



**THE DATASHEET OF
74LVC1T45GM-Q100X**



74LVC1T45-Q100; 74LVCH1T45-Q100

Dual supply translating transceiver; 3-state

Rev. 6 — 4 August 2023

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
- 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 μ A maximum I_{CC}
- I_{OFF} circuitry provides partial Power-down mode operation
- 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: ANSI/ESDA/JEDEC JS-001 class 3A exceeds 4000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|-----------------------------------------------------------------------|-------------------|--------|---------------------------------------------------------------------------------------------|--------------------------|
| | Temperature range | Name | Description | |
| 74LVC1T45GW-Q100 74LVCH1T45GW-Q100 | -40 °C to +125 °C | TSSOP6 | plastic thin shrink small outline package; 6 leads; body width 1.25 mm | SOT363-2 |
| 74LVC1T45GM-Q100 | -40 °C to +125 °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm | SOT886 |

4. Marking

Table 2. Marking

| Type number | Marking code ^[1] |
|-------------------|-----------------------------|
| 74LVC1T45GW-Q100 | V5 |
| 74LVCH1T45GW-Q100 | X5 |
| 74LVC1T45GM-Q100 | V5 |

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

5. Functional diagram

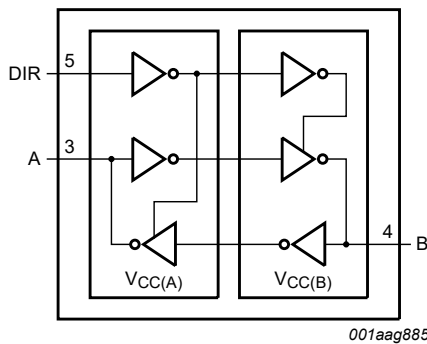


Fig. 1. Logic symbol

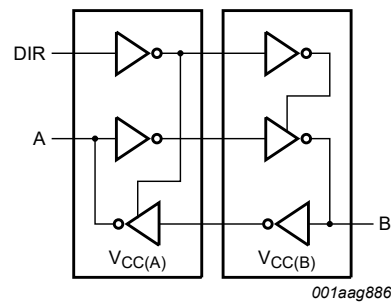
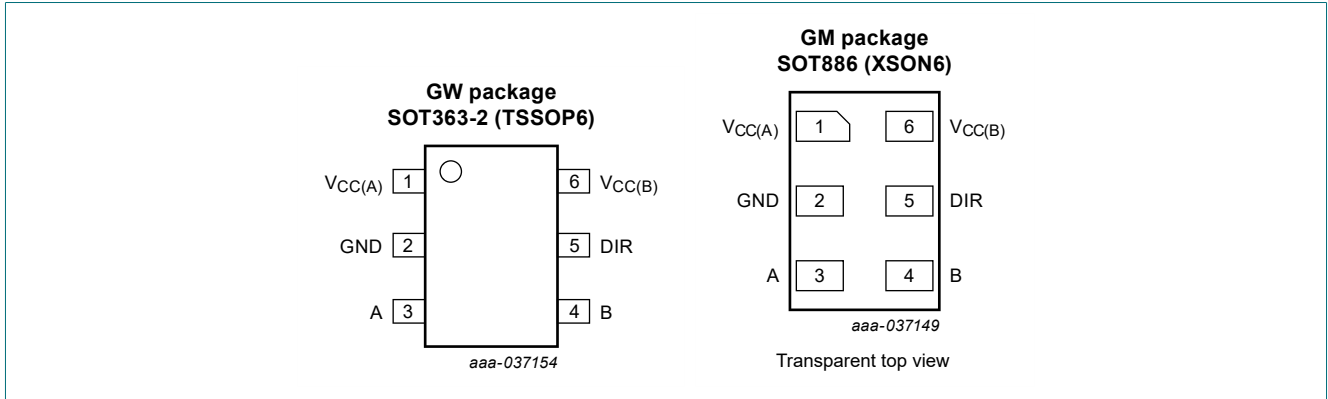


Fig. 2. Logic diagram

6. Pinning information

6.1. Pinning



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

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

| Supply voltage | Input | Input/output [1] | |
|-----------------------------------------|-------|------------------|-------|
| | | A | B |
| V _{CC(A)} , V _{CC(B)} | DIR | A = B | input |
| 1.2 V to 5.5 V | L | A = B | input |
| 1.2 V to 5.5 V | H | input | B = A |
| 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 SOT363-2 (TSSOP6) package: P_{tot} derates linearly with 3.7 mW/K above 83 °C.

For SOT886 (XSON6) package: P_{tot} derates linearly with 3.3 mW/K above 74 °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 |
| $\Delta t/\Delta V$ | 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 $T_{amb} = 25\text{ °C}$

At recommended operating conditions; voltages are referenced to GND (ground = 0 V). [1] [2]

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

[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} .

Table 8. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V). [1] [2]

| 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 | | | | | |
| | | $V_{CCI} = 1.2\text{ V}$ | $0.8V_{CCI}$ | - | $0.8V_{CCI}$ | - | V |
| | | $V_{CCI} = 1.4\text{ V}$ to 1.95 V | $0.65V_{CCI}$ | - | $0.65V_{CCI}$ | - | V |
| | | $V_{CCI} = 2.3\text{ V}$ to 2.7 V | 1.7 | - | 1.7 | - | V |
| | | $V_{CCI} = 3.0\text{ V}$ to 3.6 V | 2.0 | - | 2.0 | - | V |
| | | $V_{CCI} = 4.5\text{ V}$ to 5.5 V | $0.7V_{CCI}$ | - | $0.7V_{CCI}$ | - | V |
| | | DIR input | | | | | |
| | | $V_{CCI} = 1.2\text{ V}$ | $0.8V_{CC(A)}$ | - | $0.8V_{CC(A)}$ | - | V |
| | | $V_{CCI} = 1.4\text{ V}$ to 1.95 V | $0.65V_{CC(A)}$ | - | $0.65V_{CC(A)}$ | - | V |
| | | $V_{CCI} = 2.3\text{ V}$ to 2.7 V | 1.7 | - | 1.7 | - | V |
| | | $V_{CCI} = 3.0\text{ V}$ to 3.6 V | 2.0 | - | 2.0 | - | V |
| | | $V_{CCI} = 4.5\text{ V}$ 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 | | | | | | | |
| | | 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 | 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 | | |
| V _{OL} | LOW-level output voltage | V _I = V _{IL} | | | | | | | |
| | | 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 _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 | | | | | |
| | | | | 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 | | | | | | | |
| | | 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 [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 [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 | - | ±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 | | | | | |
| | | 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 $V_{CC(A)} = 1.2\text{ V}$ and $T_{amb} = 25\text{ °C}$

