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Team Nexperia

# 74LVC162244A; 74LVCH162244A

16-bit buffer/line driver; 30  $\Omega$  series termination resistors; 5 V tolerant input/output; 3-state

Rev. 6 — 16 December 2011

Product data sheet

## 1. General description

The 74LVC162244A; 74LVCH162244A are 16-bit non-inverting buffer/line drivers with 3-state bus compatible outputs. The device can be used as four 4-bit buffers, two 8-bit buffers or one 16-bit buffer. It features four output enable inputs, ( $\overline{1OE}$  to  $\overline{4OE}$ ) each controlling four of the 3-state outputs. A HIGH on  $\overline{nOE}$  causes the outputs to assume a high-impedance OFF-state. The device is designed with 30  $\Omega$  series termination resistors in both HIGH and LOW output stages to reduce line noise.

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.

The 74LVCH162244A bus hold on data inputs eliminates the need for external pull-up resistors to hold unused inputs.

## 2. Features and benefits

- 5 V tolerant inputs/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 when  $V_{CC} = 0$  V
- All data inputs have bus hold. (74LVCH162244A only)
- 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-A115-B 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	Temperature range	Package		Version
		Name	Description	
74LVC162244ADL	-40 °C to +125 °C	SSOP48	plastic shrink small outline package; 48 leads; body width 7.5 mm	SOT370-1
74LVCH162244ADL				
74LVC162244ADGG	-40 °C to +125 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1
74LVCH162244ADGG				

