

# 74ALVC16245; 74ALVCH16245

16-bit transceiver with direction pin; 3-state

Rev. 03 — 12 May 2004

Product data sheet

## 1. General description

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The 74ALVC16245; 74ALVCH16245 is a 16-bit transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions.

The 74ALVC16245; 74ALVCH16245 features two output enable inputs (pins  $\overline{nOE}$ ) for easy cascading and two send or receive inputs (pins  $nDIR$ ) for direction control. Pins  $\overline{nOE}$  control the outputs so that the buses are effectively isolated. This device can be used as two 8-bit transceivers or one 16-bit transceiver.

The 74ALVCH16245 has an active bushold circuitry which is provided to hold unused or floating data inputs at a valid logic level. This feature eliminates the need for external pull-up or pull-down resistors.

## 2. Features

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- Wide supply voltage range from 1.2 V to 3.6 V
- Complies with JEDEC standard JESD8-B
- CMOS low power consumption
- MULTIBYTE flow-through standard pin-out architecture
- Low inductance multiple  $V_{CC}$  and GND pins for minimize noise and ground bounce
- Direct interface with TTL levels
- All data inputs have bushold (74ALVCH16245 only)
- Output drive capability 50  $\Omega$  transmission lines at 85 °C
- Current drive  $\pm 24$  mA at  $V_{CC} = 3.0$  V.

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### 3. Quick reference data

**Table 1: Quick reference data**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$t_{PHL}$ , $t_{PLH}$	propagation delay An to Bn; Bn to An	$V_{CC} = 2.5\text{ V}$ ; $C_L = 30\text{ pF}$	-	2.0	-	ns	
		$V_{CC} = 3.3\text{ V}$ ; $C_L = 50\text{ pF}$	-	1.9	-	ns	
$C_I$	input capacitance		-	4.0	-	pF	
$C_{I/O}$	input/output capacitance		-	8.0	-	pF	
$C_{PD}$	power dissipation capacitance per buffer	outputs enabled	[1] [2]	-	29	-	pF
		outputs disabled	[1] [2]	-	5	-	pF

[1]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in Volts;

$N$  = total load switching outputs;

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

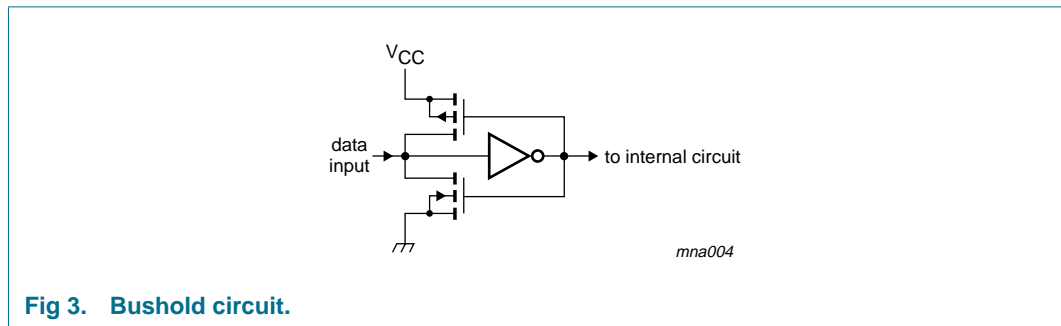
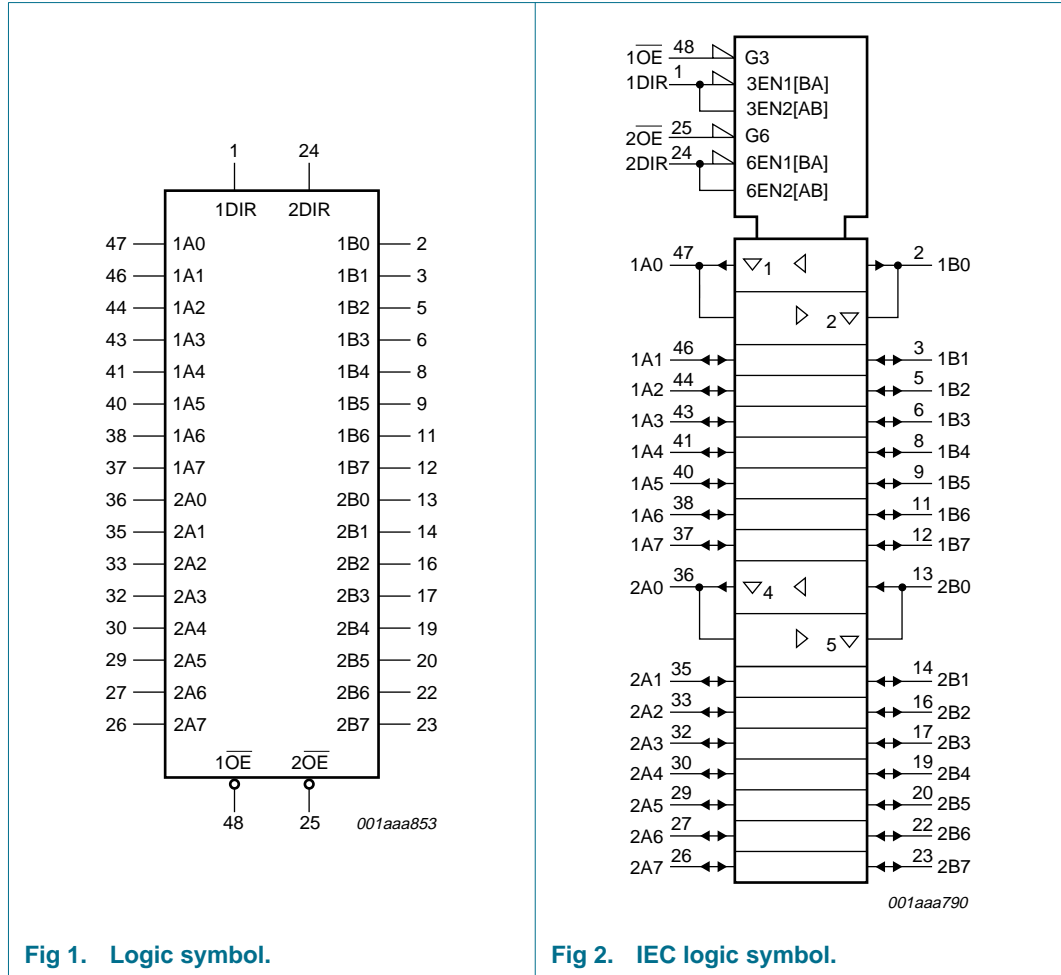
[2] The condition is  $V_I = \text{GND to } V_{CC}$ .

