

# 74LVC162245A-Q100

16-bit transceiver with direction pin; 30  $\Omega$  series termination resistors; 5 V tolerant input/output; 3-state

Rev. 2 — 11 February 2019

Product data sheet

## 1. General description

The 74LVC162245A-Q100 is a 16-bit transceivers with non-inverting 3-state bus compatible outputs in both send and receive directions. Two send/receive (nDIR) inputs control direction, and two output enable (nOE) inputs make cascading easy. The nOE inputs 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.

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 as translators in mixed 3.3 V and 5 V applications.

Both HIGH and LOW output stages include 30  $\Omega$  series termination resistors to reduce line noise.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

## 2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- 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
- Integrated 30  $\Omega$  termination resistors
- High-impedance when  $V_{CC} = 0$  V
- 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-A exceeds 200 V ( $C = 200$  pF,  $R = 0$   $\Omega$ )
  - CDM ANSI/ESDA/Jedec JS-002 exceeds 1000 V

### 3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC162245ADGG-Q100	-40 °C to +125 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1
74LVC162245ADGV-Q100	-40 °C to +125 °C	TSSOP48 [1]	plastic thin shrink small outline package; 48 leads; body width 4.4 mm; lead pitch 0.4 mm	SOT480-1

[1] Also known as TVSOP48.

### 4. Functional diagram

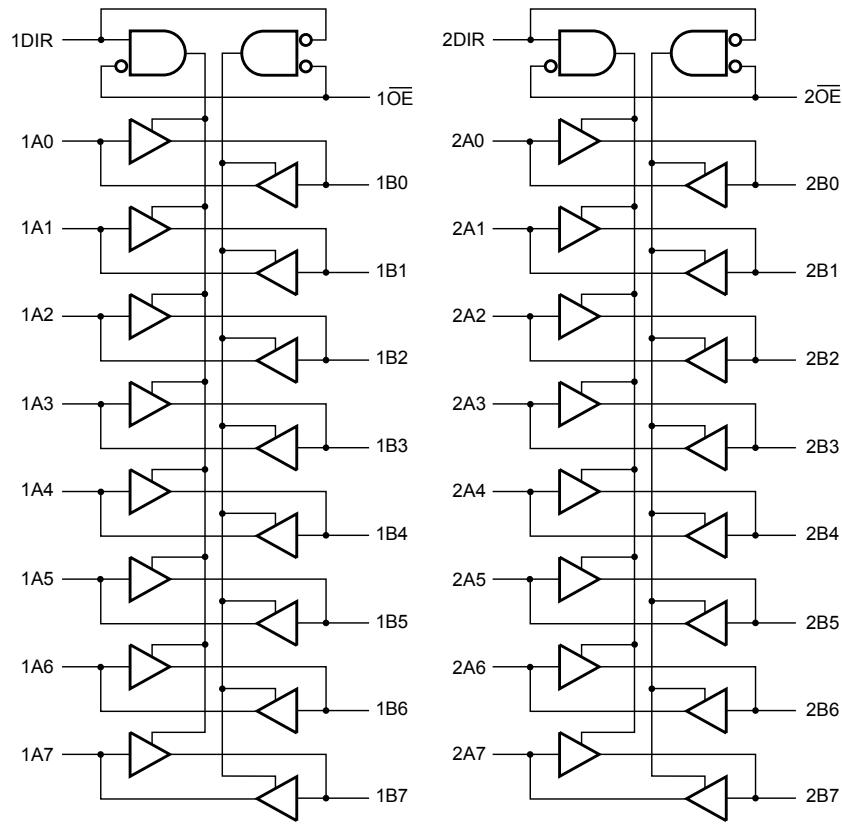


Fig. 1. Logic symbol

16-bit transceiver with direction pin; 30  $\Omega$  series termination resistors; 5 V tolerant input/output; 3-state

