

# 74LVC1T45; 74LVCH1T45

Dual supply translating transceiver; 3-state

Rev. 7 — 19 March 2019

Product data sheet

## 1. General description

The 74LVC1T45; 74LVCH1T45 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 at any voltage between 1.2 V and 5.5 V making the device suitable for translating between any of the low voltage nodes (1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V and 5.0 V). Pins 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 holds unused or floating data inputs at a valid logic level.

## 2. Features and benefits

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

### 3. Ordering information

Table 1. Ordering information

| Type number  | Package           |       |   |         |
|--------------|-------------------|-------|---|---------|
|              | Temperature range | Name  | Description   | Version |
| 74LVC1T45GW  | -40 °C to +125 °C | SC-88 | plastic surface-mounted package; 6 leads  | SOT363  |
| 74LVCH1T45GW |                   |       |   |         |
| 74LVC1T45GM  | -40 °C to +125 °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm | SOT886  |
| 74LVCH1T45GM |                   |       |   |         |
| 74LVC1T45GF  | -40 °C to +125 °C | XSON6 | plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1 × 0.5 mm    | SOT891  |
| 74LVCH1T45GF |                   |       |   |         |
| 74LVC1T45GN  | -40 °C to +125 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body 0.9 × 1.0 × 0.35 mm       | SOT1115 |
| 74LVCH1T45GN |                   |       |   |         |
| 74LVC1T45GS  | -40 °C to +125 °C | XSON6 | extremely thin small outline package; no leads; 6 terminals; body 1.0 × 1.0 × 0.35 mm       | SOT1202 |
| 74LVCH1T45GS |                   |       |   |         |

### 4. Marking

Table 2. Marking

| Type number  | Marking code [1] |
|--------------|------------------|
| 74LVC1T45GW  | V5               |
| 74LVCH1T45GW | X5               |
| 74LVC1T45GM  | V5               |
| 74LVCH1T45GM | X5               |
| 74LVC1T45GF  | V5               |
| 74LVCH1T45GF | X5               |
| 74LVC1T45GN  | V5               |
| 74LVCH1T45GN | X5               |
| 74LVC1T45GS  | V5               |
| 74LVCH1T45GS | 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

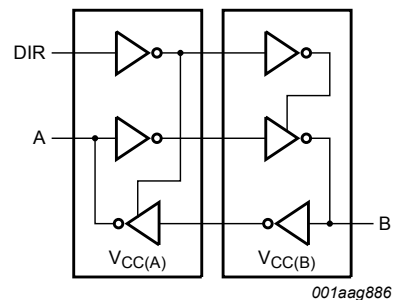


Fig. 2. Logic diagram

## 6. Pinning information

### 6.1. Pinning



### 6.2. Pin description

Table 3. Pin description

| Symbol             | Pin | Description                   |
|--------------------|-----|-------------------------------|
| V <sub>CC(A)</sub> | 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 <sub>CC(B)</sub> | 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] |       |
|---|-------|------------------|-------|
| V <sub>CC(A)</sub> , V <sub>CC(B)</sub> | 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 [2]                                 | X     | Z                | Z     |

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

[2] When either V<sub>CC(A)</sub> or V<sub>CC(B)</sub> 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]      | -    | $\pm 50$        | 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.  
 For XSON6 package: above 118 °C the value of  $P_{tot}$  derates linearly with 7.8 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  $T_{amb} = 25\text{ °C}$**

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 $5.5\text{ V}$ ;<br>$V_{CCI} = 1.2\text{ V}$ to $5.5\text{ V}$                                    | -   | -    | $\pm 1$ | $\mu\text{A}$ |
| $I_{BHL}$  | bus hold LOW current            | A or B port; $V_I = 0.42\text{ V}$ ; $V_{CCI} = 1.2\text{ V}$  | -   | 19   | -       | $\mu\text{A}$ |
| $I_{BHH}$  | bus hold HIGH current           | A or B port; $V_I = 0.78\text{ V}$ ; $V_{CCI} = 1.2\text{ V}$  | -   | -19  | -       | $\mu\text{A}$ |
| $I_{BHLO}$ | bus hold LOW overdrive current  | A or B port; $V_{CCI} = 1.2\text{ V}$ [3]  | -   | 19   | -       | $\mu\text{A}$ |
| $I_{BHHO}$ | bus hold HIGH overdrive current | A or B port; $V_{CCI} = 1.2\text{ V}$ [3]  | -   | -19  | -       | $\mu\text{A}$ |
| $I_{OZ}$   | OFF-state output current        | A or B port; $V_O = 0\text{ V}$ or $V_{CCO}$ ;<br>$V_{CCO} = 1.2\text{ V}$ to $5.5\text{ V}$                                       | -   | -    | $\pm 1$ | $\mu\text{A}$ |
| $I_{OFF}$  | power-off leakage current       | A port; $V_I$ or $V_O = 0\text{ V}$ to $5.5\text{ V}$ ; $V_{CC(A)} = 0\text{ V}$ ;<br>$V_{CC(B)} = 1.2\text{ V}$ to $5.5\text{ V}$ | -   | -    | $\pm 1$ | $\mu\text{A}$ |
|            |                                 | B port; $V_I$ or $V_O = 0\text{ V}$ to $5.5\text{ V}$ ; $V_{CC(B)} = 0\text{ V}$ ;<br>$V_{CC(A)} = 1.2\text{ V}$ to $5.5\text{ V}$ | -   | -    | $\pm 1$ | $\mu\text{A}$ |
| $C_I$      | input capacitance               | DIR input; $V_I = 0\text{ V}$ or $3.3\text{ V}$ ;<br>$V_{CC(A)} = V_{CC(B)} = 3.3\text{ V}$  | -   | 2.2  | -       | pF            |
| $C_{I/O}$  | input/output capacitance        | A and B port; suspend mode;<br>$V_O = 3.3\text{ V}$ or $0\text{ V}$ ; $V_{CC(A)} = V_{CC(B)} = 3.3\text{ V}$                       | -   | 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 $1.95\text{ V}$ | $0.65V_{CCI}$    | -   | $0.65V_{CCI}$     | -   | V    |
|          |                          | $V_{CCI} = 2.3\text{ V}$ to $2.7\text{ V}$  | 1.7              | -   | 1.7               | -   | V    |
|          |                          | $V_{CCI} = 3.0\text{ V}$ to $3.6\text{ V}$  | 2.0              | -   | 2.0               | -   | V    |
|          |                          | $V_{CCI} = 4.5\text{ V}$ to $5.5\text{ V}$  | $0.7V_{CCI}$     | -   | $0.7V_{CCI}$      | -   | 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 $1.95\text{ V}$ | $0.65V_{CC(A)}$  | -   | $0.65V_{CC(A)}$   | -   | V    |
|          |                          | $V_{CCI} = 2.3\text{ V}$ to $2.7\text{ V}$  | 1.7              | -   | 1.7               | -   | V    |
|          |                          | $V_{CCI} = 3.0\text{ V}$ to $3.6\text{ V}$  | 2.0              | -   | 2.0               | -   | V    |
|          |                          | $V_{CCI} = 4.5\text{ V}$ to $5.5\text{ V}$  | $0.7V_{CC(A)}$   | -   | $0.7V_{CC(A)}$    | -   | V    |

