74ALVC164245-Q100

16-bit dual supply translating transceiver; 3-state

Rev. 2 — 12 November 2018 Product data sheet

1. General description

The 74ALVC164245-Q100 is a high-performance, low-power, low-voltage, Si-gate CMOS device, superior to most advanced CMOS compatible TTL families.

The 74ALVC164245-Q100 is a 16-bit (dual octal) dual supply translating transceiver featuring non-inverting 3-state bus compatible outputs in both send and receive directions. It is designed to interface between a 3 V and 5 V bus in a mixed 3 V and 5 V supply environment.

This device can be used as two 8-bit transceivers or one 16-bit transceiver.

The direction control inputs (1DIR and 2DIR) determine the direction of the data flow. nDIR (active HIGH) enables data from nAn ports to nBn ports. nDIR (active LOW) enables data from nBn ports to nAn ports. The output enable inputs ($1\overline{OE}$ and $2\overline{OE}$), when HIGH, disable both nAn and nBn ports by placing them in a high-impedance OFF-state. Pins nAn, $n\overline{OE}$ and nDIR are referenced to $V_{CC(A)}$ and pins nBn are referenced to $V_{CC(B)}$.

In suspend mode, when one of the supply voltages is zero, there is no current flow from the non-zero supply towards the zero supply. The nAn outputs must be set 3-state and the voltage on the A-bus must be smaller than V_{diode} (typical 0.7 V). $V_{CC(B)} \geq V_{CC(A)}$ (except in suspend mode).

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:
  - 3 V port ($V_{CC(A)}$): 1.5 V to 3.6 V
  - 5 V port ($V_{CC(B)}$): 1.5 V to 5.5 V
- CMOS low power consumption
- Direct interface with TTL levels
- Control inputs voltage range from 2.7 V to 5.5 V
- Inputs accept voltages up to 5.5 V
- High-impedance outputs when $V_{CC(A)}$ or $V_{CC(B)}$ = 0 V
- Complies with JEDEC standard JESD8-B/JESD36
- ESD protection:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74ALVC164245DGG-Q100	-40 °C to +125 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1