### 4. Ordering information

**Table 2: Ordering information**

Type number	Package			Version
	Temperature range	Name	Description	
74ALVC16245DGG	-40 °C to +85 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1
74ALVCH16245DGG	-40 °C to +85 °C			
74ALVC16245DL	-40 °C to +85 °C	SSOP48	plastic shrink small outline package; 48 leads; body width 7.5 mm	SOT370-1
74ALVCH16245DL	-40 °C to +85 °C			

## 5. Functional diagram



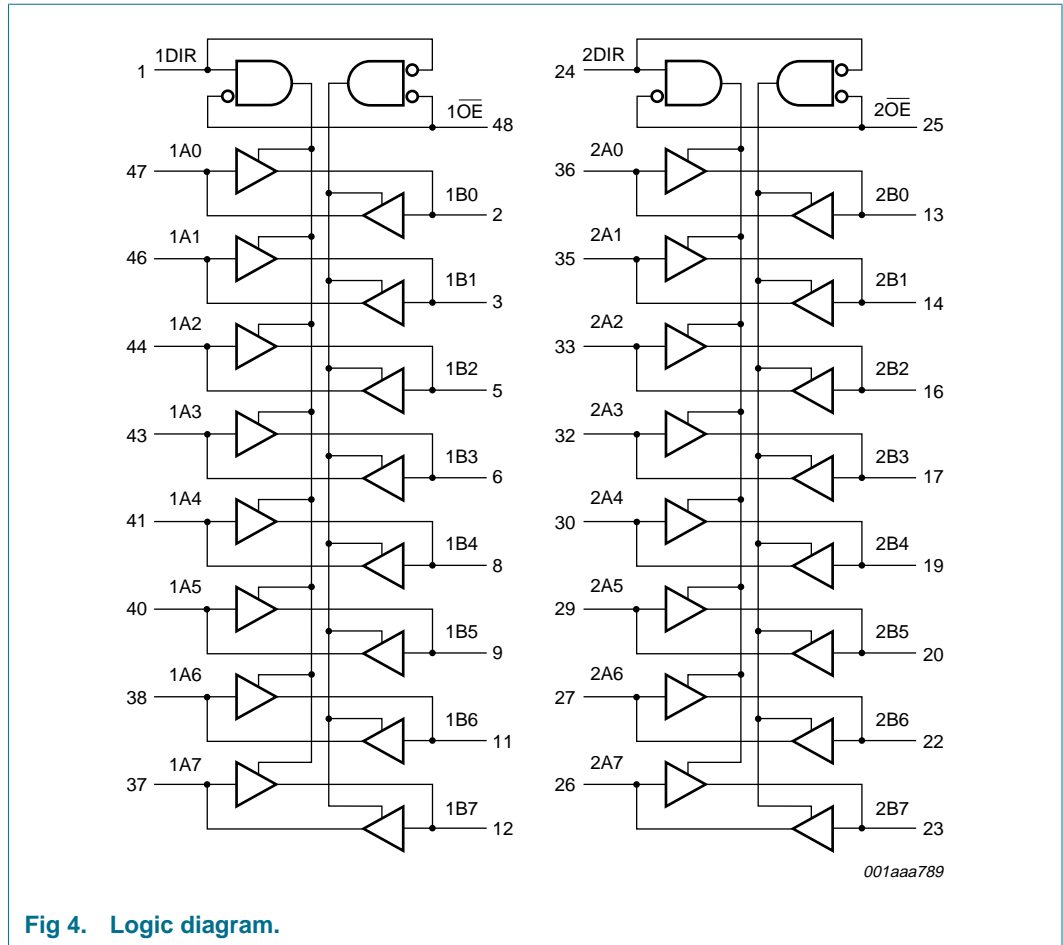


Fig 4. Logic diagram.

