74AXP4T245

4-bit dual supply translating transceiver; 3-state

Rev. 2 — 6 February 2020 Product data sheet

1. General description

The 74AXP4T245 is an 4-bit dual supply translating transceiver with 3-state outputs that enable bidirectional level translation. The device can be used as two 2-bit transceivers or as a 4-bit transceiver. It features four 2-bit input-output ports (nAn and nBn), a direction control input (nDIR), a output enable input ($n\overline{OE}$) and dual supply pins ($V_{CC(A)}$ and $V_{CC(B)}$). Both $V_{CC(A)}$ and $V_{CC(B)}$ can be supplied at any voltage between 0.9 V and 5.5 V making the device suitable for translating between any of the low voltage nodes (0.9 V, 1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V and 5.0 V). No power supply sequencing is required and output glitches during power supply transitions are prevented using patented circuitry. As a result glitches will not appear on the outputs for supply transitions during power-up/down between 20 mV/μs and 5.5 V/s.

Pins nAn, $n\overline{OE}$ and nDIR are referenced to $V_{CC(A)}$ and pins nBn are referenced to $V_{CC(B)}$. A HIGH on nDIR allows transmission from nAn to nBn and a LOW on nDIR allows transmission from nBn to nAn. The output enable input ($n\overline{OE}$) can be used to disable the outputs so the buses are effectively isolated.

The device is fully specified for partial power-down applications using I_{OFF}. The I_{OFF} circuitry disables the output, preventing any damaging backflow current through the device when it is powered down. In suspend mode when either $V_{CC(A)}$ or $V_{CC(B)}$ are at GND level, both nAn and nBn are in the high-impedance OFF-state.

2. Features and benefits

- Wide supply voltage range:
  - $V_{CC(A)}$: 0.9 V to 5.5 V
  - $V_{CC(B)}$: 0.9 V to 5.5 V
- Low input capacitance; C_I = 1.2 pF (typical)
- Low output capacitance; C_O = 3.6 pF (typical)
- Low dynamic power consumption; C_{PD} = 10 pF (typical)
- Low static power consumption; I_{CC} = 2 μA (25 °C maximum)
- High noise immunity
- Complies with JEDEC standard:
  - JESD8-12 (1.1 V to 1.3 V; inputs)
  - JESD8-11 (1.4 V to 1.6 V)
  - JESD8-7 (1.65 V to 1.95 V)
  - JESD8-5 (2.3 V to 2.7 V)
  - JESD8C (2.7 V to 3.6 V)
  - JESD12-6 (4.5 V to 5.5 V)
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2 kV
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1 kV
- Latch-up performance exceeds 100 mA per JESD78D Class II
- Inputs accept voltages up to 5.5 V
- Low noise overshoot and undershoot < 10% of V_{CCO}
- I_{OFF} circuitry provides partial power-down mode operation
- Specified from -40 °C to +125 °C

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3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AXP4T245PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74AXP4T245BQ	-40 °C to +125 °C	DHVQFN16	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm	SOT763-1

4. Functional diagram

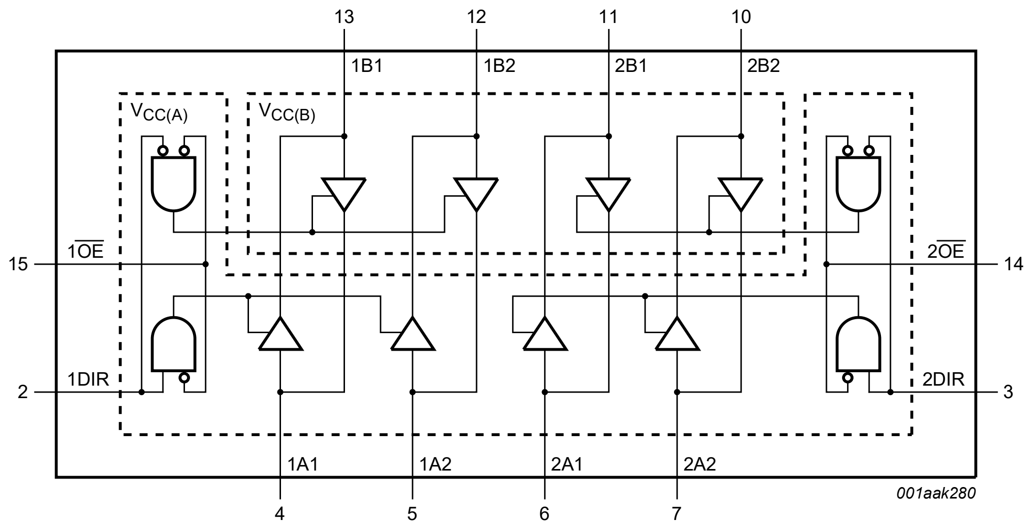


Fig. 1. Logic symbol

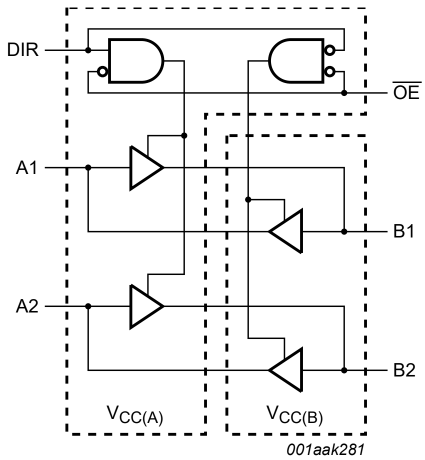


Fig. 2. Logic diagram (one 2-bit transceiver)

5. Pinning information

5.1. Pinning

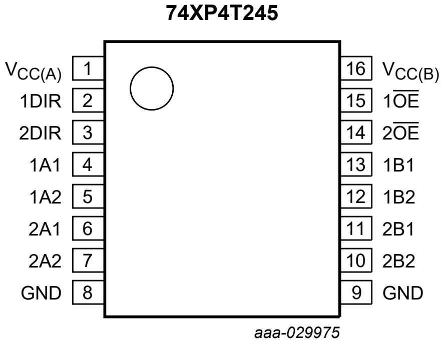
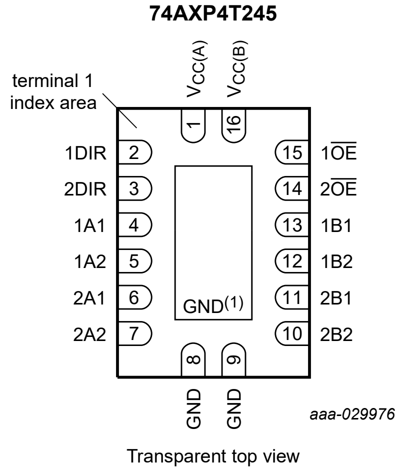


Fig. 3. Pin configuration SOT403-1 (TSSOP16)



(1) This is not a ground pin. There is no electrical or mechanical requirement to solder the pad. In case soldered, the solder land should remain floating or connected to GND.