| Symbol  | Parameter                 | Conditions   | -40 °C to +85 °C       |                        | -40 °C to +125 °C      |                        | Unit |
|---|---------------------------|--|------------------------|------------------------|------------------------|------------------------|------|
|   |                           |  | Min                    | Max                    | Min                    | Max                    |      |
| V <sub>IL</sub>                                   | LOW-level input voltage   | data input   |                        |                        |                        |                        |      |
|   |                           | V <sub>CCI</sub> = 1.2 V   | -                      | 0.2V <sub>CCI</sub>    | -                      | 0.2V <sub>CCI</sub>    | V    |
|   |                           | V <sub>CCI</sub> = 1.4 V to 1.95 V   | -                      | 0.35V <sub>CCI</sub>   | -                      | 0.35V <sub>CCI</sub>   | V    |
|   |                           | V <sub>CCI</sub> = 2.3 V to 2.7 V  | -                      | 0.7                    | -                      | 0.7                    | V    |
|   |                           | V <sub>CCI</sub> = 3.0 V to 3.6 V  | -                      | 0.8                    | -                      | 0.8                    | V    |
|   |                           | V <sub>CCI</sub> = 4.5 V to 5.5 V  | -                      | 0.3V <sub>CCI</sub>    | -                      | 0.3V <sub>CCI</sub>    | V    |
|   |                           | DIR input  |                        |                        |                        |                        |      |
|   |                           | V <sub>CCI</sub> = 1.2 V   | -                      | 0.2V <sub>CC(A)</sub>  | -                      | 0.2V <sub>CC(A)</sub>  | V    |
|   |                           | V <sub>CCI</sub> = 1.4 V to 1.95 V   | -                      | 0.35V <sub>CC(A)</sub> | -                      | 0.35V <sub>CC(A)</sub> | V    |
|   |                           | V <sub>CCI</sub> = 2.3 V to 2.7 V  | -                      | 0.7                    | -                      | 0.7                    | V    |
|   |                           | V <sub>CCI</sub> = 3.0 V to 3.6 V  | -                      | 0.8                    | -                      | 0.8                    | V    |
| V <sub>CCI</sub> = 4.5 V to 5.5 V                 | -                         | 0.3V <sub>CC(A)</sub>  | -                      | 0.3V <sub>CC(A)</sub>  | V                      |                        |      |
| V <sub>OH</sub>                                   | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub>   |                        |                        |                        |                        |      |
|   |                           | I <sub>O</sub> = -100 µA; V <sub>CCO</sub> = 1.2 V to 4.5 V                    | V <sub>CCO</sub> - 0.1 | -                      | V <sub>CCO</sub> - 0.1 | -                      | V    |
|   |                           | I <sub>O</sub> = -6 mA; V <sub>CCO</sub> = 1.4 V                               | 1.0                    | -                      | 1.0                    | -                      | V    |
|   |                           | I <sub>O</sub> = -8 mA; V <sub>CCO</sub> = 1.65 V                              | 1.2                    | -                      | 1.2                    | -                      | V    |
|   |                           | I <sub>O</sub> = -12 mA; V <sub>CCO</sub> = 2.3 V                              | 1.9                    | -                      | 1.9                    | -                      | V    |
|   |                           | I <sub>O</sub> = -24 mA; V <sub>CCO</sub> = 3.0 V                              | 2.4                    | -                      | 2.4                    | -                      | V    |
| I <sub>O</sub> = -32 mA; V <sub>CCO</sub> = 4.5 V | 3.8                       | -  | 3.8                    | -                      | V                      |                        |      |
| V <sub>OL</sub>                                   | LOW-level output voltage  | V <sub>I</sub> = V <sub>IL</sub>   |                        |                        |                        |                        |      |
|   |                           | I <sub>O</sub> = 100 µA; V <sub>CCO</sub> = 1.2 V to 4.5 V                     | -                      | 0.1                    | -                      | 0.1                    | V    |
|   |                           | I <sub>O</sub> = 6 mA; V <sub>CCO</sub> = 1.4 V                                | -                      | 0.3                    | -                      | 0.3                    | V    |
|   |                           | I <sub>O</sub> = 8 mA; V <sub>CCO</sub> = 1.65 V                               | -                      | 0.45                   | -                      | 0.45                   | V    |
|   |                           | I <sub>O</sub> = 12 mA; V <sub>CCO</sub> = 2.3 V                               | -                      | 0.3                    | -                      | 0.3                    | V    |
|   |                           | I <sub>O</sub> = 24 mA; V <sub>CCO</sub> = 3.0 V                               | -                      | 0.55                   | -                      | 0.55                   | V    |
| I <sub>O</sub> = 32 mA; V <sub>CCO</sub> = 4.5 V  | -                         | 0.55   | -                      | 0.55                   | V                      |                        |      |
| I <sub>I</sub>                                    | input leakage current     | DIR input; V <sub>I</sub> = 0 V to 5.5 V;<br>V <sub>CCI</sub> = 1.2 V to 5.5 V | -                      | ±2                     | -                      | ±10                    | µA   |
| I <sub>BHL</sub>                                  | bus hold LOW current      | A or B port  |                        |                        |                        |                        |      |
|   |                           | V <sub>I</sub> = 0.49 V; V <sub>CCI</sub> = 1.4 V                              | 15                     | -                      | 10                     | -                      | µA   |
|   |                           | V <sub>I</sub> = 0.58 V; V <sub>CCI</sub> = 1.65 V                             | 25                     | -                      | 20                     | -                      | µA   |
|   |                           | V <sub>I</sub> = 0.70 V; V <sub>CCI</sub> = 2.3 V                              | 45                     | -                      | 45                     | -                      | µA   |