4. Functional diagram

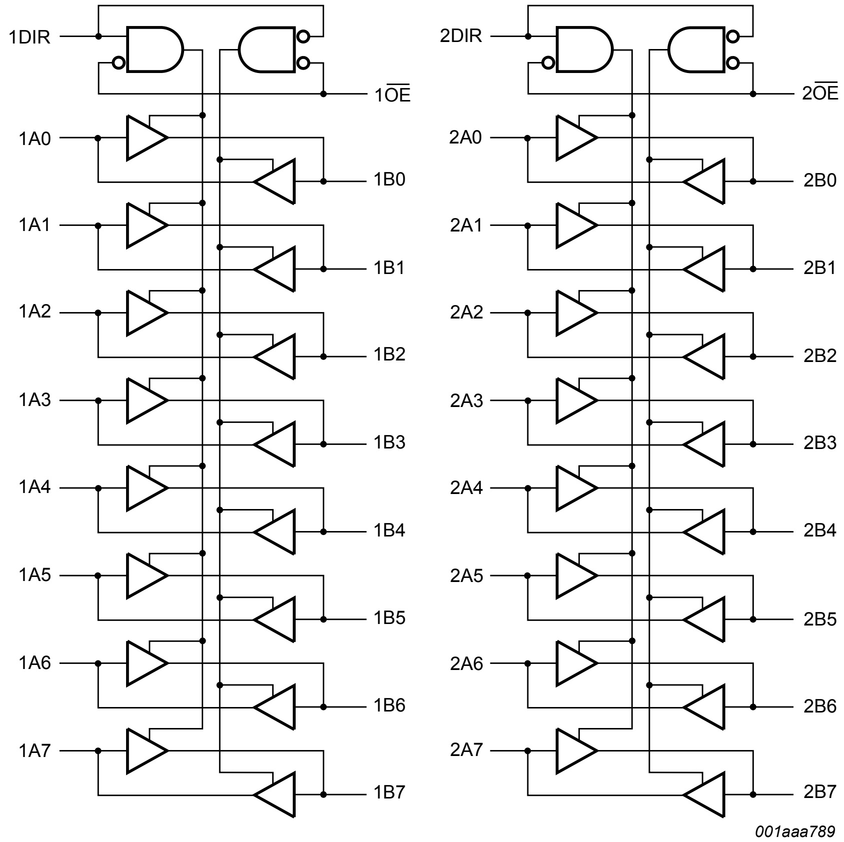


Fig. 1. Logic symbol

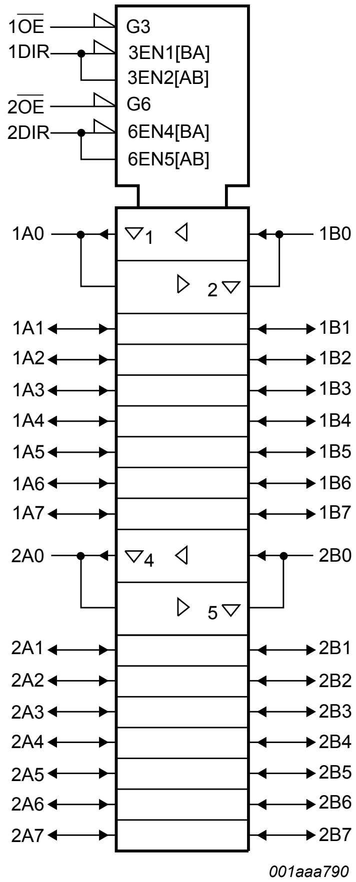


Fig. 2. IEC logic symbol

5. Pinning information

5.1. Pinning

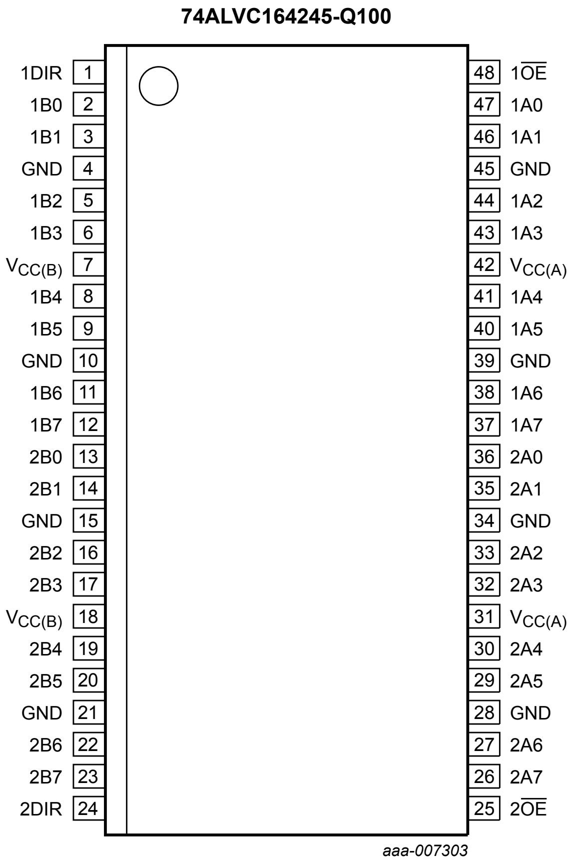


Fig. 3. Pin configuration SOT362-1 (TSSOP48)

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1DIR, 2DIR	1, 24	direction control input
1B0, 1B1, 1B2, 1B3, 1B4, 1B5, 1B6, 1B7	2, 3, 5, 6, 8, 9, 11, 12	data input/output
2B0, 2B1, 2B2, 2B3, 2B4, 2B5, 2B6, 2B7	13, 14, 16, 17, 19, 20, 22, 23	data input/output
GND	4, 10, 15, 21, 28, 34, 39, 45	ground (0 V)
$V_{CC(B)}$	7, 18	supply voltage B (5 V bus)
$1\overline{OE}$, $2\overline{OE}$	48, 25	output enable input (active LOW)
1A0, 1A1, 1A2, 1A3, 1A4, 1A5, 1A6, 1A7	47, 46, 44, 43, 41, 40, 38, 37	data input/output
2A0, 2A1, 2A2, 2A3, 2A4, 2A5, 2A6, 2A7	36, 35, 33, 32, 30, 29, 27, 26	data input/output
$V_{CC(A)}$	31, 42	supply voltage A (3 V bus)

6. Functional description

Table 3. Function table

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

Inputs		Outputs	
$n\overline{OE}$	nDIR	nAn	nBn
L	L	nAn = nBn	inputs
L	H	inputs	nBn = nAn
H	X	Z	Z

