

74AVC2T45-Q100

Dual-bit, dual-supply voltage level translator/transceiver;
3-state

Rev. 5 — 4 November 2021

Product data sheet

1. General description

The 74AVC2T45-Q100 is a dual-bit, dual-supply transceiver that enables bidirectional level translation. It features two data input-output ports (nA and nB), a direction control input (DIR) and dual-supply pins ($V_{CC(A)}$ and $V_{CC(B)}$). Both $V_{CC(A)}$ and $V_{CC(B)}$ can be supplied at any voltage between 0.8 V and 3.6 V making the device suitable for translating between any of the low voltage nodes (0.8 V, 1.2 V, 1.5 V, 1.8 V, 2.5 V and 3.3 V). Pins nA and DIR are referenced to $V_{CC(A)}$ and pins nB are referenced to $V_{CC(B)}$. A HIGH on DIR allows transmission from nA to nB and a LOW on DIR allows transmission from nB to nA.

The device is fully specified for partial power-down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing any damaging backflow current through the device when it is powered down. In Suspend mode when either $V_{CC(A)}$ or $V_{CC(B)}$ are at GND level, both A and B are in the high-impedance OFF-state.

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:
 - $V_{CC(A)}$: 0.8 V to 3.6 V
 - $V_{CC(B)}$: 0.8 V to 3.6 V
- High noise immunity
- Complies with JEDEC standards:
 - JESD8-12 (0.8 V to 1.3 V)
 - JESD8-11 (0.9 V to 1.65 V)
 - JESD8-7 (1.2 V to 1.95 V)
 - JESD8-5 (1.8 V to 2.7 V)
 - JESD8-B (2.7 V to 3.6 V)
- ESD protection:
 - MIL-STD-883, method 3015 Class 3B exceeds 8000 V
 - HBM JESD22-A114E Class 3B exceeds 8000 V
 - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- Maximum data rates:
 - 500 Mbit/s (1.8 V to 3.3 V translation)
 - 320 Mbit/s (<1.8 V to 3.3 V translation)
 - 320 Mbit/s (translate to 2.5 V or 1.8 V)
 - 280 Mbit/s (translate to 1.5 V)
 - 240 Mbit/s (translate to 1.2 V)
- Suspend mode
- Latch-up performance exceeds 100 mA per JESD 78 Class II
- Inputs accept voltages up to 3.6 V
- Low noise overshoot and undershoot < 10 % of V_{CC}
- I_{OFF} circuitry provides partial Power-down mode operation

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|------------------|-------------------|--------|---|----------|
| | Temperature range | Name | Description | |
| 74AVC2T45DP-Q100 | -40 °C to +125 °C | TSSOP8 | plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm | SOT505-2 |
| 74AVC2T45DC-Q100 | -40 °C to +125 °C | VSSOP8 | plastic very thin shrink small outline package; 8 leads; body width 2.3 mm | SOT765-1 |
| 74AVC2T45GT-Q100 | -40 °C to +125 °C | XSON8 | plastic extremely thin small outline package; no leads; 8 terminals; body 1 × 1.95 × 0.5 mm | SOT833-1 |

4. Marking

Table 2. Marking

| Type number | Marking code[1] |
|------------------|-----------------|
| 74AVC2T45DP-Q100 | B45 |
| 74AVC2T45DC-Q100 | B45 |
| 74AVC2T45GT-Q100 | B45 |

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

5. Functional diagram

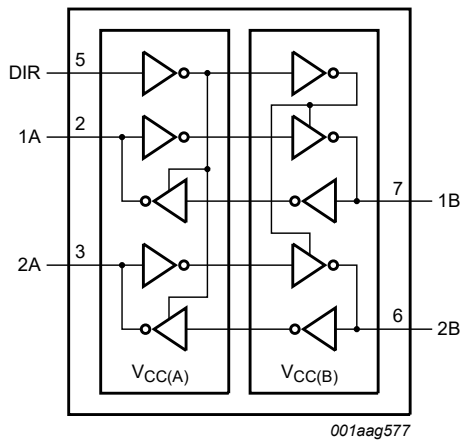


Fig. 1. Logic symbol

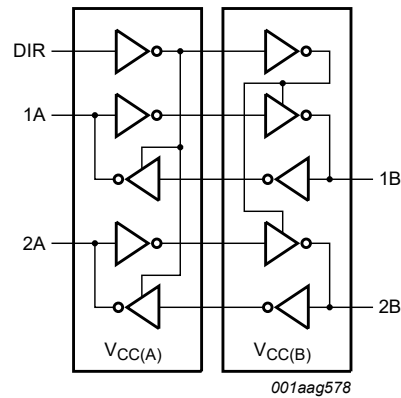


Fig. 2. Logic diagram

6. Pinning information

6.1. Pinning

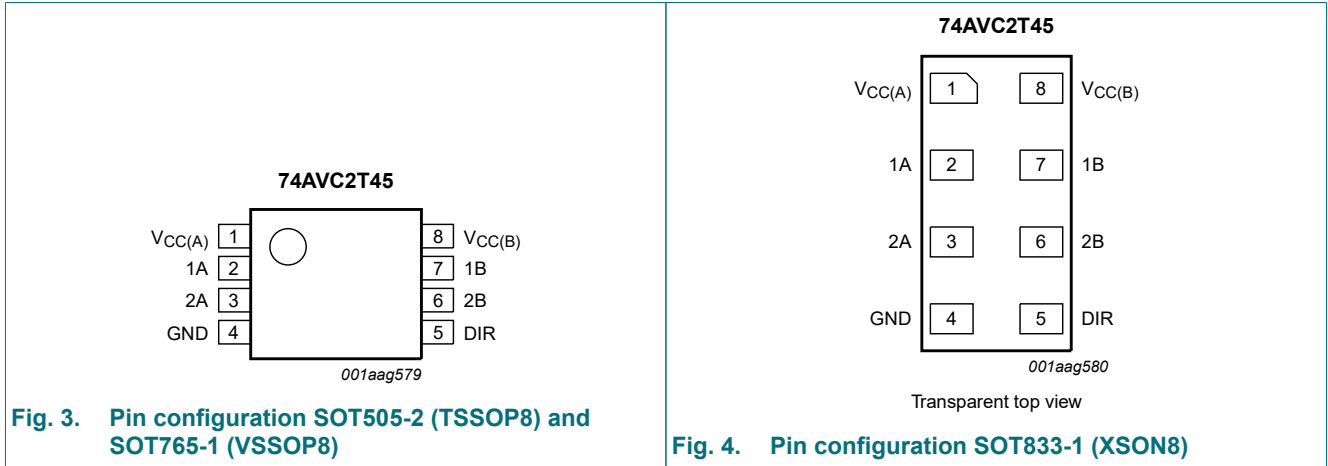


Fig. 3. Pin configuration SOT505-2 (TSSOP8) and SOT765-1 (VSSOP8)

Fig. 4. Pin configuration SOT833-1 (XSON8)

6.2. Pin description

Table 3. Pin description

| Symbol | Pin | Description |
|--------------------|-----|--|
| V _{CC(A)} | 1 | supply voltage A (referenced to pins 1A, 2A and DIR) |
| 1A | 2 | data input or output |
| 2A | 3 | data input or output |
| GND | 4 | ground (0 V) |
| DIR | 5 | direction control |
| 2B | 6 | data input or output |
| 1B | 7 | data input or output |
| V _{CC(B)} | 8 | supply voltage B (referenced to pins 1B and 2B) |

7. Functional description

Table 4. Function table

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

| Supply voltage | Input | Input/output [1] | |
|---|---------|------------------|---------|
| V _{CC(A)} , V _{CC(B)} | DIR [2] | nA | nB |
| 0.8 V to 3.6 V | L | nA = nB | input |
| 0.8 V to 3.6 V | H | input | nB = nA |
| GND [3] | X | Z | Z |

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

[2] The DIR input circuit is referenced to V_{CC(A)}.

