74LVC1T45-Q100; 74LVCH1T45-Q100

Dual supply translating transceiver; 3-state

Rev. 2 — 30 May 2016 **Product data sheet**

1. General description

The 74LVC1T45-Q100; 74LVCH1T45-Q100 are single bit, dual supply transceivers with 3-state outputs that enable bidirectional level translation. They feature 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 with any voltage between 1.2 V and 5.5 V. This flexibility makes 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 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 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 74LVCH1T45-Q100 holds unused or floating data inputs at a valid logic level.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from –40 °C to +85 °C and from –40 °C to +125 °C
- 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:
  - MIL-STD-883, method 3015 Class 3A exceeds 4000 V
  - HBM JESD22-A114F Class 3A exceeds 4000 V

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- 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

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC1T45GW-Q100	–40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363
74LVCH1T45GW-Q100				

4. Marking

Table 2. Marking

Type number	Marking code[1]
74LVC1T45GW-Q100	V5
74LVCH1T45GW-Q100	X5

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

5. Functional diagram

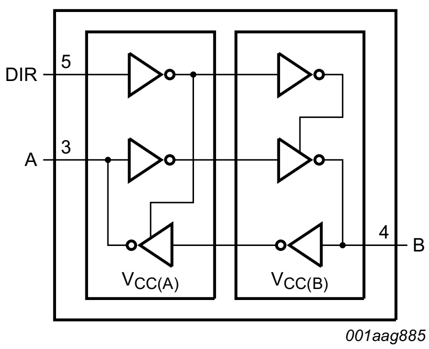


Fig 1. Logic symbol

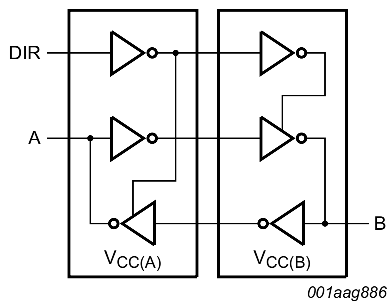


Fig 2. Logic diagram

6. Pinning information

6.1 Pinning

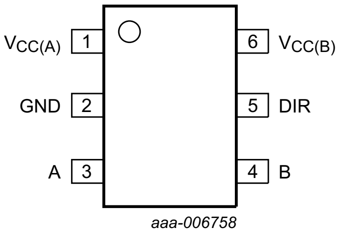


Fig 3. Pin configuration SOT363 (SC-88)

6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
$V_{CC(A)}$	1	supply voltage port A and DIR
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 port B

7. Functional description

Table 4. Function table[1]

Supply voltage	Input	Input/output[2]	
$V_{CC(A)}$, $V_{CC(B)}$	**DIR**	**A**	**B**
1.2 V to 5.5 V	L	A = B	input
1.2 V to 5.5 V	H	input	B = A
GND[3]	X	Z	Z

[1] H = HIGH voltage level; L = LOW voltage level; X = don’t care; Z = high-impedance OFF-state.

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

[3] 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 SC-88 package: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.

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
$\Delta t/\Delta V$	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
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

Table 8. Static characteristics *...continued*

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_{OL}	LOW-level output voltage	$V_I = V_{IL}$ [2]					
		$I_O = 100\ \mu A$; $V_{CCO} = 1.2\ V$ 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
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

Table 8. Static characteristics *...continued*

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	
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
		$V_{CC(B)}$ = 5.5 V; $V_{CC(A)}$ = 0 V		-	2	-	2	μA
		$V_{CC(B)}$ = 0 V; $V_{CC(A)}$ = 5.5 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	$V_{CC(A)}$, $V_{CC(B)}$ = 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 (74LVC1T45-Q100).

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 Figure 6; for waveforms see Figure 4 and Figure 5

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 14.4 "Enable times"

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 Figure 6; for waveforms see Figure 4 and Figure 5

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 14.4 "Enable times"

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).

Symbol	Parameter	Conditions	$V_{CC(A)}$ and $V_{CC(B)}$				Unit
			1.8 V	2.5 V	3.3 V	5.5 V	
C_{PD}	power dissipation capacitance	A port: (direction A to B); B port: (direction B to A)	2	3	3	4	pF
		A port: (direction B to A); B port: (direction A to B)	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; $R_L = \infty\ \Omega$.

