

74LVC16241A

16-bit buffer/line driver with 5 V tolerant inputs/outputs;
3-state

Rev. 4 — 26 October 2011

Product data sheet

1. General description

The 74LVC16241A is a 16-bit non-inverting buffer/line driver with 3-state outputs. The 3-state outputs are controlled by the output enable inputs ($\overline{1OE}$, 2OE, 3OE and $\overline{4OE}$). Schmitt trigger action at all inputs makes the circuit highly tolerant of slower input rise and fall times. The device can be used as four 4-bit buffers, two 8-bit buffers or one 16-bit buffer.

Inputs can be driven from either 3.3 V or 5 V devices. When disabled, up to 5.5 V can be applied to the outputs. These features allow the use of these devices in mixed 3.3 V and 5 V applications.

2. Features and benefits

- 5 V tolerant inputs and outputs for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- MULTIBYTE flow-through standard pin-out architecture
- Low inductance multiple power and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- High-impedance outputs when $V_{CC} = 0$ V
- Complies with JEDEC standard:
 - ◆ JESD8-7A (1.65 V to 1.95 V)
 - ◆ JESD8-5A (2.3 V to 2.7 V)
 - ◆ JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115B exceeds 200 V
 - ◆ CDM JESD22-C101E exceeds 1000 V
- Specified from -40 °C to $+85$ °C and -40 °C to $+125$ °C.



3. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|----------------|-------------------|---------|--|----------|
| | Temperature range | Name | Description | |
| 74LVC16241ADL | -40 °C to +125 °C | SSOP48 | plastic shrink small outline package; 48 leads; body width 7.5 mm | SOT370-1 |
| 74LVC16241ADGG | -40 °C to +125 °C | TSSOP48 | plastic thin shrink small outline package; 48 leads; body width 6.1 mm | SOT362-1 |

