

# 74AVCH16245

16-bit transceiver with direction pin; 3.6 V tolerant; 3-state

Rev. 3 — 8 January 2013

Product data sheet

## 1. General description

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The 74AVCH16245 is a 16-bit transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions. The device features two output enable inputs ( $\overline{\text{nOE}}$ ) for easy cascading and two send/receive inputs ( $\text{nDIR}$ ) for direction control. Inputs  $\overline{\text{nOE}}$  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 74AVCH16245 is designed to have an extremely fast propagation delay and a minimum amount of power consumption.

To ensure the high-impedance output state during power-up or power-down, tie pins  $\overline{\text{nOE}}$  to  $V_{\text{CC}}$  through a pull-up resistor (Live Insertion).

A Dynamic Controlled Output (DCO) circuitry is implemented to support termination line drive during transient (see [Figure 4](#) and [Figure 5](#))

The 74AVCH16245 has active bus-hold circuitry 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 and benefits

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- Wide supply voltage range from 1.2 V to 3.6 V
- Complies with JEDEC standards:
  - ◆ JESD8-7 (1.2 V to 1.95 V)
  - ◆ JESD8-5 (1.8 V to 2.7 V)
  - ◆ JESD8-1A (2.7 V to 3.6 V)
- CMOS low power consumption
- Input/output tolerant up to 3.6 V
- Dynamic Controlled Output (DCO) circuit dynamically changes output impedance, resulting in noise reduction without speed degradation
- Low inductance multiple VCC and GND pins to minimize noise and ground bounce
- Supports Live Insertion
- All inputs have bus-hold



3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74AVCH16245DGG	−40 °C to +85 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1

