

# 74LVCH16541A

16-bit buffer/line driver; 3-state

Rev. 3 — 15 February 2012

Product data sheet

## 1. General description

The 74LVCH16541A is a 16-bit buffer/line driver with 3-state outputs. The 3-state outputs are controlled by the output enable inputs (1OEn and 2OEn). A HIGH on nOEn causes the outputs to assume a high-impedance OFF-state.

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.

Bus hold on data inputs eliminates the need for external pull-up resistors to hold unused inputs.

## 2. Features and benefits

- 5 Volt 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
- All data inputs have bus hold
- 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  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  and  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

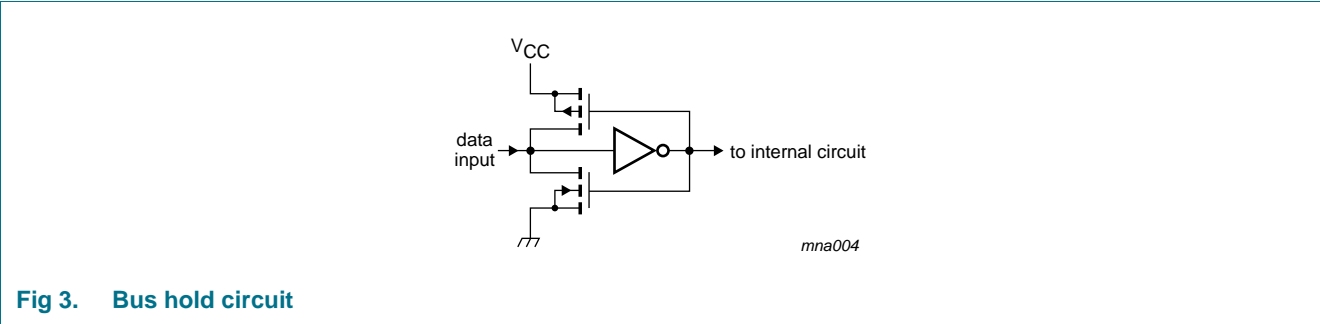
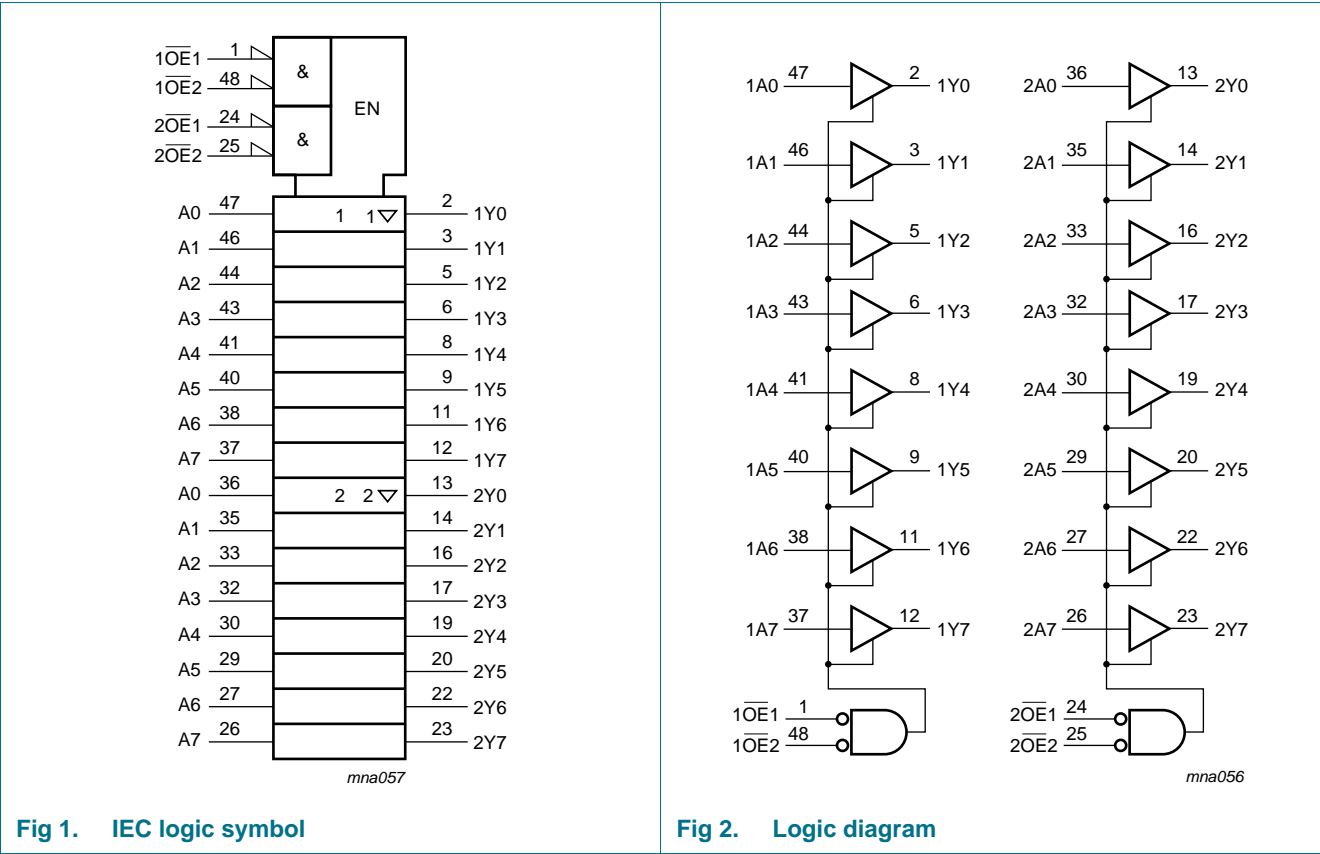