|   |                           | V <sub>I</sub> = 0.80 V; V <sub>CCI</sub> = 3.0 V                              | 100                    | -                      | 80                     | -                      | µA   |
| V <sub>I</sub> = 1.35 V; V <sub>CCI</sub> = 4.5 V | 100                       | -  | 100                    | -                      | µA                     |                        |      |
| I <sub>BHH</sub>                                  | bus hold HIGH current     | A or B port  |                        |                        |                        |                        |      |
|   |                           | V <sub>I</sub> = 0.91 V; V <sub>CCI</sub> = 1.4 V                              | -15                    | -                      | -10                    | -                      | µA   |
|   |                           | V <sub>I</sub> = 1.07 V; V <sub>CCI</sub> = 1.65 V                             | -25                    | -                      | -20                    | -                      | µA   |
|   |                           | V <sub>I</sub> = 1.60 V; V <sub>CCI</sub> = 2.3 V                              | -45                    | -                      | -45                    | -                      | µA   |
|   |                           | V <sub>I</sub> = 2.00 V; V <sub>CCI</sub> = 3.0 V                              | -100                   | -                      | -80                    | -                      | µA   |
| V <sub>I</sub> = 3.15 V; V <sub>CCI</sub> = 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 <sub>BHLO</sub>   | bus hold LOW overdrive current  | A or B port [3]   |                  |      |                   |     |      |
|   |                                 | V <sub>CCI</sub> = 1.6 V  | 125              | -    | 125               | -   | μA   |
|   |                                 | V <sub>CCI</sub> = 1.95 V   | 200              | -    | 200               | -   | μA   |
|   |                                 | V <sub>CCI</sub> = 2.7 V  | 300              | -    | 300               | -   | μA   |
|   |                                 | V <sub>CCI</sub> = 3.6 V  | 500              | -    | 500               | -   | μA   |
|   | V <sub>CCI</sub> = 5.5 V        | 900   | -                | 900  | -                 | μA  |      |
| I <sub>BHHO</sub>   | bus hold HIGH overdrive current | A or B port [3]   |                  |      |                   |     |      |
|   |                                 | V <sub>CCI</sub> = 1.6 V  | -125             | -    | -125              | -   | μA   |
|   |                                 | V <sub>CCI</sub> = 1.95 V   | -200             | -    | -200              | -   | μA   |
|   |                                 | V <sub>CCI</sub> = 2.7 V  | -300             | -    | -300              | -   | μA   |
|   |                                 | V <sub>CCI</sub> = 3.6 V  | -500             | -    | -500              | -   | μA   |
|   | V <sub>CCI</sub> = 5.5 V        | -900  | -                | -900 | -                 | μA  |      |
| I <sub>OZ</sub>   | OFF-state output current        | A or B port; V <sub>O</sub> = 0 V or V <sub>CCO</sub> ;<br>V <sub>CCO</sub> = 1.2 V to 5.5 V                                | -                | ±2   | -                 | ±10 | μA   |
| I <sub>OFF</sub>  | power-off leakage current       | A port; V <sub>I</sub> or V <sub>O</sub> = 0 V to 5.5 V;<br>V <sub>CC(A)</sub> = 0 V; V <sub>CC(B)</sub> = 1.2 V to 5.5 V   | -                | ±2   | -                 | ±10 | μA   |
|   |                                 | B port; V <sub>I</sub> or V <sub>O</sub> = 0 V to 5.5 V;<br>V <sub>CC(B)</sub> = 0 V; V <sub>CC(A)</sub> = 1.2 V to 5.5 V   | -                | ±2   | -                 | ±10 | μA   |
| I <sub>CC</sub>   | supply current                  | A port; V <sub>I</sub> = 0 V or V <sub>CCI</sub> ; I <sub>O</sub> = 0 A   |                  |      |                   |     |      |
|   |                                 | V <sub>CC(A)</sub> , V <sub>CC(B)</sub> = 1.2 V to 5.5 V  | -                | 8    | -                 | 8   | μA   |
|   |                                 | V <sub>CC(A)</sub> , V <sub>CC(B)</sub> = 1.65 V to 5.5 V   | -                | 3    | -                 | 3   | μA   |
|   |                                 | V <sub>CC(A)</sub> = 5.5 V; V <sub>CC(B)</sub> = 0 V  | -                | 2    | -                 | 2   | μA   |
|   |                                 | V <sub>CC(A)</sub> = 0 V; V <sub>CC(B)</sub> = 5.5 V  | -2               | -    | -2                | -   | μA   |
|   |                                 | B port; V <sub>I</sub> = 0 V or V <sub>CCI</sub> ; I <sub>O</sub> = 0 A   |                  |      |                   |     |      |
|   |                                 | V <sub>CC(A)</sub> , V <sub>CC(B)</sub> = 1.2 V to 5.5 V  | -                | 8    | -                 | 8   | μA   |
|   |                                 | V <sub>CC(A)</sub> , V <sub>CC(B)</sub> = 1.65 V to 5.5 V   | -                | 3    | -                 | 3   | μA   |
|   |                                 | V <sub>CC(B)</sub> = 5.5 V; V <sub>CC(A)</sub> = 0 V  | -                | 2    | -                 | 2   | μA   |
|   |                                 | V <sub>CC(B)</sub> = 0 V; V <sub>CC(A)</sub> = 5.5 V  | -2               | -    | -2                | -   | μA   |
|   |                                 | A plus B port (I <sub>CC(A)</sub> + I <sub>CC(B)</sub> ); I <sub>O</sub> = 0 A;<br>V <sub>I</sub> = 0 V or V <sub>CCI</sub> |                  |      |                   |     |      |
| V <sub>CC(A)</sub> , V <sub>CC(B)</sub> = 1.2 V to 5.5 V  | -                               | 16  | -                | 16   | μA                |     |      |
| V <sub>CC(A)</sub> , V <sub>CC(B)</sub> = 1.65 V to 5.5 V | -                               | 4   | -                | 4    | μA                |     |      |
| ΔI <sub>CC</sub>  | additional supply current       | V <sub>CC(A)</sub> , V <sub>CC(B)</sub> = 3.0 V to 5.5 V  |                  |      |                   |     |      |
|   |                                 | A port; A port at V <sub>CC(A)</sub> - 0.6 V;<br>DIR at V <sub>CC(A)</sub> ; B port = open [4]                              | -                | 50   | -                 | 75  | μA   |
|   |                                 | DIR input; DIR at V <sub>CC(A)</sub> - 0.6 V;<br>A port at V <sub>CC(A)</sub> or GND;<br>B port = open                      | -                | 50   | -                 | 75  | μA   |
|   |                                 | B port; B port at V <sub>CC(B)</sub> - 0.6 V;<br>DIR at GND; A port = open [4]  | -                | 50   | -                 | 75  | μA   |