## 6. Pinning information

### 6.1 Pinning

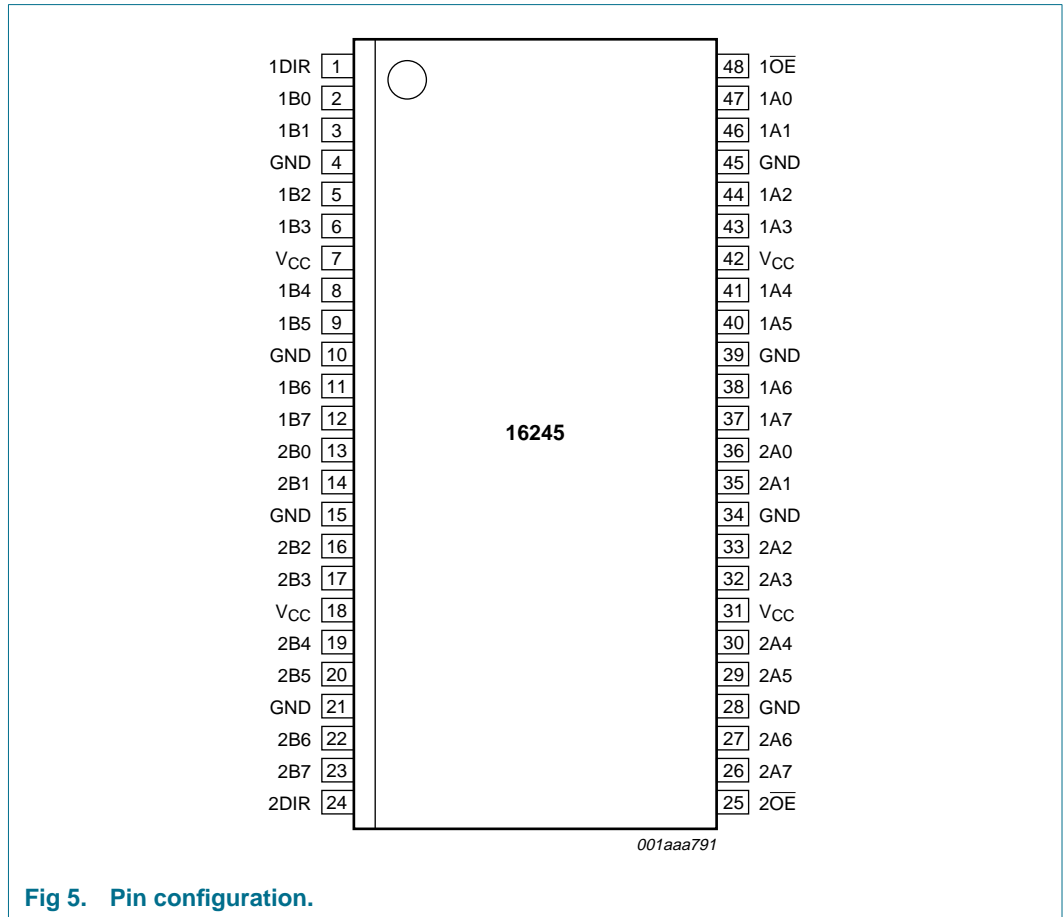


Fig 5. Pin configuration.

### 6.2 Pin description

Table 3: Pin description

Pin	Symbol	Description
1	1DIR	direction control input
2	1B0	data output or input
3	1B1	data output or input
4	GND	ground (0 V)
5	1B2	data output or input
6	1B3	data output or input
7	V <sub>CC</sub>	positive supply voltage
8	1B4	data output or input
9	1B5	data output or input
10	GND	ground (0 V)
11	1B6	data output or input