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 5; for waveforms see Fig. 3 and Fig. 4.

| 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 $V_{CC(B)} = 1.2\text{ V}$ and $T_{amb} = 25\text{ °C}$

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 5; for waveforms see Fig. 3 and Fig. 4.

| 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 $T_{amb} = 25\text{ °C}$

Voltages are referenced to GND (ground = 0 V). [1][2]

| 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).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

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;

$\sum(C_L \times V_{CC}^2 \times f_o)$ = 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 = ∞ 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. 5; for wave forms see Fig. 3 and Fig. 4.

| 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 | |
| $V_{CC(A)} = 1.4\text{ V to }1.6\text{ V}$ | | | | | | | | | | | | | |
| 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 | 6.4 | ns | |
| 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 |

| 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. 5](#); for wave forms see [Fig. 3](#) and [Fig. 4](#).

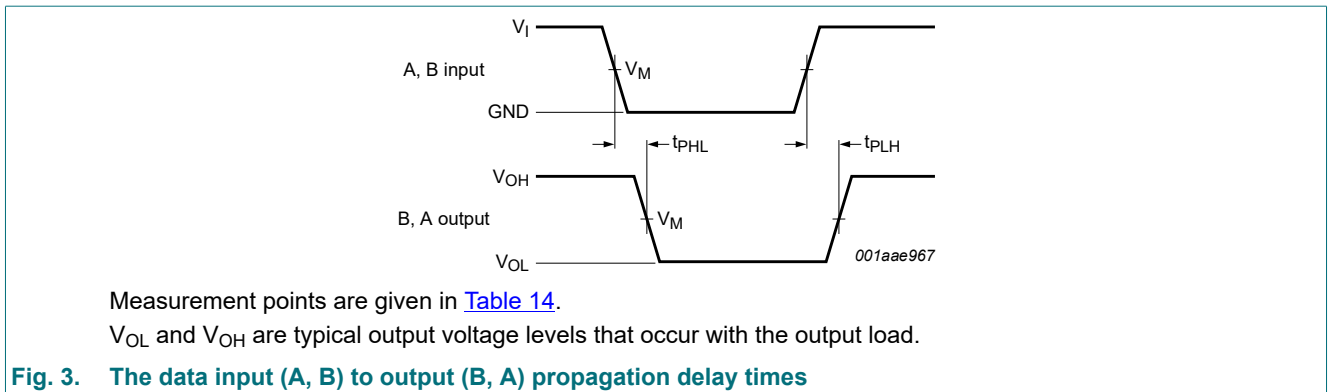
| Symbol | Parameter | Conditions | V _{CC(B)} | | | | | | | | | | Unit |
|-------------------------------------------|-------------------------------------|--------------|--------------------|------|-------------------|------|------------------|------|------------------|------|------------------|------|------|
| | | | 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 | 7.4 | 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 |
| 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 |

| 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



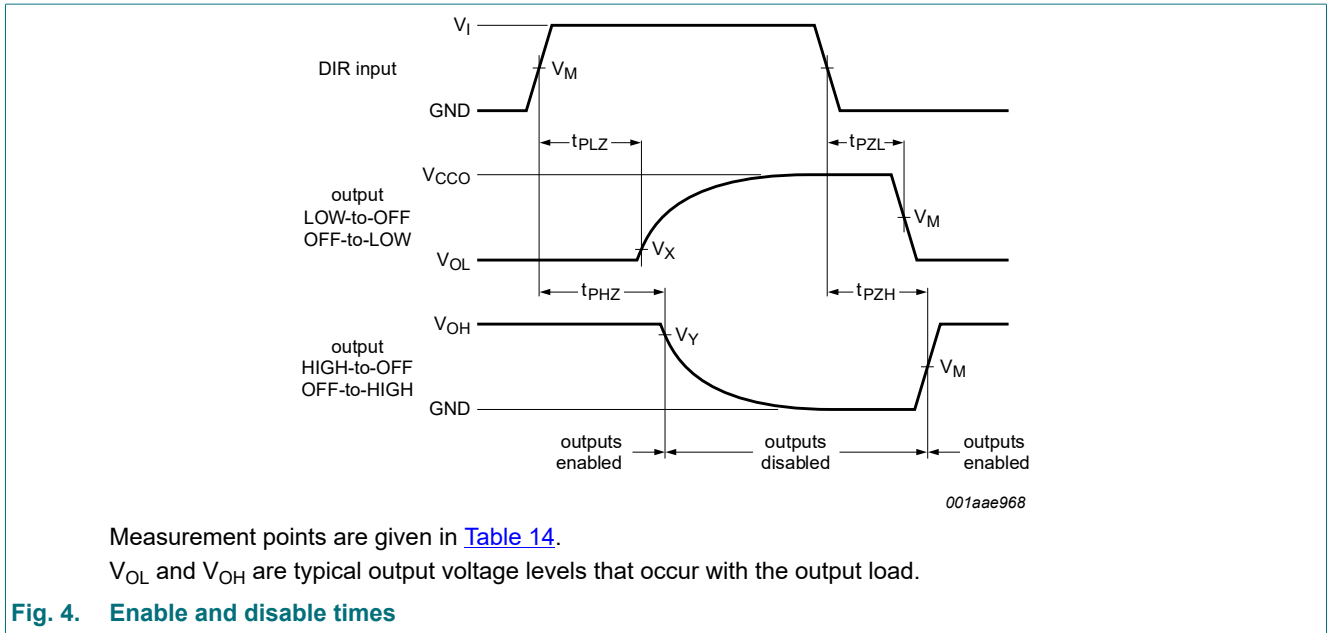
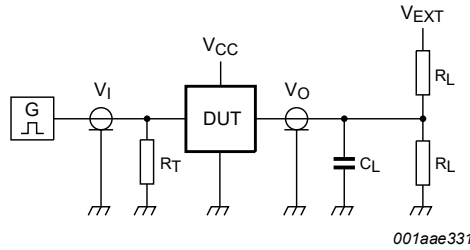
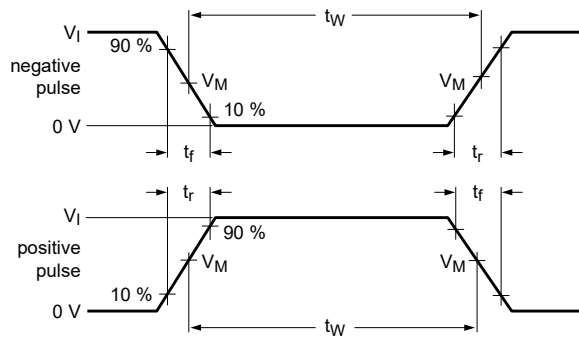


Table 14. Measurement points

| 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 | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.1\text{ V}$ | $V_{OH} - 0.1\text{ V}$ |
| 1.65 V to 2.7 V | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.15\text{ V}$ | $V_{OH} - 0.15\text{ V}$ |
| 3.0 V to 5.5 V | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.3\text{ V}$ | $V_{OH} - 0.3\text{ V}$ |

[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.



