

74LVC162245A-Q100

16-bit transceiver with direction pin; 30 Ω 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 Ω 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 Ω 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 Ω)
 - CDM ANSI/ESDA/Jedec JS-002 exceeds 1000 V

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

3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
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

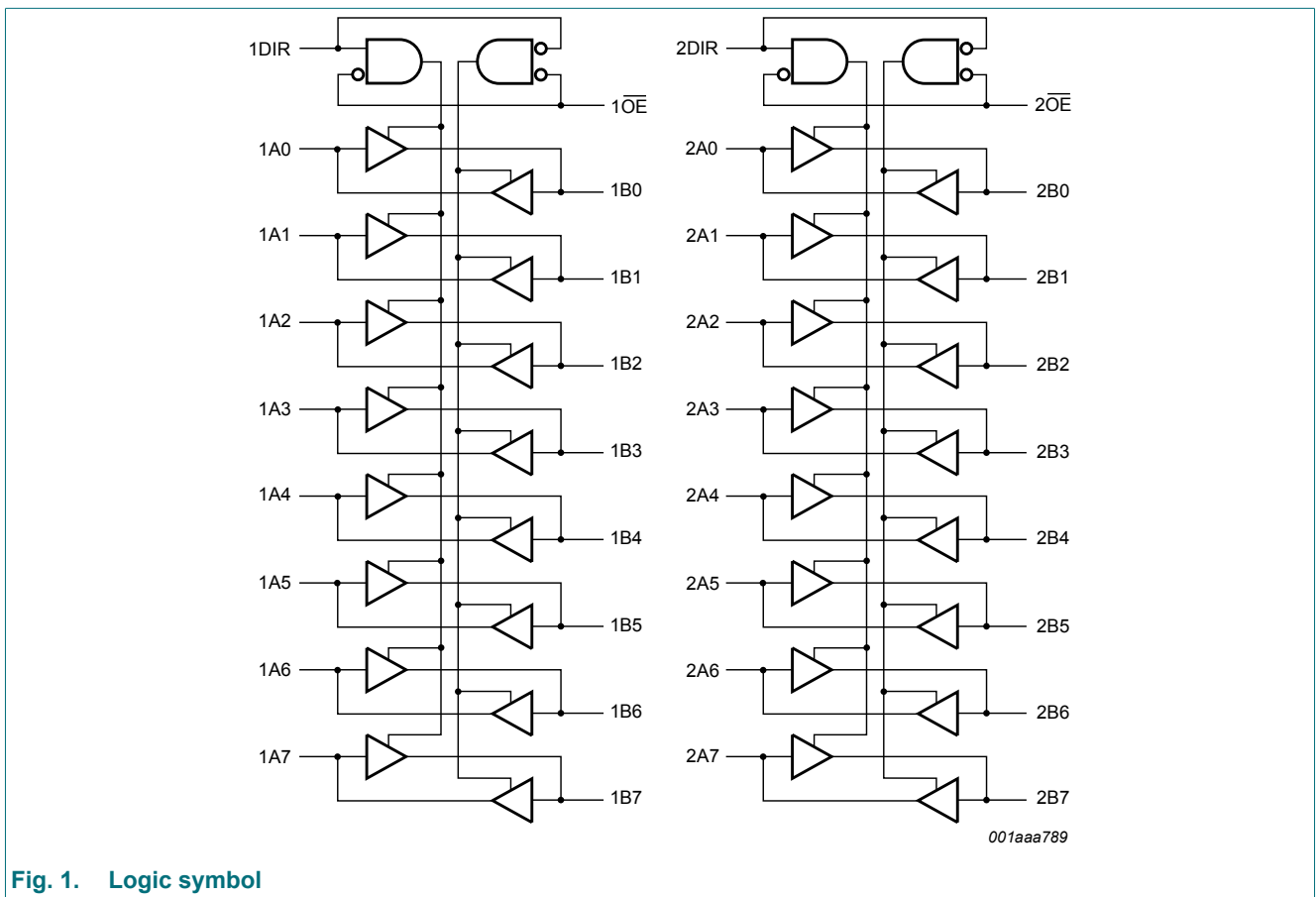


Fig. 1. Logic symbol

