

# NTB0101

Dual supply translating transceiver; auto direction sensing;  
3-state

Rev. 7 — 9 April 2018

Product data sheet

## 1. General description

The NTB0101 is a 1-bit, dual supply translating transceiver with auto direction sensing, that enables bidirectional voltage level translation. It features two 1-bit input-output ports (A and B), one output enable input (OE) and two supply pins ( $V_{CC(A)}$  and  $V_{CC(B)}$ ).  $V_{CC(A)}$  can be supplied at any voltage between 1.2 V and 3.6 V and  $V_{CC(B)}$  can be supplied at any voltage between 1.65 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 OE are referenced to  $V_{CC(A)}$  and pin B is referenced to  $V_{CC(B)}$ . A LOW level at pin OE causes the outputs to assume a high-impedance OFF-state. This device is fully specified for partial power-down applications using  $I_{OFF}$ . The  $I_{OFF}$  circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

## 2. Features and benefits

- Wide supply voltage range:
  - ◆  $V_{CC(A)}$ : 1.2 V to 3.6 V and  $V_{CC(B)}$ : 1.65 V to 5.5 V
- $I_{OFF}$  circuitry provides partial Power-down mode operation
- Inputs accept voltages up to 5.5 V
- ESD protection:
  - ◆ HBM JESD22-A114E Class 2 exceeds 2500 V for A port
  - ◆ HBM JESD22-A114E Class 3B exceeds 15000 V for B port
  - ◆ MM JESD22-A115-A exceeds 200 V
  - ◆ CDM JESD22-C101E exceeds 1500 V
- Latch-up performance exceeds 100 mA per JESD 78B Class II
- Multiple package options
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$



### 3. Ordering information

Table 1. Device information

| Type number | Topside marking <sup>[1]</sup> | Package |                                                                                             |           |
|-------------|--------------------------------|---------|---------------------------------------------------------------------------------------------|-----------|
|             |                                | Name    | Description                                                                                 | Version   |
| NTB0101GW   | t1                             | SC-88   | plastic surface-mounted package; 6 leads                                                    | SOT363    |
| NTB0101GM   | t1                             | XSON6   | plastic extremely thin small outline package; no leads; 6 terminals; 1 × 1.45 × 0.5 mm body | SOT886    |
| NTB0101GF   | t1                             | XSON6   | plastic extremely thin small outline package; no leads; 6 terminals; 1 × 1 × 0.5 mm body    | SOT891    |
| NTB0101GS   | t1                             | XSON6   | extremely thin small outline package; no leads; 6 terminals; 1.0 × 1.0 × 0.35 mm body       | SOT1202   |
| NTB0101GS1  | T1                             | X2SON6  | plastic super thin small outline package; no leads; 6 terminals; 1.0 × 1.0 × 0.32 mm body   | SOT1202-2 |
| NTB0101GN   | t1                             | XSON6   | extremely thin small outline package; no leads; 6 terminals; 0.9 × 1.0 × 0.35 mm body       | SOT1115   |

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

#### 3.1 Ordering options

Table 2. Ordering options

| Type number              | Orderable part number | Package | Packing method                            | Minimum order qty | Temperature                          |
|--------------------------|-----------------------|---------|-------------------------------------------|-------------------|--------------------------------------|
| NTB0101GW <sup>[3]</sup> | NTB0101GW,125         | SC-88   | REEL 7" Q3/T4<br>*STANDARD MARK           | 3000              | T <sub>amb</sub> = −40 °C to +125 °C |
| NTB0101GM                | NTB0101GM,115         | XSON6   | REEL 7" Q1/T1<br>*STANDARD MARK SMD       | 5000              | T <sub>amb</sub> = −40 °C to +125 °C |
| NTB0101GF <sup>[1]</sup> | NTB0101GF,132         | XSON6   | REEL 7" Q1/T1,Q3/T4<br>*STANDARD MARK SMD | 5000              | T <sub>amb</sub> = −40 °C to +125 °C |
| NTB0101GS <sup>[2]</sup> | NTB0101GS,132         | XSON6   | REEL 7" Q1/T1,Q3/T4<br>*STANDARD MARK SMD | 5000              | T <sub>amb</sub> = −40 °C to +125 °C |
| NTB0101GS1               | NTB0101GS1Z           | X2SON6  | REEL 7" Q2/T3<br>*STANDARD MARK           | 10000             | T <sub>amb</sub> = −40 °C to +125 °C |
| NTB0101GN <sup>[1]</sup> | NTB0101GN,132         | XSON6   | REEL 7" Q1/T1,Q3/T4<br>*STANDARD MARK SMD | 5000              | T <sub>amb</sub> = −40 °C to +125 °C |

[1] Discontinued with 24 Apr 2018 Last Time Buy and 24 Jul 2018 Last Time Ship date.

[2] Discontinued with 31 Aug 2018 Last Time Buy and 30 Nov 2018 Last Time Ship date.

[3] Not recommend for new design.

4. Functional diagram

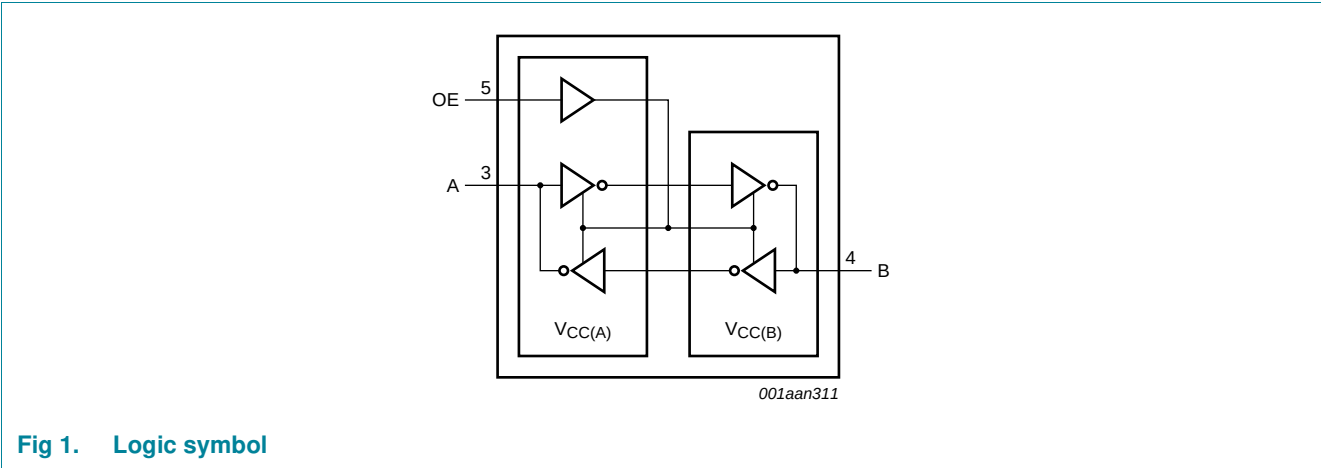


Fig 1. Logic symbol

5. Pinning information

5.1 Pinning

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Pin configuration SOT363: V<sub>CC(A)</sub> (1), GND (2), A (3), V<sub>CC(B)</sub> (6), OE (5), B (4).

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Pin configuration SOT886 and SOT1115: V<sub>CC(A)</sub> (1), GND (2), A (3), V<sub>CC(B)</sub> (6), OE (5), B (4).

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Transparent top view

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Pin configuration SOT891, SOT1202 and SOT1202-2: V<sub>CC(A)</sub> (1), GND (2), A (3), V<sub>CC(B)</sub> (6), OE (5), B (4).

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Transparent top view

Fig 2. Pin configuration SOT363

Fig 3. Pin configuration SOT886 and SOT1115

Fig 4. Pin configuration SOT891, SOT1202 and SOT1202-2

5.2 Pin description

Table 3. Pin description

| Symbol             | Pin | Description                                                          |
|--------------------|-----|----------------------------------------------------------------------|
| V <sub>CC(A)</sub> | 1   | supply voltage A                                                     |
| GND                | 2   | ground (0 V)                                                         |
| A                  | 3   | data input or output (referenced to V <sub>CC(A)</sub> )             |
| B                  | 4   | data input or output (referenced to V <sub>CC(B)</sub> )             |
| OE                 | 5   | output enable input (active HIGH; referenced to V <sub>CC(A)</sub> ) |
| V <sub>CC(B)</sub> | 6   | supply voltage B                                                     |

## 6. Functional description

**Table 4.** Function table<sup>[1]</sup>

| Supply voltage              |                    | Input | Input/output    |                 |
|-----------------------------|--------------------|-------|-----------------|-----------------|
| V <sub>CC(A)</sub>          | V <sub>CC(B)</sub> | OE    | A               | B               |
| 1.2 V to V <sub>CC(B)</sub> | 1.65 V to 5.5 V    | L     | Z               | Z               |
| 1.2 V to V <sub>CC(B)</sub> | 1.65 V to 5.5 V    | H     | input or output | output or input |
| GND <sup>[2]</sup>          | GND <sup>[2]</sup> | X     | Z               | Z               |

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

[2] When either V<sub>CC(A)</sub> or V<sub>CC(B)</sub> is at GND level, the device goes into Power-down mode.

## 7. 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 <sub>CC(A)</sub> | supply voltage A        |                                          |           | −0.5 | +6.5                   | V    |
| V <sub>CC(B)</sub> | supply voltage B        |                                          |           | −0.5 | +6.5                   | V    |
| V <sub>I</sub>     | input voltage           |                                          | [1]       | −0.5 | +6.5                   | V    |
| V <sub>O</sub>     | output voltage          | Active mode                              | [1][2][3] | −0.5 | V <sub>CCO</sub> + 0.5 | V    |
|                    |                         | Power-down or 3-state mode               | [1]       | −0.5 | +6.5                   | V    |
| I <sub>IK</sub>    | input clamping current  | V <sub>I</sub> < 0 V                     |           | −50  | -                      | mA   |
| I <sub>OK</sub>    | output clamping current | V <sub>O</sub> < 0 V                     |           | −50  | -                      | mA   |
| I <sub>O</sub>     | output current          | V <sub>O</sub> = 0 V to V <sub>CCO</sub> | [2]       | -    | ±50                    | mA   |
| I <sub>CC</sub>    | supply current          | I <sub>CC(A)</sub> or I <sub>CC(B)</sub> |           | -    | 100                    | mA   |
| I <sub>GND</sub>   | ground current          |                                          |           | −100 | -                      | mA   |
| T <sub>stg</sub>   | storage temperature     |                                          |           | −65  | +150                   | °C   |
| P <sub>tot</sub>   | total power dissipation | T <sub>amb</sub> = −40 °C to +125 °C     | [4]       | -    | 250                    | mW   |

[1] The minimum input and minimum output voltage ratings may be exceeded if the input and output current ratings are observed.

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

[3] V<sub>CCO</sub> + 0.5 V should not exceed 6.5 V.