[3] If at least one of V_{CC(A)} or V_{CC(B)} is at GND level, the device goes into Suspend mode.

8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-------------|-------------------------|-----------------------------------|------|-----------------|------|
| $V_{CC(A)}$ | supply voltage A | | -0.5 | +4.6 | V |
| $V_{CC(B)}$ | supply voltage B | | -0.5 | +4.6 | V |
| I_{IK} | input clamping current | $V_I < 0$ V | -50 | - | mA |
| V_I | input voltage | [1] | -0.5 | +4.6 | 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 | +4.6 | V |
| I_O | output current | $V_O = 0$ V to V_{CCO} | - | ± 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 rating 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 4.6 V.

[4] For SOT505-2 (TSSOP8) package: P_{tot} derates linearly with 4.6 mW/K above 96 °C.

For SOT765-1 (VSSOP8) package: P_{tot} derates linearly with 4.9 mW/K above 99 °C.

For SOT833-1 (XSON8) package: P_{tot} derates linearly with 3.1 mW/K above 68 °C.

9. Recommended operating conditions

Table 6. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---------------------|-------------------------------------|--------------------------------|-----|-----------|------|
| $V_{CC(A)}$ | supply voltage A | | 0.8 | 3.6 | V |
| $V_{CC(B)}$ | supply voltage B | | 0.8 | 3.6 | V |
| V_I | input voltage | | 0 | 3.6 | V |
| V_O | output voltage | Active mode [1] | 0 | V_{CCO} | V |
| | | Suspend or 3-state mode | 0 | 3.6 | V |
| T_{amb} | ambient temperature | | -40 | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CCI} = 0.8$ V to 3.6 V [2] | - | 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).

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|---------------------------|--|--------|-------------|------------|---------------|
| V_{OH} | HIGH-level output voltage | $V_I = V_{IH}$ or V_{IL} ; $I_O = -1.5\text{ mA}$; $V_{CC(A)} = V_{CC(B)} = 0.8\text{ V}$ | - | 0.69 | - | V |
| V_{OL} | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} ; $I_O = 1.5\text{ mA}$; $V_{CC(A)} = V_{CC(B)} = 0.8\text{ V}$ | - | 0.07 | - | V |
| I_I | input leakage current | DIR input; $V_I = 0\text{ V}$ or 3.6 V ; $V_{CC(A)} = V_{CC(B)} = 0.8\text{ V}$ to 3.6 V | - | ± 0.025 | ± 0.25 | μA |
| I_{OZ} | OFF-state output current | A or B port; $V_O = 0\text{ V}$ or V_{CCO} ; $V_{CC(A)} = V_{CC(B)} = 0.8\text{ V}$ to 3.6 V | [1][2] | ± 0.5 | ± 2.5 | μA |
| I_{OFF} | power-off leakage current | A port; V_I or $V_O = 0\text{ V}$ to 3.6 V ; $V_{CC(A)} = 0\text{ V}$; $V_{CC(B)} = 0.8\text{ V}$ to 3.6 V | - | ± 0.1 | ± 1 | μA |
| | | B port; V_I or $V_O = 0\text{ V}$ to 3.6 V ; $V_{CC(B)} = 0\text{ V}$; $V_{CC(A)} = 0.8\text{ V}$ to 3.6 V | - | ± 0.1 | ± 1 | μA |
| C_I | input capacitance | DIR input; $V_I = 0\text{ V}$ or 3.3 V ; $V_{CC(A)} = V_{CC(B)} = 3.3\text{ V}$ | - | 1.0 | - | pF |
| $C_{I/O}$ | input/output capacitance | A and B port; Suspend mode; $V_O = V_{CCO}$ or GND; $V_{CC(A)} = V_{CC(B)} = 3.3\text{ V}$ | [2] | 4.0 | - | pF |

[1] For I/O ports, the parameter I_{OZ} includes the input leakage current.

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

Table 8. Static characteristics

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

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|--|--|---|------------------|-----------------|-------------------|-----------------|------|
| | | | Min | Max | Min | Max | |
| V_{IH} | HIGH-level input voltage | data input [1] | | | | | |
| | | $V_{CCI} = 0.8\text{ V}$ | $0.70V_{CCI}$ | - | $0.70V_{CCI}$ | - | V |
| | | $V_{CCI} = 1.1\text{ V}$ to 1.95 V | $0.65V_{CCI}$ | - | $0.65V_{CCI}$ | - | V |
| | | $V_{CCI} = 2.3\text{ V}$ to 2.7 V | 1.6 | - | 1.6 | - | V |
| | | $V_{CCI} = 3.0\text{ V}$ to 3.6 V | 2 | - | 2 | - | V |
| | | DIR input | | | | | |
| | | $V_{CC(A)} = 0.8\text{ V}$ | $0.70V_{CC(A)}$ | - | $0.70V_{CC(A)}$ | - | V |
| | | $V_{CC(A)} = 1.1\text{ V}$ to 1.95 V | $0.65V_{CC(A)}$ | - | $0.65V_{CC(A)}$ | - | V |
| V_{IL} | LOW-level input voltage | data input [1] | | | | | |
| | | $V_{CCI} = 0.8\text{ V}$ | - | $0.30V_{CCI}$ | - | $0.30V_{CCI}$ | V |
| | | $V_{CCI} = 1.1\text{ V}$ to 1.95 V | - | $0.35V_{CCI}$ | - | $0.35V_{CCI}$ | V |
| | | $V_{CCI} = 2.3\text{ V}$ to 2.7 V | - | 0.7 | - | 0.7 | V |
| | | $V_{CCI} = 3.0\text{ V}$ to 3.6 V | - | 0.9 | - | 0.9 | V |
| | | DIR input | | | | | |
| | | $V_{CC(A)} = 0.8\text{ V}$ | - | $0.30V_{CC(A)}$ | - | $0.30V_{CC(A)}$ | V |
| | | $V_{CC(A)} = 1.1\text{ V}$ to 1.95 V | - | $0.35V_{CC(A)}$ | - | $0.35V_{CC(A)}$ | V |
| $V_{CC(A)} = 2.3\text{ V}$ to 2.7 V | - | 0.7 | - | 0.7 | V | | |
| | $V_{CC(A)} = 3.0\text{ V}$ to 3.6 V | - | 0.9 | - | 0.9 | V | |

