

# 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

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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

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- 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.

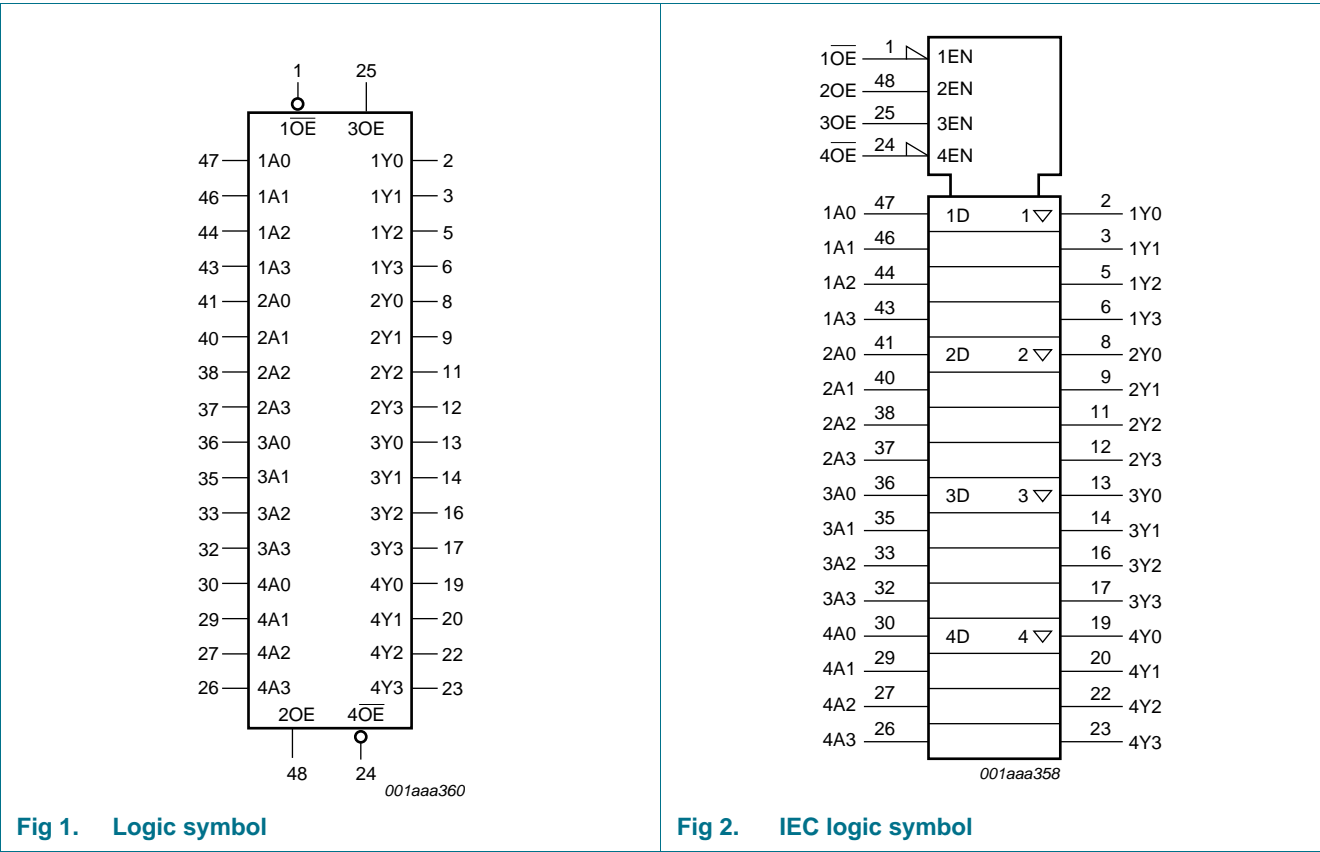


3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
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