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

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6; for wave forms see Figure 4 and Figure 5

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
$V_{CC(A)}$ = 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	6.4	ns

Table 12. Dynamic characteristics for temperature range –40 °C to +85 °C *...continued*

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6; for wave forms see Figure 4 and Figure 5

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	
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A [1]	-	35.2	-	33.7	-	25.2	-	23.9	-	21.8	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	5.3	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A [1]	-	28.1	-	22.5	-	17.5	-	16.4	-	12.8	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
$V_{CC(A)}$ = 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

Table 12. Dynamic characteristics for temperature range –40 °C to +85 °C *...continued*

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6; for wave forms see Figure 4 and Figure 5

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	
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 14.4 "Enable times"

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

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6; for wave forms see Figure 4 and Figure 5

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
$V_{CC(A)}$ = 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	7.4	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A [1]	-	38.8	-	37.1	-	27.8	-	26.4	-	24.1	ns
		DIR to B [1]	-	32.7	-	31.1	-	21.9	-	19.6	-	19.1	ns

Table 13. Dynamic characteristics for temperature range –40 °C to +125 °C *...continued*
Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6; for wave forms see Figure 4 and Figure 5

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	
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	5.9	ns
t_{PZH}	OFF-state to HIGH propagation delay	DIR to A	[1]	-	31.0	-	24.9	-	19.3	-	18.1	-	14.2	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
$V_{CC(A)}$ = 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

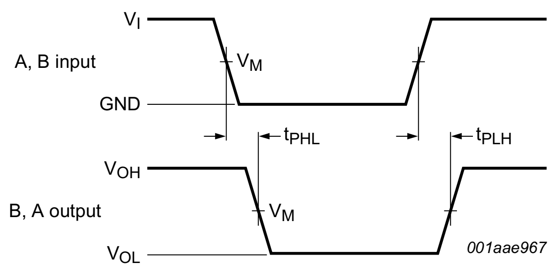
Table 13. Dynamic characteristics for temperature range –40 °C to +125 °C *...continued*

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6; for wave forms see Figure 4 and Figure 5

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	
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 14.4 “Enable times”

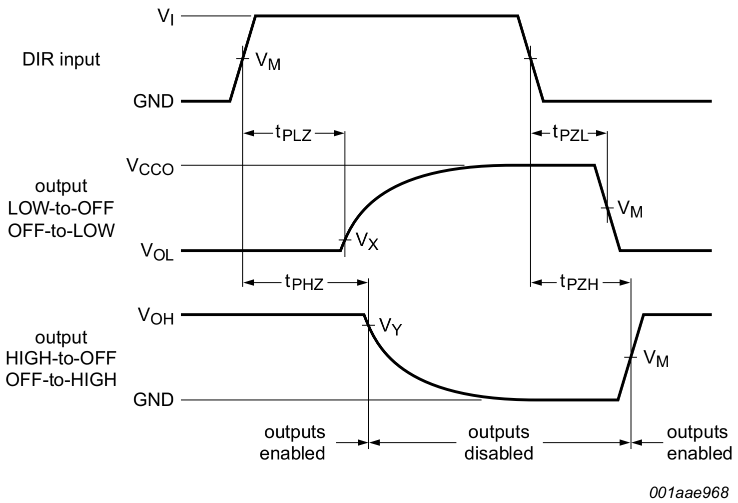
12. Waveforms



Measurement points are given in Table 14.

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

Fig 4. 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.

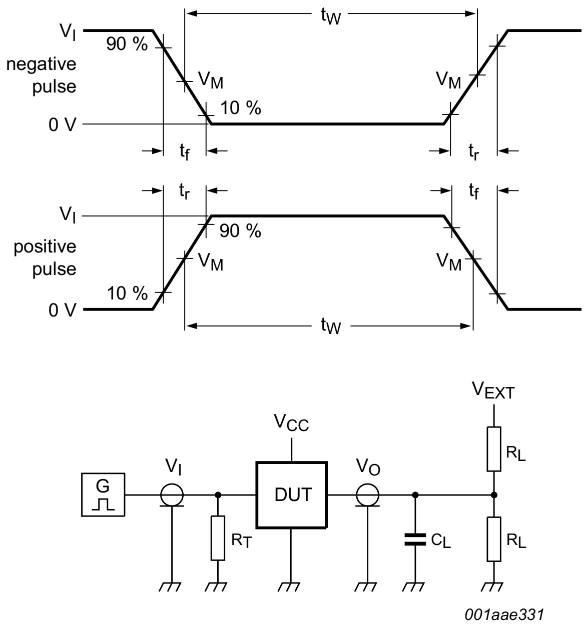
Fig 5. Enable and disable times

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 6. Test circuit for measuring switching times

Table 15. Test data

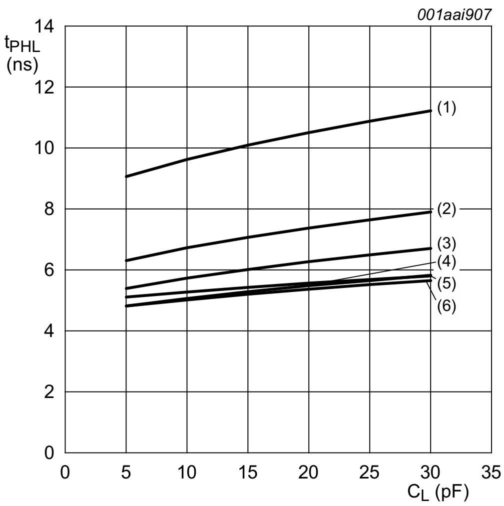
Supply voltage	Input		Load		V_{EXT}		
$V_{CC(A)}$, $V_{CC(B)}$	V_I[1]	$\Delta t/\Delta V$[2]	C_L	R_L	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}[3]
1.2 V to 5.5 V	V_{CCI}	≤ 1.0 ns/V	15 pF	2 kΩ	open	GND	$2V_{CCO}$