4. Functional diagram

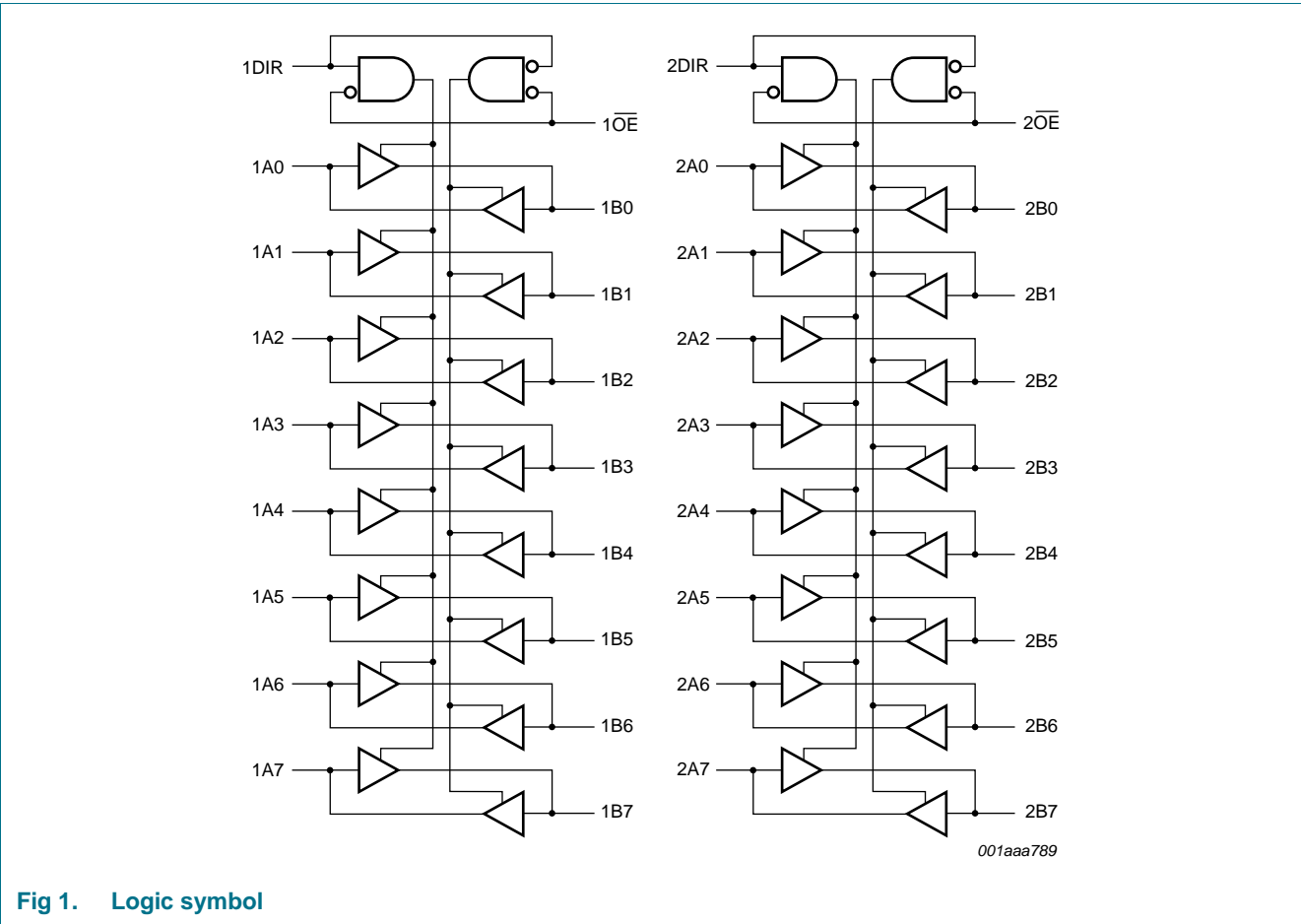


Fig 1. Logic symbol

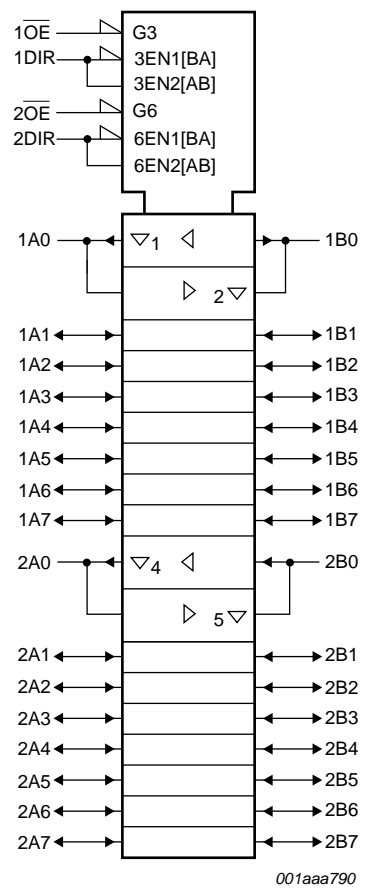


Fig 2. IEC logic symbol

5. Pinning information

5.1 Pinning

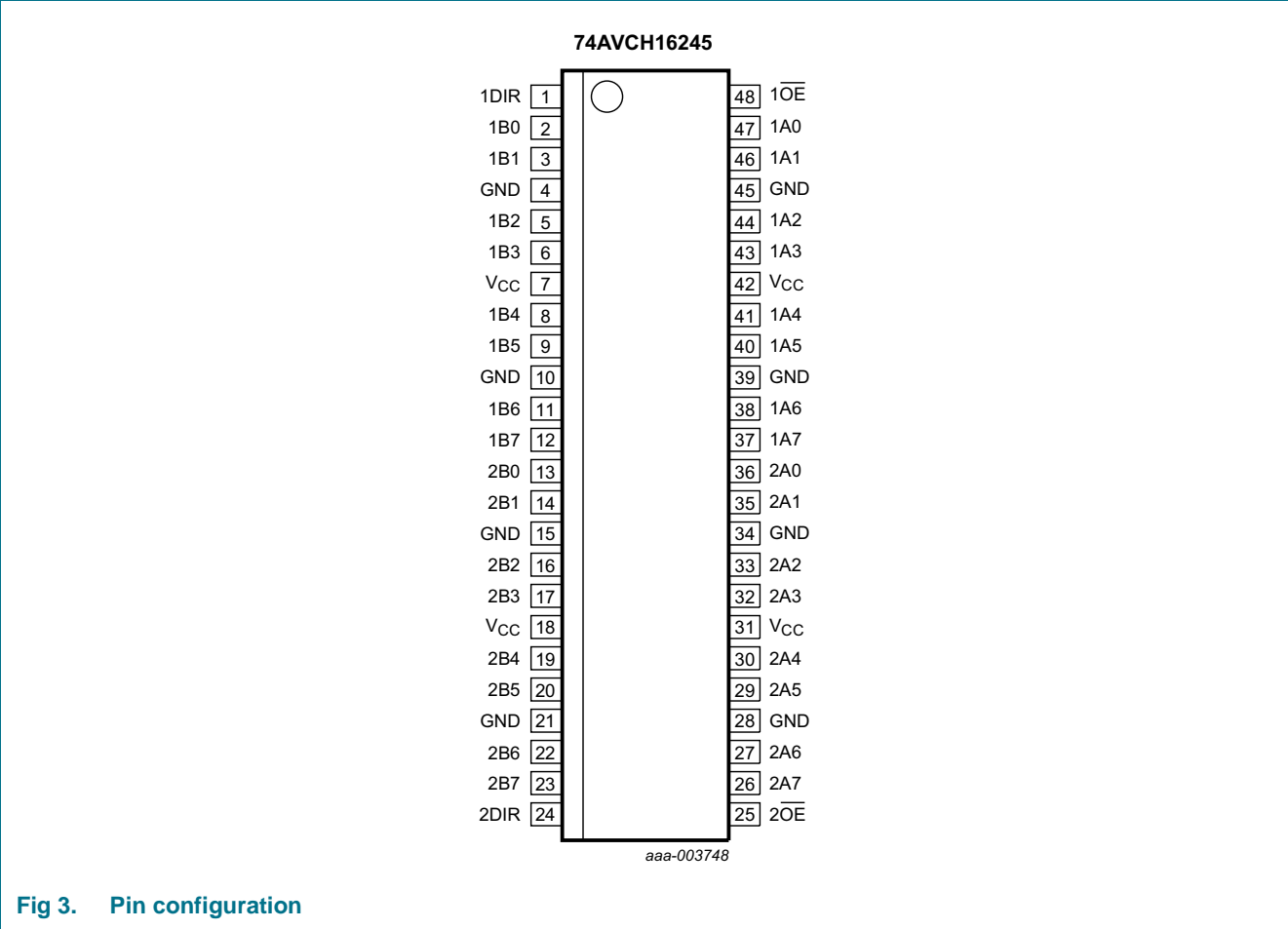


Fig 3. Pin configuration

## 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1DIR, 2DIR	1, 24	direction control input
1B0 to 1B7	2, 3, 5, 6, 8, 9, 11, 12	data input/output
2B0 to 2B7	13, 14, 16, 17, 19, 20, 22, 23	data input/output
GND	4, 10, 15, 21, 28, 34, 39, 45	ground (0 V)
V <sub>CC</sub>	7, 18, 31, 42	supply voltage
1 $\overline{\text{OE}}$ , 2 $\overline{\text{OE}}$	48, 25	output enable input (active LOW)
1A0 to 1A7	47, 46, 44, 43, 41, 40, 38, 37	data input/output
2A0 to 2A7	36, 35, 33, 32, 30, 29, 27, 26	data input/output

## 6. Functional description

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

Inputs		Outputs	
n $\overline{\text{OE}}$	nDIR	nAn	nBn
L	L	A = B	inputs
L	H	inputs	B = A
H	X	Z	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	+4.6	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	+4.6	V
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < 0 V	-50	-	mA
V <sub>O</sub>	output voltage	output HIGH or LOW	<sup>[1]</sup> -0.5	V <sub>CC</sub> + 0.5	V
		output 3-state	<sup>[1]</sup> -0.5	+4.6	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>[2]</sup> -	500	mW