Fig. 4. Pin configuration SOT763-1 (DHVQFN16)

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
$V_{CC(A)}$	1	supply voltage A (nAn, n$\overline{OE}$ and nDIR are referenced to $V_{CC(A)}$)
1DIR, 2DIR	2, 3	direction control
1A1, 1A2	4, 5	data input or output
2A1, 2A2	6, 7	data input or output
GND [1]	8, 9	ground (0 V)
2B2, 2B1	10, 11	data input or output
1B2, 1B1	12, 13	data input or output
2$\overline{OE}$, 1$\overline{OE}$	14, 15	output enable input (active LOW)
$V_{CC(B)}$	16	supply voltage B (nBn is referenced to $V_{CC(B)}$)

[1] All GND pins must be connected to ground (0 V).

6. Functional description

Table 3. Function table

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

Supply voltage	Input		Input/output [1]	
$V_{CC(A)}$, $V_{CC(B)}$	$n\overline{OE}$ [2]	nDIR [2]	nAn [2]	nBn [2]
0.9 V to 5.5 V	L	L	nAn = nBn	input
0.9 V to 5.5 V	L	H	input	nBn = nAn
0.9 V to 5.5 V	H	X	Z	Z
GND [1]	X	X	Z	Z

[1] If at least one of $V_{CC(A)}$ or $V_{CC(B)}$ is at GND level, the device goes into suspend mode.
[2] nAn, nDIR and $n\overline{OE}$ are referenced to $V_{CC(A)}$; nBn is referenced to $V_{CC(B)}$.

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
$V_{CC(A)}$	supply voltage A		-0.5	+6.5	V
$V_{CC(B)}$	supply voltage B		-0.5	+6.5	V
I_{IK}	input clamping current	$V_I < 0$ V	-20	-	mA
V_I	input voltage	[1]	-0.5	+6.5	V
I_{OK}	output clamping current	$V_O < 0$ V	-20	-	mA
V_O	output voltage	Active mode [1][2][3]	-0.5	V_{CCO} + 0.5	V
		Suspend or 3-state mode [1]	-0.5	+6.5	V
I_O	output current	V_O = 0 V to V_{CCO} [2]	-	±25	mA
I_{CC}	supply current	$I_{CC(A)}$ or $I_{CC(B)}$; per V_{CC} pin	-	100	mA
I_{GND}	ground current	per GND pin	-100	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	T_{amb} = -40 °C to +125 °C [4]	-	500	mW

[1] The minimum input voltage ratings and output voltage ratings may be exceeded if the input and output current ratings are observed.
[2] V_{CCO} is the supply voltage associated with the output port.
[3] V_{CCO} + 0.5 V should not exceed 6.5 V.
[4] For SOT403-1 (TSSOP16) package: P_{tot} derates linearly with 8.5 mW/K above 91 °C.
For SOT763-1 (DHVQFN16) package: P_{tot} derates linearly with 11.2 mW/K above 106 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{CC(A)}$	supply voltage A			0.9	5.5	V
$V_{CC(B)}$	supply voltage B			0.9	5.5	V
V_I	input voltage			0	5.5	V
V_O	output voltage	Active mode	[1]	0	V_{CCO}	V
		Suspend or 3-state mode		0	5.5	V
T_{amb}	ambient temperature			-40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CCI} = 0.9 V	[2]	-	20	ns/V
		V_{CCI} = 1.2 V		-	20	ns/V
		V_{CCI} = 1.4 V to 1.95 V		-	20	ns/V
		V_{CCI} = 2.3 V to 2.7 V		-	20	ns/V
		V_{CCI} = 3 V to 3.6 V		-	10	ns/V
		V_{CCI} = 4.5 V to 5.5 V		-	8	ns/V

[1] V_{CCO} is the supply voltage associated with the output port.
[2] V_{CCI} is the supply voltage associated with the input port.

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 +125 °C	+25 °C		-40 °C to +85 °C	-40 °C to +125 °C	Unit
				Min	Typ	Max	Max	Max	
V_{IH}	HIGH-level input voltage	nAn, nBn, nDIR, $n\overline{OE}$ input	[1]						
		V_{CCI} = 0.9 V		$0.7V_{CCI}$	-	-	-	-	V
		V_{CCI} = 1.1 V to 1.95 V		$0.65V_{CCI}$	-	-	-	-	V
		V_{CCI} = 2.3 V to 2.7 V		1.6	-	-	-	-	V
		V_{CCI} = 3.0 V to 3.6 V		2.0	-	-	-	-	V
		V_{CCI} = 4.5 V to 5.5 V		$0.7V_{CCI}$	-	-	-	-	V
V_{IL}	LOW-level input voltage	nAn, nBn, nDIR, $n\overline{OE}$ input	[1]						
		V_{CCI} = 0.9 V		-	-	$0.3V_{CCI}$	$0.3V_{CCI}$	$0.3V_{CCI}$	V
		V_{CCI} = 1.1 V to 1.95 V		-	-	$0.35V_{CCI}$	$0.35V_{CCI}$	$0.35V_{CCI}$	V
		V_{CCI} = 2.3 V to 2.7 V		-	-	0.7	0.7	0.7	V
		V_{CCI} = 3.0 V to 3.6 V		-	-	0.8	0.8	0.8	V
		V_{CCI} = 4.5 V to 5.5 V		-	-	$0.3V_{CCI}$	$0.3V_{CCI}$	$0.3V_{CCI}$	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$	[2]						
		I_O = -0.1 mA; V_{CCO} = 0.9 V to 5.5 V	[3]	V_{CCO} - 0.1	V_{CCO}	-	-	-	V
		I_O = -1.5 mA; V_{CCO} = 1.1 V		0.825	-	-	-	-	V
		I_O = -3 mA; V_{CCO} = 1.4 V		1.05	-	-	-	-	V
		I_O = -4.5 mA; V_{CCO} = 1.65 V		1.2	-	-	-	-	V
		I_O = -8 mA; V_{CCO} = 2.3 V		1.7	-	-	-	-	V
		I_O = -10 mA; V_{CCO} = 3.0 V		2.2	-	-	-	-	V
		I_O = -12 mA; V_{CCO} = 4.5 V		3.7	-	-	-	-	V