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

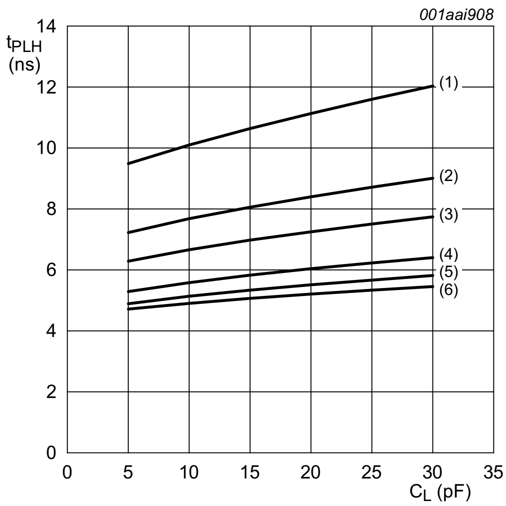
[2] dV/dt ≥ 1.0 V/ns

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

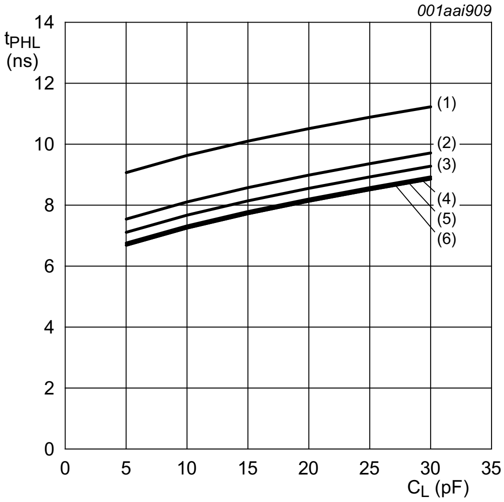
13. Typical propagation delay characteristics



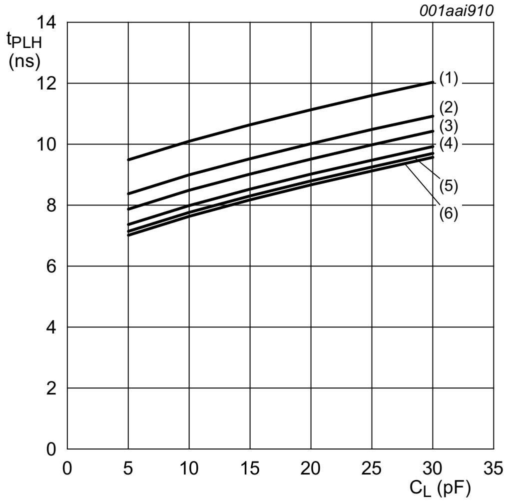
a. HIGH to LOW propagation delay (A to B)



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



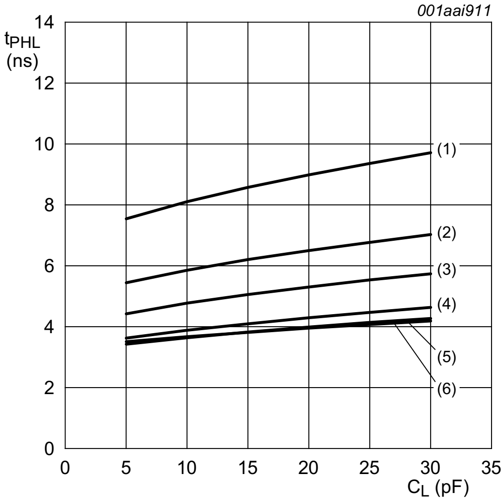
c. HIGH to LOW propagation delay (B to A)



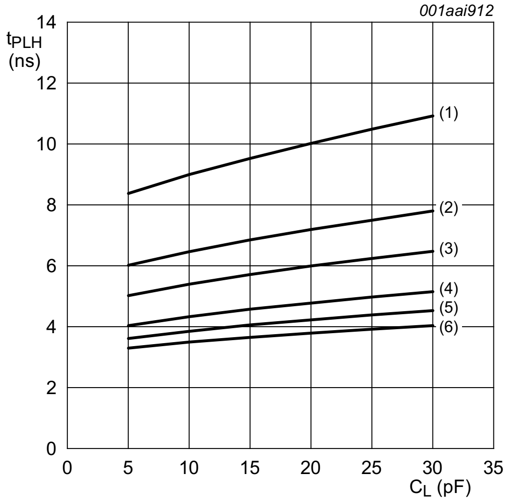
d. LOW to HIGH propagation delay (B to A)

(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.