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

[2] 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	according to JEDEC Low Voltage Standards	1.4	-	1.6	V
			1.65	-	1.95	V
			2.3	-	2.7	V
			3.0	-	3.6	V
		for low-voltage applications	1.2	-	3.6	V
V <sub>I</sub>	input voltage		0	-	3.6	V
V <sub>O</sub>	output voltage	output HIGH or LOW	0	-	V <sub>CC</sub>	V
		output 3-state	0	-	3.6	V
T <sub>amb</sub>	ambient temperature	in free air	-40	-	+85	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 1.4 V to 1.6 V	0	-	40	ns/V
		V <sub>CC</sub> = 1.65 V to 1.95 V	0	-	30	ns/V
		V <sub>CC</sub> = 2.3 V to 3.0 V	0	-	20	ns/V
		V <sub>CC</sub> = 3.0 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	Min	Typ <sup>[1]</sup>	Max	Unit
T <sub>amb</sub> = -40 °C to +85 °C						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	V <sub>CC</sub>	-	-	V
		V <sub>CC</sub> = 1.4 V to 1.6 V	0.65 × V <sub>CC</sub>	0.9	-	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>	0.9	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	1.2	-	V
		V <sub>CC</sub> = 3.0 V to 3.6 V	2.0	1.5	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	GND	V
		V <sub>CC</sub> = 1.4 V to 1.6 V	-	0.9	0.35 × V <sub>CC</sub>	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	0.9	0.35 × V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	1.2	0.7	V
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	1.5	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> - 0.20	V <sub>CC</sub>	-	V
		I <sub>O</sub> = -3 mA; V <sub>CC</sub> = 1.4 V	V <sub>CC</sub> - 0.35	V <sub>CC</sub> - 0.21	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	V <sub>CC</sub> - 0.45	V <sub>CC</sub> - 0.25	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	V <sub>CC</sub> - 0.55	V <sub>CC</sub> - 0.37	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 3.0 V	V <sub>CC</sub> - 0.70	V <sub>CC</sub> - 0.47	-	V

**Table 6.** Static characteristics ...continued

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

Symbol	Parameter	Conditions	Min	Typ <sup>[1]</sup>	Max	Unit
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	-	GND	0.20	V
		I <sub>O</sub> = 3 mA; V <sub>CC</sub> = 1.4 V	-	0.22	0.35	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	0.24	0.45	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	0.38	0.55	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 3.0 V	-	0.53	0.70	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 1.4 V to 3.6 V	-	0.1	2.5	µA
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = 3.6 V; V <sub>CC</sub> = 0.0 V	-	±0.1	±10	µA
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND				
		V <sub>CC</sub> = 1.4 V to 2.7 V	-	0.1	5	µA
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	0.1	10	µA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A				
		V <sub>CC</sub> = 1.4 V to 2.7 V	-	0.1	20	µA
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	0.2	40	µA
I <sub>BHL</sub>	bus hold LOW current	V <sub>CC</sub> = 1.65 V; V <sub>I</sub> = 0.35 × V <sub>CC</sub>	25	-	-	µA
		V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 0.7 V	45	-	-	µA
		V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 0.8 V	75	-	-	µA
I <sub>BHH</sub>	bus hold HIGH current	V <sub>CC</sub> = 1.65 V; V <sub>I</sub> = 0.35 × V <sub>CC</sub>	-25	-	-	µA
		V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 0.35 × V <sub>CC</sub>	-45	-	-	µA
		V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 0.35 × V <sub>CC</sub>	-75	-	-	µA
I <sub>BHLO</sub>	bus hold LOW overdrive current	V <sub>CC</sub> = 1.95 V	200	-	-	µA
		V <sub>CC</sub> = 2.7 V	300	-	-	µA
		V <sub>CC</sub> = 3.6 V	450	-	-	µA
I <sub>BHHO</sub>	bus hold HIGH overdrive current	V <sub>CC</sub> = 1.95 V	-200	-	-	µA
		V <sub>CC</sub> = 2.7 V	-300	-	-	µA
		V <sub>CC</sub> = 3.6 V	-450	-	-	µA
C <sub>I</sub>	input capacitance		-	5.0	-	pF

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

## 9.1 Graphs

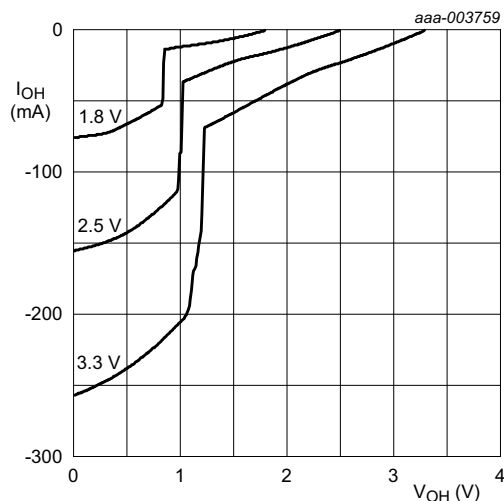


Fig 4. Output voltage as a function of the HIGH-level output current.