Table 3: Pin description ...continued

Pin	Symbol	Description
12	1B7	data output or input
13	2B0	data output or input
14	2B1	data output or input
15	GND	ground (0 V)
16	2B2	data output or input
17	2B3	data output or input
18	V <sub>CC</sub>	positive supply voltage
19	2B4	data output or input
20	2B5	data output or input
21	GND	ground (0 V)
22	2B6	data output or input
23	2B7	data output or input
24	2DIR	direction control input
25	2 $\overline{\text{OE}}$	output enable input (active LOW)
26	2A7	data input or output
27	2A6	data input or output
28	GND	ground (0 V)
29	2A5	data input or output
30	2A4	data input or output
31	V <sub>CC</sub>	positive supply voltage
32	2A3	data input or output
33	2A2	data input or output
34	GND	ground (0 V)
35	2A1	data input or output
36	2A0	data input or output
37	1A7	data input or output
38	1A6	data input or output
39	GND	ground (0 V)
40	1A5	data input or output
41	1A4	data input or output
42	V <sub>CC</sub>	positive supply voltage
43	1A3	data input or output
44	1A2	data input or output
45	GND	ground (0 V)
46	1A1	data input or output
47	1A0	data input or output
48	1 $\overline{\text{OE}}$	output enable input (active LOW)

## 7. Functional description

### 7.1 Function table

Table 4: Function table [1]

Input		Input or output	
nOE	nDIR	nAn	nBn
L	L	A = B	input
L	H	input	B = A
H	X	Z	Z

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

## 8. Limiting values

Table 5: 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	+4.6	V
$I_{IK}$	input diode current	$V_I < 0$ V	-50	-	mA
$V_I$	input voltage	data inputs with bushold	[1] -0.5	$V_{CC} + 0.5$	V
		data inputs without bushold	[1] -0.5	+4.6	V
		control pins	[1] -0.5	+4.6	V
$I_{OK}$	output diode current	$V_O > V_{CC}$ or $V_O < 0$ V	-	$\pm 50$	mA
$V_O$	output voltage		[1] -0.5	$V_{CC} + 0.5$	V
$I_O$	output source or sink current	$V_O = 0$ V to $V_{CC}$	-	$\pm 50$	mA
$I_{GND}, I_{CC}$	$V_{CC}$ or GND current		-	$\pm 100$	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	power dissipation	$T_{amb} = -40$ °C to +85 °C			
		SSOP package	[2] -	850	mW
		TSSOP package	[3] -	600	mW

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] Above 55 °C the value of  $P_{tot}$  derates linearly with 11.3 mW/K.

[3] Above 55 °C the value of  $P_{tot}$  derates linearly with 8 mW/K.

## 9. Recommended operating conditions

**Table 6: Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	maximum speed performance				
		$C_L = 30 \text{ pF}$	2.3	-	2.7	V
		$C_L = 50 \text{ pF}$	3.0	-	3.6	V
		low-voltage applications	1.2	-	3.6	V
$V_I$	input voltage		0	-	$V_{CC}$	V
$V_O$	output voltage		0	-	$V_{CC}$	V
$T_{amb}$	operating ambient temperature		-40	-	+85	°C
$t_r, t_f$	input rise and fall times	$V_{CC} = 2.3 \text{ V to } 3.0 \text{ V}$	0	-	20	ns/V
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	0	-	10	ns/V

## 10. Static characteristics

**Table 7: Static characteristics**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{amb} = -40 \text{ °C to } +85 \text{ °C [1]}$						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.7	1.2	-	V
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	2.0	1.5	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	-	1.2	0.7	V
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	-	1.5	0.8	V
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH} \text{ or } V_{IL}$				
		$I_O = -100 \text{ }\mu\text{A}; V_{CC} = 2.3 \text{ V to } 3.6 \text{ V}$	$V_{CC} - 0.2$	$V_{CC}$	-	V
		$I_O = -6 \text{ mA}; V_{CC} = 2.3 \text{ V}$	$V_{CC} - 0.3$	$V_{CC} - 0.08$	-	V
		$I_O = -12 \text{ mA}; V_{CC} = 2.3 \text{ V}$	$V_{CC} - 0.6$	$V_{CC} - 0.26$	-	V
		$I_O = -12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	$V_{CC} - 0.5$	$V_{CC} - 0.14$	-	V
		$I_O = -12 \text{ mA}; V_{CC} = 3.0 \text{ V}$	$V_{CC} - 0.6$	$V_{CC} - 0.09$	-	V
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH} \text{ or } V_{IL}$				
		$I_O = 100 \text{ }\mu\text{A}; V_{CC} = 2.3 \text{ V to } 3.6 \text{ V}$	-	GND	0.20	V
		$I_O = 6 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	0.07	0.40	V
		$I_O = 12 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	0.15	0.70	V
		$I_O = 12 \text{ mA}; V_{CC} = 2.7 \text{ V}$	-	0.14	0.40	V
		$I_O = 24 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	0.27	0.55	V
$I_{LI}$	input leakage current	$V_I = V_{CC} \text{ or } \text{GND}; V_{CC} = 2.3 \text{ V to } 3.6 \text{ V}$	-	0.1	5	$\mu\text{A}$
$I_{OZ}$	3-state output OFF-state current	$V_I = V_{IH} \text{ or } V_{IL}; V_O = V_{CC} \text{ or } \text{GND}; V_{CC} = 2.3 \text{ V to } 3.6 \text{ V}$	-	0.1	10	$\mu\text{A}$