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

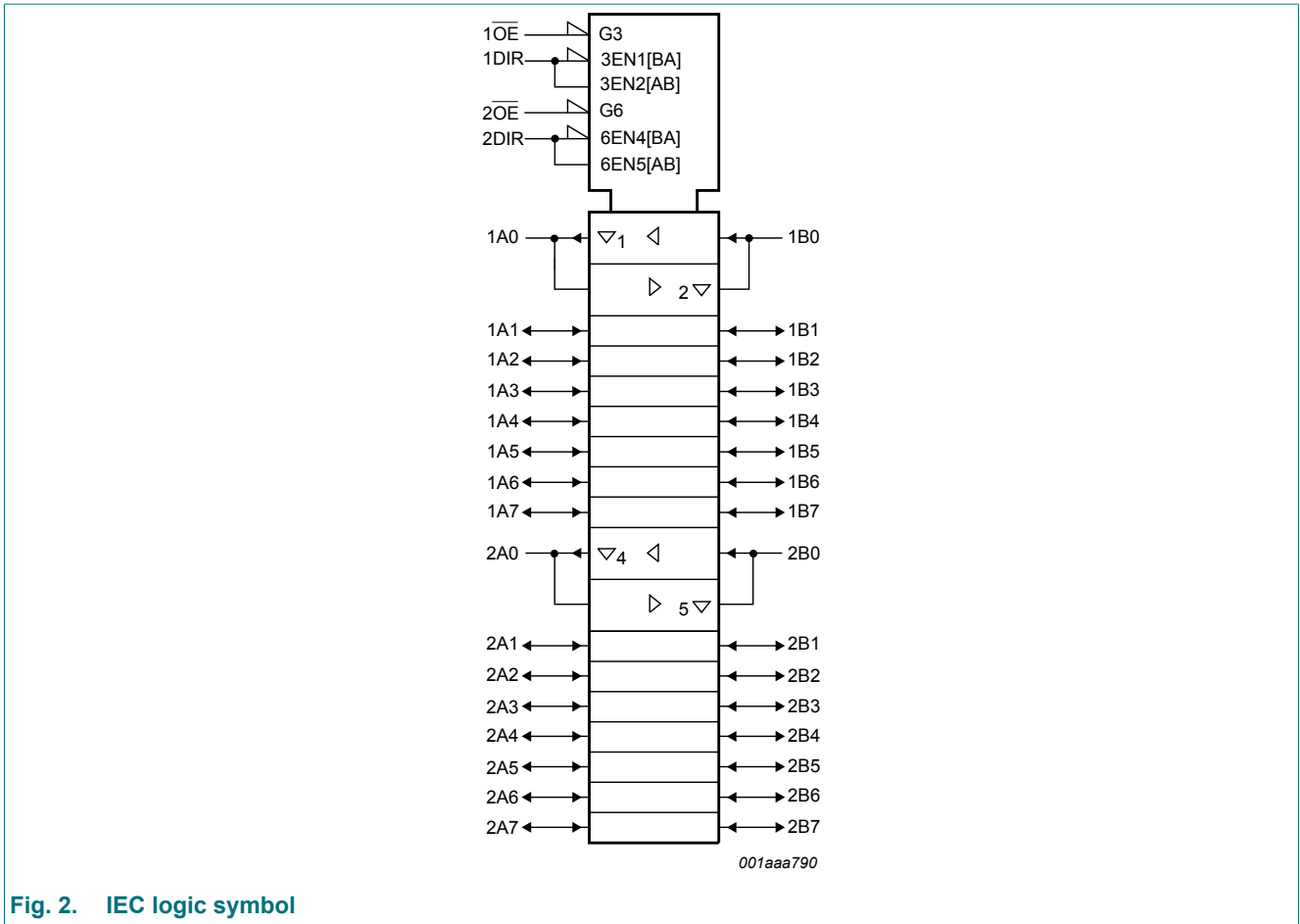


Fig. 2. IEC logic symbol

5. Pinning information

5.1. Pinning

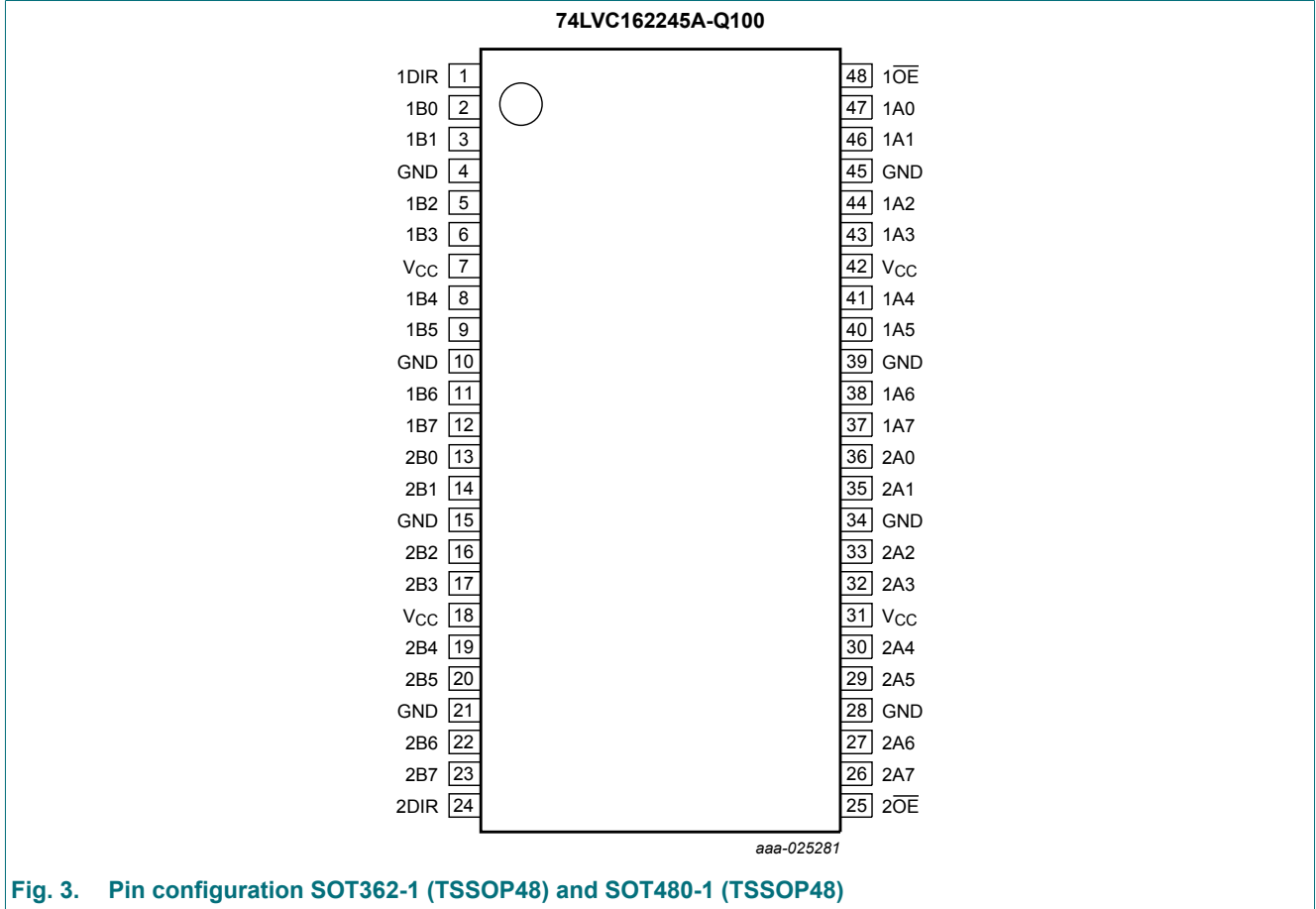


Fig. 3. Pin configuration SOT362-1 (TSSOP48) and SOT480-1 (TSSOP48)