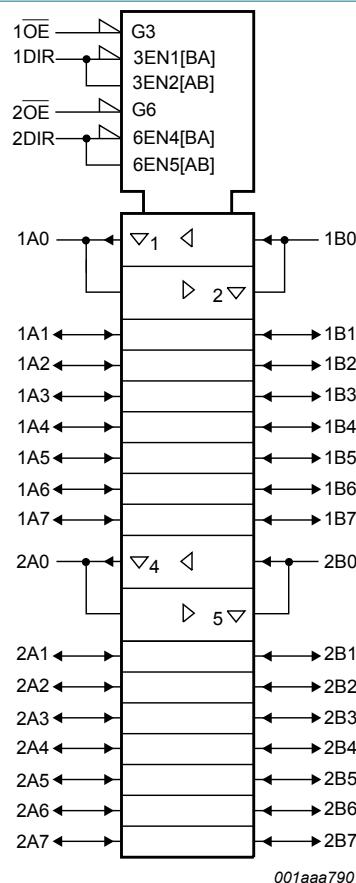
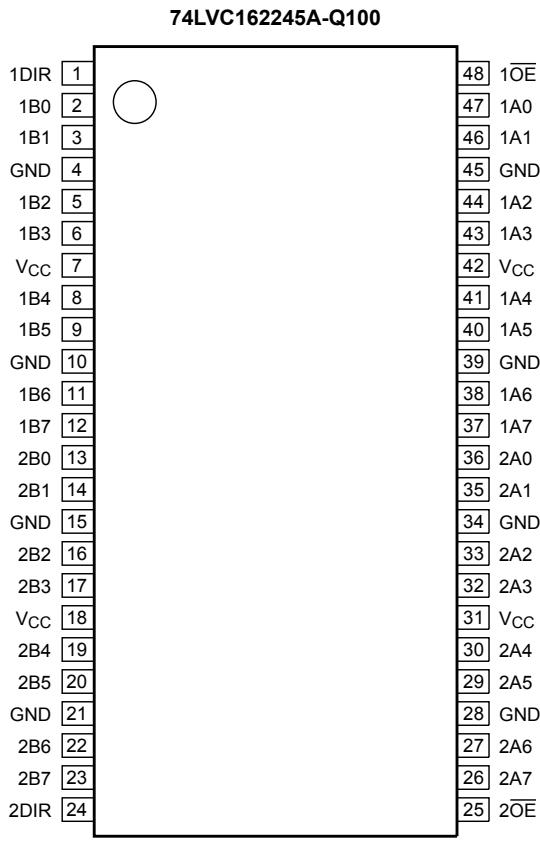


Fig. 2. IEC logic symbol

## 5. Pinning information

### 5.1. Pinning



aaa-025281

Fig. 3. Pin configuration SOT362-1 (TSSOP48) and SOT480-1 (TSSOP48)

### 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
1OE, 2OE	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**