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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. 5. Test circuit for measuring switching times

Table 15. Test data

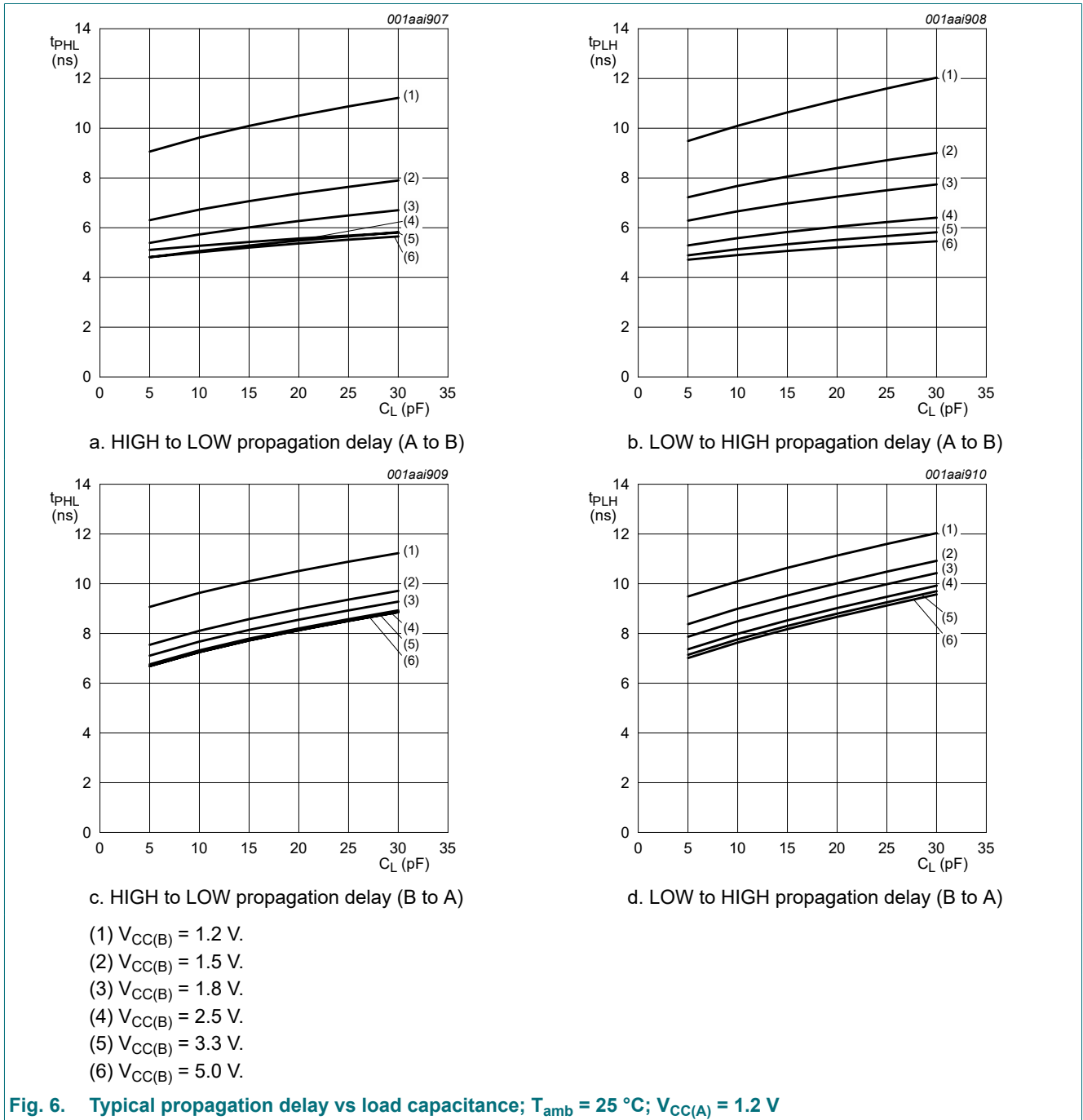
| Supply voltage | Input | | Load | | V_{EXT} | | |
|------------------------|-----------|-------------------------|-------|--------------|--------------------|--------------------|------------------------|
| $V_{CC(A)}, V_{CC(B)}$ | V_I [1] | $\Delta t/\Delta V$ [2] | C_L | R_L | t_{PLH}, t_{PHL} |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

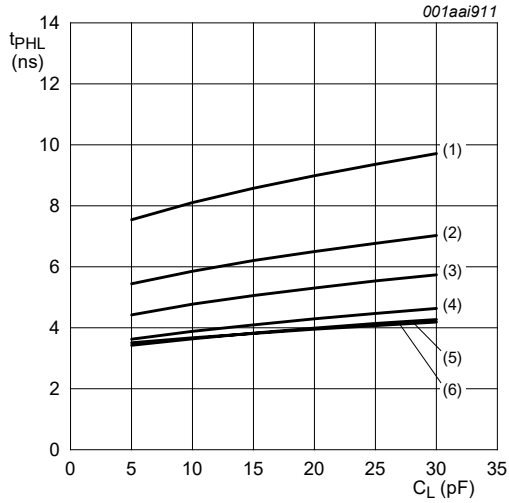
[1] V_{CCI} is the supply voltage associated with the data input port.