[4] For SC-88 and SC-74A packages: above 87.5 °C the value of P<sub>tot</sub> derates linearly with 4.0 mW/K.

For XSON6 packages: above 118 °C the value of P<sub>tot</sub> derates linearly with 7.8 mW/K.

## 8. Recommended operating conditions

**Table 6.** Recommended operating conditions<sup>[1][2]</sup>

| Symbol             | Parameter        | Conditions |  | Min  | Max | Unit |
|--------------------|------------------|------------|--|------|-----|------|
| V <sub>CC(A)</sub> | supply voltage A |            |  | 1.2  | 3.6 | V    |
| V <sub>CC(B)</sub> | supply voltage B |            |  | 1.65 | 5.5 | V    |
| V <sub>I</sub>     | input voltage    |            |  | 0    | 5.5 | V    |

**Table 6.** Recommended operating conditions<sup>[1][2]</sup> ...continued

| Symbol           | Parameter                           | Conditions                                                                                                  |  | Min | Max  | Unit |
|------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------|--|-----|------|------|
| V <sub>O</sub>   | output voltage                      | Power-down or 3-state mode;<br>V <sub>CC(A)</sub> = 1.2 V to 3.6 V;<br>V <sub>CC(B)</sub> = 1.65 V to 5.5 V |  |     |      |      |
|                  |                                     | A port                                                                                                      |  | 0   | 3.6  | V    |
|                  |                                     | B port                                                                                                      |  | 0   | 5.5  | V    |
| T <sub>amb</sub> | ambient temperature                 |                                                                                                             |  | -40 | +125 | °C   |
| Δt/ΔV            | input transition rise and fall rate | V <sub>CC(A)</sub> = 1.2 V to 3.6 V;<br>V <sub>CC(B)</sub> = 1.65 V to 5.5 V                                |  | -   | 40   | ns/V |

[1] The A and B sides of an unused I/O pair must be held in the same state, both at V<sub>CCI</sub> or both at GND.

[2] V<sub>CC(A)</sub> must be less than or equal to V<sub>CC(B)</sub>.

## 9. Static characteristics

**Table 7.** Typical static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); T<sub>amb</sub> = 25 °C.

| Symbol           | Parameter                 | Conditions                                                                                                                           |     | Min | Typ  | Max | Unit |
|------------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----|-----|------|-----|------|
| V <sub>OH</sub>  | HIGH-level output voltage | A port; V <sub>CC(A)</sub> = 1.2 V; I <sub>O</sub> = -20 μA                                                                          |     | -   | 1.1  | -   | V    |
| V <sub>OL</sub>  | LOW-level output voltage  | A port; V <sub>CC(A)</sub> = 1.2 V; I <sub>O</sub> = 20 μA                                                                           |     | -   | 0.09 | -   | V    |
| I <sub>I</sub>   | input leakage current     | OE input; V <sub>I</sub> = 0 V to 3.6 V; V <sub>CC(A)</sub> = 1.2 V to 3.6 V;<br>V <sub>CC(B)</sub> = 1.65 V to 5.5 V                |     | -   | -    | ±1  | μA   |
| I <sub>OZ</sub>  | OFF-state output current  | A or B port; V <sub>O</sub> = 0 V to V <sub>CCO</sub> ; V <sub>CC(A)</sub> = 1.2 V to 3.6 V;<br>V <sub>CC(B)</sub> = 1.65 V to 5.5 V | [1] | -   | -    | ±1  | μA   |
| I <sub>OFF</sub> | power-off leakage current | A port; V <sub>I</sub> or V <sub>O</sub> = 0 V to 3.6 V;<br>V <sub>CC(A)</sub> = 0 V; V <sub>CC(B)</sub> = 0 V to 5.5 V              |     | -   | -    | ±1  | 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> = 0 V to 3.6 V              |     | -   | -    | ±1  | μA   |
| C <sub>I</sub>   | input capacitance         | OE input; V <sub>CC(A)</sub> = 1.2 V to 3.6 V; V <sub>CC(B)</sub> = 1.65 V to 5.5 V                                                  |     | -   | 1.0  | -   | pF   |
| C <sub>I/O</sub> | input/output capacitance  | A port; V <sub>CC(A)</sub> = 1.2 V to 3.6 V; V <sub>CC(B)</sub> = 1.65 V to 5.5 V                                                    |     | -   | 4.0  | -   | pF   |
|                  |                           | B port; V <sub>CC(A)</sub> = 1.2 V to 3.6 V; V <sub>CC(B)</sub> = 1.65 V to 5.5 V                                                    |     | -   | 7.5  | -   | pF   |

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

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

**Table 8.** Typical supply current

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); T<sub>amb</sub> = 25 °C.

| V <sub>CC(A)</sub> | V <sub>CC(B)</sub> |                    |                    |                    |                    |                    |                    |                    | Unit |
|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------|
|                    | 1.8 V              |                    | 2.5 V              |                    | 3.3 V              |                    | 5.0 V              |                    |      |
|                    | I <sub>CC(A)</sub> | I <sub>CC(B)</sub> | I <sub>CC(A)</sub> | I <sub>CC(B)</sub> | I <sub>CC(A)</sub> | I <sub>CC(B)</sub> | I <sub>CC(A)</sub> | I <sub>CC(B)</sub> |      |
| 1.2 V              | 10                 | 10                 | 10                 | 10                 | 10                 | 20                 | 10                 | 1050               | nA   |
| 1.5 V              | 10                 | 10                 | 10                 | 10                 | 10                 | 10                 | 10                 | 650                | nA   |

**Table 8.** Typical ...continued supply current ...continuedAt recommended operating conditions; voltages are referenced to GND (ground = 0 V);  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

| V <sub>CC(A)</sub> | V <sub>CC(B)</sub> |                    |                    |                    |                    |                    |                    |                    | Unit |
|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------|
|                    | 1.8 V              |                    | 2.5 V              |                    | 3.3 V              |                    | 5.0 V              |                    |      |
|                    | I <sub>CC(A)</sub> | I <sub>CC(B)</sub> | I <sub>CC(A)</sub> | I <sub>CC(B)</sub> | I <sub>CC(A)</sub> | I <sub>CC(B)</sub> | I <sub>CC(A)</sub> | I <sub>CC(B)</sub> |      |
| 1.8 V              | 10                 | 10                 | 10                 | 10                 | 10                 | 10                 | 10                 | 350                | nA   |
| 2.5 V              | -                  | -                  | 10                 | 10                 | 10                 | 10                 | 10                 | 40                 | nA   |
| 3.3 V              | -                  | -                  | -                  | -                  | 10                 | 10                 | 10                 | 10                 | nA   |

**Table 9.** 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  | A or B port and OE input [1]                                                                                                                |                  |               |                   |               |               |
|           |                           | $V_{CC(A)} = 1.2\text{ V to }3.6\text{ V};$<br>$V_{CC(B)} = 1.65\text{ V to }5.5\text{ V}$                                                  | $0.65V_{CCI}$    | -             | $0.65V_{CCI}$     | -             | V             |
| $V_{IL}$  | LOW-level input voltage   | A or B port and OE input [1]                                                                                                                |                  |               |                   |               |               |
|           |                           | $V_{CC(A)} = 1.2\text{ V to }3.6\text{ V};$<br>$V_{CC(B)} = 1.65\text{ V to }5.5\text{ V}$                                                  | -                | $0.35V_{CCI}$ | -                 | $0.35V_{CCI}$ | V             |
| $V_{OH}$  | HIGH-level output voltage | $I_O = -20\text{ }\mu\text{A}$ [2]                                                                                                          |                  |               |                   |               |               |
|           |                           | A port; $V_{CC(A)} = 1.4\text{ V to }3.6\text{ V}$                                                                                          | $V_{CCO} - 0.4$  | -             | $V_{CCO} - 0.4$   | -             | V             |
|           |                           | B port; $V_{CC(B)} = 1.65\text{ V to }5.5\text{ V}$                                                                                         | $V_{CCO} - 0.4$  | -             | $V_{CCO} - 0.4$   | -             | V             |
| $V_{OL}$  | LOW-level output voltage  | $I_O = 20\text{ }\mu\text{A}$ [2]                                                                                                           |                  |               |                   |               |               |
|           |                           | A port; $V_{CC(A)} = 1.4\text{ V to }3.6\text{ V}$                                                                                          | -                | 0.4           | -                 | 0.4           | V             |
|           |                           | B port; $V_{CC(B)} = 1.65\text{ V to }5.5\text{ V}$                                                                                         | -                | 0.4           | -                 | 0.4           | V             |
| $I_I$     | input leakage current     | OE input; $V_I = 0\text{ V to }3.6\text{ V};$<br>$V_{CC(A)} = 1.2\text{ V to }3.6\text{ V};$<br>$V_{CC(B)} = 1.65\text{ V to }5.5\text{ V}$ | -                | $\pm 2$       | -                 | $\pm 5$       | $\mu\text{A}$ |
| $I_{OZ}$  | OFF-state output current  | A or B port; $V_O = 0\text{ V or }V_{CCO};$<br>$V_{CC(A)} = 1.2\text{ V to }3.6\text{ V};$<br>$V_{CC(B)} = 1.65\text{ V to }5.5\text{ V}$   | -                | $\pm 2$       | -                 | $\pm 10$      | $\mu\text{A}$ |
| $I_{OFF}$ | power-off leakage current | A port; $V_I$ or $V_O = 0\text{ V to }3.6\text{ V};$<br>$V_{CC(A)} = 0\text{ V}; V_{CC(B)} = 0\text{ V to }5.5\text{ V}$                    | -                | $\pm 2$       | -                 | $\pm 10$      | $\mu\text{A}$ |
|           |                           | B port; $V_I$ or $V_O = 0\text{ V to }5.5\text{ V};$<br>$V_{CC(B)} = 0\text{ V}; V_{CC(A)} = 0\text{ V to }3.6\text{ V}$                    | -                | $\pm 2$       | -                 | $\pm 10$      | $\mu\text{A}$ |