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| Symbol | Parameter | Conditions | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|--|---------------------------|---|--------------------------|---|------------------------|------|------|
| | | | Min | Max | Min | Max | |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} [2] | | | | | |
| | | I _O = -100 µA; V _{CC(A)} = V _{CC(B)} = 0.8 V to 3.6 V | V _{CCO} - 0.1 | - | V _{CCO} - 0.1 | - | V |
| | | I _O = -3 mA; V _{CC(A)} = V _{CC(B)} = 1.1 V | 0.85 | - | 0.85 | - | V |
| | | I _O = -6 mA; V _{CC(A)} = V _{CC(B)} = 1.4 V | 1.05 | - | 1.05 | - | V |
| | | I _O = -8 mA; V _{CC(A)} = V _{CC(B)} = 1.65 V | 1.2 | - | 1.2 | - | V |
| | | I _O = -9 mA; V _{CC(A)} = V _{CC(B)} = 2.3 V | 1.75 | - | 1.75 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | |
| | | I _O = 100 µA; V _{CC(A)} = V _{CC(B)} = 0.8 V to 3.6 V | - | 0.1 | - | 0.1 | V |
| | | I _O = 3 mA; V _{CC(A)} = V _{CC(B)} = 1.1 V | - | 0.25 | - | 0.25 | V |
| | | I _O = 6 mA; V _{CC(A)} = V _{CC(B)} = 1.4 V | - | 0.35 | - | 0.35 | V |
| | | I _O = 8 mA; V _{CC(A)} = V _{CC(B)} = 1.65 V | - | 0.45 | - | 0.45 | V |
| | | I _O = 9 mA; V _{CC(A)} = V _{CC(B)} = 2.3 V | - | 0.55 | - | 0.55 | V |
| I _I | input leakage current | DIR input; V _I = 0 V or 3.6 V; V _{CC(A)} = V _{CC(B)} = 0.8 V to 3.6 V | - | ±1 | - | ±1.5 | µA |
| | | I _{OZ} | OFF-state output current | A or B port; V _O = 0 V or V _{CCO} ; V _{CC(A)} = V _{CC(B)} = 3.6 V [2][3] | - | ±5 | - |
| I _{OFF} | power-off leakage current | A port; V _I or V _O = 0 V to 3.6 V; V _{CC(A)} = 0 V; V _{CC(B)} = 0.8 V to 3.6 V | - | ±5 | - | ±35 | µA |
| | | B port; V _I or V _O = 0 V to 3.6 V; V _{CC(B)} = 0 V; V _{CC(A)} = 0.8 V to 3.6 V | - | ±5 | - | ±35 | µA |
| I _{CC} | supply current | A port; V _I = 0 V or V _{CCI} ; I _O = 0 A [1] | | | | | |
| | | V _{CC(A)} = 0.8 V to 3.6 V; V _{CC(B)} = 0.8 V to 3.6 V | - | 8 | - | 11.5 | µA |
| | | V _{CC(A)} = 3.6 V; V _{CC(B)} = 0 V | - | 8 | - | 11.5 | µA |
| | | V _{CC(A)} = 0 V; V _{CC(B)} = 3.6 V | -2 | - | -8 | - | µA |
| | | B port; V _I = 0 V or V _{CCI} ; I _O = 0 A [1] | | | | | |
| | | V _{CC(A)} = 0.8 V to 3.6 V; V _{CC(B)} = 0.8 V to 3.6 V | - | 8 | - | 11.5 | µA |
| | | V _{CC(A)} = 3.6 V; V _{CC(B)} = 0 V | -2 | - | -8 | - | µA |
| | | V _{CC(A)} = 0 V; V _{CC(B)} = 3.6 V | - | 8 | - | 11.5 | 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)} = 0.8 V to 3.6 V; V _{CC(B)} = 0.8 V to 3.6 V [1] | - | 16 | - | 23 | 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] For I/O ports, the parameter I_{OZ} includes the input leakage current.

11. Dynamic characteristics

Table 9. Typical dynamic characteristics at $V_{CC(A)} = 0.8\text{ V}$ and $T_{amb} = 25\text{ }^{\circ}\text{C}$

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7; for waveforms see Fig. 5 and Fig. 6

| Symbol | Parameter | Conditions | $V_{CC(B)}$ | | | | | | Unit |
|-----------|-------------------|--------------|-------------|-------|-------|-------|-------|-------|------|
| | | | 0.8 V | 1.2 V | 1.5 V | 1.8 V | 2.5 V | 3.3 V | |
| t_{pd} | propagation delay | A to B [1] | 15.5 | 8.1 | 7.6 | 7.7 | 8.4 | 9.2 | ns |
| | | B to A [1] | 15.5 | 12.7 | 12.3 | 12.2 | 12.0 | 11.8 | ns |
| t_{dis} | disable time | DIR to A [2] | 12.2 | 12.2 | 12.2 | 12.2 | 12.2 | 12.2 | ns |
| | | DIR to B [2] | 11.7 | 7.9 | 7.6 | 8.2 | 8.7 | 10.2 | ns |
| t_{en} | enable time | DIR to A [3] | 27.2 | 20.6 | 19.9 | 20.4 | 20.7 | 22.0 | ns |
| | | DIR to B [3] | 27.7 | 20.3 | 19.8 | 19.9 | 20.6 | 21.4 | ns |

[1] t_{pd} is the same as t_{PLH} and t_{PHL}

[2] t_{dis} is the same as t_{PLZ} and t_{PHZ}

[3] t_{en} is the same as t_{PZL} and t_{PZH}

t_{en} is a calculated value using the formula shown in Section 12.4

Table 10. Typical dynamic characteristics at $V_{CC(B)} = 0.8\text{ V}$ and $T_{amb} = 25\text{ }^{\circ}\text{C}$

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7; for waveforms see Fig. 5 and Fig. 6

| Symbol | Parameter | Conditions | $V_{CC(A)}$ | | | | | | Unit |
|-----------|-------------------|--------------|-------------|-------|-------|-------|-------|-------|------|
| | | | 0.8 V | 1.2 V | 1.5 V | 1.8 V | 2.5 V | 3.3 V | |
| t_{pd} | propagation delay | A to B [1] | 15.5 | 12.7 | 12.3 | 12.2 | 12.0 | 11.8 | ns |
| | | B to A [1] | 15.5 | 8.1 | 7.6 | 7.7 | 8.4 | 9.2 | ns |
| t_{dis} | disable time | DIR to A [2] | 12.2 | 4.9 | 3.8 | 3.7 | 2.8 | 3.4 | ns |
| | | DIR to B [2] | 11.7 | 9.2 | 9.0 | 8.8 | 8.7 | 8.6 | ns |
| t_{en} | enable time | DIR to A [3] | 27.2 | 17.3 | 16.6 | 16.5 | 17.1 | 17.8 | ns |
| | | DIR to B [3] | 27.7 | 17.6 | 16.1 | 15.9 | 14.8 | 15.2 | ns |

[1] t_{pd} is the same as t_{PLH} and t_{PHL}

[2] t_{dis} is the same as t_{PLZ} and t_{PHZ}

[3] t_{en} is the same as t_{PZL} and t_{PZH}

t_{en} is a calculated value using the formula shown in Section 12.4

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

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

| Symbol | Parameter | Conditions | $V_{CC(A)}$ and $V_{CC(B)}$ | | | | | | Unit |
|----------|-------------------------------|---|-----------------------------|-------|-------|-------|-------|-------|------|
| | | | 0.8 V | 1.2 V | 1.5 V | 1.8 V | 2.5 V | 3.3 V | |
| C_{PD} | power dissipation capacitance | [1][2] | | | | | | | |
| | | A port: (direction A to B); B port: (direction B to A) | 1 | 2 | 2 | 2 | 2 | 2 | pF |
| | | A port: (direction B to A); B port: (direction A to B) | 9 | 11 | 11 | 12 | 14 | 17 | pF |

[1] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$ 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] $f_i = 10\text{ MHz}$; $V_i = \text{GND to } V_{CC}$; $t_r = t_f = 1\text{ ns}$; $C_L = 0\text{ pF}$; $R_L = \infty\ \Omega$.

