

# 74ALVT16241

16-bit buffer/driver; 3-state

Rev. 03 — 4 July 2005

Product data sheet

## 1. General description

The 74ALVT16241 is a high-performance BiCMOS device designed for  $V_{CC}$  operation at 2.5 V or 3.3 V with I/O compatibility up to 5 V.

The 74ALVT16241 is a 16-bit buffer that is ideal for driving bus lines. The device features four output enable inputs ( $1\overline{OE}$ ,  $2OE$ ,  $3OE$ ,  $4\overline{OE}$ ), each controlling four of the 3-state outputs.

## 2. Features

- 5 V I/O compatible
- Live insertion and extraction permitted
- 3-state buffers
- Power-up 3-state
- Output capability: +64 mA and -32 mA
- Latch-up protection:
  - ◆ JESD 78 exceeds 500 mA
- Electrostatic discharge protection:
  - ◆ MIL STD 883 method 3015: exceeds 2000 V
  - ◆ Machine model: exceeds 200 V
- Bus hold data inputs eliminate need for external pull-up resistors to hold unused inputs
- 16-bit bus interface
- TTL input and output switching levels
- Input and output interface capability to systems at 5 V supply
- No bus current loading when output is tied to 5 V bus

## 3. Quick reference data

Table 1: Quick reference data

$T_{amb} = 25^\circ C$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{PLH}$	propagation delay nAx to nYx	$C_L = 50 \text{ pF}; V_{CC} = 2.5 \text{ V}$	0.5	2.1	3.0	ns
		$C_L = 50 \text{ pF}; V_{CC} = 3.3 \text{ V}$	0.5	1.6	2.2	ns
$t_{PHL}$	propagation delay nAx to nYx	$C_L = 50 \text{ pF}; V_{CC} = 2.5 \text{ V}$	0.5	2.0	3.0	ns
		$C_L = 50 \text{ pF}; V_{CC} = 3.3 \text{ V}$	0.5	1.6	2.3	ns
$C_i$	input capacitance on $n\overline{OE}$	$V_I = 0 \text{ V or } V_{CC}$	-	3	-	pF

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**Table 1: Quick reference data ...continued**  
 $T_{amb} = 25^{\circ}\text{C}$ .

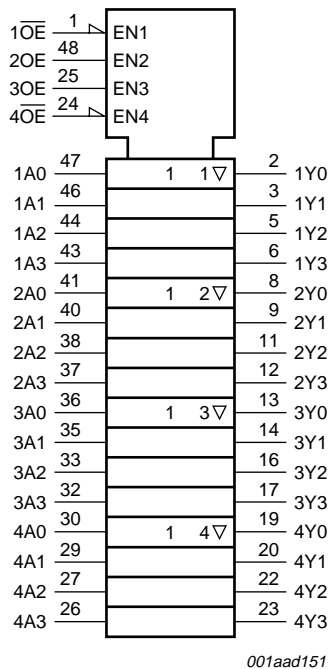
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_o$	output capacitance	$V_{IO} = 0\text{ V or }V_{CC}$	-	9	-	pF
$I_{CC}$	supply current	outputs disabled; $V_{CC} = 2.5\text{ V}$	-	40	100	$\mu\text{A}$
		outputs disabled; $V_{CC} = 3.3\text{ V}$	-	70	100	$\mu\text{A}$

## 4. Ordering information

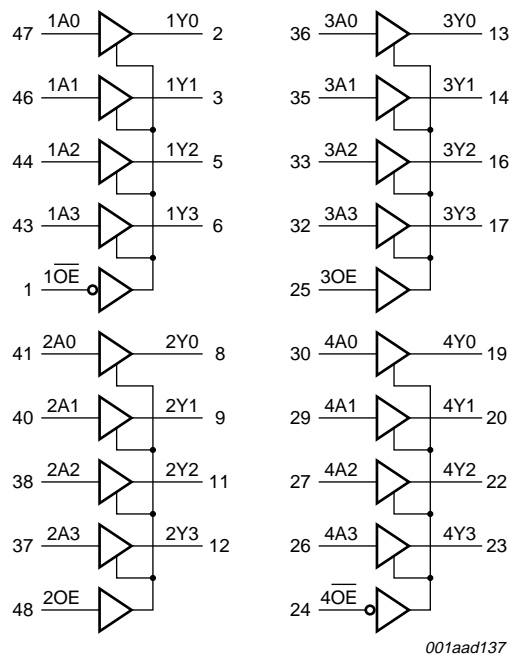
**Table 2: Ordering information**

Type number	Package			Version
	Temperature range	Name	Description	
74ALVT16241DL	-40 °C to +85 °C	SSOP48	plastic shrink small outline package; 48 leads; body width 7.5 mm	SOT370-1
74ALVT16241DGG	-40 °C to +85 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1