**Table 7: Static characteristics ...continued**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{CC}$	quiescent supply current	$V_{CC} = 2.3 \text{ V to } 3.6 \text{ V};$ $V_I = V_{CC} \text{ or GND}; I_O = 0 \text{ A}$	-	0.2	40	$\mu\text{A}$
$\Delta I_{CC}$	additional quiescent supply current given per data I/O pin with bushold	$V_{CC} = 2.3 \text{ V to } 3.6 \text{ V};$ $V_I = V_{CC} - 0.6 \text{ V}; I_O = 0 \text{ A}$	-	150	750	$\mu\text{A}$
$I_{BHL}$	bushold LOW sustaining current	$V_{CC} = 2.3 \text{ V}; V_I = 0.7 \text{ V}$	[2] 45	-	-	$\mu\text{A}$
		$V_{CC} = 3.0 \text{ V}; V_I = 0.8 \text{ V}$	[2] 75	150	-	$\mu\text{A}$
$I_{BHH}$	bushold HIGH sustaining current	$V_{CC} = 2.3 \text{ V}; V_I = 1.7 \text{ V}$	[2] -45	-	-	$\mu\text{A}$
		$V_{CC} = 3.0 \text{ V}; V_I = 2.0 \text{ V}$	[2] -75	-175	-	$\mu\text{A}$
$I_{BHLO}$	bushold LOW overdrive current	$V_{CC} = 3.6 \text{ V}$	[2] 500	-	-	$\mu\text{A}$
$I_{BHHO}$	bushold HIGH overdrive current	$V_{CC} = 3.6 \text{ V}$	[2] -500	-	-	$\mu\text{A}$
$C_I$	input capacitance		-	4.0	-	$\text{pF}$
$C_{I/O}$	input/output capacitance		-	8.0	-	$\text{pF}$

[1] All typical values are measured at  $T_{amb} = 25 \text{ }^\circ\text{C}$ .

[2] Valid for data inputs of bushold parts.

## 11. Dynamic characteristics

**Table 8: Dynamic characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); test circuit [Figure 8](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b>T<sub>amb</sub> = -40 °C to +85 °C [1]</b>							
t <sub>PHL</sub> , t <sub>PLH</sub>	propagation delay nAn to nBn; nBn to nAn	see <a href="#">Figure 6</a>					
		V <sub>CC</sub> = 2.3 V to 2.7 V	[2]	1.0	2.0	3.7	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	[3]	1.0	1.9	3.0	ns
		V <sub>CC</sub> = 2.7 V		1.0	2.1	3.6	ns
t <sub>PZH</sub> , t <sub>PZL</sub>	3-state output enable time nOE to nAn; nOE to nBn	see <a href="#">Figure 7</a>					
		V <sub>CC</sub> = 2.3 V to 2.7 V	[2]	1.0	2.7	5.7	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	[3]	1.0	2.3	4.4	ns
		V <sub>CC</sub> = 2.7 V		1.0	3.0	5.4	ns
t <sub>PHZ</sub> , t <sub>PLZ</sub>	3-state output disable time nOE to nAn; nOE to nBn	see <a href="#">Figure 7</a>					
		V <sub>CC</sub> = 2.3 V to 2.7 V	[2]	1.0	2.2	5.2	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	[3]	1.0	2.8	4.1	ns
		V <sub>CC</sub> = 2.7 V		1.0	3.1	4.6	ns
C <sub>PD</sub>	power dissipation capacitance per buffer	outputs enabled	[4] [5]	-	29	-	pF
		outputs disabled	[4] [5]	-	5	-	pF

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

[2] Typical values are measured at V<sub>CC</sub> = 2.5 V.

[3] Typical values are measured at V<sub>CC</sub> = 3.3 V.

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

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

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;

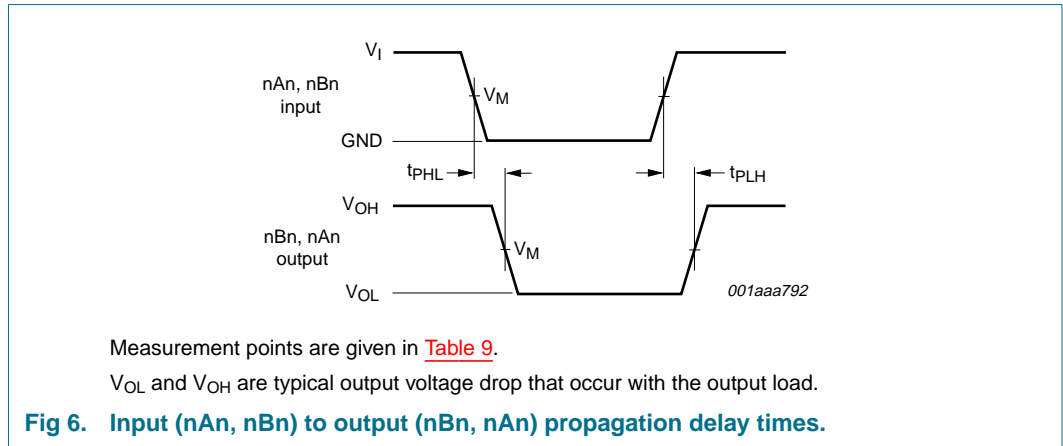
V<sub>CC</sub> = supply voltage in Volts;

