74AXP1T45

1-bit dual supply translating transceiver; 3-state

Rev. 1 — 25 June 2020 Product data sheet

1. General description

The 74AXP1T45 is a single bit, dual supply transceiver with 3-state output that enables bidirectional level translation. It features two 1-bit input-output ports (A and B), a direction control input (DIR) 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 A and DIR are referenced to $V_{CC(A)}$ and pin B is referenced to $V_{CC(B)}$. A HIGH on DIR allows transmission from A to B and a LOW on DIR allows transmission from B to A.

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 A and B 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 = 1.5 pF (typical)
- Low output capacitance; C_O = 3.8 pF (typical)
- Low dynamic power consumption; C_{PD} = 11 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

nexperia

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AXP1T45GW	-40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363
74AXP1T45GX	-40 °C to +125 °C	X2SON6	plastic thermal enhanced extremely thin small outline package; no leads; 6 terminals; body 1.0 × 0.8 × 0.32 mm	SOT1255-2

4. Marking

Table 2. Marking

Type number	Marking code[1]
74AXP1T45GW	R5
74AXP1T45GX	R5

[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

5. Functional diagram

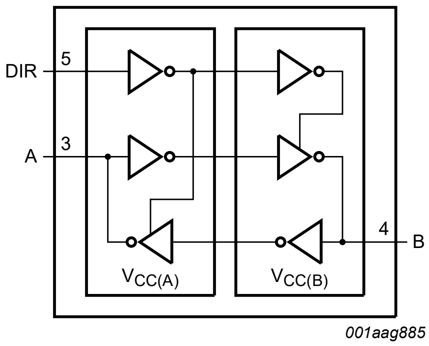


Fig. 1. Logic symbol

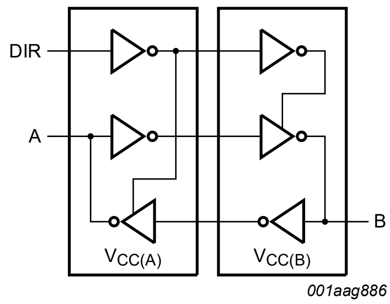


Fig. 2. Logic diagram

6. Pinning information

6.1. Pinning

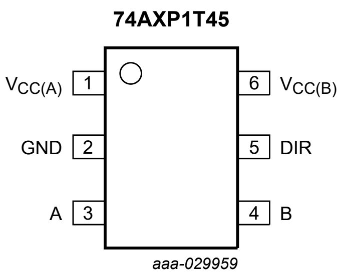
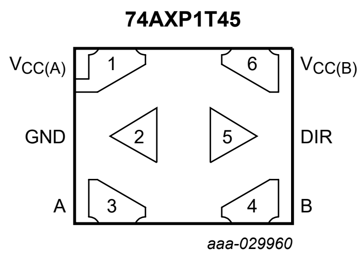


Fig. 3. Pin configuration SOT363 (SC-88)



Transparent top view

Fig. 4. Pin configuration SOT1255-2 (X2SON6)

6.2. Pin description

Table 3. Pin description

Symbol	Pin	Description
$V_{CC(A)}$	1	supply voltage A (A and DIR are referenced to $V_{CC(A)}$)
GND	2	ground (0 V)
A	3	data input or output
B	4	data input or output
DIR	5	direction control
$V_{CC(B)}$	6	supply voltage B (B is referenced to $V_{CC(B)}$)

7. Functional description

Table 4. 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]	
$V_{CC(A)}$, $V_{CC(B)}$	**DIR[2]**	**A[2]**	**B[2]**
0.9 V to 5.5 V	L	A = B	input
0.9 V to 5.5 V	H	input	B = A
GND[3]	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] A and DIR are referenced to $V_{CC(A)}$; B is referenced to $V_{CC(B)}$.
[3] If at least one of $V_{CC(A)}$ or $V_{CC(B)}$ is at GND level, the device goes into suspend mode.

8. Limiting values

Table 5. 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]	-	250	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 SOT363 (SC-88) package: P_{tot} derates linearly with 3.7 mW/K above 83 °C.
For SOT1255-2 (X2SON6) package: P_{tot} derates linearly with 3.3 mW/K above 75 °C.

9. Recommended operating conditions

Table 6. 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
Δt/ΔV	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} = 3.0 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.