**Table 9. Static characteristics ...continued**

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

| Symbol          | Parameter      | Conditions                                                                                 | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-----------------|----------------|--------------------------------------------------------------------------------------------|------------------|-----|-------------------|-----|------|
|                 |                |                                                                                            | Min              | Max | Min               | Max |      |
| I <sub>CC</sub> | supply current | V <sub>I</sub> = 0 V or V <sub>CCI</sub> ; I <sub>O</sub> = 0 A <a href="#">[1]</a>        |                  |     |                   |     |      |
|                 |                | I <sub>CC(A)</sub>                                                                         |                  |     |                   |     |      |
|                 |                | OE = LOW;<br>V <sub>CC(A)</sub> = 1.4 V to 3.6 V;<br>V <sub>CC(B)</sub> = 1.65 V to 5.5 V  | -                | 3   | -                 | 15  | μA   |
|                 |                | OE = HIGH;<br>V <sub>CC(A)</sub> = 1.4 V to 3.6 V;<br>V <sub>CC(B)</sub> = 1.65 V to 5.5 V | -                | 3   | -                 | 20  | μA   |
|                 |                | V <sub>CC(A)</sub> = 3.6 V; V <sub>CC(B)</sub> = 0 V                                       | -                | 2   | -                 | 15  | μA   |
|                 |                | V <sub>CC(A)</sub> = 0 V; V <sub>CC(B)</sub> = 5.5 V                                       | -                | –2  | -                 | –15 | μA   |
|                 |                | I <sub>CC(B)</sub>                                                                         |                  |     |                   |     |      |
|                 |                | OE = LOW;<br>V <sub>CC(A)</sub> = 1.4 V to 3.6 V;<br>V <sub>CC(B)</sub> = 1.65 V to 5.5 V  | -                | 5   | -                 | 15  | μA   |
|                 |                | OE = HIGH;<br>V <sub>CC(A)</sub> = 1.4 V to 3.6 V;<br>V <sub>CC(B)</sub> = 1.65 V to 5.5 V | -                | 5   | -                 | 20  | μA   |
|                 |                | V <sub>CC(A)</sub> = 3.6 V; V <sub>CC(B)</sub> = 0 V                                       | -                | –2  | -                 | –15 | μA   |
|                 |                | V <sub>CC(A)</sub> = 0 V; V <sub>CC(B)</sub> = 5.5 V                                       | -                | 2   | -                 | 15  | μA   |
|                 |                | I <sub>CC(A)</sub> + I <sub>CC(B)</sub>                                                    |                  |     |                   |     |      |
|                 |                | V <sub>CC(A)</sub> = 1.4 V to 3.6 V;<br>V <sub>CC(B)</sub> = 1.65 V to 5.5 V               | -                | 8   | -                 | 40  | μA   |

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

## 10. Dynamic characteristics

**Table 10. Typical dynamic characteristics for temperature 25 °C**[\[1\]](#)Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 7](#); for waveforms see [Figure 5](#) and [Figure 6](#).

| Symbol                                               | Parameter         | Conditions                | V <sub>CC(B)</sub> |       |       |       | Unit |    |
|------------------------------------------------------|-------------------|---------------------------|--------------------|-------|-------|-------|------|----|
|                                                      |                   |                           | 1.8 V              | 2.5 V | 3.3 V | 5.0 V |      |    |
| V <sub>CC(A)</sub> = 1.2 V; T <sub>amb</sub> = 25 °C |                   |                           |                    |       |       |       |      |    |
| t <sub>pd</sub>                                      | propagation delay | A to B                    |                    | 5.9   | 4.8   | 4.4   | 4.2  | ns |
|                                                      |                   | B to A                    |                    | 5.6   | 4.8   | 4.5   | 4.4  | ns |
| t <sub>en</sub>                                      | enable time       | OE to A, B                |                    | 0.5   | 0.5   | 0.5   | 0.5  | μs |
| t <sub>dis</sub>                                     | disable time      | OE to A; no external load | [2]                | 6.9   | 6.9   | 6.9   | 6.9  | ns |
|                                                      |                   | OE to B; no external load | [2]                | 9.5   | 8.6   | 8.5   | 8.0  | ns |
|                                                      |                   | OE to A                   |                    | 81    | 69    | 83    | 68   | ns |
|                                                      |                   | OE to B                   |                    | 81    | 69    | 83    | 68   | ns |

**Table 10. Typical dynamic characteristics for temperature 25 °C<sup>[1]</sup> ...continued**

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

| Symbol            | Parameter       | Conditions  | V <sub>CC(B)</sub> |       |       |       | Unit |
|-------------------|-----------------|-------------|--------------------|-------|-------|-------|------|
|                   |                 |             | 1.8 V              | 2.5 V | 3.3 V | 5.0 V |      |
| t <sub>t</sub>    | transition time | A port      | 4.0                | 4.0   | 4.1   | 4.1   | ns   |
|                   |                 | B port      | 2.6                | 2.0   | 1.7   | 1.4   | ns   |
| t <sub>W</sub>    | pulse width     | data inputs | 15                 | 13    | 13    | 13    | ns   |
| f <sub>data</sub> | data rate       |             | 70                 | 80    | 80    | 80    | Mbps |

[1] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.

t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.

t<sub>t</sub> is the same as t<sub>THL</sub> and t<sub>TLH</sub>.

[2] Delay between OE going LOW and when the outputs are actually disabled.

**Table 11. Dynamic characteristics for temperature range -40 °C to +85 °C<sup>[1]</sup>**

Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 7](#); for wave forms see [Figure 5](#) and [Figure 6](#).

| Symbol                              | Parameter         | Conditions                |                     | V <sub>CC(B)</sub> |      |               |      |               |      |               |      | Unit |
|-------------------------------------|-------------------|---------------------------|---------------------|--------------------|------|---------------|------|---------------|------|---------------|------|------|
|                                     |                   |                           |                     | 1.8 V ± 0.15 V     |      | 2.5 V ± 0.2 V |      | 3.3 V ± 0.3 V |      | 5.0 V ± 0.5 V |      |      |
|                                     |                   |                           |                     | Min                | Max  | Min           | Max  | Min           | Max  | Min           | Max  |      |
| V <sub>CC(A)</sub> = 1.5 V ± 0.1 V  |                   |                           |                     |                    |      |               |      |               |      |               |      |      |
| t <sub>pd</sub>                     | propagation delay | A to B                    |                     | 1.4                | 12.9 | 1.2           | 10.1 | 1.1           | 10.0 | 0.8           | 9.9  | ns   |
|                                     |                   | B to A                    |                     | 0.9                | 14.2 | 0.7           | 12.0 | 0.4           | 11.7 | 0.3           | 13.7 | ns   |
| t <sub>en</sub>                     | enable time       | OE to A, B                |                     | -                  | 1.0  | -             | 1.0  | -             | 1.0  | -             | 1.0  | µs   |
| t <sub>dis</sub>                    | disable time      | OE to A; no external load | <a href="#">[2]</a> | 1.0                | 11.9 | 1.0           | 11.9 | 1.0           | 11.9 | 1.0           | 11.9 | ns   |
|                                     |                   | OE to B; no external load | <a href="#">[2]</a> | 1.0                | 16.9 | 1.0           | 15.2 | 1.0           | 14.1 | 1.0           | 13.8 | ns   |
|                                     |                   | OE to A                   |                     | -                  | 320  | -             | 260  | -             | 260  | -             | 280  | ns   |
|                                     |                   | OE to B                   |                     | -                  | 200  | -             | 200  | -             | 200  | -             | 200  | ns   |
| t <sub>t</sub>                      | transition time   | A port                    |                     | 0.9                | 5.1  | 0.9           | 5.1  | 0.9           | 5.1  | 0.9           | 5.1  | ns   |
|                                     |                   | B port                    |                     | 0.9                | 4.7  | 0.6           | 3.2  | 0.5           | 2.5  | 0.4           | 2.7  | ns   |
| t <sub>W</sub>                      | pulse width       | data inputs               |                     | 25                 | -    | 25            | -    | 25            | -    | 25            | -    | ns   |
| f <sub>data</sub>                   | data rate         |                           |                     | -                  | 40   | -             | 40   | -             | 40   | -             | 40   | Mbps |
| V <sub>CC(A)</sub> = 1.8 V ± 0.15 V |                   |                           |                     |                    |      |               |      |               |      |               |      |      |
| t <sub>pd</sub>                     | propagation delay | A to B                    |                     | 1.6                | 11.0 | 1.4           | 7.7  | 1.3           | 6.8  | 1.2           | 6.5  | ns   |
|                                     |                   | B to A                    |                     | 1.5                | 12.0 | 1.3           | 8.4  | 1.0           | 7.6  | 0.9           | 7.1  | ns   |
| t <sub>en</sub>                     | enable time       | OE to A, B                |                     | -                  | 1.0  | -             | 1.0  | -             | 1.0  | -             | 1.0  | µs   |
| t <sub>dis</sub>                    | disable time      | OE to A; no external load | <a href="#">[2]</a> | 1.0                | 11.0 | 1.0           | 11.0 | 1.0           | 11.0 | 1.0           | 11.0 | ns   |
|                                     |                   | OE to B; no external load | <a href="#">[2]</a> | 1.0                | 15.4 | 1.0           | 13.5 | 1.0           | 12.4 | 1.0           | 12.1 | ns   |
|                                     |                   | OE to A                   |                     | -                  | 260  | -             | 230  | -             | 230  | -             | 230  | ns   |
|                                     |                   | OE to B                   |                     | -                  | 200  | -             | 200  | -             | 200  | -             | 200  | ns   |
| t <sub>t</sub>                      | transition time   | A port                    |                     | 0.8                | 4.1  | 0.8           | 4.1  | 0.8           | 4.1  | 0.8           | 4.1  | ns   |
|                                     |                   | B port                    |                     | 0.9                | 4.7  | 0.6           | 3.2  | 0.5           | 2.5  | 0.4           | 2.7  | ns   |
| t <sub>W</sub>                      | pulse width       | data inputs               |                     | 20                 | -    | 17            | -    | 17            | -    | 17            | -    | ns   |
| f <sub>data</sub>                   | data rate         |                           |                     | -                  | 49   | -             | 60   | -             | 60   | -             | 60   | Mbps |

**Table 11. Dynamic characteristics for temperature range  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$**  [\[1\]](#) ...continuedVoltages are referenced to GND (ground = 0 V); for test circuit see [Figure 7](#); for wave forms see [Figure 5](#) and [Figure 6](#).