## 5. Functional diagram



**Fig 1. Logic symbol**



**Fig 2. Logic diagram**

## 6. Pinning information

### 6.1 Pinning

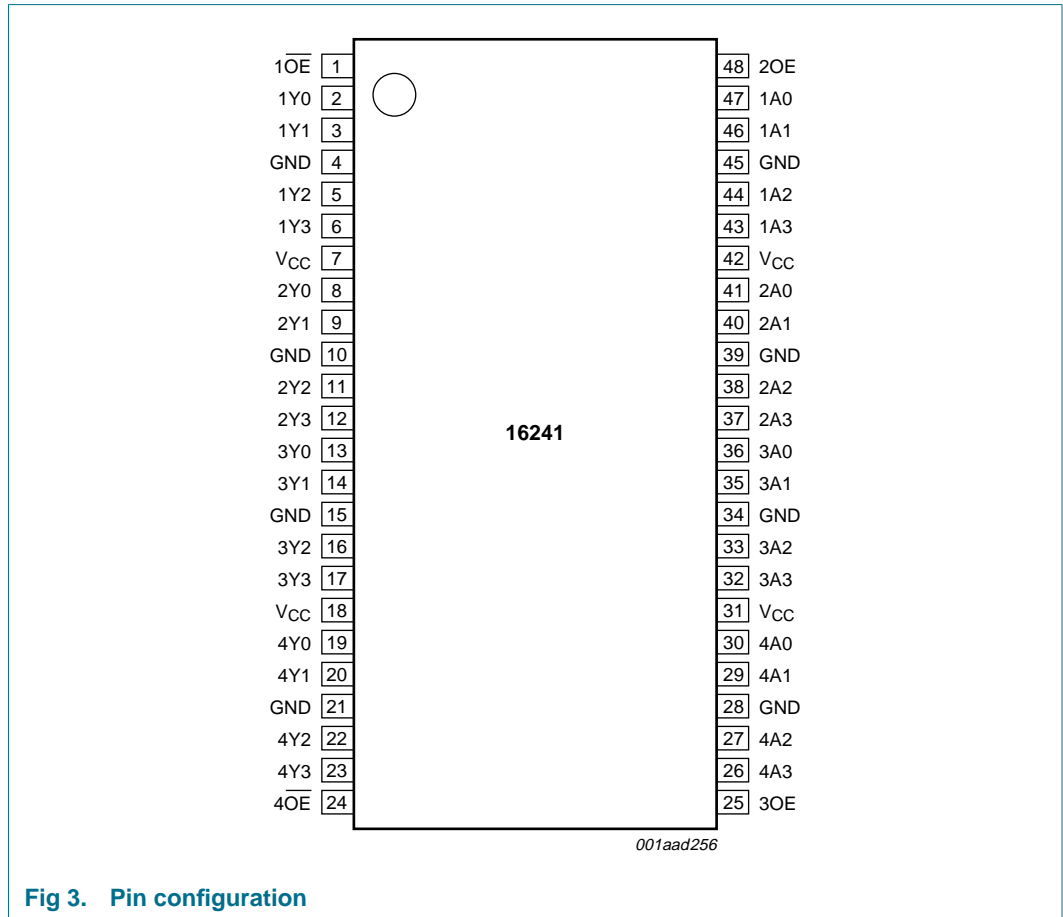


Fig 3. Pin configuration

### 6.2 Pin description

Table 3: Pin description

Symbol	Pin	Description
1 $\overline{OE}$	1	output enable input (active LOW)
1Y0	2	data output
1Y1	3	data output
GND	4	ground (0 V)
1Y2	5	data output
1Y3	6	data output
V <sub>CC</sub>	7	supply voltage
2Y0	8	data output
2Y1	9	data output
GND	10	ground (0 V)
2Y2	11	data output

Table 3: Pin description ...continued

Symbol	Pin	Description
2Y3	12	data output
3Y0	13	data output
3Y1	14	data output
GND	15	ground (0 V)
3Y2	16	data output
3Y4	17	data output
V <sub>CC</sub>	18	supply voltage
4Y0	19	data output
4Y1	20	data output
GND	21	ground (0 V)
4Y2	22	data output
4Y3	23	data output
4 $\overline{\text{OE}}$	24	output enable input (active LOW)
3OE	25	output enable input
4A3	26	data input
4A2	27	data input
GND	28	ground (0 V)
4A1	29	data input
4A0	30	data input
V <sub>CC</sub>	31	supply voltage
3A3	32	data input
3A2	33	data input
GND	34	ground (0 V)
3A1	35	data input
3A0	36	data input
2A3	37	data input
2A2	38	data input
GND	39	ground (0 V)
2A1	40	data input
2A0	41	data input
V <sub>CC</sub>	42	supply voltage
1A3	43	data input
1A2	44	data input
GND	45	ground (0 V)
1A1	46	data input
1A0	47	data input
2OE	48	output enable input

## 7. Functional description

### 7.1 Function table

Table 4: Function table [\[1\]](#)

Input		Output
$1\overline{OE}$ , $4\overline{OE}$	$1Ax$ , $4Ax$	$1Yx$ , $4Yx$
L	H	H
L	L	L
H	X	Z

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

Table 5: Function table [\[1\]](#)

Input		Output
$2\overline{OE}$ , $3\overline{OE}$	$2Ax$ , $3Ax$	$2Yx$ , $3Yx$
H	H	H
H	L	L
L	X	Z

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

## 8. Limiting values

Table 6: Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		-0.5	+4.6	V
$I_{IK}$	input diode current	$V_I < 0$ V	-	-50	mA
$V_I$	input voltage		<a href="#">[1]</a> -0.5	+7.0	V
$I_{OK}$	output diode current	$V_O < 0$ V	-	-50	mA
$V_O$	output voltage	output in OFF-state or HIGH-state	<a href="#">[1]</a> -0.5	+7.0	V
$I_O$	output current	output in LOW-state	-	128	mA
		output in HIGH-state	-	-64	mA
$T_{stg}$	storage temperature		-65	+150	°C
$T_j$	junction temperature		<a href="#">[2]</a> -	+150	°C

- [1] The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.
- [2] The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability.