10. Static characteristics

Table 7. 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	A, B and DIR 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	A, B and DIR 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	0.9	-	-	-	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	DIR 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	DIR 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	DIR 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	4	9	μA
		$V_{CC(A)}$ = 5.5 V; $V_{CC(B)}$ = 0 V	-	-	2	4	9	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	4	9	μA
		$V_{CC(B)}$ = 5.5 V; $V_{CC(A)}$ = 0 V	-	-	2	4	9	μA
		$V_{CC(B)}$ = 0 V; $V_{CC(A)}$ = 5.5 V	-	-	±0.1	±0.4	±1	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 input 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 8. 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	0.08	0.08	0.08	0.08	0.08	0.08	0.08	μA
1.2 V	0.01	0.10	0.10	0.10	0.10	0.10	0.10	0.10	μA
1.5 V	0.01	0.13	0.13	0.13	0.13	0.13	0.13	0.13	μA
1.8 V	0.01	0.16	0.16	0.16	0.16	0.16	0.16	0.16	μA
2.5 V	0.01	0.22	0.22	0.22	0.22	0.22	0.22	0.22	μA
3.3 V	0.01	0.29	0.29	0.29	0.29	0.29	0.29	0.29	μA
5.0 V	0.01	0.44	0.44	0.44	0.44	0.44	0.44	0.44	μA

Table 9. 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	0.08	0.10	0.13	0.16	0.22	0.29	0.44	μA
1.2 V	0.01	0.08	0.10	0.13	0.16	0.22	0.29	0.44	μA
1.5 V	0.01	0.08	0.10	0.13	0.16	0.22	0.29	0.44	μA
1.8 V	0.01	0.08	0.10	0.13	0.16	0.22	0.29	0.44	μA
2.5 V	0.01	0.08	0.10	0.13	0.16	0.22	0.29	0.44	μA
3.3 V	0.01	0.08	0.10	0.13	0.16	0.22	0.29	0.44	μA
5.0 V	0.01	0.08	0.10	0.13	0.16	0.22	0.29	0.44	μA

11. Dynamic characteristics

Table 10. 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	A to B	[1]	40	22	18.5	16.5	15	15	15	ns
		B to A	[1]	40	33	32	31	31	31	32	ns
t_{dis}	disable time	DIR to A	[1]	34	34	34	34	34	34	34	ns
		DIR to B	[1]	42	30	26	26	24	25	23	ns
t_{en}	enable time	DIR to A	[1]	82	63	58	57	55	56	55	ns
		DIR to B	[1]	74	56	53	51	49	49	49	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 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	A to B	[1]	40	33	32	31	31	31	32	ns
		B to A	[1]	40	22	18.5	16.5	15	15	15	ns
t_{dis}	disable time	DIR to A	[1]	34	16	11	10	7.0	7.7	5.3	ns
		DIR to B	[1]	42	31	28	28	27	27	27	ns
t_{en}	enable time	DIR to A	[1]	82	53	47	45	42	42	42	ns
		DIR to B	[1]	74	49	43	41	38	39	37	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 12. Typical dynamic characteristics at T_{amb} = 25 °C

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)	[1] [2]	1.5	1.6	1.7	1.7	1.9	2.1	2.7	pF
		A port: (direction B to A); B port: (direction A to B)	[1] [2]	10	10.4	10.6	10.7	10.9	11.3	12.1	pF
C_I	input capacitance	V_I = 0 V or V_{CCI}; V_{CCI} = 0 V to 5.5 V		1.9	1.9	1.9	1.9	1.9	1.9	1.9	pF
$C_{I/O}$	input/output capacitance	V_O = 0 V; V_{CCO} = 0 V		4.5	4.5	4.5	4.5	4.5	4.5	4.5	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 13. 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	A to B [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4.0	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	3.0	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	9.0	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	2.0	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	5.0	ns
		B to A													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4.0	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	3.0	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	2.0	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	9.0	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	5.0	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	DIR to A	[1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V		9.6	67.3	9.6	67.3	9.6	67.3	9.6	67.3	9.6	67.3	9.6	67.3	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V		7.4	37.5	7.4	37.5	7.4	37.5	7.4	37.5	7.4	37.5	7.4	37.5	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V		6.7	29	6.7	29	6.7	29	6.7	29	6.7	29	6.7	29	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V		4.9	19	4.9	19	4.9	19	4.9	19	4.9	19	4.9	19	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V		5.3	17.3	5.3	17.3	5.3	17.3	5.3	17.3	5.3	17.3	5.3	17.3	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V		3.7	12	3.7	12	3.7	12	3.7	12	3.7	12	3.7	12	ns
		DIR to B														
		$V_{CC(A)}$ = 1.2 V ± 0.1 V		8.9	58.3	8.5	49.3	8.3	47	8.0	45.8	7.8	45	7.6	44.7	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V		7.4	45.2	6.9	32.5	6.7	29.8	6.5	27.2	6.3	26.6	6.1	26	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V		7.1	42	6.7	28.9	6.4	26.2	6.2	23.9	6.1	23	5.9	22.5	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V		5.7	37	5.3	25	5.0	22.5	4.8	20.1	4.6	19	4.5	18.4	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V		6.2	37.2	5.8	23.8	5.5	21.2	5.3	18.6	5.1	17.7	4.9	17.1	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V		5.1	33.7	4.6	21	4.3	18.2	4.0	15.7	3.8	14.6	3.6	13.9	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	DIR to A [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4.9	31	4.9	31	4.9	31	4.9	31	4.9	31	4.9	31	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.9	17.8	3.9	17.8	3.9	17.8	3.9	17.8	3.9	17.8	3.9	17.8	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	4.0	15.9	4.0	15.9	4.0	15.9	4.0	15.9	4.0	15.9	4.0	15.9	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	2.9	12.9	2.9	12.9	2.9	12.9	2.9	12.9	2.9	12.9	2.9	12.9	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	3.5	12.3	3.5	12.3	3.5	12.3	3.5	12.3	3.5	12.3	3.5	12.3	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	2.4	9.6	2.4	9.6	2.4	9.6	2.4	9.6	2.4	9.6	2.4	9.6	ns
		DIR to B													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	5.6	36.8	4.8	27.9	5.1	26.7	4.4	22.8	5.1	23.5	4.1	20.7	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	5.1	32.3	4.4	23.1	4.6	21.8	3.8	17.6	4.6	18.5	3.6	15.8	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	4.7	30.9	4.0	21.5	4.3	20	3.4	16	4.2	15.5	3.3	13.2	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	4.3	29	3.6	20	3.9	17.7	3.0	14	3.9	14.3	2.9	10.7	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	4.2	28.9	3.5	19	3.7	16.7	2.9	12.6	3.7	13	2.7	10.3	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	4.1	27.8	3.3	18.9	3.6	16.5	2.7	12.4	3.5	12.4	2.5	9.4	ns
t_t	transition time	A, B output													
		$V_{CC(A)}$ = 1.1 V to 5.5 V	1.0	-	1.0	-	1.0	-	1.0	-	1.0	-	1.0	-	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 14. 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.