4. Functional diagram

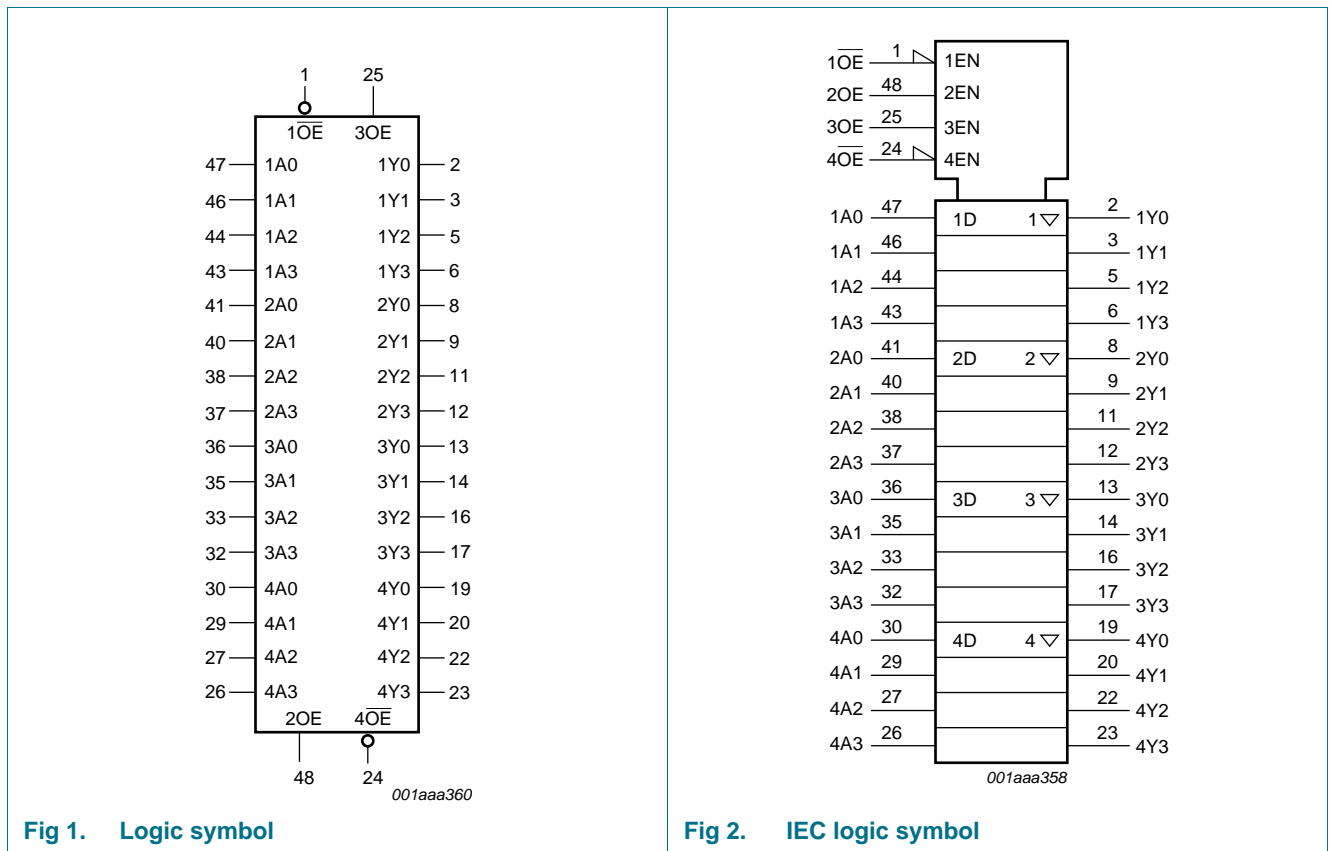


Fig 1. Logic symbol

Fig 2. IEC logic symbol

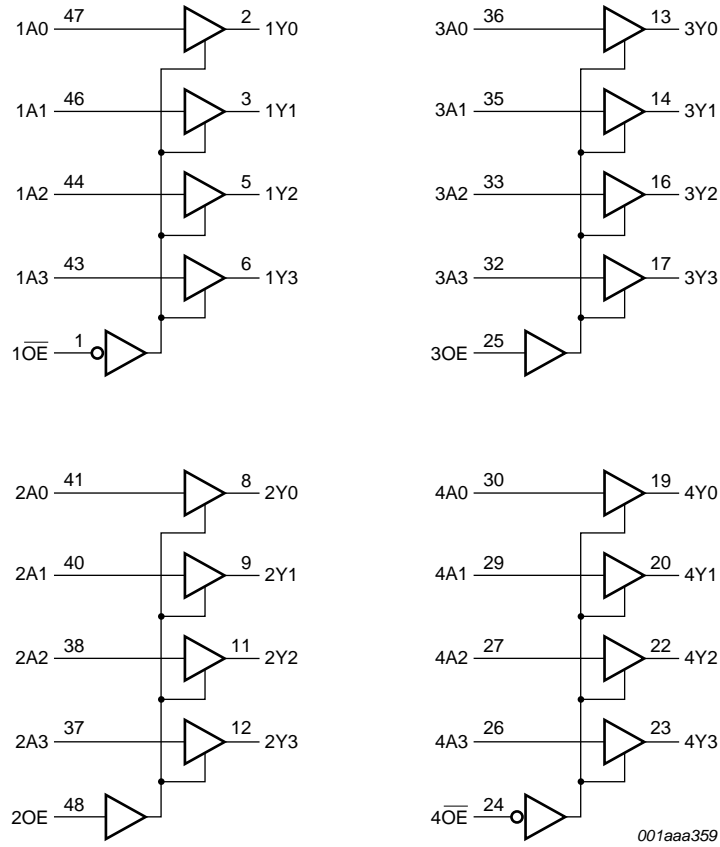


Fig 3. Logic diagram

5. Pinning information

5.1 Pinning

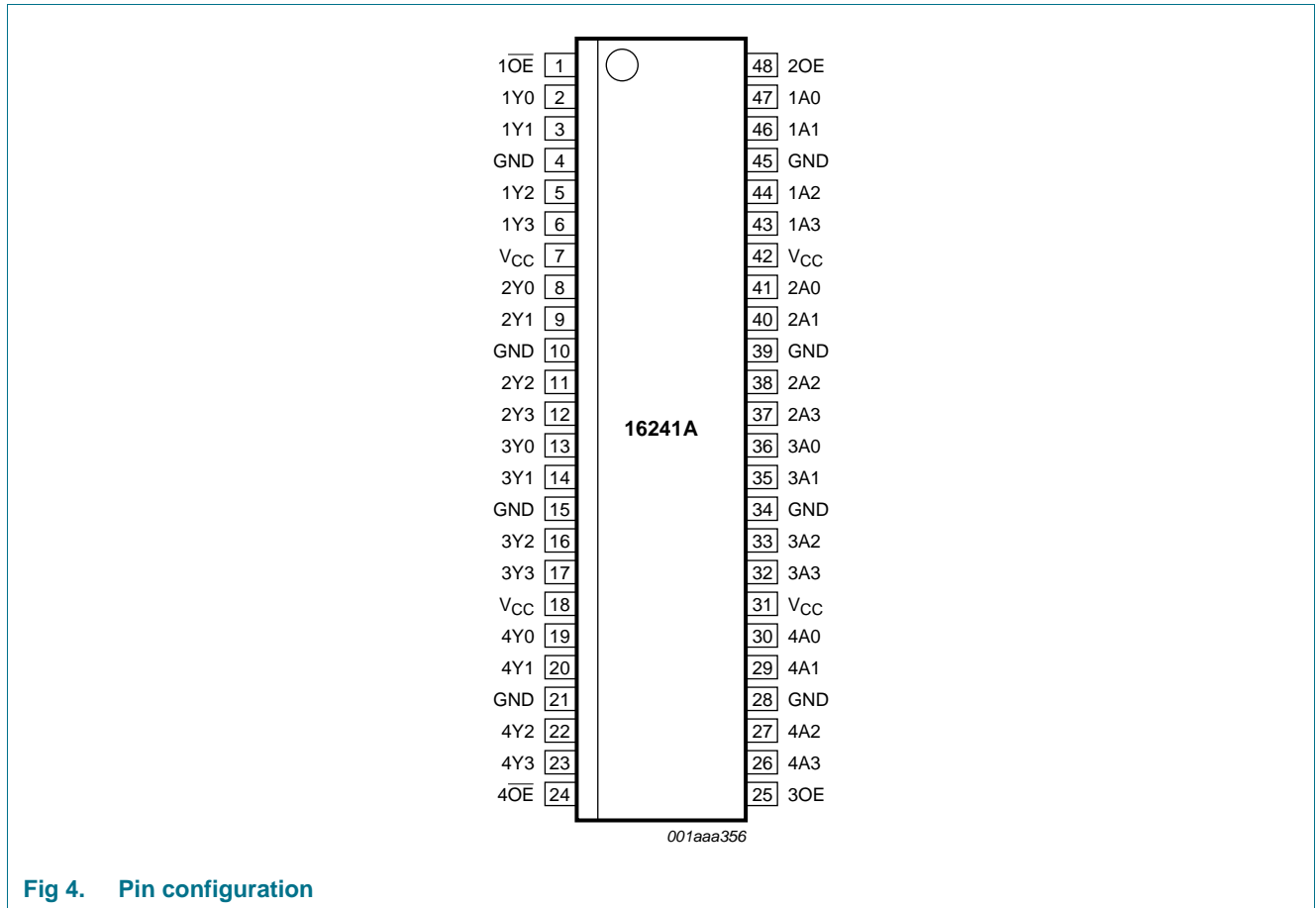


Fig 4. Pin configuration

5.2 Pin description

Table 2. Pin description

| Name | Pin | Description |
|-----------------|-------------------------------|-----------------------------------|
| 1OE | 1 | output enable input (active LOW) |
| 2OE | 48 | output enable input (active HIGH) |
| 3OE | 25 | output enable input (active HIGH) |
| 4OE | 24 | output enable input (active LOW) |
| GND | 4, 10, 15, 21, 28, 34, 39, 45 | ground (0 V) |
| V _{CC} | 7, 18, 31, 42 | supply voltage |
| 1Y[0:3] | 2, 3, 5, 6 | data output |
| 2Y[0:3] | 8, 9, 11, 12 | data output |
| 3Y[0:3] | 13, 14, 16, 17 | data output |
| 4Y[0:3] | 19, 20, 22, 23 | data output |
| 1A[0:3] | 47, 46, 44, 43 | data input |

Table 2. Pin description ...continued

| Name | Pin | Description |
|---------|----------------|-------------|
| 2A[0:3] | 41, 40, 38, 37 | data input |
| 3A[0:3] | 36, 35, 33, 32 | data input |
| 4A[0:3] | 30, 29, 27, 26 | data input |

6. Functional description

Table 3. Function table^[1]

| Input | | | Output |
|-------|-------------------------|-----|--------|
| nAn | $\overline{\text{nOE}}$ | nOE | nYn |
| H | L | - | H |
| | - | H | H |
| L | L | - | L |
| | - | H | L |
| X | H | - | Z |
| | - | L | Z |

- [1] H = HIGH voltage level
 L = LOW voltage level
 X = don't care
 Z = high-impedance OFF-state

