74LVC2T45; 74LVCH2T45

Dual supply translating transceiver; 3-state

Rev. 10 — 11 May 2021 — Product data sheet

1. General description

The 74LVC2T45; 74LVCH2T45 are dual bit, dual supply translating transceivers with 3-state outputs that enable bidirectional level translation. They feature two 2-bits input-output ports (nA and nB), 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 1.2 V and 5.5 V making the device suitable for translating between any of the low voltage nodes (1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V and 5.0 V). Pins nA and DIR are referenced to $V_{CC(A)}$ and pins nB are referenced to $V_{CC(B)}$. A HIGH on DIR allows transmission from nA to nB and a LOW on DIR allows transmission from nB to nA.

The devices are 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 port and B port are in the high-impedance OFF-state.

Active bus hold circuitry in the 74LVCH2T45 holds unused or floating data inputs at a valid logic level.

2. Features and benefits

- Wide supply voltage range:
  - $V_{CC(A)}$: 1.2 V to 5.5 V
  - $V_{CC(B)}$: 1.2 V to 5.5 V
- High noise immunity
- Complies with JEDEC standards:
  - JESD8-7 (1.2 V to 1.95 V)
  - JESD8-5 (1.8 V to 2.7 V)
  - JESD8C (2.7 V to 3.6 V)
  - JESD36 (4.5 V to 5.5 V)
- ESD protection:
  - HBM JESD22-A114F Class 3A exceeds 4000 V
  - MM JESD22-A115-A exceeds 200 V
  - CDM JESD22-C101E exceeds 1000 V
- Maximum data rates:
  - 420 Mbps (3.3 V to 5.0 V translation)
  - 210 Mbps (translate to 3.3 V))
  - 140 Mbps (translate to 2.5 V)
  - 75 Mbps (translate to 1.8 V)
  - 60 Mbps (translate to 1.5 V)
- Suspend mode
- Latch-up performance exceeds 100 mA per JESD 78 Class II
- ±24 mA output drive (V_{CC} = 3.0 V)
- Inputs accept voltages up to 5.5 V
- Low power consumption: 16 μA maximum I_{CC}
- I_{OFF} circuitry provides partial Power-down mode operation
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

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3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC2T45DC	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1
74LVCH2T45DC				
74LVC2T45GT	-40 °C to +125 °C	XSON8	plastic extremely thin small outline package; no leads; 8 terminals; body 1 × 1.95 × 0.5 mm	SOT833-1
74LVCH2T45GT				
74LVC2T45GF	-40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body 1.35 × 1 × 0.5 mm	SOT1089
74LVCH2T45GF				
74LVC2T45GM	-40 °C to +125 °C	XQFN8	plastic, extremely thin quad flat package; no leads; 8 terminals; body 1.6 × 1.6 × 0.5 mm	SOT902-2
74LVC2T45GN	-40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body 1.2 × 1.0 × 0.35 mm	SOT1116
74LVCH2T45GN				
74LVC2T45GS	-40 °C to +125 °C	XSON8	extremely thin small outline package; no leads; 8 terminals; body 1.35 × 1.0 × 0.35 mm	SOT1203
74LVCH2T45GS				

4. Marking

Table 2. Marking

Type number	Marking code [1]
74LVC2T45DC	V45
74LVCH2T45DC	X45
74LVC2T45GT	V45
74LVCH2T45GT	X45
74LVC2T45GF	V5
74LVCH2T45GF	X5
74LVC2T45GM	V45
74LVC2T45GN	V5
74LVCH2T45GN	X5
74LVC2T45GS	V5
74LVCH2T45GS	X5

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

5. Functional diagram

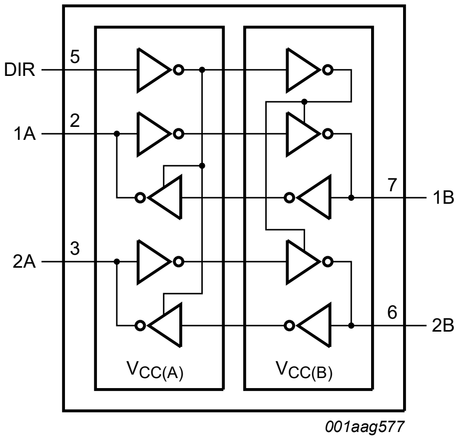


Fig. 1. Logic symbol

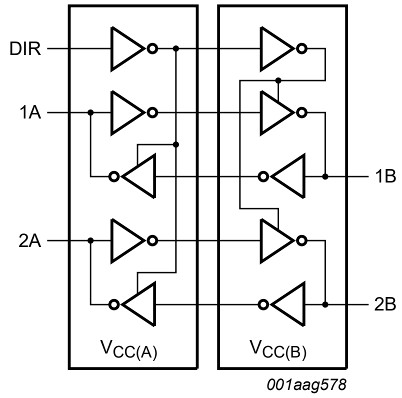


Fig. 2. Logic diagram

6. Pinning information

6.1. Pinning

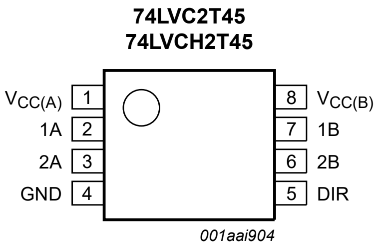


Fig. 3. Pin configuration SOT765-1 (VSSOP8)

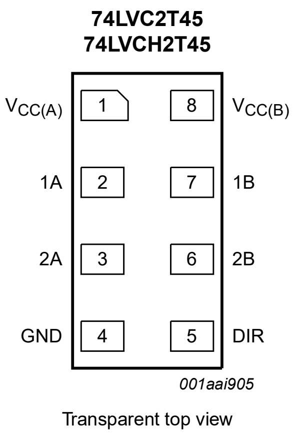


Fig. 4. Pin configuration SOT833-1, SOT1089, SOT1116 and SOT1203 (XSON8)

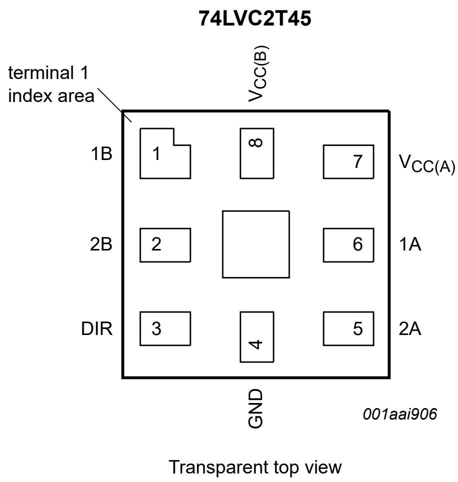


Fig. 5. Pin configuration SOTSOT902-2 (XQFN8)

6.2. Pin description

Table 3. Pin description

Symbol	Pin		Description
	SOT765-1, SOT833-1, SOT1089, SOT1116 and SOT1203	**SOT902-2**	
$V_{CC(A)}$	1	7	supply voltage A (port A and DIR)
1A	2	6	data input or output
2A	3	5	data input or output
GND	4	4	ground (0 V)
DIR	5	3	direction control
2B	6	2	data input or output
1B	7	1	data input or output
$V_{CC(B)}$	8	8	supply voltage B (port 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**	**nA**	**nB**
1.2 V to 5.5 V	L	nA = nB	input
1.2 V to 5.5 V	H	input	nB = nA
GND [2]	X	Z	Z

[1] The input circuit of the data I/O is always active.

[2] When either $V_{CC(A)}$ 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		-50	-	mA
V_I	input voltage		[1]	-0.5	+6.5	V
I_{OK}	output clamping current	$V_O < 0$ V		-50	-	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]	-	±50	mA
I_{CC}	supply current	$I_{CC(A)}$ or $I_{CC(B)}$		-	100	mA
I_{GND}	ground current			-100	-	mA
T_{stg}	storage temperature			-65	+150	°C
P_{tot}	total power dissipation	T_{amb} = -40 °C to +125 °C	[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 SOT765-1 (VSSOP8) package: P_{tot} derates linearly with 4.9 mW/K above 99 °C.
For SOT833-1 (XSON8) package: P_{tot} derates linearly with 3.1 mW/K above 68 °C.
For SOT1089 (XSON8) package: P_{tot} derates linearly with 4.0 mW/K above 88 °C.
For SOT902-2 (XQFN8) packages: P_{tot} derates linearly with 4.1 mW/K above 89 °C.
For SOT1116 (XSON8) package: P_{tot} derates linearly with 4.2 mW/K above 90 °C.
For SOT1203 (XSON8) package: P_{tot} derates linearly with 3.6 mW/K above 81 °C.

9. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{CC(A)}$	supply voltage A			1.2	5.5	V
$V_{CC(B)}$	supply voltage B			1.2	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} = 1.2 V	[2]	-	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		-	5	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. Typical static characteristics at T_{amb} = 25 °C

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}; I_O = -3 mA; V_{CCO} = 1.2 V	[1]	-	1.09	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}; I_O = 3 mA; V_{CCO} = 1.2 V	[1]	-	0.07	-	V
I_I	input leakage current	DIR input; V_I = 0 V to 5.5 V; V_{CCI} = 1.2 V to 5.5 V	[2]	-	-	±1	μA
I_{BHL}	bus hold LOW current	A or B port; V_I = 0.42 V; V_{CCI} = 1.2 V	[2]	-	19	-	μA
I_{BHH}	bus hold HIGH current	A or B port; V_I = 0.78 V; V_{CCI} = 1.2 V	[2]	-	-19	-	μA
I_{BHLO}	bus hold LOW overdrive current	A or B port; V_{CCI} = 1.2 V	[2] [3]	-	19	-	μA
I_{BHHO}	bus hold HIGH overdrive current	A or B port; V_{CCI} = 1.2 V	[2] [3]	-	-19	-	μA
I_{OZ}	OFF-state output current	A or B port; V_O = 0 V or V_{CCO}; V_{CCO} = 1.2 V to 5.5 V	[1]	-	-	±1	μA
I_{OFF}	power-off leakage current	A port; V_I or V_O = 0 V to 5.5 V; $V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 1.2 V to 5.5 V		-	-	±1	μA
		B port; V_I or V_O = 0 V to 5.5 V; $V_{CC(B)}$ = 0 V; $V_{CC(A)}$ = 1.2 V to 5.5 V		-	-	±1	μA
C_I	input capacitance	DIR input; V_I = 0 V or 3.3 V; $V_{CC(A)} = V_{CC(B)}$ = 3.3 V		-	2.2	-	pF
$C_{I/O}$	input/output capacitance	A and B port; suspend mode; V_O = 3.3 V or 0 V; $V_{CC(A)} = V_{CC(B)}$ = 3.3 V		-	6.0	-	pF

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

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

[3] To guarantee the node switches, an external driver must source/sink at least I_{BHLO}/I_{BHHO} when the input is in the range V_{IL} to V_{IH}.