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 _{CC}	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[1]		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		-0.5	+6.5	V
I_{OK}	output clamping current	$V_O > V_{CC}$ or $V_O < 0$ V	-	± 50	mA
V_O	output voltage	output HIGH or LOW	-0.5	$V_{CC} + 0.5$	V
		output 3-state	-0.5	+6.5	V
I_O	output current	$V_O = 0$ V to V_{CC}	-	± 50	mA
I_{CC}	supply current		-	100	mA
I_{GND}	ground current		-100	-	mA
T_{stg}	storage temperature		-65	+150	$^{\circ}$ C
P_{tot}	total power dissipation	$T_{amb} = -40$ $^{\circ}$ C to +125 $^{\circ}$ C	-	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 $^{\circ}$ 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	$^{\circ}$ 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 V	1.08	-	-	1.08	-	V			
		V _{CC} = 1.65 V to 1.95 V	0.65V _{CC}	-	-	0.65V _{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	-	-	0.35V _{CC}	-	0.35V _{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 μA; V _{CC} = 1.65 V to 3.6 V	V _{CC} - 0.2	V _{CC}	-	V _{CC} - 0.3	-	V			
		I _O = -2 mA; V _{CC} = 1.65 V	1.2	-	-	1.05	-	V			
		I _O = -4 mA; V _{CC} = 2.3 V	1.8	-	-	1.65	-	V			
		I _O = -6 mA; V _{CC} = 2.7 V	2.2	-	-	2.05	-	V			
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}									
		I _O = 100 μA; V _{CC} = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V			
		I _O = 2 mA; V _{CC} = 1.65 V	-	-	0.45	-	0.65	V			
		I _O = 4 mA; V _{CC} = 2.3 V	-	-	0.6	-	0.8	V			
		I _O = 6 mA; V _{CC} = 2.7 V	-	-	0.4	-	0.6	V			
I _I	input leakage current	V _I = 5.5 V or GND; V _{CC} = 3.6 V	-	±0.1	±5	-	±20	μA			
		I _{OZ}	OFF-state output current	V _I = V _{IH} or V _{IL} ; V _O = 5.5 V or GND; V _{CC} = 3.6 V	[2]	-	±0.1	±5	-	±20	μA
		I _{OFF}	power-off leakage current	V _I or V _O = 5.5 V; V _{CC} = 0.0 V	-	±0.1	±10	-	±20	μA	
		I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 3.6 V	-	0.1	20	-	80	μA	
		ΔI _{CC}	additional supply current	per input pin; V _I = V _{CC} - 0.6 V; I _O = 0 A; V _{CC} = 2.7 V to 3.6 V	-	5	500	-	5000	μA	
C _I	input capacitance	V _{CC} = 0 V to 3.6 V; V _I = GND to V _{CC}	-	5.0	-	-	-	pF			
C _{I/O}	input/output capacitance	V _{CC} = 0 V to 3.6 V; V _I = GND to V _{CC}	-	10	-	-	-	pF			

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °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 [1]	Max	Min	Max	
t _{pd}	propagation delay	nAn to nBn; nBn to nAn; see Fig. 4 [2]						
		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 Fig. 5 [2]						
		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 Fig. 5 [2]						
		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 = GND to V _{CC} [3]						
		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 μW).