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|-------------------------|-------------------------------|---------------------|----------------|------|
| V_{CC} | supply voltage | | -0.5 | +6.5 | V |
| I_{IK} | input clamping current | $V_I < 0$ V | -50 | - | mA |
| V_I | input voltage | | ^[1] -0.5 | +6.5 | V |
| I_{OK} | output clamping current | $V_O > V_{CC}$ or $V_O < 0$ V | - | ±50 | mA |
| V_O | output voltage | HIGH or LOW state | ^[2] -0.5 | $V_{CC} + 0.5$ | V |
| | | 3-state | ^[2] -0.5 | +6.5 | V |
| I_O | output current | $V_O = 0$ V to V_{CC} | - | ±50 | mA |
| I_{CC} | supply current | | - | 100 | mA |
| I_{GND} | ground current | | -100 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40$ °C to +125 °C | ^[3] - | 500 | mW |

- [1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.
 [2] The output voltage ratings may be exceeded if the output current ratings are observed.
 [3] Above 60 °C the value of P_{tot} derates linearly with 5.5 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------------|-------------------------------------|-----------------------------------|------|-----|-----------------|------|
| V _{CC} | supply voltage | | 1.65 | - | 3.6 | V |
| | | functional | 1.2 | - | - | V |
| V _I | input voltage | | 0 | - | 5.5 | V |
| V _O | output voltage | HIGH or LOW state | 0 | - | V _{CC} | V |
| | | 3-state | 0 | - | 5.5 | V |
| T _{amb} | ambient temperature | in free air | -40 | - | +125 | °C |
| Δt/ΔV | input transition rise and fall rate | V _{CC} = 1.65 V to 2.7 V | 0 | - | 20 | ns/V |
| | | V _{CC} = 2.7 V to 3.6 V | 0 | - | 10 | ns/V |