Table 8. 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	Max	Min	Max	
V_{IH}	HIGH-level input voltage	data input	[1]					
		V_{CCI} = 1.2 V		$0.8V_{CCI}$	-	$0.8V_{CCI}$	-	V
		V_{CCI} = 1.4 V to 1.95 V		$0.65V_{CCI}$	-	$0.65V_{CCI}$	-	V
		V_{CCI} = 2.3 V to 2.7 V		1.7	-	1.7	-	V
		V_{CCI} = 3.0 V to 3.6 V		2.0	-	2.0	-	V
		V_{CCI} = 4.5 V to 5.5 V		$0.7V_{CCI}$	-	$0.7V_{CCI}$	-	V
		DIR input						
		V_{CCI} = 1.2 V		$0.8V_{CC(A)}$	-	$0.8V_{CC(A)}$	-	V
		V_{CCI} = 1.4 V to 1.95 V		$0.65V_{CC(A)}$	-	$0.65V_{CC(A)}$	-	V
		V_{CCI} = 2.3 V to 2.7 V		1.7	-	1.7	-	V
		V_{CCI} = 3.0 V to 3.6 V		2.0	-	2.0	-	V
		V_{CCI} = 4.5 V to 5.5 V		$0.7V_{CC(A)}$	-	$0.7V_{CC(A)}$	-	V

Symbol	Parameter	Conditions	-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Max	Min	Max	
V_{IL}	LOW-level input voltage	data input [1]					
		V_{CCI} = 1.2 V	-	$0.2V_{CCI}$	-	$0.2V_{CCI}$	V
		V_{CCI} = 1.4 V to 1.95 V	-	$0.35V_{CCI}$	-	$0.35V_{CCI}$	V
		V_{CCI} = 2.3 V to 2.7 V	-	0.7	-	0.7	V
		V_{CCI} = 3.0 V to 3.6 V	-	0.8	-	0.8	V
		V_{CCI} = 4.5 V to 5.5 V	-	$0.3V_{CCI}$	-	$0.3V_{CCI}$	V
		DIR input					
		V_{CCI} = 1.2 V	-	$0.2V_{CC(A)}$	-	$0.2V_{CC(A)}$	V
		V_{CCI} = 1.4 V to 1.95 V	-	$0.35V_{CC(A)}$	-	$0.35V_{CC(A)}$	V
		V_{CCI} = 2.3 V to 2.7 V	-	0.7	-	0.7	V
		V_{CCI} = 3.0 V to 3.6 V	-	0.8	-	0.8	V
		V_{CCI} = 4.5 V to 5.5 V	-	$0.3V_{CC(A)}$	-	$0.3V_{CC(A)}$	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$					
		I_O = -100 μA; V_{CCO} = 1.2 V to 4.5 V [2]	V_{CCO} - 0.1	-	V_{CCO} - 0.1	-	V
		I_O = -6 mA; V_{CCO} = 1.4 V	1.0	-	1.0	-	V
		I_O = -8 mA; V_{CCO} = 1.65 V	1.2	-	1.2	-	V
		I_O = -12 mA; V_{CCO} = 2.3 V	1.9	-	1.9	-	V
		I_O = -24 mA; V_{CCO} = 3.0 V	2.4	-	2.4	-	V
		I_O = -32 mA; V_{CCO} = 4.5 V	3.8	-	3.8	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IL}$ [2]					
		I_O = 100 μA; V_{CCO} = 1.2 V to 4.5 V	-	0.1	-	0.1	V
		I_O = 6 mA; V_{CCO} = 1.4 V	-	0.3	-	0.3	V
		I_O = 8 mA; V_{CCO} = 1.65 V	-	0.45	-	0.45	V
		I_O = 12 mA; V_{CCO} = 2.3 V	-	0.3	-	0.3	V
		I_O = 24 mA; V_{CCO} = 3.0 V	-	0.55	-	0.55	V
		I_O = 32 mA; V_{CCO} = 4.5 V	-	0.55	-	0.55	V
I_I	input leakage current	DIR input; V_I = 0 V to 5.5 V; V_{CCI} = 1.2 V to 5.5 V	-	±2	-	±10	μA
I_{BHL}	bus hold LOW current	A or B port [1]					
		V_I = 0.49 V; V_{CCI} = 1.4 V	15	-	10	-	μA
		V_I = 0.58 V; V_{CCI} = 1.65 V	25	-	20	-	μA
		V_I = 0.70 V; V_{CCI} = 2.3 V	45	-	45	-	μA
		V_I = 0.80 V; V_{CCI} = 3.0 V	100	-	80	-	μA
		V_I = 1.35 V; V_{CCI} = 4.5 V	100	-	100	-	μA
I_{BHH}	bus hold HIGH current	A or B port [1]					
		V_I = 0.91 V; V_{CCI} = 1.4 V	-15	-	-10	-	μA
		V_I = 1.07 V; V_{CCI} = 1.65 V	-25	-	-20	-	μA
		V_I = 1.60 V; V_{CCI} = 2.3 V	-45	-	-45	-	μA
		V_I = 2.00 V; V_{CCI} = 3.0 V	-100	-	-80	-	μA
		V_I = 3.15 V; V_{CCI} = 4.5 V	-100	-	-100	-	μA

Symbol	Parameter	Conditions		-40 °C to +85 °C		-40 °C to +125 °C		Unit
				Min	Max	Min	Max	
I_{BHLO}	bus hold LOW overdrive current	A or B port	[1] [3]					
		V_{CCI} = 1.6 V		125	-	125	-	μA
		V_{CCI} = 1.95 V		200	-	200	-	μA
		V_{CCI} = 2.7 V		300	-	300	-	μA
		V_{CCI} = 3.6 V		500	-	500	-	μA
		V_{CCI} = 5.5 V		900	-	900	-	μA
I_{BHHO}	bus hold HIGH overdrive current	A or B port	[1] [3]					
		V_{CCI} = 1.6 V		-125	-	-125	-	μA
		V_{CCI} = 1.95 V		-200	-	-200	-	μA
		V_{CCI} = 2.7 V		-300	-	-300	-	μA
		V_{CCI} = 3.6 V		-500	-	-500	-	μA
		V_{CCI} = 5.5 V		-900	-	-900	-	μA
I_{OZ}	OFF-state output current	A or B port; V_O = 0 V or V_{CCO}; V_{CCO} = 1.2 V to 5.5 V	[2]	-	±2	-	±10	μA
I_{OFF}	power-off leakage current	A port; V_I or V_O = 0 V to 5.5 V; $V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 1.2 V to 5.5 V		-	±2	-	±10	μA
		B port; V_I or V_O = 0 V to 5.5 V; $V_{CC(B)}$ = 0 V; $V_{CC(A)}$ = 1.2 V to 5.5 V		-	±2	-	±10	μA
I_{CC}	supply current	A port; V_I = 0 V or V_{CCI}; I_O = 0 A	[1]					
		$V_{CC(A)}$, $V_{CC(B)}$ = 1.2 V to 5.5 V		-	8	-	8	μA
		$V_{CC(A)}$, $V_{CC(B)}$ = 1.65 V to 5.5 V		-	3	-	3	μA
		$V_{CC(A)}$ = 5.5 V; $V_{CC(B)}$ = 0 V		-	2	-	2	μA
		$V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 5.5 V		-2	-	-2	-	μA
		B port; V_I = 0 V or V_{CCI}; I_O = 0 A						
		$V_{CC(A)}$, $V_{CC(B)}$ = 1.2 V to 5.5 V		-	8	-	8	μA
		$V_{CC(A)}$, $V_{CC(B)}$ = 1.65 V to 5.5 V		-	3	-	3	μA
		$V_{CC(B)}$ = 0 V; $V_{CC(A)}$ = 5.5 V		-2	-	-2	-	μA
		$V_{CC(B)}$ = 5.5 V; $V_{CC(A)}$ = 0 V		-	2	-	2	μA
		A plus B port ($I_{CC(A)}$ + $I_{CC(B)}$); I_O = 0 A; V_I = 0 V or V_{CCI}						
		$V_{CC(A)}$, $V_{CC(B)}$ = 1.2 V to 5.5 V		-	16	-	16	μA
		$V_{CC(A)}$, $V_{CC(B)}$ = 1.65 V to 5.5 V		-	4	-	4	μA
ΔI_{CC}	additional supply current	per input; $V_{CC(A)}$, $V_{CC(B)}$ = 3.0 V to 5.5 V						
		A port; A port at $V_{CC(A)}$ - 0.6 V; DIR at $V_{CC(A)}$; B port = open	[4]	-	50	-	75	μA
		DIR input; DIR at $V_{CC(A)}$ - 0.6 V; A port at $V_{CC(A)}$ or GND; B port = open		-	50	-	75	μA
		B port; B port at $V_{CC(B)}$ - 0.6 V; DIR at GND; A port = open	[4]	-	50	-	75	μA

[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.
[3] To guarantee the node switches, an external driver must source/sink at least I_{BHLO}/I_{BHHO} when the input is in the range V_{IL} to V_{IH}.
[4] For non bus hold parts only (74LVC2T45).

11. Dynamic characteristics

Table 9. Typical dynamic characteristics at $V_{CC(A)}$ = 1.2 V and T_{amb} = 25 °C

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 8; for waveforms see Fig. 6 and Fig. 7.

Symbol	Parameter	Conditions		$V_{CC(B)}$						Unit
				1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	5.0 V	
t_{PLH}	LOW to HIGH propagation delay	A to B		10.6	8.1	7.0	5.8	5.3	5.1	ns
		B to A		10.6	9.5	9.0	8.5	8.3	8.2	ns
t_{PHL}	HIGH to LOW propagation delay	A to B		10.1	7.1	6.0	5.3	5.2	5.4	ns
		B to A		10.1	8.6	8.1	7.8	7.6	7.6	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A		9.4	9.4	9.4	9.4	9.4	9.4	ns
		DIR to B		12.0	9.4	9.0	7.8	8.4	7.9	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A		7.1	7.1	7.1	7.1	7.1	7.1	ns
		DIR to B		9.5	7.8	7.7	6.9	7.6	7.0	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A	[1]	20.1	17.3	16.7	15.4	15.9	15.2	ns
		DIR to B	[1]	17.7	15.2	14.1	12.9	12.4	12.2	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A	[1]	22.1	18.0	17.1	15.6	16.0	15.5	ns
		DIR to B	[1]	19.5	16.5	15.4	14.7	14.6	14.8	ns

[1] t_{PZH} and t_{PZL} are calculated values using the formula shown in Section 13.4.

Table 10. Typical dynamic characteristics at $V_{CC(B)}$ = 1.2 V and T_{amb} = 25 °C

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 8; for waveforms see Fig. 6 and Fig. 7.

Symbol	Parameter	Conditions		$V_{CC(A)}$						Unit
				1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	5.0 V	
t_{PLH}	LOW to HIGH propagation delay	A to B		10.6	9.5	9.0	8.5	8.3	8.2	ns
		B to A		10.6	8.1	7.0	5.8	5.3	5.1	ns
t_{PHL}	HIGH to LOW propagation delay	A to B		10.1	8.6	8.1	7.8	7.6	7.6	ns
		B to A		10.1	7.1	6.0	5.3	5.2	5.4	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A		9.4	6.5	5.7	4.1	4.1	3.0	ns
		DIR to B		12.0	6.1	5.4	4.6	4.3	4.0	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A		7.1	4.9	4.5	3.2	3.4	2.5	ns
		DIR to B		9.5	7.3	6.6	5.9	5.7	5.6	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A	[1]	20.1	15.4	13.6	11.7	11.0	10.7	ns
		DIR to B	[1]	17.7	14.4	13.5	11.7	11.7	10.7	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A	[1]	22.1	13.2	11.4	9.9	9.5	9.4	ns
		DIR to B	[1]	19.5	15.1	13.8	11.9	11.7	10.6	ns

[1] t_{PZH} and t_{PZL} are calculated values using the formula shown in Section 13.4.

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

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

Symbol	Parameter	Conditions	$V_{CC(A)}$ and $V_{CC(B)}$				Unit
			1.8 V	2.5 V	3.3 V	5.0 V	
C_{PD}	power dissipation capacitance[1] [2]	A port: (direction A to B); B port: (direction B to A)	2	3	3	4	pF
		A port: (direction A to B); B port: (direction B to A)	15	16	16	18	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 = 10 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. 8; for waveforms see Fig. 6 and Fig. 7.