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

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

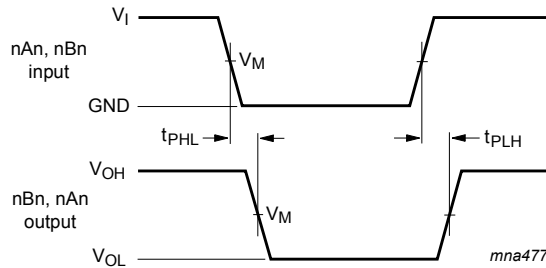
C_L = output load capacitance in pF

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.

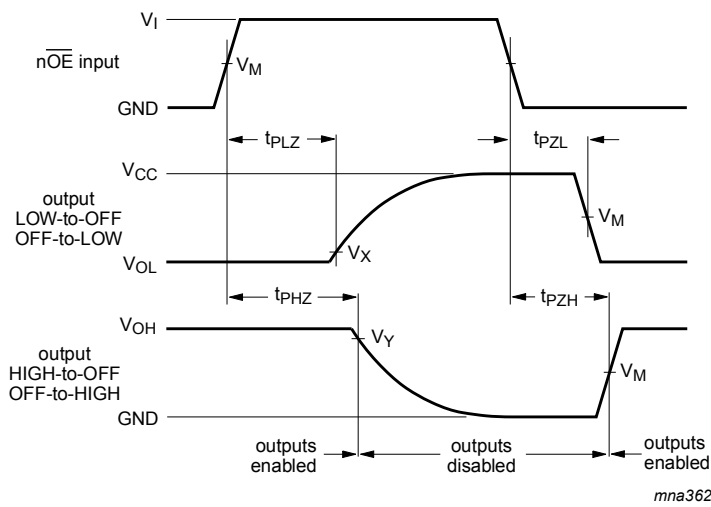
10.1. Waveforms and test circuit



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



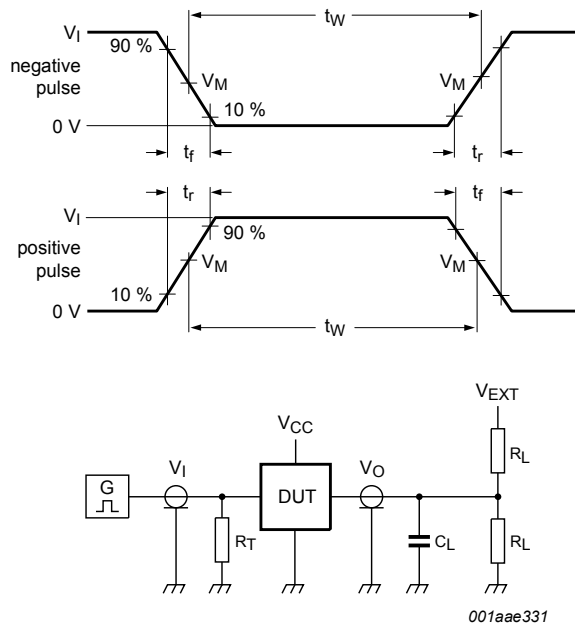
Measurement points are given in [Table 8](#).

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_M	V_I	V_M	V_X	V_Y
1.2 V	$0.5 \times V_{CC}$	V_{CC}	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
1.65 V to 1.95 V	$0.5 \times V_{CC}$	V_{CC}	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.3 V to 2.7 V	$0.5 \times V_{CC}$	V_{CC}	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.7 V	1.5 V	2.7 V	1.5 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	1.5 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. 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}	t_{PHZ}, t_{PZH}
1.2 V	V_{CC}	≤ 2 ns	30 pF	1 kΩ	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	V_{CC}	≤ 2 ns	30 pF	1 kΩ	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	V_{CC}	≤ 2 ns	30 pF	500 Ω	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	$2 \times V_{CC}$	GND