N = total load switching outputs;

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

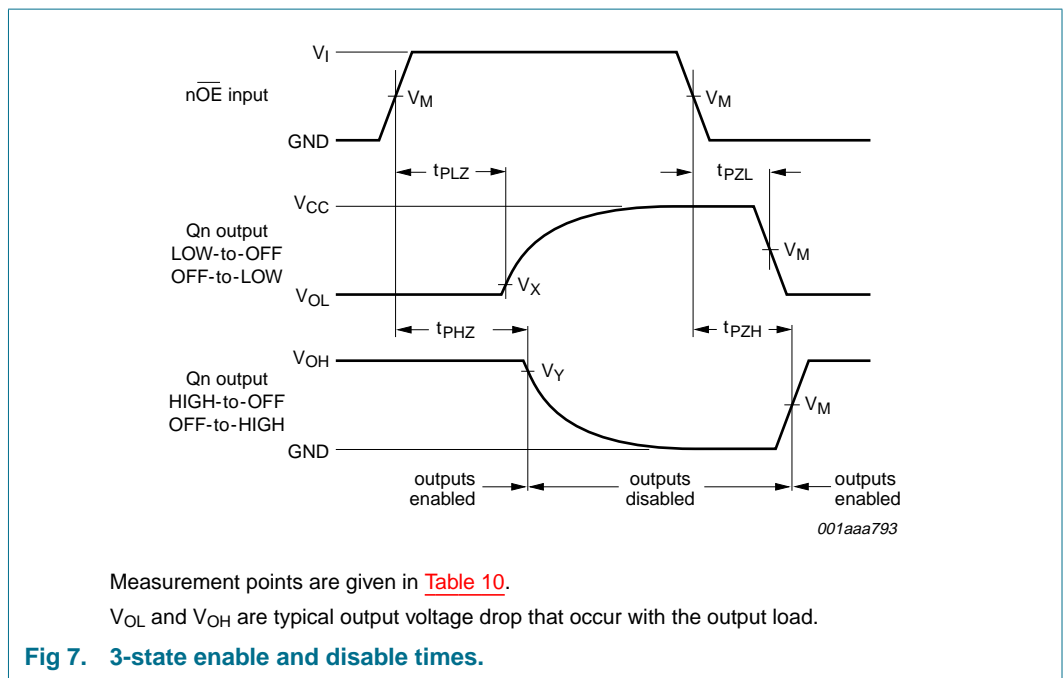
[5] The condition is V<sub>I</sub> = GND to V<sub>CC</sub>.

## 12. Waveforms



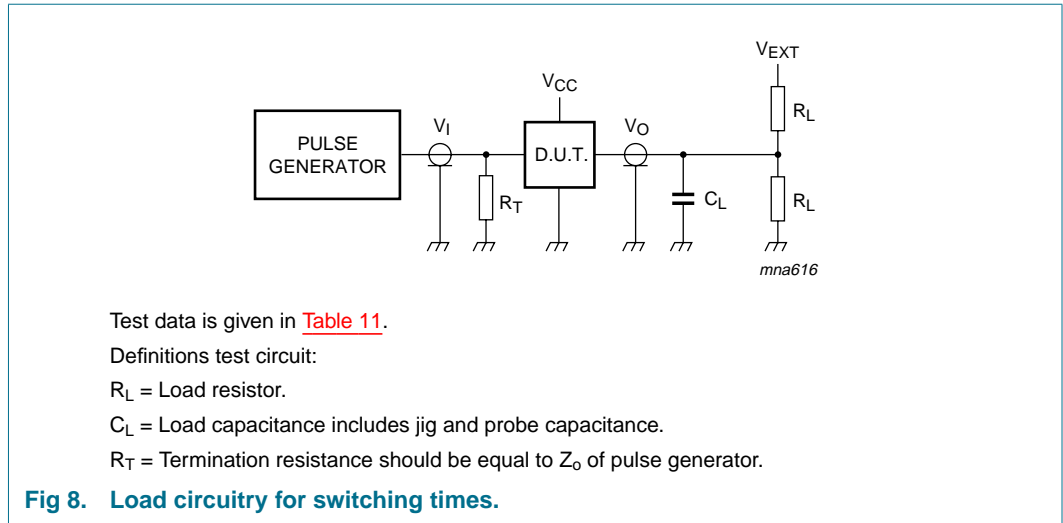
**Table 9: Measurement points**

Supply voltage	Input	Output
$V_{CC}$	$V_M$	$V_M$
$< 2.7 V$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
$\geq 2.7 V$	1.5 V	1.5 V