## 4. Functional diagram

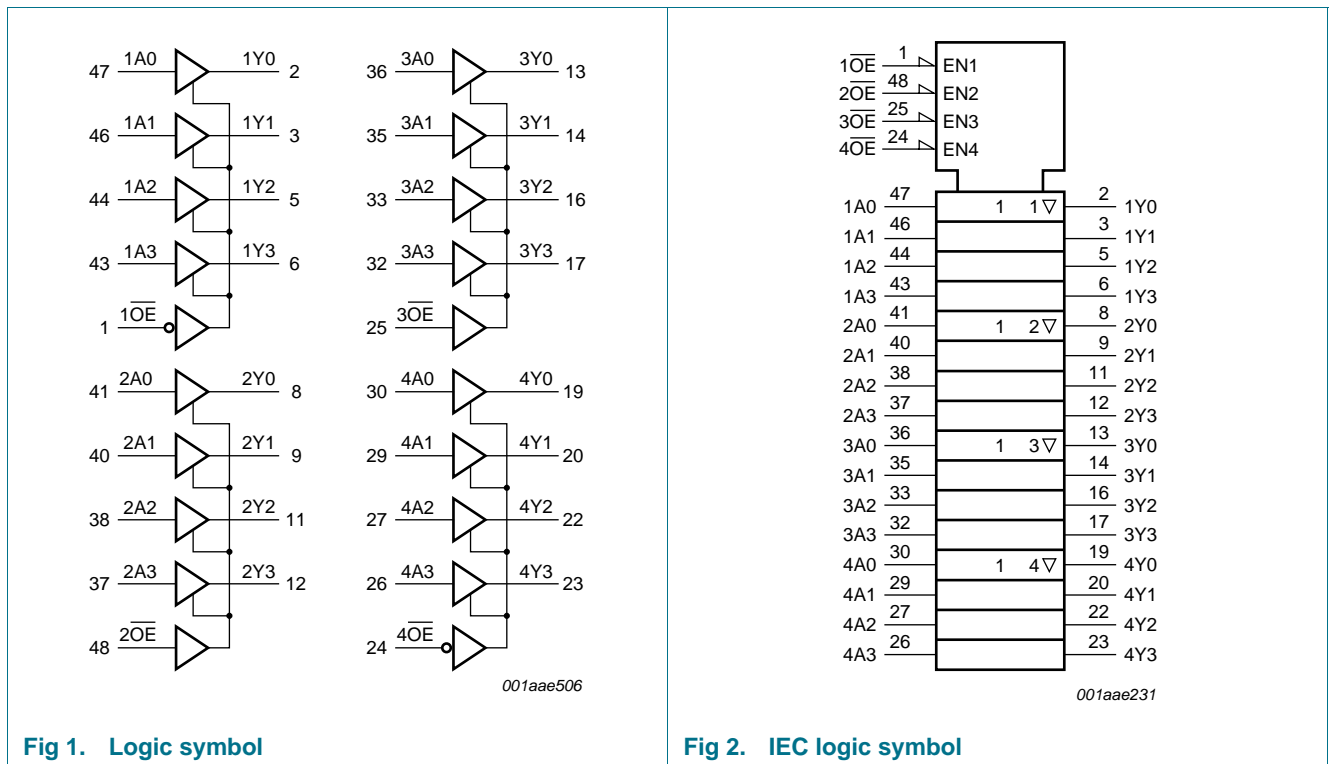


Fig 1. Logic symbol

Fig 2. IEC logic symbol

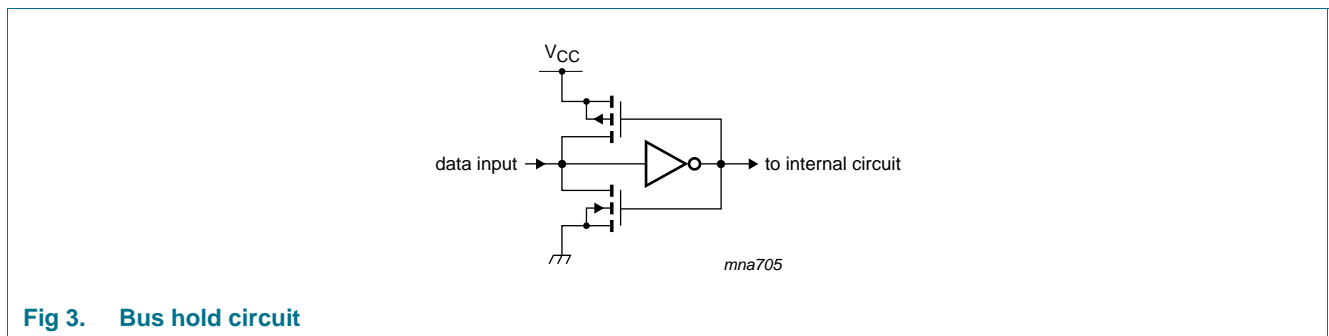


Fig 3. Bus hold circuit

## 5. Pinning information

### 5.1 Pinning

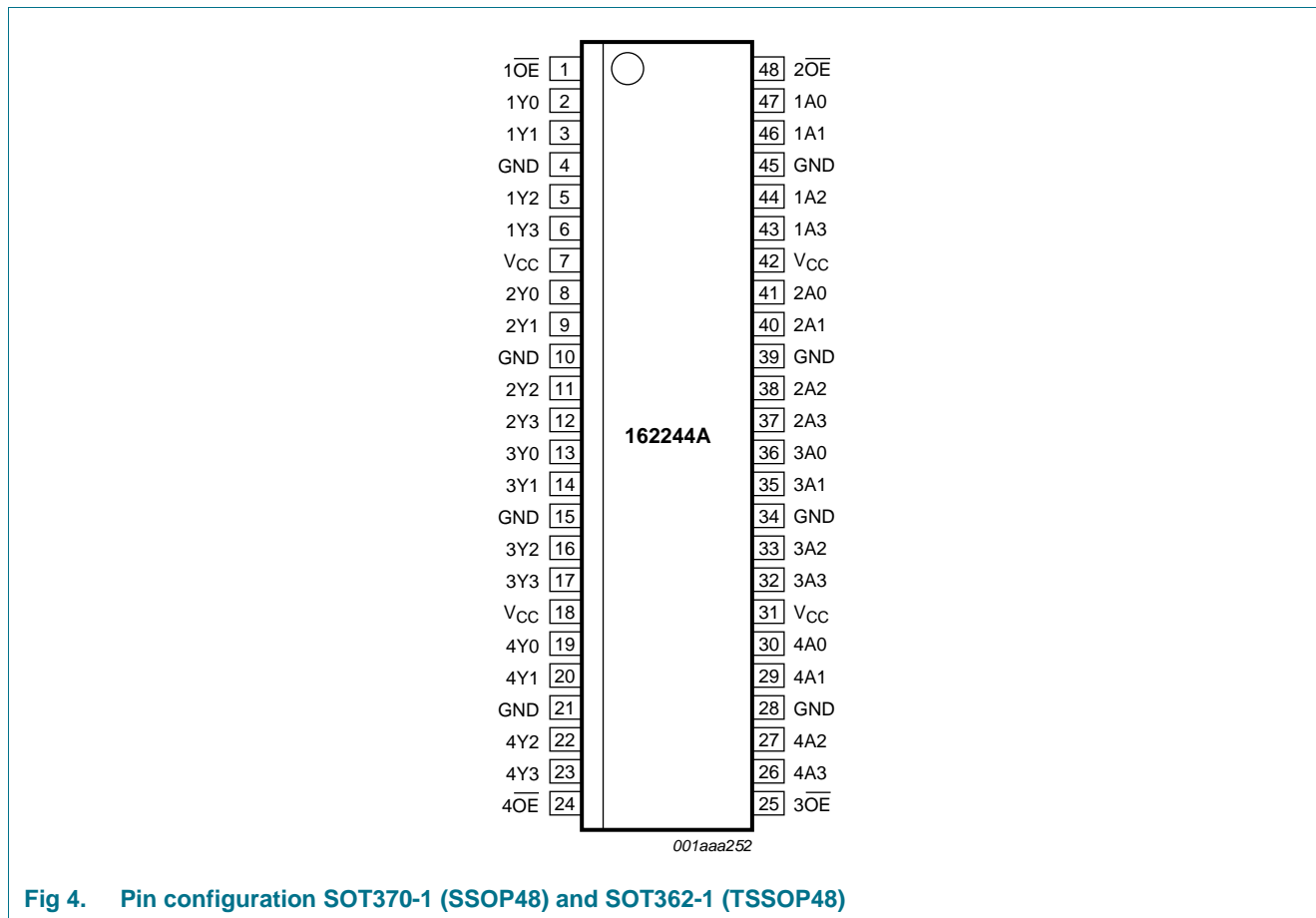


Fig 4. Pin configuration SOT370-1 (SSOP48) and SOT362-1 (TSSOP48)

### 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1OE	1	output enable input (active LOW)
2OE	48	output enable input (active LOW)
3OE	25	output enable input (active LOW)
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
1A[0:3]	47, 46, 44, 43	data input
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
1Y[0:3]	2, 3, 5, 6	data output

Table 2. Pin description ...continued

Symbol	Pin	Description
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	dataoutput

## 6. Functional description

Table 3. Function table<sup>[1]</sup>

Control	Input	Output
nOE	nAn	nYn
L	L	L
L	H	H
H	X	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	-	$\pm 50$	mA
$V_O$	output voltage	output HIGH or LOW	[2] -0.5	$V_{CC} + 0.5$	V
		output 3-state	[2] -0.5	+6.5	V
$I_O$	output current	$V_O = 0$ V to $V_{CC}$	-	$\pm 50$	mA
$I_{CC}$	supply current		-	100	mA
$I_{GND}$	ground current		-100	-	mA
$T_{stg}$	storage temperature		-65	+150	$^{\circ}$ C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ $^{\circ}$ C to +125 $^{\circ}$ 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  $^{\circ}$ 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 <sub>CC</sub>	supply voltage		1.65	-	3.6	V
		functional	1.2	-	3.6	V
V <sub>I</sub>	input voltage		0	-	5.5	V
V <sub>O</sub>	output voltage	output HIGH or LOW	0	-	V <sub>CC</sub>	V