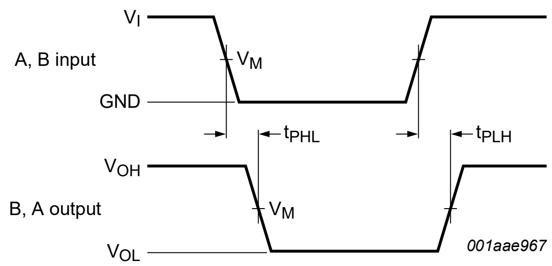
Symbol	Parameter	Conditions	$V_{CC(B)}$												Unit
			1.2 V ± 0.1 V		1.5 V ± 0.1 V		1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{pd}	propagation delay	A to B [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4.0	38	3.6	26	3.4	22	3.1	17	2.9	15	2.7	15	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.5	33	3.0	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	9.4	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	2.0	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
		B to A													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4.0	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	3.0	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	2.0	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	9.4	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	DIR to A [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	9.6	67.6	9.6	67.6	9.6	67.6	9.6	67.6	9.6	67.6	9.6	67.6	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	7.4	38	7.4	38	7.4	38	7.4	38	7.4	38	7.4	38	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	6.7	30.2	6.7	30.2	6.7	30.2	6.7	30.2	6.7	30.2	6.7	30.2	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	4.9	19.9	4.9	19.9	4.9	19.9	4.9	19.9	4.9	19.9	4.9	19.9	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	5.3	17.9	5.3	17.9	5.3	17.9	5.3	17.9	5.3	17.9	5.3	17.9	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	3.7	12.2	3.7	12.2	3.7	12.2	3.7	12.2	3.7	12.2	3.7	12.2	ns
		DIR to B													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	8.9	58.6	8.5	49.8	8.3	47.3	8.0	46	7.8	45.5	7.6	44.9	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	7.4	45.9	6.9	33.3	6.7	30	6.5	27.8	6.3	26.8	6.1	26.3	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	7.1	42.5	6.7	30	6.4	27	6.2	24.5	6.1	24	5.9	23	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	5.7	37.6	5.3	25.2	5.0	22.7	4.8	20.3	4.6	19.2	4.5	18.5	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	6.2	37.5	5.8	24.8	5.5	21.5	5.3	18.9	5.1	18	4.9	17.3	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	5.1	34.1	4.6	21.5	4.3	18.5	4.0	15.9	3.8	14.8	3.6	14	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	DIR to A [1]													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	4.9	31.2	4.9	31.2	4.9	31.2	4.9	31.2	4.9	31.2	4.9	31.2	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	3.9	18	3.9	18	3.9	18	3.9	18	3.9	18	3.9	18	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	4.0	16	4.0	16	4.0	16	4.0	16	4.0	16	4.0	16	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	12.4	3.5	12.4	3.5	12.4	3.5	12.4	3.5	12.4	3.5	12.4	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
		DIR to B													
		$V_{CC(A)}$ = 1.2 V ± 0.1 V	5.6	37	4.8	28.3	5.1	27.1	4.4	23.2	5.1	23.8	4.1	21	ns
		$V_{CC(A)}$ = 1.5 V ± 0.1 V	5.1	32.6	4.4	23.6	4.6	22	3.8	18	4.6	18.7	3.6	16	ns
		$V_{CC(A)}$ = 1.8 V ± 0.15 V	4.7	31.1	4.0	22	4.3	20.1	3.4	16.1	4.2	15.6	3.3	13.4	ns
		$V_{CC(A)}$ = 2.5 V ± 0.2 V	4.3	29.8	3.6	20.2	3.9	17.9	3.0	14.1	3.9	14.4	2.9	10.9	ns
		$V_{CC(A)}$ = 3.3 V ± 0.3 V	4.2	29.1	3.5	19.1	3.7	16.9	2.9	12.9	3.7	13.1	2.7	10.4	ns
		$V_{CC(A)}$ = 5.0 V ± 0.5 V	4.1	28	3.3	19	3.6	16.7	2.7	12.5	3.5	12.5	2.5	9.5	ns
t_t	transition time	A, B output													
		$V_{CC(A)}$ = 1.1 V to 5.5 V	1.0	-	1.0	-	1.0	-	1.0	-	1.0	-	1.0	-	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}.