[2] $dV/dt \geq 1.0 \text{ V/ns}$

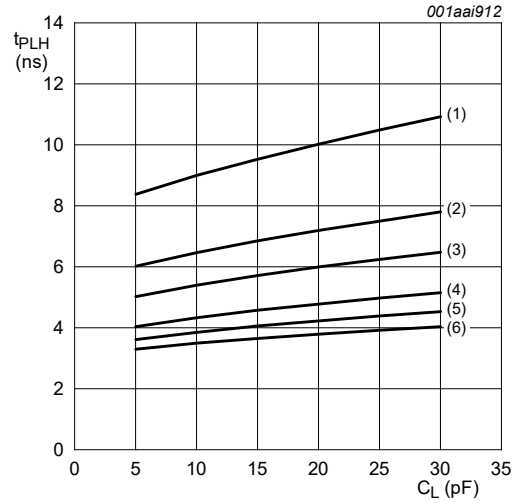
[3] V_{CCO} is the supply voltage associated with the output port.

12. Typical propagation delay characteristics

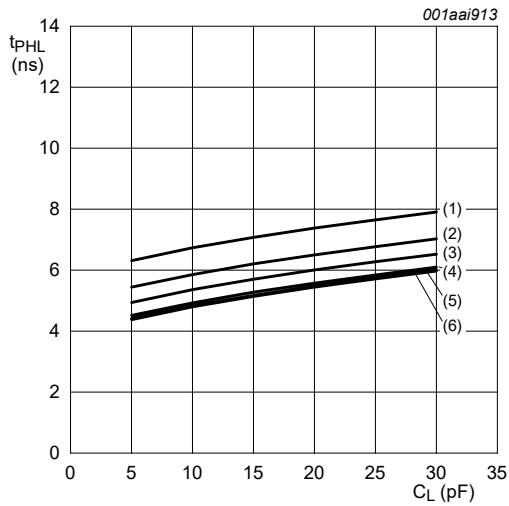




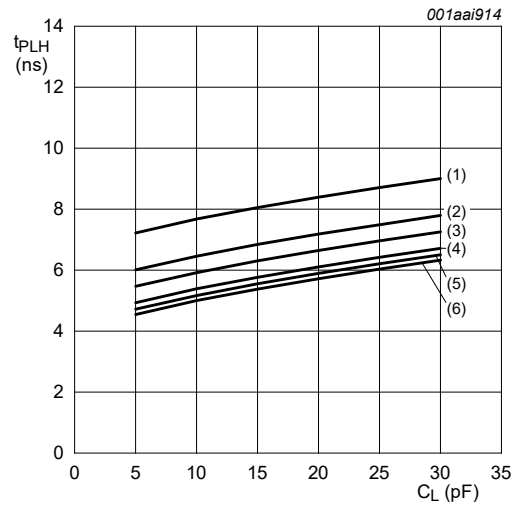
a. HIGH to LOW propagation delay (A to B)



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



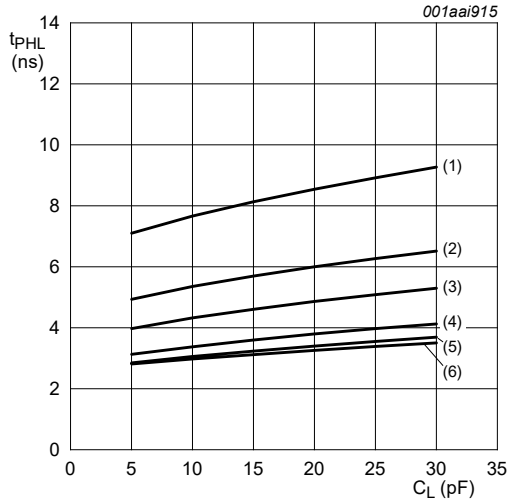
c. HIGH to LOW propagation delay (B to A)



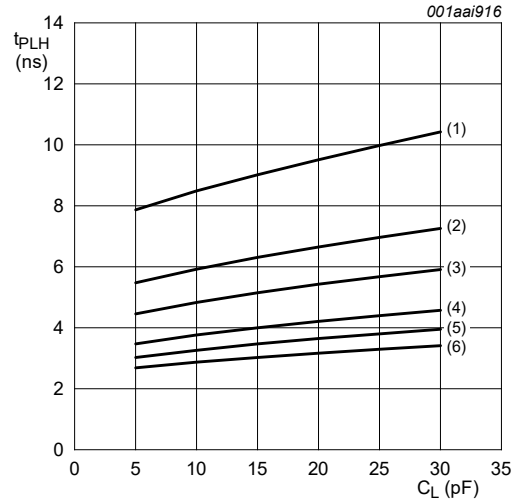
d. LOW to HIGH propagation delay (B to A)

- (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.

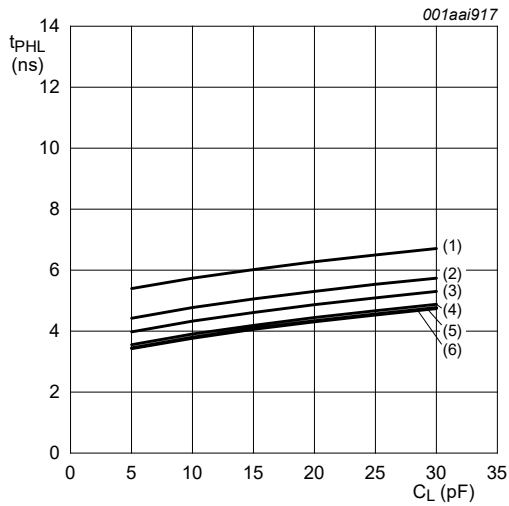
Fig. 7. Typical propagation delay vs load capacitance; $T_{amb} = 25$ °C; $V_{CC(A)} = 1.5$ V



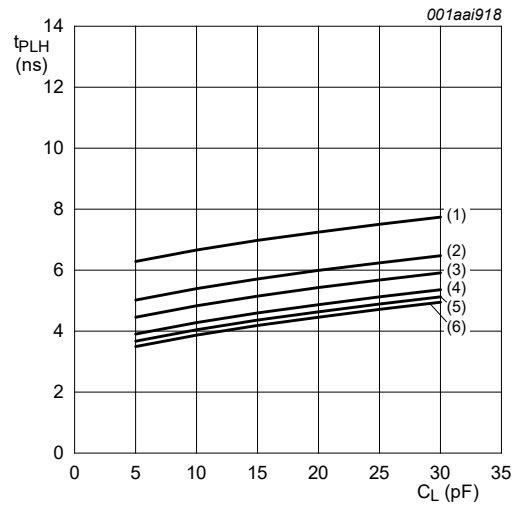
a. HIGH to LOW propagation delay (A to B)