		output 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> = -2 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	1.05	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 2.3 V	1.7	-	-	1.55	-	V
		I <sub>O</sub> = -6 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	2.05	-	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> = 2 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	0.65	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 2.3 V	-	-	0.6	-	0.8	V
		I <sub>O</sub> = 6 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	0.6	V
I <sub>I</sub>	input leakage current	I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	0.8	V
		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; <sup>[2]</sup>	-	±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 input pin; 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
I <sub>BHL</sub>	bus hold LOW current	V <sub>CC</sub> = 1.65 V; V <sub>I</sub> = 0.58 V <sup>[3][4]</sup>	10	-	-	10	-	μA
		V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 0.7 V	30	-	-	25	-	μA
		V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 0.8 V	75	-	-	60	-	μA
I <sub>BHH</sub>	bus hold HIGH current	V <sub>CC</sub> = 1.65 V; V <sub>I</sub> = 1.07 V <sup>[3][4]</sup>	-10	-	-	-10	-	μA
		V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 1.7 V	-30	-	-	-25	-	μA
		V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 2.0 V	-75	-	-	-60	-	μA
I <sub>BHLO</sub>	bus hold LOW overdrive current	V <sub>CC</sub> = 1.95 V <sup>[3][5]</sup>	200	-	-	200	-	μA
		V <sub>CC</sub> = 2.7 V	300	-	-	300	-	μA
		V <sub>CC</sub> = 3.6 V	500	-	-	500	-	μA
I <sub>BHHO</sub>	bus hold HIGH overdrive current	V <sub>CC</sub> = 1.95 V <sup>[3][5]</sup>	-200	-	-	-200	-	μA
		V <sub>CC</sub> = 2.7 V	-300	-	-	-300	-	μA
		V <sub>CC</sub> = 3.6 V	-500	-	-	-500	-	μA