9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|-----------------|---------------------------|---|------------------------|--------------------|------------------------|------------------------|------------------------|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 1.2 V | 1.08 | - | - | 1.08 | - | V |
| | | V _{CC} = 1.65 V to 1.95 V | 0.65 × V _{CC} | - | - | 0.65 × V _{CC} | - | V |
| | | V _{CC} = 2.3 V to 2.7 V | 1.7 | - | - | 1.7 | - | V |
| | | V _{CC} = 2.7 V to 3.6 V | 2.0 | - | - | 2.0 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 1.2 V | - | - | 0.12 | - | 0.12 | V |
| | | V _{CC} = 1.65 V to 1.95 V | - | - | 0.35 × V _{CC} | - | 0.35 × V _{CC} | V |
| | | V _{CC} = 2.3 V to 2.7 V | - | - | 0.7 | - | 0.7 | V |
| | | V _{CC} = 2.7 V to 3.6 V | - | - | 0.8 | - | 0.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | |
| | | I _O = -100 μA; V _{CC} = 1.65 V to 3.6 V | V _{CC} - 0.2 | - | - | V _{CC} - 0.3 | - | V |
| | | I _O = -4 mA; V _{CC} = 1.65 V | 1.2 | - | - | 1.05 | - | V |
| | | I _O = -8 mA; V _{CC} = 2.3 V | 1.8 | - | - | 1.65 | - | V |
| | | I _O = -12 mA; V _{CC} = 2.7 V | 2.2 | - | - | 2.05 | - | V |
| | | I _O = -18 mA; V _{CC} = 3.0 V | 2.4 | - | - | 2.25 | - | V |
| | | I _O = -24 mA; V _{CC} = 3.0 V | 2.2 | - | - | 2.0 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | |
| | | I _O = 100 μA; V _{CC} = 1.65 V to 3.6 V | - | - | 0.2 | - | 0.3 | V |
| | | I _O = 4 mA; V _{CC} = 1.65 V | - | - | 0.45 | - | 0.65 | V |
| | | I _O = 8 mA; V _{CC} = 2.3 V | - | - | 0.6 | - | 0.8 | V |
| | | I _O = 12 mA; V _{CC} = 2.7 V | - | - | 0.4 | - | 0.6 | V |
| | | I _O = 24 mA; V _{CC} = 3.0 V | - | - | 0.55 | - | 0.8 | V |
| I _I | input leakage current | V _{CC} = 3.6 V; V _I = 5.5 V or GND | - | ±0.1 | ±5 | - | ±20 | μA |

Table 6. Static characteristics ...continued

At recommended operating conditions. Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|------------------|---------------------------|--|------------------|--------------------|-----|-------------------|------|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| I _{OZ} | OFF-state output current | V _I = V _{IH} or V _{IL} ; V _{CC} = 3.6 V; V _O = 5.5 V or GND; | - | ±0.1 | ±5 | - | ±20 | μA |
| I _{OFF} | power-off leakage current | V _{CC} = 0 V; V _I or V _O = 5.5 V | - | ±0.1 | ±10 | - | ±20 | μA |
| I _{CC} | supply current | V _{CC} = 3.6 V; V _I = V _{CC} or GND; I _O = 0 A | - | 0.1 | 20 | - | 80 | μA |
| ΔI _{CC} | additional supply current | per inputpin; V _{CC} = 2.7 V to 3.6 V; V _I = V _{CC} - 0.6 V; I _O = 0 A | - | 5 | 500 | - | 5000 | μA |
| C _I | input capacitance | V _{CC} = 0 V to 3.6 V; V _I = GND to V _{CC} | - | 5.0 | - | - | - | pF |

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.

10. Dynamic characteristics

Table 7. Dynamic characteristicsVoltages are referenced to GND (ground = 0 V). For test circuit see [Figure 8](#).

| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|----------------------------------|-------------------|--|-------------------------------------|--------------------|------|-------------------|------|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| t _{pd} | propagation delay | nAn to nYn; see Figure 5 [2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 13 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.7 | 4.8 | 10.1 | 1.7 | 11.7 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.5 | 2.6 | 5.3 | 1.5 | 6.1 | ns |
| | | V _{CC} = 2.7 V | 1.0 | 2.6 | 5.0 | 1.0 | 6.5 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.0 | 2.2 | 4.4 | 1.0 | 5.5 | ns |
| t _{en} | enable time | nOE to nYn; see Figure 6 [2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 17 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.0 | 5.2 | 12.5 | 1.0 | 13.2 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.0 | 3.0 | 6.9 | 1.0 | 7.3 | ns |
| | | V _{CC} = 2.7 V | 1.0 | 3.2 | 6.0 | 1.0 | 7.5 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.0 | 2.4 | 5.5 | 1.0 | 7.0 | ns |
| | | nOE to nYn; see Figure 7 | | | | | | |
| | | V _{CC} = 1.2 V | - | 19 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 2.5 | 6.9 | 14.2 | 2.5 | 15.0 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 2.1 | 3.9 | 7.5 | 2.1 | 8.3 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 3.3 | 6.0 | 1.5 | 7.5 | ns |
| V _{CC} = 3.0 V to 3.6 V | 1.5 | 3.1 | 5.5 | 1.5 | 7.0 | ns | | |

Table 7. Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 8](#).

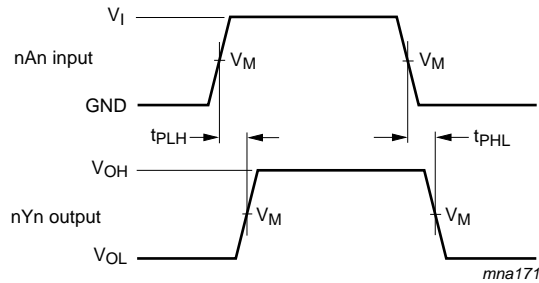
| Symbol | Parameter | Conditions | T _{amb} = -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|------------------|-------------------------------|---|-------------------------------------|--------------------|-----|-------------------|-----|------|
| | | | Min | Typ ^[1] | Max | Min | Max | |
| t _{dis} | disable time | nOE to nYn; see Figure 6 ^[2] | | | | | | |
| | | V _{CC} = 1.2 V | - | 9.0 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 2.4 | 4.3 | 8.3 | 2.4 | 9.2 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 1.0 | 2.4 | 4.7 | 1.0 | 5.2 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 3.2 | 5.5 | 1.5 | 7.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.5 | 3.0 | 5.0 | 1.5 | 6.5 | ns |
| | | nOE to nYn; see Figure 7 | | | | | | |
| | | V _{CC} = 1.2 V | - | 8.0 | - | - | - | ns |
| | | V _{CC} = 1.65 V to 1.95 V | 1.5 | 3.5 | 8.4 | 1.5 | 9.6 | ns |
| | | V _{CC} = 2.3 V to 2.7 V | 0.5 | 1.9 | 4.8 | 0.5 | 5.5 | ns |
| | | V _{CC} = 2.7 V | 1.5 | 3.5 | 5.5 | 1.5 | 7.0 | ns |
| | | V _{CC} = 3.0 V to 3.6 V | 1.0 | 2.6 | 5.0 | 1.0 | 6.5 | ns |
| C _{PD} | power dissipation capacitance | per input; V _I = GND to V _{CC} ^[3] | | | | | | |
| | | V _{CC} = 1.65 V to 1.95 V | - | 8.4 | - | - | - | pF |
| | | V _{CC} = 2.3 V to 2.7 V | - | 11.9 | - | - | - | pF |
| | | V _{CC} = 3.0 V to 3.6 V | - | 15.0 | - | - | - | pF |

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.2 V, 1.8 V, 2.5 V, 2.7 V, and 3.3 V respectively.

[2] t_{pd} is the same as t_{PLH} and t_{PHL}.
 t_{en} is the same as t_{PZL} and t_{PZH}.
 t_{dis} is the same as t_{PLZ} and t_{PHZ}.

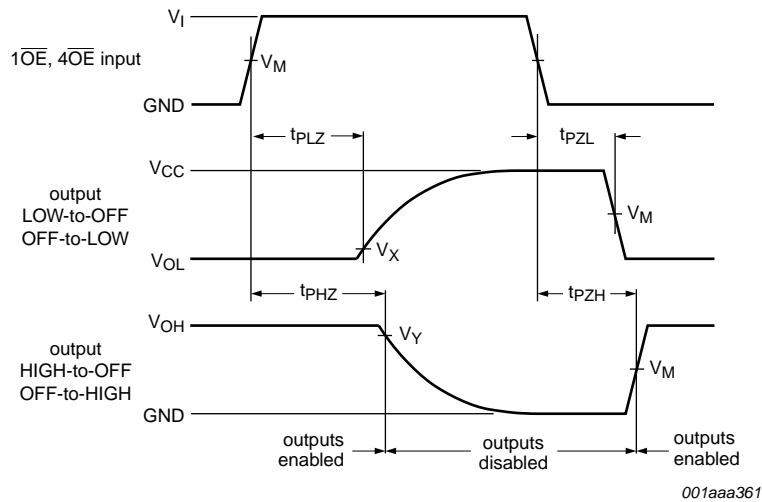
[3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
 f_i = input frequency in MHz; f_o = output frequency in MHz
 C_L = output load capacitance in pF
 V_{CC} = supply voltage in Volts
 N = number of inputs switching
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs

11. Waveforms



$V_M = 1.5\text{ V}$ at $V_{CC} \geq 2.7\text{ V}$;
 $V_M = 0.5 \times V_{CC}$ at $V_{CC} < 2.7\text{ V}$.
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 5. Input nAn to output nYn propagation delays

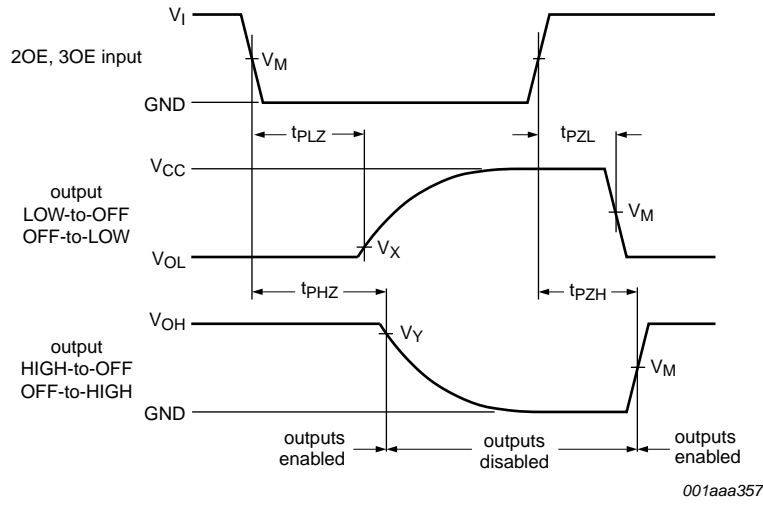


Measurements points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 6. 3-state enable and disable times for inputs $\overline{1OE}$ and $\overline{4OE}$

Table 8. Measurement points

| Supply voltage | Input | Output | | |
|------------------|---------------------|---------------------|--------------------------|--------------------------|
| V_{CC} | V_M | V_M | V_X | V_Y |
| 1.2 V | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $V_{OL} + 0.15\text{ V}$ | $V_{OH} - 0.15\text{ V}$ |
| 1.65 V to 1.95 V | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $V_{OL} + 0.15\text{ V}$ | $V_{OH} - 0.15\text{ V}$ |
| 2.3 V to 2.7 V | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $V_{OL} + 0.15\text{ V}$ | $V_{OH} - 0.15\text{ V}$ |
| 2.7 V | 1.5 V | 1.5 V | $V_{OL} + 0.3\text{ V}$ | $V_{OH} - 0.3\text{ V}$ |
| 3.0 V to 3.6 V | 1.5 V | 1.5 V | $V_{OL} + 0.3\text{ V}$ | $V_{OH} - 0.3\text{ V}$ |



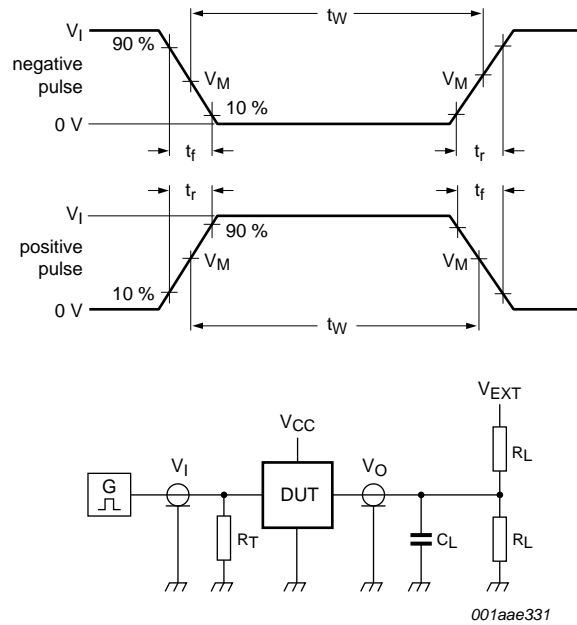
Measurements points are given in [Table 9](#).

V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 7. 3-state enable and disable times for inputs 2OE and 3OE

Table 9. Measurement points

| Supply voltage | Input | Output | | |
|------------------|---------------------|---------------------|---------------------------|---------------------------|
| V_{CC} | V_M | V_M | V_X | V_Y |
| 1.2 V | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |
| 1.65 V to 1.95 V | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |
| 2.3 V to 2.7 V | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |
| 2.7 V | 1.5 V | 1.5 V | $V_{OL} + 0.3 \text{ V}$ | $V_{OH} - 0.3 \text{ V}$ |
| 3.0 V to 3.6 V | 1.5 V | 1.5 V | $V_{OL} + 0.3 \text{ V}$ | $V_{OH} - 0.3 \text{ V}$ |



Test data is given in [Table 10](#).

Definitions for test circuit:

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

V_{EXT} = External voltage for measuring switching times.