3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVCH16541ADGG	−40 to +125 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1
74LVCH16541ADL	−40 to +125 °C	SSOP48	plastic shrink small outline package; 48 leads; body width 7.5 mm	SOT370-1

4. Functional diagram



5. Pinning information

5.1 Pinning

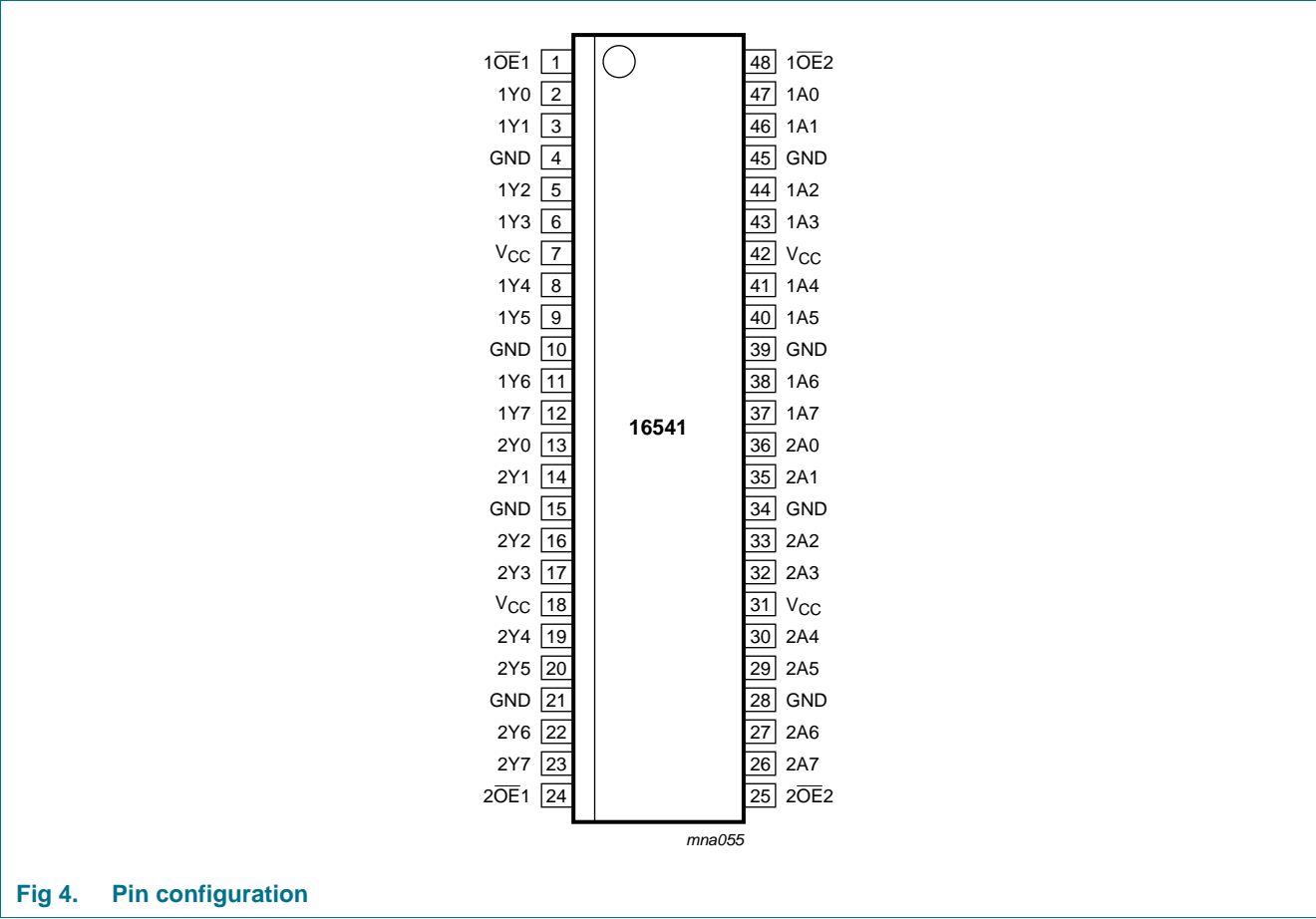


Fig 4. Pin configuration

5.2 Pin description

Table 2. Pin description

Name	Pin	Description
1OE1	1	output enable input (active LOW)
1OE2	48	output enable input (active LOW)
2OE1	24	output enable input (active LOW)
2OE2	25	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	positive supply voltage
1Y[0:7]	2, 3, 5, 6, 8, 9, 11, 12	data output
2Y[0:7]	13, 14, 16, 17, 19, 20, 22, 23	data output
1A[0:7]	47, 46, 44, 43, 41, 40, 38, 37	data input
2A[0:7]	36, 35, 33, 32, 30, 29, 27, 26	data input

## 6. Functional description

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

Input			Output
nOE1	nOE2	nAn	nYn
L	L	L	L
L	L	H	H
X	H	X	Z
H	X	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 <sub>CC</sub>	supply voltage		-0.5	+6.5	V
V <sub>I</sub>	input voltage	<sup>[1]</sup>	-0.5	+6.5	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0	-50	-	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0	-	±50	mA
V <sub>O</sub>	output voltage	output HIGH or LOW state	<sup>[2]</sup> -0.5	V <sub>CC</sub> + 0.5	V
		output 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 operations**

Symbol	Parameter	Conditions	Min	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	output HIGH or LOW state	0	$V_{CC}$	V
		output 3-state or $V_{CC} = 0$ V	0	5.5	V
$T_{amb}$	ambient temperature	in free air	-40	+125	°C