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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. 7; for waveforms see Fig. 5 and Fig. 6.

| Symbol | Parameter | Conditions | $V_{CC(B)}$ | | | | | | | | | | Unit |
|------------------------------|-------------------|--------------------------------|----------------------|------|----------------------|------|-----------------------|------|----------------------|------|----------------------|------|------|
| | | | 1.2 V ± 0.1 V | | 1.5 V ± 0.1 V | | 1.8 V ± 0.15 V | | 2.5 V ± 0.2 V | | 3.3 V ± 0.3 V | | |
| | | | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | |
| t_{pd} | propagation delay | A to B [1] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | 1.0 | 9.0 | 0.7 | 6.8 | 0.6 | 6.1 | 0.5 | 5.7 | 0.5 | 6.1 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | 1.0 | 8.0 | 0.7 | 5.4 | 0.6 | 4.6 | 0.5 | 3.7 | 0.5 | 3.5 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | 1.0 | 7.7 | 0.6 | 5.1 | 0.5 | 4.3 | 0.5 | 3.4 | 0.5 | 3.1 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | 1.0 | 7.2 | 0.5 | 4.7 | 0.5 | 3.9 | 0.5 | 3.0 | 0.5 | 2.6 | ns |
| | | $V_{CC(A)} = 3.0$ V to 3.6 V | 1.0 | 7.1 | 0.5 | 4.5 | 0.5 | 3.7 | 0.5 | 2.8 | 0.5 | 2.4 | ns |
| | | B to A [1] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | 1.0 | 9.0 | 0.8 | 8.0 | 0.7 | 7.7 | 0.6 | 7.2 | 0.5 | 7.1 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | 1.0 | 6.8 | 0.8 | 5.4 | 0.7 | 5.1 | 0.6 | 4.7 | 0.5 | 4.5 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | 1.0 | 6.1 | 0.7 | 4.6 | 0.5 | 4.4 | 0.5 | 3.9 | 0.5 | 3.7 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | 1.0 | 5.7 | 0.6 | 3.8 | 0.5 | 3.4 | 0.5 | 3.0 | 0.5 | 2.8 | ns |
| $V_{CC(A)} = 3.0$ V to 3.6 V | 1.0 | 6.1 | 0.6 | 3.6 | 0.5 | 3.1 | 0.5 | 2.6 | 0.5 | 2.4 | ns | | |
| t_{dis} | disable time | DIR to A [2] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | 2.2 | 8.8 | 2.2 | 8.8 | 2.2 | 8.8 | 2.2 | 8.8 | 2.2 | 8.8 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | 1.6 | 6.3 | 1.6 | 6.3 | 1.6 | 6.3 | 1.6 | 6.3 | 1.6 | 6.3 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | 1.6 | 5.5 | 1.6 | 5.5 | 1.6 | 5.5 | 1.6 | 5.5 | 1.6 | 5.5 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | 1.5 | 4.2 | 1.5 | 4.2 | 1.5 | 4.2 | 1.5 | 4.2 | 1.5 | 4.2 | ns |
| | | $V_{CC(A)} = 3.0$ V to 3.6 V | 1.5 | 4.7 | 1.5 | 4.7 | 1.5 | 4.7 | 1.5 | 4.7 | 1.5 | 4.7 | ns |
| | | DIR to B [2] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | 2.2 | 8.4 | 1.8 | 6.7 | 2.0 | 6.9 | 1.7 | 6.2 | 2.4 | 7.2 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | 2.0 | 7.6 | 1.8 | 5.9 | 1.6 | 6.0 | 1.2 | 4.8 | 1.7 | 5.5 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | 1.8 | 7.7 | 1.8 | 5.7 | 1.4 | 5.8 | 1.0 | 4.5 | 1.5 | 5.2 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | 1.7 | 7.3 | 2.0 | 5.2 | 1.5 | 5.1 | 0.6 | 4.2 | 1.1 | 4.8 | ns |
| $V_{CC(A)} = 3.0$ V to 3.6 V | 1.7 | 7.2 | 0.7 | 5.5 | 0.6 | 5.5 | 0.7 | 4.1 | 1.7 | 4.7 | ns | | |
| t_{en} | enable time | DIR to A [3][4] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | - | 17.4 | - | 14.7 | - | 14.6 | - | 13.4 | - | 14.3 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | - | 14.4 | - | 11.3 | - | 11.1 | - | 9.5 | - | 10.0 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | - | 13.8 | - | 10.3 | - | 10.2 | - | 8.4 | - | 8.9 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | - | 13.0 | - | 9.0 | - | 8.5 | - | 7.2 | - | 7.6 | ns |
| | | $V_{CC(A)} = 3.0$ V to 3.6 V | - | 13.3 | - | 9.1 | - | 8.6 | - | 6.7 | - | 7.1 | ns |
| | | DIR to B [3][4] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | - | 17.8 | - | 15.6 | - | 14.9 | - | 14.5 | - | 14.9 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | - | 14.3 | - | 11.7 | - | 10.9 | - | 10.0 | - | 9.8 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | - | 13.2 | - | 10.6 | - | 9.8 | - | 8.9 | - | 8.6 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | - | 11.4 | - | 8.9 | - | 8.1 | - | 7.2 | - | 6.8 | ns |
| $V_{CC(A)} = 3.0$ V to 3.6 V | - | 11.8 | - | 9.2 | - | 8.4 | - | 7.5 | - | 7.1 | ns | | |

[1] t_{pd} is the same as t_{PLH} and t_{PHL} [2] t_{dis} is the same as t_{PLZ} and t_{PHZ} [3] t_{en} is the same as t_{PZL} and t_{PZH} [4] t_{en} is a calculated value using the formula shown in Section 12.4

Dual-bit, dual-supply voltage level translator/transceiver; 3-state

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. 7; for waveforms see Fig. 5 and Fig. 6.