## 9. Recommended operating conditions

Table 7: Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}</math></b>						
$V_{CC}$	supply voltage		2.3	-	2.7	V
$V_I$	input voltage		0	-	5.5	V
$V_{IH}$	HIGH-level input voltage		1.7	-	-	V
$V_{IL}$	LOW-level input voltage		-	-	0.7	V
$I_{OH}$	HIGH-level output current		-	-	-8	mA
$I_{OL}$	LOW-level output current	none	-	-	8	mA
		current duty cycle $\leq 50\%$ ; $f \geq 1\text{ kHz}$	-	-	24	mA
$\Delta t/\Delta V$	input transition rise or fall rate	outputs enabled	-	-	10	ns/V
$T_{amb}$	ambient temperature	in free air	-40	-	+85	°C
<b><math>V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}</math></b>						
$V_{CC}$	supply voltage		3.0	-	3.6	V
$V_I$	input voltage		0	-	5.5	V
$V_{IH}$	HIGH-level input voltage		2.0	-	-	V
$V_{IL}$	LOW-level input voltage		-	-	0.8	V
$I_{OH}$	HIGH-level output current		-	-	-32	mA
$I_{OL}$	LOW-level output current	none	-	-	32	mA
		current duty cycle $\leq 50\%$ ; $f \geq 1\text{ kHz}$	-	-	64	mA
$\Delta t/\Delta V$	input transition rise or fall rate	outputs enabled	-	-	10	ns/V
$T_{amb}$	ambient temperature	in free air	-40	-	+85	°C

## 10. Static characteristics

**Table 8: Static characteristics**

At recommended operating conditions; voltages are referred to GND (ground = 0 V);  $T_{amb} = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b><math>V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}</math> [1]</b>							
$V_{IK}$	input diode voltage	$V_{CC} = 2.3\text{ V}$ ; $I_{IK} = -18\text{ mA}$	-	-0.85	-1.2	V	
$V_{OH}$	HIGH-level output voltage	$V_{CC} = 2.3\text{ V}$ to $3.6\text{ V}$ ; $I_{OH} = -100\text{ }\mu\text{A}$	$V_{CC} - 0.2$	$V_{CC}$	-	V	
		$V_{CC} = 2.3\text{ V}$ ; $I_{OH} = -8\text{ mA}$	1.8	2.1	-	V	
$V_{OL}$	LOW-level output voltage	$V_{CC} = 2.3\text{ V}$					
		$I_{OL} = 100\text{ }\mu\text{A}$	-	0.07	0.2	V	
		$I_{OL} = 24\text{ mA}$	-	0.3	0.5	V	
$I_{LI}$	input leakage current	control pins	$V_{CC} = 2.7\text{ V}$ ; $V_I = V_{CC}$ or GND	-	0.1	$\pm 1$	$\mu\text{A}$
			$V_{CC} = 0\text{ V}$ or $2.7\text{ V}$ ; $V_I = 5.5\text{ V}$	-	0.1	10	$\mu\text{A}$
	data pins	$V_{CC} = 2.7\text{ V}$ ; $V_I = V_{CC}$	[2]	-	0.1	1	$\mu\text{A}$
		$V_{CC} = 2.7\text{ V}$ ; $V_I = 0\text{ V}$	[2]	-	+0.1	-5	$\mu\text{A}$
$I_{OFF}$	power-down output current	$V_{CC} = 0\text{ V}$ ; $V_I$ or $V_O = 0\text{ V}$ to $4.5\text{ V}$	-	0.1	$\pm 100$	$\mu\text{A}$	
$I_{HOLD}$	bus hold current on data inputs	$V_{CC} = 2.5\text{ V}$ ; $V_I = 0.7\text{ V}$	[3]	-	90	-	$\mu\text{A}$
		$V_{CC} = 2.5\text{ V}$ ; $V_I = 1.7\text{ V}$	[3]	-	-70	-	$\mu\text{A}$
$I_{EX}$	external current into output	output HIGH-state; $V_O = 5.5\text{ V}$ ; $V_{CC} = 3.0\text{ V}$	-	10	125	$\mu\text{A}$	
$I_{PU}$	power-up 3-state output current	$V_{CC} \leq 1.2\text{ V}$ ; $V_O = 0.5\text{ V}$ to $V_{CC}$ ; $V_I = \text{GND}$ or $V_{CC}$	[4]	-	1	$\pm 100$	$\mu\text{A}$
$I_{PD}$	powerdown 3-state output current	$V_{CC} \leq 1.2\text{ V}$ ; $V_O = 0.5\text{ V}$ to $V_{CC}$ ; $V_I = \text{GND}$ or $V_{CC}$	[4]	-	1	$\pm 100$	$\mu\text{A}$
$I_{OZ}$	3-state output current	$V_{CC} = 2.7\text{ V}$ ; $V_I = V_{IL}$ or $V_{IH}$					
		output HIGH-state; $V_O = 2.3\text{ V}$	-	0.5	5	$\mu\text{A}$	
		output LOW-state; $V_O = 0.5\text{ V}$	-	+0.5	-5	$\mu\text{A}$	
$I_{CC}$	supply current	$V_{CC} = 2.7\text{ V}$ ; $V_I = \text{GND}$ or $V_{CC}$ ; $I_O = 0\text{ A}$					
		outputs HIGH-state	-	0.04	0.1	mA	
		outputs LOW-state	-	2.3	4.5	mA	
		outputs disabled	[5]	-	0.04	0.1	mA
$\Delta I_{CC}$	additional supply current per input pin	$V_{CC} = 2.3\text{ V}$ to $2.7\text{ V}$ ; one input at $V_{CC} - 0.6\text{ V}$ ; other inputs at $V_{CC}$ or GND	[6]	-	0.01	0.4	mA
$C_i$	input capacitance on $\overline{nOE}$	$V_I = 0\text{ V}$ or $V_{CC}$	-	3	-	pF	
$C_o$	output capacitance	$V_{I/O} = 0\text{ V}$ or $V_{CC}$	-	9	-	pF	
<b><math>V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}</math> [7]</b>							
$V_{IK}$	input diode voltage	$V_{CC} = 3.0\text{ V}$ ; $I_{IK} = -18\text{ mA}$	-	-0.85	-1.2	V	
$V_{OH}$	HIGH-level output voltage	$V_{CC} = 3.0\text{ V}$ to $3.6\text{ V}$ ; $I_{OH} = -100\text{ }\mu\text{A}$	$V_{CC} - 0.2$	$V_{CC}$	-	V	
		$V_{CC} = 3.0\text{ V}$ ; $I_{OH} = -32\text{ mA}$	2.0	2.3	-	V	

