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Kind regards,

Team Nexperia

# XC7WT14

## Triple inverting Schmitt trigger

Rev. 3 — 23 January 2013

Product data sheet

## 1. General description

The XC7WT14 is a high-speed Si-gate CMOS device. This device provides three inverting buffers with Schmitt trigger action. This device is capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

## 2. Features and benefits

- Symmetrical output impedance
- High noise immunity
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
  - ◆ CDM JESD22-C101D exceeds 1000 V
- Low power dissipation
- Balanced propagation delays
- 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. Applications

- Wave and pulse shaper for highly noisy environment
- Astable multivibrator
- Monostable multivibrator

## 4. Ordering information

Table 1. Ordering information

| Type number | Package                                                         |        |                                                                                                                |          |
|-------------|-----------------------------------------------------------------|--------|----------------------------------------------------------------------------------------------------------------|----------|
|             | Temperature range                                               | Name   | Description                                                                                                    | Version  |
| XC7WT14DP   | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | TSSOP8 | plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm                        | SOT505-2 |
| XC7WT14DC   | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | VSSOP8 | plastic very thin shrink small outline package; 8 leads; body width 2.3 mm                                     | SOT765-1 |
| XC7WT14GT   | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | XSON8  | plastic extremely thin small outline package; no leads; 8 terminals; body $1 \times 1.95 \times 0.5\text{ mm}$ | SOT833-1 |
| XC7WT14GD   | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | XSON8  | plastic extremely thin small outline package; no leads; 8 terminals; body $3 \times 2 \times 0.5\text{ mm}$    | SOT996-2 |



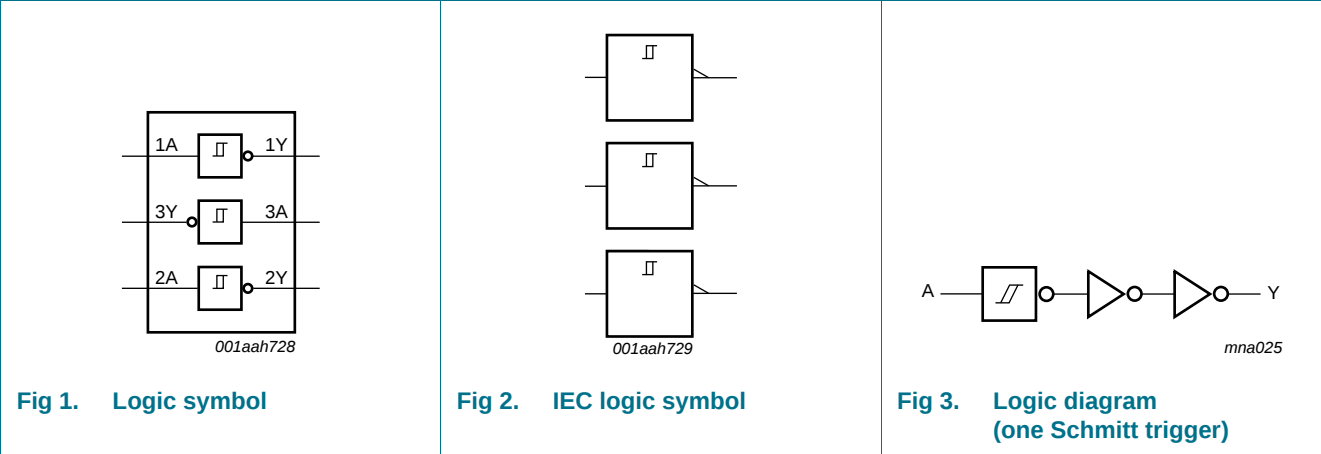
## 5. Marking

Table 2. Marking codes

| Type number | Marking code <sup>[1]</sup> |
|-------------|-----------------------------|
| XC7WT14DP   | g14                         |
| XC7WT14DC   | g14                         |
| XC7WT14GT   | g14                         |
| XC7WT14GD   | g14                         |