[1] V<sub>CCI</sub> is the supply voltage associated with the data input port.

[2] V<sub>CCO</sub> is the supply voltage associated with the output port.

[3] To guarantee the node switches, an external driver must source/sink at least I<sub>BHLO</sub>/I<sub>BHHO</sub> when the input is in the range V<sub>IL</sub> to V<sub>IH</sub>.

[4] For non bus hold parts only (74LVC1T45).

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

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

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

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

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

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

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



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

*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);<br>B port: (direction B to A) | 2                           | 3     | 3     | 4     | pF   |
|          |                               | A port: (direction B to A);<br>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  $\mu\text{W}$ ).

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

$f_i$  = 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;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.

[2]  $f_i = 10\text{ MHz}$ ;  $V_i = \text{GND to } V_{CC}$ ;  $t_r = t_f = 1\text{ ns}$ ;  $C_L = 0\text{ pF}$ ;  $R_L = \infty\ \Omega$ .

**Table 12. Dynamic characteristics for temperature range  $-40\text{ °C}$  to  $+85\text{ °C}$**

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

| Symbol  | Parameter                           | Conditions   | $V_{CC(B)}$                 |      |                              |      |                             |      |                             |      |                             |      | Unit |
|---|-------------------------------------|--------------|-----------------------------|------|------------------------------|------|-----------------------------|------|-----------------------------|------|-----------------------------|------|------|
|   |                                     |              | 1.5 V<br>$\pm 0.1\text{ V}$ |      | 1.8 V<br>$\pm 0.15\text{ V}$ |      | 2.5 V<br>$\pm 0.2\text{ V}$ |      | 3.3 V<br>$\pm 0.3\text{ V}$ |      | 5.0 V<br>$\pm 0.5\text{ V}$ |      |      |
|   |                                     |              | Min                         | Max  | Min                          | Max  | Min                         | Max  | Min                         | Max  | Min                         | Max  |      |
| <b><math>V_{CC(A)} = 1.4\text{ V to } 1.6\text{ V}</math></b> |                                     |              |                             |      |                              |      |                             |      |                             |      |                             |      |      |
| $t_{PLH}$   | 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 <sub>CC(B)</sub> |      |                   |      |                  |      |                  |      |                  |      | Unit |    |
|---|-------------------------------------|------------|--------------------|------|-------------------|------|------------------|------|------------------|------|------------------|------|------|----|
|   |                                     |            | 1.5 V<br>± 0.1 V   |      | 1.8 V<br>± 0.15 V |      | 2.5 V<br>± 0.2 V |      | 3.3 V<br>± 0.3 V |      | 5.0 V<br>± 0.5 V |      |      |    |
|   |                                     |            | Min                | Max  | Min               | Max  | Min              | Max  | Min              | Max  | Min              | Max  |      |    |
| <b>V<sub>CC(A)</sub> = 1.65 V to 1.95 V</b> |                                     |            |                    |      |                   |      |                  |      |                  |      |                  |      |      |    |
| t <sub>PLH</sub>                            | 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 <sub>PHL</sub>                            | 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 <sub>PHZ</sub>                            | 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 <sub>PLZ</sub>                            | 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 <sub>PZH</sub>                            | 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 <sub>PZL</sub>                            | 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 |
| <b>V<sub>CC(A)</sub> = 2.3 V to 2.7 V</b>   |                                     |            |                    |      |                   |      |                  |      |                  |      |                  |      |      |    |
| t <sub>PLH</sub>                            | 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 <sub>PHL</sub>                            | 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 <sub>PHZ</sub>                            | 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 <sub>PLZ</sub>                            | 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 <sub>PZH</sub>                            | 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 <sub>PZL</sub>                            | 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 |
| <b>V<sub>CC(A)</sub> = 3.0 V to 3.6 V</b>   |                                     |            |                    |      |                   |      |                  |      |                  |      |                  |      |      |    |
| t <sub>PLH</sub>                            | 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 <sub>PHL</sub>                            | 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 <sub>PHZ</sub>                            | 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 <sub>PLZ</sub>                            | 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 <sub>PZH</sub>                            | 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 <sub>PZL</sub>                            | 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 <sub>CC(B)</sub> |      |                   |      |                  |     |                  |     |                  |     | Unit |    |
|---|-------------------------------------|------------|--------------------|------|-------------------|------|------------------|-----|------------------|-----|------------------|-----|------|----|
|   |                                     |            | 1.5 V<br>± 0.1 V   |      | 1.8 V<br>± 0.15 V |      | 2.5 V<br>± 0.2 V |     | 3.3 V<br>± 0.3 V |     | 5.0 V<br>± 0.5 V |     |      |    |
|   |                                     |            | Min                | Max  | Min               | Max  | Min              | Max | Min              | Max | Min              | Max |      |    |
| <b>V<sub>CC(A)</sub> = 4.5 V to 5.5 V</b> |                                     |            |                    |      |                   |      |                  |     |                  |     |                  |     |      |    |
| t <sub>PLH</sub>                          | 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 <sub>PHL</sub>                          | 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 <sub>PHZ</sub>                          | 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 <sub>PLZ</sub>                          | 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 <sub>PZH</sub>                          | 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 <sub>PZL</sub>                          | 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<sub>PZH</sub> and t<sub>PZL</sub> are calculated values using the formula shown in [Section 13.4](#)

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

Voltages are referenced to GND (ground = 0 V); for test circuit see [Fig. 8](#); for wave forms see [Fig. 6](#) and [Fig. 7](#)