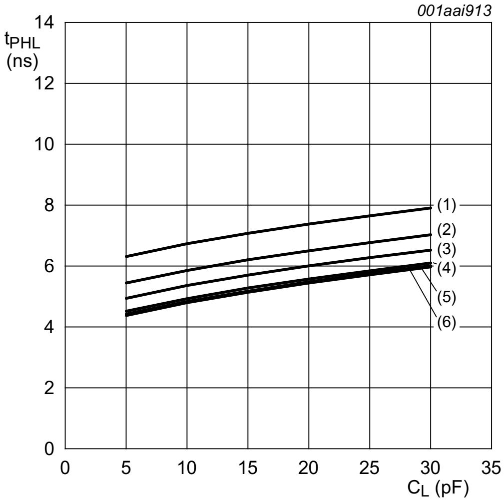
Fig 7. Typical propagation delay vs load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 1.2 V



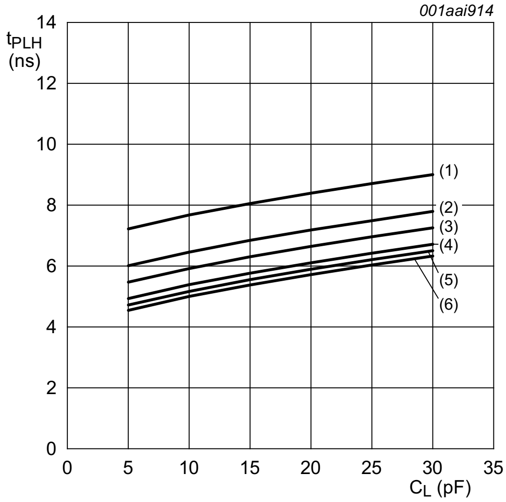
a. HIGH to LOW propagation delay (A to B)



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.

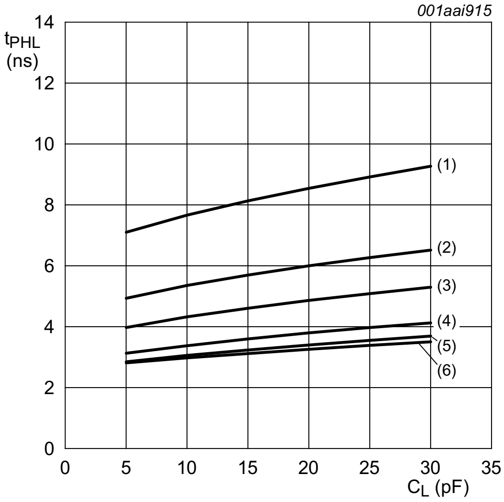
(3) $V_{CC(B)}$ = 1.8 V.

(4) $V_{CC(B)}$ = 2.5 V.

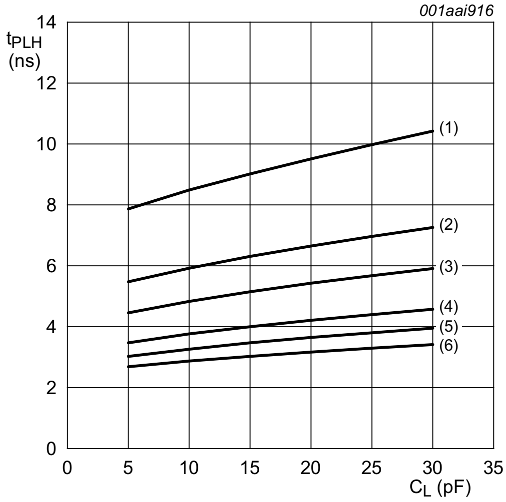
(5) $V_{CC(B)}$ = 3.3 V.

(6) $V_{CC(B)}$ = 5.0 V.

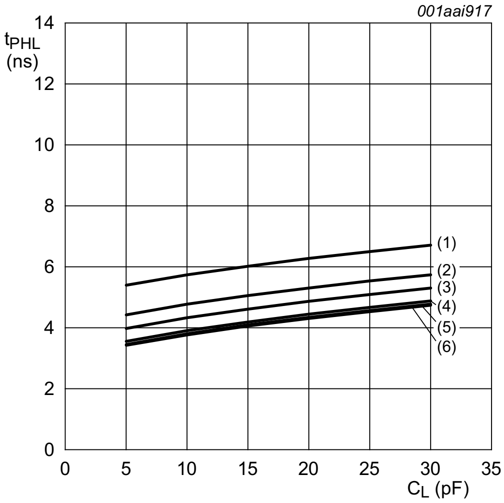
Fig 8. Typical propagation delay vs load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 1.5 V