Symbol	Parameter	Conditions	$V_{CC(B)}$										Unit
			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	
$V_{CC(A)}$ = 1.4 V to 1.6 V													
t_{PLH}	LOW to HIGH propagation delay	A to B	2.8	21.3	2.4	17.6	2.0	13.5	1.7	11.8	1.6	10.5	ns
		B to A	2.8	21.3	2.6	19.1	2.3	14.9	2.3	12.4	2.2	12.0	ns
t_{PHL}	HIGH to LOW propagation delay	A to B	2.6	19.3	2.2	15.3	1.8	11.8	1.7	10.9	1.7	10.8	ns
		B to A	2.6	19.3	2.4	17.3	2.3	13.2	2.2	11.3	2.3	11.0	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A	3.0	18.7	3.0	18.7	3.0	18.7	3.0	18.7	3.0	18.7	ns
		DIR to B	3.5	24.8	3.5	23.6	3.0	11.0	3.3	11.3	2.8	10.3	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A	2.4	11.4	2.4	11.4	2.4	11.4	2.4	11.4	2.4	11.4	ns
		DIR to B	2.8	18.3	3.0	17.2	2.5	9.4	3.0	10.1	2.5	9.4	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A [1]	-	39.6	-	36.3	-	24.3	-	22.5	-	21.4	ns
		DIR to B [1]	-	32.7	-	29.0	-	24.9	-	23.2	-	21.9	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A [1]	-	44.1	-	40.9	-	24.2	-	22.6	-	21.3	ns
		DIR to B [1]	-	38.0	-	34.0	-	30.5	-	29.6	-	29.5	ns

Symbol	Parameter	Conditions		$V_{CC(B)}$										Unit
				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	
$V_{CC(A)}$ = 1.65 V to 1.95 V														
t_{PLH}	LOW to HIGH propagation delay	A to B		2.6	19.1	2.2	17.7	2.2	9.3	1.7	7.2	1.4	6.8	ns
		B to A		2.4	17.6	2.2	17.7	2.3	16.0	2.1	15.5	1.9	15.1	ns
t_{PHL}	HIGH to LOW propagation delay	A to B		2.4	17.3	2.0	14.3	1.6	8.5	1.8	7.1	1.7	7.0	ns
		B to A		2.2	15.3	2.0	14.3	2.1	12.9	2.0	12.6	1.8	12.2	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A		2.9	17.1	2.9	17.1	2.9	17.1	2.9	17.1	2.9	17.1	ns
		DIR to B		3.2	24.1	3.2	21.9	2.7	11.5	3.0	10.3	2.5	8.2	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A		2.4	10.5	2.4	10.5	2.4	10.5	2.4	10.5	2.4	10.5	ns
		DIR to B		2.5	17.6	2.6	16.0	2.2	9.2	2.7	8.4	2.4	7.1	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A	[1]	-	35.2	-	33.7	-	25.2	-	23.9	-	22.2	ns
		DIR to B	[1]	-	29.6	-	28.2	-	19.8	-	17.7	-	17.3	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A	[1]	-	39.4	-	36.2	-	24.4	-	22.9	-	20.4	ns
		DIR to B	[1]	-	34.4	-	31.4	-	25.6	-	24.2	-	24.1	ns
$V_{CC(A)}$ = 2.3 V to 2.7 V														
t_{PLH}	LOW to HIGH propagation delay	A to B		2.3	17.9	2.3	16.0	1.5	8.5	1.3	6.2	1.1	4.8	ns
		B to A		2.0	13.5	2.2	9.3	1.5	8.5	1.4	8.0	1.0	7.5	ns
t_{PHL}	HIGH to LOW propagation delay	A to B		2.3	15.8	2.1	12.9	1.4	7.5	1.3	5.4	0.9	4.6	ns
		B to A		1.8	11.8	1.9	8.5	1.4	7.5	1.3	7.0	0.9	6.2	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A		2.1	8.1	2.1	8.1	2.1	8.1	2.1	8.1	2.1	8.1	ns
		DIR to B		3.0	22.5	3.0	21.4	2.5	11.0	2.8	9.3	2.3	6.9	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A		1.7	5.8	1.7	5.8	1.7	5.8	1.7	5.8	1.7	5.8	ns
		DIR to B		2.3	14.6	2.5	13.2	2.0	9.0	2.5	8.4	1.8	5.8	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A	[1]	-	28.1	-	22.5	-	17.5	-	16.4	-	13.3	ns
		DIR to B	[1]	-	23.7	-	21.8	-	14.3	-	12.0	-	10.6	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A	[1]	-	34.3	-	29.9	-	18.5	-	16.3	-	13.1	ns
		DIR to B	[1]	-	23.9	-	21.0	-	15.6	-	13.5	-	12.7	ns
$V_{CC(A)}$ = 3.0 V to 3.6 V														
t_{PLH}	LOW to HIGH propagation delay	A to B		2.3	17.1	2.1	15.5	1.4	8.0	0.8	5.6	0.7	4.4	ns
		B to A		1.7	11.8	1.7	7.2	1.3	6.2	0.7	5.6	0.6	5.4	ns
t_{PHL}	HIGH to LOW propagation delay	A to B		2.2	15.6	2.0	12.6	1.3	7.0	0.8	5.0	0.7	4.0	ns
		B to A		1.7	10.9	1.8	7.1	1.3	5.4	0.8	5.0	0.7	4.5	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A		2.3	7.3	2.3	7.3	2.3	7.3	2.3	7.3	2.7	7.3	ns
		DIR to B		2.9	18.0	2.9	16.5	2.3	10.1	2.7	8.6	2.2	6.3	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A		2.0	5.6	2.0	5.6	2.0	5.6	2.0	5.6	2.0	5.6	ns
		DIR to B		2.3	13.6	2.4	12.5	1.9	7.8	2.3	7.1	1.7	4.9	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A	[1]	-	25.4	-	19.7	-	14.0	-	12.7	-	10.3	ns
		DIR to B	[1]	-	22.7	-	21.1	-	13.6	-	11.2	-	10.0	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A	[1]	-	28.9	-	23.6	-	15.5	-	13.6	-	10.8	ns
		DIR to B	[1]	-	22.9	-	19.9	-	14.3	-	12.3	-	11.3	ns

Symbol	Parameter	Conditions		$V_{CC(B)}$										Unit
				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	
$V_{CC(A)}$ = 4.5 V to 5.5 V														
t_{PLH}	LOW to HIGH propagation delay	A to B		2.2	16.6	1.9	15.1	1.0	7.5	0.7	5.4	0.5	3.9	ns
		B to A		1.6	10.5	1.4	6.8	1.0	4.8	0.7	4.4	0.5	3.9	ns
t_{PHL}	HIGH to LOW propagation delay	A to B		2.3	15.3	1.8	12.2	1.0	6.2	0.7	4.5	0.5	3.5	ns
		B to A		1.7	10.8	1.7	7.0	0.9	4.6	0.7	4.0	0.5	3.5	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A		1.7	5.4	1.7	5.4	1.7	5.4	1.7	5.4	1.7	5.4	ns
		DIR to B		2.9	17.3	2.9	16.1	2.3	9.7	2.7	8.0	2.5	5.7	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A		1.4	3.7	1.4	3.7	1.3	3.7	1.0	3.7	0.9	3.7	ns
		DIR to B		2.3	13.1	2.4	12.1	1.9	7.4	2.3	7.0	1.8	4.5	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A	[1]	-	23.6	-	18.9	-	12.2	-	11.4	-	8.4	ns
		DIR to B	[1]	-	20.3	-	18.8	-	11.2	-	9.1	-	7.6	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A	[1]	-	28.1	-	23.1	-	14.3	-	12.0	-	9.2	ns
		DIR to B	[1]	-	20.7	-	17.6	-	11.6	-	9.9	-	8.9	ns

[1] t_{PZH} and t_{PZL} are calculated values using the formula shown in Section 13.4.

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. 8; for waveforms see Fig. 6 and Fig. 7.

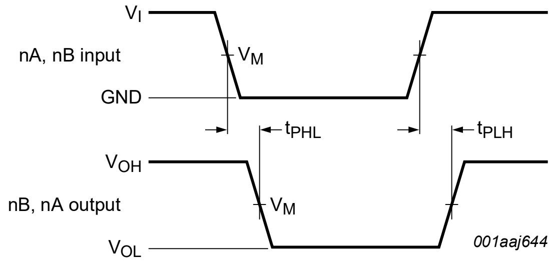
Symbol	Parameter	Conditions		$V_{CC(B)}$										Unit
				1.5 V ± 0.1 V		1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
				Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$V_{CC(A)}$ = 1.4 V to 1.6 V														
t_{PLH}	LOW to HIGH propagation delay	A to B		2.5	23.5	2.1	19.4	1.8	14.9	1.5	13.0	1.4	11.6	ns
		B to A		2.5	23.5	2.3	21.1	2.0	16.4	2.0	13.7	1.9	13.2	ns
t_{PHL}	HIGH to LOW propagation delay	A to B		2.3	21.3	1.9	16.9	1.6	13.0	1.5	12.0	1.5	11.9	ns
		B to A		2.3	21.3	2.1	19.1	2.0	14.6	1.9	12.5	2.0	12.1	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A		2.7	20.6	2.7	20.6	2.7	20.6	2.7	20.6	2.7	20.6	ns
		DIR to B		3.1	27.3	3.1	26.0	2.7	12.1	2.9	12.5	2.5	11.4	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A		2.1	12.6	2.1	12.6	2.1	12.6	2.1	12.6	2.1	12.6	ns
		DIR to B		2.5	20.2	2.7	19.0	2.2	10.4	2.7	11.2	2.2	10.4	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A	[1]	-	43.7	-	40.1	-	26.8	-	24.9	-	23.6	ns
		DIR to B	[1]	-	36.1	-	32.0	-	27.5	-	25.6	-	24.2	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A	[1]	-	48.6	-	45.1	-	26.7	-	25.0	-	23.5	ns
		DIR to B	[1]	-	41.9	-	37.5	-	33.6	-	32.6	-	32.5	ns

Symbol	Parameter	Conditions	$V_{CC(B)}$										Unit
			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	
$V_{CC(A)}$ = 1.65 V to 1.95 V													
t_{PLH}	LOW to HIGH propagation delay	A to B	2.3	21.1	1.9	19.5	1.9	10.3	1.5	8.0	1.2	7.5	ns
		B to A	2.1	19.4	1.9	19.5	2.0	17.6	1.8	17.1	1.7	16.7	ns
t_{PHL}	HIGH to LOW propagation delay	A to B	2.1	19.1	1.8	15.8	1.4	9.4	1.6	7.9	1.5	7.7	ns
		B to A	1.9	16.9	1.8	15.8	1.8	14.2	1.8	13.9	1.6	13.5	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A	2.6	18.9	2.6	18.9	2.6	18.9	2.6	18.9	2.6	18.9	ns
		DIR to B	2.8	26.6	2.8	24.1	2.4	12.7	2.7	11.4	2.2	9.1	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A	2.1	11.6	2.1	11.6	2.1	11.6	2.1	11.6	2.1	11.6	ns
		DIR to B	2.2	19.4	2.3	17.6	1.9	10.2	2.4	9.3	2.1	7.9	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A [1]	-	38.8	-	37.1	-	27.8	-	26.4	-	24.6	ns
		DIR to B [1]	-	32.7	-	31.1	-	21.9	-	19.6	-	19.1	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A [1]	-	43.5	-	39.9	-	26.9	-	25.3	-	22.6	ns
		DIR to B [1]	-	38.0	-	34.7	-	28.3	-	26.8	-	26.6	ns
$V_{CC(A)}$ = 2.3 V to 2.7 V													
t_{PLH}	LOW to HIGH propagation delay	A to B	2.0	19.7	2.0	17.6	1.3	9.4	1.1	6.9	0.9	5.3	ns
		B to A	1.8	14.9	1.9	10.3	1.3	9.4	1.2	8.8	0.9	8.3	ns
t_{PHL}	HIGH to LOW propagation delay	A to B	2.0	17.4	1.8	14.2	1.2	8.3	1.1	6.0	0.8	5.1	ns
		B to A	1.6	13.0	1.7	9.4	1.2	8.3	1.1	7.7	0.8	6.9	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A	1.8	9.0	1.8	9.0	1.8	9.0	1.8	9.0	1.8	9.0	ns
		DIR to B	2.7	24.8	2.7	23.6	2.2	12.1	2.5	10.3	2.0	7.6	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A	1.5	6.4	1.5	6.4	1.5	6.4	1.5	6.4	1.5	6.4	ns
		DIR to B	2.0	16.1	2.2	14.6	1.8	9.9	2.2	9.3	1.6	6.4	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A [1]	-	31.0	-	24.9	-	19.3	-	18.1	-	14.7	ns
		DIR to B [1]	-	26.1	-	24.0	-	15.8	-	13.3	-	11.7	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A [1]	-	37.8	-	33.0	-	20.4	-	18.0	-	14.5	ns
		DIR to B [1]	-	26.4	-	23.2	-	17.3	-	15.0	-	14.1	ns
$V_{CC(A)}$ = 3.0 V to 3.6 V													
t_{PLH}	LOW to HIGH propagation delay	A to B	2.0	18.9	1.8	17.1	1.2	8.8	0.7	6.2	0.6	4.9	ns
		B to A	1.5	13.0	1.5	8.0	1.1	6.9	0.6	6.2	0.5	6.0	ns
t_{PHL}	HIGH to LOW propagation delay	A to B	1.9	17.2	1.8	13.9	1.1	7.7	0.7	5.5	0.6	4.4	ns
		B to A	1.5	12.0	1.6	7.9	1.1	6.0	0.7	5.5	0.6	5.0	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A	2.0	8.1	2.0	8.1	2.0	8.1	2.0	8.1	2.4	8.1	ns
		DIR to B	2.6	19.8	2.6	18.2	2.0	11.2	2.4	9.5	1.9	7.0	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A	1.8	6.2	1.8	6.2	1.8	6.2	1.8	6.2	1.8	6.2	ns
		DIR to B	2.0	15.0	2.1	13.8	1.7	8.6	2.0	7.9	1.5	5.4	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A [1]	-	28.0	-	21.8	-	15.5	-	14.1	-	11.4	ns
		DIR to B [1]	-	25.1	-	23.3	-	15.0	-	12.4	-	11.1	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A [1]	-	31.8	-	26.1	-	17.2	-	15.0	-	12.0	ns
		DIR to B [1]	-	25.3	-	22.0	-	15.8	-	13.6	-	12.5	ns