Symbol	Parameter	Conditions		-40 °C to +125 °C	+25 °C		-40 °C to +85 °C	-40 °C to +125 °C	Unit
				Min	Typ	Max	Max	Max	
V_{OL}	LOW-level output voltage	$V_I = V_{IL}$	[2]						
		I_O = 0.1 mA; V_{CCO} = 0.9 V to 5.5 V	[3]	-	0	0.1	0.1	0.1	V
		I_O = 1.5 mA; V_{CCO} = 1.1 V		-	-	0.275	0.275	0.275	V
		I_O = 3 mA; V_{CCO} = 1.4 V		-	-	0.35	0.35	0.35	V
		I_O = 4.5 mA; V_{CCO} = 1.65 V		-	-	0.45	0.45	0.45	V
		I_O = 8 mA; V_{CCO} = 2.3 V		-	-	0.7	0.7	0.7	V
		I_O = 10 mA; V_{CCO} = 3.0 V		-	-	0.8	0.8	0.8	V
		I_O = 8 mA; V_{CCO} = 4.5 V		-	-	0.5	0.5	0.5	V
		I_O = 12 mA; V_{CCO} = 4.5 V		-	-	0.8	0.8	0.8	V
I_I	input leakage current	nDIR, $n\overline{OE}$ input; V_I = 0 V to 5.5 V; V_{CCI} = 0.9 V to 5.5 V		-	-	±0.1	±0.5	±1	μA
I_{OZ}	OFF-state output current	A or B port; V_O = 0 V or V_{CCO}; V_{CCO} = 0.9 V to 5.5 V	[2]	-	-	±0.1	±0.5	±2	μA
		suspend mode A port; V_O = 0 V or V_{CCO}; $V_{CC(A)}$ = 5.5 V; $V_{CC(B)}$ = 0 V	[2]	-	-	±0.1	±0.5	±2	μA
		suspend mode B port; V_O = 0 V or V_{CCO}; $V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 5.5 V	[2]	-	-	±0.1	±0.5	±2	μA
I_{OFF}	power-off leakage current	nDIR, $n\overline{OE}$ input; V_I = 0 V to 5.5 V; $V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 0.9 V to 5.5 V		-	-	0.1	0.5	2	μA
		A port; V_I or V_O = 0 V to 5.5 V; $V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 0.9 V to 5.5 V		-	-	0.1	0.5	2	μA
		B port; V_I or V_O = 0 V to 5.5 V; $V_{CC(B)}$ = 0 V; $V_{CC(A)}$ = 0.9 V to 5.5 V		-	-	0.1	0.5	2	μA
ΔI_{OFF}	additional power-off leakage current	nDIR, $n\overline{OE}$ input; V_I = 0 V or 5.5 V; $V_{CC(A)}$ = 0 V to 0.1 V; $V_{CC(B)}$ = 0.9 V to 5.5 V		-	-	±0.1	±0.5	±2	μA
		A port; V_O = 0 V or 5.5 V; $V_{CC(A)}$ = 0 V to 0.1 V; $V_{CC(B)}$ = 0.9 V to 5.5 V; V_I = 0 V or 5.5 V		-	-	±0.1	±0.5	±2	μA
		B port; V_O = 0 V or 5.5 V; $V_{CC(B)}$ = 0 V to 0.1 V; $V_{CC(A)}$ = 0.9 V to 5.5 V; V_I = 0 V or 5.5 V		-	-	±0.1	±0.5	±2	μA

Symbol	Parameter	Conditions	-40 °C to +125 °C	+25 °C		-40 °C to +85 °C	-40 °C to +125 °C	Unit
			Min	Typ	Max	Max	Max	
I_{CC}	supply current	A port; V_I = 0 V or V_{CCI}; I_O = 0 A [1]						
		$V_{CC(A)}$, $V_{CC(B)}$ = 0.9 V to 5.5 V	-	-	2	8	20	μA
		$V_{CC(A)}$ = 5.5 V; $V_{CC(B)}$ = 0 V	-	-	2	8	20	μA
		$V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 5.5 V	-	-	-0.1	±0.4	±1	μA
		B port; V_I = 0 V or V_{CCI}; I_O = 0 A						
		$V_{CC(A)}$, $V_{CC(B)}$ = 0.9 V to 5.5 V	-	-	2	8	20	μA
		$V_{CC(B)}$ = 5.5 V; $V_{CC(A)}$ = 0 V	-	-	-0.1	±0.4	±1	μA
		$V_{CC(B)}$ = 0 V; $V_{CC(A)}$ = 5.5 V	-	-	2	8	20	μA
ΔI_{CC}	additional supply current	per input; other pins at V_{CCI} or ground (0 V); I_O = 0 A; $V_{CC(A)}$, $V_{CC(B)}$ = 4.5 V to 5.5 V; V_I = V_{CCI} - 0.6 V [4]	-	2	100	150	200	μA

[1] V_{CCI} is the supply voltage associated with the control inputs or input port.
[2] V_{CCO} is the supply voltage associated with the output port.
[3] Typical values for V_{OL} and V_{OH} are measured at V_{CCO} is 0.9 V.
[4] Typical values for ΔI_{CC} are measured at $V_{CC(A)}$, $V_{CC(B)}$ = 5 V.

Table 7. Typical total supply current $I_{CC(A)}$ at T_{amb} = 25 °C

Voltages are referenced to GND (ground = 0 V).

$V_{CC(A)}$	$V_{CC(B)}$								Unit
	0 V	0.9 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	5.0 V	
0 V	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	μA
0.9 V	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	μA
1.2 V	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	μA
1.5 V	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	μA
1.8 V	0.01	0.06	0.03	0.01	0.01	0.01	0.01	0.01	μA
2.5 V	0.01	0.20	0.17	0.12	0.07	0.01	0.01	0.01	μA
3.3 V	0.01	0.39	0.37	0.34	0.29	0.12	0.01	0.01	μA
5.0 V	0.01	0.96	0.96	0.94	0.90	0.77	0.54	0.01	μA

Table 8. Typical total supply current $I_{CC(B)}$ at T_{amb} = 25 °C

Voltages are referenced to GND (ground = 0 V).

$V_{CC(A)}$	$V_{CC(B)}$								Unit
	0 V	0.9 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	5.0 V	
0 V	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	μA
0.9 V	0.01	0.01	0.01	0.02	0.06	0.20	0.39	0.96	μA
1.2 V	0.01	0.01	0.01	0.01	0.03	0.17	0.37	0.96	μA
1.5 V	0.01	0.01	0.01	0.01	0.01	0.12	0.34	0.94	μA
1.8 V	0.01	0.01	0.01	0.01	0.01	0.07	0.29	0.90	μA
2.5 V	0.01	0.01	0.01	0.01	0.01	0.01	0.12	0.77	μA
3.3 V	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.54	μA
5.0 V	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	μA

10. Dynamic characteristics

Table 9. Typical dynamic characteristics at $V_{CC(A)}$ = 0.9 V and T_{amb} = 25 °C

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7; for waveforms see Fig. 5 and Fig. 6.

Symbol	Parameter	Conditions		$V_{CC(B)}$							Unit
				0.9 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	5.0 V	
t_{pd}	propagation delay	nAn to nBn	[1]	40	22	18.5	16.5	15	15	15	ns
		nBn to nAn	[1]	40	33	32	31	31	31	32	ns
t_{dis}	disable time	$n\overline{OE}$ to nAn	[1]	34	34	34	34	34	34	34	ns
		$n\overline{OE}$ to nBn	[1]	42	30	26	26	24	25	23	ns
t_{en}	enable time	$n\overline{OE}$ to nAn	[1]	49	49	49	49	49	49	49	ns
		$n\overline{OE}$ to nBn	[1]	52	32	28	27	27	27	30	ns

[1] t_{pd} is the same as t_{PLH} and t_{PHL}; t_{dis} is the same as t_{PLZ} and t_{PHZ}; t_{en} is the same as t_{PZL} and t_{PZH}.

Table 10. Typical dynamic characteristics at $V_{CC(B)}$ = 0.9 V and T_{amb} = 25 °C

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7; for waveforms see Fig. 5 and Fig. 6.