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
$V_{CC(B)}$	supply voltage B	$V_{CC(B)} \geq V_{CC(A)}$		-0.5	+6.0	V
$V_{CC(A)}$	supply voltage A	$V_{CC(B)} \geq V_{CC(A)}$		-0.5	+4.6	V
I_{IK}	input clamping current	$V_I < 0$ V		-50	-	mA
V_I	input voltage		[1]	-0.5	+6.0	V
$V_{I/O}$	input/output voltage			-0.5	V_{CC} + 0.5	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	[1]	-0.5	V_{CC} + 0.5	V
		output 3-state	[1]	-0.5	+6.0	V
$I_{O(sink/source)}$	output sink or source 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	°C
T_j	junction temperature		[2]	-	+150	°C
P_{tot}	total power dissipation	T_{amb} = -40 °C to +125 °C	[3]	-	500	mW

[1] The input and output voltage ratings may be exceeded if the input and output 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.
[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
$V_{CC(B)}$	supply voltage B	$V_{CC(B)} \geq V_{CC(A)}$				
		maximum speed performance	2.7	-	5.5	V
		low-voltage applications	1.5	-	5.5	V
$V_{CC(A)}$	supply voltage A	$V_{CC(B)} \geq V_{CC(A)}$				
		maximum speed performance	2.7	-	3.6	V
		low-voltage applications	1.5	-	3.6	V
V_I	input voltage	control inputs: n$\overline{OE}$ and nDIR	0	-	5.5	V
$V_{I/O}$	input/output voltage	nAn port	0	-	$V_{CC(A)}$	V
		nBn port	0	-	$V_{CC(B)}$	V
V_O	output voltage	nAn port	0	-	$V_{CC(A)}$	V
		nBn port	0	-	$V_{CC(B)}$	V
T_{amb}	ambient temperature		-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	$V_{CC(A)}$ = 2.7 V to 3.0 V	0	-	20	ns/V
		$V_{CC(A)}$ = 3.0 V to 3.6 V	0	-	10	ns/V
		$V_{CC(B)}$ = 3.0 V to 4.5 V	0	-	20	ns/V
		$V_{CC(B)}$ = 4.5 V to 5.5 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		T_{amb} = -40 °C to +85 °C			T_{amb} = -40 °C to +125 °C		Unit
				Min	Typ [1]	Max	Min	Max	
V_{IH}	HIGH-level input voltage	nBn port							
		$V_{CC(B)}$ = 3.0 V to 5.5 V	[2]	2.0	-	-	2.0	-	V
		nAn port, n$\overline{OE}$ and nDIR							
		$V_{CC(A)}$ = 3.0 V to 3.6 V		2.0	-	-	2.0	-	V
		$V_{CC(A)}$ = 2.3 V to 2.7 V	[2]	1.7	-	-	1.7	-	V
V_{IL}	LOW-level input voltage	nBn port							
		$V_{CC(B)}$ = 4.5 V to 5.5 V	[2]	-	-	0.8	-	0.8	V
		$V_{CC(B)}$ = 3.0 V to 3.6 V	[2]	-	-	0.7	-	0.7	V
		nAn port, n$\overline{OE}$ and nDIR							
		$V_{CC(A)}$ = 3.0 V to 3.6 V		-	-	0.8	-	0.8	V
		$V_{CC(A)}$ = 2.3 V to 2.7 V	[2]	-	-	0.7	-	0.7	V