Symbol	Parameter	Conditions		$V_{CC(B)}$										Unit
				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	
$V_{CC(A)}$ = 4.5 V to 5.5 V														
t_{PLH}	LOW to HIGH propagation delay	A to B		1.9	18.3	1.7	16.7	0.9	8.3	0.6	6.0	0.4	4.3	ns
		B to A		1.4	11.6	1.2	7.5	0.9	5.3	0.6	4.9	0.4	4.3	ns
t_{PHL}	HIGH to LOW propagation delay	A to B		2.0	16.9	1.6	13.5	0.9	6.9	0.6	5.0	0.4	3.9	ns
		B to A		1.5	11.9	1.5	7.7	0.8	5.1	0.6	4.4	0.4	3.9	ns
t_{PHZ}	HIGH to OFF-state propagation delay	DIR to A		1.5	6.0	1.5	6.0	1.5	6.0	1.5	6.0	1.5	6.0	ns
		DIR to B		2.6	19.1	2.6	17.8	2.0	10.7	2.4	8.8	2.2	6.3	ns
t_{PLZ}	LOW to OFF-state propagation delay	DIR to A		1.2	4.1	1.2	4.1	1.1	4.1	0.9	4.1	0.8	4.1	ns
		DIR to B		2.0	14.5	2.1	13.4	1.7	8.2	2.0	7.7	1.6	5.0	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A	[1]	-	26.1	-	20.9	-	13.5	-	12.6	-	9.3	ns
		DIR to B	[1]	-	22.4	-	20.8	-	12.4	-	10.1	-	8.4	ns
t_{PZL}	OFF-state to LOW propagation delay	DIR to A	[1]	-	31.0	-	25.5	-	15.8	-	13.2	-	10.2	ns
		DIR to B	[1]	-	22.9	-	19.5	-	12.9	-	11.0	-	9.9	ns

[1] t_{PZH} and t_{PZL} are calculated values using the formula shown in Section 13.4.

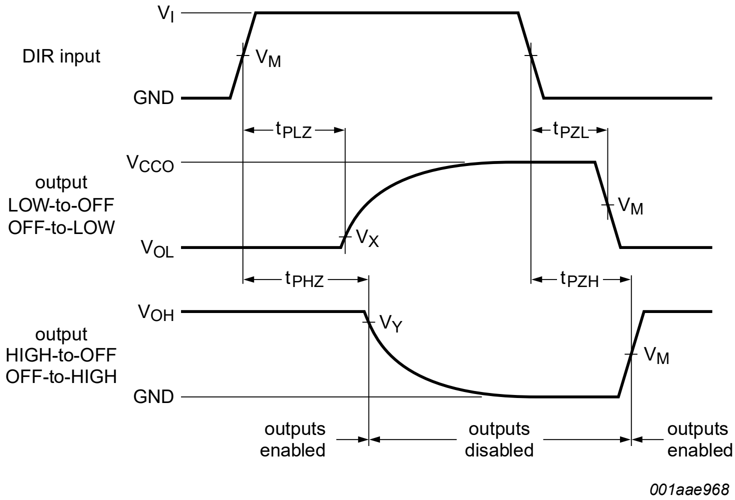
11.1. Waveforms and test circuit



Measurement points are given in Table 14.

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

Fig. 6. The data input (A, B) to output (B, A) propagation delay times



Measurement points are given in Table 14.

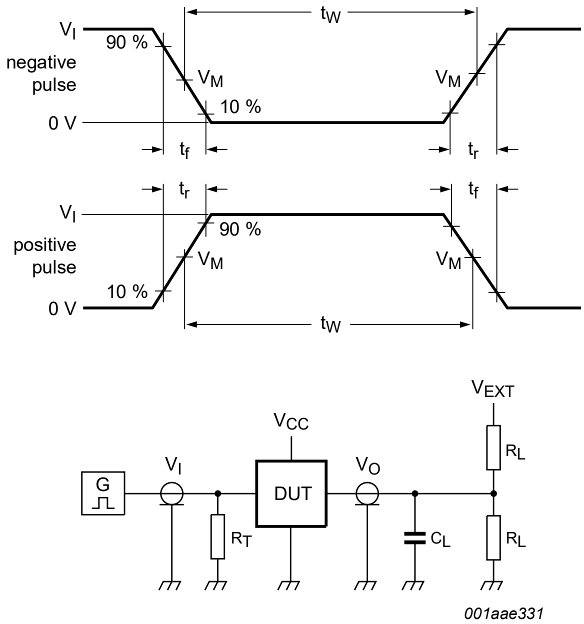
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 7. 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
1.2 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. 8. Test circuit for measuring switching times

Table 15. Test data

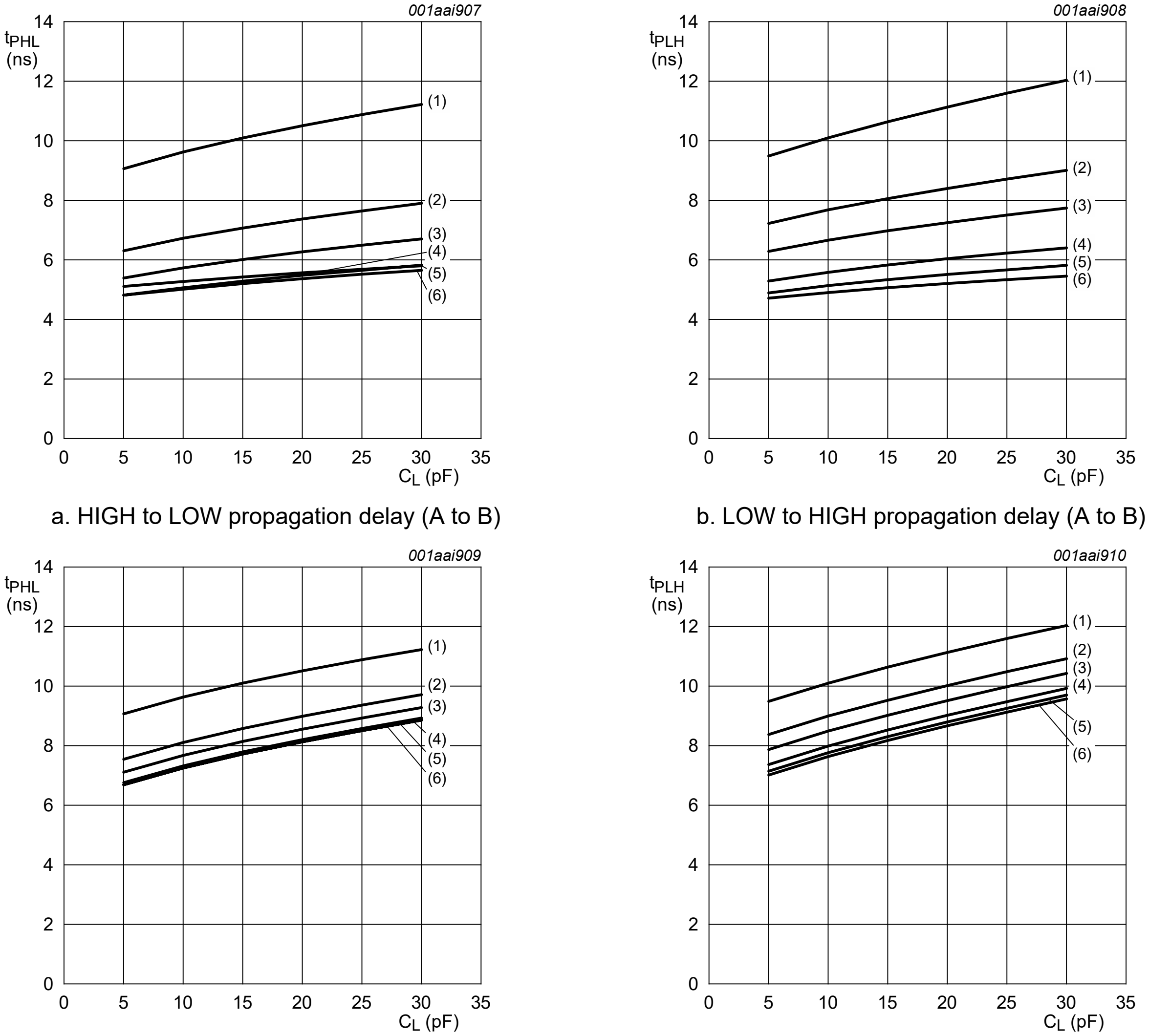
Supply voltage	Input		Load		V_{EXT}		
$V_{CC(A)}$, $V_{CC(B)}$	V_I [1]	$\Delta t/\Delta V$ [2]	C_L	R_L	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ} [3]
1.2 V to 5.5 V	V_{CCI}	≤ 1.0 ns/V	15 pF	2 kΩ	open	GND	$2V_{CCO}$

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

[2] dV/dt ≥ 1.0 V/ns.

[3] V_{CCO} is the supply voltage associated with the output port.

12. Typical propagation delay characteristics



a. HIGH to LOW propagation delay (A to B)

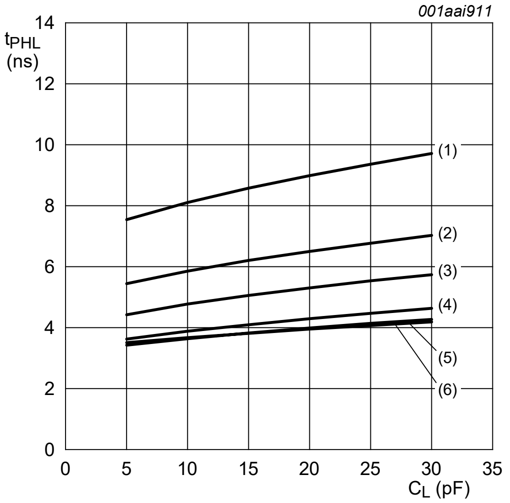
b. LOW to HIGH propagation delay (A to B)

c. HIGH to LOW propagation delay (B to A)

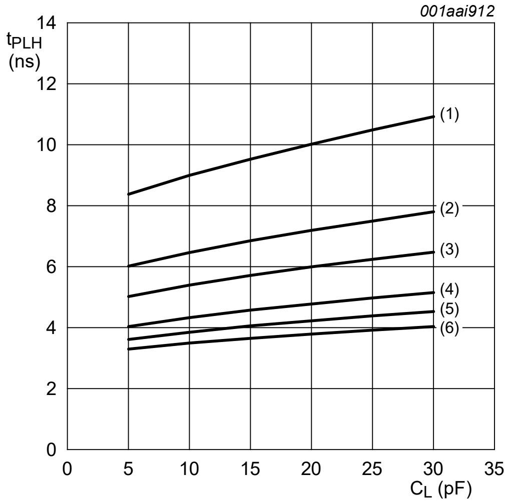
d. LOW to HIGH propagation delay (B to A)

(1) $V_{CC(B)}$ = 1.2 V.
(2) $V_{CC(B)}$ = 1.5 V.
(3) $V_{CC(B)}$ = 1.8 V.
(4) $V_{CC(B)}$ = 2.5 V.
(5) $V_{CC(B)}$ = 3.3 V.
(6) $V_{CC(B)}$ = 5.0 V.