Symbol	Parameter	Conditions		$V_{CC(A)}$							Unit
				0.9 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	5.0 V	
t_{pd}	propagation delay	nAn to nBn	[1]	40	33	32	31	31	31	32	ns
		nBn to nAn	[1]	40	22	18.5	16.5	15	15	15	ns
t_{dis}	disable time	$n\overline{OE}$ to nAn	[1]	34	16	11	10	7	7.7	5.3	ns
		$n\overline{OE}$ to nBn	[1]	42	31	28	28	27	27	27	ns
t_{en}	enable time	$n\overline{OE}$ to nAn	[1]	49	18	11.5	8.4	5.6	4.5	3.6	ns
		$n\overline{OE}$ to nBn	[1]	52	39	36	35	34	34	35	ns

[1] t_{pd} is the same as t_{PLH} and t_{PHL}; t_{dis} is the same as t_{PLZ} and t_{PHZ}; t_{en} is the same as t_{PZL} and t_{PZH}.

Table 11. Typical power dissipation capacitance at $V_{CC(A)}$ = $V_{CC(B)}$ and T_{amb} = 25 °C

[1] [2]Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7.

Symbol	Parameter	Conditions	$V_{CC(A)}$ and $V_{CC(B)}$							Unit
			0.9 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	5.0 V	
C_{PD}	power dissipation capacitance	A port: (direction A to B); B port: (direction B to A)	0.5	0.5	0.5	0.5	0.5	0.7	0.9	pF
		A port: (direction B to A); B port: (direction A to B)	9.0	9.3	9.5	9.7	9.9	10.2	10.9	pF
C_I	input capacitance	V_I = 0 V or V_{CCI}; V_{CCI} = 0 V to 5.5 V	1.2	1.2	1.2	1.2	1.2	1.2	1.2	pF
$C_{I/O}$	input/output capacitance	V_O = 0 V; V_{CCO} = 0 V	3.6	3.6	3.6	3.6	3.6	3.6	3.6	pF

[1] 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 = 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 the outputs.

[2] f_i = 1 MHz; V_I = GND to V_{CC}; $t_r = t_f$ = 1 ns; C_L = 0 pF; $R_L = \infty$ Ω.

Table 12. Dynamic characteristics for temperature range -40 °C to +85 °C

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7; for waveforms see Fig. 5 and Fig. 6.

Symbol	Parameter	Conditions	$V_{CC(B)}$												Unit
			1.2 V ± 0.1 V		1.5 V ± 0.1 V		1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{pd}	propagation delay	nAn to nBn [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4	38	3.6	25	3.4	21	3.1	16	2.9	14.5	2.7	14.5	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.5	33	3	21	2.8	16.5	2.6	12.5	2.4	10.5	2.2	9.8	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	3.1	32	2.7	19	2.4	15	2.2	11	2.1	9	1.9	8.2	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	2.8	31	2.4	17.5	2.1	13.5	1.9	9.1	1.7	7.5	1.6	6.6	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	2.7	31	2.3	17	2	13	1.8	8.5	1.6	6.9	1.4	5.8	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	2.7	31	2.2	16.5	1.9	12.5	1.6	8.1	1.4	6.4	1.2	5	ns
		nBn to nAn													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4	38	3.5	33	3.1	32	2.8	31	2.7	31	2.7	31	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.6	25	3	21	2.7	19	2.4	17.5	2.3	17	2.2	16.5	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	3.4	21	2.8	16.5	2.4	15	2.1	13.5	2	13	1.9	12.5	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	3.1	16	2.6	12.5	2.2	11	1.9	9.1	1.8	8.5	1.6	8.1	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	2.9	14.5	2.4	10.5	2.1	9	1.7	7.5	1.6	6.9	1.4	6.4	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	2.7	14.5	2.2	9.8	1.9	8.2	1.6	6.6	1.4	5.8	1.2	5	ns

Symbol	Parameter	Conditions	$V_{CC(B)}$												Unit
			1.2 V ± 0.1 V		1.5 V ± 0.1 V		1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{en}	enable time	n$\overline{OE}$ to nAn [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4.6	48	4.6	48	4.6	48	4.6	48	4.6	48	4.6	48	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.6	24	3.6	24	3.6	24	3.6	24	3.6	24	3.6	24	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	2.9	17.5	2.9	17.5	2.9	17.5	2.9	17.5	2.9	17.5	2.9	17.5	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	2.3	11	2.3	11	2.3	11	2.3	11	2.3	11	2.3	11	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	2	8.1	2	8.1	2	8.1	2	8.1	2	8.1	2	8.1	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	1.8	6	1.8	6	1.8	6	1.8	6	1.8	6	1.8	6	ns
		n$\overline{OE}$ to nBn													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	5	46	4.6	32	4.1	27	4.1	24	4	25.5	4.1	26	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	4.2	40	3.8	24	3.5	19.5	3.3	16	3.3	15	3.3	14.5	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	3.9	36	3.3	21	3	17.5	2.8	13.5	2.8	12	2.8	11.5	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	3.4	35	2.8	18.5	2.5	14.5	2.3	11	2.2	9.3	2.2	8.4	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	3.2	34	2.7	17.5	2.3	13.5	2.1	9.5	1.9	8.1	1.9	7.1	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	3.1	37	2.4	17	2.1	13	1.9	8.7	1.8	7.3	1.7	6.1	ns

Symbol	Parameter	Conditions	$V_{CC(B)}$												Unit
			1.2 V ± 0.1 V		1.5 V ± 0.1 V		1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{dis}	disable time	n$\overline{OE}$ to nAn [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4.9	36	4.9	36	4.9	36	4.9	36	4.9	36	4.9	36	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.9	22	3.9	22	3.9	22	3.9	22	3.9	22	3.9	22	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	4	19	4	19	4	19	4	19	4	19	4	19	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	2.9	13	2.9	13	2.9	13	2.9	13	2.9	13	2.9	13	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	3.5	13	3.5	13	3.5	13	3.5	13	3.5	13	3.5	13	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	2.4	9.7	2.4	9.7	2.4	9.7	2.4	9.7	2.4	9.7	2.4	9.7	ns
		n$\overline{OE}$ to nBn													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	5.6	41	4.8	32	5.1	30	4.4	26	5.1	27	4.1	24	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	5.1	34	4.4	25	4.6	23	3.8	18.5	4.6	19.5	3.6	17	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	4.7	32	4	23	4.3	21	3.4	16.5	4.2	17.5	3.3	15	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	4.3	29.5	3.6	20.6	3.9	18.5	3	14.5	3.9	15	2.9	12.1	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	4.2	29	3.5	19.5	3.7	17.5	2.9	13.5	3.7	14	2.7	11	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	4.1	28	3.3	19	3.6	16.5	2.7	12.5	3.5	13	2.5	10	ns
t_t	transition time	nAn, nBn output													
		$V_{CC(A)}$ = 1.1 V to 5.5 V	1	-	1	-	1	-	1	-	1	-	1	-	ns

[1] t_{pd} is the same as t_{PLH} and t_{PHL}; t_{dis} is the same as t_{PLZ} and t_{PHZ}; t_{en} is the same as t_{PZL} and t_{PZH}.

Table 13. Dynamic characteristics for temperature range -40 °C to +125 °C

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7; for waveforms see Fig. 5 and Fig. 6.