Symbol	Parameter	Conditions	T_{amb} = -40 °C to +85 °C			T_{amb} = -40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
V_{OH}	HIGH-level output voltage	nBn port; $V_I = V_{IH}$ or V_{IL}						
		I_O = -24 mA; $V_{CC(B)}$ = 4.5 V	$V_{CC(B)}$ - 0.8	-	-	$V_{CC(B)}$ - 1.2	-	V
		I_O = -12 mA; $V_{CC(B)}$ = 4.5 V	$V_{CC(B)}$ - 0.5	-	-	$V_{CC(B)}$ - 0.8	-	V
		I_O = -18 mA; $V_{CC(B)}$ = 3.0 V	$V_{CC(B)}$ - 0.8	-	-	$V_{CC(B)}$ - 1.0	-	V
		I_O = -100 μA; $V_{CC(B)}$ = 3.0 V	$V_{CC(B)}$ - 0.2	$V_{CC(B)}$	-	$V_{CC(B)}$ - 0.3	-	V
		nAn port; $V_I = V_{IH}$ or V_{IL}						
		I_O = -24 mA; $V_{CC(A)}$ = 3.0 V	$V_{CC(A)}$ - 0.7	-	-	$V_{CC(A)}$ - 1.0	-	V
		I_O = -100 μA; $V_{CC(A)}$ = 3.0 V	$V_{CC(A)}$ - 0.2	-	-	$V_{CC(A)}$ - 0.3	-	V
		I_O = -12 mA; $V_{CC(A)}$ = 2.7 V	$V_{CC(A)}$ - 0.5	-	-	$V_{CC(A)}$ - 0.8	-	V
		I_O = -8 mA; $V_{CC(A)}$ = 2.3 V	$V_{CC(A)}$ - 0.6	-	-	$V_{CC(A)}$ - 0.6	-	V
		I_O = -100 μA; $V_{CC(A)}$ = 2.3 V	$V_{CC(A)}$ - 0.2	$V_{CC(A)}$	-	$V_{CC(A)}$ - 0.3	-	V
V_{OL}	LOW-level output voltage	nBn port; $V_I = V_{IH}$ or V_{IL}						
		I_O = 24 mA; $V_{CC(B)}$ = 4.5 V	-	-	0.55	-	0.60	V
		I_O = 12 mA; $V_{CC(B)}$ = 4.5 V	-	-	0.40	-	0.80	V
		I_O = 100 μA; $V_{CC(B)}$ = 4.5 V	-	-	0.20	-	0.30	V
		I_O = 18 mA; $V_{CC(B)}$ = 3.0 V	-	-	0.55	-	0.80	V
		I_O = 100 μA; $V_{CC(B)}$ = 3.0 V	-	-	0.20	-	0.30	V
		nAn port; $V_I = V_{IH}$ or V_{IL}						
		I_O = 24 mA; $V_{CC(A)}$ = 3.0 V	-	-	0.55	-	0.80	V
		I_O = 100 μA; $V_{CC(A)}$ = 3.0 V	-	-	0.20	-	0.30	V
		I_O = 12 mA; $V_{CC(A)}$ = 2.7 V	-	-	0.40	-	0.60	V
		I_O = 12 mA; $V_{CC(A)}$ = 2.3 V	-	-	0.60	-	0.60	V
		I_O = 100 μA; $V_{CC(A)}$ = 2.3 V	-	-	0.20	-	0.20	V
I_I	input leakage current	V_I = 5.5 V or GND	-	±0.1	±5	-	±10	μA
I_{OZ}	OFF-state output current	$V_I = V_{IH}$ or V_{IL}; $V_O = V_{CC}$ or GND [3]	-	±0.1	±10	-	±20	μA
I_{CC}	supply current	$V_I = V_{CC}$ or GND; I_O = 0 A	-	0.1	40	-	80	μA
ΔI_{CC}	additional supply current	per control pin; $V_I = V_{CC}$ - 0.6 V; I_O = 0 A [4]	-	5	500	-	5000	μA
C_I	input capacitance		-	4.0	-	-	-	pF
$C_{I/O}$	input/output capacitance	nAn and nBn port	-	5.0	-	-	-	pF

[1] All typical values are measured at $V_{CC(B)}$ = 5.0 V, $V_{CC(A)}$ = 3.3 V and T_{amb} = 25 °C.
[2] If $V_{CC(A)}$ < 2.7 V, the switching levels at all inputs are not TTL compatible.
[3] For transceivers, the parameter I_{OZ} includes the input leakage current.
[4] $V_{CC(A)}$ = 2.7 V to 3.6 V: other inputs at $V_{CC(A)}$ or GND; $V_{CC(B)}$ = 4.5 V to 5.5 V: other inputs at $V_{CC(B)}$ or GND.