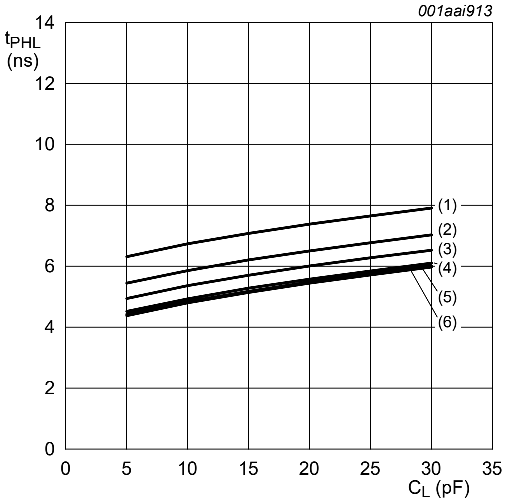
Fig. 9. Typical propagation delay versus load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 1.2 V



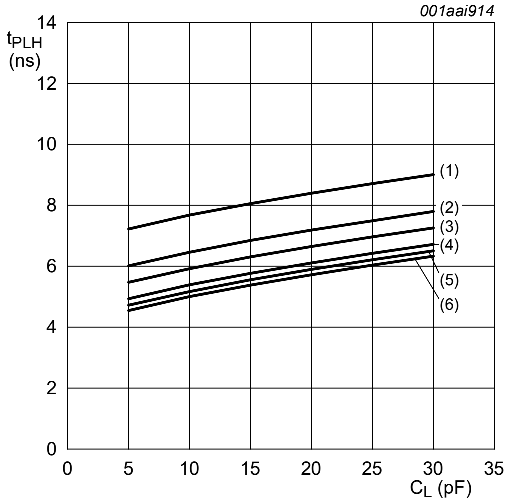
a. HIGH to LOW propagation delay (A to B)



b. LOW to HIGH propagation delay (A to B)



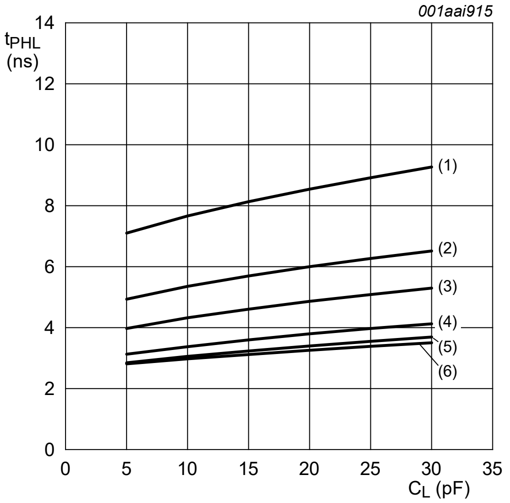
c. HIGH to LOW propagation delay (B to A)



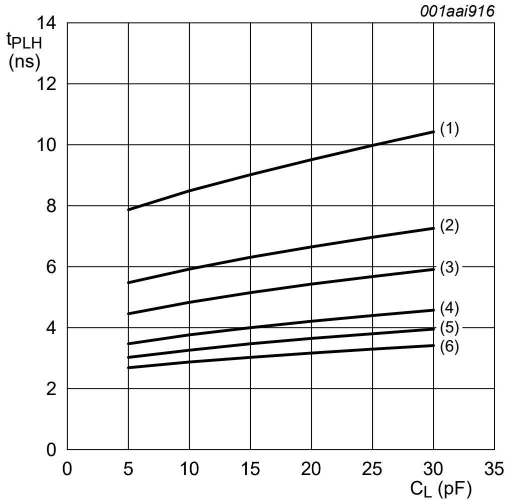
d. LOW to HIGH propagation delay (B to A)

(1) $V_{CC(B)}$ = 1.2 V.
(2) $V_{CC(B)}$ = 1.5 V.
(3) $V_{CC(B)}$ = 1.8 V.
(4) $V_{CC(B)}$ = 2.5 V.
(5) $V_{CC(B)}$ = 3.3 V.
(6) $V_{CC(B)}$ = 5.0 V.

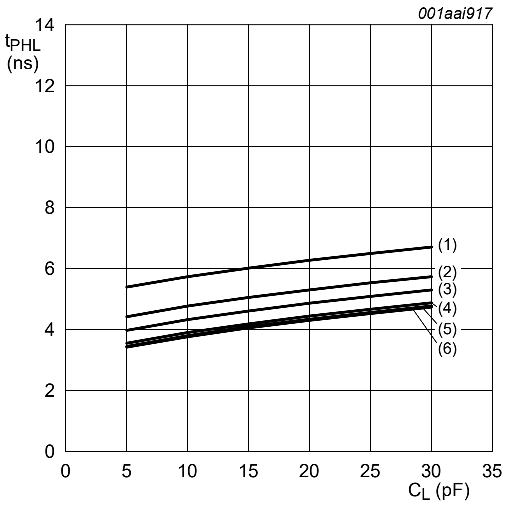
Fig. 10. Typical propagation delay versus load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 1.5 V



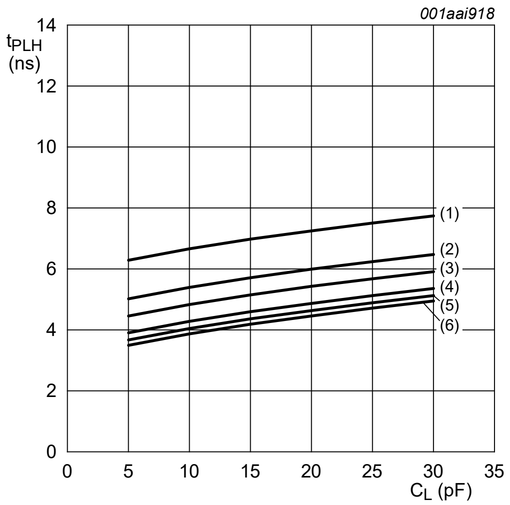
a. HIGH to LOW propagation delay (A to B)



b. LOW to HIGH propagation delay (A to B)



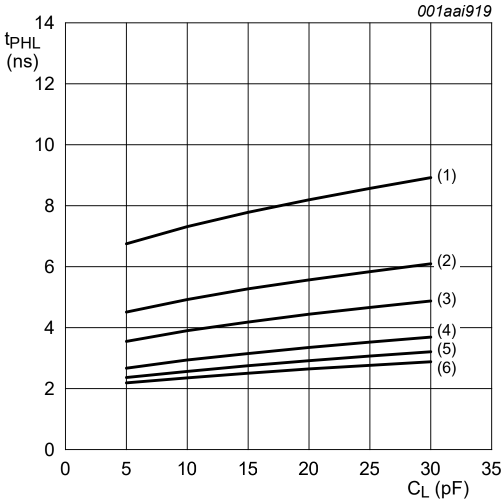
c. HIGH to LOW propagation delay (B to A)



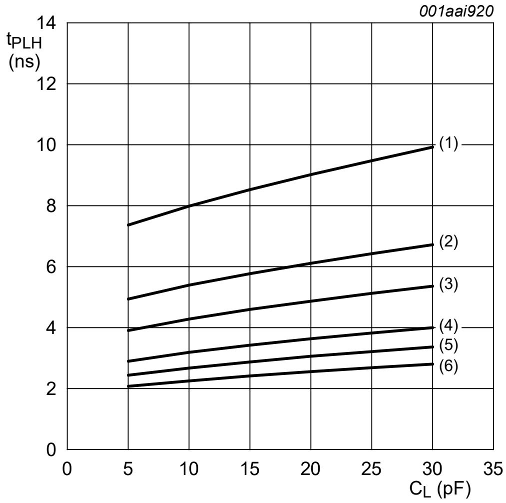
d. LOW to HIGH propagation delay (B to A)

(1) $V_{CC(B)}$ = 1.2 V.
(2) $V_{CC(B)}$ = 1.5 V.
(3) $V_{CC(B)}$ = 1.8 V.
(4) $V_{CC(B)}$ = 2.5 V.
(5) $V_{CC(B)}$ = 3.3 V.
(6) $V_{CC(B)}$ = 5.0 V.

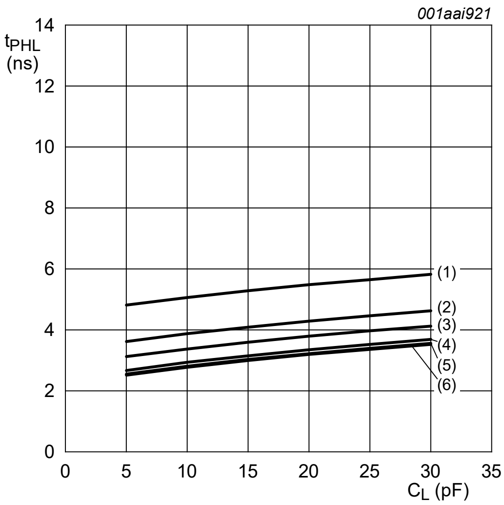
Fig. 11. Typical propagation delay versus load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 1.8 V



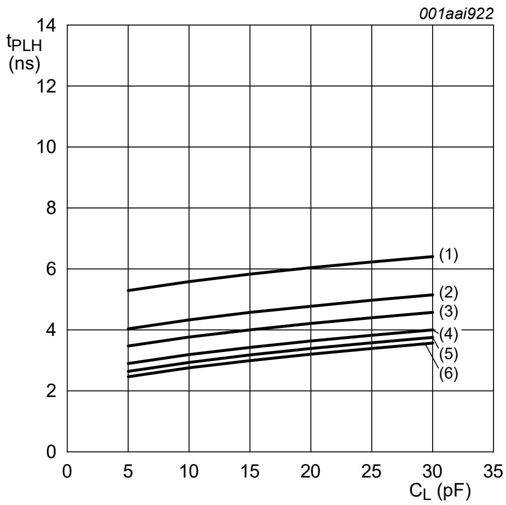
a. HIGH to LOW propagation delay (A to B)



b. LOW to HIGH propagation delay (A to B)