| Symbol                             | Parameter         | Conditions                |     | V <sub>CC(B)</sub> |     |               |      |               |      |               |      | Unit |  |
|------------------------------------|-------------------|---------------------------|-----|--------------------|-----|---------------|------|---------------|------|---------------|------|------|--|
|                                    |                   |                           |     | 1.8 V ± 0.15 V     |     | 2.5 V ± 0.2 V |      | 3.3 V ± 0.3 V |      | 5.0 V ± 0.5 V |      |      |  |
|                                    |                   |                           |     | Min                | Max | Min           | Max  | Min           | Max  | Min           | Max  |      |  |
| V <sub>CC(A)</sub> = 2.5 V ± 0.2 V |                   |                           |     |                    |     |               |      |               |      |               |      |      |  |
| t <sub>pd</sub>                    | propagation delay | A to B                    |     | -                  | -   | 1.1           | 6.3  | 1.0           | 5.2  | 0.9           | 4.7  | ns   |  |
|                                    |                   | B to A                    |     | -                  | -   | 1.2           | 6.6  | 1.1           | 5.1  | 0.9           | 4.4  | ns   |  |
| t <sub>en</sub>                    | enable time       | OE to A, B                |     | -                  | -   | -             | 1.0  | -             | 1.0  | -             | 1.0  | μs   |  |
| t <sub>dis</sub>                   | disable time      | OE to A; no external load | [2] | -                  | -   | 1.0           | 9.2  | 1.0           | 9.2  | 1.0           | 9.2  | ns   |  |
|                                    |                   | OE to B; no external load | [2] | -                  | -   | 1.0           | 11.9 | 1.0           | 10.7 | 1.0           | 10.2 | ns   |  |
|                                    |                   | OE to A                   |     | -                  | -   | -             | 200  | -             | 200  | -             | 200  | ns   |  |
|                                    |                   | OE to B                   |     | -                  | -   | -             | 200  | -             | 200  | -             | 200  | ns   |  |
| t <sub>t</sub>                     | transition time   | A port                    |     | -                  | -   | 0.7           | 3.0  | 0.7           | 3.0  | 0.7           | 3.0  | ns   |  |
|                                    |                   | B port                    |     | -                  | -   | 0.7           | 3.2  | 0.5           | 2.5  | 0.4           | 2.7  | ns   |  |
| t <sub>W</sub>                     | pulse width       | data inputs               |     | -                  | -   | 12            | -    | 10            | -    | 10            | -    | ns   |  |
| f <sub>data</sub>                  | data rate         |                           |     | -                  | -   | -             | 85   | -             | 100  | -             | 100  | Mbps |  |
| V <sub>CC(A)</sub> = 3.3 V ± 0.3 V |                   |                           |     |                    |     |               |      |               |      |               |      |      |  |
| t <sub>pd</sub>                    | propagation delay | A to B                    |     | -                  | -   | -             | -    | 0.9           | 4.7  | 0.8           | 4.0  | ns   |  |
|                                    |                   | B to A                    |     | -                  | -   | -             | -    | 1.0           | 4.9  | 0.9           | 3.8  | ns   |  |
| t <sub>en</sub>                    | enable time       | OE to A, B                |     | -                  | -   | -             | -    | -             | 1.0  | -             | 1.0  | μs   |  |
| t <sub>dis</sub>                   | disable time      | OE to A; no external load | [2] | -                  | -   | -             | -    | 1.0           | 9.2  | 1.0           | 9.2  | ns   |  |
|                                    |                   | OE to B; no external load | [2] | -                  | -   | -             | -    | 1.0           | 10.1 | 1.0           | 9.6  | ns   |  |
|                                    |                   | OE to A                   |     | -                  | -   | -             | -    | -             | 260  | -             | 260  | ns   |  |
|                                    |                   | OE to B                   |     | -                  | -   | -             | -    | -             | 200  | -             | 200  | ns   |  |
| t <sub>t</sub>                     | transition time   | A port                    |     | -                  | -   | -             | -    | 0.7           | 2.5  | 0.7           | 2.5  | ns   |  |
|                                    |                   | B port                    |     | -                  | -   | -             | -    | 0.5           | 2.5  | 0.4           | 2.7  | ns   |  |
| t <sub>W</sub>                     | pulse width       | data inputs               |     | -                  | -   | -             | -    | 10            | -    | 10            | -    | ns   |  |
| f <sub>data</sub>                  | data rate         |                           |     | -                  | -   | -             | -    | -             | 100  | -             | 100  | Mbps |  |

[1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ . $t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ . $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ . $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .

[2] Delay between OE going LOW and when the outputs are actually disabled.

**Table 12. Dynamic characteristics for temperature range  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  [1]**Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 7](#); for wave forms see [Figure 5](#) and [Figure 6](#).

| Symbol                              | Parameter         | Conditions                |     | V <sub>CC(B)</sub> |      |               |      |               |      |               |      | Unit |
|-------------------------------------|-------------------|---------------------------|-----|--------------------|------|---------------|------|---------------|------|---------------|------|------|
|                                     |                   |                           |     | 1.8 V ± 0.15 V     |      | 2.5 V ± 0.2 V |      | 3.3 V ± 0.3 V |      | 5.0 V ± 0.5 V |      |      |
|                                     |                   |                           |     | Min                | Max  | Min           | Max  | Min           | Max  | Min           | Max  |      |
| V <sub>CC(A)</sub> = 1.5 V ± 0.1 V  |                   |                           |     |                    |      |               |      |               |      |               |      |      |
| t <sub>pd</sub>                     | propagation delay | A to B                    |     | 1.4                | 15.9 | 1.2           | 13.1 | 1.1           | 13.0 | 0.8           | 12.9 | ns   |
|                                     |                   | B to A                    |     | 0.9                | 17.2 | 0.7           | 15.0 | 0.4           | 14.7 | 0.3           | 16.7 | ns   |
| t <sub>en</sub>                     | enable time       | OE to A, B                |     | -                  | 1.0  | -             | 1.0  | -             | 1.0  | -             | 1.0  | μs   |
| t <sub>dis</sub>                    | disable time      | OE to A; no external load | [2] | 1.0                | 12.5 | 1.0           | 12.5 | 1.0           | 12.5 | 1.0           | 12.5 | ns   |
|                                     |                   | OE to B; no external load | [2] | 1.0                | 18.1 | 1.0           | 16.2 | 1.0           | 14.9 | 1.0           | 14.6 | ns   |
|                                     |                   | OE to A                   |     | -                  | 340  | -             | 280  | -             | 280  | -             | 300  | ns   |
|                                     |                   | OE to B                   |     | -                  | 220  | -             | 220  | -             | 220  | -             | 220  | ns   |
| t <sub>t</sub>                      | transition time   | A port                    |     | 0.9                | 7.1  | 0.9           | 7.1  | 0.9           | 7.1  | 0.9           | 7.1  | ns   |
|                                     |                   | B port                    |     | 0.9                | 6.5  | 0.6           | 5.2  | 0.5           | 4.8  | 0.4           | 4.7  | ns   |
| t <sub>W</sub>                      | pulse width       | data inputs               |     | 25                 | -    | 25            | -    | 25            | -    | 25            | -    | ns   |
| f <sub>data</sub>                   | data rate         |                           |     | -                  | 40   | -             | 40   | -             | 40   | -             | 40   | Mbps |
| V <sub>CC(A)</sub> = 1.8 V ± 0.15 V |                   |                           |     |                    |      |               |      |               |      |               |      |      |
| t <sub>pd</sub>                     | propagation delay | A to B                    |     | 1.6                | 14.0 | 1.4           | 10.7 | 1.3           | 9.8  | 1.2           | 9.5  | ns   |
|                                     |                   | B to A                    |     | 1.5                | 15.0 | 1.3           | 11.4 | 1.0           | 10.6 | 0.9           | 10.1 | ns   |
| t <sub>en</sub>                     | enable time       | OE to A, B                |     | -                  | 1.0  | -             | 1.0  | -             | 1.0  | -             | 1.0  | μs   |
| t <sub>dis</sub>                    | disable time      | OE to A; no external load | [2] | 1.0                | 11.5 | 1.0           | 11.5 | 1.0           | 11.5 | 1.0           | 11.5 | ns   |
|                                     |                   | OE to B; no external load | [2] | 1.0                | 16.5 | 1.0           | 14.5 | 1.0           | 13.3 | 1.0           | 12.7 | ns   |
|                                     |                   | OE to A                   |     | -                  | 280  | -             | 250  | -             | 250  | -             | 250  | ns   |
|                                     |                   | OE to B                   |     | -                  | 220  | -             | 220  | -             | 220  | -             | 220  | ns   |
| t <sub>t</sub>                      | transition time   | A port                    |     | 0.8                | 6.2  | 0.8           | 6.1  | 0.8           | 6.1  | 0.8           | 6.1  | ns   |
|                                     |                   | B port                    |     | 0.9                | 5.8  | 0.6           | 5.2  | 0.5           | 4.8  | 0.4           | 4.7  | ns   |
| t <sub>W</sub>                      | pulse width       | data inputs               |     | 22                 | -    | 19            | -    | 19            | -    | 19            | -    | ns   |
| f <sub>data</sub>                   | data rate         |                           |     | -                  | 45   | -             | 55   | -             | 55   | -             | 55   | Mbps |
| V <sub>CC(A)</sub> = 2.5 V ± 0.2 V  |                   |                           |     |                    |      |               |      |               |      |               |      |      |
| t <sub>pd</sub>                     | propagation delay | A to B                    |     | -                  | -    | 1.1           | 9.3  | 1.0           | 8.2  | 0.9           | 7.7  | ns   |
|                                     |                   | B to A                    |     | -                  | -    | 1.2           | 9.6  | 1.1           | 8.1  | 0.9           | 7.4  | ns   |
| t <sub>en</sub>                     | enable time       | OE to A, B                |     | -                  | -    | -             | 1.0  | -             | 1.0  | -             | 1.0  | μs   |
| t <sub>dis</sub>                    | disable time      | OE to A; no external load | [2] | -                  | -    | 1.0           | 9.6  | 1.0           | 9.6  | 1.0           | 9.6  | ns   |
|                                     |                   | OE to B; no external load | [2] | -                  | -    | 1.0           | 12.6 | 1.0           | 11.4 | 1.0           | 10.8 | ns   |
|                                     |                   | OE to A                   |     | -                  | -    | -             | 220  | -             | 220  | -             | 220  | ns   |
|                                     |                   | OE to B                   |     | -                  | -    | -             | 220  | -             | 220  | -             | 220  | ns   |
| t <sub>t</sub>                      | transition time   | A port                    |     | -                  | -    | 0.7           | 5.0  | 0.7           | 5.0  | 0.7           | 5.0  | ns   |
|                                     |                   | B port                    |     | -                  | -    | 0.7           | 4.6  | 0.5           | 4.8  | 0.4           | 4.7  | ns   |
| t <sub>W</sub>                      | pulse width       | data inputs;              |     | -                  | -    | 14            | -    | 13            | -    | 10            | -    | ns   |
| f <sub>data</sub>                   | data rate         |                           |     | -                  | -    | -             | 75   | -             | 80   | -             | 100  | Mbps |

**Table 12. Dynamic characteristics for temperature range  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$**  <sup>[1]</sup> ...continuedVoltages are referenced to GND (ground = 0 V); for test circuit see [Figure 7](#); for wave forms see [Figure 5](#) and [Figure 6](#).