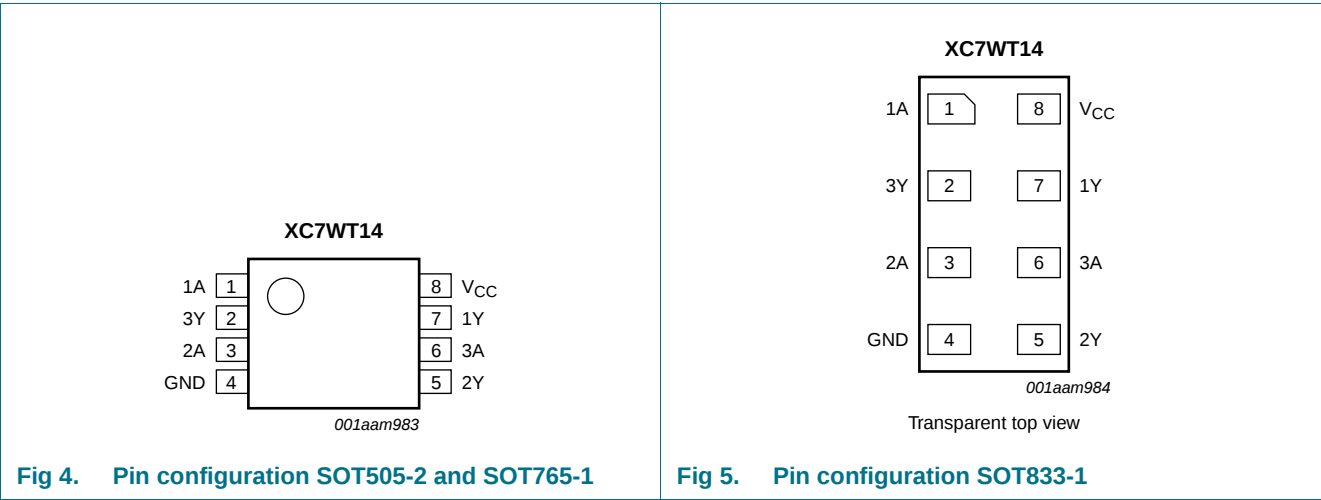
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

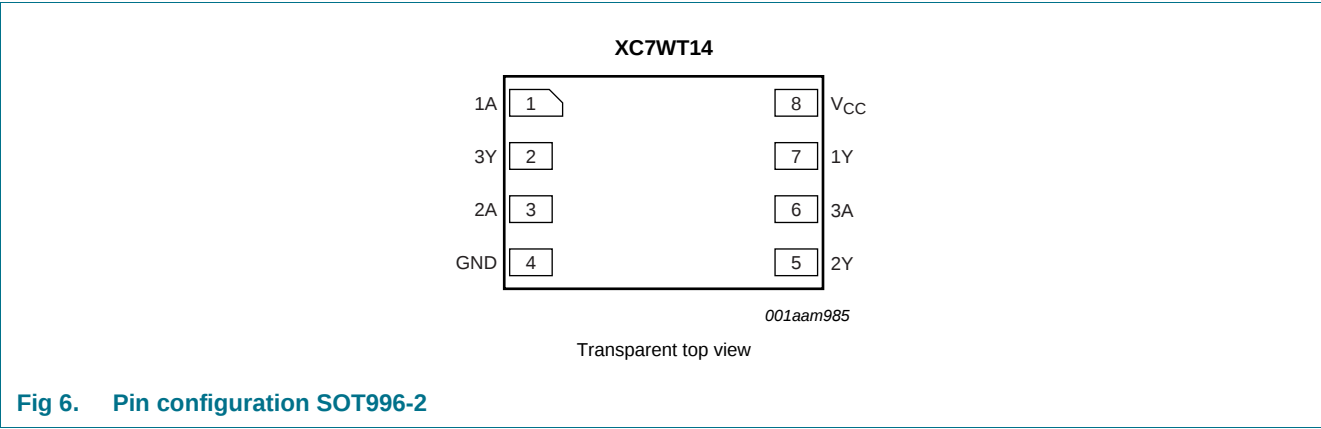
## 6. Functional diagram



## 7. Pinning information

### 7.1 Pinning





7.2 Pin description

Table 3. Pin description

| Symbol          | Pin     | Description    |
|-----------------|---------|----------------|
| 1A, 2A, 3A      | 1, 3, 6 | data input     |
| GND             | 4       | ground (0 V)   |
| 1Y, 2Y, 3Y      | 7, 5, 2 | data output    |
| V <sub>CC</sub> | 8       | supply voltage |

8. Functional description

Table 4. Function table [\[1\]](#)

| Input nA | Output nY |
|----------|-----------|
| L        | H         |
| H        | L         |

[1] H = HIGH voltage level; L = LOW voltage level

## 9. Limiting values

**Table 5. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol    | Parameter               | Conditions                               | Min   | Max  | Unit |
|-----------|-------------------------|------------------------------------------|-------|------|------|
| $V_{CC}$  | supply voltage          |                                          | -0.5  | +7.0 | V    |
| $V_I$     | input voltage           |                                          | -0.5  | +7.0 | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5$ V                           | -20   | -    | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V | [1] - | ±20  | mA   |
| $I_O$     | output current          | $-0.5$ V < $V_O$ < $V_{CC} + 0.5$ V      | -     | ±25  | mA   |
| $I_{CC}$  | supply current          |                                          | -     | 75   | mA   |
| $I_{GND}$ | ground current          |                                          | -75   | -    | mA   |
| $T_{stg}$ | storage temperature     |                                          | -65   | +150 | °C   |
| $P_{tot}$ | total power dissipation | $T_{amb} = -40$ °C to +125 °C            | [2] - | 250  | mW   |

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

[2] For TSSOP8 package: above 55 °C the value of  $P_{tot}$  derates linearly at 2.5 mW/K.