Inputs <sup>[1]</sup>		Outputs	
nOE	nDIR	nAn	nBn
L	L	nAn = nBn	inputs
L	H	inputs	nBn = nAn
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
$V_{CC}$	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	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40$ °C to +125 °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 °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
$V_{CC}$	supply voltage		1.65	-	3.6	V
		functional	1.2	-	3.6	V
$V_I$	input voltage		0	-	5.5	V
$V_O$	output voltage	output HIGH or LOW	0	-	$V_{CC}$	V
		output 3-state	0	-	5.5	V
$T_{amb}$	ambient temperature	in free air	-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.2$ 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 [1]	Max	Min	Max		
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 1.2 \text{ V}$	1.08	-	-	1.08	-	V	
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	$0.65V_{CC}$	-	-	$0.65V_{CC}$	-	V	
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.7	-	-	1.7	-	V	
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	2.0	-	-	2.0	-	V	
$V_{IL}$	LOW-level input voltage	$V_{CC} = 1.2 \text{ V}$	-	-	0.12	-	0.12	V	
		$V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$	-	-	$0.35V_{CC}$	-	$0.35V_{CC}$	V	
		$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	-	-	0.7	-	0.7	V	
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	-	-	0.8	-	0.8	V	
$V_{OH}$	HIGH-level output voltage	$V_I = V_{IH}$ or $V_{IL}$							
		$I_O = -100 \mu\text{A}; V_{CC} = 1.65 \text{ V to } 3.6 \text{ V}$	$V_{CC} - 0.2$	$V_{CC}$	-	$V_{CC} - 0.3$	-	V	
		$I_O = -2 \text{ mA}; V_{CC} = 1.65 \text{ V}$	1.2	-	-	1.05	-	V	
		$I_O = -4 \text{ mA}; V_{CC} = 2.3 \text{ V}$	1.8	-	-	1.65	-	V	
		$I_O = -6 \text{ mA}; V_{CC} = 2.7 \text{ V}$	2.2	-	-	2.05	-	V	
		$I_O = -12 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.2	-	-	2.0	-	V	
$V_{OL}$	LOW-level output voltage	$V_I = V_{IH}$ or $V_{IL}$							
		$I_O = 100 \mu\text{A}; V_{CC} = 1.65 \text{ V to } 3.6 \text{ V}$	-	-	0.2	-	0.3	V	
		$I_O = 2 \text{ mA}; V_{CC} = 1.65 \text{ V}$	-	-	0.45	-	0.65	V	
		$I_O = 4 \text{ mA}; V_{CC} = 2.3 \text{ V}$	-	-	0.6	-	0.8	V	
		$I_O = 6 \text{ mA}; V_{CC} = 2.7 \text{ V}$	-	-	0.4	-	0.6	V	
		$I_O = 12 \text{ mA}; V_{CC} = 3.0 \text{ V}$	-	-	0.55	-	0.8	V	
$I_I$	input leakage current	$V_I = 5.5 \text{ V or GND}; V_{CC} = 3.6 \text{ V}$	-	$\pm 0.1$	$\pm 5$	-	$\pm 20$	$\mu\text{A}$	
$I_{OZ}$	OFF-state output current	$V_I = V_{IH}$ or $V_{IL}$ ; $V_O = 5.5 \text{ V or GND}$ ; $V_{CC} = 3.6 \text{ V}$	[2]	-	$\pm 0.1$	$\pm 5$	-	$\pm 20$	$\mu\text{A}$
$I_{OFF}$	power-off leakage current	$V_I$ or $V_O = 5.5 \text{ V}; V_{CC} = 0.0 \text{ V}$	-	$\pm 0.1$	$\pm 10$	-	$\pm 20$	$\mu\text{A}$	
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$ ; $V_{CC} = 3.6 \text{ V}$	-	0.1	20	-	80	$\mu\text{A}$	
$\Delta I_{CC}$	additional supply current	per input pin; $V_I = V_{CC} - 0.6 \text{ V}$ ; $I_O = 0 \text{ A}; V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	-	5	500	-	5000	$\mu\text{A}$	
$C_I$	input capacitance	$V_{CC} = 0 \text{ V to } 3.6 \text{ V}$ ; $V_I = \text{GND to } V_{CC}$	-	5.0	-	-	-	$\text{pF}$	
$C_{I/O}$	input/output capacitance	$V_{CC} = 0 \text{ V to } 3.6 \text{ V}$ ; $V_I = \text{GND to } V_{CC}$	-	10	-	-	-	$\text{pF}$	

[1] All typical values are measured at  $V_{CC} = 3.3 \text{ V}$  (unless stated otherwise) and  $T_{amb} = 25 \text{ }^\circ\text{C}$ .

[2] For I/O ports the parameter  $I_{OZ}$  includes the input leakage current.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit see [Fig. 6](#).