Fig 8. Test circuit for measuring switching times

Table 10. Test data

| Supply voltage | Input | | Load | | V_{EXT} | | |
|------------------|----------|---------------|-------|--------------|--------------------|--------------------|--------------------|
| | V_I | t_r, t_f | C_L | R_L | t_{PLH}, t_{PHL} | t_{PLZ}, t_{PZL} | t_{PHZ}, t_{PZH} |
| 1.2 V | V_{CC} | ≤ 2 ns | 30 pF | 1 k Ω | open | $2 \times V_{CC}$ | GND |
| 1.65 V to 1.95 V | V_{CC} | ≤ 2 ns | 30 pF | 1 k Ω | open | $2 \times V_{CC}$ | GND |
| 2.3 V to 2.7 V | V_{CC} | ≤ 2 ns | 30 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |
| 2.7 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |
| 3.0 V to 3.6 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | open | $2 \times V_{CC}$ | GND |

12. Package outline

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

SOT370-1

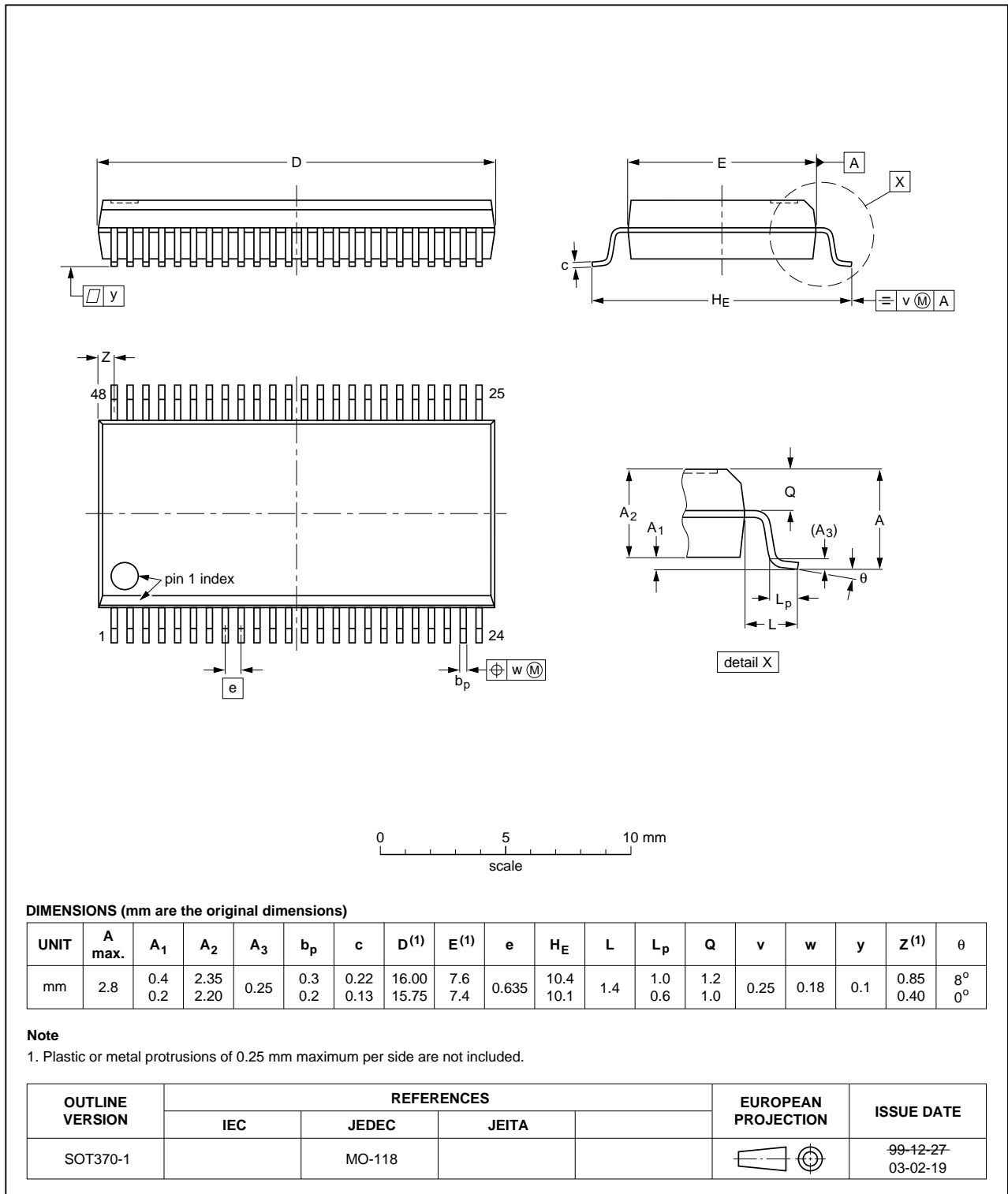


Fig 9. Package outline SOT370-1 (SSOP48)