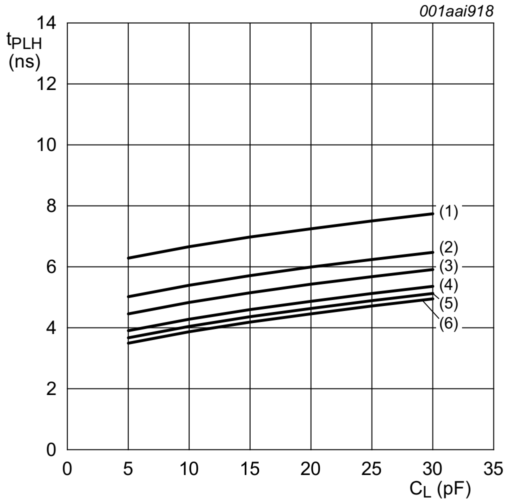
a. HIGH to LOW propagation delay (A to B)



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.

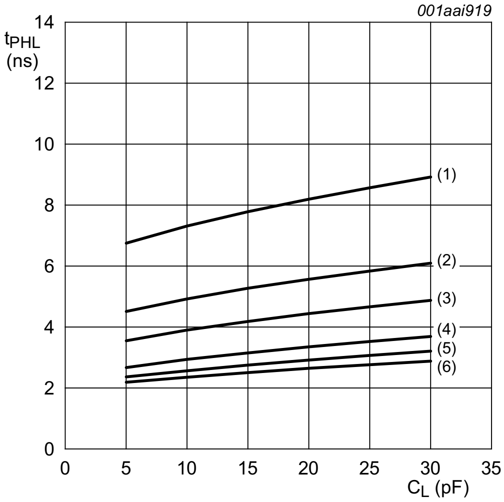
(3) $V_{CC(B)}$ = 1.8 V.

(4) $V_{CC(B)}$ = 2.5 V.

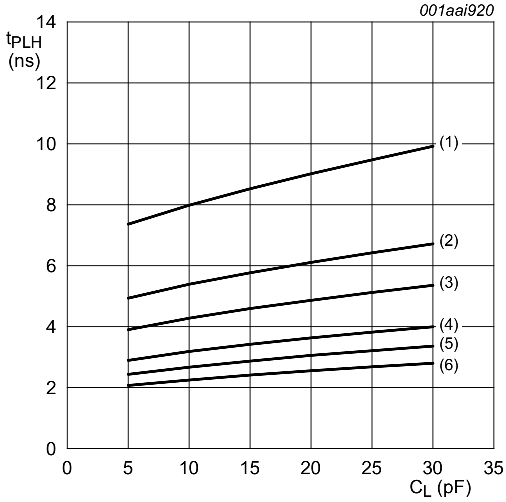
(5) $V_{CC(B)}$ = 3.3 V.

(6) $V_{CC(B)}$ = 5.0 V.

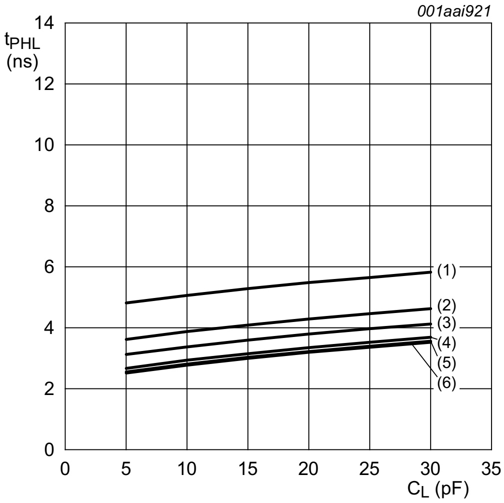
Fig 9. Typical propagation delay vs load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 1.8 V



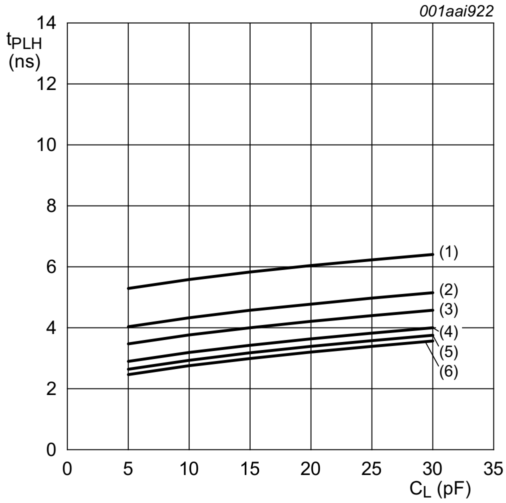
a. HIGH to LOW propagation delay (A to B)



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.