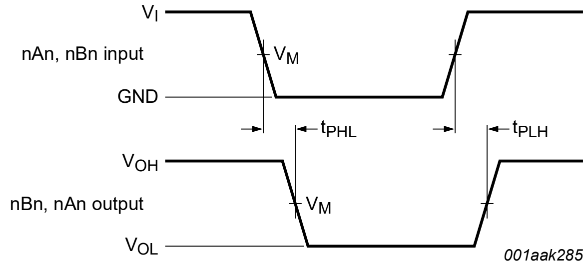
Symbol	Parameter	Conditions	$V_{CC(B)}$												Unit
			1.2 V ± 0.1 V		1.5 V ± 0.1 V		1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{pd}	propagation delay	nAn to nBn [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4	38	3.6	26	3.4	22	3.1	17	2.9	15	2.7	15	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.5	33	3	22	2.8	17.5	2.6	13.5	2.4	11.5	2.2	10.5	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	3.1	32	2.7	20	2.4	16	2.2	12	2.1	9.7	1.9	8.7	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	2.8	31	2.4	18.5	2.1	14.5	1.9	9.8	1.7	8.1	1.6	7.1	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	2.7	31	2.3	18	2	14	1.8	9.2	1.6	7.5	1.4	6.3	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	2.7	31	2.2	17.5	1.9	13.5	1.6	8.8	1.4	6.9	1.2	5.5	ns
		nBn to nAn													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4	38	3.5	33	3.1	32	2.8	31	2.7	31	2.7	31	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.6	26	3	22	2.7	20	2.4	18.5	2.3	18	2.2	17.5	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	3.4	22	2.8	17.5	2.4	16	2.1	14.5	2	14	1.9	13.5	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	3.1	17	2.6	13.5	2.2	12	1.9	9.8	1.8	9.2	1.6	8.8	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	2.9	15	2.4	11.5	2.1	9.7	1.7	8.1	1.6	7.5	1.4	6.9	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	2.7	15	2.2	10.5	1.9	8.7	1.6	7.1	1.4	6.3	1.2	5.5	ns

Symbol	Parameter	Conditions	$V_{CC(B)}$												Unit
			1.2 V ± 0.1 V		1.5 V ± 0.1 V		1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{en}	enable time	n$\overline{OE}$ to nAn [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4.6	48	4.6	48	4.6	48	4.6	48	4.6	48	4.6	48	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.6	25	3.6	25	3.6	25	3.6	25	3.6	25	3.6	25	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	2.9	18.5	2.9	18.5	2.9	18.5	2.9	18.5	2.9	18.5	2.9	18.5	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	2.3	11.5	2.3	11.5	2.3	11.5	2.3	11.5	2.3	11.5	2.3	11.5	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	2	8.7	2	8.7	2	8.7	2	8.7	2	8.7	2	8.7	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	1.8	6.5	1.8	6.5	1.8	6.5	1.8	6.5	1.8	6.5	1.8	6.5	ns
		n$\overline{OE}$ to nBn													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	5	46	4.6	32	4.1	28	4.1	25	4	26	4.1	26	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	4.2	40	3.8	25	3.5	21	3.3	17	3.3	16	3.3	15.5	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	3.9	36	3.3	23	3	19	2.8	14.5	2.8	13	2.8	12.5	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	3.4	35	2.8	19.5	2.5	15.5	2.3	12	2.2	10.5	2.2	9.1	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	3.2	34	2.7	18.5	2.3	14.5	2.1	10.5	1.9	8.7	1.9	7.6	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	3.1	37	2.4	18	2.1	14	1.9	9.4	1.8	7.9	1.7	6.7	ns

Symbol	Parameter	Conditions	$V_{CC(B)}$												Unit
			1.2 V ± 0.1 V		1.5 V ± 0.1 V		1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{dis}	disable time	$n\overline{OE}$ to nAn [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4.9	36	4.9	36	4.9	36	4.9	36	4.9	36	4.9	36	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.9	23	3.9	23	3.9	23	3.9	23	3.9	23	3.9	23	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	4	20	4	20	4	20	4	20	4	20	4	20	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	2.9	14	2.9	14	2.9	14	2.9	14	2.9	14	2.9	14	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	3.5	14	3.5	14	3.5	14	3.5	14	3.5	14	3.5	14	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	2.4	10.2	2.4	10.2	2.4	10.2	2.4	10.2	2.4	10.2	2.4	10.2	ns
		$n\overline{OE}$ to nBn													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	5.6	41	4.8	33	5.1	31	4.4	27	5.1	28	4.1	25	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	5.1	35	4.4	27	4.6	25	3.8	20	4.6	21	3.6	18	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	4.7	33	4	24	4.3	22	3.4	17.5	4.2	18.5	3.3	16	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	4.3	31	3.6	22	3.9	19.5	3	15.5	3.9	16	2.9	13	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	4.2	30	3.5	21	3.7	18.5	2.9	14.5	3.7	15	2.7	11.5	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	4.1	29	3.3	20	3.6	17.5	2.7	13.5	3.5	13.5	2.5	10.5	ns
t_t	transition time	nAn, nBn output													
		$V_{CC(A)}$ = 1.1 V to 5.5 V	1		1		1		1		1		1		ns

[1] t_{pd} is the same as t_{PLH} and t_{PHL}; t_{dis} is the same as t_{PLZ} and t_{PHZ}; t_{en} is the same as t_{PZL} and t_{PZH}.

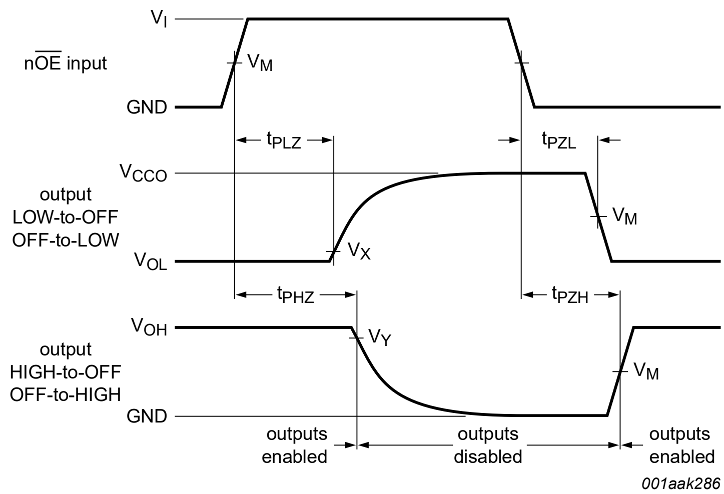
10.1. Waveforms and test circuit



Measurement points are given in Table 14.

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

Fig. 5. The data input (nAn, nBn) to output (nBn, nAn) propagation delay times



Measurement points are given in Table 14.