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

SOT362-1

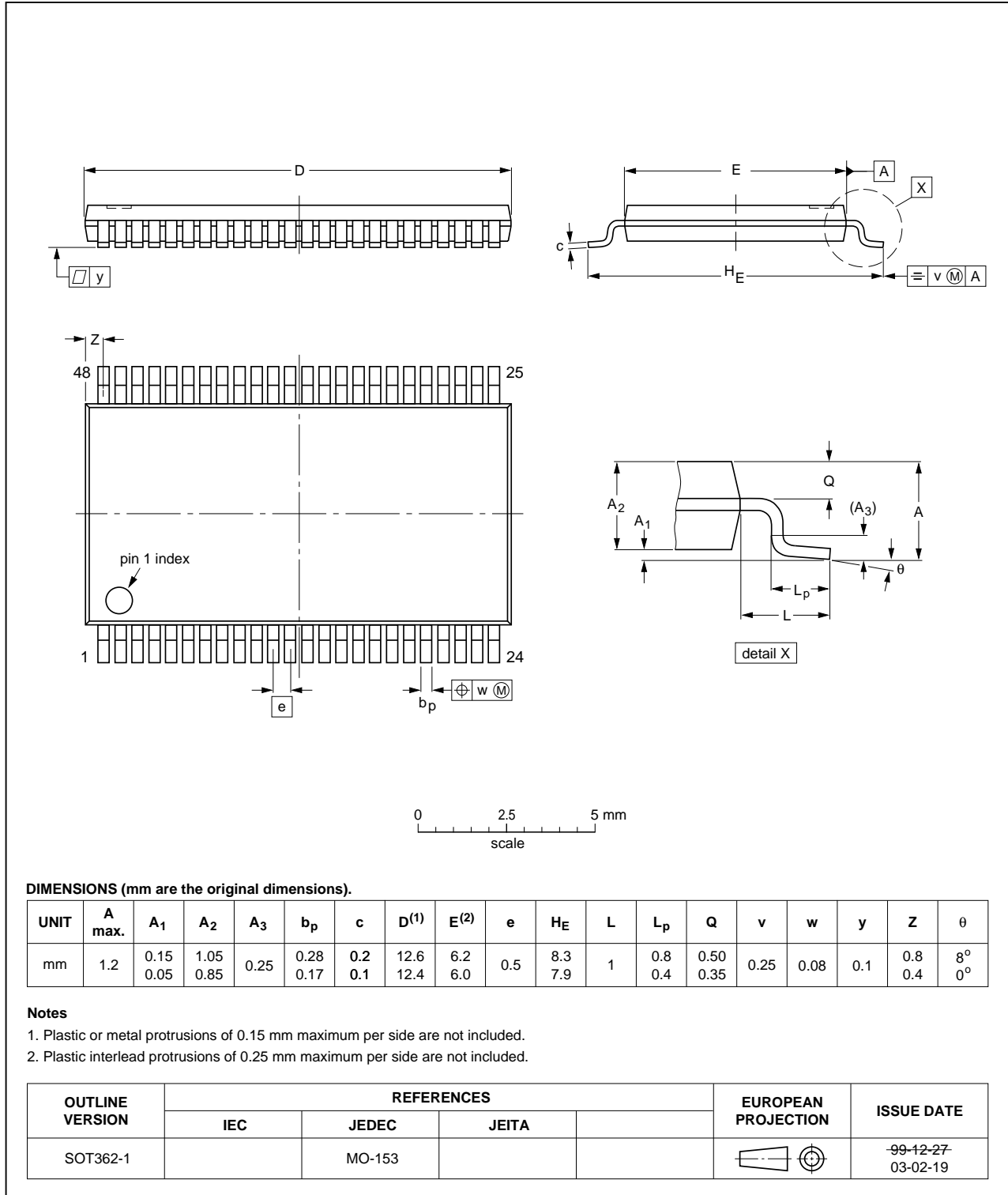


Fig 10. Package outline SOT362-1 (TSSOP48)

13. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|-----------------------------|
| CDM | Charged Device Model |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MM | Machine Model |
| TTL | Transistor-Transistor Logic |

14. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-----------------|---|-----------------------|---------------|-----------------|
| 74LVC16241A v.4 | 20111026 | Product data sheet | - | 74LVC16241A v.3 |
| Modifications: | <ul style="list-style-type: none"> The format of this document has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate. Table 4, Table 5, Table 6, Table 7, and Table 10: values added for lower voltage ranges. | | | |
| 74LVC16241A v.3 | 20040305 | Product specification | - | 74LVC16241A v.2 |
| 74LVC16241A v.2 | 19970729 | Product specification | - | 74LVC16241A v.1 |
| 74LVC16241A v.1 | 19951226 | Product specification | - | - |

15. Legal information

15.1 Data sheet status

| Document status ^{[1][2]} | Product status ^[3] | Definition |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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