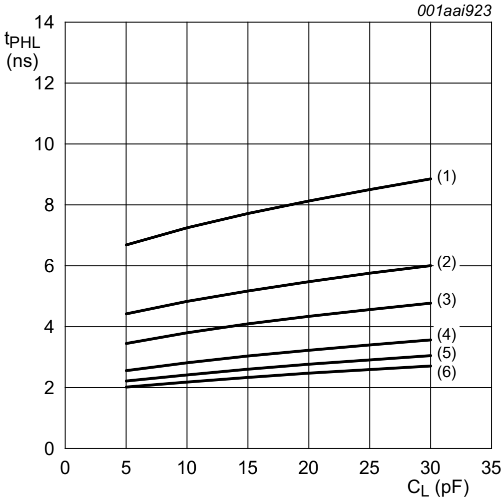
(3) $V_{CC(B)}$ = 1.8 V.

(4) $V_{CC(B)}$ = 2.5 V.

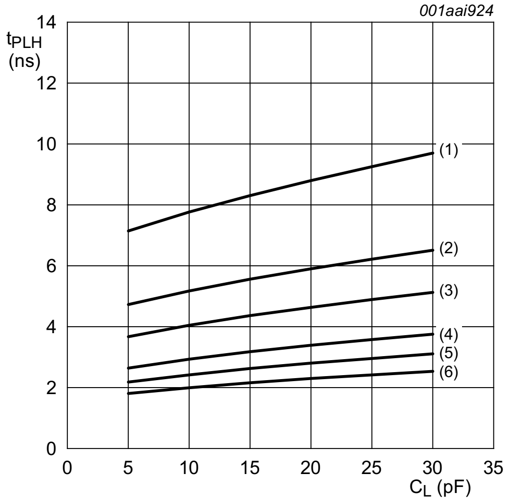
(5) $V_{CC(B)}$ = 3.3 V.

(6) $V_{CC(B)}$ = 5.0 V.

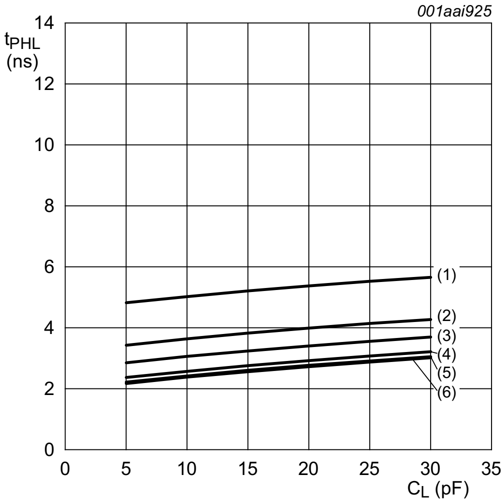
Fig 10. Typical propagation delay vs load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 2.5 V



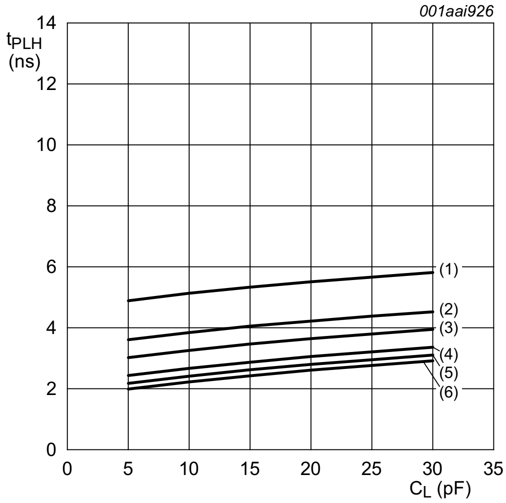
a. HIGH to LOW propagation delay (A to B)