$\Delta t/\Delta V$	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 <sup>[1]</sup>	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	$0.65 \times V_{CC}$	-	-	$0.65 \times V_{CC}$	-	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	-	-	$0.35 \times V_{CC}$	-	$0.35 \times V_{CC}$	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 $V_{IL}$						
		$I_O = -100$ $\mu$ A; $V_{CC} = 1.65$ V to 3.6 V	$V_{CC} - 0.2$	$V_{CC}$	-	$V_{CC} - 0.3$	-	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 $V_{IL}$						
		$I_O = 100$ $\mu$ A; $V_{CC} = 1.65$ 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 <sup>[2]</sup>	-	$\pm 0.1$	$\pm 5$	-	$\pm 20$	$\mu$ A

**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 <sup>[2]</sup>	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 supply	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> = 1.65 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 <sup>[3][4]</sup>	V <sub>CC</sub> = 1.65; V <sub>I</sub> = 0.58 V	10	-	-	10	-	μA
		V <sub>CC</sub> = 2.3; V <sub>I</sub> = 0.7 V	30	-	-	25	-	μA
		V <sub>CC</sub> = 3.0; V <sub>I</sub> = 0.8 V	75	-	-	60	-	μA
I <sub>BHH</sub>	bus hold HIGH current <sup>[3][4]</sup>	V <sub>CC</sub> = 1.65; V <sub>I</sub> = 1.07 V	–10	-	-	–10	-	μA
		V <sub>CC</sub> = 2.3; V <sub>I</sub> = 1.7 V	–30	-	-	–25	-	μA
		V <sub>CC</sub> = 3.0; V <sub>I</sub> = 2.0 V	–75	-	-	–60	-	μA
I <sub>BHLO</sub>	bus hold LOW overdrive current <sup>[3][5]</sup>	V <sub>CC</sub> = 1.95 V	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 <sup>[3][5]</sup>	V <sub>CC</sub> = 1.95 V	–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 (unless stated otherwise) 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 pin.

[3] For data inputs only; control inputs do not have a bus hold circuit.