- [1] All typical values are measured at V<sub>CC</sub> = 3.3 V and T<sub>amb</sub> = 25 °C.
- [2] The bus hold circuit is switched off when V<sub>I</sub> > V<sub>CC</sub> allowing 5.5 V on the input terminal.
- [3] Valid for data inputs only. Control inputs do not have a bus hold circuit.
- [4] The specified sustaining current at the data input holds the input below the specified V<sub>I</sub> level.
- [5] The specified overdrive current at the data input forces the data input to the opposite logic input state.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <sup>[2]</sup>	Max	Min	Max	
t <sub>pd</sub>	propagation delay	nAn to nYn; see <a href="#">Figure 5</a> <sup>[1]</sup>						
		V <sub>CC</sub> = 1.2 V	-	11.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.5	6.0	15.0	1.5	17.2	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	3.2	7.4	1.0	8.2	ns
		V <sub>CC</sub> = 2.7 V	1.0	3.3	6.7	1.0	8.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.7	5.8	1.0	7.5	ns
t <sub>en</sub>	enable time	nOE to nYn; see <a href="#">Figure 6</a> <sup>[1]</sup>						
		V <sub>CC</sub> = 1.2 V	-	15.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.7	6.8	15.3	1.7	17.7	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	3.8	8.0	1.5	8.9	ns
		V <sub>CC</sub> = 2.7 V	1.5	4.2	7.6	1.5	9.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	3.1	6.0	1.0	7.5	ns
t <sub>dis</sub>	disable time	nOE to nYn; see <a href="#">Figure 6</a> <sup>[1]</sup>						
		V <sub>CC</sub> = 1.2 V	-	10.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.2	3.9	8.2	2.2	9.5	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.5	2.1	4.4	0.5	5.0	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.1	4.7	1.5	6.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	2.8	4.5	1.5	6.0	ns
C <sub>PD</sub>	power dissipation capacitance	per input; V <sub>i</sub> = GND to V <sub>CC</sub> <sup>[3]</sup>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	4.8	-	-	-	pF
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	8.3	-	-	-	pF
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	11.4	-	-	-	pF

[1] 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>.

[2] 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.

[3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

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

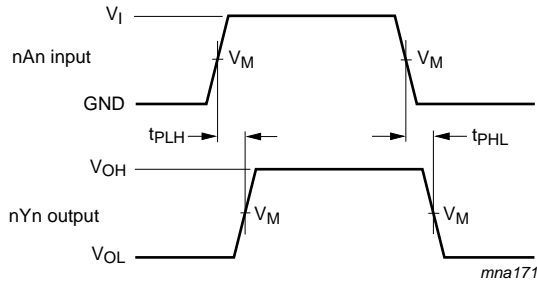
V<sub>CC</sub> = supply voltage in Volts

N = number of inputs switching

Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs.