| Symbol                                    | Parameter                           | Conditions | V <sub>CC(B)</sub> |      |                   |      |                  |      |                  |      |                  |      | Unit |    |
|---|-------------------------------------|------------|--------------------|------|-------------------|------|------------------|------|------------------|------|------------------|------|------|----|
|   |                                     |            | 1.5 V<br>± 0.1 V   |      | 1.8 V<br>± 0.15 V |      | 2.5 V<br>± 0.2 V |      | 3.3 V<br>± 0.3 V |      | 5.0 V<br>± 0.5 V |      |      |    |
|   |                                     |            | Min                | Max  | Min               | Max  | Min              | Max  | Min              | Max  | Min              | Max  |      |    |
| <b>V<sub>CC(A)</sub> = 1.4 V to 1.6 V</b> |                                     |            |                    |      |                   |      |                  |      |                  |      |                  |      |      |    |
| t <sub>PLH</sub>                          | 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 <sub>PHL</sub>                          | 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 <sub>PHZ</sub>                          | 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 <sub>PLZ</sub>                          | 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 <sub>PZH</sub>                          | 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 <sub>PZL</sub>                          | 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 <sub>CC(B)</sub> |      |                   |      |                  |      |                  |      |                  |      | Unit |    |
|---|-------------------------------------|------------|--------------------|------|-------------------|------|------------------|------|------------------|------|------------------|------|------|----|
|   |                                     |            | 1.5 V<br>± 0.1 V   |      | 1.8 V<br>± 0.15 V |      | 2.5 V<br>± 0.2 V |      | 3.3 V<br>± 0.3 V |      | 5.0 V<br>± 0.5 V |      |      |    |
|   |                                     |            | Min                | Max  | Min               | Max  | Min              | Max  | Min              | Max  | Min              | Max  |      |    |
| <b>V<sub>CC(A)</sub> = 1.65 V to 1.95 V</b> |                                     |            |                    |      |                   |      |                  |      |                  |      |                  |      |      |    |
| t <sub>PLH</sub>                            | 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 <sub>PHL</sub>                            | 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 <sub>PHZ</sub>                            | 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 <sub>PLZ</sub>                            | 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 <sub>PZH</sub>                            | 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 <sub>PZL</sub>                            | 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 |
| <b>V<sub>CC(A)</sub> = 2.3 V to 2.7 V</b>   |                                     |            |                    |      |                   |      |                  |      |                  |      |                  |      |      |    |
| t <sub>PLH</sub>                            | 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 <sub>PHL</sub>                            | 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 <sub>PHZ</sub>                            | 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 <sub>PLZ</sub>                            | 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 <sub>PZH</sub>                            | 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 <sub>PZL</sub>                            | 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 |
| <b>V<sub>CC(A)</sub> = 3.0 V to 3.6 V</b>   |                                     |            |                    |      |                   |      |                  |      |                  |      |                  |      |      |    |
| t <sub>PLH</sub>                            | 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 <sub>PHL</sub>                            | 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 <sub>PHZ</sub>                            | 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 <sub>PLZ</sub>                            | 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 <sub>PZH</sub>                            | 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 <sub>PZL</sub>                            | 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<br>$\pm 0.1$ V |      | 1.8 V<br>$\pm 0.15$ V |      | 2.5 V<br>$\pm 0.2$ V |      | 3.3 V<br>$\pm 0.3$ V |      | 5.0 V<br>$\pm 0.5$ 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

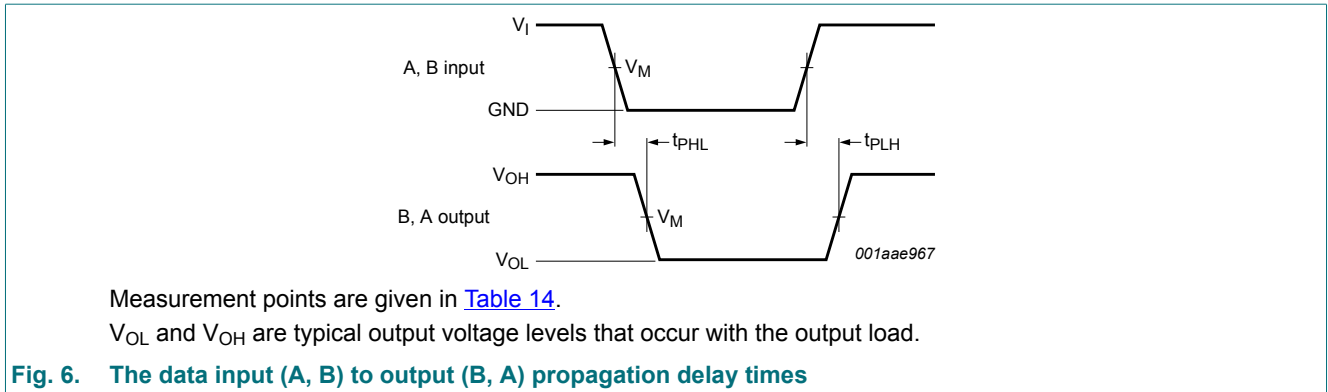
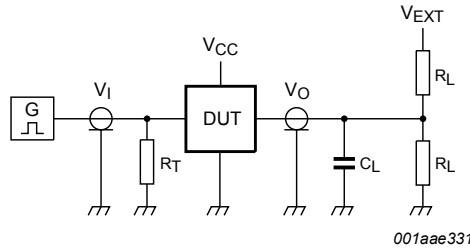
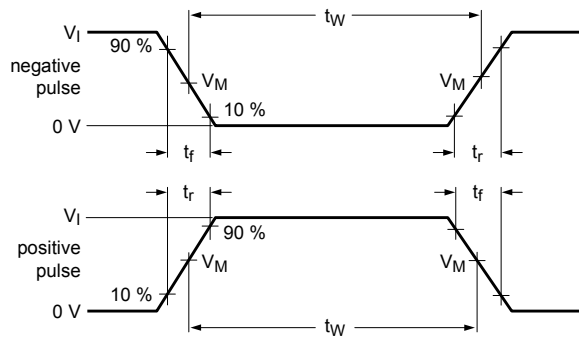




Table 14. Measurement points

| Supply voltage  | Input [1]    |              | Output [2]               |                          |
|-----------------|--------------|--------------|--------------------------|--------------------------|
|                 | $V_M$        | $V_M$        | $V_X$                    | $V_Y$                    |
| 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.



Test data is given in [Table 15](#).

$R_L$  = Load resistance.

$C_L$  = Load capacitance including jig and probe capacitance.

$R_T$  = Termination resistance.

$V_{EXT}$  = External voltage for measuring switching times.

**Fig. 8. Test circuit for measuring switching times**

**Table 15. Test data**

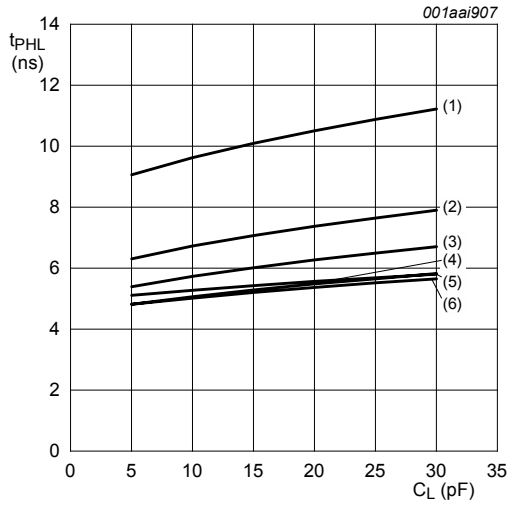
| Supply voltage         | Input     |                         | Load  |              | $V_{EXT}$          |                    |                        |
|------------------------|-----------|-------------------------|-------|--------------|--------------------|--------------------|------------------------|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