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



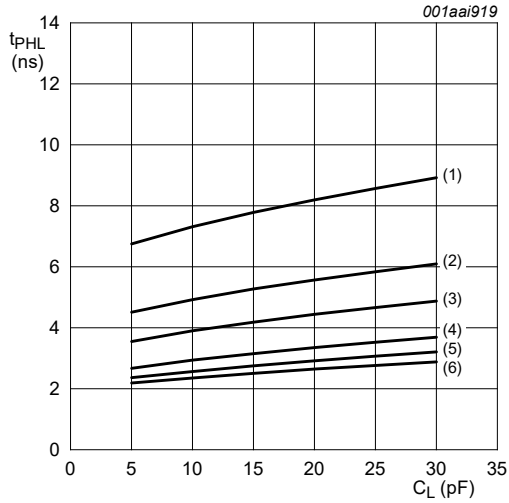
c. HIGH to LOW propagation delay (B to A)



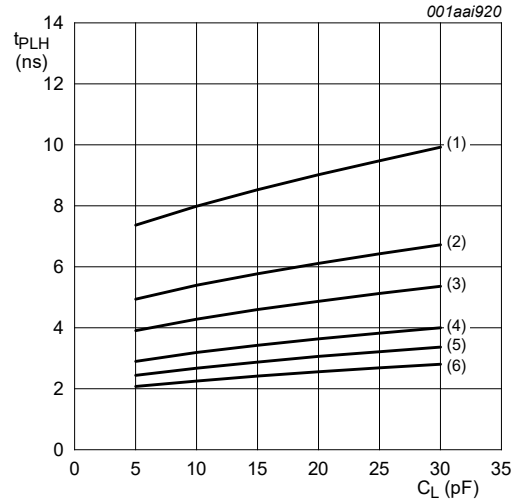
d. LOW to HIGH propagation delay (B to A)

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

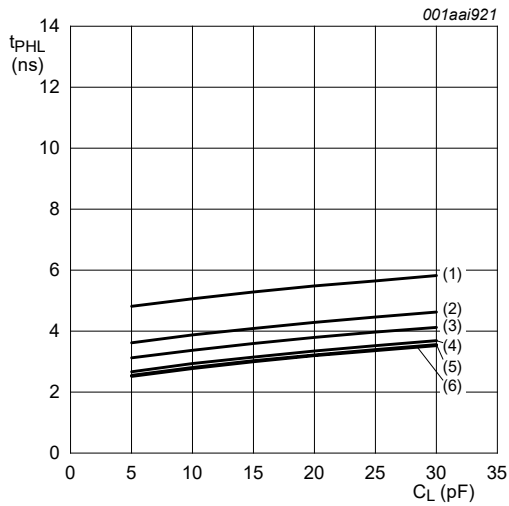
Fig. 8. Typical propagation delay vs load capacitance; $T_{amb} = 25\text{ }^\circ\text{C}$; $V_{CC(A)} = 1.8\text{ V}$



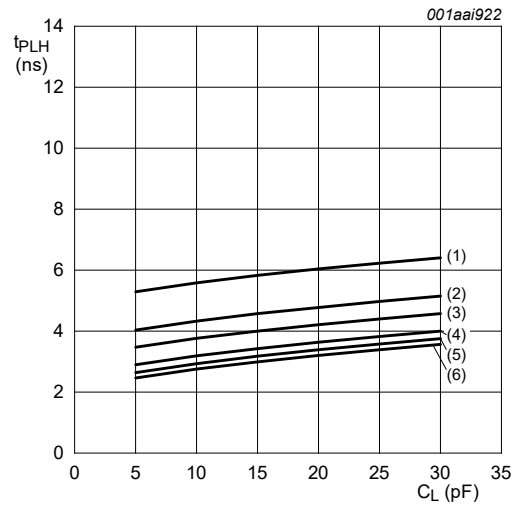
a. HIGH to LOW propagation delay (A to B)



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



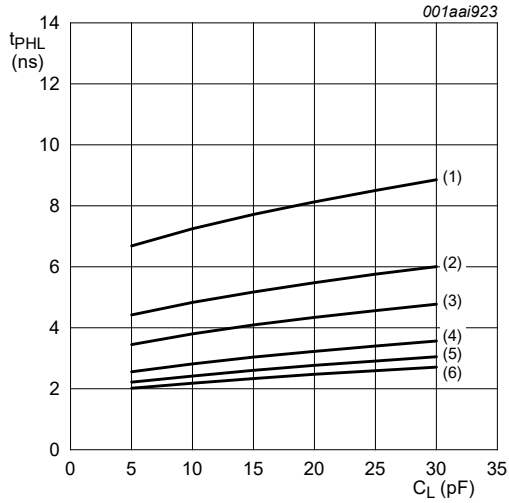
c. HIGH to LOW propagation delay (B to A)



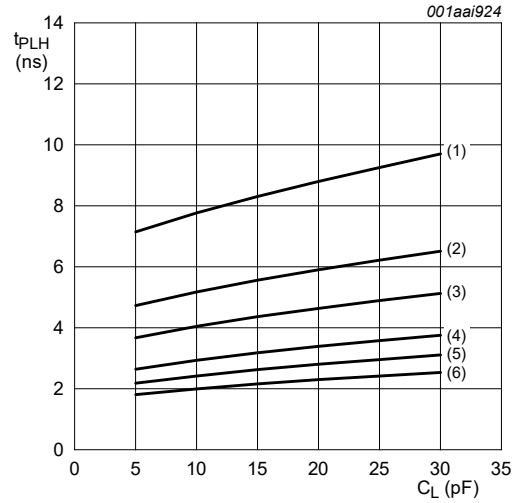
d. LOW to HIGH propagation delay (B to A)

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

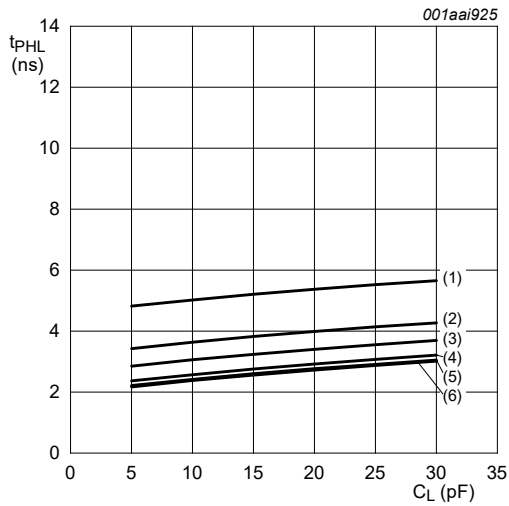
Fig. 9. Typical propagation delay vs load capacitance; $T_{amb} = 25\text{ }^\circ\text{C}$; $V_{CC(A)} = 2.5\text{ V}$