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ <a href="#">[1]</a>	Max	Min	Max	
$t_{pd}$	propagation delay	nAn to nBn; nBn to nAn; see <a href="#">Fig. 4</a> <a href="#">[2]</a>						
		$V_{CC} = 1.2$ V	-	12	-	-	-	ns
		$V_{CC} = 1.65$ V to 1.95 V	1.5	6.6	16.0	1.5	18.4	ns
		$V_{CC} = 2.3$ V to 2.7 V	1.0	3.5	7.8	1.0	9.1	ns
		$V_{CC} = 2.7$ V	1.0	3.5	6.7	1.0	9.5	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.0	2.9	5.7	1.0	8.5	ns
$t_{en}$	enable time	nOE to nAn, nBn; see <a href="#">Fig. 5</a> <a href="#">[2]</a>						
		$V_{CC} = 1.2$ V	-	18	-	-	-	ns
		$V_{CC} = 1.65$ V to 1.95 V	2.0	7.7	17.2	2.0	19.8	ns
		$V_{CC} = 2.3$ V to 2.7 V	1.5	4.3	9.4	1.5	10.9	ns
		$V_{CC} = 2.7$ V	1.5	4.6	8.5	1.5	9.5	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.0	3.5	7.5	1.0	7.5	ns
$t_{dis}$	disable time	nOE to nAn, nBn; see <a href="#">Fig. 5</a> <a href="#">[2]</a>						
		$V_{CC} = 1.2$ V	-	10	-	-	-	ns
		$V_{CC} = 1.65$ V to 1.95 V	2.8	4.6	11.0	2.8	12.7	ns
		$V_{CC} = 2.3$ V to 2.7 V	1.0	2.6	6.3	1.0	7.3	ns
		$V_{CC} = 2.7$ V	1.5	3.4	7.5	1.5	11.0	ns
		$V_{CC} = 3.0$ V to 3.6 V	1.5	3.2	6.5	1.5	8.5	ns
$C_{PD}$	power dissipation capacitance	per input; $V_I = \text{GND to } V_{CC}$ <a href="#">[3]</a>						
		$V_{CC} = 1.65$ V to 1.95 V	-	10.4	-	-	-	pF
		$V_{CC} = 2.3$ V to 2.7 V	-	14.0	-	-	-	pF
		$V_{CC} = 3.0$ V to 3.6 V	-	17.2	-	-	-	pF

[1] Typical values are measured at  $T_{amb} = 25$  °C and  $V_{CC} = 1.2$  V, 1.8 V, 2.5 V, 2.7 V and 3.3 V respectively.

[2]  $t_{pd}$  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  $t_{PHZ}$ .