| Symbol | Parameter | Conditions | $V_{CC(B)}$ | | | | | | | | | | Unit |
|-----------|-------------------|--------------------------------|----------------------|------|----------------------|------|-----------------------|------|----------------------|------|----------------------|------|------|
| | | | 1.2 V ± 0.1 V | | 1.5 V ± 0.1 V | | 1.8 V ± 0.15 V | | 2.5 V ± 0.2 V | | 3.3 V ± 0.3 V | | |
| | | | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | |
| t_{pd} | propagation delay | A to B [1] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | 1.0 | 9.9 | 0.7 | 7.5 | 0.6 | 6.8 | 0.5 | 6.3 | 0.5 | 6.8 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | 1.0 | 8.8 | 0.7 | 6.0 | 0.6 | 5.1 | 0.5 | 4.1 | 0.5 | 3.9 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | 1.0 | 8.5 | 0.6 | 5.7 | 0.5 | 4.8 | 0.5 | 3.8 | 0.5 | 3.5 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | 1.0 | 8.0 | 0.5 | 5.2 | 0.5 | 4.3 | 0.5 | 3.3 | 0.5 | 2.9 | ns |
| | | $V_{CC(A)} = 3.0$ V to 3.6 V | 1.0 | 7.9 | 0.5 | 5.0 | 0.5 | 4.1 | 0.5 | 3.1 | 0.5 | 2.7 | ns |
| | | B to A [1] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | 1.0 | 9.9 | 0.8 | 8.8 | 0.7 | 8.5 | 0.6 | 8.0 | 0.5 | 7.9 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | 1.0 | 7.5 | 0.8 | 6.0 | 0.7 | 5.7 | 0.6 | 5.2 | 0.5 | 5.0 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | 1.0 | 6.8 | 0.7 | 5.1 | 0.5 | 4.9 | 0.5 | 4.3 | 0.5 | 4.1 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | 1.0 | 6.3 | 0.6 | 4.2 | 0.5 | 3.8 | 0.5 | 3.3 | 0.5 | 3.1 | ns |
| | | $V_{CC(A)} = 3.0$ V to 3.6 V | 1.0 | 6.8 | 0.6 | 4.0 | 0.5 | 3.5 | 0.5 | 2.9 | 0.5 | 2.7 | ns |
| t_{dis} | disable time | DIR to A [2] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | 2.2 | 9.7 | 2.2 | 9.7 | 2.2 | 9.7 | 2.2 | 9.7 | 2.2 | 9.7 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | 1.6 | 7.0 | 1.6 | 7.0 | 1.6 | 7.0 | 1.6 | 7.0 | 1.6 | 7.0 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | 1.6 | 6.1 | 1.6 | 6.1 | 1.6 | 6.1 | 1.6 | 6.1 | 1.6 | 6.1 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | 1.5 | 4.7 | 1.5 | 4.7 | 1.5 | 4.7 | 1.5 | 4.7 | 1.5 | 4.7 | ns |
| | | $V_{CC(A)} = 3.0$ V to 3.6 V | 1.5 | 5.2 | 1.5 | 5.2 | 1.5 | 5.2 | 1.5 | 5.2 | 1.5 | 5.2 | ns |
| | | DIR to B [2] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | 2.2 | 9.2 | 1.8 | 7.4 | 2.0 | 7.6 | 1.7 | 6.9 | 2.4 | 8.0 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | 2.0 | 8.3 | 1.8 | 6.5 | 1.6 | 6.6 | 1.2 | 5.3 | 1.7 | 6.1 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | 1.8 | 8.5 | 1.8 | 6.3 | 1.4 | 6.4 | 1.0 | 5.0 | 1.5 | 5.8 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | 1.7 | 8.0 | 2.0 | 5.8 | 1.5 | 5.7 | 0.6 | 4.7 | 1.1 | 5.3 | ns |
| | | $V_{CC(A)} = 3.0$ V to 3.6 V | 1.7 | 7.9 | 0.7 | 6.1 | 0.6 | 6.1 | 0.7 | 4.6 | 1.7 | 5.2 | ns |
| t_{en} | enable time | DIR to A [3][4] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | - | 19.1 | - | 16.2 | - | 16.1 | - | 14.9 | - | 15.9 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | - | 15.8 | - | 12.5 | - | 12.3 | - | 10.5 | - | 11.1 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | - | 15.3 | - | 11.4 | - | 11.3 | - | 9.3 | - | 9.9 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | - | 14.3 | - | 10.0 | - | 9.5 | - | 8.0 | - | 8.4 | ns |
| | | $V_{CC(A)} = 3.0$ V to 3.6 V | - | 14.7 | - | 10.1 | - | 9.6 | - | 7.5 | - | 7.9 | ns |
| | | DIR to B [3][4] | | | | | | | | | | | |
| | | $V_{CC(A)} = 1.1$ V to 1.3 V | - | 19.6 | - | 17.2 | - | 16.5 | - | 16.0 | - | 16.5 | ns |
| | | $V_{CC(A)} = 1.4$ V to 1.6 V | - | 15.8 | - | 13.0 | - | 12.1 | - | 11.1 | - | 10.9 | ns |
| | | $V_{CC(A)} = 1.65$ V to 1.95 V | - | 14.6 | - | 11.8 | - | 10.9 | - | 9.9 | - | 9.6 | ns |
| | | $V_{CC(A)} = 2.3$ V to 2.7 V | - | 12.7 | - | 9.9 | - | 9.0 | - | 8.0 | - | 7.6 | ns |
| | | $V_{CC(A)} = 3.0$ V to 3.6 V | - | 13.1 | - | 10.2 | - | 9.3 | - | 8.3 | - | 7.9 | ns |

[1] t_{pd} is the same as t_{PLH} and t_{PHL} [2] t_{dis} is the same as t_{PLZ} and t_{PHZ} [3] t_{en} is the same as t_{PZL} and t_{PZH} [4] t_{en} is a calculated value using the formula shown in Section 12.4

11.1. Waveforms and test circuit

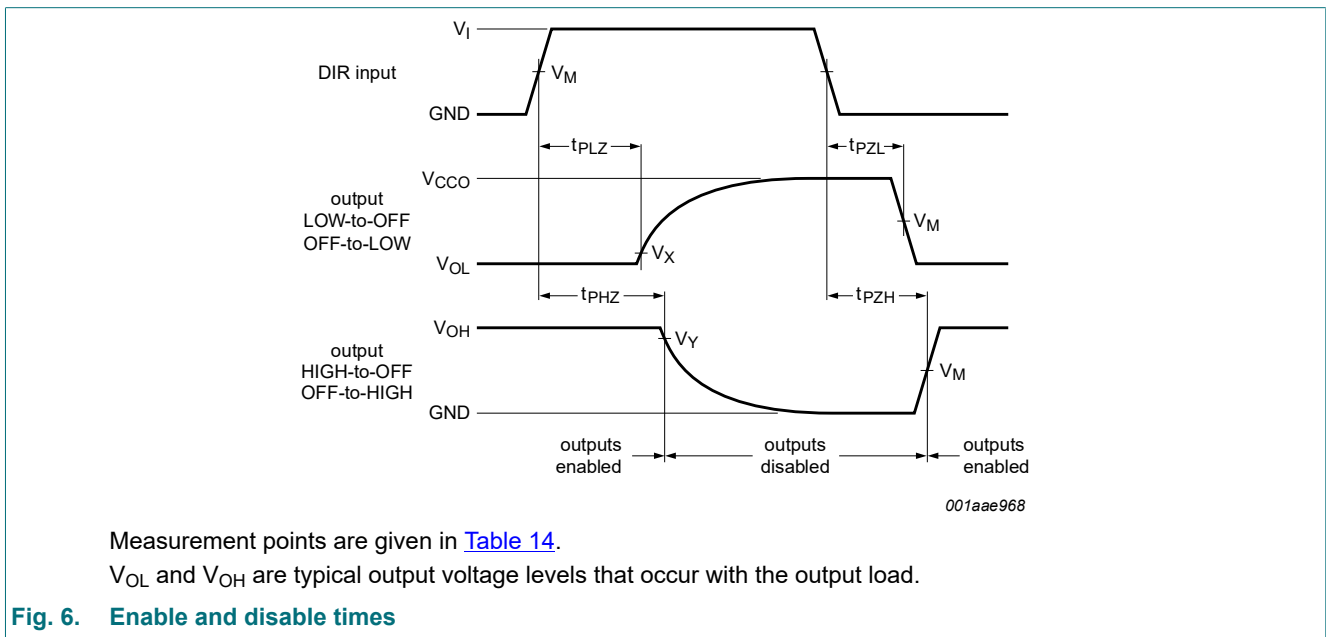
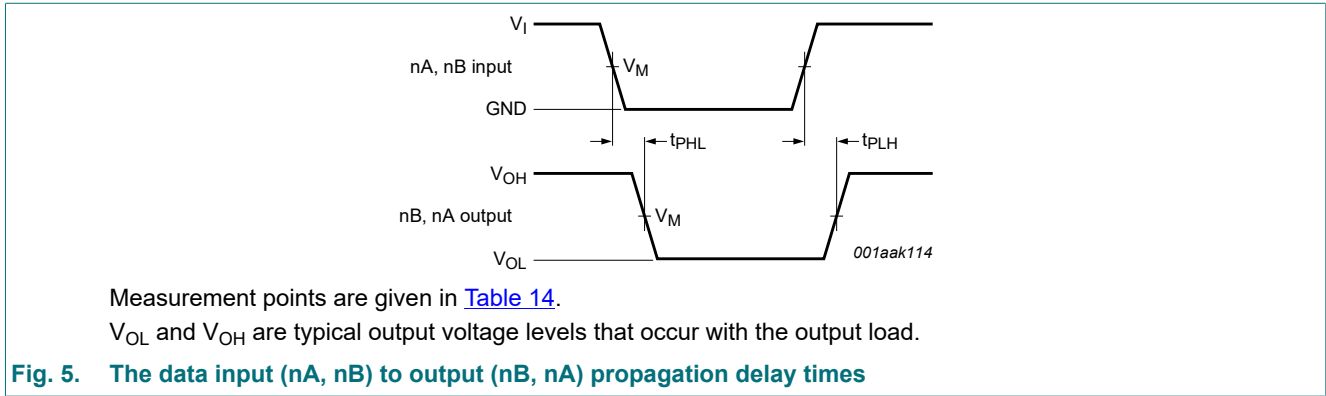
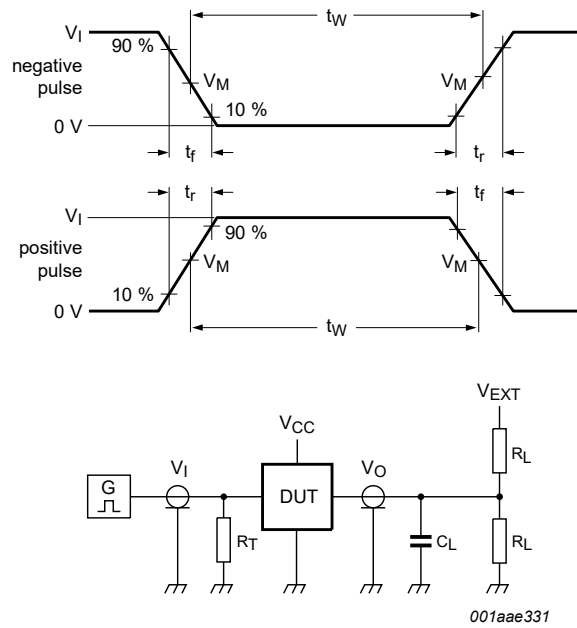