[4] The specified sustaining current at the data inputs 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	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	-	10	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	1.8	4.7	10.4	1.8	12.0	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.5	2.6	5.2	1.5	6.0	ns
		V <sub>CC</sub> = 2.7 V	1.0	2.5	5.0	1.0	6.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.2	4.2	1.0	5.5	ns
t <sub>en</sub>	enable time	n $\overline{\text{OEn}}$ 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	1.5	5.5	14.6	1.5	16.8	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	3.2	7.7	1.0	8.9	ns
		V <sub>CC</sub> = 2.7 V	1.5	3.4	6.9	1.5	9.0	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.6	5.6	1.0	7.0	ns
t <sub>dis</sub>	disable time	n $\overline{\text{OEn}}$ to nYn; see <a href="#">Figure 6</a> <sup>[2]</sup>						
		V <sub>CC</sub> = 1.2 V	-	9.0	-	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	2.6	7.3	9.2	2.6	10.6	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	4.1	5.2	1.0	6.0	ns
		V <sub>CC</sub> = 2.7 V	1.5	4.6	6.5	1.5	8.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.5	4.5	5.5	1.5	7.0	ns
t <sub>sk(o)</sub>	output skew time	V <sub>CC</sub> = 3.0 V to 3.6 V <sup>[3]</sup>	-	-	1.0	-	1.5	ns
C <sub>PD</sub>	power dissipation capacitance	per input; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[4]</sup>						
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	8.5	-	-	-	pF
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	12.1	-	-	-	pF
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	15.3	-	-	-	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] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in  $\mu$ W).

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

f<sub>i</sub> = input frequency in MHz; f<sub>o</sub> = output frequency in MHz

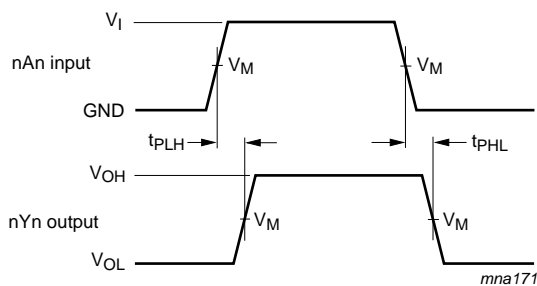
C<sub>L</sub> = output load capacitance in pF

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

N = number of inputs switching

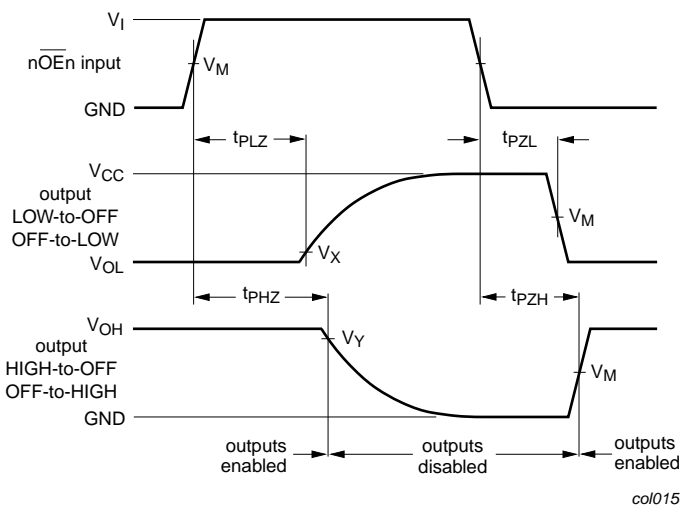
$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs

11. Waveforms



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

**Fig 5. Input nAn to output nYn propagation delays**



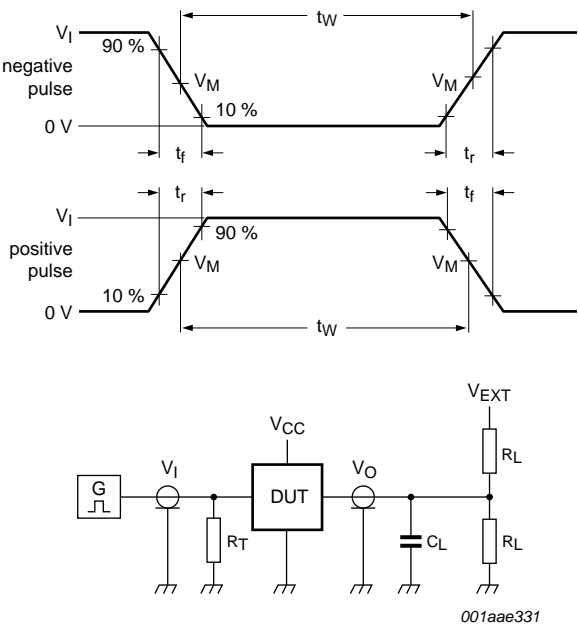
Measurement points are given in [Table 8](#).  
Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