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

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

$f_i$  = input frequency in MHz;  $f_o$  = output frequency in MHz

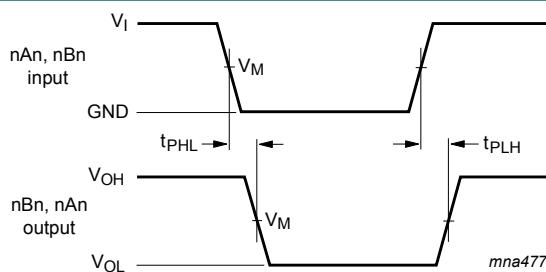
$C_L$  = output load capacitance in pF

$V_{CC}$  = supply voltage in Volts

$N$  = number of inputs switching

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

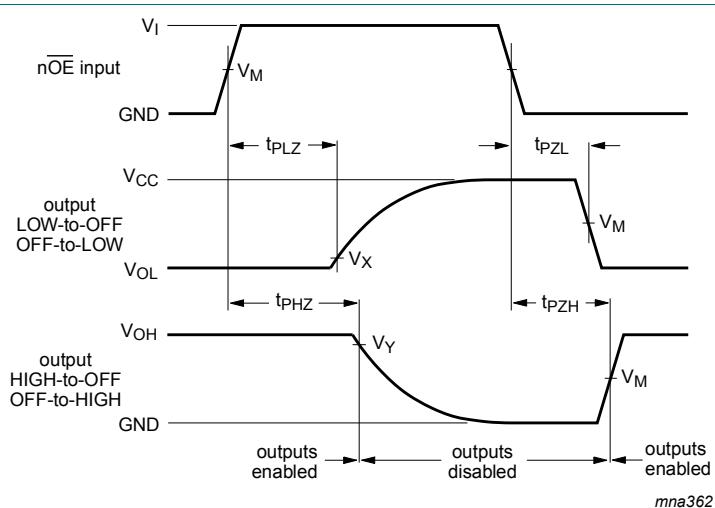
### 10.1. Waveforms and test circuit



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

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

**Fig. 4. The input (nAn, nBn) to output (nBn, nAn) propagation delays**



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

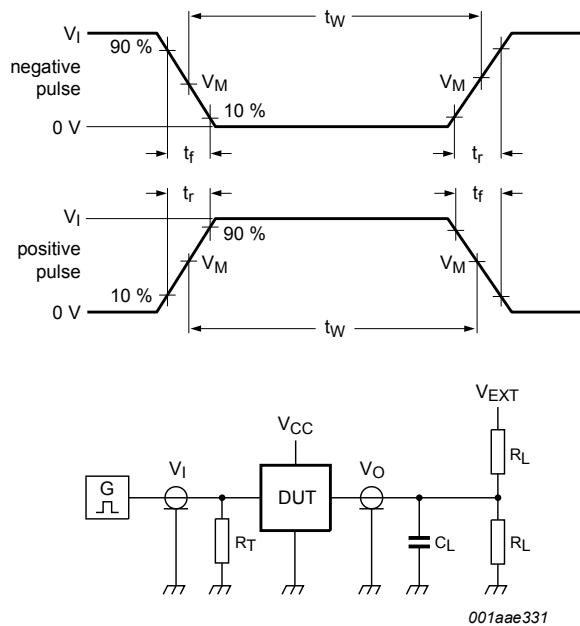
$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig. 5. 3-state enable and disable times**

**Table 8. Measurement points**

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

16-bit transceiver with direction pin; 30  $\Omega$  series termination resistors; 5 V tolerant input/output; 3-state



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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  $Z_0$  of the pulse generator.