| Symbol                             | Parameter         | Conditions                |     | V <sub>CC(B)</sub> |     |               |     |               |      |               |     | Unit |
|------------------------------------|-------------------|---------------------------|-----|--------------------|-----|---------------|-----|---------------|------|---------------|-----|------|
|                                    |                   |                           |     | 1.8 V ± 0.15 V     |     | 2.5 V ± 0.2 V |     | 3.3 V ± 0.3 V |      | 5.0 V ± 0.5 V |     |      |
|                                    |                   |                           |     | Min                | Max | Min           | Max | Min           | Max  | Min           | Max |      |
| V <sub>CC(A)</sub> = 3.3 V ± 0.3 V |                   |                           |     |                    |     |               |     |               |      |               |     |      |
| t <sub>pd</sub>                    | propagation delay | A to B                    |     | -                  | -   | -             | -   | 0.9           | 7.7  | 0.8           | 7.0 | ns   |
|                                    |                   | B to A                    |     | -                  | -   | -             | -   | 1.0           | 7.9  | 0.9           | 6.8 | ns   |
| t <sub>en</sub>                    | enable time       | OE to A, B                |     | -                  | -   | -             | -   | -             | 1.0  | -             | 1.0 | μs   |
| t <sub>dis</sub>                   | disable time      | OE to A; no external load | [2] | -                  | -   | -             | -   | 1.0           | 9.5  | 1.0           | 9.5 | ns   |
|                                    |                   | OE to B; no external load | [2] | -                  | -   | -             | -   | 1.0           | 10.7 | 1.0           | 9.6 | ns   |
|                                    |                   | OE to A                   |     | -                  | -   | -             | -   | -             | 280  | -             | 280 | ns   |
|                                    |                   | OE to B                   |     | -                  | -   | -             | -   | -             | 220  | -             | 220 | ns   |
| t <sub>t</sub>                     | transition time   | A port                    |     | -                  | -   | -             | -   | 0.7           | 4.5  | 0.7           | 4.5 | ns   |
|                                    |                   | B port                    |     | -                  | -   | -             | -   | 0.5           | 4.1  | 0.4           | 4.7 | ns   |
| t <sub>W</sub>                     | pulse width       | data inputs               |     | -                  | -   | -             | -   | 10            | -    | 10            | -   | ns   |
| f <sub>data</sub>                  | data rate         |                           |     | -                  | -   | -             | -   | -             | 100  | -             | 100 | Mbps |

[1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ . $t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ . $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ . $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .

[2] Delay between OE going LOW and when the outputs are actually disabled.

**Table 13. Typical power dissipation capacitance**Voltages are referenced to GND (ground = 0 V).<sup>[1][2]</sup>

| Symbol                   | Parameter                     | Conditions                               | V <sub>CC(A)</sub> |       |       |       |       |       |                |    | Unit |
|--------------------------|-------------------------------|------------------------------------------|--------------------|-------|-------|-------|-------|-------|----------------|----|------|
|                          |                               |                                          | 1.2 V              | 1.2 V | 1.5 V | 1.8 V | 2.5 V | 2.5 V | 3.3 V          |    |      |
|                          |                               |                                          | V <sub>CC(B)</sub> |       |       |       |       |       |                |    |      |
|                          |                               |                                          | 1.8 V              | 5.0 V | 1.8 V | 1.8 V | 2.5 V | 5.0 V | 3.3 V to 5.0 V |    |      |
| T <sub>amb</sub> = 25 °C |                               |                                          |                    |       |       |       |       |       |                |    |      |
| C <sub>PD</sub>          | power dissipation capacitance | outputs enabled; OE = V <sub>CC(A)</sub> |                    |       |       |       |       |       |                |    |      |
|                          |                               | A port: (direction A to B)               | 5                  | 5     | 5     | 5     | 5     | 5     | 5              | pF |      |
|                          |                               | A port: (direction B to A)               | 8                  | 8     | 8     | 8     | 8     | 8     | 8              | pF |      |
|                          |                               | B port: (direction A to B)               | 18                 | 18    | 18    | 18    | 18    | 18    | 18             | pF |      |
|                          |                               | B port: (direction B to A)               | 13                 | 16    | 12    | 12    | 12    | 12    | 13             | pF |      |
|                          |                               | outputs disabled; OE = GND               |                    |       |       |       |       |       |                |    |      |
|                          |                               | A port: (direction A to B)               | 0.12               | 0.12  | 0.04  | 0.05  | 0.08  | 0.08  | 0.07           | pF |      |
|                          |                               | A port: (direction B to A)               | 0.01               | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01           | pF |      |
|                          |                               | B port: (direction A to B)               | 0.01               | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01           | pF |      |
|                          |                               | B port: (direction B to A)               | 0.07               | 0.09  | 0.07  | 0.07  | 0.05  | 0.09  | 0.09           | pF |      |

[1] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

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

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

C<sub>L</sub> = load capacitance in pF;

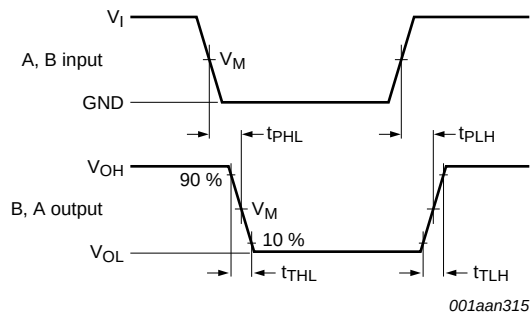
V<sub>CC</sub> = supply voltage in V;

N = number of inputs switching;

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

[2] f<sub>i</sub> = 10 MHz; V<sub>I</sub> = GND to V<sub>CC</sub>; t<sub>r</sub> = t<sub>f</sub> = 1 ns; C<sub>L</sub> = 0 pF; R<sub>L</sub> = ∞ Ω.

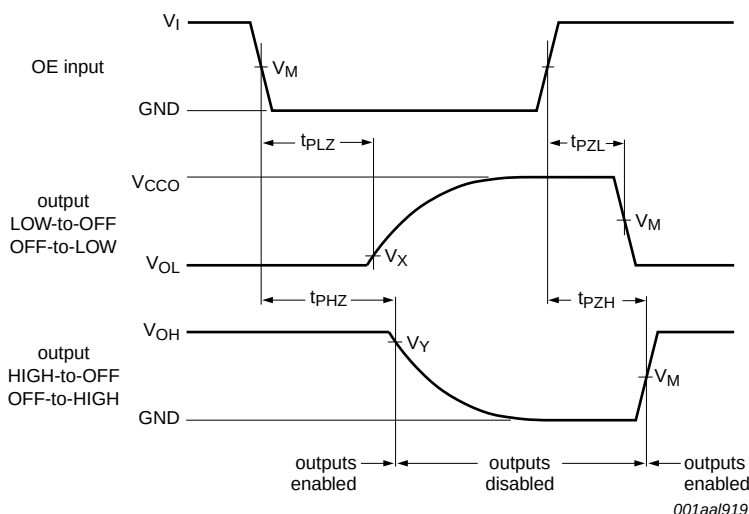
## 11. Waveforms



Measurement points are given in [Table 14](#).

V<sub>OL</sub> and V<sub>OH</sub> are typical output voltage levels that occur with the output load.

**Fig 5. Data input (A, B) to data output (B, A) propagation delay times**



Measurement points are given in [Table 14](#).

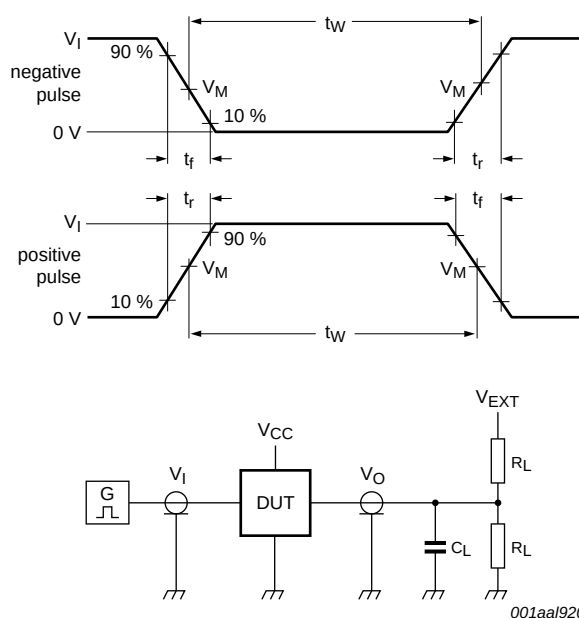
$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 6. Enable and disable times**

**Table 14. Measurement points<sup>[1]</sup>**

| Supply voltage                     | Input        | Output       |                           |                           |
|------------------------------------|--------------|--------------|---------------------------|---------------------------|
| $V_{CCO}$                          | $V_M$        | $V_M$        | $V_X$                     | $V_Y$                     |
| 1.2 V                              | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.1 \text{ V}$  | $V_{OH} - 0.1 \text{ V}$  |
| $1.5 \text{ V} \pm 0.1 \text{ V}$  | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.1 \text{ V}$  | $V_{OH} - 0.1 \text{ V}$  |
| $1.8 \text{ V} \pm 0.15 \text{ V}$ | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |
| $2.5 \text{ V} \pm 0.2 \text{ V}$  | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |
| $3.3 \text{ V} \pm 0.3 \text{ V}$  | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.3 \text{ V}$  | $V_{OH} - 0.3 \text{ V}$  |
| $5.0 \text{ V} \pm 0.5 \text{ V}$  | $0.5V_{CCI}$ | $0.5V_{CCO}$ | $V_{OL} + 0.3 \text{ V}$  | $V_{OH} - 0.3 \text{ V}$  |

[1]  $V_{CCI}$  is the supply voltage associated with the input and  $V_{CCO}$  is the supply voltage associated with the output.



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

All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ;  $Z_O = 50 \Omega$ ;  $dV/dt \geq 1.0 \text{ V/ns}$ .

$R_L$  = Load resistance.

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

$V_{EXT}$  = 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] | $\Delta t/\Delta V$     | $C_L$ | $R_L$ [2]                    | $t_{PLH}$ , $t_{PHL}$ | $t_{PZH}$ , $t_{PHZ}$ | $t_{PZL}$ , $t_{PLZ}$ [3] |
| 1.2 V to 3.6 V | 1.65 V to 5.5 V | $V_{CCI}$ | $\leq 1.0 \text{ ns/V}$ | 15 pF | 50 k $\Omega$ , 1 M $\Omega$ | open                  | open                  | $2V_{CCO}$                |

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

[2] For measuring data rate, pulse width, propagation delay and output rise and fall measurements,  $R_L = 1 \text{ M}\Omega$ ; for measuring enable and disable times,  $R_L = 50 \text{ k}\Omega$ .

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

## 12. Application information

### 12.1 Applications

Voltage level-translation applications. The NTB0101 can be used to interface between devices or systems operating at different supply voltages. See [Figure 8](#) for a typical operating circuit using the NTB0101.