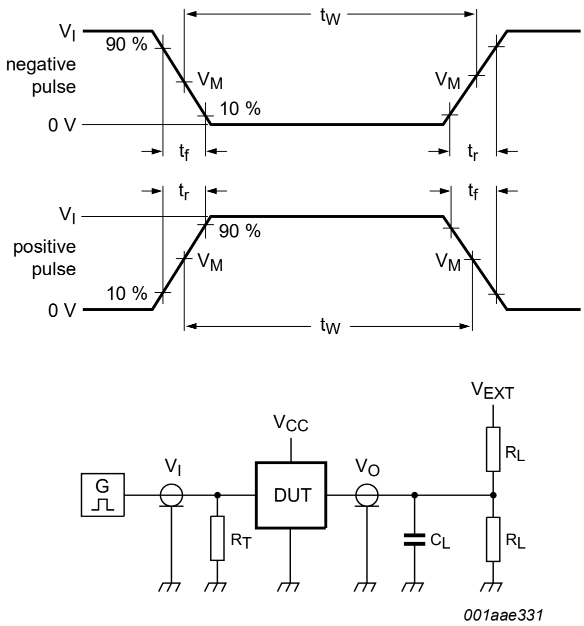
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 6. Enable and disable times

Table 14. Measurement points

Supply voltage	Input [1]	Output [2]		
$V_{CC(A)}$, $V_{CC(B)}$	V_M	V_M	V_X	V_Y
0.9 V to 1.6 V	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.1 V	V_{OH} - 0.1 V
1.65 V to 2.7 V	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.15 V	V_{OH} - 0.15 V
3.0 V to 5.5 V	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.3 V	V_{OH} - 0.3 V

[1] V_{CCI} is the supply voltage associated with the data input port.
[2] V_{CCO} is the supply voltage associated with the output port.



Test data is given in Table 15.
R_L = Load resistance.
C_L = Load capacitance including jig and probe capacitance.
R_T = Termination resistance.
V_{EXT} = External voltage for measuring switching times.

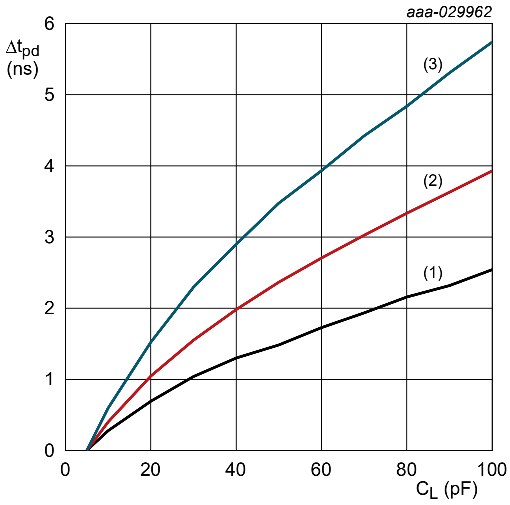
Fig. 7. Test circuit for measuring switching times

Table 15. Test data

Supply voltage	Load		Input		V_{EXT}		
$V_{CC(A)}$, $V_{CC(B)}$	C_L	R_L	t_r, t_f	V_I [1]	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ} [2]
0.9 V to 5.5 V	5 pF	10 kΩ	≤3.0 ns	V_{CCI}	GND	GND	$2V_{CCO}$

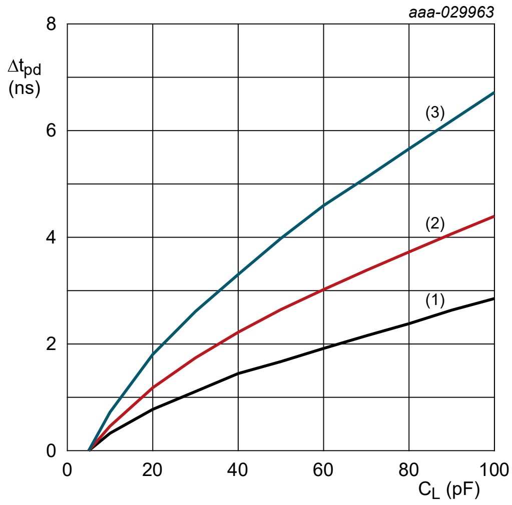
[1] V_{CCI} is the supply voltage associated with the data input port.
[2] V_{CCO} is the supply voltage associated with the output port.

10.2. Additional propagation delay versus load capacitance graphs



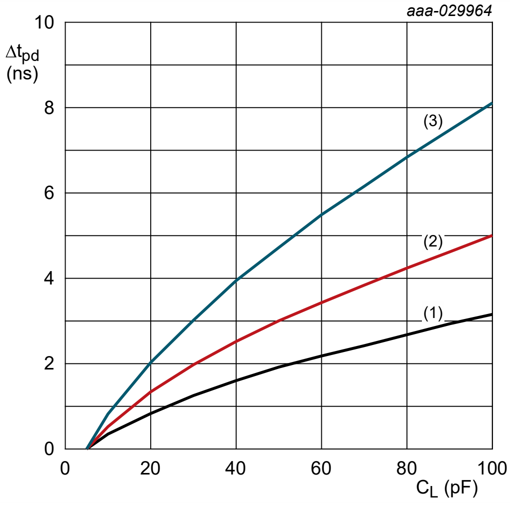
T_{amb} = -40 °C to +125 °C
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}
(1) Minimum: V_{CCO} = 5.5 V
(2) Typical: T_{amb} = 25 °C; V_{CCO} = 5 V
(3) Maximum: V_{CCO} = 4.5 V

Fig. 8. Additional propagation delay versus load capacitance



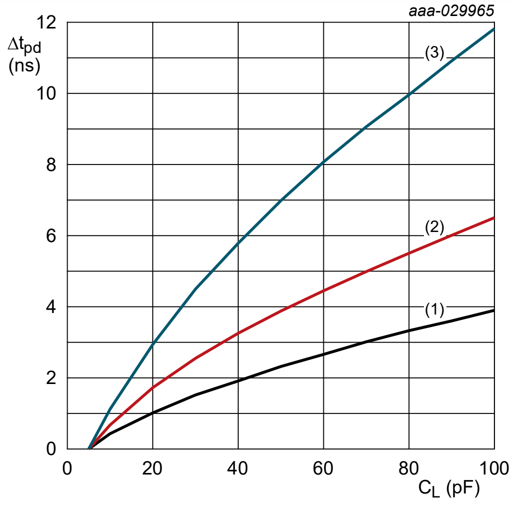
T_{amb} = -40 °C to +125 °C
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}
(1) Minimum: V_{CCO} = 3.6 V
(2) Typical: T_{amb} = 25 °C; V_{CCO} = 3.3 V
(3) Maximum: V_{CCO} = 3 V

Fig. 9. Additional propagation delay versus load capacitance



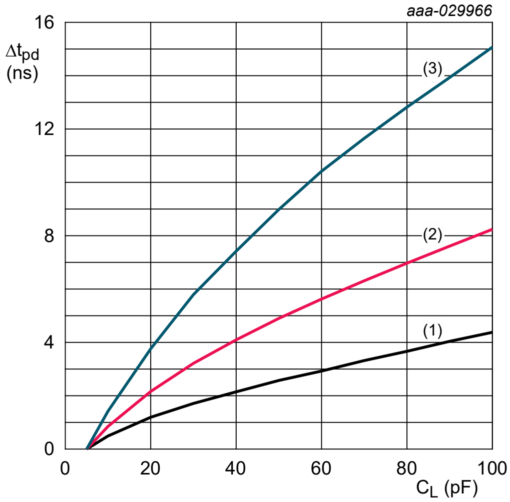
T_{amb} = -40 °C to +125 °C
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}
(1) Minimum: V_{CCO} = 2.7 V
(2) Typical: T_{amb} = 25 °C; V_{CCO} = 2.5 V
(3) Maximum: V_{CCO} = 2.3 V