**Table 8: Static characteristics ...continued**At recommended operating conditions; voltages are referred to GND (ground = 0 V);  $T_{amb} = -40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$V_{OL}$	LOW-level output voltage	$V_{CC} = 3.0\text{ V}$					
		$I_{OL} = 100\text{ }\mu\text{A}$	-	0.07	0.2	V	
		$I_{OL} = 16\text{ mA}$	-	0.25	0.4	V	
		$I_{OL} = 32\text{ mA}$	-	0.3	0.5	V	
		$I_{OL} = 64\text{ mA}$	-	0.4	0.55	V	
$I_{LI}$	input leakage current	control pins	$V_{CC} = 3.6\text{ V}; V_I = V_{CC}$ or GND	-	0.1	$\pm 1$	$\mu\text{A}$
			$V_{CC} = 0\text{ V}$ or $3.6\text{ V}; V_I = 5.5\text{ V}$	-	0.1	10	$\mu\text{A}$
	data pins	$V_{CC} = 3.6\text{ V}; V_I = V_{CC}$	[2] -	0.5	1	$\mu\text{A}$	
		$V_{CC} = 3.6\text{ V}; V_I = 0\text{ V}$	[2] -	+0.1	-5	$\mu\text{A}$	
$I_{OFF}$	power-down output current	$V_{CC} = 0\text{ V}; V_I$ or $V_O = 0\text{ V}$ to $4.5\text{ V}$	-	0.1	$\pm 100$	$\mu\text{A}$	
$I_{HOLD}$	bus hold current on data inputs	$V_{CC} = 3\text{ V}; V_I = 0.8\text{ V}$	[3] 75	130	-	$\mu\text{A}$	
		$V_{CC} = 3\text{ V}; V_I = 2.0\text{ V}$	[3] -75	-140	-	$\mu\text{A}$	
		$V_{CC} = 0\text{ V}$ to $3.6\text{ V}; V_I = 3.6\text{ V}$	$\pm 500$	-	-	$\mu\text{A}$	
$I_{EX}$	external current into output	output HIGH-state; $V_O = 5.5\text{ V}; V_{CC} = 3.0\text{ V}$	[3] -	10	125	$\mu\text{A}$	
$I_{PU}$	power-up 3-state output current	$V_{CC} \leq 1.2\text{ V}; V_O = 0.5\text{ V}$ to $V_{CC}; V_I = \text{GND}$ or $V_{CC}$	-	1	$\pm 100$	$\mu\text{A}$	
$I_{PD}$	power-down 3-state output current	$V_{CC} \leq 1.2\text{ V}; V_O = 0.5\text{ V}$ to $V_{CC}; V_I = \text{GND}$ or $V_{CC}$	-	1	$\pm 100$	$\mu\text{A}$	
$I_{OZ}$	3-state output current	$V_{CC} = 3.6\text{ V}; V_I = V_{IL}$ or $V_{IH}$					
		output HIGH-state; $V_O = 3.0\text{ V}$	-	0.5	5	$\mu\text{A}$	
		output LOW-state; $V_O = 0.5\text{ V}$	-	+0.5	-5	$\mu\text{A}$	
$I_{CC}$	supply current	$V_{CC} = 3.6\text{ V}; V_I = \text{GND}$ or $V_{CC}; I_O = 0\text{ A}$					
		outputs HIGH-state	-	0.07	0.1	mA	
		outputs LOW-state	-	3.5	7	mA	
		outputs disabled	[5] -	0.07	0.1	mA	
$\Delta I_{CC}$	additional supply current per input pin	$V_{CC} = 3\text{ V}$ to $3.6\text{ V};$ one input at $V_{CC} - 0.6\text{ V};$ other inputs at $V_{CC}$ or GND	[6] -	0.04	0.4	mA	

[1] All typical values are at  $V_{CC} = 2.5\text{ V}$  and  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .[2] Unused pins at  $V_{CC}$  or GND.