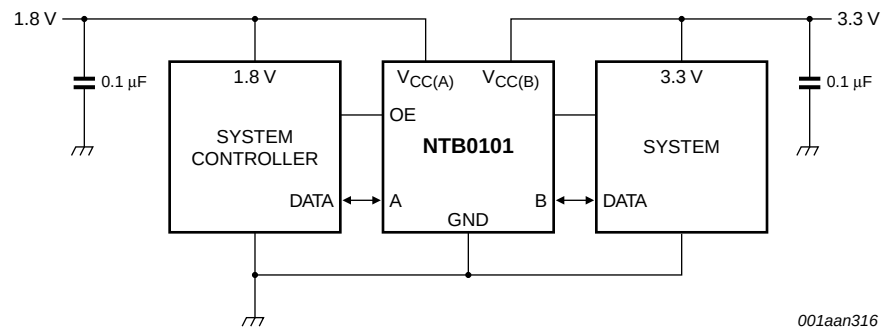


**Fig 8.** Typical operating circuit

## 12.2 Architecture

The architecture of the NTB0101 is shown in [Figure 9](#). The device does not require an extra input signal to control the direction of data flow from A to B or from B to A. In a static state, the output drivers of the NTB0101 can maintain a defined output level, but the output architecture is designed to be weak, so that they can be overdriven by an external driver when data on the bus starts flowing in the opposite direction. The output of one-shot circuits detect rising or falling edges on the A or B ports. During a rising edge, the one-shot circuits turn on the PMOS transistors (T1, T3) for a short duration, accelerating the LOW-to-HIGH transition. Similarly, during a falling edge, the one-shot circuits turn on the NMOS transistors (T2, T4) for a short duration, accelerating the HIGH-to-LOW transition. During output transitions the typical output impedance is 70  $\Omega$  at  $V_{CCO} = 1.2$  V to 1.8 V, 50  $\Omega$  at  $V_{CCO} = 1.8$  V to 3.3 V and 40  $\Omega$  at  $V_{CCO} = 3.3$  V to 5.0 V.

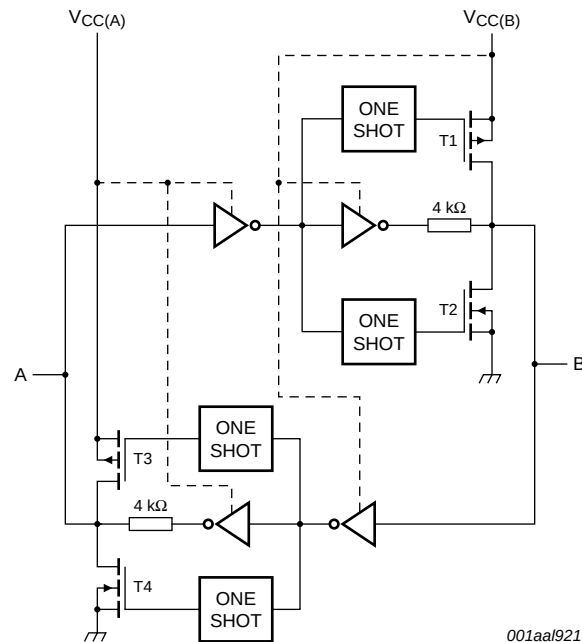
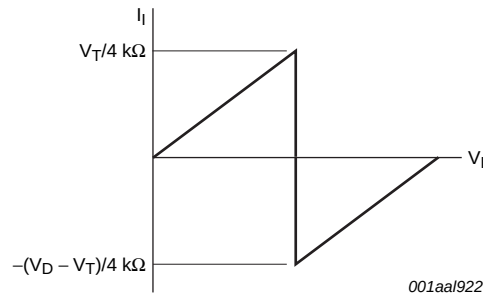


**Fig 9.** Architecture of NTB0101 I/O cell

### 12.3 Input driver requirements

For correct operation, the device driving the data I/Os of the NTB0101 must have a minimum drive capability of  $\pm 2$  mA. See [Figure 10](#) for a plot of typical input current versus input voltage.



$V_T$ : input threshold voltage of the NTB0101 (typically  $V_{CCI} / 2$ ).

$V_D$ : supply voltage of the external driver.

**Fig 10. Typical input current versus input voltage graph**

### 12.4 Power-up

During operation  $V_{CC(A)}$  must never be higher than  $V_{CC(B)}$ , however during power-up  $V_{CC(A)} \geq V_{CC(B)}$  does not damage the device, so either power supply can be ramped up first. There is no special power-up sequencing required. The NTB0101 includes circuitry that disables all output ports when either  $V_{CC(A)}$  or  $V_{CC(B)}$  is switched off.

### 12.5 Enable and disable

An output enable input (OE) is used to disable the device. Setting OE = LOW causes all I/Os to assume the high-impedance OFF-state. The disable time ( $t_{dis}$  with no external load) indicates the delay between when OE goes LOW and when outputs actually become disabled. The enable time ( $t_{en}$ ) indicates the amount of time the user must allow for one one-shot circuitry to become operational after OE is taken HIGH. To ensure the high-impedance OFF-state during power-up or power-down, pin OE should be tied to GND through a pull-down resistor, the minimum value of the resistor is determined by the current-sourcing capability of the driver.

### 12.6 Pull-up or pull-down resistors on I/O lines

As mentioned previously the NTB0101 is designed with low static drive strength to drive capacitive loads of up to 70 pF. To avoid output contention issues, any pull-up or pull-down resistors used must be above 50 kΩ. For this reason the NTB0101 is not recommended for use in open drain driver applications such as 1-Wire or I<sup>2</sup>C-bus. For these applications, the NTS0101 level translator is recommended.

### 13. Package outline

Plastic surface-mounted package; 6 leads

SOT363

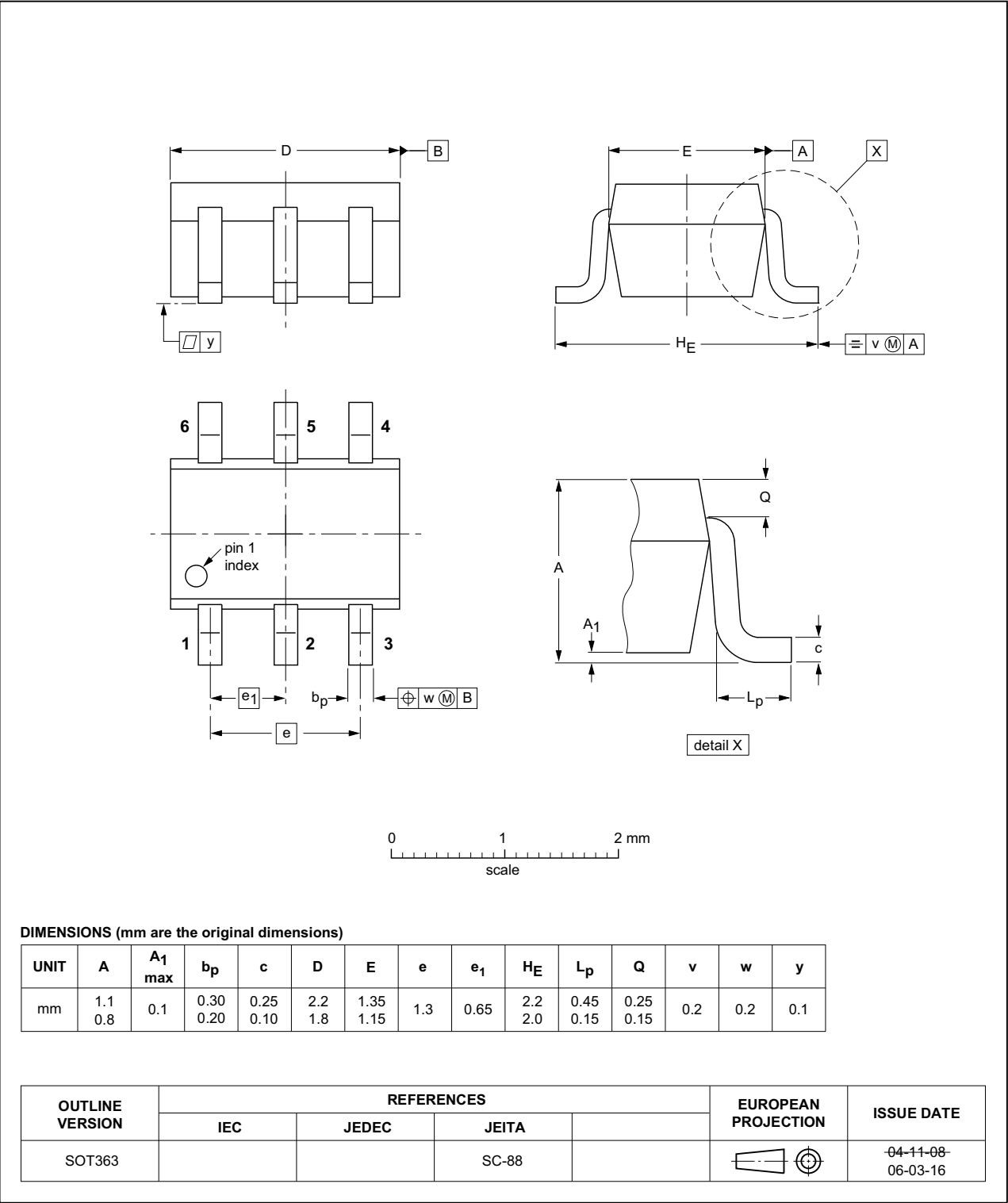


Fig 11. Package outline SOT363 (SC-88)