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

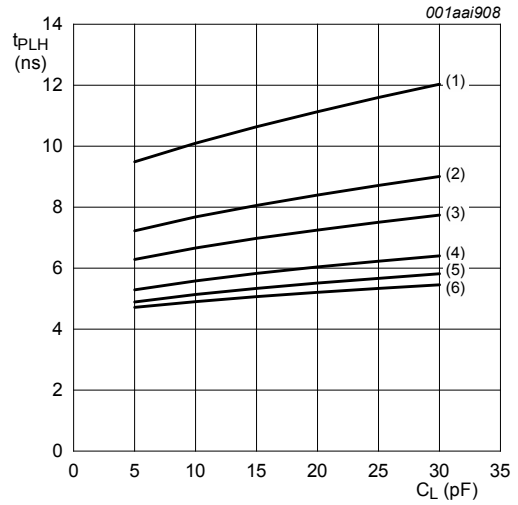
[2]  $dV/dt \geq 1.0 \text{ V/ns}$

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

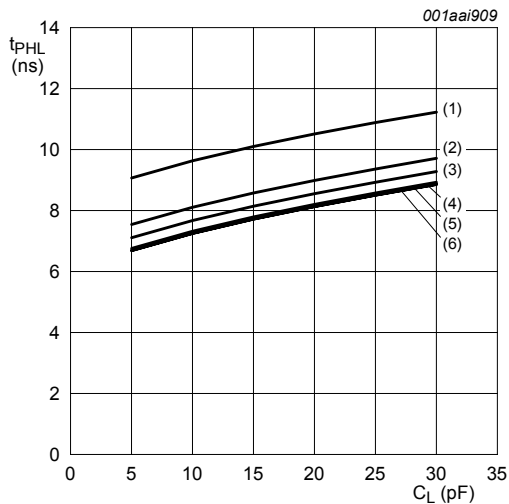
## 12. Typical propagation delay characteristics



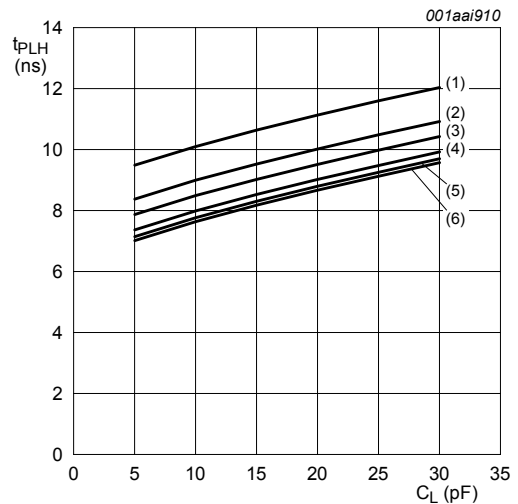
a. HIGH to LOW propagation delay (A to B)



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)  $V_{CC(B)} = 1.2\text{ V}$ .
- (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;  $T_{amb} = 25\text{ °C}$ ;  $V_{CC(A)} = 1.2\text{ V}$





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)  $V_{CC(B)} = 1.2$  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;  $V_{CC(A)} = 1.5$  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. 11. 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. 12. 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)



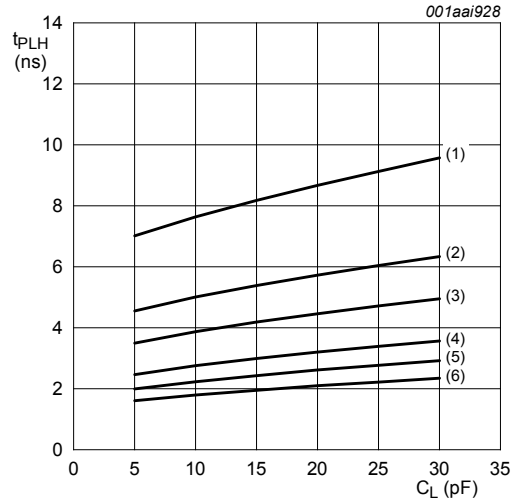
d. LOW to HIGH propagation delay (B to A)

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



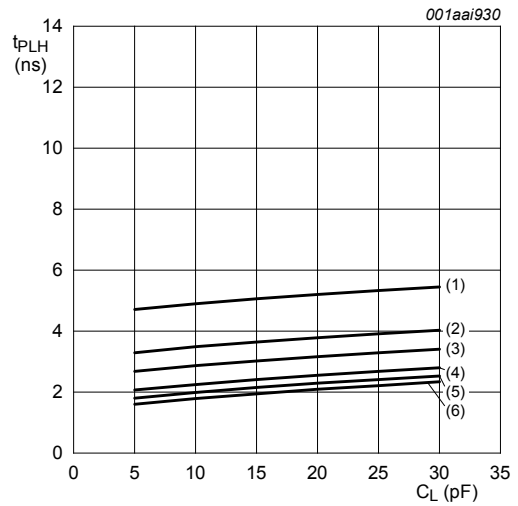
a. HIGH to LOW propagation delay (A to B)



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

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

### 13. Application information

#### 13.1. Unidirectional logic level-shifting application

The circuit given in Fig. 15 is an example of the 74LVC1T45; 74LVCH1T45 being used in a unidirectional logic level-shifting application.

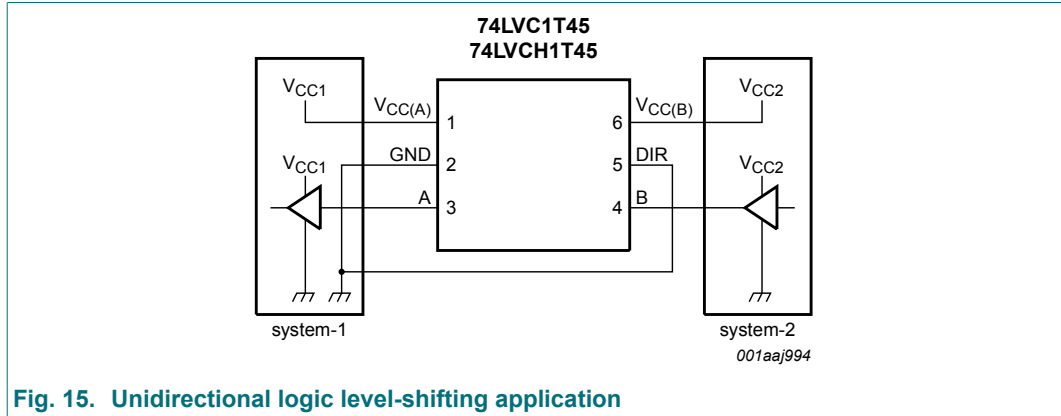


Fig. 15. Unidirectional logic level-shifting application

Table 16. Description unidirectional logic level-shifting application

| Pin | Name               | Function         | Description   |
|-----|--------------------|------------------|---|
| 1   | V <sub>CC(A)</sub> | V <sub>CC1</sub> | 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 <sub>CC1</sub> voltage          |
| 4   | B                  | IN               | input threshold value depends on V <sub>CC2</sub> voltage |
| 5   | DIR                | DIR              | the GND (LOW level) determines B port to A port direction |
| 6   | V <sub>CC(B)</sub> | V <sub>CC2</sub> | supply voltage of system-2 (1.2 V to 5.5 V)               |