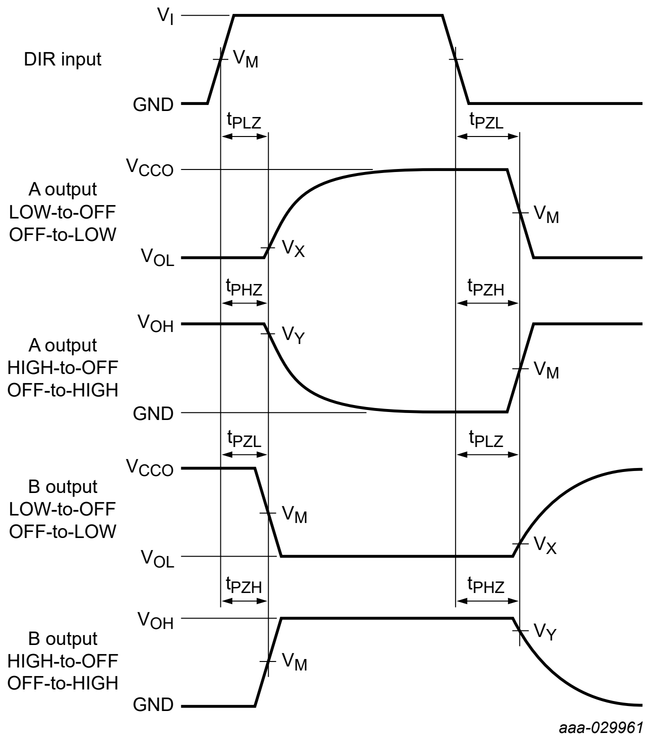
11.1. Waveforms and test circuit



Measurement points are given in Table 15.

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

Fig. 5. The data input (A, B) to output (B, A) propagation delay times



Measurement points are given in Table 15.

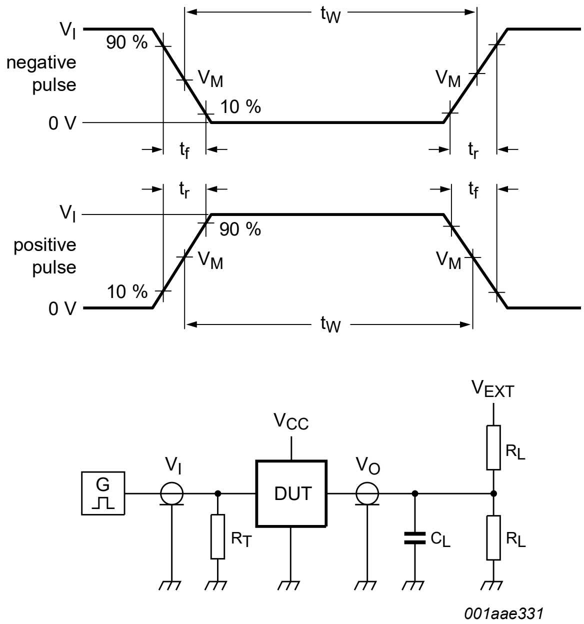
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 6. Enable and disable times

Table 15. 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 control input or input port.
[2] V_{CCO} is the supply voltage associated with the output port.



Test data is given in Table 16.

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.