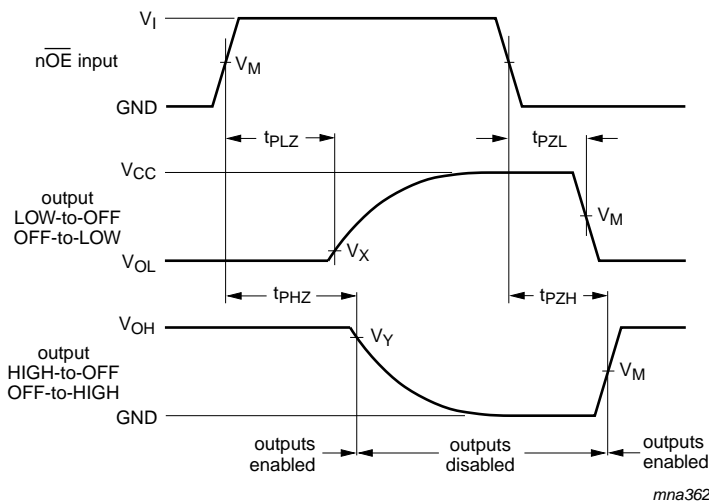
## 11. Waveforms



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

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

**Fig 5. The input (nAn) to output (nYn) propagation delays**



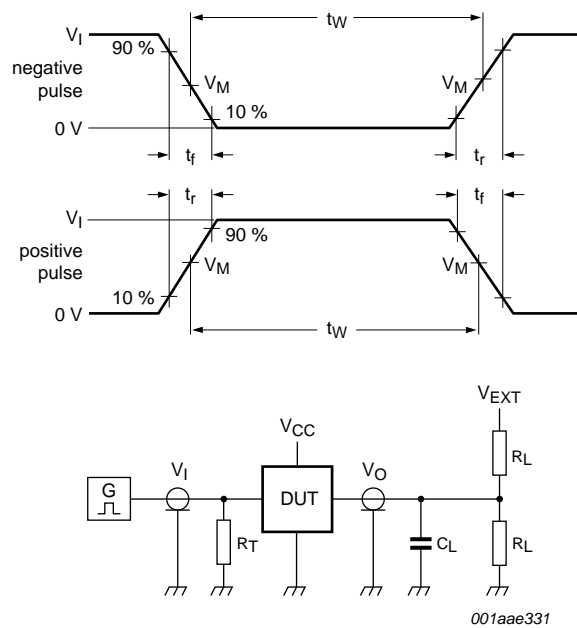
Measurement points are given in [Table 8](#).

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

**Fig 6. 3-state enable and disable times.**

**Table 8. Measurement points**

Supply voltage $V_{CC}$	$V_M$	Input		Output	
		$V_I$	$t_r = t_f$	$V_X$	$V_Y$
1.2 V	$0.5 \times V_{CC}$	$V_{CC}$	$\leq 2.5$ ns	$V_{OL} + 0.15$ V	$V_{OH} - 0.15$ V
1.65 V to 1.95 V	$0.5 \times V_{CC}$	$V_{CC}$	$\leq 2.5$ ns	$V_{OL} + 0.15$ V	$V_{OH} - 0.15$ V
2.3 V to 2.7 V	$0.5 \times V_{CC}$	$V_{CC}$	$\leq 2.5$ ns	$V_{OL} + 0.15$ V	$V_{OH} - 0.15$ V
2.7 V	1.5 V	2.7 V	$\leq 2.5$ ns	$V_{OL} + 0.3$ V	$V_{OH} - 0.3$ V
3.0 V to 3.6 V	1.5 V	2.7 V	$\leq 2.5$ ns	$V_{OL} + 0.3$ V	$V_{OH} - 0.3$ V



Test data is given in [Table 9](#).

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 7. Test circuit for measuring switching times**

**Table 9. 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	$V_{CC}$	$\leq 2$ ns	30 pF	1 kΩ	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 kΩ	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	$V_{CC}$	$\leq 2$ ns	30 pF	500 Ω	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 Ω	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ 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