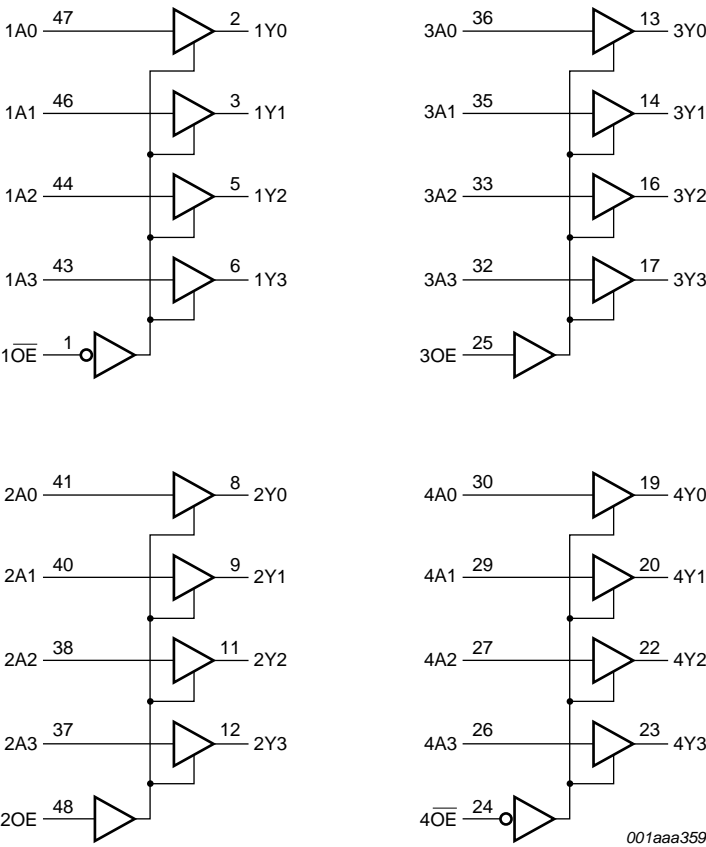
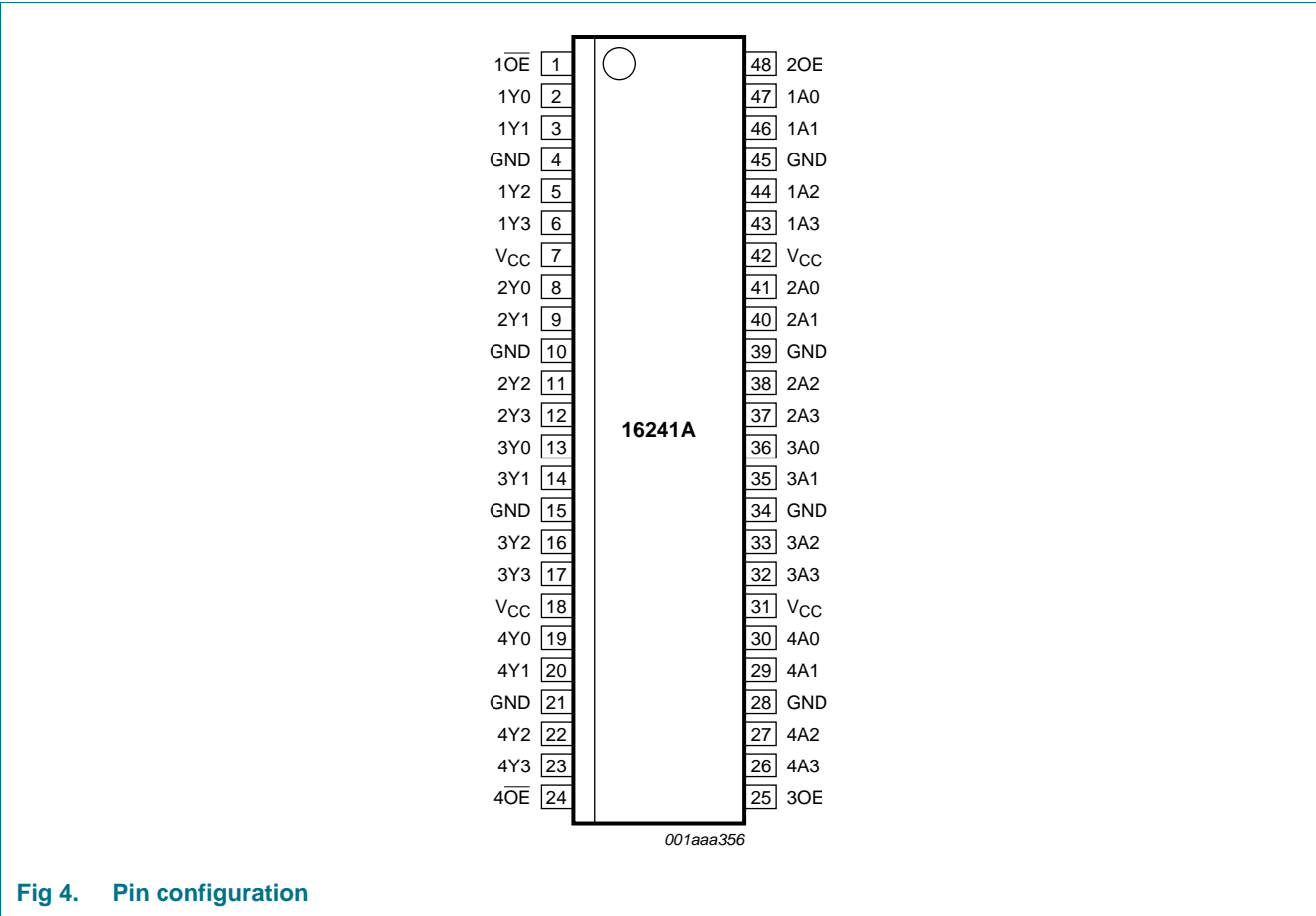