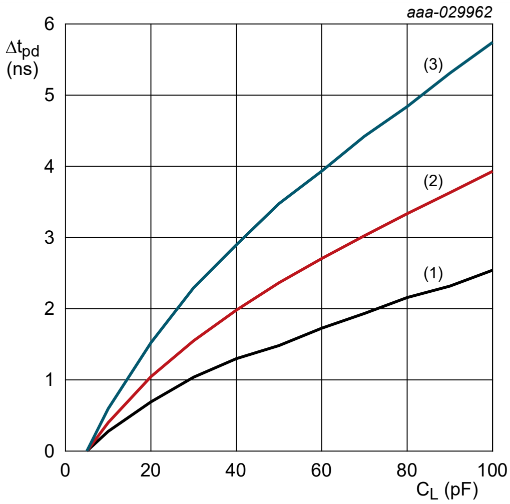
Fig. 7. Test circuit for measuring switching times

Table 16. 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	$2V_{CCO}$

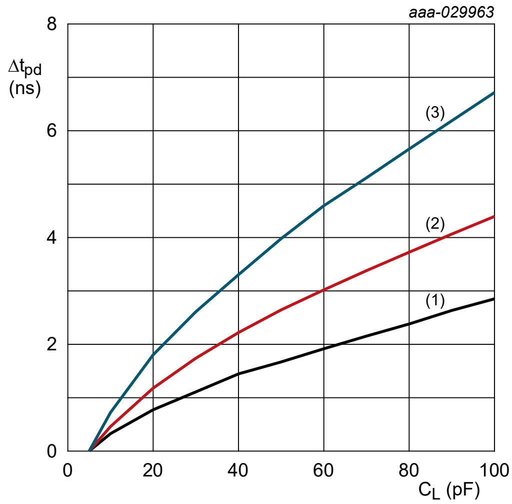
[1] V_{CCI} is the supply voltage associated with the control input or input port.
[2] V_{CCO} is the supply voltage associated with the output port.

11.2. Additional propagation delay versus load capacitance graphs



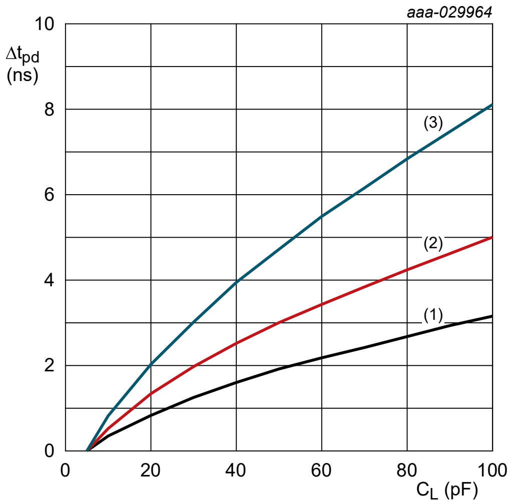
T_{amb} = -40 °C to +125 °C
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}
(1) Minimum: V_{CCO} = 5.5 V
(2) Typical: T_{amb} = 25 °C; V_{CCO} = 5 V
(3) Maximum: V_{CCO} = 4.5 V

Fig. 8. Additional propagation delay versus load capacitance



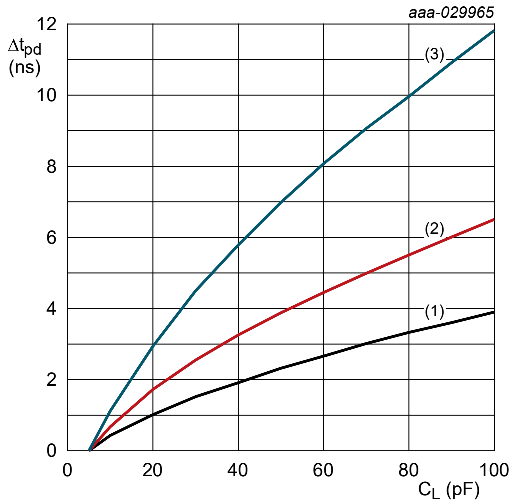
T_{amb} = -40 °C to +125 °C
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}
(1) Minimum: V_{CCO} = 3.6 V
(2) Typical: T_{amb} = 25 °C; V_{CCO} = 3.3 V
(3) Maximum: V_{CCO} = 3 V

Fig. 9. Additional propagation delay versus load capacitance



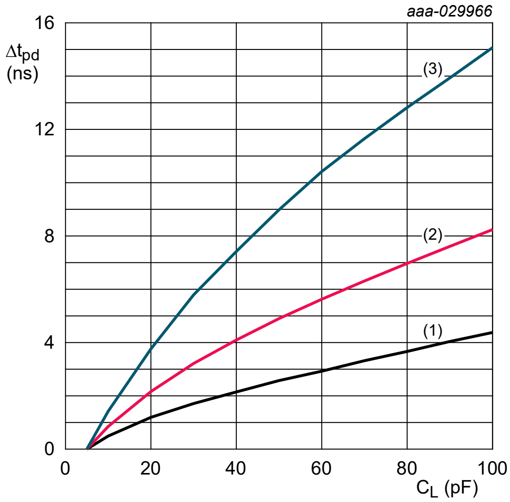
T_{amb} = -40 °C to +125 °C
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}
(1) Minimum: V_{CCO} = 2.7 V
(2) Typical: T_{amb} = 25 °C; V_{CCO} = 2.5 V
(3) Maximum: V_{CCO} = 2.3 V