#### 13.2. Bidirectional logic level-shifting application

Fig. 16 shows the 74LVC1T45; 74LVCH1T45 being used in a bidirectional logic level-shifting application. Since the device does not have an output enable pin, the system designer should take precautions to avoid bus contention between system-1 and system-2 when changing directions.

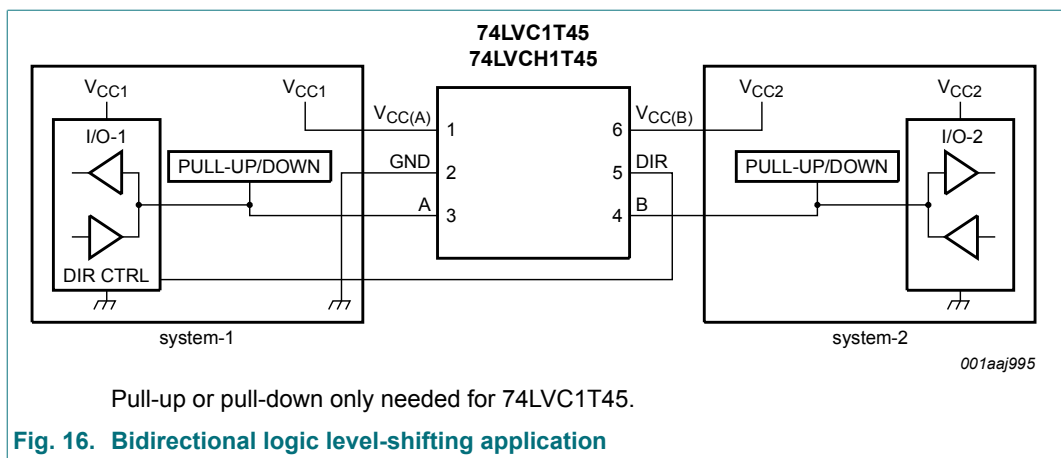


Fig. 16. Bidirectional logic level-shifting application

Table 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   | $\mu\text{A}$ |
| 1.8 V       | < 1         | < 2   | < 2   | < 2   | 2     | $\mu\text{A}$ |
| 2.5 V       | < 1         | < 2   | < 2   | < 2   | < 2   | $\mu\text{A}$ |
| 3.3 V       | < 1         | < 2   | < 2   | < 2   | < 2   | $\mu\text{A}$ |
| 5.0 V       | < 1         | 2     | < 2   | < 2   | < 2   | $\mu\text{A}$ |

### 13.4. Enable times

Calculate the enable times for the 74LVC1T45; 74LVCH1T45 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; 74LVCH1T45 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

Plastic surface-mounted package; 6 leads

SOT363

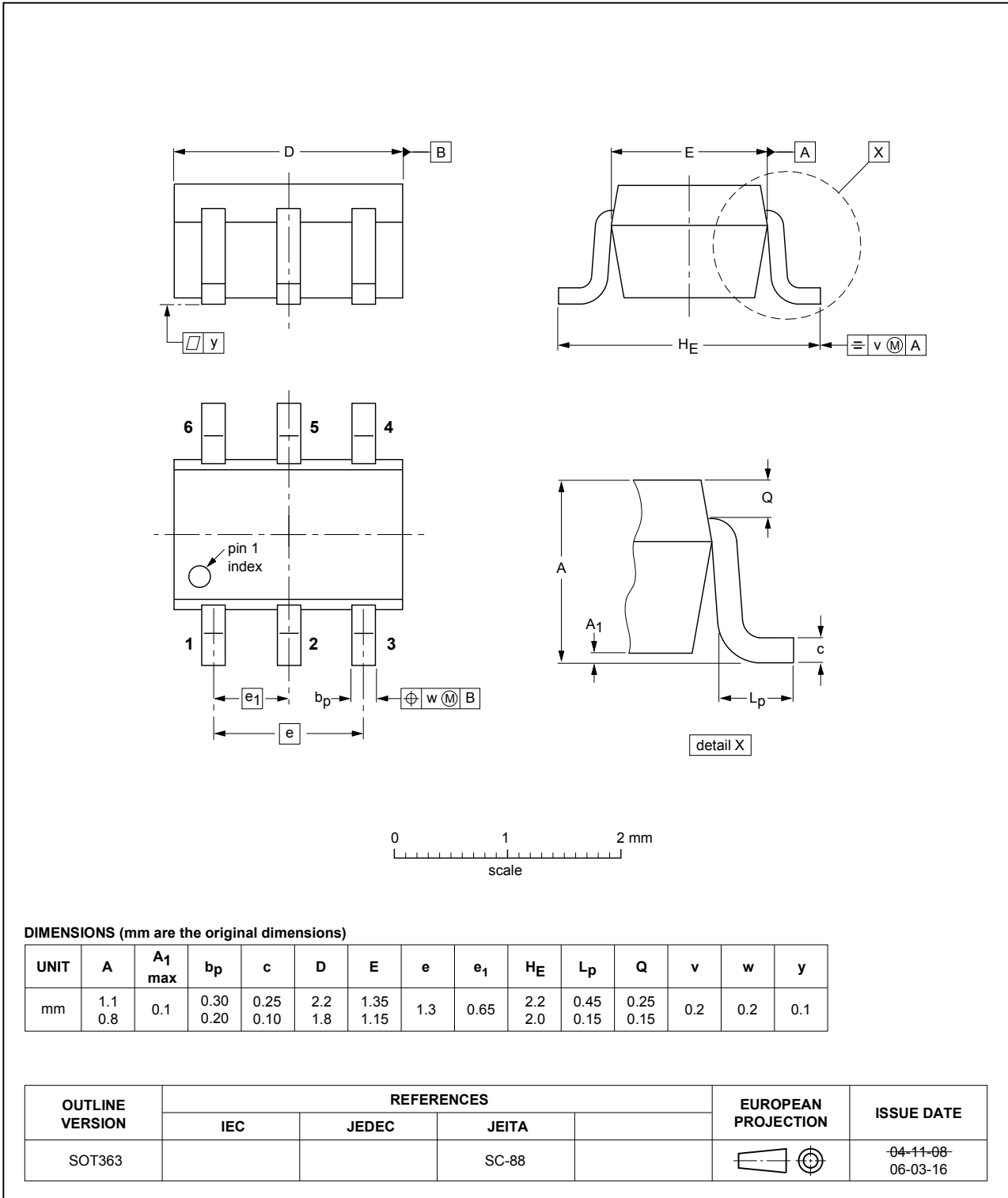


Fig. 17. Package outline SOT363 (SC-88)