Fig 3. Logic diagram

5. Pinning information

5.1 Pinning



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 <sub>CC</sub>	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<sup>[1]</sup>

Input			Output
nAn	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 <sub>CC</sub>	supply voltage		-0.5	+6.5	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	-50	-	mA
V <sub>I</sub>	input voltage		<sup>[1]</sup> -0.5	+6.5	V
I <sub>OK</sub>	output clamping current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0 V	-	±50	mA
V <sub>O</sub>	output voltage	HIGH or LOW state	<sup>[2]</sup> -0.5	V <sub>CC</sub> + 0.5	V
		3-state	<sup>[2]</sup> -0.5	+6.5	V
I <sub>O</sub>	output current	V <sub>O</sub> = 0 V to V <sub>CC</sub>	-	±50	mA
I <sub>CC</sub>	supply current		-	100	mA
I <sub>GND</sub>	ground current		-100	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C	<sup>[3]</sup> -	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<sub>tot</sub> derates linearly with 5.5 mW/K.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>O</sub>	output voltage	HIGH or LOW state	0	-	V <sub>CC</sub>	V
		3-state	0	-	5.5	V
T <sub>amb</sub>	ambient temperature	in free air	-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.65 V to 2.7 V	0	-	20	ns/V
		V <sub>CC</sub> = 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 <sup>[1]</sup>	Max	Min	Max	
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	1.08	-	-	1.08	-	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>	-	-	0.65 × V <sub>CC</sub>	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	0.12	-	0.12	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 × V <sub>CC</sub>	-	0.35 × V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>						
		I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.3	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	1.05	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.8	-	-	1.65	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	2.05	-	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	2.4	-	-	2.25	-	V
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.2	-	-	2.0	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>						
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.65	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.6	-	0.8	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	0.6	V
		I <sub>O</sub> = 24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	0.8	V
I <sub>I</sub>	input leakage current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = 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 <sup>[1]</sup>	Max	Min	Max	
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 3.6 V; V <sub>O</sub> = 5.5 V or GND;	-	±0.1	±5	-	±20	µA
I <sub>OFF</sub>	power-off leakage current	V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 5.5 V	-	±0.1	±10	-	±20	µA
I <sub>CC</sub>	supply current	V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A	-	0.1	20	-	80	µA
ΔI <sub>CC</sub>	additional supply current	per inputpin; V <sub>CC</sub> = 2.7 V to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A	-	5	500	-	5000	µA
C <sub>I</sub>	input capacitance	V <sub>CC</sub> = 0 V to 3.6 V; V <sub>I</sub> = GND to V <sub>CC</sub>	-	5.0	-	-	-	pF

[1] All typical values are measured at V<sub>CC</sub> = 3.3 V (unless stated otherwise) and T<sub>amb</sub> = 25 °C.