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

SOT886

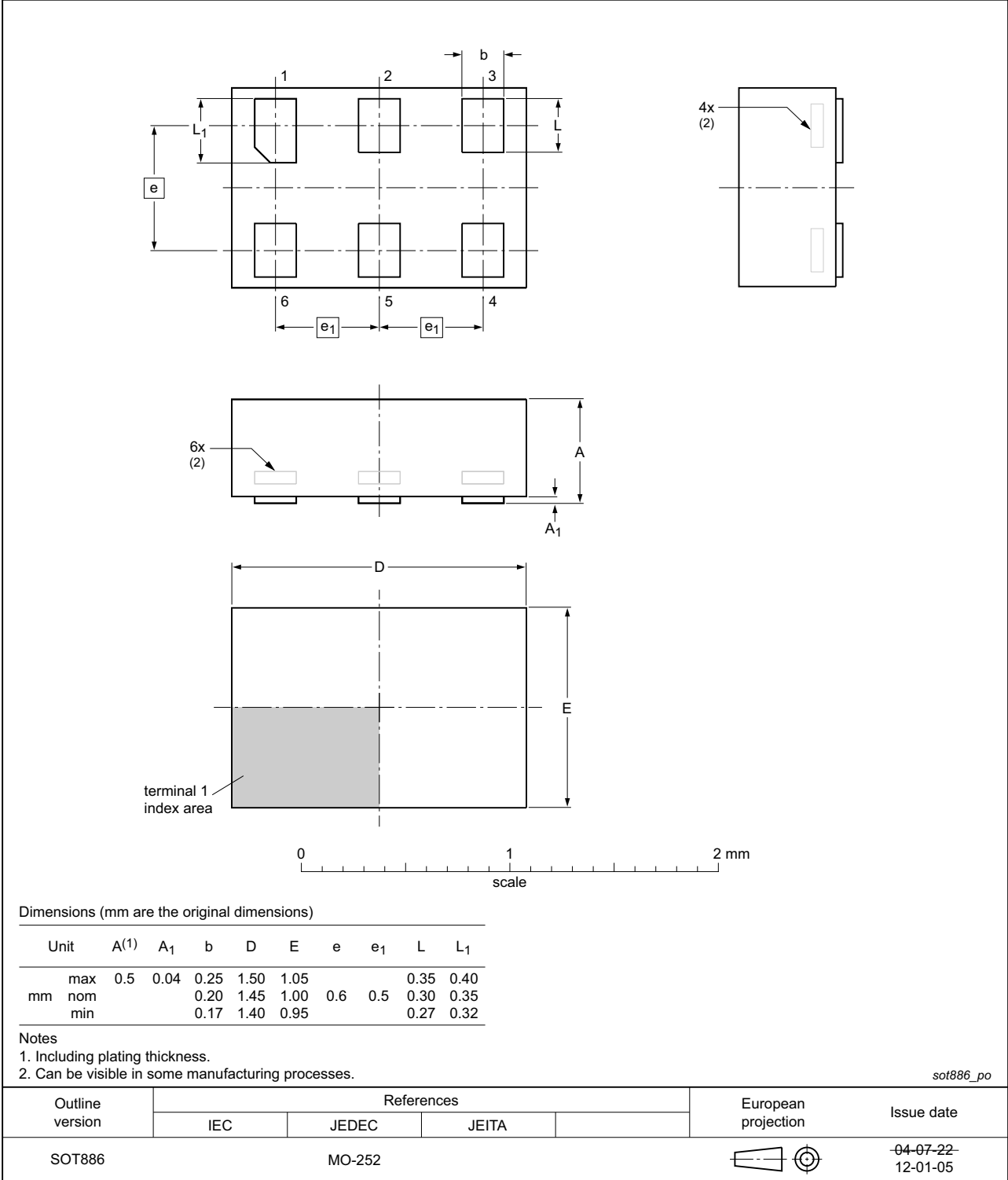


Fig 12. Package outline SOT886 (XSON6)

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

SOT891

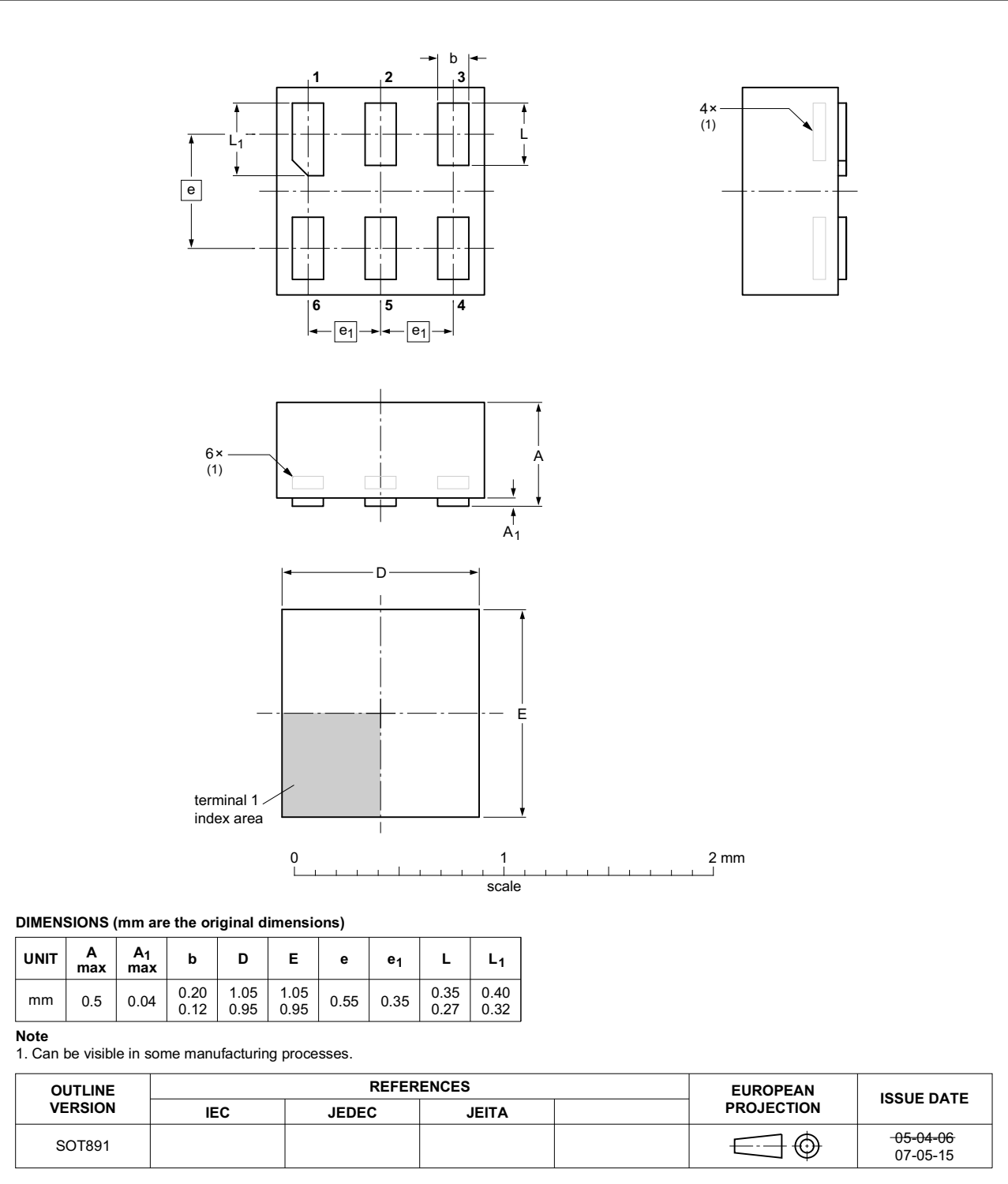


Fig 13. Package outline SOT891 (XSON6)

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

SOT1202

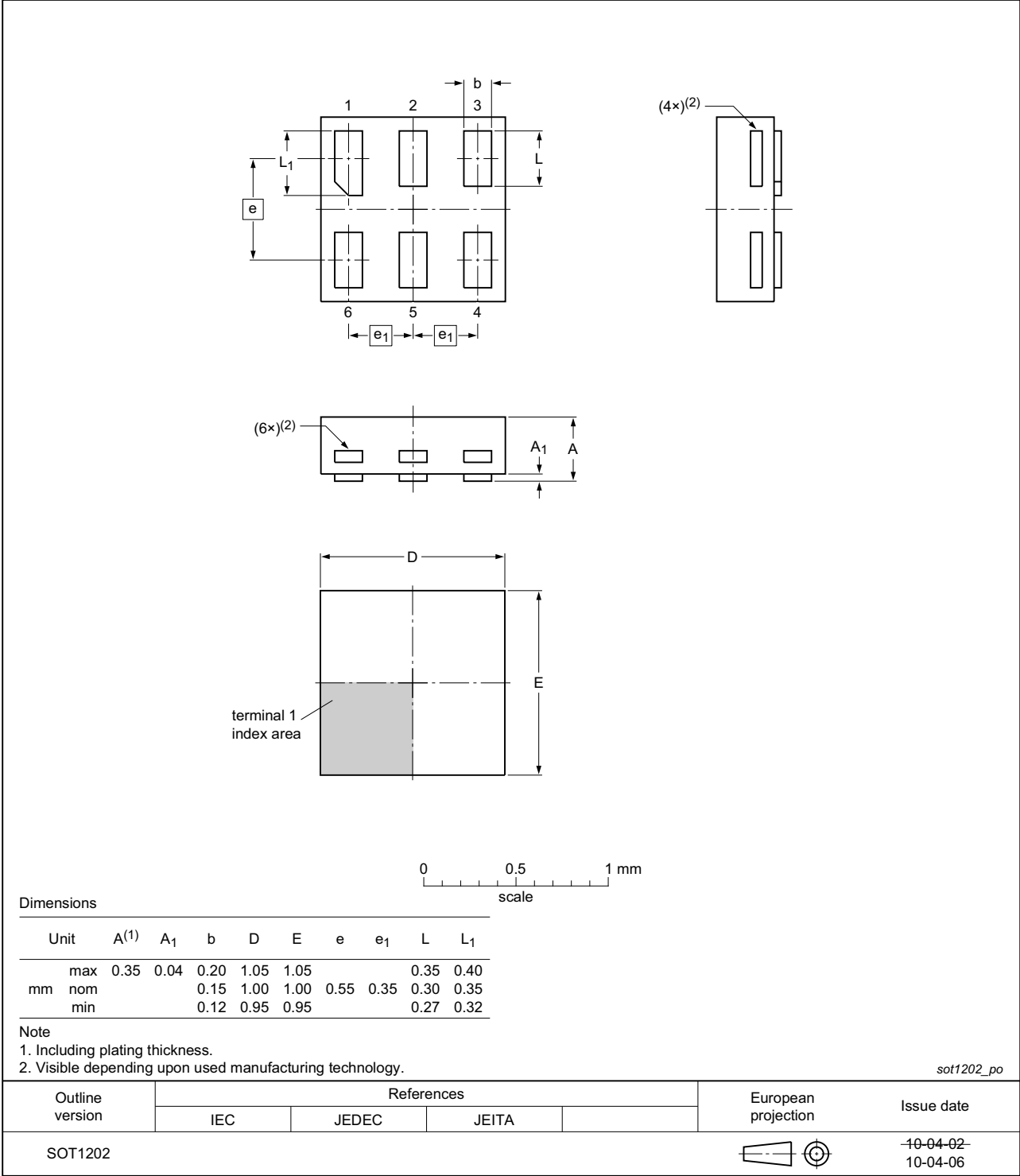
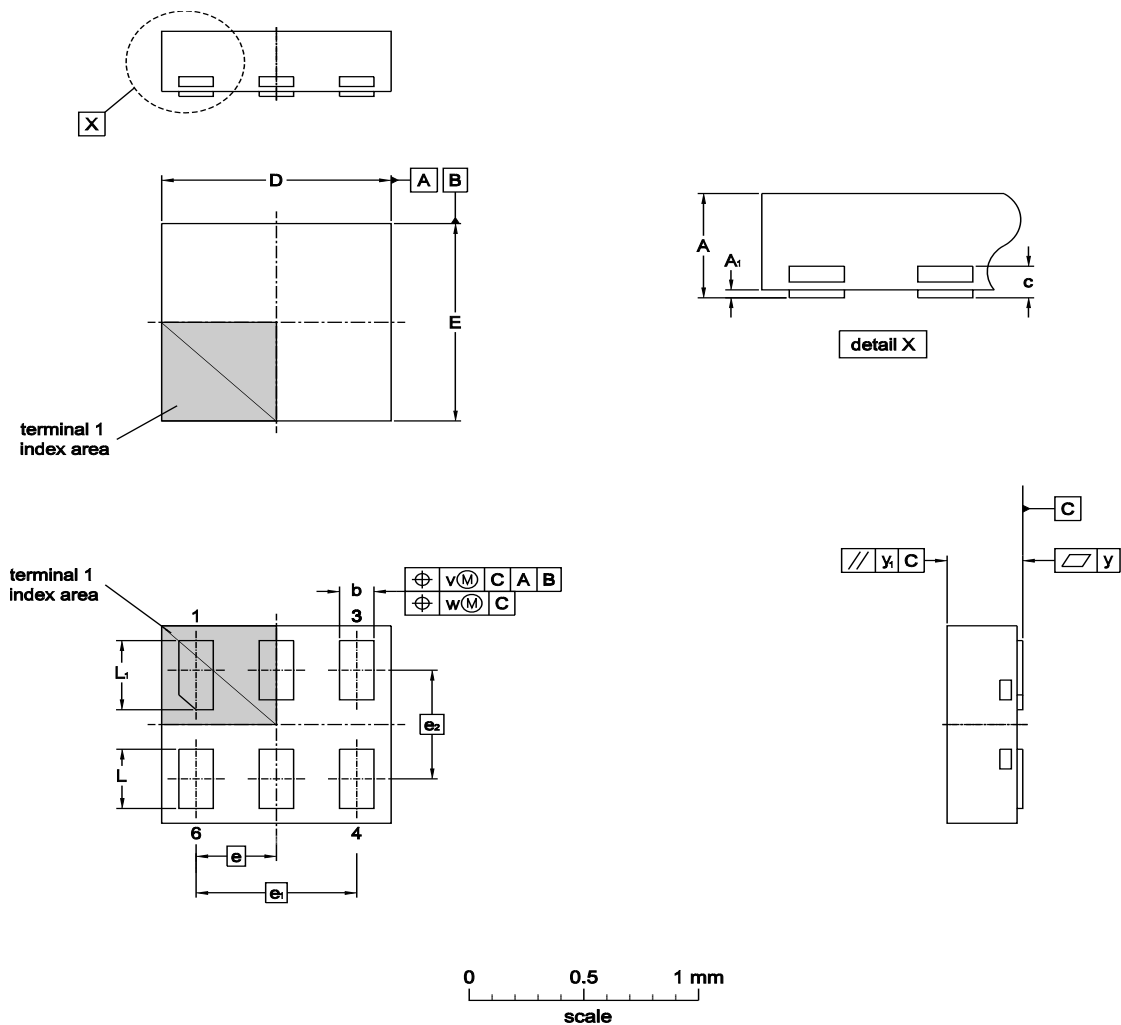