Table 14. Measurement points

| Supply voltage | Input [1] | Output [2] | | |
|------------------------|--------------|--------------|-------------------|-------------------|
| $V_{CC(A)}, V_{CC(B)}$ | V_M | V_M | V_X | V_Y |
| 1.1 V to 1.6 V | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.1 V$ | $V_{OH} - 0.1 V$ |
| 1.65 V to 2.7 V | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.15 V$ | $V_{OH} - 0.15 V$ |
| 3.0 V to 3.6 V | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.3 V$ | $V_{OH} - 0.3 V$ |

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



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

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance.

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

Fig. 7. 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] |
| 1.1 V to 1.6 V | V_{CCI} | $\leq 1.0 \text{ ns/V}$ | 15 pF | 2 k Ω | open | GND | $2V_{CCO}$ |
| 1.65 V to 2.7 V | V_{CCI} | $\leq 1.0 \text{ ns/V}$ | 15 pF | 2 k Ω | open | GND | $2V_{CCO}$ |
| 3.0 V to 3.6 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. Application information

12.1. Unidirectional logic level-shifting application

The circuit given in Fig. 8 is an example of the 74AVC2T45-Q100 being used in an unidirectional logic level-shifting application.

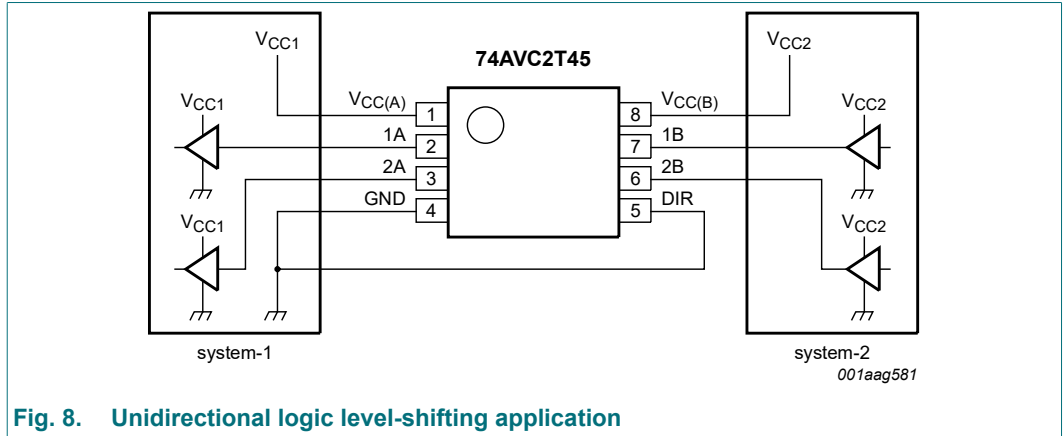


Fig. 8. Unidirectional logic level-shifting application

Table 16. Unidirectional logic level-shifting application

| Pin | Name | Function | Description |
|-----|--------------------|------------------|---|
| 1 | V _{CC(A)} | V _{CC1} | supply voltage of system-1 (0.8 V to 3.6 V) |
| 2 | 1A | OUT1 | output level depends on V _{CC1} voltage |
| 3 | 2A | OUT2 | output level depends on V _{CC1} voltage |
| 4 | GND | GND | device GND |
| 5 | DIR | DIR | the GND (LOW level) determines B port to A port direction |
| 6 | 2B | IN2 | input threshold value depends on V _{CC2} voltage |
| 7 | 1B | IN1 | input threshold value depends on V _{CC2} voltage |
| 8 | V _{CC(B)} | V _{CC2} | supply voltage of system-2 (0.8 V to 3.6 V) |

12.2. Bidirectional logic level-shifting application

Fig. 9 shows the 74AVC2T45-Q100 being used in a bidirectional logic level-shifting application. Since the device does not have an output enable (OE) pin, the system designer should take precautions to avoid bus contention between system-1 and system-2 when changing directions.

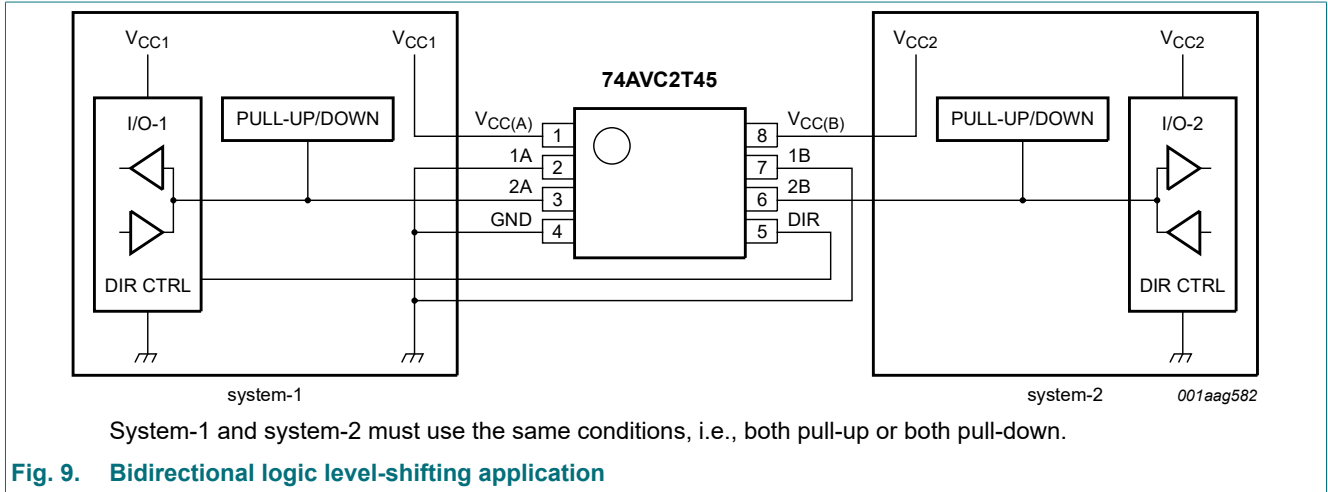


Table 17 gives a sequence that will illustrate data transmission from system-1 to system-2 and then from system-2 to system-1.