11. Package outline

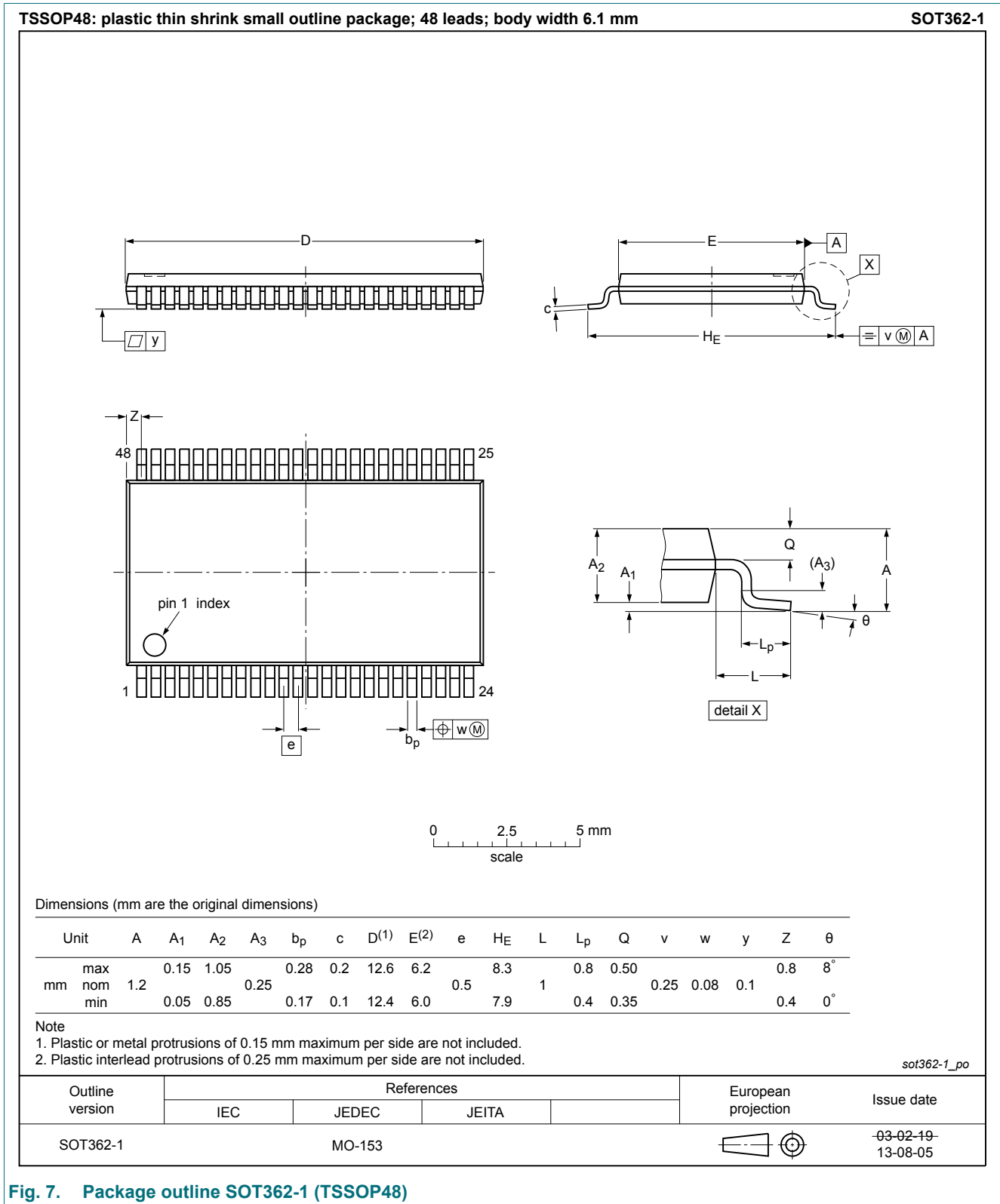


Fig. 7. Package outline SOT362-1 (TSSOP48)

16-bit transceiver with direction pin; 30 Ω 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