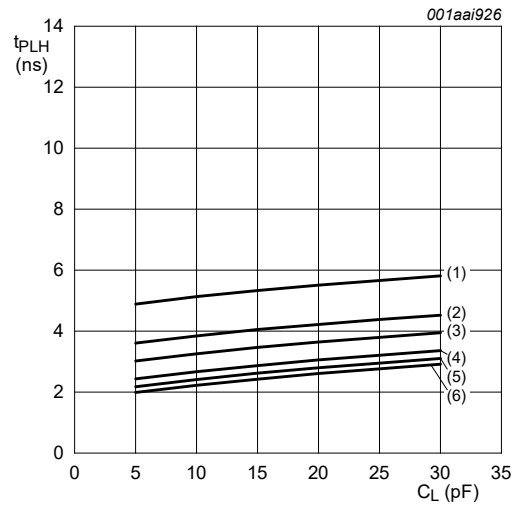
a. HIGH to LOW propagation delay (A to B)



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



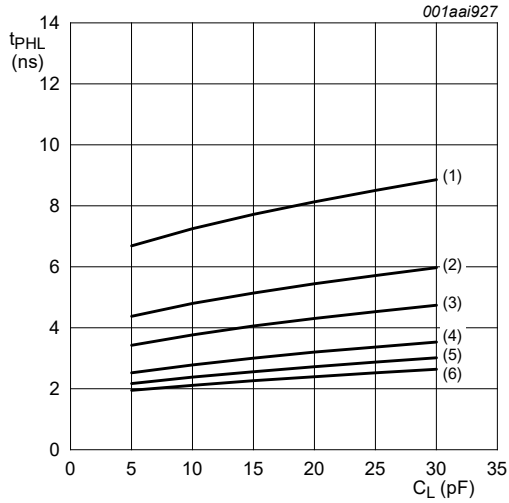
c. HIGH to LOW propagation delay (B to A)



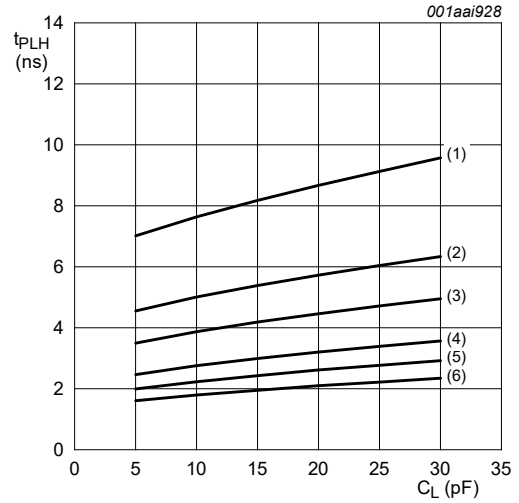
d. LOW to HIGH propagation delay (B to A)

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

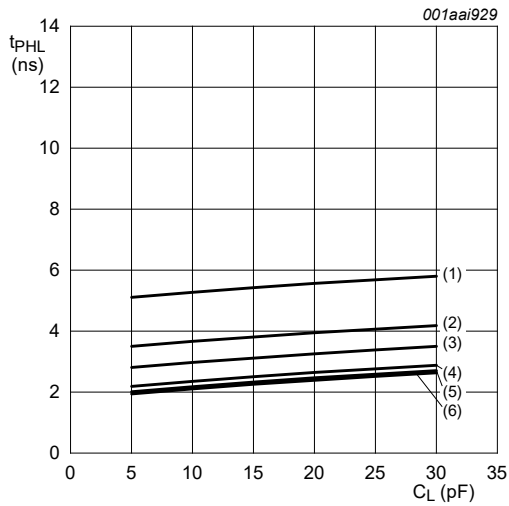
Fig. 10. Typical propagation delay vs load capacitance; $T_{amb} = 25\text{ }^\circ\text{C}$; $V_{CC(A)} = 3.3\text{ V}$



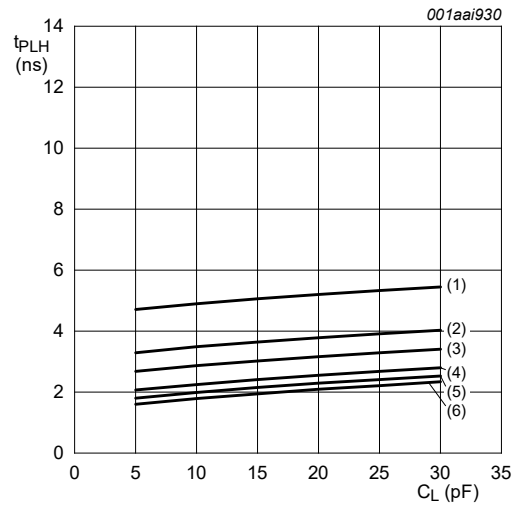
a. HIGH to LOW propagation delay (A to B)



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

Fig. 11. Typical propagation delay vs load capacitance; $T_{amb} = 25\text{ }^\circ\text{C}$; $V_{CC(A)} = 5.0\text{ V}$

13. Application information

13.1. Unidirectional logic level-shifting application

The circuit given in Fig. 12 is an example of the 74LVC1T45-Q100; 74LVCH1T45-Q100 being used in a unidirectional logic level-shifting application.

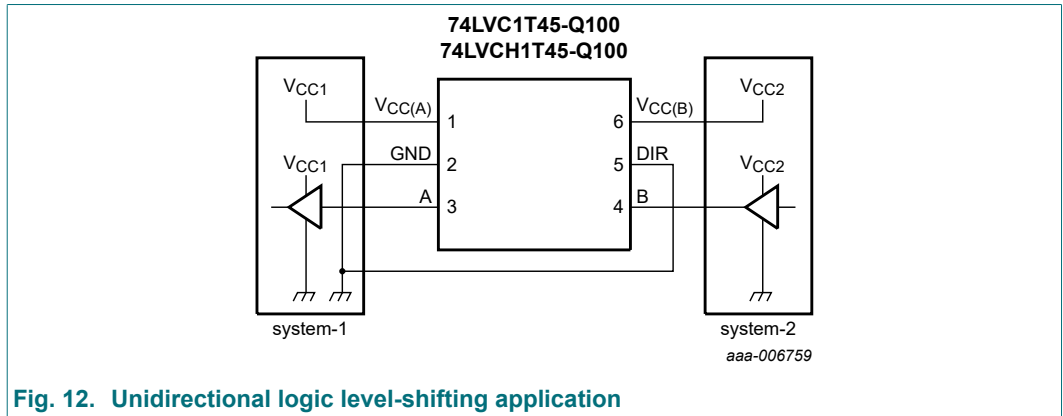


Fig. 12. Unidirectional logic level-shifting application

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) |

13.2. Bidirectional logic level-shifting application

Fig. 13 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, the system designer should take precautions to avoid bus contention between system-1 and system-2 when changing directions.