Table 17. 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 the pull-up or pull-down. |
| 3 | L | Z | Z | DIR bit is set LOW. I/O-1 and I/O-2 still are disabled. The bus-line state depends on the pull-up or pull-down. |
| 4 | L | input | output | system-2 data to system-1 |

System-1 and system-2 must use the same conditions, i.e., both pull-up or both pull-down.

12.3. 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 | 0.8 V | 1.2 V | 1.5 V | 1.8 V | 2.5 V | 3.3 V | |
| 0 V | 0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | μA |
| 0.8 V | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.7 | 2.3 | μA |
| 1.2 V | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 1.4 | μA |
| 1.5 V | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.9 | μA |
| 1.8 V | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.5 | μA |
| 2.5 V | 0.1 | 0.7 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | μA |
| 3.3 V | 0.1 | 2.3 | 1.4 | 0.9 | 0.5 | 0.1 | 0.1 | μA |

12.4. Enable times

The enable times for the 74AVC2T45-Q100 are calculated from the following formulas:

- $t_{\text{en}} (\text{DIR to nA}) = t_{\text{dis}} (\text{DIR to nB}) + t_{\text{pd}} (\text{nB to nA})$
- $t_{\text{en}} (\text{DIR to nB}) = t_{\text{dis}} (\text{DIR to nA}) + t_{\text{pd}} (\text{nA to nB})$

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 74AVC2T45-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.

13. Package outline

TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm SOT505-2

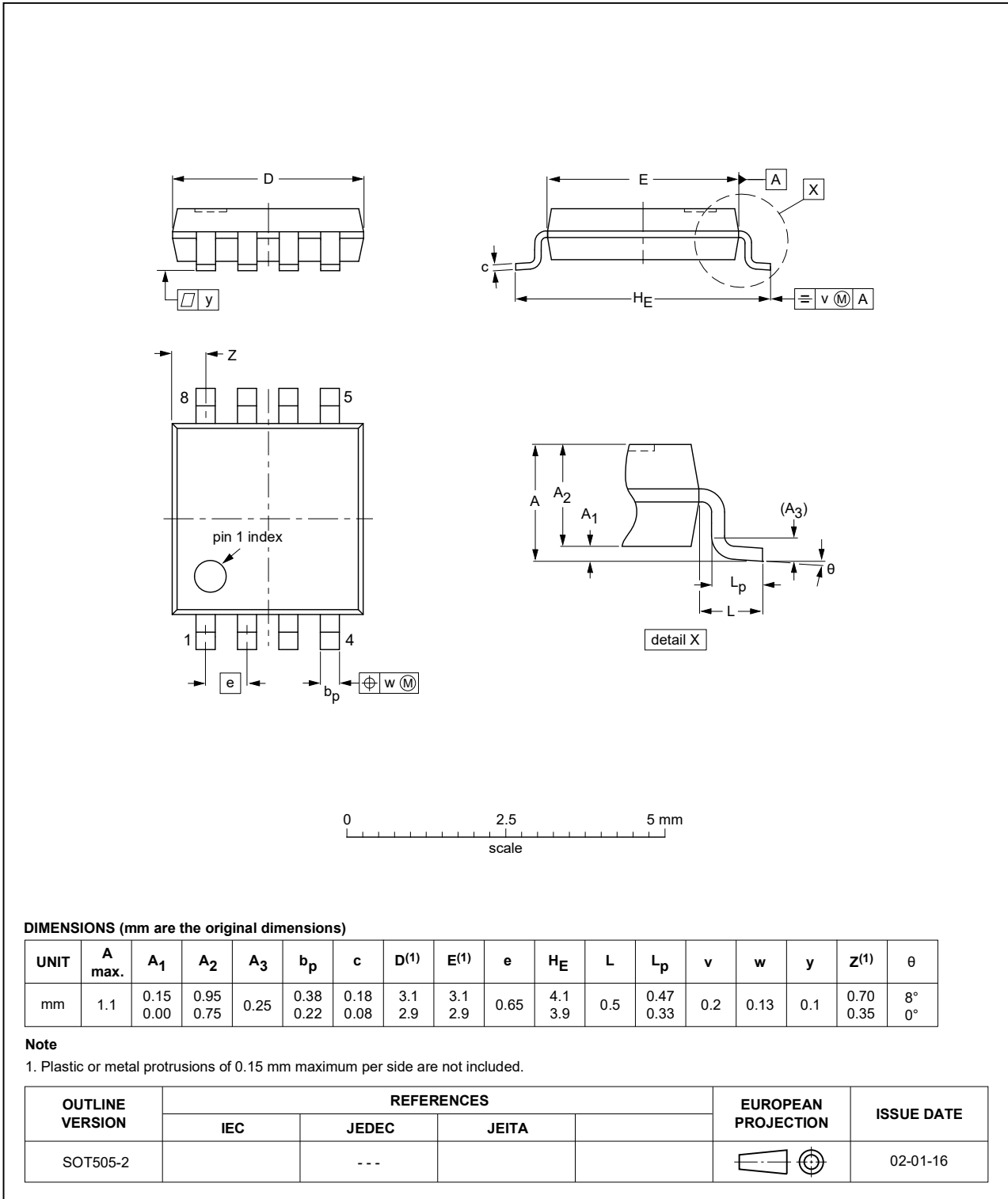


Fig. 10. Package outline SOT505-2 (TSSOP8)