## 10. Dynamic characteristics

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

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
t <sub>pd</sub>	propagation delay	nAn to nYn; see <a href="#">Figure 5</a> <sup>[2]</sup>						
		V <sub>CC</sub> = 1.2 V	-	13	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.7	4.8	10.1	1.7	11.7	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	2.6	5.3	1.5	6.1	ns
		V <sub>CC</sub> = 2.7 V	1.0	2.6	5.0	1.0	6.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.2	4.4	1.0	5.5	ns
t <sub>en</sub>	enable time	nOE to nYn; see <a href="#">Figure 6</a> <sup>[2]</sup>						
		V <sub>CC</sub> = 1.2 V	-	17	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.0	5.2	12.5	1.0	13.2	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	3.0	6.9	1.0	7.3	ns
		V <sub>CC</sub> = 2.7 V	1.0	3.2	6.0	1.0	7.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.4	5.5	1.0	7.0	ns
		nOE to nYn; see <a href="#">Figure 7</a>						
		V <sub>CC</sub> = 1.2 V	-	19	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.5	6.9	14.2	2.5	15.0	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	2.1	3.9	7.5	2.1	8.3	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.3	6.0	1.5	7.5	ns
		V <sub>CC</sub> = 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 <sub>amb</sub> = −40 °C to +85 °C			−40 °C to +125 °C		Unit
			Min	Typ <sup>[1]</sup>	Max	Min	Max	
t <sub>dis</sub>	disable time	nOE to nYn; see <a href="#">Figure 6</a> <a href="#">[2]</a>						
		V <sub>CC</sub> = 1.2 V	-	9.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.4	4.3	8.3	2.4	9.2	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	2.4	4.7	1.0	5.2	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.2	5.5	1.5	7.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	3.0	5.0	1.5	6.5	ns
		nOE to nYn; see <a href="#">Figure 7</a>						
		V <sub>CC</sub> = 1.2 V	-	8.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.5	3.5	8.4	1.5	9.6	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.5	1.9	4.8	0.5	5.5	ns
C <sub>PD</sub>	power dissipation capacitance	V <sub>CC</sub> = 2.7 V	1.5	3.5	5.5	1.5	7.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.6	5.0	1.0	6.5	ns
		per input; V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[3]</a>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	8.4	-	-	-	pF
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	11.9	-	-	-	pF
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	15.0	-	-	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.2 V, 1.8 V, 2.5 V, 2.7 V, and 3.3 V respectively.

[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

t<sub>en</sub> is the same as t<sub>pZL</sub> and t<sub>pZH</sub>.

t<sub>dis</sub> is the same as t<sub>pLZ</sub> and t<sub>pHZ</sub>.

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> 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<sub>i</sub> = input frequency in MHz; f<sub>o</sub> = output frequency in MHz

C<sub>L</sub> = output load capacitance in pF

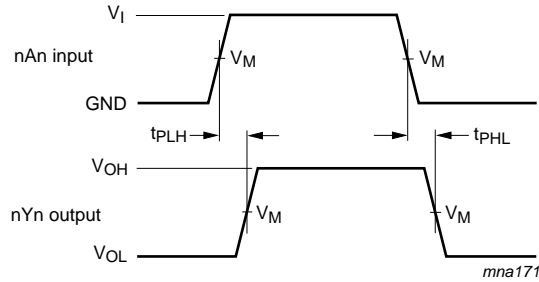
V<sub>CC</sub> = supply voltage in Volts

N = number of inputs switching

$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs



## 11. Waveforms

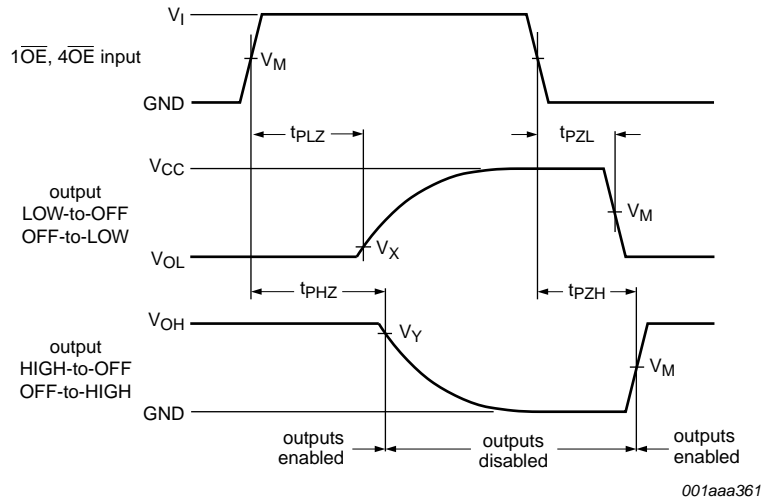


$V_M = 1.5 \text{ V}$  at  $V_{CC} \geq 2.7 \text{ V}$ ;