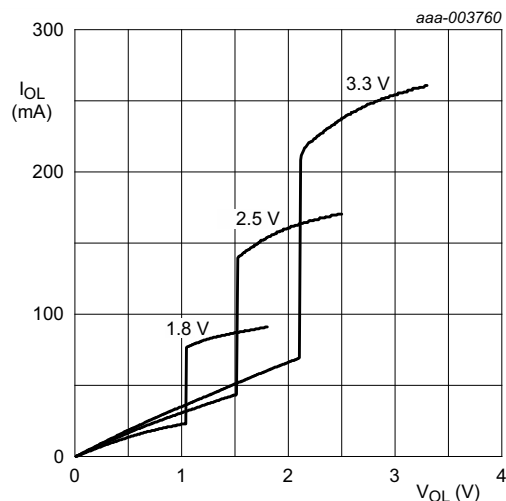


Fig 5. Output voltage as a function of the LOW-level output current.

## 10. Dynamic characteristics

Table 7. Dynamic characteristics

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

Symbol	Parameter	Conditions	–40 °C to +85 °C			Unit
			Min	Typ <sup>[2]</sup>	Max	
$t_{pd}$	propagation delay	nAn to nBn; nBn to nAn; see <a href="#">Figure 6</a> <sup>[1]</sup>				
		$V_{CC} = 1.2 \text{ V}$	-	5.4	-	ns
		$V_{CC} = 1.4 \text{ V to } 1.6 \text{ V}$	-	3.1	-	ns
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	1.4	2.3	3.3	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	0.5	1.6	2.2	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	0.7	1.4	2.0	ns
$t_{en}$	enable time	nOE to nAn, nBn; see <a href="#">Figure 7</a> <sup>[1]</sup>				
		$V_{CC} = 1.2 \text{ V}$	-	7.4	-	ns
		$V_{CC} = 1.4 \text{ V to } 1.6 \text{ V}$	-	6.4	-	ns
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	1.4	4.4	7.0	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.0	2.8	4.3	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	0.7	2.3	3.7	ns
$t_{dis}$	disable time	nOE to nAn, nBn; see <a href="#">Figure 7</a> <sup>[1]</sup>				
		$V_{CC} = 1.2 \text{ V}$	-	7.3	-	ns
		$V_{CC} = 1.4 \text{ V to } 1.6 \text{ V}$	-	5.7	-	ns
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	2.2	4.2	7.0	ns
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.1	2.3	5.4	ns
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	1.2	2.5	3.9	ns

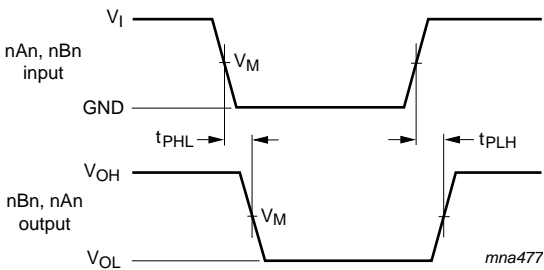


**Table 7. Dynamic characteristics ...continued**  
Voltages are referenced to GND (ground = 0 V). For test circuit see [Figure 8](#).

Symbol	Parameter	Conditions	−40 °C to +85 °C			Unit
			Min	Typ <sup>[2]</sup>	Max	
C <sub>PD</sub>	power dissipation capacitance	per input; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[3]</sup>				
		outputs enabled	-	42	-	pF
		outputs disabled	-	2	-	pF