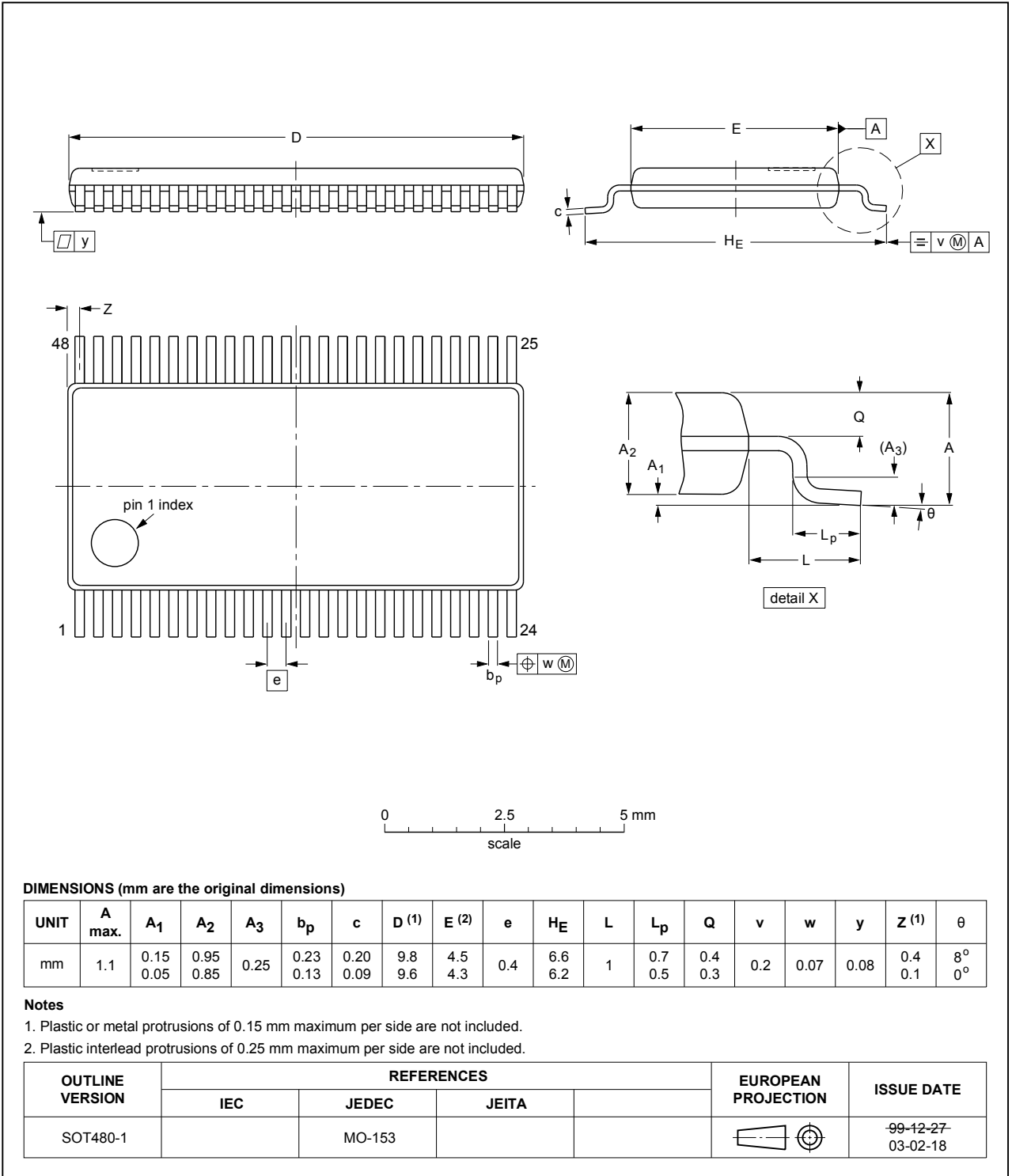


Fig. 8. Package outline SOT480-1 (TSSOP48)

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"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Type numbers 74LVC162245ADGV-Q100 (SOT480-1) added. 			
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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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