Fig 14. Package outline SOT1202 (XSON6)



Dimensions (mm are the original dimensions)

| UNIT | A    | A <sub>1</sub> | b    | c    | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | e <sub>1</sub> | e <sub>2</sub> | L    | L <sub>1</sub> | v   | w    | y    | y <sub>1</sub> |
|------|------|----------------|------|------|------------------|------------------|------|----------------|----------------|------|----------------|-----|------|------|----------------|
| MAX  | 0.33 | 0.05           | 0.20 |      | 1.05             | 1.05             |      |                |                | 0.35 | 0.40           |     |      |      |                |
| NOM  | 0.32 | 0.02           | 0.15 | 0.10 | 1.00             | 1.00             | 0.35 | 0.70           | 0.55           | 0.30 | 0.35           | 0.1 | 0.05 | 0.05 | 0.1            |
| MIN  | 0.30 | 0.00           | 0.10 |      | 0.95             | 0.95             |      |                |                | 0.25 | 0.30           |     |      |      |                |

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

| OUTLINE<br>VERSION | REFERENCES |       |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE  |
|--------------------|------------|-------|-------|--|------------------------|-------------|
|                    | IEC        | JEDEC | JEITA |  |                        |             |
| SOT1202-2          |            |       |       |  |                        | 08-MAR-2018 |

Fig 15. Package outline SOT1202-2 (X2SON6)

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

SOT1115

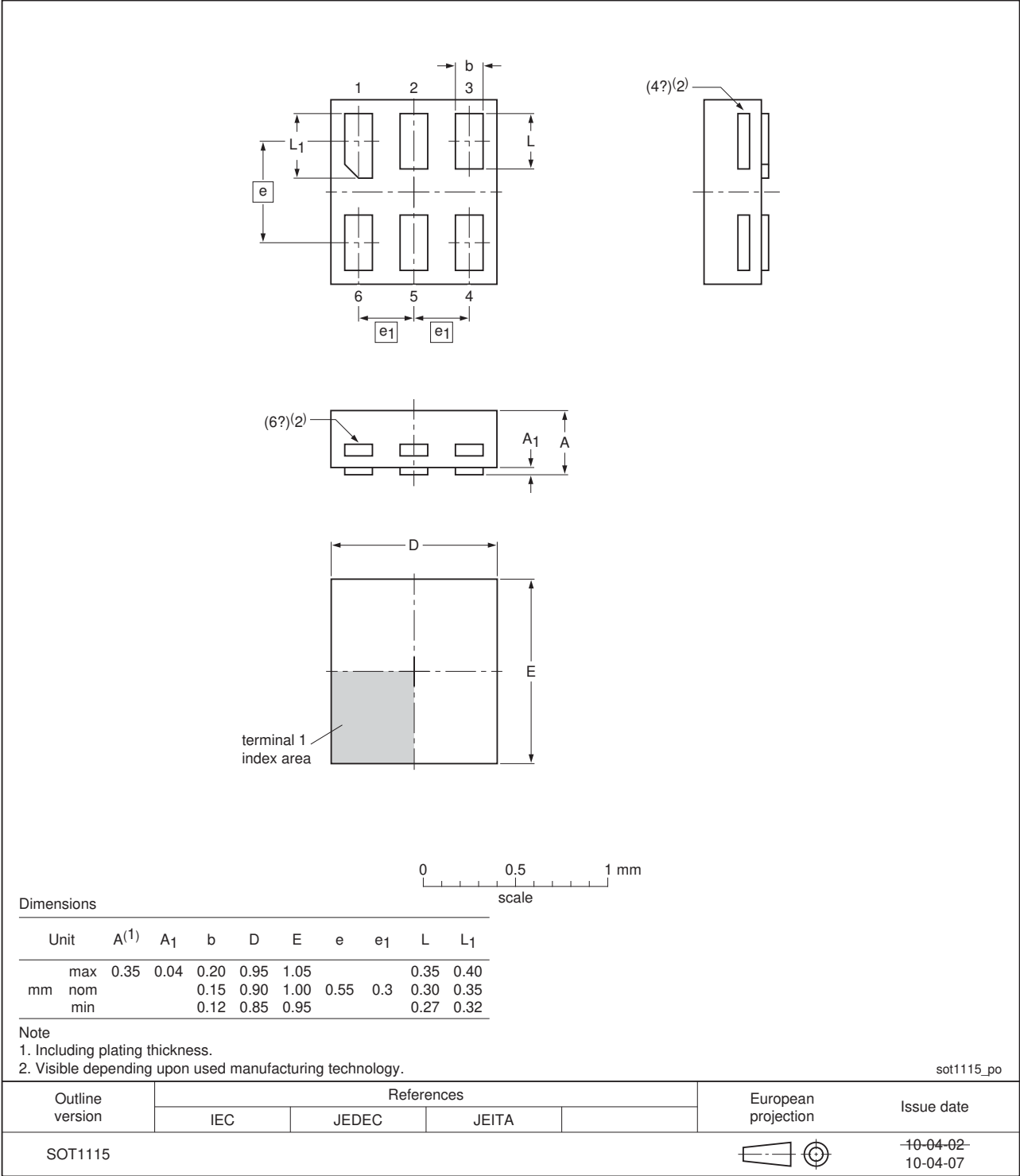


Fig 16. Package outline SOT1115 (XSON6)

## 14. Abbreviations

Table 16. Abbreviations

| Acronym | Description                      |
|---------|----------------------------------|
| CDM     | Charged Device Model             |
| DUT     | Device Under Test                |
| ESD     | ElectroStatic Discharge          |
| HBM     | Human Body Model                 |
| MM      | Machine Model                    |
| NMOS    | N-type Metal Oxide Semiconductor |
| PMOS    | P-type Metal Oxide Semiconductor |
| PRR     | Pulse Repetition Rate            |

## 15. Revision history

Table 17. Revision history

| Document ID    | Release date                                                                                                                                                                                                                                                                                                                     | Data sheet status  | Change notice | Supersedes  |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|-------------|
| NTB0101 v.7    | 20180409                                                                                                                                                                                                                                                                                                                         | Product data sheet |               | NTB0101 v.6 |
| Modifications: | <ul style="list-style-type: none"> <li>Corrected <a href="#">Figure 15 “Package outline SOT1202-2 (X2SON6)”</a></li> <li><a href="#">Table 2 “Ordering options”</a> <ul style="list-style-type: none"> <li>Updated orderable part number, packing method and minimum order quantity for NTB0101GS1</li> </ul> </li> </ul>        |                    |               |             |
| NTB0101 v.6    | 20180301                                                                                                                                                                                                                                                                                                                         | Product data sheet |               | NTB0101 v.5 |
| Modifications: | <ul style="list-style-type: none"> <li>Added NTB0101GN and NTB0101GS1</li> <li><a href="#">Section 3 “Ordering information”</a> <ul style="list-style-type: none"> <li>Updated table notes for <a href="#">Table 1 “Device information”</a></li> <li>Added <a href="#">Section 3.1 “Ordering options”</a></li> </ul> </li> </ul> |                    |               |             |
| NTB0101 v.5    | 20160224                                                                                                                                                                                                                                                                                                                         | Product data sheet |               | NTB0101 v.4 |
| Modifications: | <ul style="list-style-type: none"> <li>Deleted NTB0101GV</li> </ul>                                                                                                                                                                                                                                                              |                    |               |             |
| NTB0101 v.4    | 20120806                                                                                                                                                                                                                                                                                                                         | Product data sheet | -             | NTB0101 v.3 |
| Modifications: | <ul style="list-style-type: none"> <li>Package outline drawing of SOT886 (<a href="#">Figure 12</a>) modified.</li> </ul>                                                                                                                                                                                                        |                    |               |             |
| NTB0101 v.3    | 20111110                                                                                                                                                                                                                                                                                                                         | Product data sheet | -             | NTB0101 v.2 |
| Modifications: | <ul style="list-style-type: none"> <li>Legal pages updated.</li> </ul>                                                                                                                                                                                                                                                           |                    |               |             |
| NTB0101 v.2    | 20110505                                                                                                                                                                                                                                                                                                                         | Product data sheet | -             | NTB0101 v.1 |
| NTB0101 v.1    | 20101230                                                                                                                                                                                                                                                                                                                         | Product data sheet | -             | -           |

## 16. Legal information

### 16.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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