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



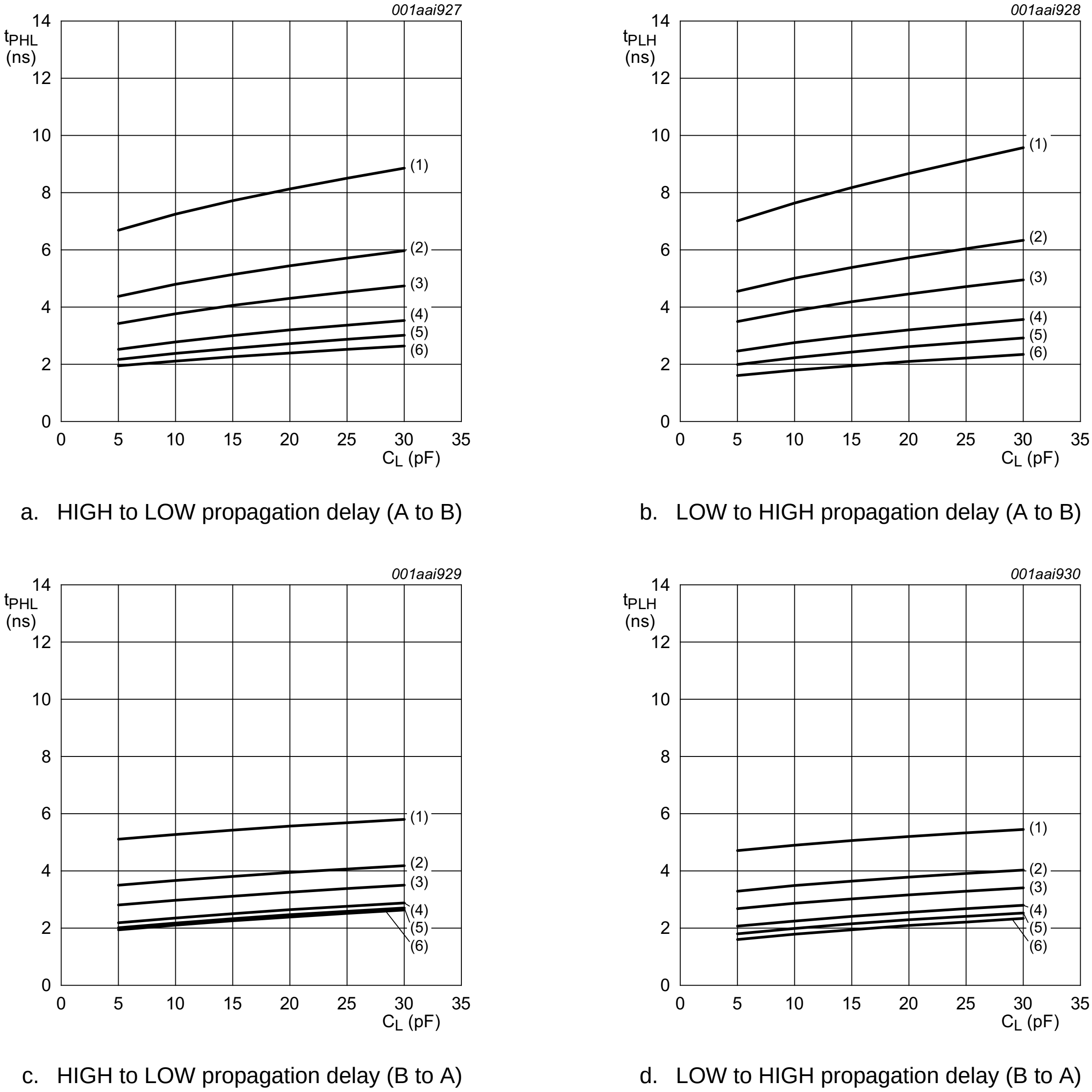
c. HIGH to LOW propagation delay (B to A)



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



(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 vs load capacitance; T_{amb} = 25 °C; $V_{CC(A)}$ = 5 V

14. Application information

14.1 Unidirectional logic level-shifting application

The circuit given in Figure 13 is an example of the 74LVC1T45-Q100; 74LVCH1T45-Q100 being used in a unidirectional logic level-shifting application.

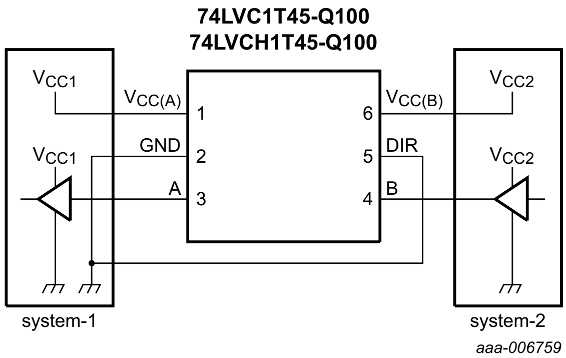


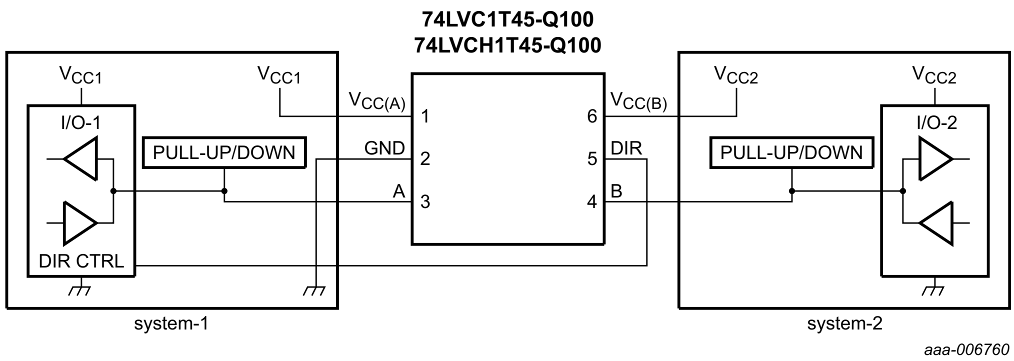
Fig 13. Unidirectional logic level-shifting application

Table 16. Description 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	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 (1.2 V to 5.5 V)

14.2 Bidirectional logic level-shifting application

Figure 14 shows the 74LVC1T45-Q100; 74LVCH1T45-Q100 being used in a bidirectional logic level-shifting application. Since the device does not have an output enable pin, take precautions during design to avoid bus contention between system-1 and system-2 when changing directions.