Fig. 10. Additional propagation delay versus load capacitance



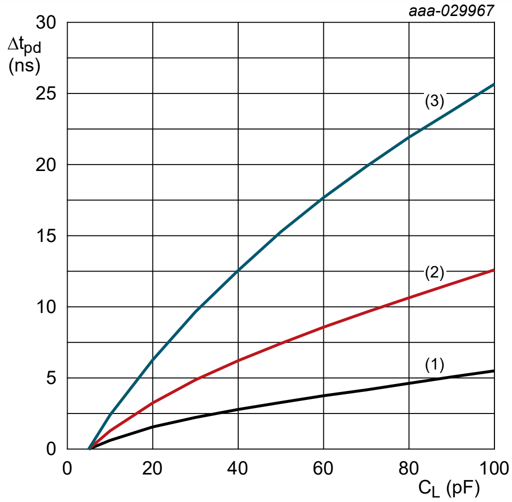
T_{amb} = -40 °C to +125 °C
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}
(1) Minimum: V_{CCO} = 1.95 V
(2) Typical: T_{amb} = 25 °C; V_{CCO} = 1.8 V
(3) Maximum: V_{CCO} = 1.65 V

Fig. 11. Additional propagation delay versus load capacitance



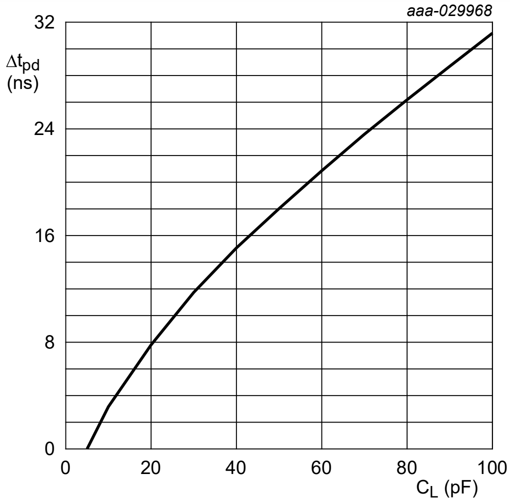
T_{amb} = -40 °C to +125 °C
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}
(1) Minimum: V_{CCO} = 1.6 V
(2) Typical: T_{amb} = 25 °C; V_{CCO} = 1.5 V
(3) Maximum: V_{CCO} = 1.4 V

Fig. 12. Additional propagation delay versus load capacitance



T_{amb} = -40 °C to +125 °C
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}
(1) Minimum: V_{CCO} = 1.3 V
(2) Typical: T_{amb} = 25 °C; V_{CCO} = 1.2 V
(3) Maximum: V_{CCO} = 1.1 V

Fig. 13. Additional propagation delay versus load capacitance



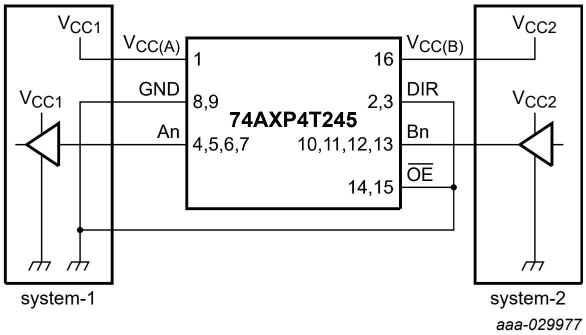
T_{amb} = 25 °C; V_{CCO} = 0.9 V
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}

Fig. 14. Additional propagation delay versus load capacitance

11. Application information

11.1. Unidirectional logic level-shifting application

The circuit given in Fig. 15 is an example of the 74AXP4T245 being used in an unidirectional logic level-shifting application.



Schematic given for one channel.

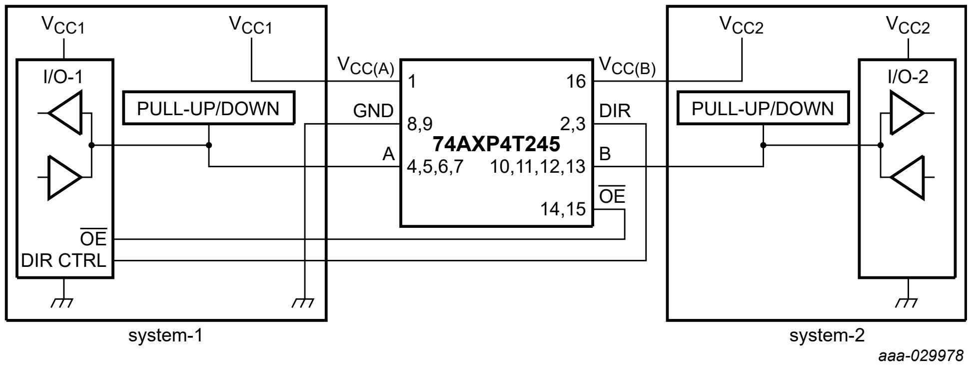
Fig. 15. Unidirectional logic level-shifting application

Table 16. Description unidirectional logic level-shifting application

Name	Function	Description
$V_{CC(A)}$	V_{CC1}	supply voltage of system-1 (0.9 V to 5.5 V)
GND	GND	device GND
A	OUT	output level depends on V_{CC1} voltage
B	IN	input threshold value depends on V_{CC2} voltage
DIR	DIR	the GND (LOW level) determines B port to A port direction
$V_{CC(B)}$	V_{CC2}	supply voltage of system-2 (0.9 V to 5.5 V)
$\overline{OE}$	$\overline{OE}$	The GND (LOW level) enables the output ports

11.2. Bidirectional logic level-shifting application

Fig. 16 shows the 74AXP4T245 being used in a bidirectional logic level-shifting application.



Schematic given for one channel.
Pull-up or pull-down only needed for 74AXP4T245.

Fig. 16. Bidirectional logic level-shifting application

Table 17 gives a sequence that will illustrate data transmission from system-1 to system-2 and then from system-2 to system-1.