10. Dynamic characteristics

Table 7. Dynamic characteristics

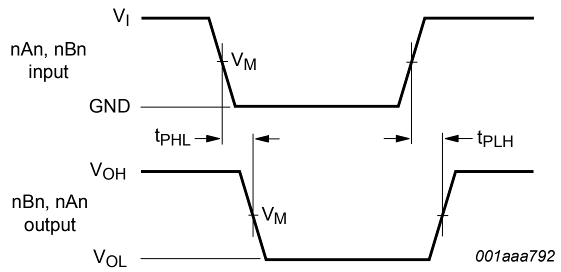
GND = 0 V; $t_r = t_f \leq 2.5$ ns; C_L = 50 pF; for test circuit see Fig. 6.

Symbol	Parameter	Conditions		T_{amb} = -40 °C to +85 °C			T_{amb} = -40 °C to +125 °C		Unit
				Min	Typ [1]	Max	Min	Max	
t_{pd}	propagation delay	nAn to nBn; see Fig. 4	[2]						
		$V_{CC(A)}$ = 2.3 V to 2.7 V; $V_{CC(B)}$ = 3.0 V to 3.6 V		1.5	3.3	7.6	1.5	9.5	ns
		$V_{CC(A)}$ = 2.7 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		1.0	3.0	5.9	1.0	7.5	ns
		$V_{CC(A)}$ = 3.0 V to 3.6 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		1.0	2.9	5.8	1.0	7.5	ns
		nBn to nAn; see Fig. 4	[2]						
		$V_{CC(A)}$ = 2.3 V to 2.7 V; $V_{CC(B)}$ = 3.0 V to 3.6 V		1.0	3.0	7.6	1.0	9.5	ns
		$V_{CC(A)}$ = 2.7 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		1.0	4.3	6.7	1.0	8.5	ns
		$V_{CC(A)}$ = 3.0 V to 3.6 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		1.2	2.5	5.8	1.2	7.5	ns
t_{en}	enable time	$n\overline{OE}$ to nBn; see Fig. 5	[3]						
		$V_{CC(A)}$ = 2.3 V to 2.7 V; $V_{CC(B)}$ = 3.0 V to 3.6 V		1.5	4.1	11.5	1.5	14.5	ns
		$V_{CC(A)}$ = 2.7 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		1.5	3.6	9.2	1.5	11.5	ns
		$V_{CC(A)}$ = 3.0 V to 3.6 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		1.0	3.2	8.9	1.0	12.0	ns
		$n\overline{OE}$ to nAn; see Fig. 5	[3]						
		$V_{CC(A)}$ = 2.3 V to 2.7 V; $V_{CC(B)}$ = 3.0 V to 3.6 V		1.5	4.6	12.3	1.5	15.5	ns
		$V_{CC(A)}$ = 2.7 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		1.5	4.3	9.3	1.5	12.0	ns
		$V_{CC(A)}$ = 3.0 V to 3.6 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		1.0	3.2	8.9	1.0	11.5	ns
t_{dis}	disable time	$n\overline{OE}$ to nBn; see Fig. 5	[4]						
		$V_{CC(A)}$ = 2.3 V to 2.7 V; $V_{CC(B)}$ = 3.0 V to 3.6 V		2.0	2.7	10.5	2.0	13.5	ns
		$V_{CC(A)}$ = 2.7 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		2.5	4.6	9.0	2.5	11.5	ns
		$V_{CC(A)}$ = 3.0 V to 3.6 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		2.1	4.9	8.6	2.1	11.0	ns
		$n\overline{OE}$ to nAn; see Fig. 5	[4]						
		$V_{CC(A)}$ = 2.3 V to 2.7 V; $V_{CC(B)}$ = 3.0 V to 3.6 V		1.0	2.7	9.3	1.0	12.0	ns
		$V_{CC(A)}$ = 2.7 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		1.5	3.5	9.0	1.5	11.5	ns
		$V_{CC(A)}$ = 3.0 V to 3.6 V; $V_{CC(B)}$ = 4.5 V to 5.5 V		2.0	3.2	8.6	2.0	11.0	ns

Symbol	Parameter	Conditions	T_{amb} = -40 °C to +85 °C			T_{amb} = -40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
C_{PD}	power dissipation capacitance	5 V port: nAn to nBn; V_I = GND to V_{CC}; $V_{CC(B)}$ = 5 V; $V_{CC(A)}$ = 3.3 V [5]						
		outputs enabled	-	30	-	-	-	pF
		outputs disabled	-	15	-	-	-	pF
		3 V port: nBn to nAn; V_I = GND to V_{CC}; $V_{CC(B)}$ = 5 V; $V_{CC(A)}$ = 3.3 V [5]						
		outputs enabled	-	40	-	-	-	pF
		outputs disabled	-	5	-	-	-	pF