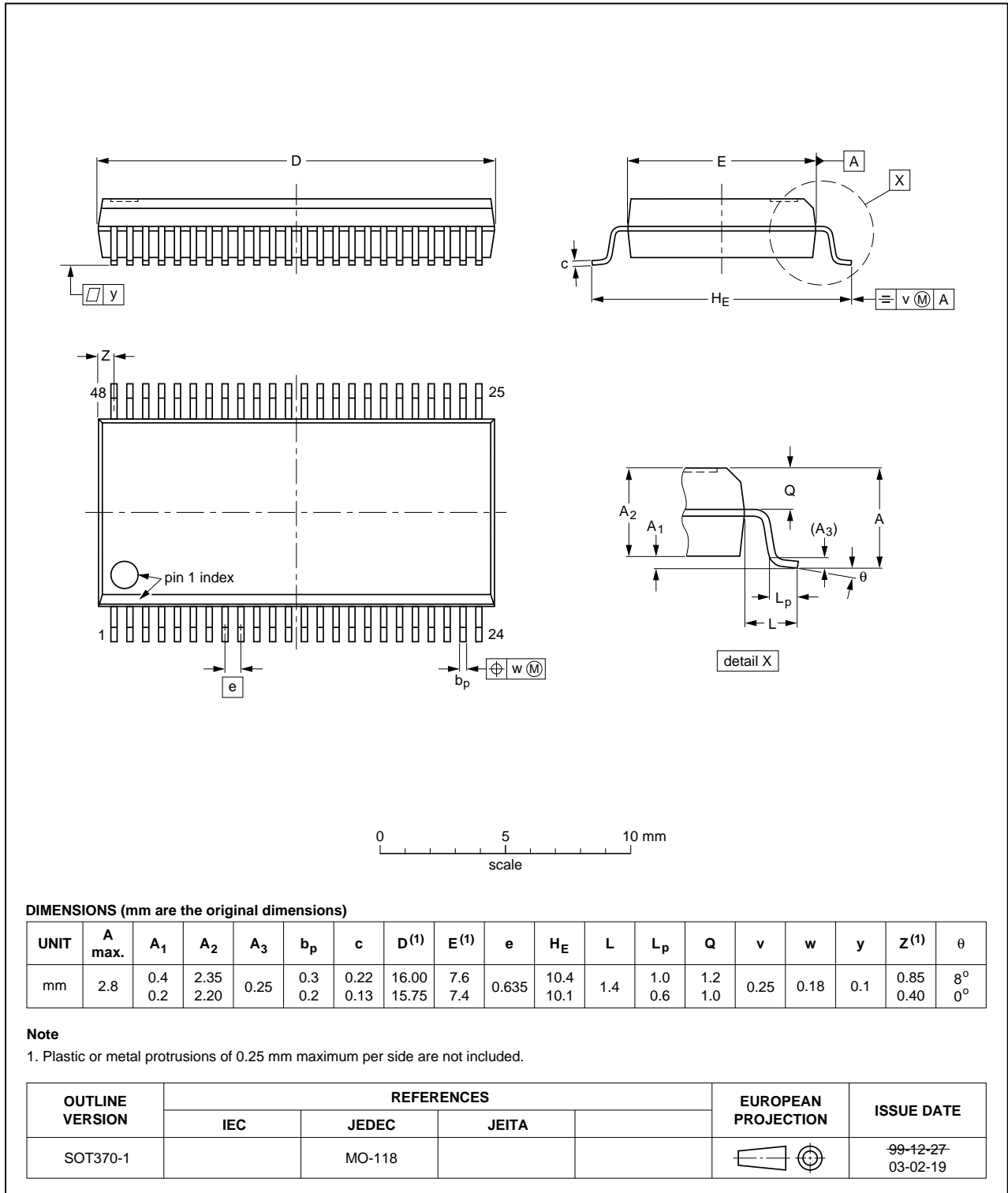


Fig 8. Package outline SOT370-1 (SSOP48)