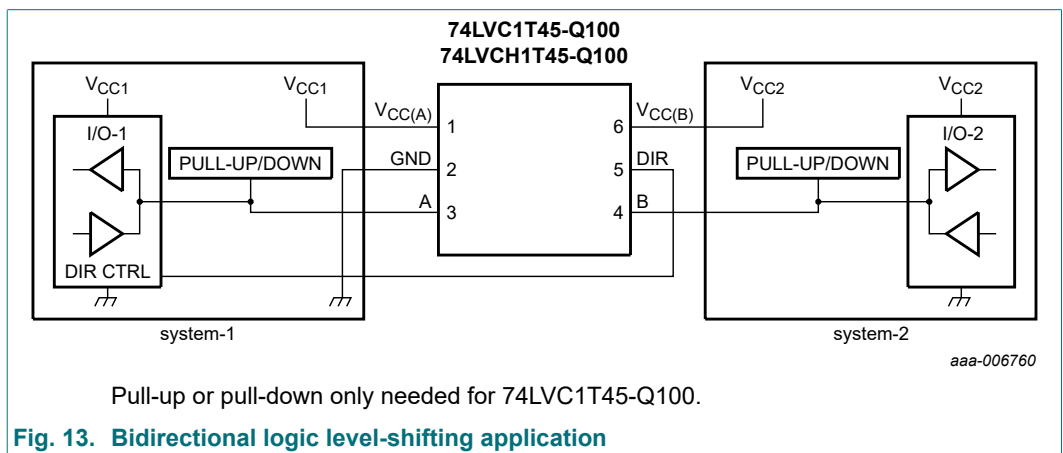


Fig. 13. Bidirectional logic level-shifting application

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

Table 17. Description bidirectional logic level-shifting application

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

| State | DIR CTRL | 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 |

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. 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 |

13.4. Enable times

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

- $t_{PZH}(\text{DIR to A}) = t_{PLZ}(\text{DIR to B}) + t_{PLH}(\text{B to A})$
- $t_{PZL}(\text{DIR to A}) = t_{PHZ}(\text{DIR to B}) + t_{PHL}(\text{B to A})$
- $t_{PZH}(\text{DIR to B}) = t_{PLZ}(\text{DIR to A}) + t_{PLH}(\text{A to B})$
- $t_{PZL}(\text{DIR to B}) = t_{PHZ}(\text{DIR to A}) + t_{PHL}(\text{A to B})$

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 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

TSSOP6: plastic thin shrink small outline package; 6 leads; body width 1.25 mm

SOT363-2

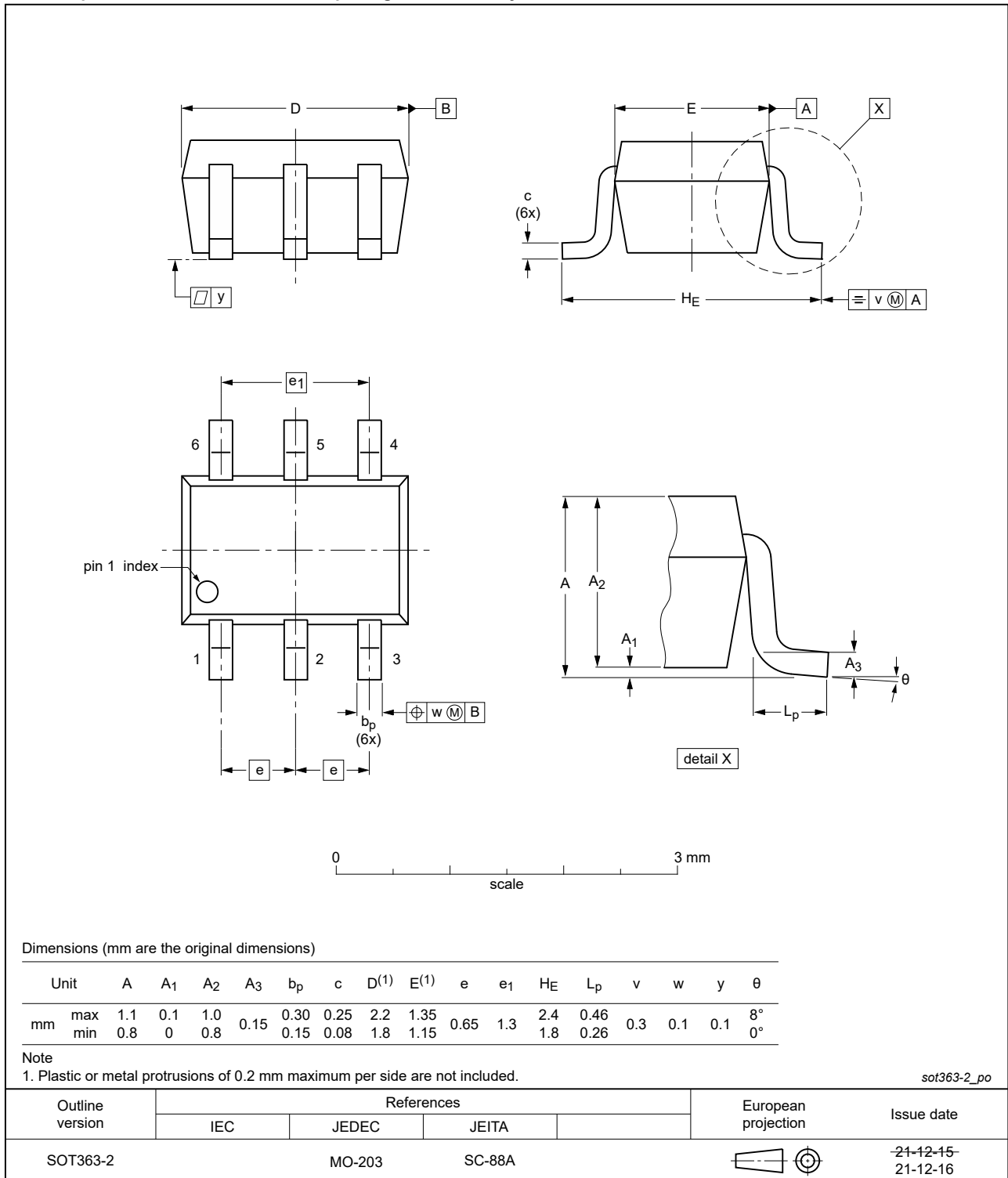


Fig. 14. Package outline SOT363-2 (TSSOP6)