**Table 10: Measurement points**

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



**Table 11: Test data**

Supply voltage	Input		Load		$V_{EXT}$		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PHZ}, t_{PZH}$	$t_{PLZ}, t_{PZL}$
< 2.7 V	$V_{CC}$	2.0 ns	30 pF	500 $\Omega$	open	GND	$2 \times V_{CC}$
2.7 V – 3.6 V	2.7 V	2.5 ns	50 pF	500 $\Omega$	open	GND	$2 \times V_{CC}$

## 13. Package outline

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

SOT370-1

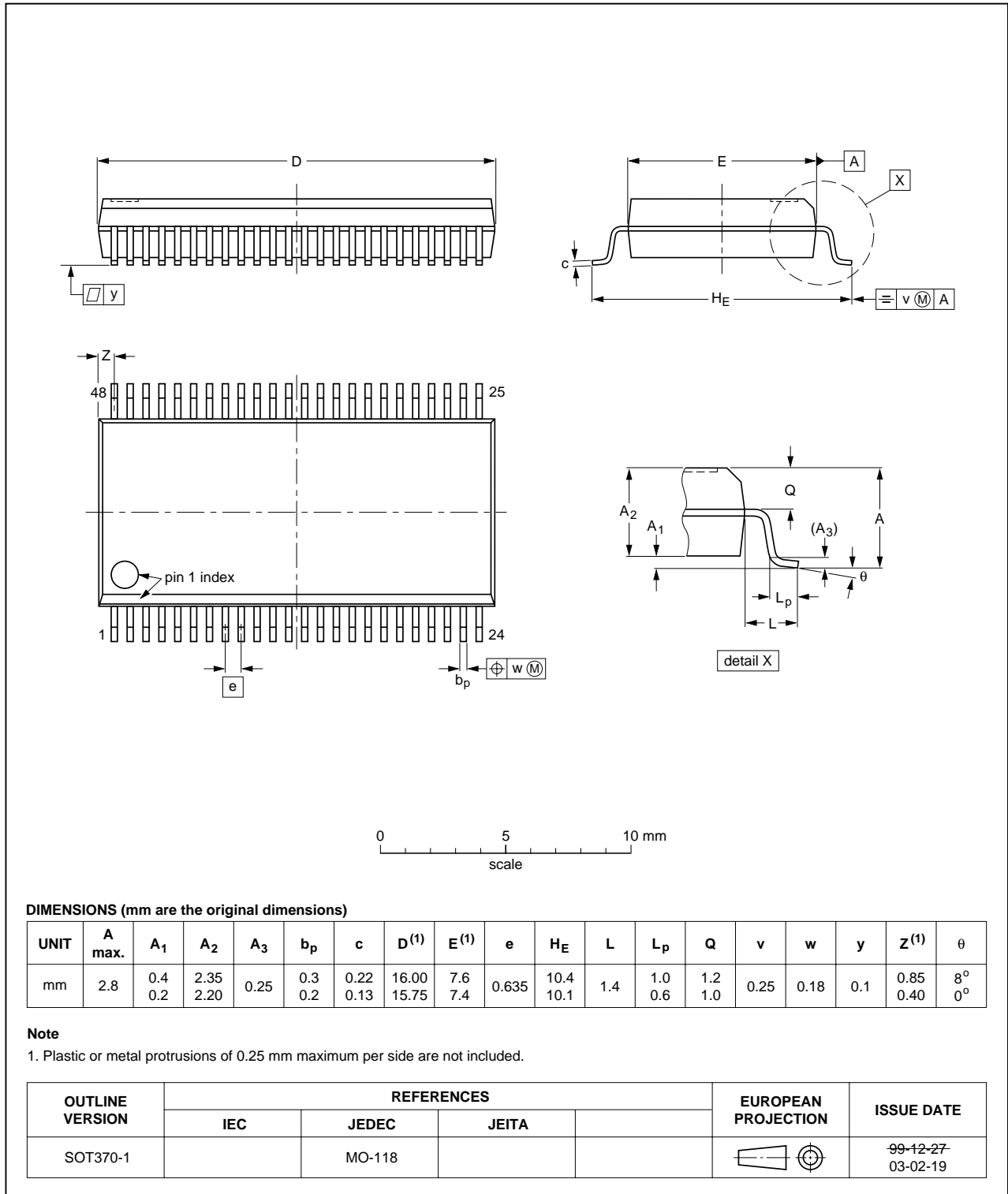


Fig 9. Package outline SSOP48.