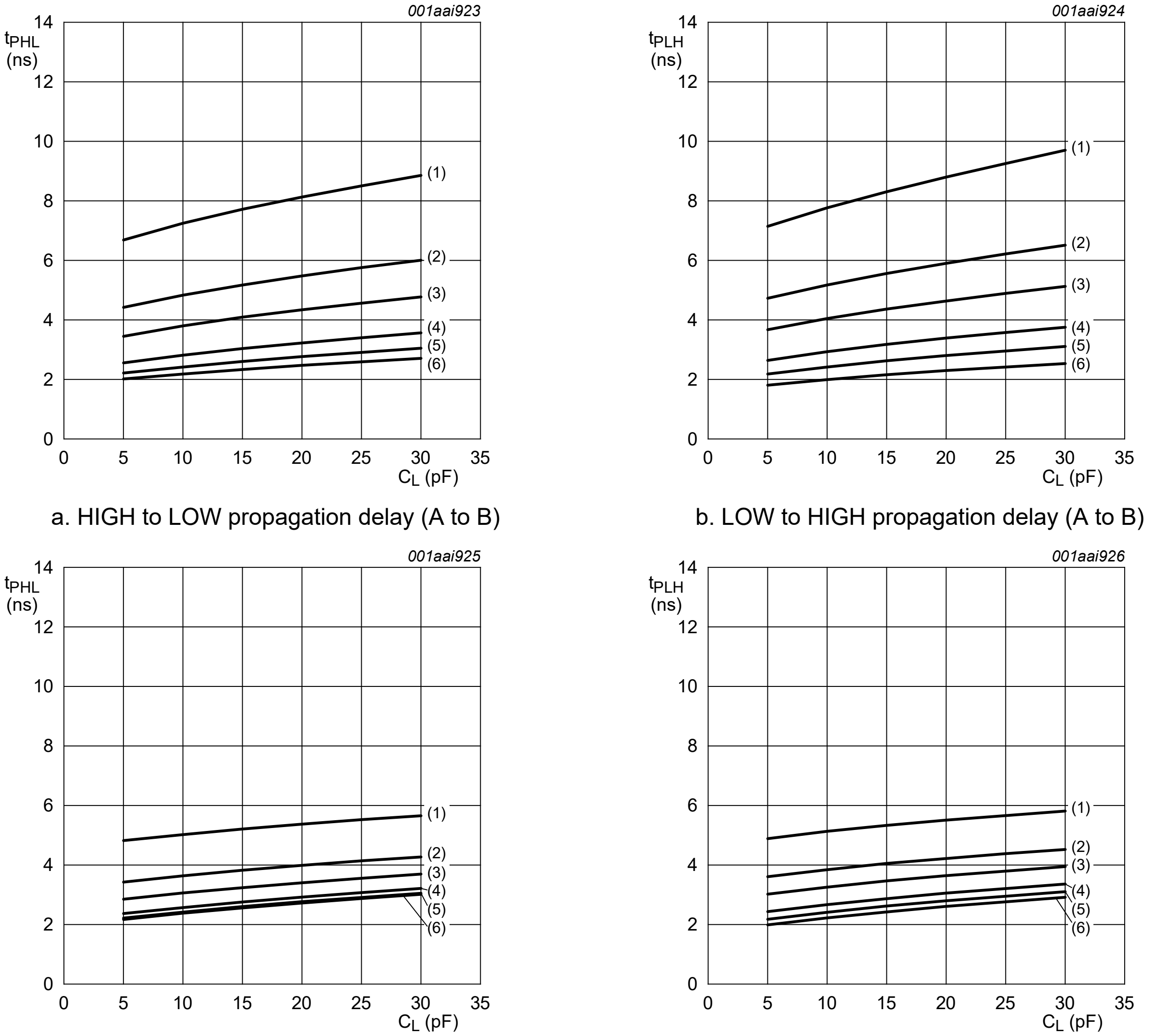
c. HIGH to LOW propagation delay (B to A)



d. LOW to HIGH propagation delay (B to A)

(1) $V_{CC(B)}$ = 1.2 V.
(2) $V_{CC(B)}$ = 1.5 V.
(3) $V_{CC(B)}$ = 1.8 V.
(4) $V_{CC(B)}$ = 2.5 V.
(5) $V_{CC(B)}$ = 3.3 V.
(6) $V_{CC(B)}$ = 5.0 V.

Fig. 12. Typical propagation delay versus load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 2.5 V



a. HIGH to LOW propagation delay (A to B)

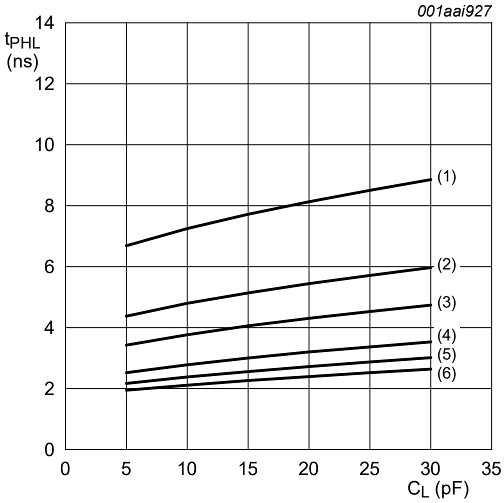
b. LOW to HIGH propagation delay (A to B)

c. HIGH to LOW propagation delay (B to A)

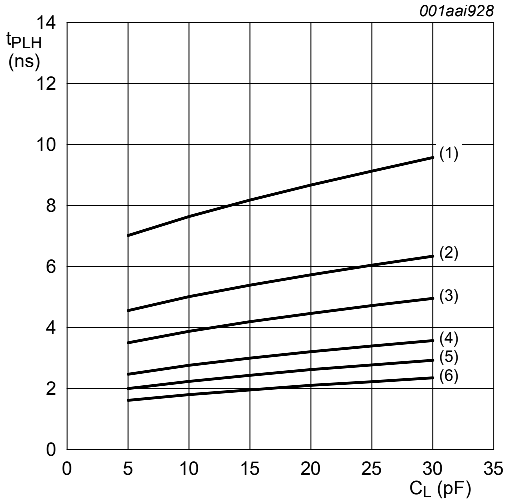
d. LOW to HIGH propagation delay (B to A)

(1) $V_{CC(B)}$ = 1.2 V.
(2) $V_{CC(B)}$ = 1.5 V.
(3) $V_{CC(B)}$ = 1.8 V.
(4) $V_{CC(B)}$ = 2.5 V.
(5) $V_{CC(B)}$ = 3.3 V.
(6) $V_{CC(B)}$ = 5.0 V.

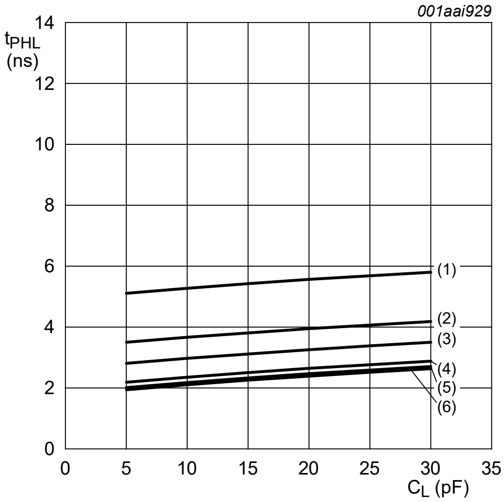
Fig. 13. Typical propagation delay versus load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 3.3 V



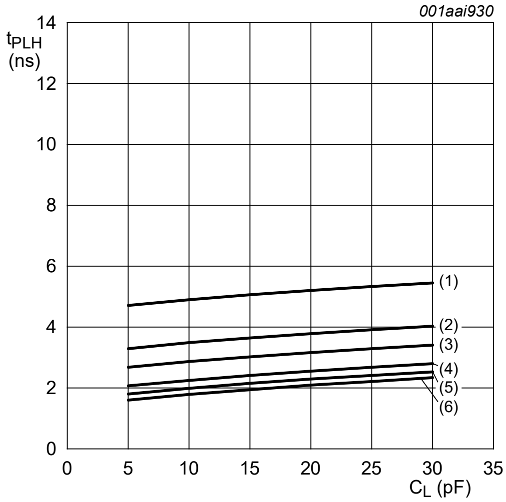
a. HIGH to LOW propagation delay (A to B)



b. LOW to HIGH propagation delay (A to B)



c. HIGH to LOW propagation delay (B to A)



d. LOW to HIGH propagation delay (B to A)

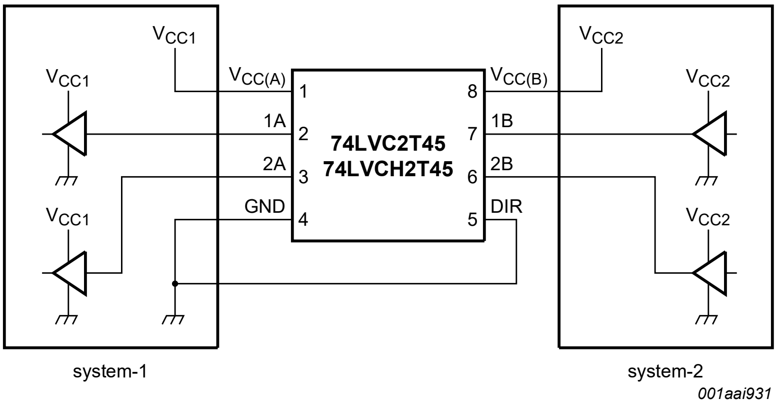
(1) $V_{CC(B)}$ = 1.2 V.
(2) $V_{CC(B)}$ = 1.5 V.
(3) $V_{CC(B)}$ = 1.8 V.
(4) $V_{CC(B)}$ = 2.5 V.
(5) $V_{CC(B)}$ = 3.3 V.
(6) $V_{CC(B)}$ = 5.0 V.

Fig. 14. Typical propagation delay versus load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 5.0 V

13. Application information

13.1. Unidirectional logic level-shifting application

The circuit given in Fig. 15 is an example of the 74LVC2T45; 74LVCH2T45 being used in a unidirectional logic level-shifting application.



Pin numbers not applicable for SOT902-2 package.

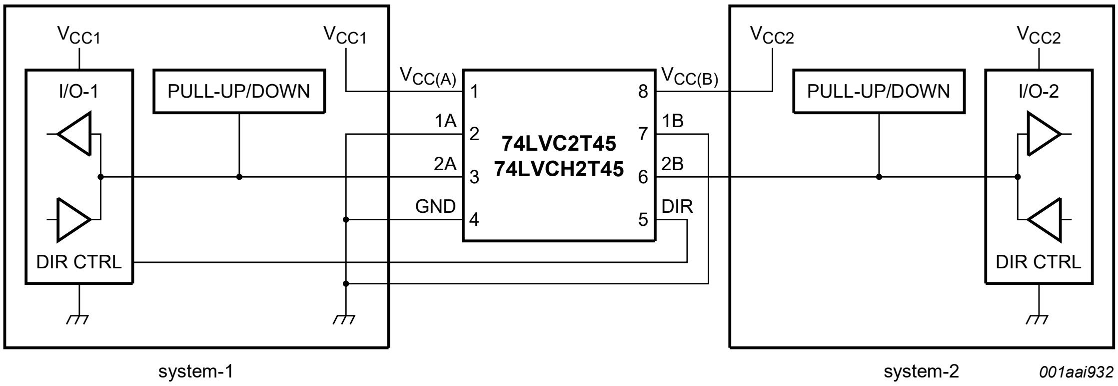
Fig. 15. Unidirectional logic level-shifting application

Table 16. Description of unidirectional logic level-shifting application

Pin	Name	Function	Description
1	$V_{CC(A)}$	V_{CC1}	supply voltage of system-1 (1.2 V to 5.5 V)
2	1A	OUT	output level depends on V_{CC1} voltage
3	2A	OUT	output level depends on V_{CC1} voltage
4	GND	GND	device GND
5	DIR	DIR	the GND (LOW level) determines B port to A port direction
6	2B	IN	input threshold value depends on V_{CC2} voltage
7	1B	IN	input threshold value depends on V_{CC2} voltage
8	$V_{CC(B)}$	V_{CC2}	supply voltage of system-2 (1.2 V to 5.5 V)

13.2. Bidirectional logic level-shifting application

Fig. 16 shows the 74LVC2T45; 74LVCH2T45 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.



Pull-up or pull-down only needed for 74LVC2T45.

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 of 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

13.3. Power-up considerations

The device is designed such that no special power-up sequence is required other than GND being applied first.