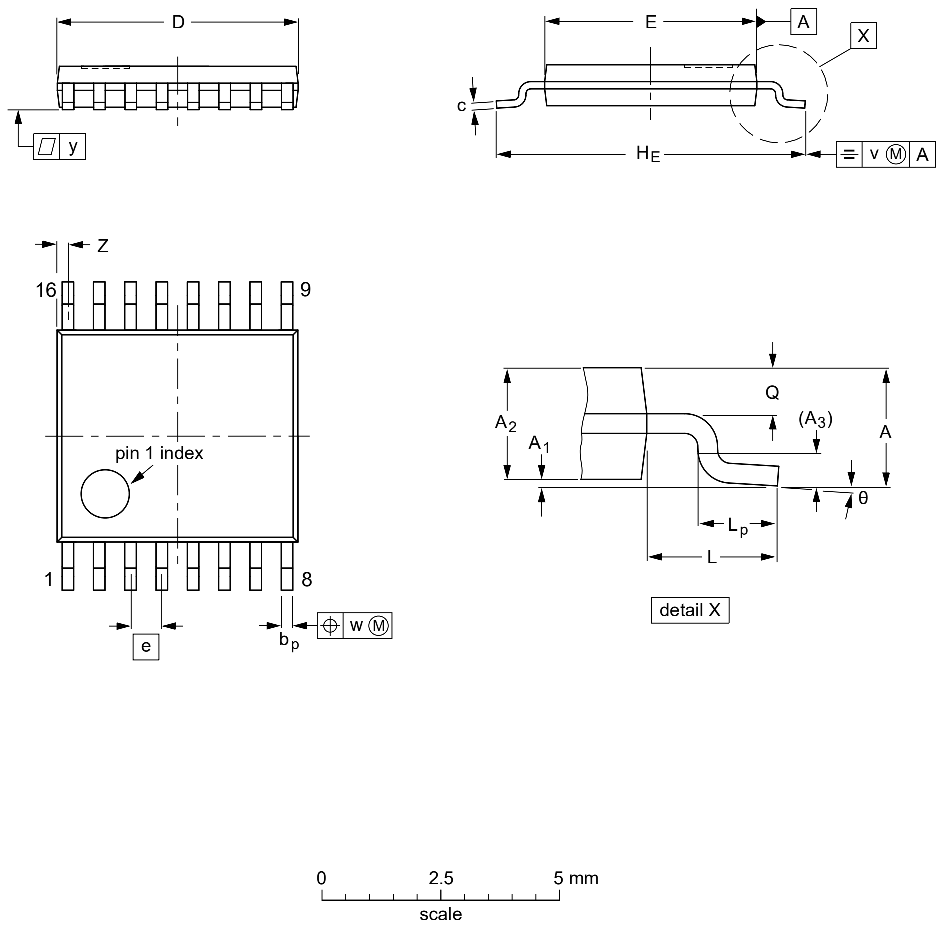
Table 17. Description bidirectional logic level-shifting application

H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

State	DIR CTRL	$\overline{OE}$	I/O-1	I/O-2	Description
1	H	L	output	input	system-1 data to system-2
2	H	H	Z	Z	system-2 is getting ready to send data to system-1. I/O-1 and I/O-2 are disabled. The bus-line state depends on bus hold.
3	L	H	Z	Z	DIR bit is set LOW. I/O-1 and I/O-2 still are disabled. The bus-line state depends on bus hold.
4	L	L	input	output	system-2 data to system-1

12. Package outline

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm **SOT403-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.40 0.06	8° 0°

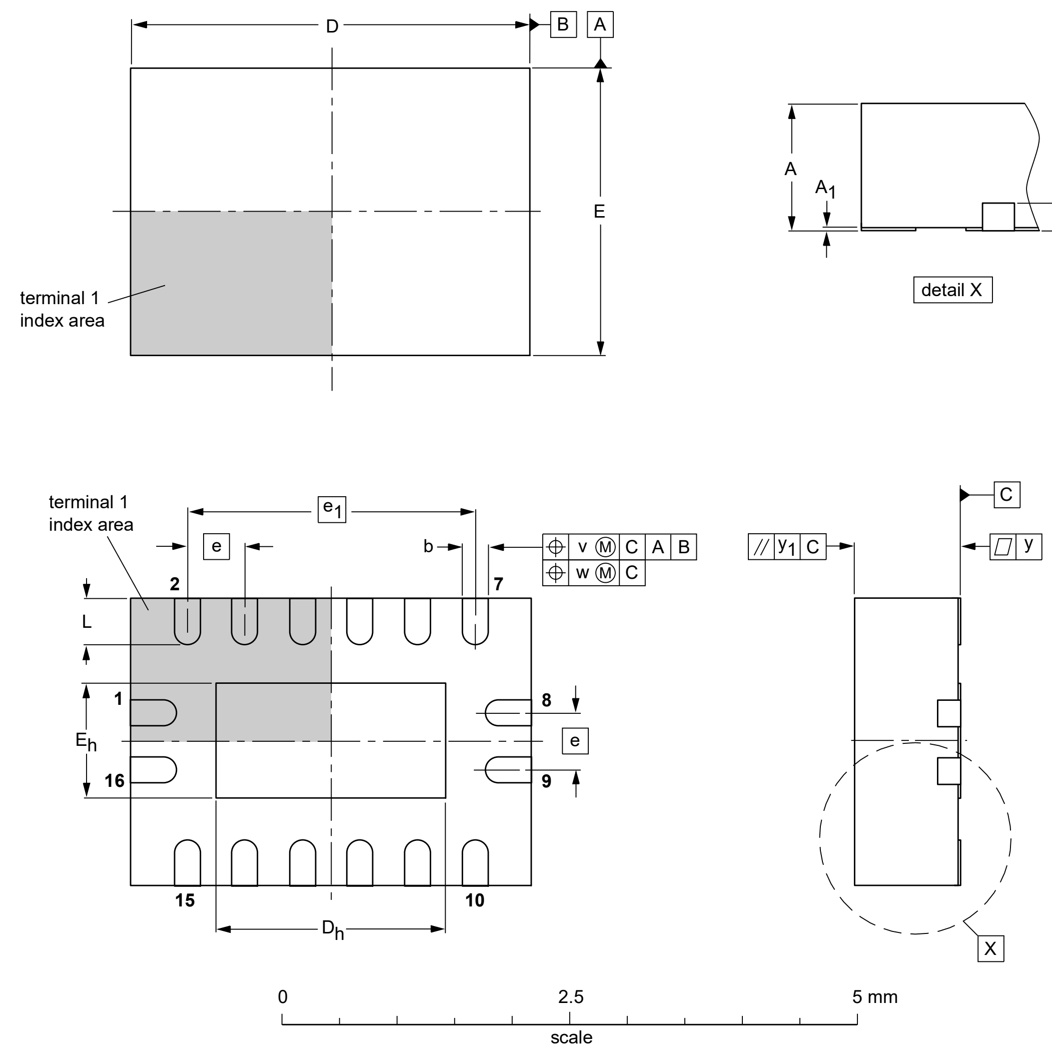
Notes

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			
SOT403-1		MO-153				~~99-12-27~~ 03-02-18

Fig. 17. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm **SOT763-1**



DIMENSIONS (mm are the original dimensions)

UNIT	$A^{(1)}$ max.	A_1	b	c	$D^{(1)}$	D_h	$E^{(1)}$	E_h	e	e_1	L	v	w	y	y_1
mm	1	0.05 0.00	0.30 0.18	0.2	3.6 3.4	2.15 1.85	2.6 2.4	1.15 0.85	0.5	2.5	0.5 0.3	0.1	0.05	0.05	0.1

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT763-1	- - -	MO-241	- - -			~~02-10-17~~ 03-01-27

Fig. 18. Package outline SOT763-1 (DHVQFN16)

13. Abbreviations

Table 18. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model

14. Revision history

Table 19. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AXP4T245 v.2	20200206	Product data sheet	-	-
Modifications:	• Section 1: General description updated.			
74AXP4T245 v.1	20190624	Product data sheet	-	-

15. 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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