[3] This is the bus hold overdrive current required to force the input to the opposite logic state.

[4] This parameter is valid for any  $V_{CC}$  between 0 V and 1.2 V with a transition time of up to 10 ms. From  $V_{CC} = 1.2\text{ V}$  to  $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$  a transition time of 100  $\mu\text{s}$  is permitted. This parameter is valid for  $T_{amb} = 25\text{ }^{\circ}\text{C}$  only.[5]  $I_{CC}$  is measured with outputs pulled up to  $V_{CC}$  or pulled down to ground.[6] This is the increase in supply current for each input at the specified voltage level other than  $V_{CC}$  or GND.[7] All typical values are at  $V_{CC} = 3.3\text{ V}$  and  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .[8] This parameter is valid for any  $V_{CC}$  between 0 V and 1.2 V with a transition time of up to 10 ms. From  $V_{CC} = 1.2\text{ V}$  to  $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  a transition time of 100  $\mu\text{s}$  is permitted. This parameter is valid for  $T_{amb} = 25\text{ }^{\circ}\text{C}$  only.

## 11. Dynamic characteristics

**Table 9: Dynamic characteristics**

$GND = 0\text{ V}$ ;  $T_{amb} = -40\text{ °C}$  to  $+85\text{ °C}$ ; for test circuit see [Figure 6](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}</math> [1]</b>						
$t_{PLH}$	propagation delay nAx to nYx	see <a href="#">Figure 4</a>	0.5	2.1	3.0	ns
$t_{PHL}$	propagation delay nAx to nYx	see <a href="#">Figure 4</a>	0.5	2.0	3.0	ns
$t_{PZH}$	output enable time to HIGH-level	see <a href="#">Figure 5</a>	1.5	3.1	5.1	ns
$t_{PZL}$	output enable time to LOW-level	see <a href="#">Figure 5</a>	1.0	2.2	4.1	ns
$t_{PHZ}$	output disable time from HIGH-level	see <a href="#">Figure 5</a>	1.0	2.9	5.7	ns
$t_{PLZ}$	output disable time from LOW-level	see <a href="#">Figure 5</a>	0.5	2.3	5.0	ns
<b><math>V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}</math> [2]</b>						
$t_{PLH}$	propagation delay nAx to nYx	see <a href="#">Figure 4</a>	0.5	1.6	2.2	ns
$t_{PHL}$	propagation delay nAx to nYx	see <a href="#">Figure 4</a>	0.5	1.6	2.3	ns
$t_{PZH}$	output enable time to HIGH-level	see <a href="#">Figure 5</a>	1.0	2.2	3.9	ns
$t_{PZL}$	output enable time to LOW-level	see <a href="#">Figure 5</a>	0.5	1.6	2.9	ns
$t_{PHZ}$	output disable time from HIGH-level	see <a href="#">Figure 5</a>	1.5	2.9	5.4	ns
$t_{PLZ}$	output disable time from LOW-level	see <a href="#">Figure 5</a>	1.0	2.5	4.6	ns

[1] All typical values are at  $V_{CC} = 2.5\text{ V}$  and  $T_{amb} = 25\text{ °C}$ .

[2] All typical values are at  $V_{CC} = 3.3\text{ V}$  and  $T_{amb} = 25\text{ °C}$ .