Table 18. Typicaltotal supply current ($I_{CC(A)} + I_{CC(B)}$)

$V_{CC(A)}$	$V_{CC(B)}$					Unit
	0 V	1.8 V	2.5 V	3.3 V	5.0 V	
0 V	0	< 1	< 1	< 1	< 1	μA
1.8 V	< 1	< 2	< 2	< 2	2	μA
2.5 V	< 1	< 2	< 2	< 2	< 2	μA
3.3 V	< 1	< 2	< 2	< 2	< 2	μA
5.0 V	< 1	2	< 2	< 2	< 2	μA

13.4. Enable times

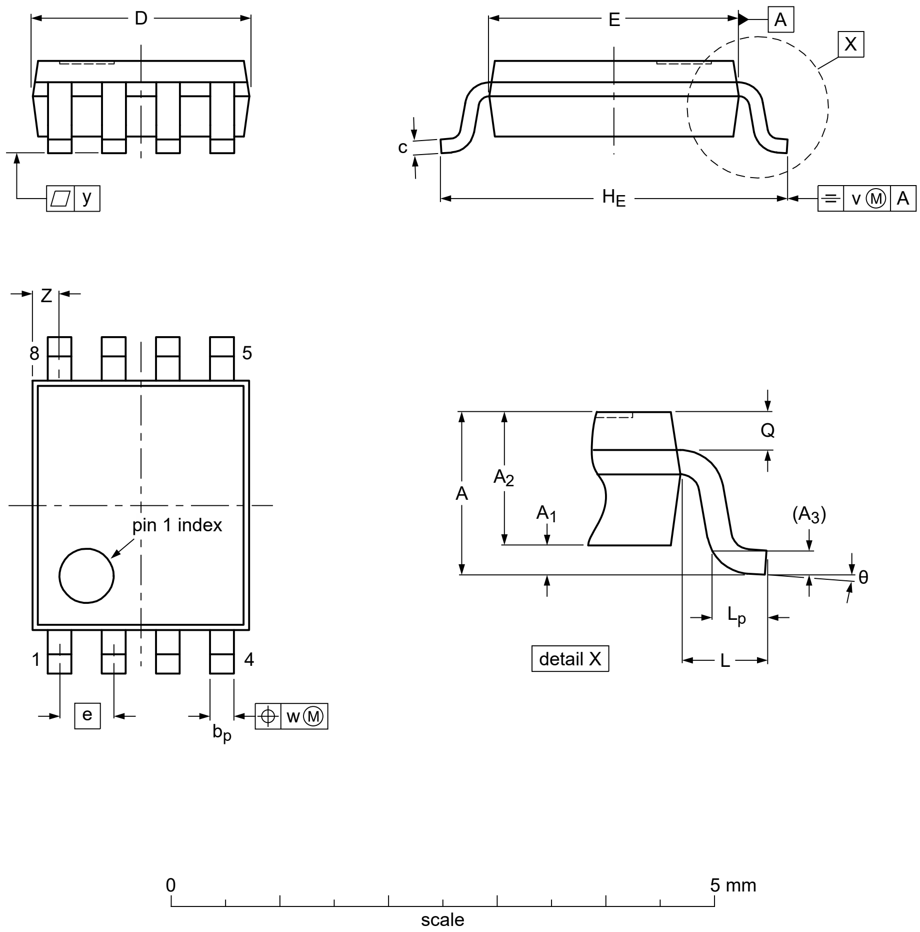
Calculate the enable times for the 74LVC2T45; 74LVCH2T45 using the following formulas:

- t_{PZH} (DIR to A) = t_{PLZ} (DIR to B) + t_{PLH} (B to A)
- t_{PZL} (DIR to A) = t_{PHZ} (DIR to B) + t_{PHL} (B to A)
- t_{PZH} (DIR to B) = t_{PLZ} (DIR to A) + t_{PLH} (A to B)
- t_{PZL} (DIR to B) = t_{PHZ} (DIR to A) + t_{PHL} (A 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 74LVC2T45; 74LVCH2T45 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.

14. Package outline

VSSOP8: plastic very thin shrink small outline package; 8 leads; body width 2.3 mm **SOT765-1**



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
	max		0.15	0.85		0.27	0.23	2.1	2.4		3.2		0.40	0.21				0.4	8°
mm	nom	1			0.12					0.5		0.4			0.2	0.08	0.1		
	min		0.00	0.60		0.17	0.08	1.9	2.2		3.0		0.15	0.19				0.1	0°

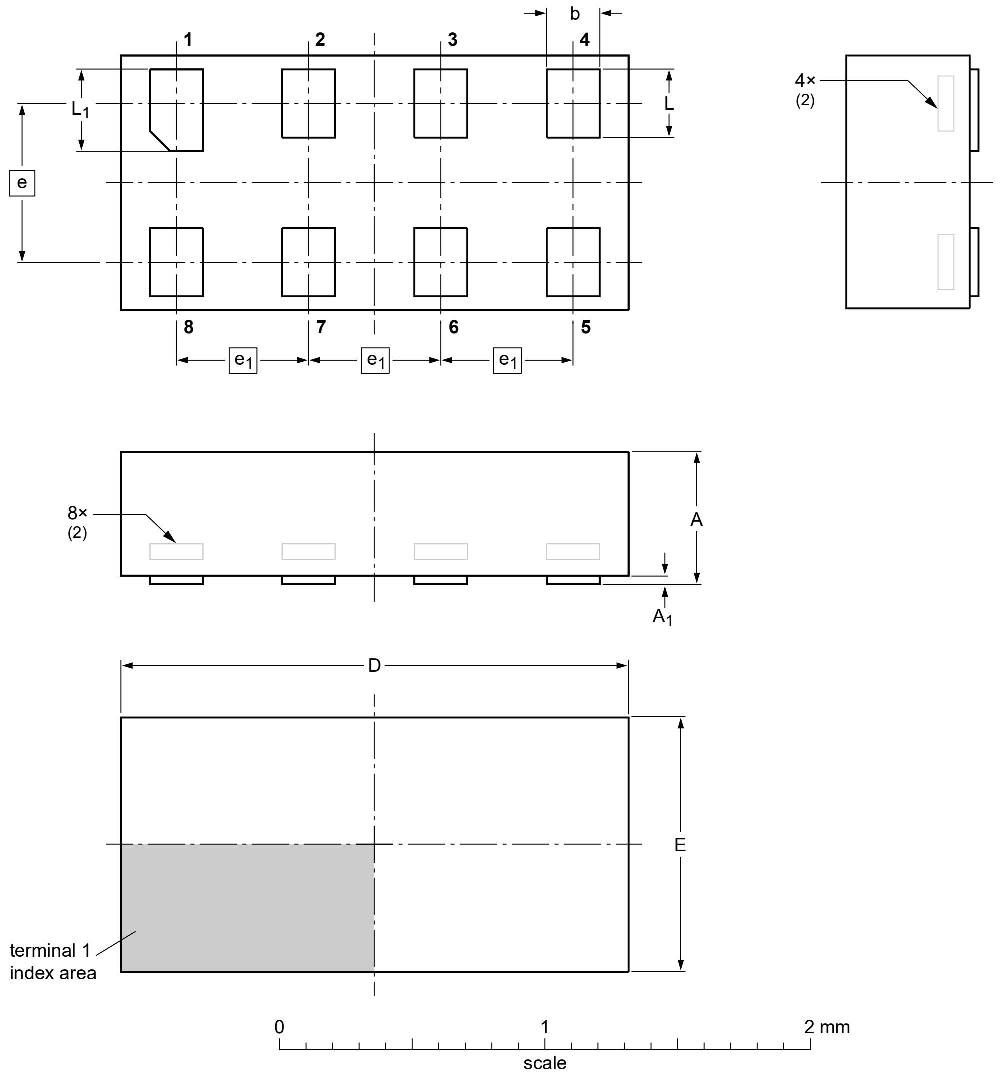
Note
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

sot765-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT765-1		MO-187				~~07-06-02~~ 16-05-31

Fig. 17. Package outline SOT765-1 (VSSOP8)

XSON8: plastic extremely thin small outline package; no leads; 8 terminals; body 1 x 1.95 x 0.5 mm **SOT833-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A(1) max	A_1 max	b	D	E	e	e_1	L	L_1
mm	0.5	0.04	0.25 0.17	2.0 1.9	1.05 0.95	0.6	0.5	0.35 0.27	0.40 0.32

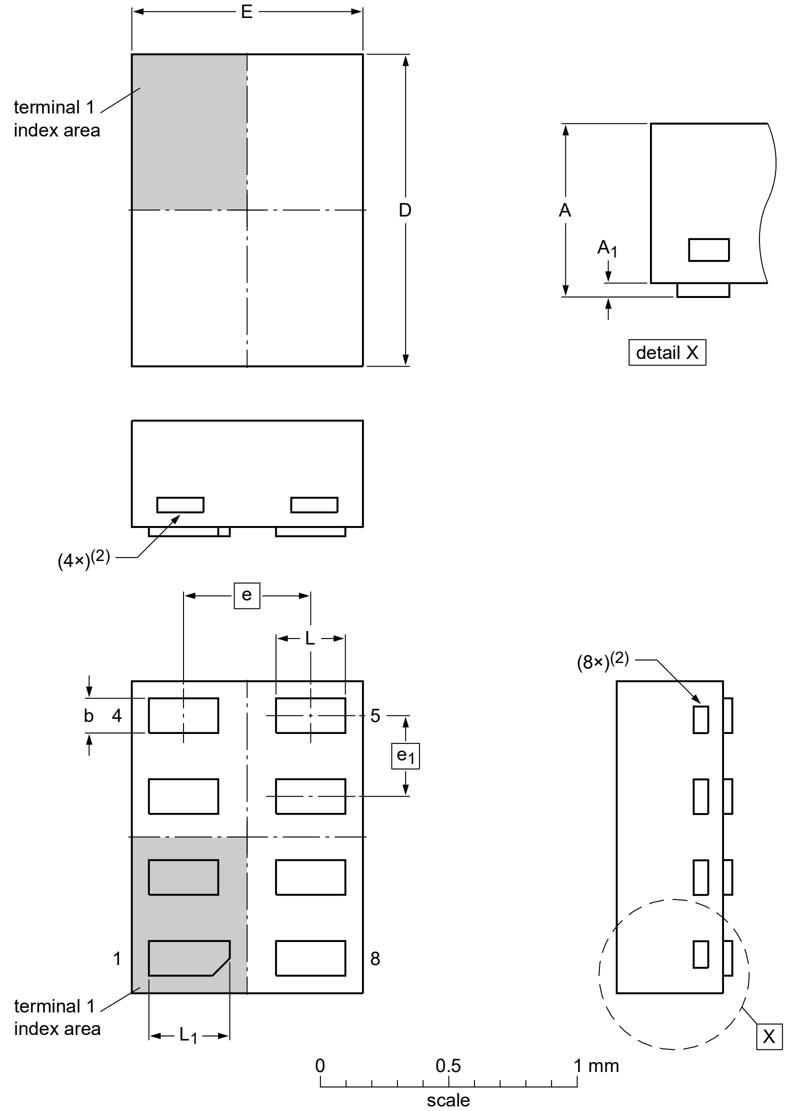
Notes

1. Including plating thickness.
2. Can be visible in some manufacturing processes.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT833-1	- - -	MO-252	- - -			~~07-11-14~~ 07-12-07

Fig. 18. Package outline SOT833-1 (XSON8)

**XSON8: extremely thin small outline package; no leads;
8 terminals; body 1.35 x 1 x 0.5 mm** **SOT1089**



Dimensions

Unit		$A^{(1)}$	A_1	b	D	E	e	e_1	L	L_1
	max	0.5	0.04	0.20	1.40	1.05			0.35	0.40
mm	nom			0.15	1.35	1.00	0.55	0.35	0.30	0.35
	min			0.12	1.30	0.95			0.27	0.32