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

SOT765-1

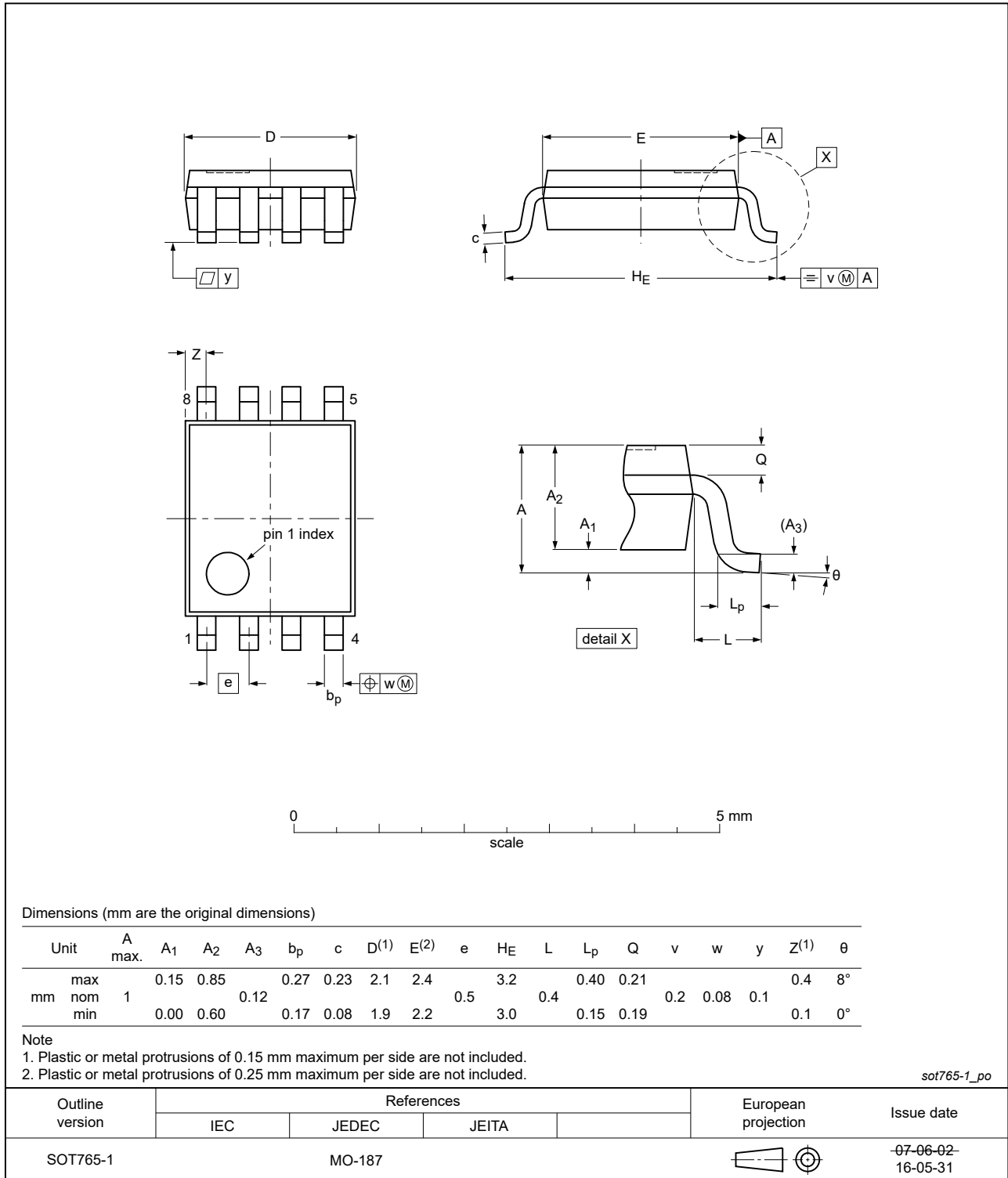


Fig. 11. Package outline SOT765-1 (VSSOP8)

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

SOT833-1

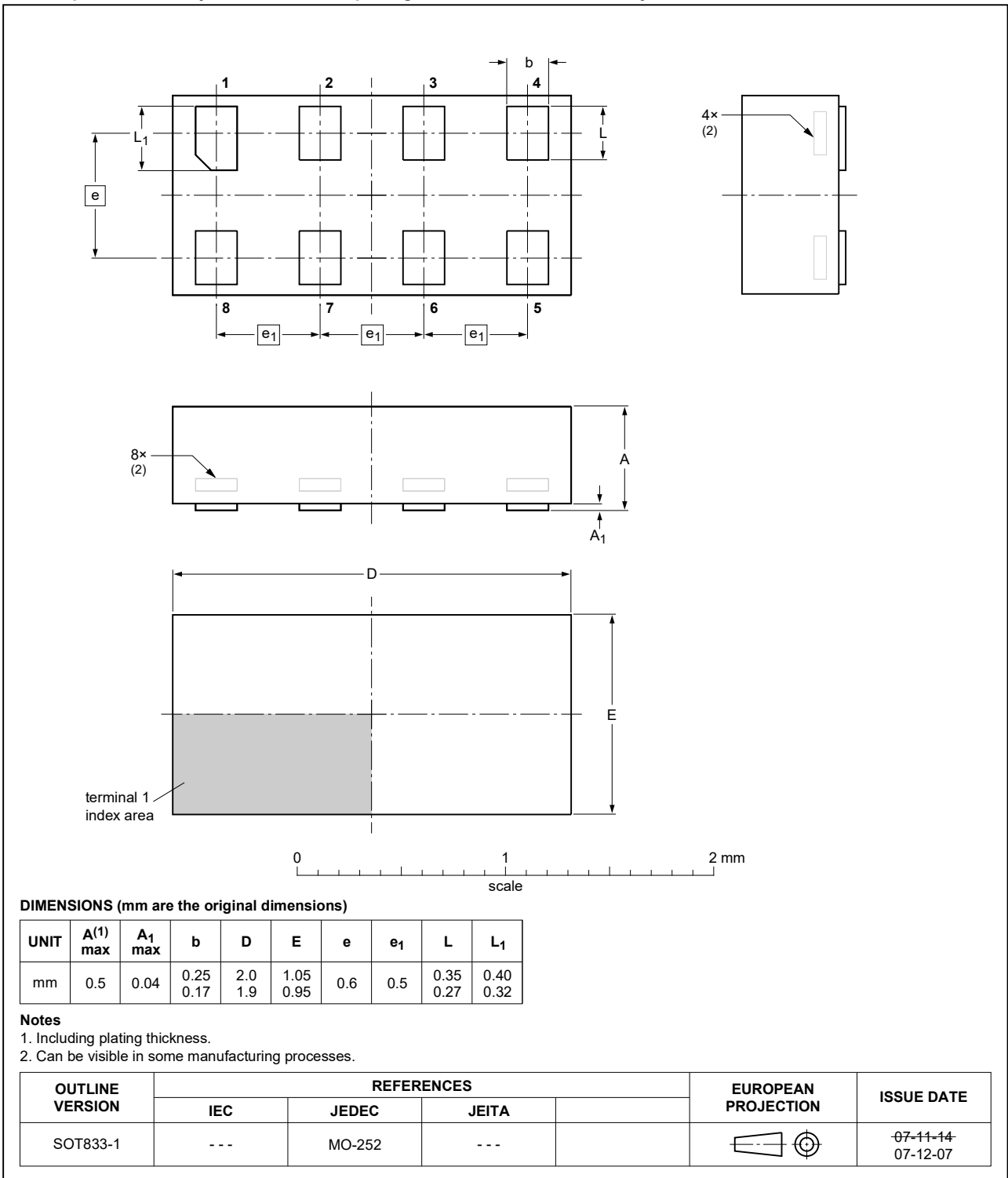


Fig. 12. Package outline SOT833-1 (XSON8)

14. Abbreviations

Table 19. Abbreviations

| Acronym | Description |
|---------|-------------------------|
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MIL | Military |
| MM | Machine Model |

15. Revision history

Table 20. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|--------------------|---|--------------------|---------------|--------------------|
| 74AVC2T45_Q100 v.5 | 20211104 | Product data sheet | - | 74AVC2T45_Q100 v.4 |
| Modifications: | <ul style="list-style-type: none"> Section 8: Derating values for P_{tot} total power dissipation updated. | | | |
| 74AVC2T45_Q100 v.4 | 20190506 | Product data sheet | - | 74AVC2T45_Q100 v.3 |
| Modifications: | <ul style="list-style-type: none"> Type number 74AVC2T45GT-Q100 (SOT833-1) added. | | | |
| 74AVC2T45_Q100 v.3 | 20180925 | Product data sheet | - | 74AVC2T45_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 74AVC2T45GD-Q100 (SOT996-2) removed. Package outline drawing Fig. 11 updated. | | | |
| 74AVC2T45_Q100 v.2 | 20130215 | Product data sheet | - | 74AVC2T45_Q100 v.1 |
| Modifications: | <ul style="list-style-type: none"> For type number 74AVC2T45GD-Q100 XSON8U has changed to XSON8. | | | |
| 74AVC2T45_Q100 v.1 | 20130131 | Product data sheet | - | - |

16. Legal information

Data sheet status

| Document status [1][2] | Product status [3] | Definition |
|--------------------------------|--------------------|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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