12. Waveforms

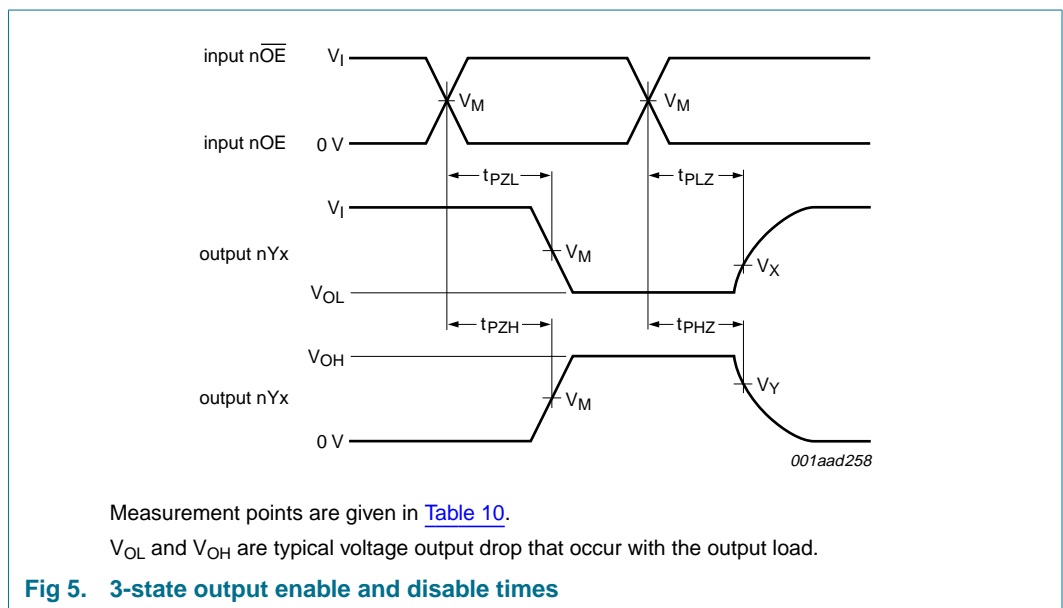
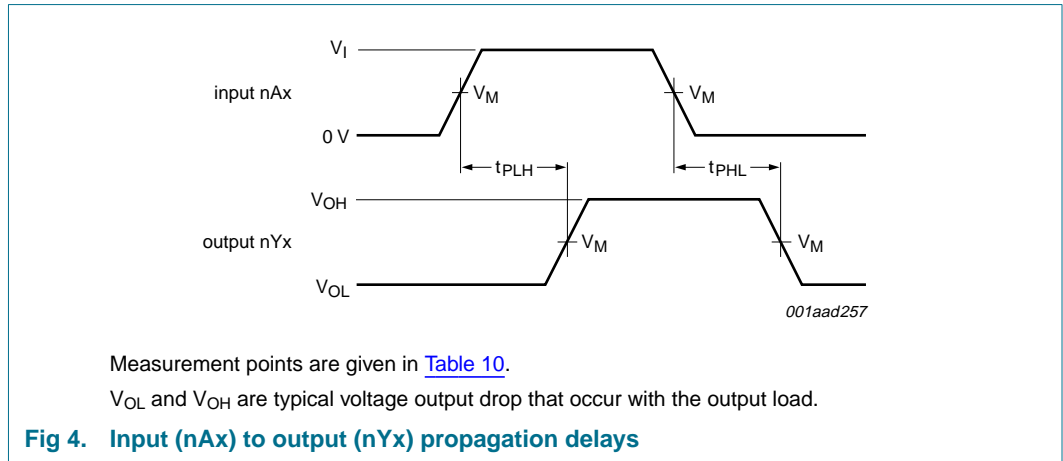


Table 10: Measurement points

Supply voltage	Input	Output		
$V_{CC}$	$V_M$	$V_M$	$V_X$	$V_Y$
$\geq 3\text{ V}$	1.5 V	1.5 V	$V_{OL} + 0.3\text{ V}$	$V_{OH} - 0.3\text{ V}$
$\leq 2.7\text{ V}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15\text{ V}$	$V_{OH} - 0.15\text{ V}$