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

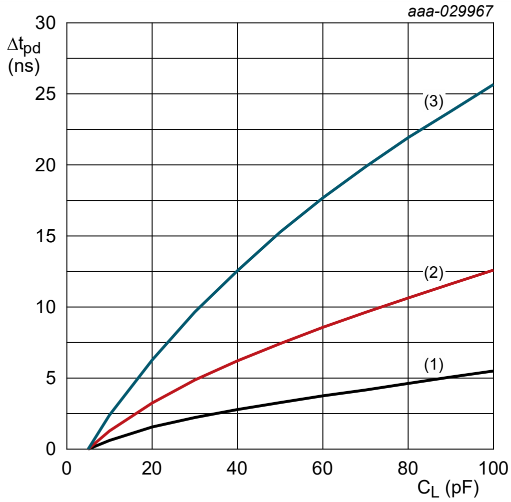
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}

(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

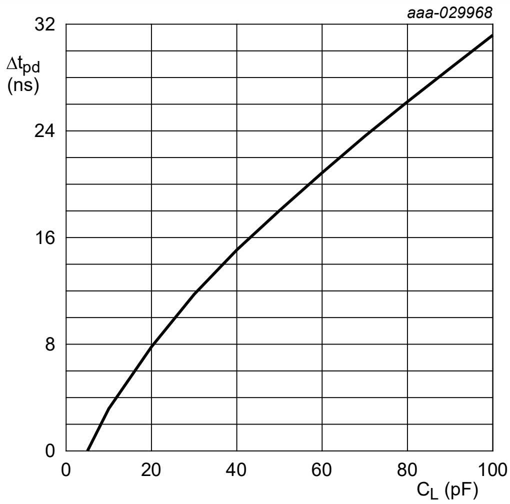
For t_{PLH}, t_{PHL}, t_{PZH} and t_{PZL}

(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

12. Application information

12.1. Unidirectional logic level-shifting application

The circuit given in Fig. 15 is an example of the 74AXP1T45 being used in an unidirectional logic level-shifting application.

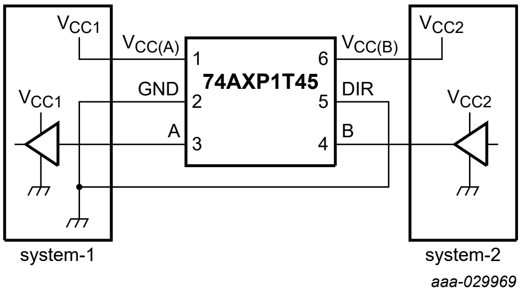


Fig. 15. Unidirectional logic level-shifting application

Table 17. Description unidirectional logic level-shifting application

Pin	Name	Function	Description
1	$V_{CC(A)}$	V_{CC1}	supply voltage of system-1 (0.9 V to 5.5 V)
2	GND	GND	device GND
3	A	OUT	output level depends on V_{CC1} voltage
4	B	IN	input threshold value depends on V_{CC2} voltage
5	DIR	DIR	the GND (LOW level) determines B port to A port direction
6	$V_{CC(B)}$	V_{CC2}	supply voltage of system-2 (0.9 V to 5.5 V)

12.2. Bidirectional logic level-shifting application

Fig. 16 shows the 74AXP1T45 being used in a bidirectional logic level-shifting application. Since the device does not have an output enable pin, the system designer should take precautions to avoid bus contention between system-1 and system-2 when changing directions.

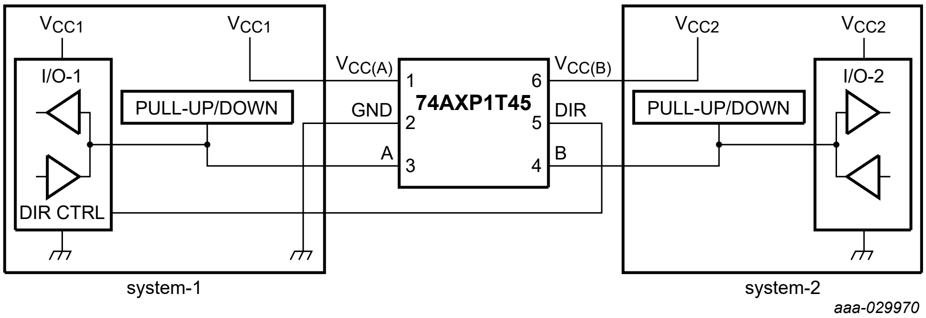


Fig. 16. Bidirectional logic level-shifting application

Table 18 gives a sequence that will illustrate data transmission from system-1 to system-2 and then from system-2 to system-1.

