0.3V$ |                  |            | $V_{CC} = 2.7V$ |      |
|                        |                                                |          | MIN                      | TYP <sup>1</sup> | MAX        | MAX             |      |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nAx to nYx                | 1        | 0.5<br>0.5               | 2.6<br>2.6       | 4.2<br>4.2 | 5.0<br>5.0      | ns   |
| $t_{PZH}$<br>$t_{PZL}$ | Output enable time<br>to High and Low level    | 2        | 1.0<br>1.0               | 3.3<br>3.0       | 5.5<br>5.0 | 6.5<br>5.5      | ns   |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output disable time<br>from High and Low Level | 2        | 1.0<br>1.0               | 3.5<br>3.2       | 5.0<br>4.5 | 5.5<br>4.5      | ns   |

### NOTE:

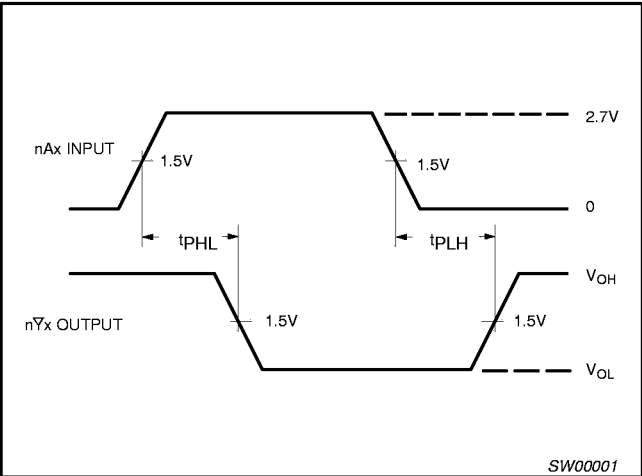
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3.3V 16-bit inverting buffer/driver with 30Ω termination resistors (3-State)

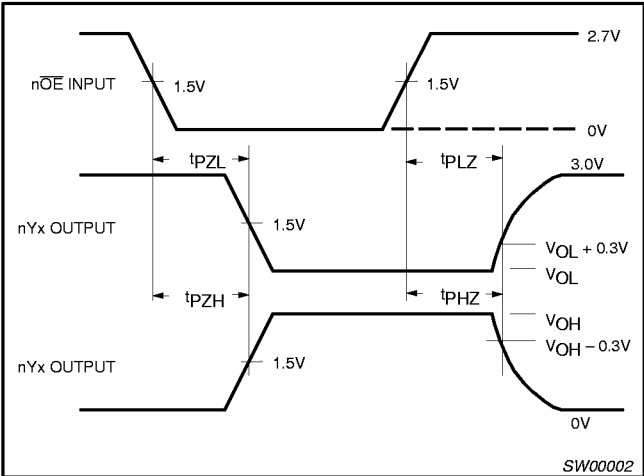
74LVT162240A

AC WAVEFORMS

$V_M = 1.5V$ ,  $V_{IN} = GND$  to  $2.7V$



Waveform 1. Input (nAx) to Output (nYx) Propagation Delays



Waveform 2. 3-State Output Enable and Disable Times

TEST CIRCUIT AND WAVEFORMS

**Test Circuit for 3-State Outputs**

**SWITCH POSITION**

| TEST              | SWITCH |
|-------------------|--------|
| $t_{PHZ}/t_{PZH}$ | GND    |
| $t_{PLZ}/t_{PLZ}$ | 6V     |
| $t_{PLH}/t_{PHL}$ | open   |

**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.

**$V_M = 1.5V$**

**Input Pulse Definition**

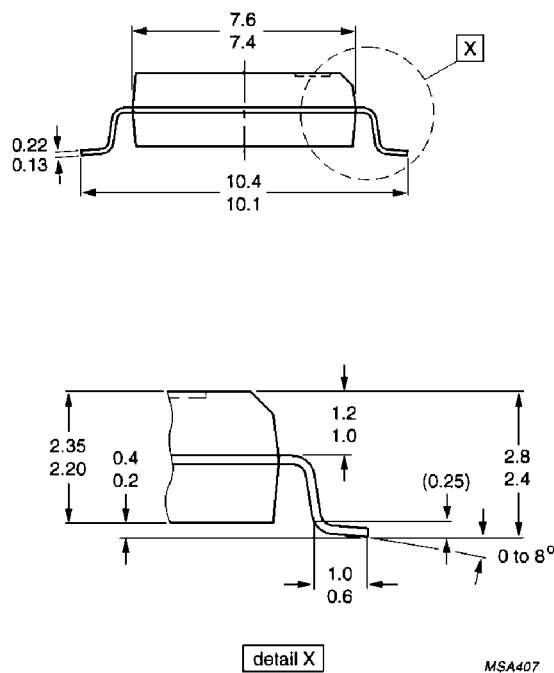
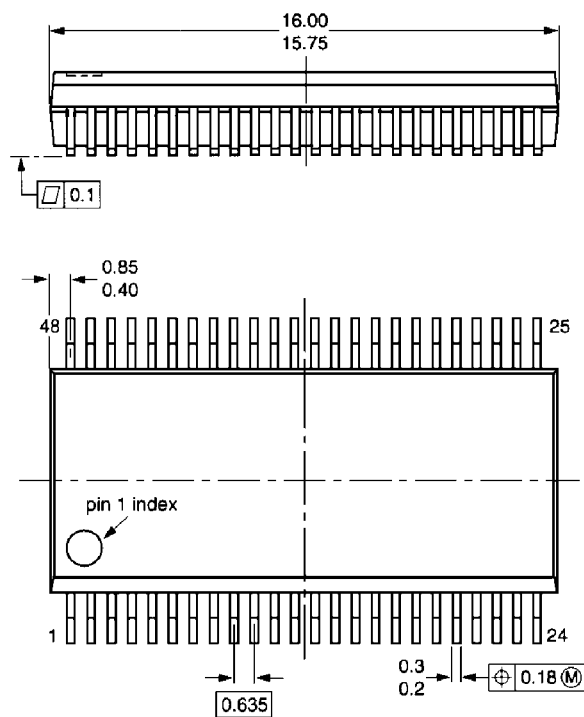
| FAMILY  | INPUT PULSE REQUIREMENTS |              |       |              |              |
|---------|--------------------------|--------------|-------|--------------|--------------|
|         | Amplitude                | Rep. Rate    | $t_W$ | $t_R$        | $t_F$        |
| 74LVT16 | 2.7V                     | $\leq 10MHz$ | 500ns | $\leq 2.5ns$ | $\leq 2.5ns$ |

# 3.3V LVT 16-bit inverting buffer/driver with 30 $\Omega$ termination resistors (3-State)

74LVT162240A

SSOP48: plastic shrink small outline package; 48 leads; body width 7.5mm

SOT370-1



Dimensions in mm.

# 3.3V LVT 16-bit inverting buffer/driver with 30Ω termination resistors (3-State)

74LVT162240A

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1mm

SOT362-1