$V_M = 0.5 \times V_{CC}$  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**



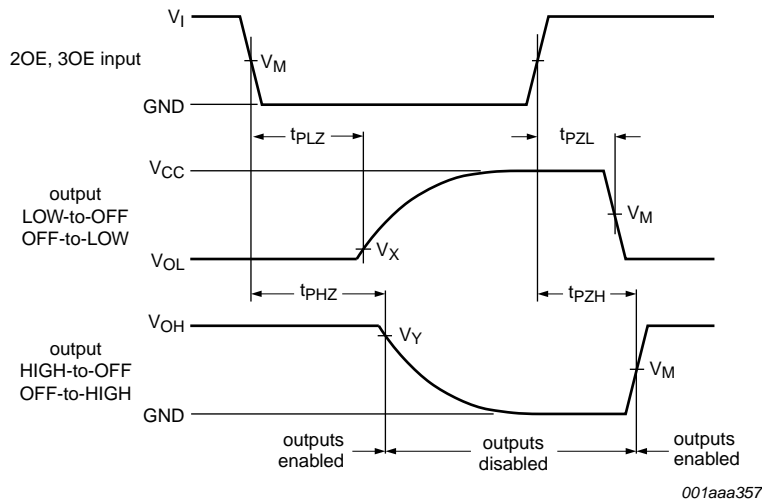
Measurements points are given in [Table 8](#).

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

**Fig 6. 3-state enable and disable times for inputs 1OE and 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	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$

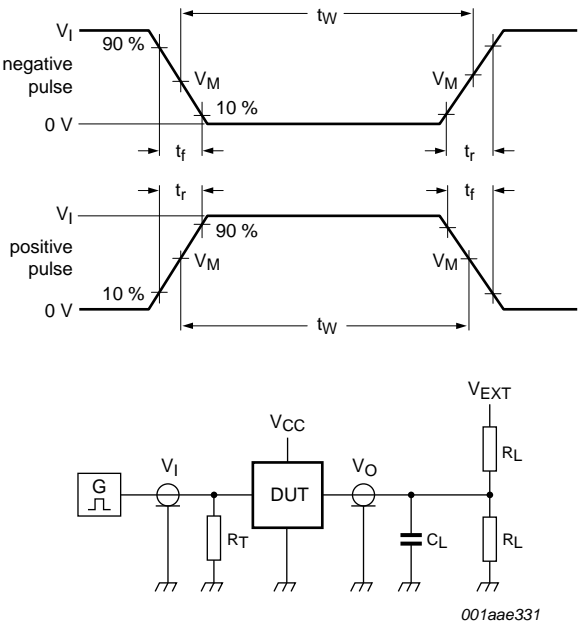


Measurements points are given in [Table 9](#).  
 $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**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 <sub>EXT</sub>		
	V <sub>I</sub>	t <sub>r</sub> , t <sub>f</sub>	C <sub>L</sub>	R <sub>L</sub>	t <sub>PLH</sub> , t <sub>PHL</sub>	t <sub>PLZ</sub> , t <sub>PZL</sub>	t <sub>PHZ</sub> , t <sub>PZH</sub>
1.2 V	V <sub>CC</sub>	≤ 2 ns	30 pF	1 kΩ	open	2 × V <sub>CC</sub>	GND
1.65 V to 1.95 V	V <sub>CC</sub>	≤ 2 ns	30 pF	1 kΩ	open	2 × V <sub>CC</sub>	GND
2.3 V to 2.7 V	V <sub>CC</sub>	≤ 2 ns	30 pF	500 Ω	open	2 × V <sub>CC</sub>	GND
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	2 × V <sub>CC</sub>	GND
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	2 × V <sub>CC</sub>	GND