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm

SOT886

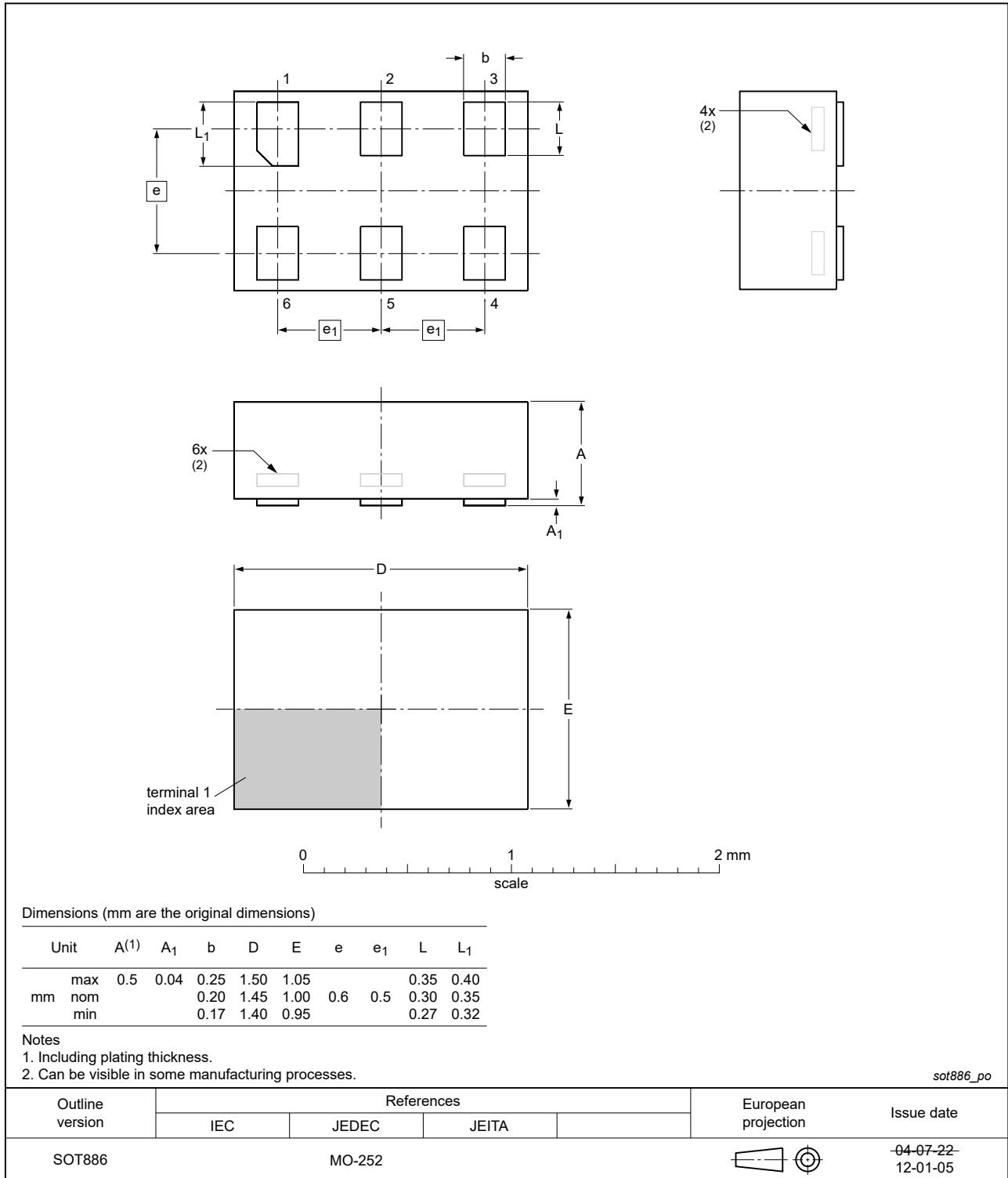


Fig. 15. Package outline SOT886 (XSON6)

15. Abbreviations

Table 19. Abbreviations

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

16. Revision history

Table 20. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-------------------------|
| 74LVC_LVCH1T45_Q100 v.6 | 20230804 | Product data sheet | - | 74LVC_LVCH1T45_Q100 v.5 |
| Modifications: | <ul style="list-style-type: none"> Section 2: ESD specification updated according to the latest JEDEC standard. | | | |
| 74LVC_LVCH1T45_Q100 v.5 | 20220210 | Product data sheet | - | 74LVC_LVCH1T45_Q100 v.4 |
| Modifications: | <ul style="list-style-type: none"> Package SOT363 (SC-88) changed to SOT363-2 (TSSOP6). | | | |
| 74LVC_LVCH1T45_Q100 v.4 | 20201201 | Product data sheet | - | 74LVC_LVCH1T45_Q100 v.3 |
| Modifications: | <ul style="list-style-type: none"> Section 2: ESD specification aligned with Non-Automotive data sheet. Table 5: Derating values for P_{tot} total power dissipation updated. | | | |
| 74LVC_LVCH1T45_Q100 v.3 | 20190319 | Product data sheet | - | 74LVC_LVCH1T45_Q100 v.2 |
| Modifications: | <ul style="list-style-type: none"> 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 number 74LVC1T45GM-Q100 (XSON6/SOT886) added. | | | |
| 74LVC_LVCH1T45_Q100 v.2 | 20160530 | Product data sheet | - | 74LVC_LVCH1T45_Q100 v.1 |
| Modifications: | <ul style="list-style-type: none"> Table 1: typo corrected in type number | | | |
| 74LVC_LVCH1T45_Q100 v.1 | 20130328 | 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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