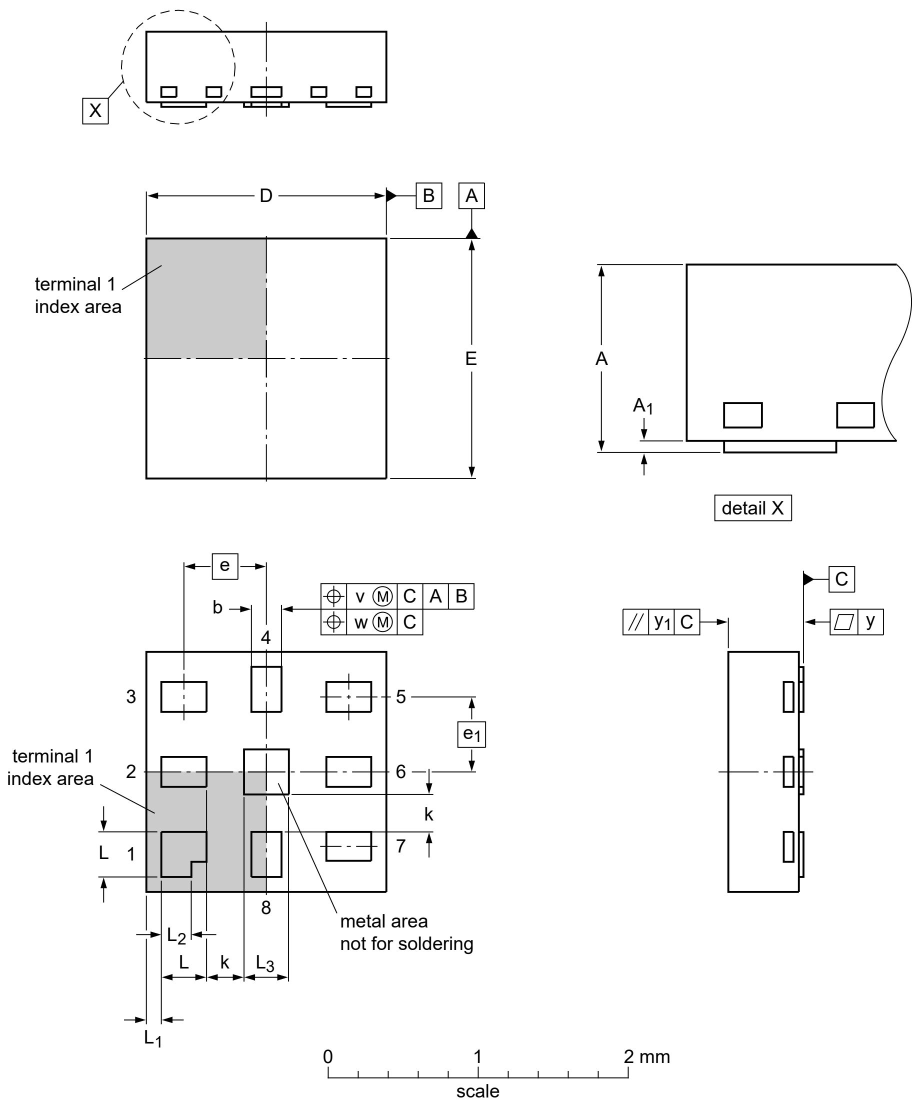
Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

sot1089_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1089		MO-252				~~10-04-09~~ 10-04-12

Fig. 19. Package outline SOT1089 (XSON8)

XQFN8: plastic, extremely thin quad flat package; no leads; 8 terminals; body 1.6 x 1.6 x 0.5 mm **SOT902-2**



Dimensions

Unit(1)		A	A_1	b	D	E	e	e_1	k	L	L_1	L_2	L_3	v	w	y	y_1
	max	0.5	0.05	0.25	1.65	1.65				0.35	0.15	0.25	0.35				
mm	nom			0.20	1.60	1.60	0.55	0.5		0.30	0.10	0.20	0.30	0.1	0.05	0.05	0.05
	min		0.00	0.15	1.55	1.55			0.2	0.25	0.05	0.15	0.25				

Note

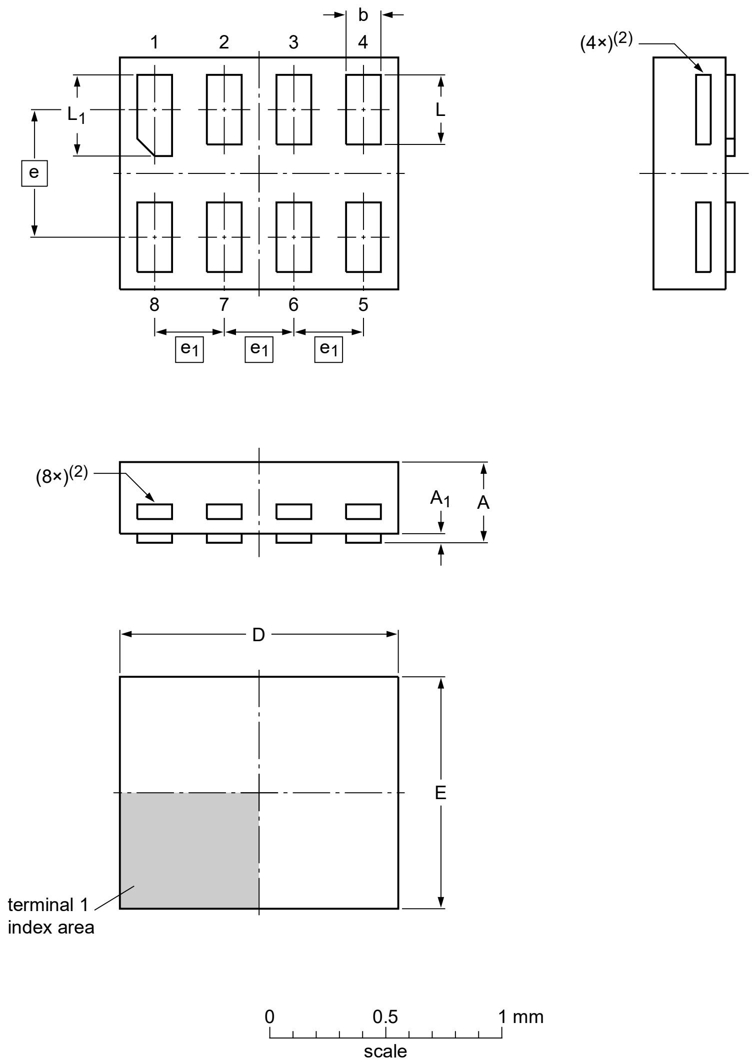
1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

sot902-2_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT902-2	- - -	MO-255	- - -			~~16-07-14~~ 16-11-08

Fig. 20. Package outline SOT902-2 (XQFN8)

XSON8: extremely thin small outline package; no leads; 8 terminals; body 1.2 x 1.0 x 0.35 mm **SOT1116**



Dimensions

Unit		A(1)	A1	b	D	E	e	e1	L	L1
mm	max	0.35	0.04	0.20	1.25	1.05			0.35	0.40
	nom			0.15	1.20	1.00	0.55	0.3	0.30	0.35
	min			0.12	1.15	0.95			0.27	0.32

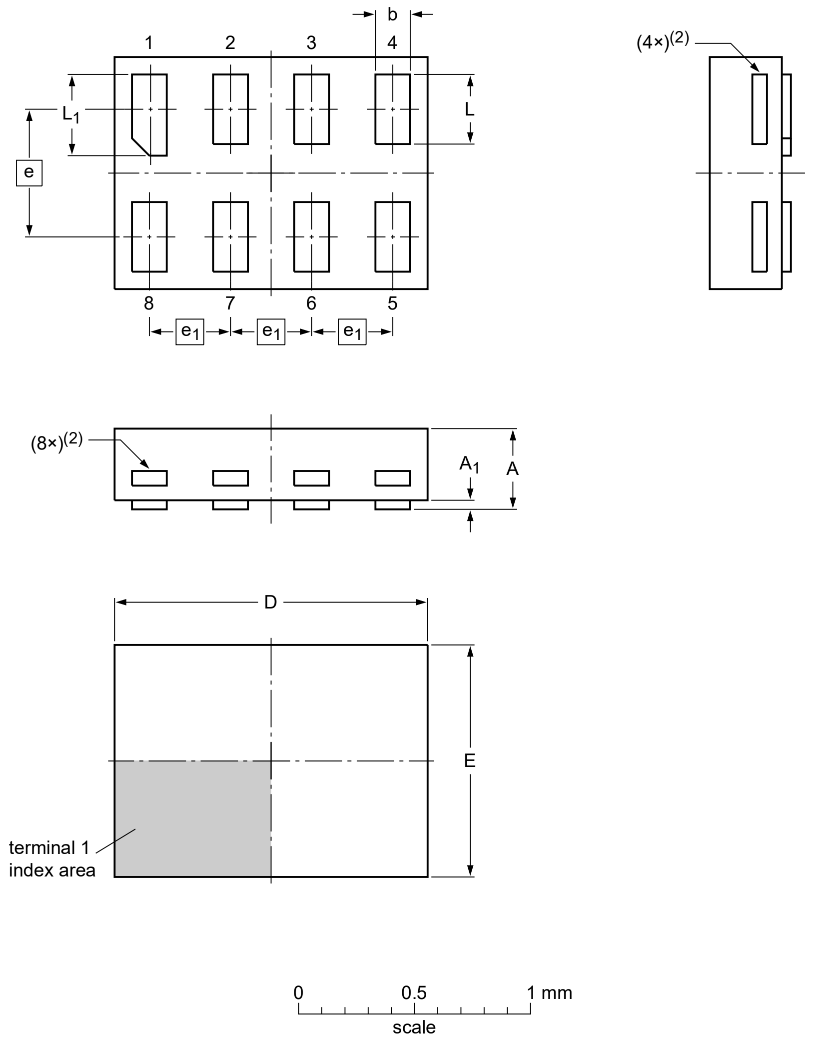
Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

sot1116_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1116						~~10-04-02~~ 10-04-07

Fig. 21. Package outline SOT1116 (XSON8)

**XSON8: extremely thin small outline package; no leads;
8 terminals; body 1.35 x 1.0 x 0.35 mm** **SOT1203**



Dimensions

Unit		$A^{(1)}$	A_1	b	D	E	e	e_1	L	L_1
mm	max	0.35	0.04	0.20	1.40	1.05			0.35	0.40
	nom			0.15	1.35	1.00	0.55	0.35	0.30	0.35
	min			0.12	1.30	0.95			0.27	0.32

Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

sot1203_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1203						~~10-04-02~~ 10-04-06

Fig. 22. Package outline SOT1203 (XSON8)

15. Abbreviations

Table 19. Abbreviations

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

16. Revision history

Table 20. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC_LVCH2T45 v.10	20210511	Product data sheet	-	74LVC_LVCH2T45 v.9
Modifications:	• Type number 74LVCH2T45GM (SOT902-2 / XQFN8) removed. • Section 8: Derating values for P_{tot} total power dissipation updated.			
74LVC_LVCH2T45 v.9	20180813	Product data sheet	-	74LVC_LVCH2T45 v.8
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. • Type numbers 74LVC2T45GD and 74LVCH2T45GD (SOT996-2) removed. • Fig. 17: Package outline drawing (SOT765-1) modified.			
74LVC_LVCH2T45 v.8	20130329	Product data sheet	-	74LVC_LVCH2T45 v.7
Modifications:	• For type numbers 74LVC2T45GD and 74LVCH2T45GD XSON8U has changed to XSON8.			
74LVC_LVCH2T45 v.7	20120619	Product data sheet	-	74LVC_LVCH2T45 v.6
Modifications:	• For type numbers 74LVC2T45GM and 74LVCH2T45GM the SOT code has changed to SOT902-2.			
74LVC_LVCH2T45 v.6	20111209	Product data sheet	-	74LVC_LVCH2T45 v.5
Modifications:	• Legal pages updated.			
74LVC_LVCH2T45 v.5	20110927	Product data sheet	-	74LVC_LVCH2T45 v.4
74LVC_LVCH2T45 v.4	20100820	Product data sheet	-	74LVC_LVCH2T45 v.3
74LVC_LVCH2T45 v.3	20100119	Product data sheet	-	74LVC_LVCH2T45 v.2
74LVC_LVCH2T45 v.2	20090205	Product data sheet	-	74LVC_LVCH2T45 v.1
74LVC_LVCH2T45 v.1	20081118	Product data sheet	-	-

17. 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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