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

SOT362-1

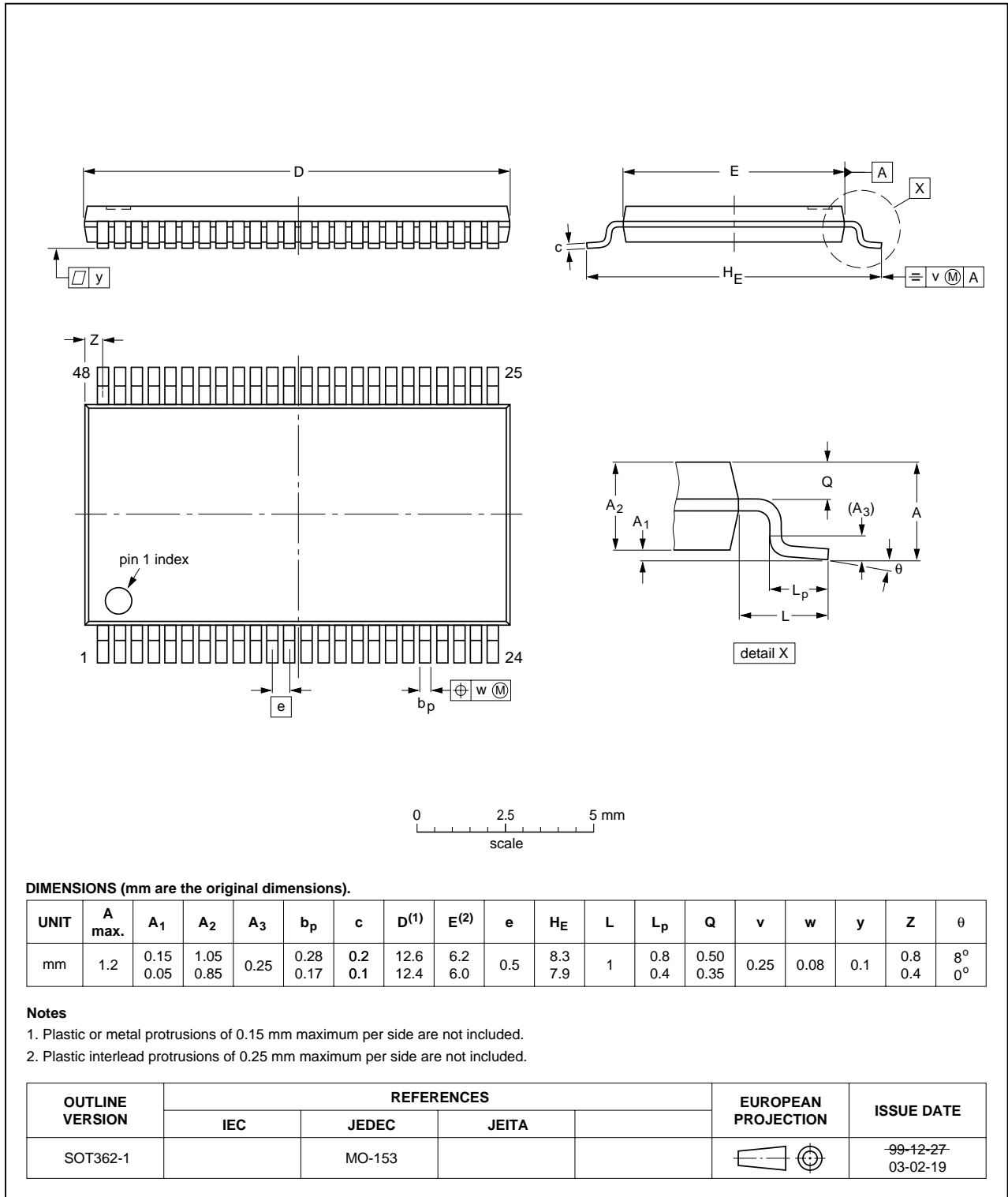


Fig 10. Package outline TSSOP48.

## 14. Revision history

Table 12: Revision history

Document ID	Release date	Data sheet status	Change notice	Order number	Supersedes
74ALVC_ALVCH16245_3	20040512	Product data	-	9397 750 13117	74ALVCH16245_2 74ALVC16245_ 74ALVCH16245_1
Modifications:		<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the current presentation and information standard of Philips Semiconductors.</li> <li><a href="#">Section 1 "General description"</a> updated.</li> </ul>			
74ALVC16245_ 74ALVCH16245_1	19980325	Product specification	-	9397 750 03385	-
74ALVCH16245_2	19980629	Product specification	-	9397 750 04538	74ALVCH16245_1
74ALVCH16245_1	19950102	Preliminary specification	-	-	-

## 15. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2]</sup> <sup>[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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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

## 16. Definitions

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**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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