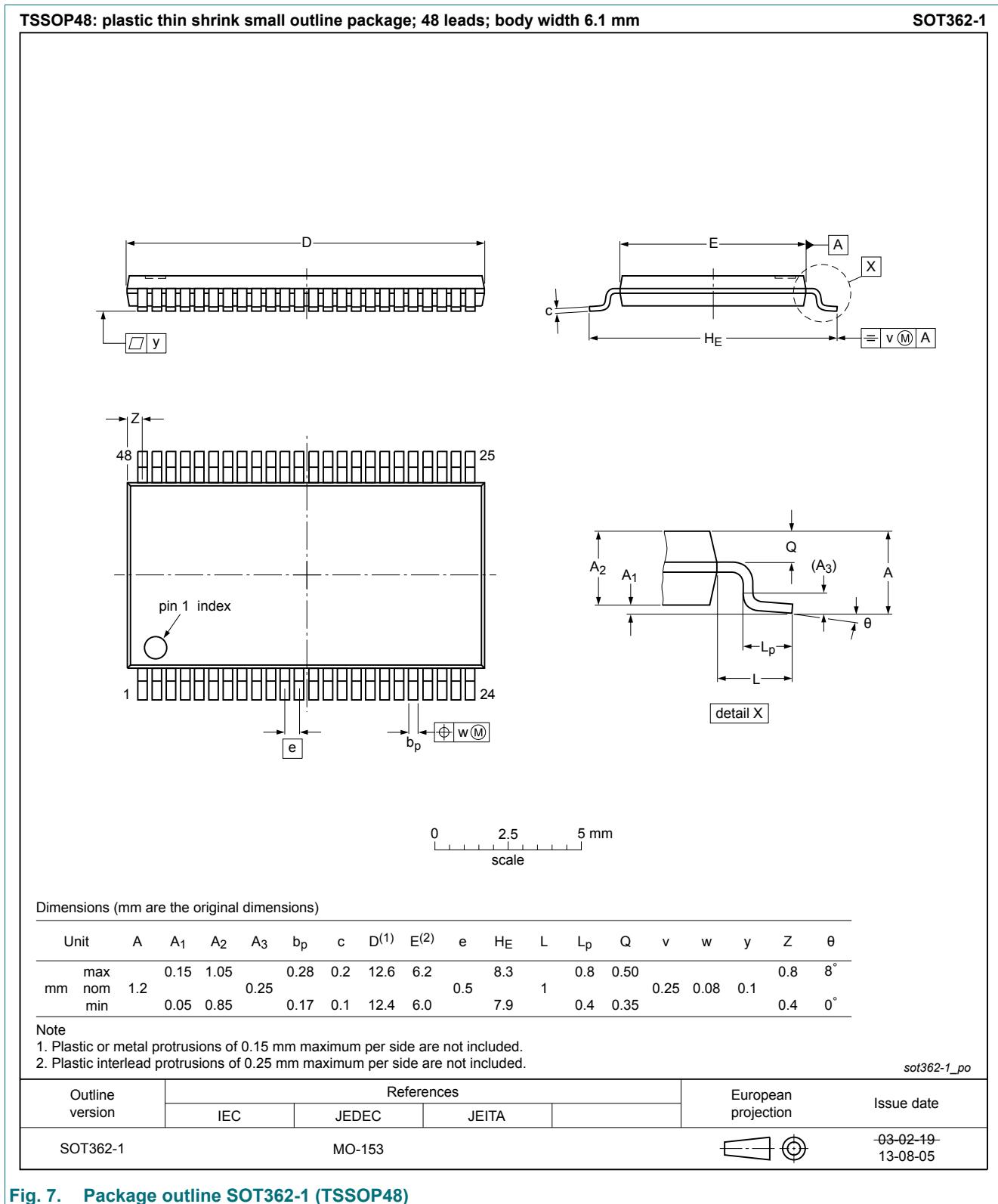
$V_{EXT}$  = External voltage for measuring switching times.

**Fig. 6. Test circuit for measuring switching times**

**Table 9. Test data**

Supply voltage	Input	Load		$V_{EXT}$		
$V_{CC}$	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$
1.2 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$
1.65 V to 1.95 V	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	open	$2 \times V_{CC}$
2.3 V to 2.7 V	$V_{CC}$	$\leq 2$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$
2.7 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$
3.0 V to 3.6 V	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$