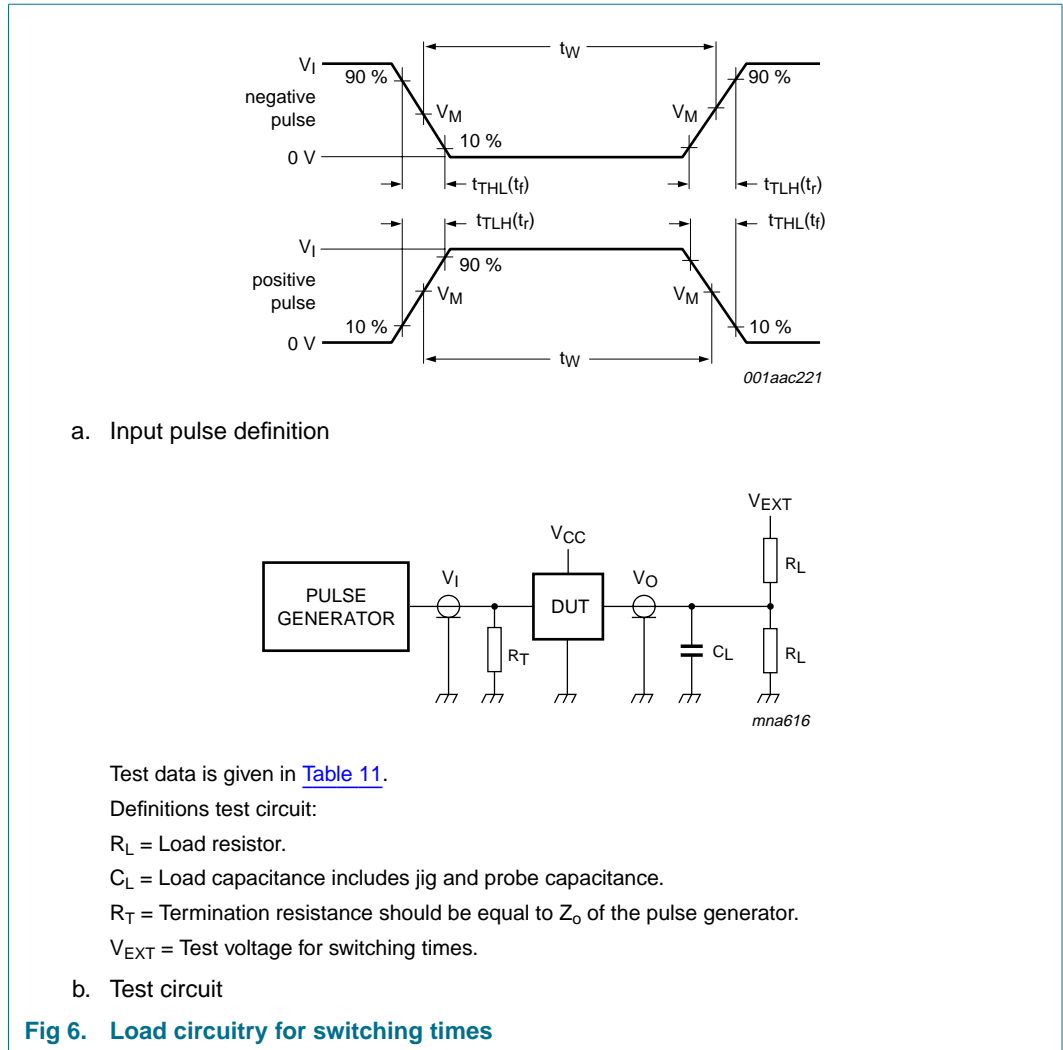


Table 11: Test data

Input				Load		$V_{EXT}$		
$V_I$	$f_i$	$t_w$	$t_r, t_f$	$C_L$	$R_L$	$t_{PHZ}, t_{PZH}$	$t_{PLZ}, t_{PZL}$	$t_{PLH}, t_{PHL}$
3.0 V or $V_{CC}$ whichever is less	$\leq 10$ MHz	500 ns	$\leq 2.5$ ns	50 pF	500 $\Omega$	GND	6 V or $2 \times V_{CC}$	open

13. Package outline

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

SOT370-1

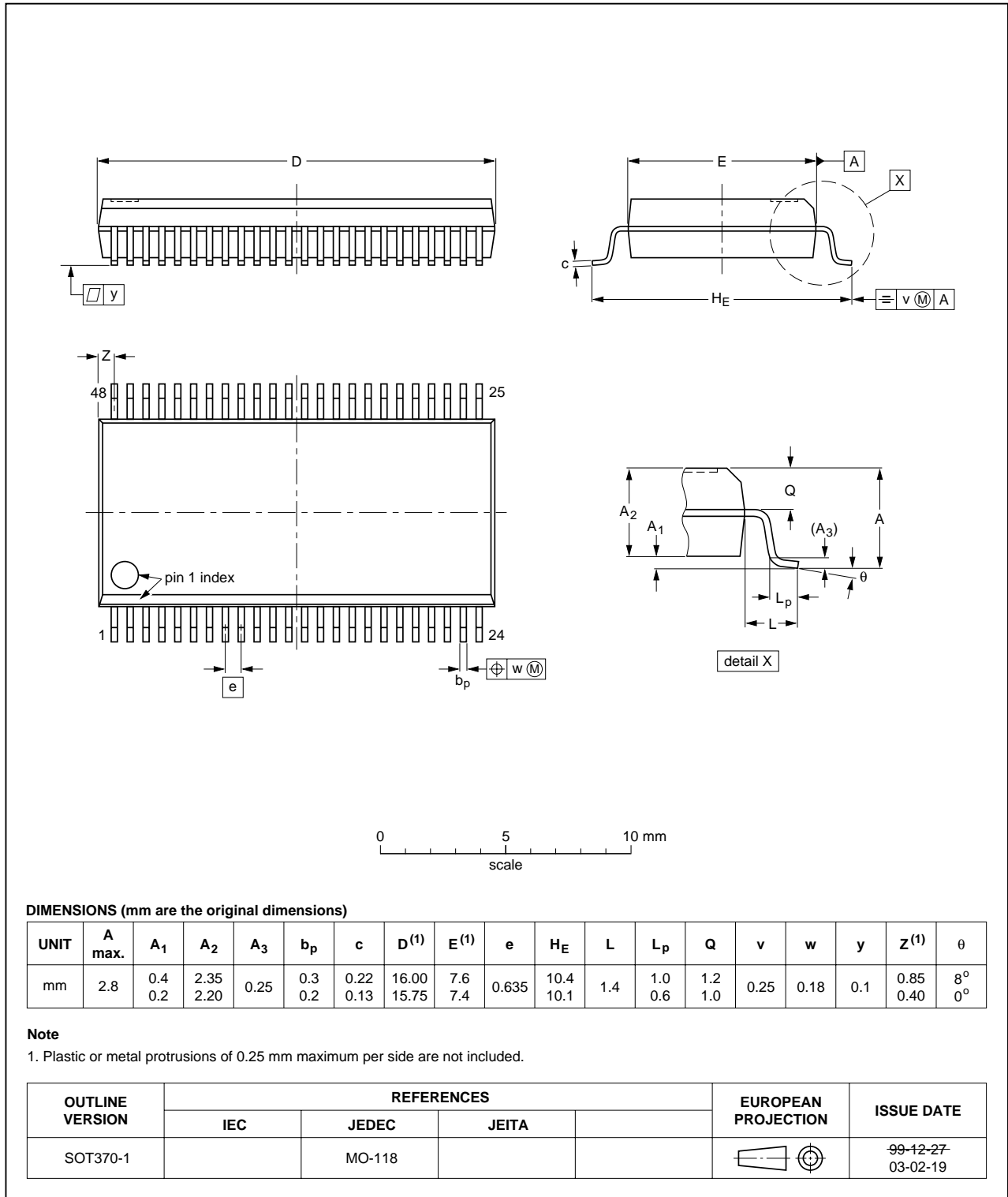


Fig 7. Package outline SOT370-1 (SSOP48)