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

**Table 8. Measurement points**

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





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 k $\Omega$	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	$V_{CC}$	$\leq 2$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND

12. Package outline

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1 mm SOT362-1

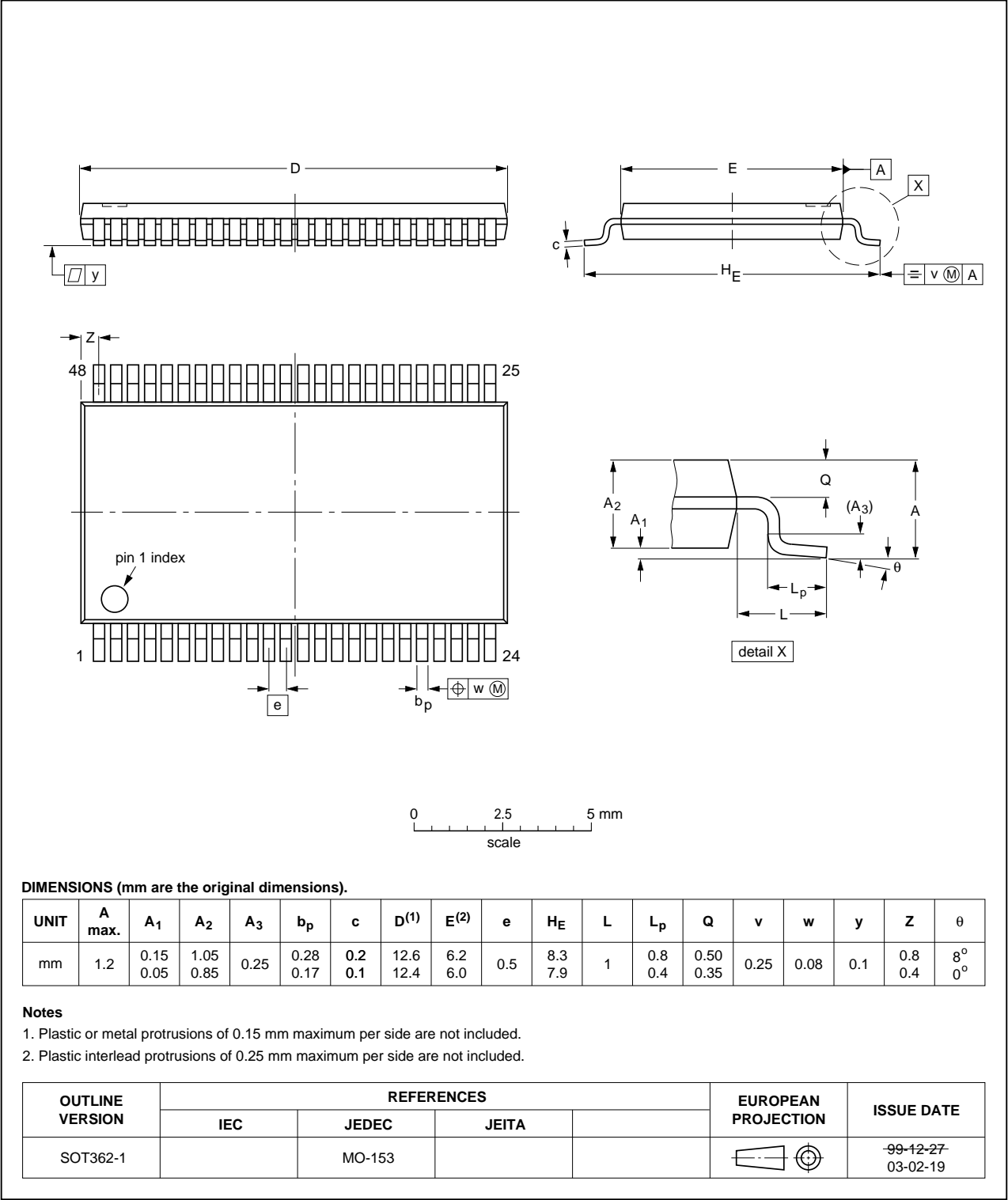


Fig 8. Package outline SOT362-1 (TSSOP48)