12. Package outline

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

SOT370-1

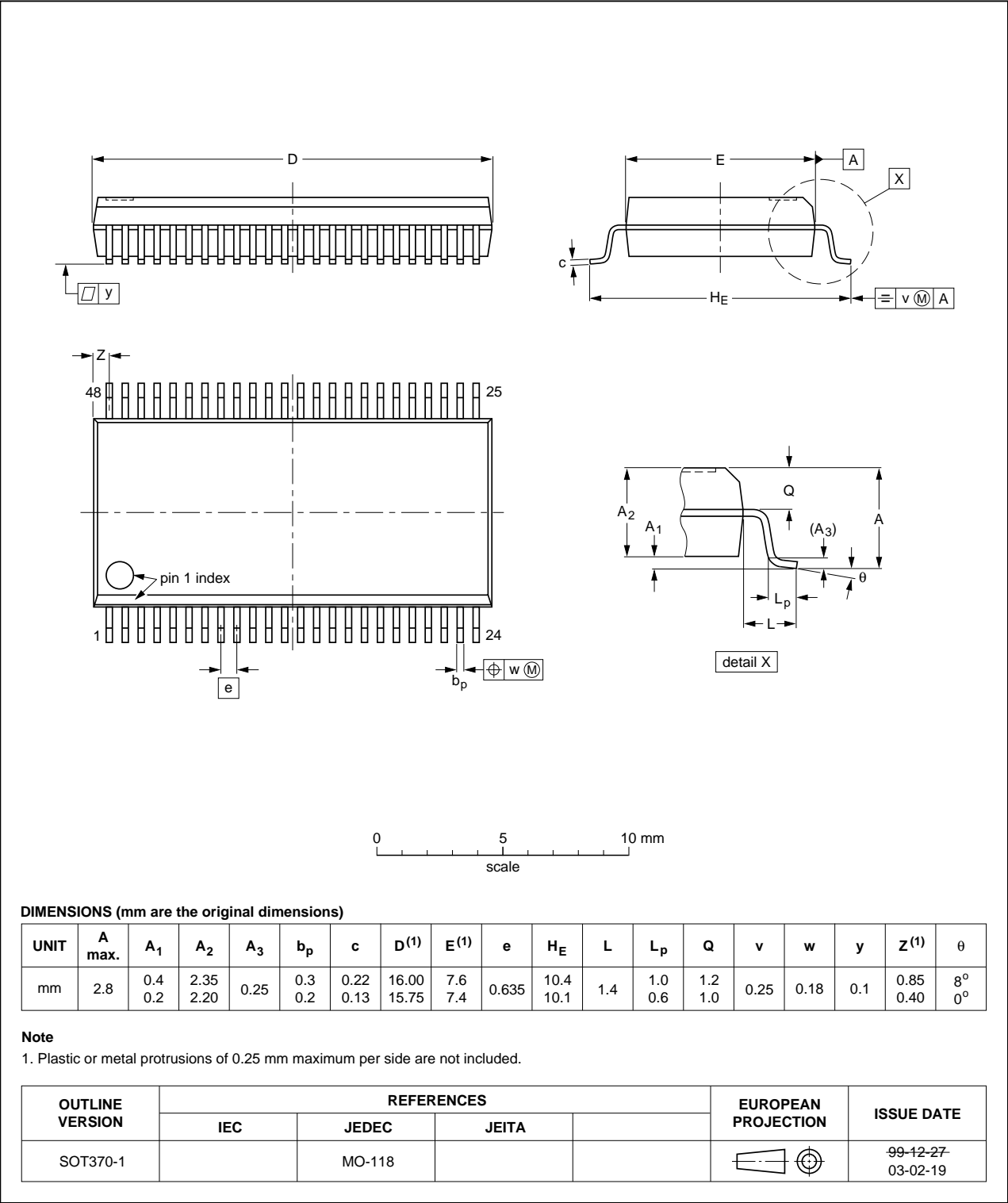


Fig 9. Package outline SOT370-1 (SSOP48)