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

SOT362-1

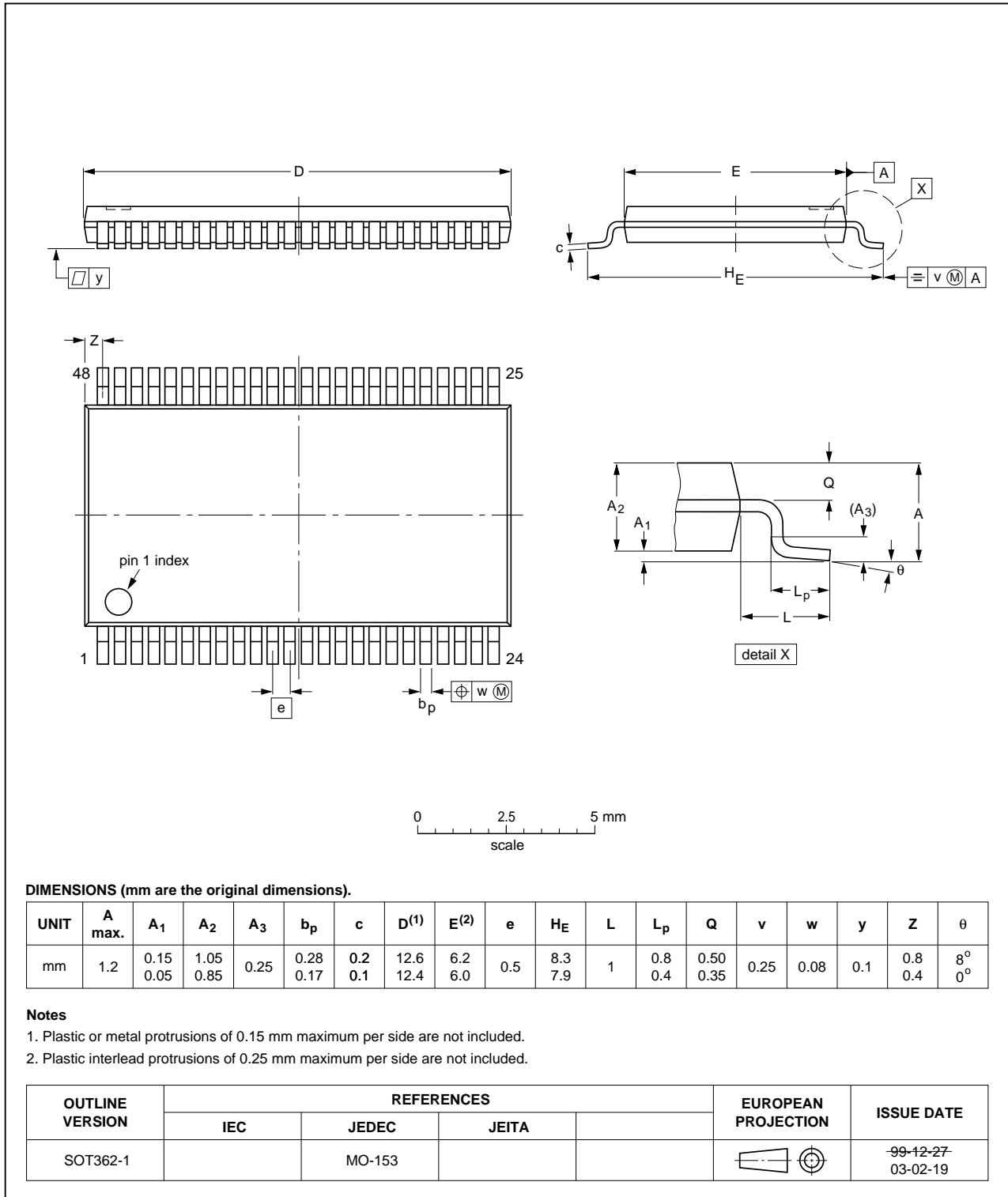


Fig 9. Package outline SOT362-1 (TSSOP48)

## 13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

## 14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC_LVCH162244A v.6	20111216	Product data sheet	-	74LVC_LVCH162244A v.5
Modifications:		<ul style="list-style-type: none"> <li>Maximum propagation delay value for <math>V_{CC} = 1.65</math> V to 1.95 V at +125 °C changed from 15.7 ns to 17.2 ns</li> <li>Maximum enable time value for <math>V_{CC} = 1.65</math> V to 1.95 V at +125 °C changed from 16.1 ns to 17.7 ns</li> <li>Maximum disable time value for <math>V_{CC} = 1.65</math> V to 1.95 V at +125 °C changed from 8.7 ns to 9.5 ns</li> </ul>		
74LVC_LVCH162244A v.5	20111108	Product data sheet	-	74LVC_LVCH162244A v.4
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 5</a>, <a href="#">Table 6</a>, <a href="#">Table 7</a> and <a href="#">Table 9</a>: values added for lower voltage ranges.</li> </ul>		
74LVC_LVCH162244A v.4	20031212	Product specification	-	74LVC_H162244A v.3
74LVC_H162244A v.3	19980217	Product specification	-	74LVC162244A_LVCH162244A v.3
74LVC162244A_LVCH162244A v.3	19980217	Product specification	-	74LVC162244A v.2
74LVC162244A v.2	19970801	Product specification	-	74LVC162244A v.1

## 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>.

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Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

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