[1] All typical values are measured at nominal voltage for $V_{CC(B)}$ and $V_{CC(A)}$ and at T_{amb} = 25 °C.
[2] t_{pd} is the same as t_{PLH} and t_{PHL}.
[3] t_{en} is the same as t_{PZL} and t_{PZH}.
[4] t_{dis} is the same as t_{PLZ} and t_{PHZ}.
[5] 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 V;
N = number of inputs switching;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

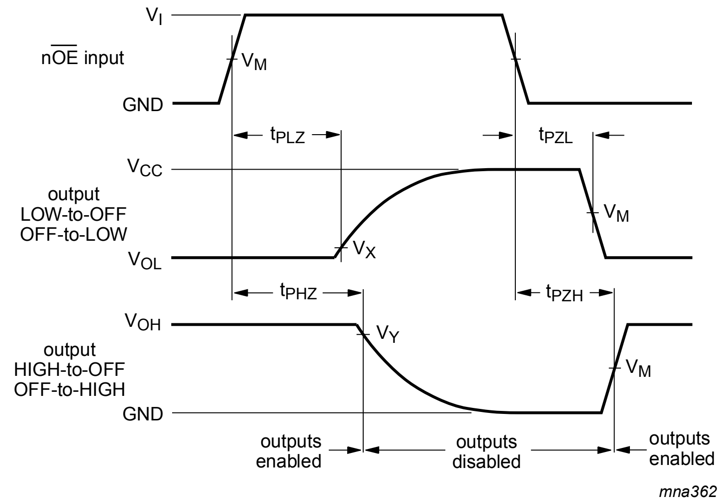
10.1. Waveforms and test circuit



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. Input (nAn, nBn) to output (nBn, nAn) propagation delays



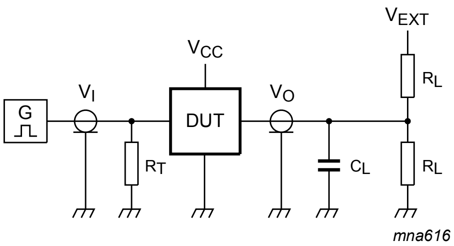
Measurement points are given in Table 8.

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

Fig. 5. 3-state enable and disable times

Table 8. Measurement points

Direction	Supply voltage		Input		Output		
	$V_{CC(A)}$	$V_{CC(B)}$	V_I	V_M	V_M	V_X	V_Y
nAn port to nBn port	2.3 V to 2.7 V	2.7 V to 3.6 V	$V_{CC(A)}$	0.5 × $V_{CC(A)}$	1.5 V	$V_{OL(B)}$ + 0.3 V	$V_{OH(B)}$ - 0.3 V
nBn port to nAn port	2.3 V to 2.7 V	2.7 V to 3.6 V	2.7 V	1.5 V	0.5 × $V_{CC(A)}$	$V_{OL(A)}$ + 0.15 V	$V_{OH(A)}$ - 0.15 V
nAn port to nBn port	2.7 V to 3.6 V	4.5 V to 5.5 V	2.7 V	1.5 V	0.5 × $V_{CC(B)}$	0.2 × $V_{CC(B)}$	0.8 × $V_{CC(B)}$
nBn port to nAn port	2.7 V to 3.6 V	4.5 V to 5.5 V	3.0 V	1.5 V	1.5 V	$V_{OL(A)}$ + 0.3 V	$V_{OH(A)}$ - 0.3 V



Test data is given in Table 9.

Definitions for test circuit:

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

C_L = Load capacitance including jig and probe capacitance.

R_L = Load resistance.