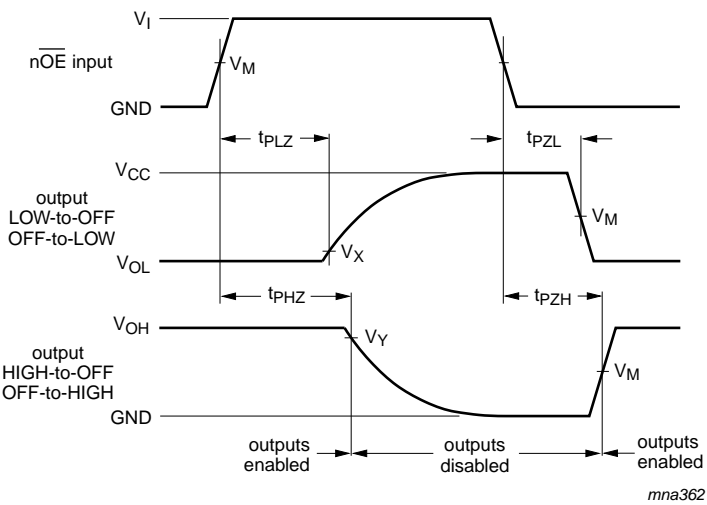
- [1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .  
 $t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ .  
 $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ .
- [2] Typical values are measured at  $T_{amb} = 25\text{ °C}$  and  $V_{CC} = 1.2\text{ V}, 1.5\text{ V}, 1.8\text{ V}, 2.5\text{ V}$  and  $3.3\text{ V}$  respectively.
- [3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$  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  
 $N$  = 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](#).  
Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 6. The input (nAn, nBn) to output (nBn, nAn) propagation delays**

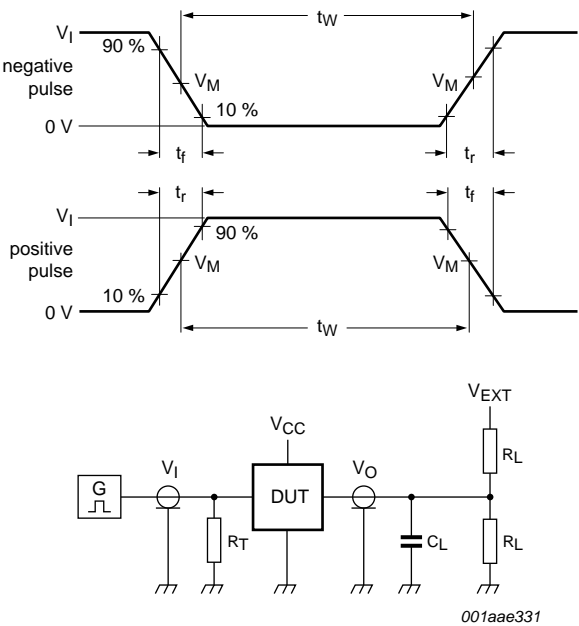


Measurement points are given in [Table 8](#).  
Logic levels: VOL and VOH are typical output voltage levels that occur with the output load.

Fig 7. 3-state enable and disable times

Table 8. Measurement points

Supply voltage	VM	Input			
VCC		VI	tr = tf	Vx	Vy
1.2 V	0.5 × VCC	VCC	≤ 2 ns	VOL + 0.15 V	VOH – 0.15 V
1.4 V to 1.6 V	0.5 × VCC	VCC	≤ 2 ns	VOL + 0.15 V	VOH – 0.15 V
1.65 V to 1.95 V	0.5 × VCC	VCC	≤ 2 ns	VOL + 0.15 V	VOH – 0.15 V
2.3 V to 2.7 V	0.5 × VCC	VCC	≤ 2 ns	VOL + 0.15 V	VOH – 0.15 V
3.0 V to 3.6 V	0.5 × VCC	VCC	≤ 2 ns	VOL + 0.3 V	VOH – 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 8. 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	15 pF	2 k $\Omega$	open	$2 \times V_{CC}$	GND
1.4 V to 1.6 V	$V_{CC}$	$\leq 2$ ns	15 pF	2 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
3.0 V to 3.6 V	$V_{CC}$	$\leq 2$ ns	30 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