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

SOT362-1

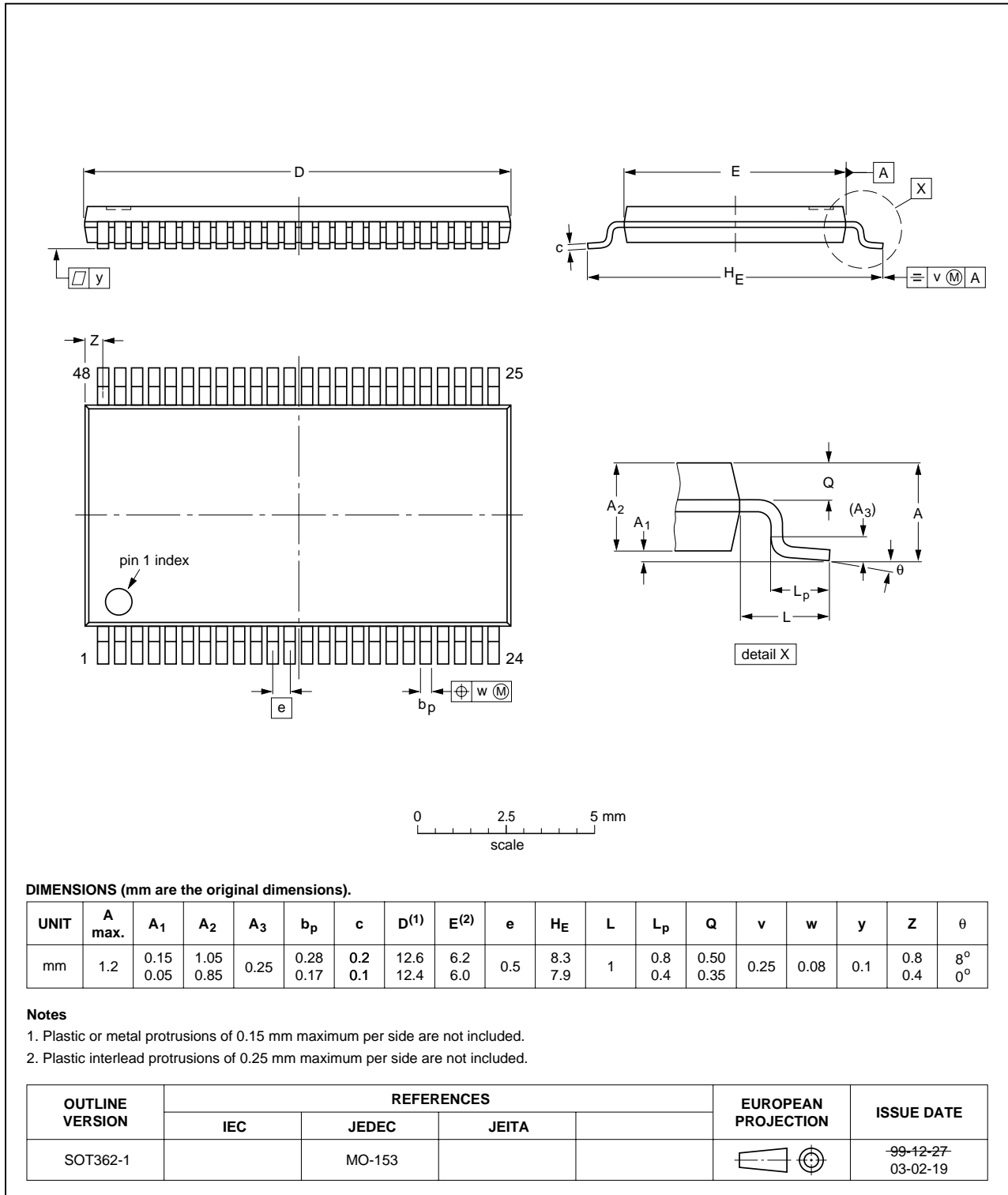


Fig 8. Package outline SOT362-1 (TSSOP48)

## 14. Revision history

**Table 12: Revision history**

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
74ALVT16241_3	20050704	Product data sheet	-	9397 750 15164	74ALVT16241_2
Modifications:					
					<ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors.</li><li>• In <a href="#">Table 1</a> and <a href="#">Table 9</a>; update of the typical and maximum propagation delay times.</li></ul>
74ALVT16241_2	19980213	Product specification	-	9397 750 03617	74ALVT16241_1
74ALVT16241_1	19960828	Product specification	-	-	-

## 15. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2] [3]</sup>	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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## 19. Contact information

For additional information, please visit: <http://www.semiconductors.philips.com>

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