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

SOT362-1

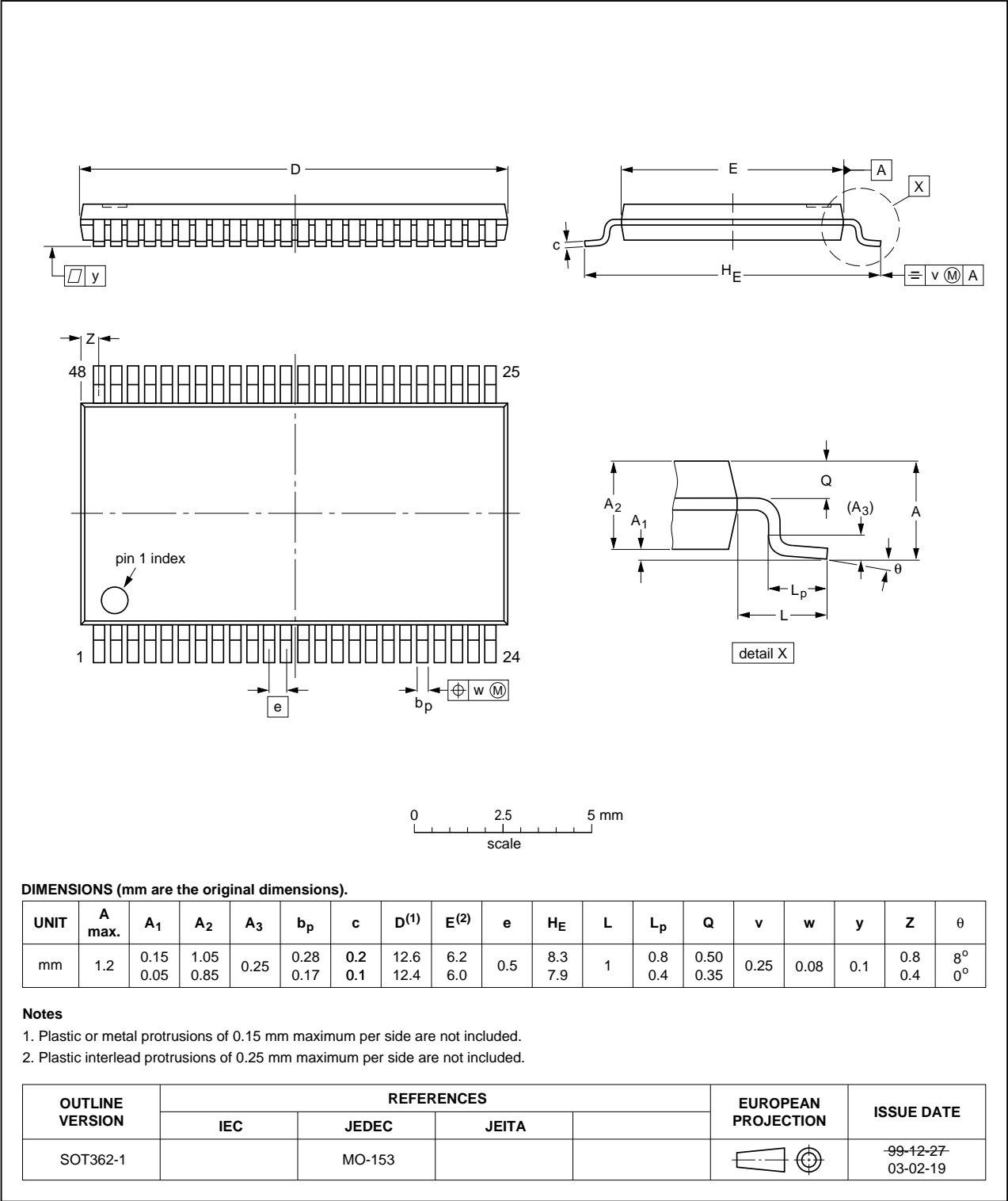


Fig 10. Package outline SOT362-1 (TSSOP48)

## 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"><li>The format of this document has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>Legal texts have been adapted to the new company name where appropriate.</li><li><a href="#">Table 4</a>, <a href="#">Table 5</a>, <a href="#">Table 6</a>, <a href="#">Table 7</a>, and <a href="#">Table 10</a>: values added for lower voltage ranges.</li></ul>			
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 <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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>.

### 15.2 Definitions

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