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

SOT370-1

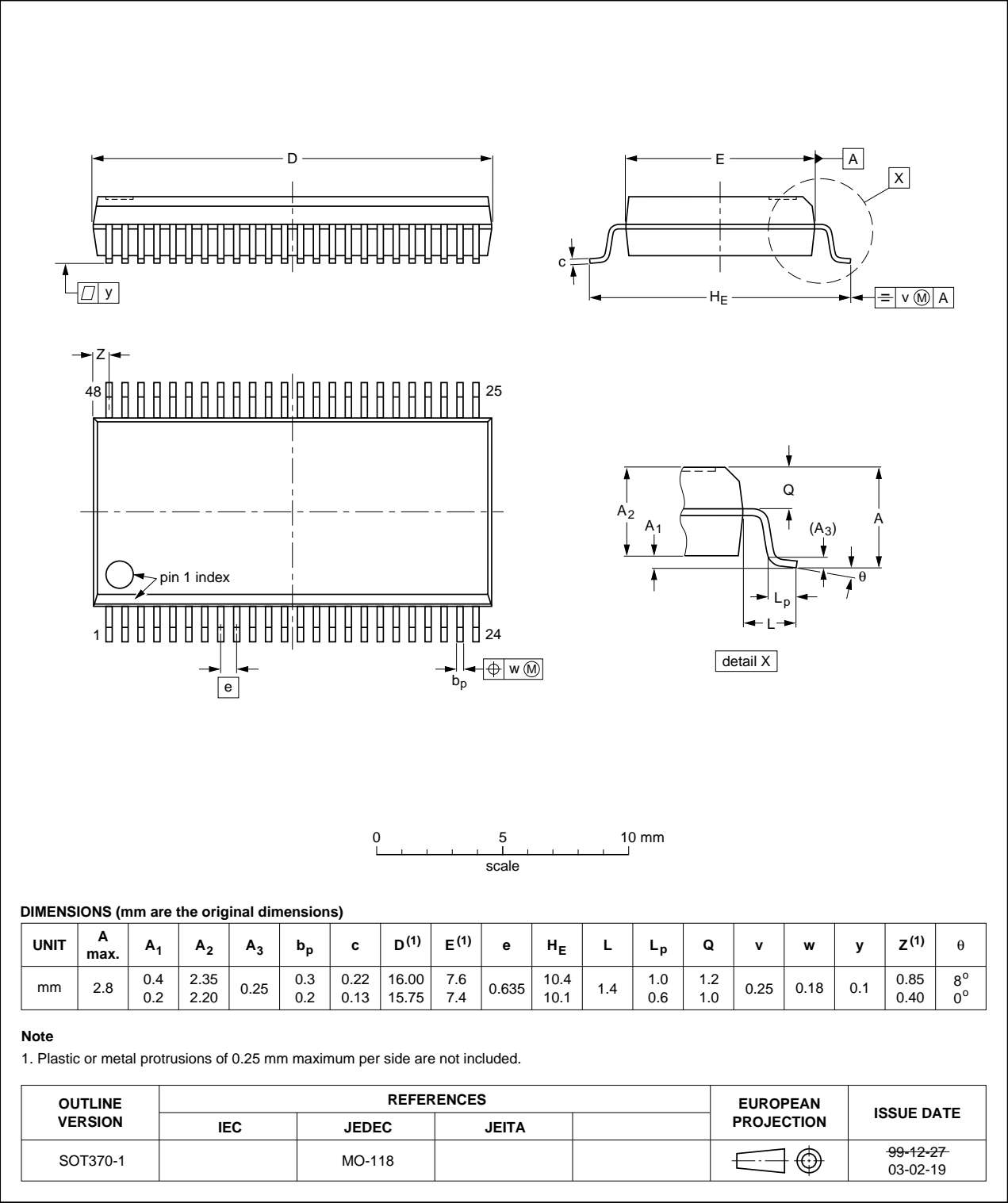


Fig 9. Package outline SOT370-1 (SSOP48)

## 13. Abbreviations

Table 10. 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 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVCH16541A v.3	20120215	Product data sheet	-	74LVCH16541A v.2
Modifications:	<ul style="list-style-type: none"><li>The format of this data sheet 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 9</a>: values added for lower voltage ranges.</li></ul>			
74LVCH16541A v.2	20040218	Product specification	-	74LVCH16541A v.1
74LVCH16541A v.1	19980519	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>.

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