Table 18. Description bidirectional logic level-shifting application

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

State	DIR CTRL	I/O-1	I/O-2	Description
1	H	output	input	system-1 data to system-2
2	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	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	input	output	system-2 data to system-1

12.3. Enable times

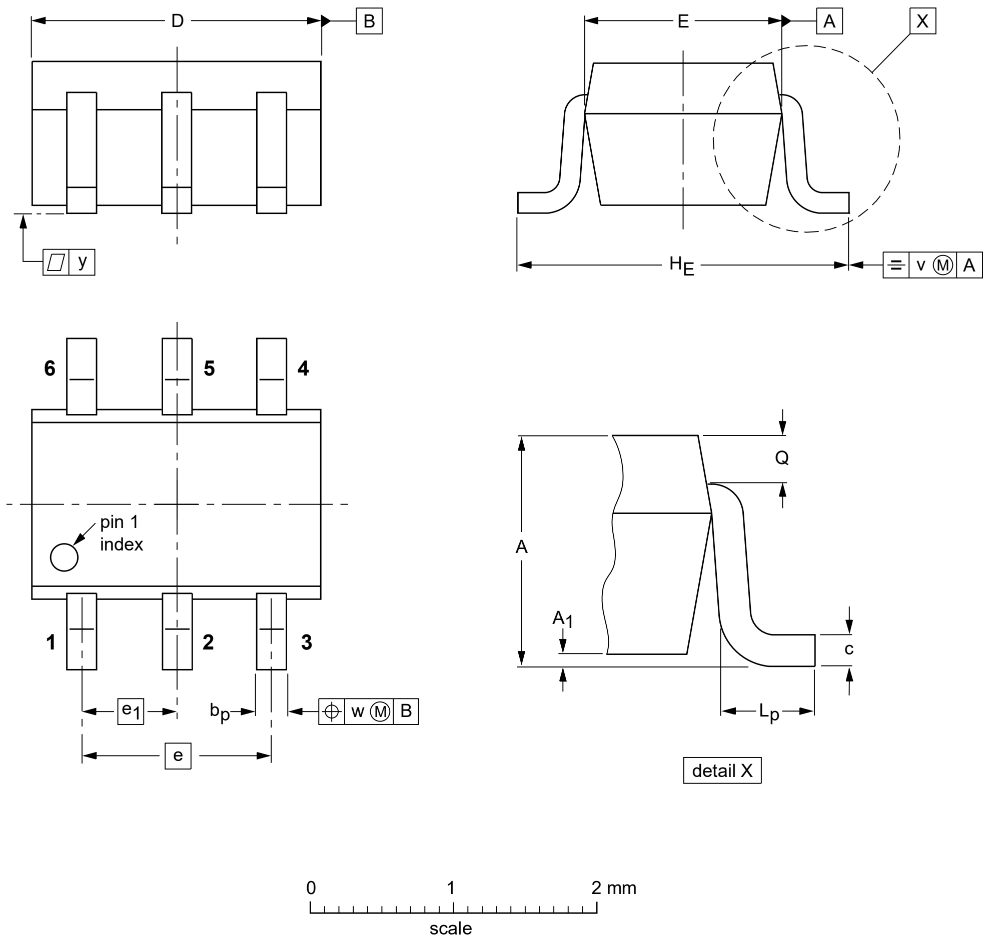
Calculate the enable times for the 74AXP1T45 using the following formulas:

- Direction A to B:
  - t_{PZL} (DIR to B) = t_{PHL} (A to B) + t_{PHZ} (DIR to A)
  - t_{PZH} (DIR to B) = t_{PLH} (A to B) + t_{PLZ} (DIR to A)
- Direction B to A:
  - t_{PZL} (DIR to A) = t_{PHL} (B to A) + t_{PHZ} (DIR to B)
  - t_{PZH} (DIR to A) = t_{PLH} (B to A) + t_{PLZ} (DIR to B)

In a bidirectional application, these enable times provide the maximum delay from the time the DIR bit is switched until an output is expected. For example, if the 74AXP1T45 initially is transmitting from A to B, then the DIR bit is switched, the B port of the device must be disabled before presenting it with an input. After the B port has been disabled, an input signal applied to it appears on the corresponding A port after the specified propagation delay.