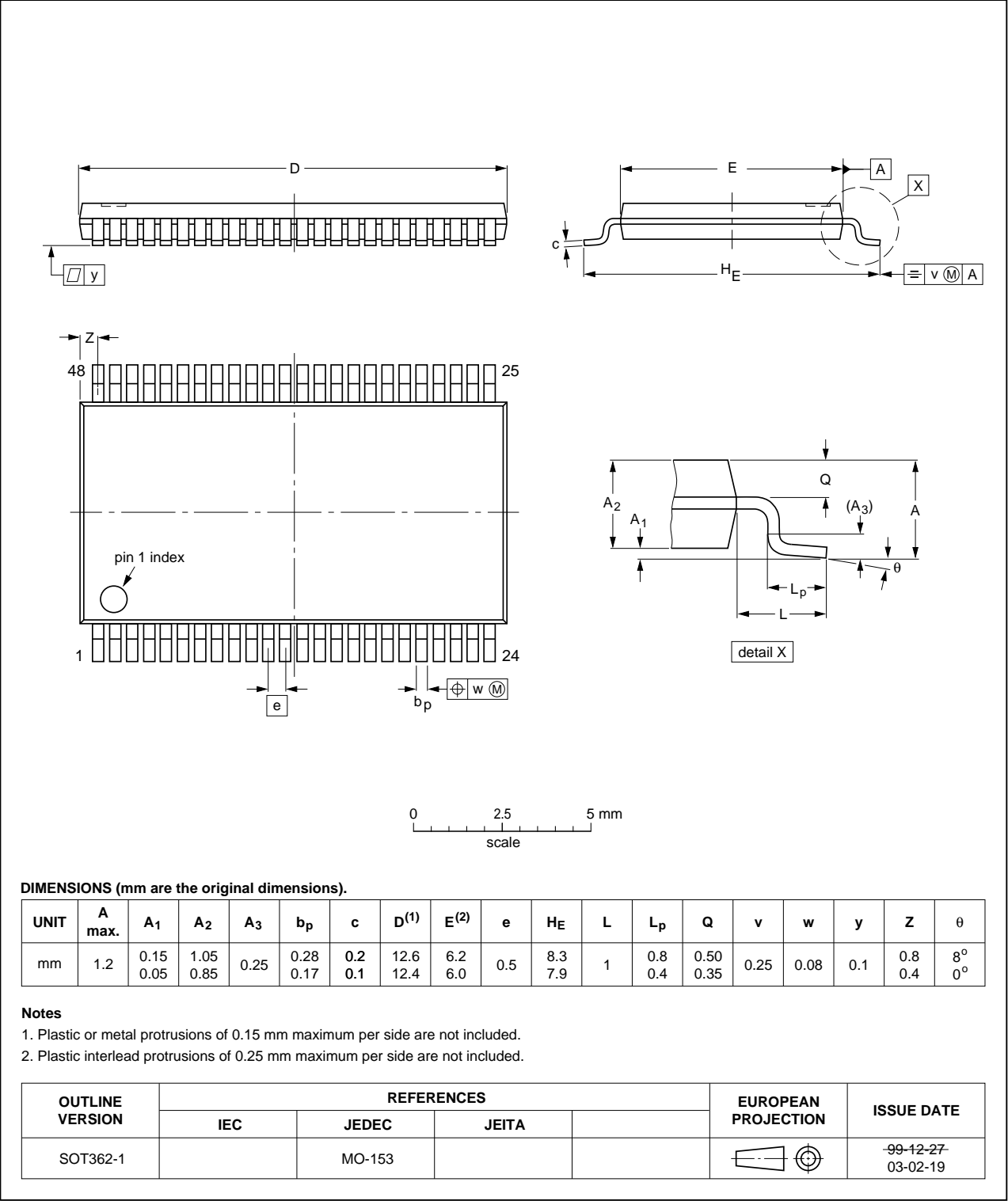


Fig 9. Package outline SOT362-1 (TSSOP48)

## 13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
TTL	Transistor-Transistor Logic

## 14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Order number	Supersedes
74AVCH16245 v.3	20130108	Product data sheet	-	-	74AVCH16245 v.2
Modifications:	<ul style="list-style-type: none"><li>• <math>\Delta I_{CC}</math> removed (errata).</li></ul>				
74AVCH16245 v.2	20120828	Product data sheet	-	-	74AVCH16245 v.1
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>• Ordering information table corrected (errata). <math>\Delta I_{CC}</math></li></ul>				
74AVCH16245 v.1	20000307	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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