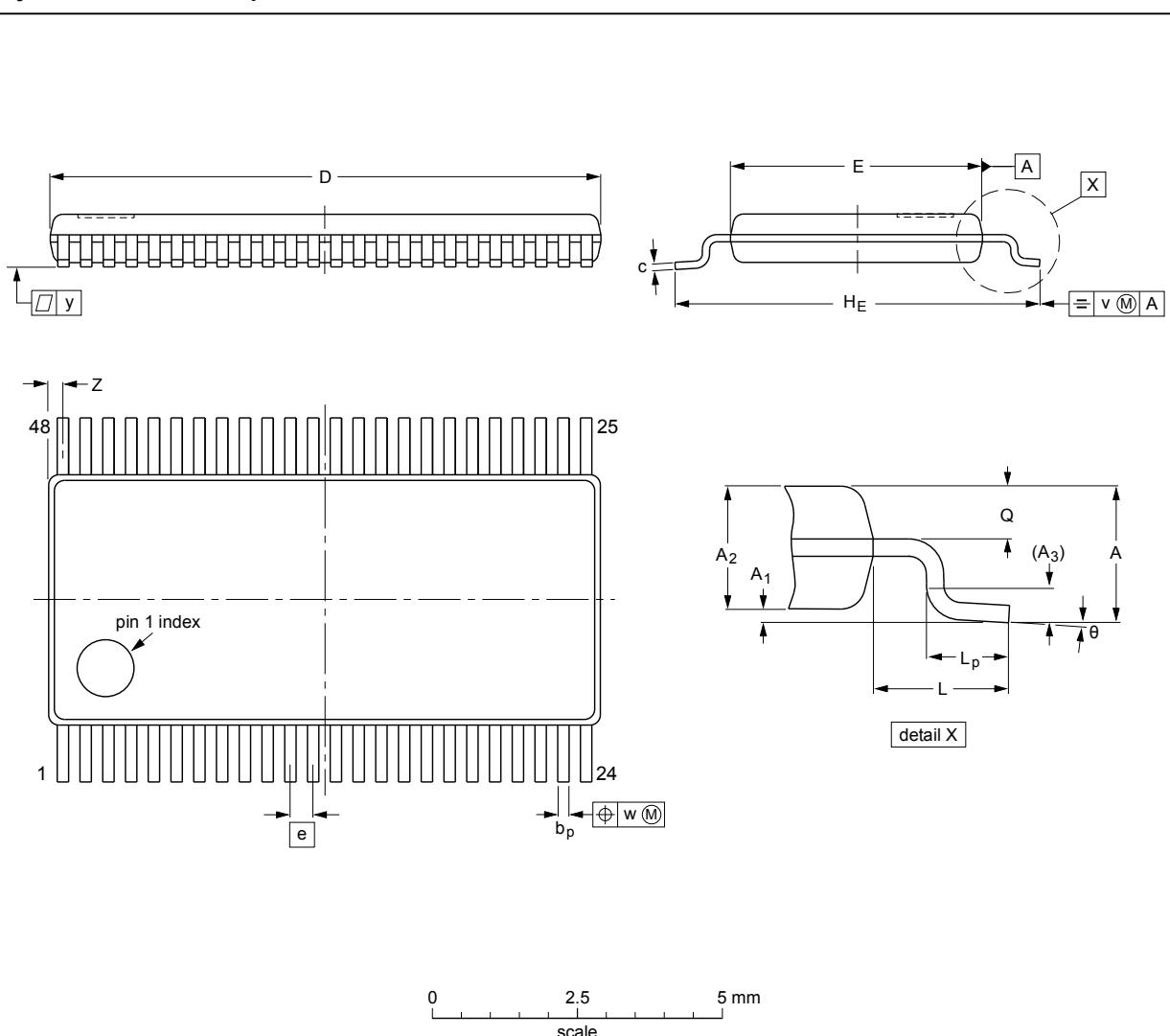
## 11. Package outline



16-bit transceiver with direction pin; 30  $\Omega$  series termination resistors; 5 V tolerant input/output; 3-state

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 4.4 mm; lead pitch 0.4 mm

SOT480-1



## DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	$\theta$
mm	1.1 0.05	0.15 0.85	0.95	0.25	0.23 0.13	0.20 0.09	9.8 9.6	4.5 4.3	0.4	6.6 6.2	1	0.7 0.5	0.4 0.3	0.2	0.07	0.08	0.4 0.1	8° 0°

## Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT480-1		MO-153				99-12-27 03-02-18

Fig. 8. Package outline SOT480-1 (TSSOP48)

## 12. 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

## 13. Revision history

**Table 11. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC162245A_Q100 v.2	20190211	Product data sheet	-	74LVC162245A_Q100 v.1
Modifications:	<ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li><li>Legal texts have been adapted to the new company name where appropriate.</li><li>Type numbers 74LVC162245ADGV-Q100 (SOT480-1) added.</li></ul>			
74LVC162245A_Q100 v.1	20161118	Product data sheet	-	-

## 14. Legal information

### Data sheet status

Document status [1][2]	Product status [3]	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 <https://www.nexperia.com>.

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