Pull-up or pull-down only needed for 74LVC1T45-Q100.

Fig 14. Bidirectional logic level-shifting application

Table 17 provides a sequence that illustrates data transmission from system-1 to system-2 and then from system-1 to system-1.

Table 17. Description bidirectional logic level-shifting application[1]

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 are still disabled. The bus-line state depends on bus hold.
4	L	input	output	system-2 data to system-1

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

14.3 Power-up considerations

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

Table 18. Typical total 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

14.4 Enable times

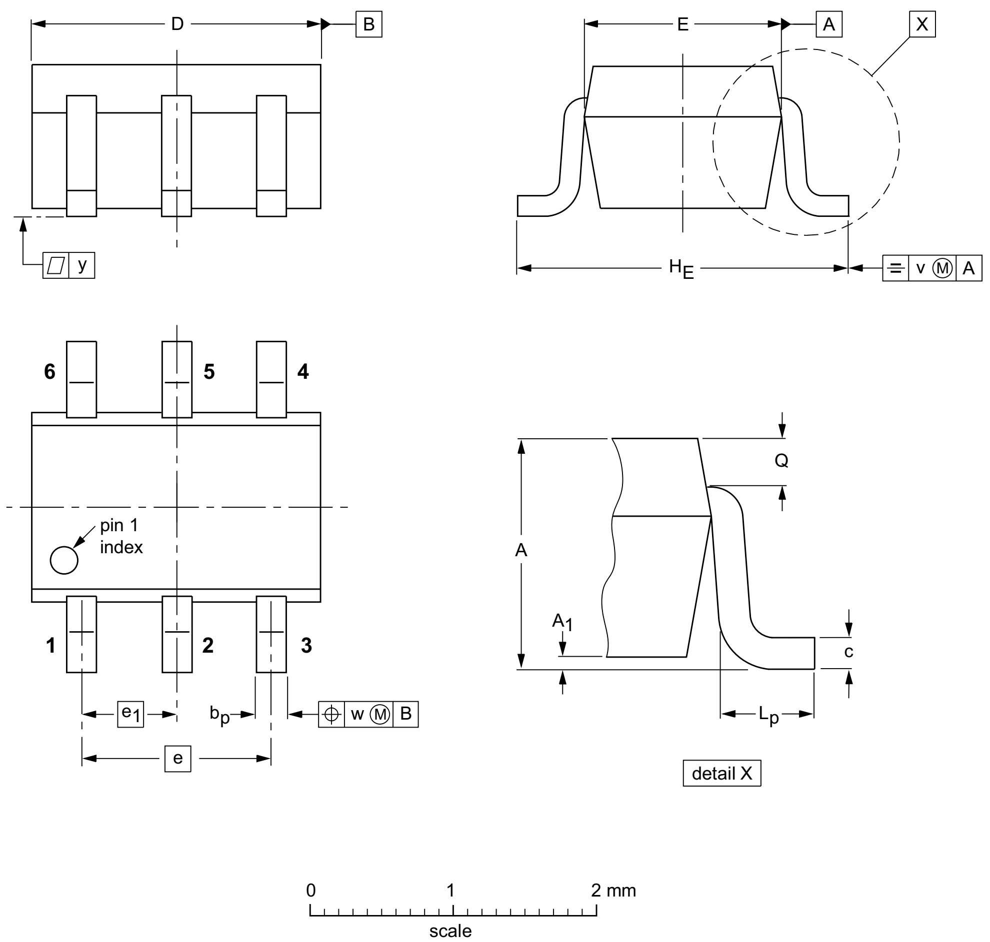
Calculate the enable times for the 74LVC1T45-Q100; 74LVCH1T45-Q100 using the following formulas:

- 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 74LVC1T45-Q100; 74LVCH1T45-Q100 initially transmits from A to B, the DIR bit is switched. In this situation, 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.

15. 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 15. Package outline SOT363 (SC-88)

16. Abbreviations

Table 19. Abbreviations

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

17. Revision history

Table 20. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC_LVCH1T45_Q100 v.2	20160530	Product data sheet	-	74LVC_LVCH1T45_Q100 v.1
Modifications:	• Table 1: typo corrected in type number			
74LVC_LVCH1T45_Q100 v.1	20130328	Product data sheet	-	-

18. Legal information

18.1 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 URL http://www.nexperia.com.

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20. Contents

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Date of release: 30 May 2016