13. Package outline

Plastic surface-mounted package; 6 leads **SOT363**



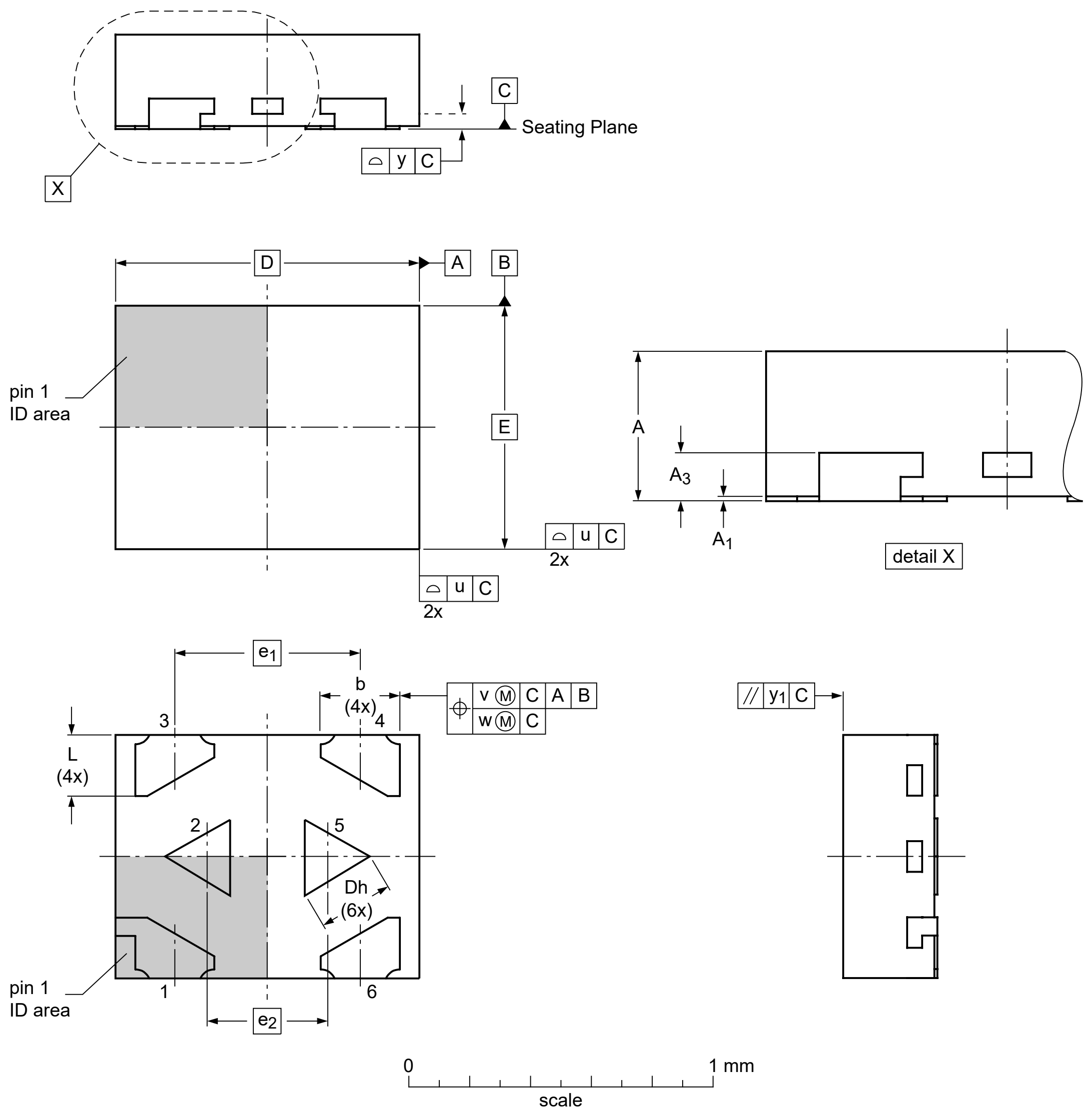
DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			~~04-11-08~~ 06-03-16

Fig. 17. Package outline SOT363 (SC-88)

X2SON6: plastic thermal enhanced extremely thin small outline package; no leads; 6 terminals; body 1.0 x 0.8 x 0.32 mm **SOT1255-2**



Dimensions (mm are the original dimensions)

Unit		A	A_1	A_3	b	D	D_h	E	e_1	e_2	L	y	y_1	u	v	w
mm	max	0.35	0.04		0.31		0.30				0.25					
	nom	0.32	0.02	0.10 (Typ.)	0.26	1.00	0.25	0.80	0.60	0.40	0.20	0.05	0.05	0.05	0.10	0.05
	min	0.30	0.00		0.21		0.20				0.15					

sot1255-2_po

Outline version	References IEC	References JEDEC	References JEITA		European projection	Issue date
SOT1255-2		- - -				~~19-11-07~~ 19-11-08

Fig. 18. Package outline SOT1255-2 (X2SON6)

14. Abbreviations

Table 19. Abbreviations

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

15. Revision history

Table 20. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AXP1T45 v.1	20200625	Product data sheet	-	-

16. 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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