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

SOT886



Fig. 18. Package outline SOT886 (XSON6)

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

SOT891



Fig. 19. Package outline SOT891 (XSON6)

XSON6: extremely thin small outline package; no leads;  
6 terminals; body 0.9 x 1.0 x 0.35 mm

SOT1115



Fig. 20. Package outline SOT1115 (XSON6)

XSON6: extremely thin small outline package; no leads;  
6 terminals; body 1.0 x 1.0 x 0.35 mm

SOT1202

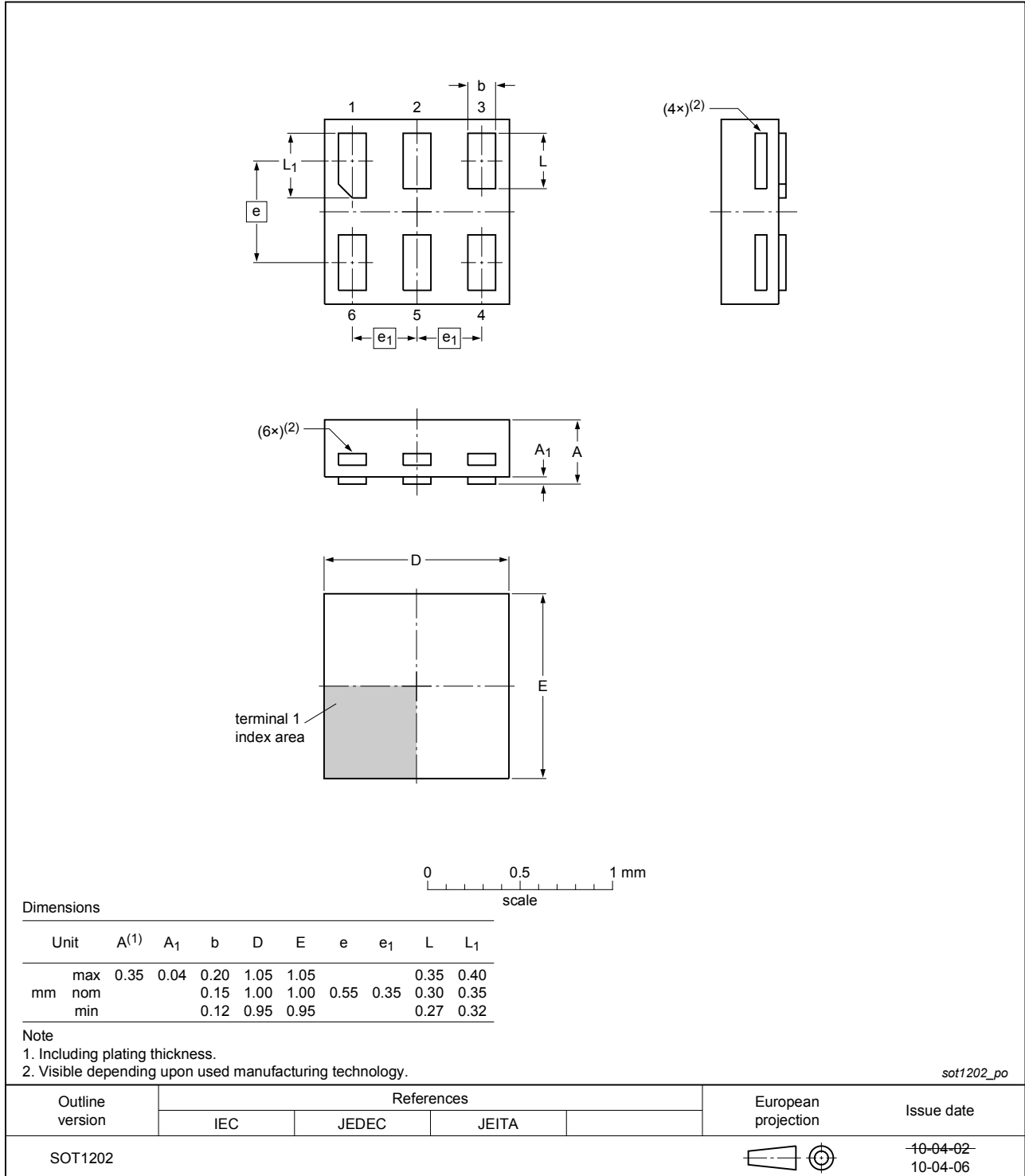


Fig. 21. Package outline SOT1202 (XSON6)

## 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 v.7 | 20190319  | Product data sheet | -             | 74LVC_LVCH1T45 v.6 |
| Modifications:     | <ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul> |                    |               |                    |
| 74LVC_LVCH1T45 v.6 | 20120806  | Product data sheet | -             | 74LVC_LVCH1T45 v.5 |
| Modifications:     | <ul style="list-style-type: none"> <li>Package outline drawing of SOT886 (<a href="#">Fig. 18</a>) modified.</li> </ul>   |                    |               |                    |
| 74LVC_LVCH1T45 v.5 | 20111219  | Product data sheet | -             | 74LVC_LVCH1T45 v.4 |
| Modifications:     | <ul style="list-style-type: none"> <li>Legal pages updated.</li> </ul>  |                    |               |                    |
| 74LVC_LVCH1T45 v.4 | 20110927  | Product data sheet | -             | 74LVC_LVCH1T45 v.3 |
| 74LVC_LVCH1T45 v.3 | 20100819  | Product data sheet | -             | 74LVC_LVCH1T45 v.2 |
| 74LVC_LVCH1T45 v.2 | 20100119  | Product data sheet | -             | 74LVC_LVCH1T45 v.1 |
| 74LVC_LVCH1T45 v.1 | 20090511  | 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".
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