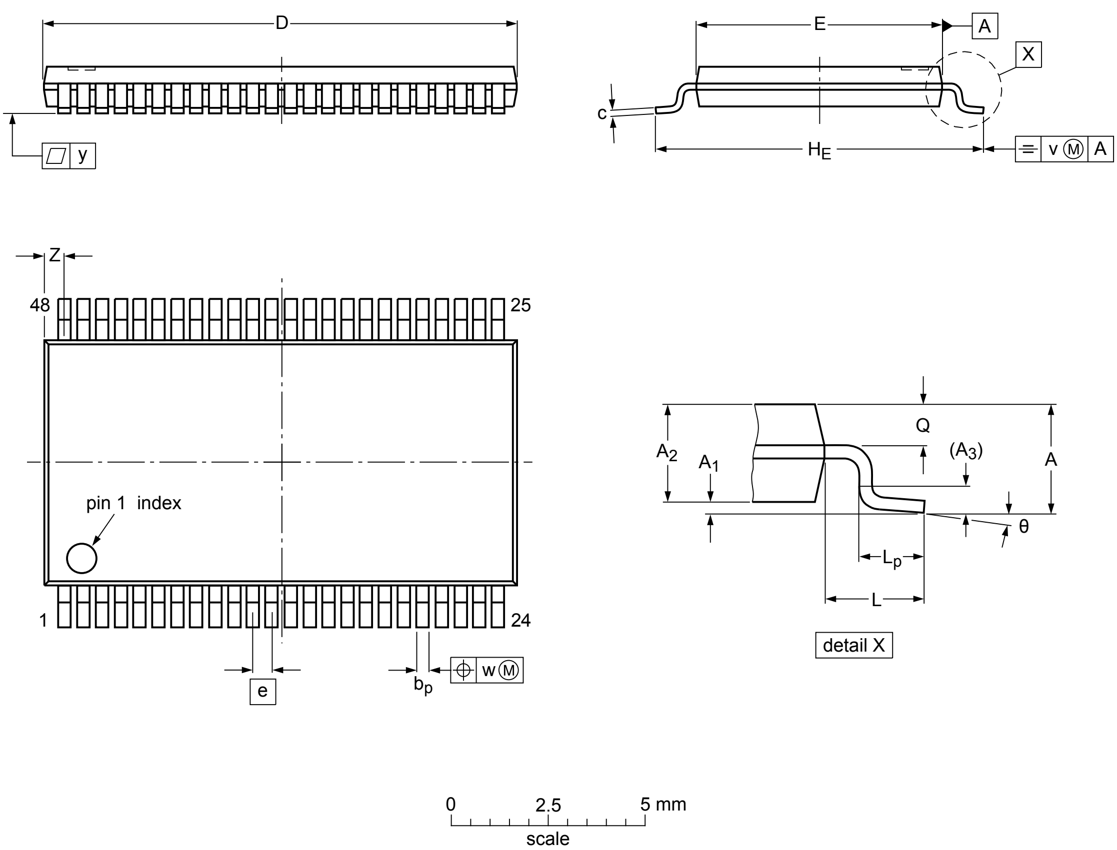
Fig. 6. Test circuit for measuring switching times

Table 9. Test data

Direction	Supply voltage		Load		V_{EXT}		
	$V_{CC(A)}$	$V_{CC(B)}$	C_L	R_L	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
nAn port to nBn port	2.3 V to 2.7 V	2.7 V to 3.6 V	50 pF	500 Ω	open	GND	2 × V_{CC}
nBn port to nAn port	2.3 V to 2.7 V	2.7 V to 3.6 V	50 pF	500 Ω	open	GND	6.0 V
nAn port to nBn port	2.7 V to 3.6 V	4.5 V to 5.5 V	50 pF	500 Ω	open	GND	2 × V_{CC}
nBn port to nAn port	2.7 V to 3.6 V	4.5 V to 5.5 V	50 pF	500 Ω	open	GND	6.0 V

11. Package outline

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1 mm **SOT362-1**



Dimensions (mm are the original dimensions)

Unit		A	A_1	A_2	A_3	b_p	c	D[(1)]	E[(2)]	e	H_E	L	L_p	Q	v	w	y	Z	θ
mm	max		0.15	1.05		0.28	0.2	12.6	6.2		8.3		0.8	0.50				0.8	8°
	nom	1.2			0.25					0.5		1			0.25	0.08	0.1		
	min		0.05	0.85		0.17	0.1	12.4	6.0		7.9		0.4	0.35				0.4	0°

Note

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.

sot362-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT362-1		MO-153				~~03-02-19~~ 13-08-05

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

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
MM	Machine Model
TTL	Transistor-Transistor Logic

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74ALVC164245_Q100 v.2	20181112	Product data sheet	-	74ALVC164245_Q100 v.1
Modifications:	• 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. • Package outline drawing SOT362-1 updated.			
74ALVC164245_Q100 v.1	20130514	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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