For VSSOP8 package: above 110 °C the value of  $P_{tot}$  derates linearly at 8 mW/K.

For XSON8 packages: above 118 °C the value of  $P_{tot}$  derates linearly with 7.8 mW/K.

## 10. Recommended operating conditions

**Table 6. Recommended operating conditions**

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

| Symbol    | Parameter           | Conditions | Min | Typ | Max      | Unit |
|-----------|---------------------|------------|-----|-----|----------|------|
| $V_{CC}$  | supply voltage      |            | 4.5 | 5.0 | 5.5      | V    |
| $V_I$     | input voltage       |            | 0   | -   | 5.5      | V    |
| $V_O$     | output voltage      |            | 0   | -   | $V_{CC}$ | V    |
| $T_{amb}$ | ambient temperature |            | -40 | +25 | +125     | °C   |

## 11. Static characteristics

**Table 7. Static characteristics**

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

| Symbol           | Parameter                 | Conditions                                                                                                                         | 25 °C |     |      | –40 °C to +85 °C |      | –40 °C to +125 °C |      | Unit |
|------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------|-------|-----|------|------------------|------|-------------------|------|------|
|                  |                           |                                                                                                                                    | Min   | Typ | Max  | Min              | Max  | Min               | Max  |      |
| V <sub>OH</sub>  | HIGH-level output voltage | V <sub>I</sub> = V <sub>T+</sub> or V <sub>T–</sub> ; V <sub>CC</sub> = 4.5 V                                                      |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = –50 µA                                                                                                            | 4.4   | 4.5 | -    | 4.4              | -    | 4.4               | -    | V    |
|                  |                           | I <sub>O</sub> = –8.0 mA                                                                                                           | 3.94  | -   | -    | 3.8              | -    | 3.70              | -    | V    |
| V <sub>OL</sub>  | LOW-level output voltage  | V <sub>I</sub> = V <sub>T+</sub> or V <sub>T–</sub> ; V <sub>CC</sub> = 4.5 V                                                      |       |     |      |                  |      |                   |      |      |
|                  |                           | I <sub>O</sub> = 50 µA                                                                                                             | -     | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                  |                           | I <sub>O</sub> = 8.0 mA                                                                                                            | -     | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = 5.5 V or GND;<br>V <sub>CC</sub> = 0 V to 5.5 V                                                                   | -     | -   | 0.1  | -                | 1.0  | -                 | 2.0  | µA   |
| I <sub>CC</sub>  | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 5.5 V                                          | -     | -   | 1.0  | -                | 10   | -                 | 40   | µA   |
| ΔI <sub>CC</sub> | additional supply current | per input pin; V <sub>I</sub> = 3.4 V;<br>other inputs at V <sub>CC</sub> or GND;<br>I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V | -     | -   | 1.35 | -                | 1.5  | -                 | 1.5  | mA   |
| C <sub>I</sub>   | input capacitance         |                                                                                                                                    | -     | 1.5 | 10   | -                | 10   | -                 | 10   | pF   |

## 11.1 Transfer characteristics

**Table 8. Transfer characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V). See [Figure 9](#) and [Figure 10](#).

| Symbol          | Parameter                        | Conditions              | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|-----------------|----------------------------------|-------------------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|                 |                                  |                         | Min   | Typ | Max | Min              | Max | Min               | Max |      |
| V <sub>T+</sub> | positive-going threshold voltage | V <sub>CC</sub> = 4.5 V | -     | -   | 2.0 | -                | 2.0 | -                 | 2.0 | V    |
|                 |                                  | V <sub>CC</sub> = 5.5 V | -     | -   | 2.0 | -                | 2.0 | -                 | 2.0 | V    |
| V <sub>T–</sub> | negative-going threshold voltage | V <sub>CC</sub> = 4.5 V | 0.5   | -   | -   | 0.5              | -   | 0.5               | -   | V    |
|                 |                                  | V <sub>CC</sub> = 5.5 V | 0.6   | -   | -   | 0.6              | -   | 0.6               | -   | V    |
| V <sub>H</sub>  | hysteresis voltage               | V <sub>CC</sub> = 4.5 V | 0.4   | -   | 1.4 | 0.4              | 1.4 | 0.35              | 1.4 | V    |
|                 |                                  | V <sub>CC</sub> = 5.5 V | 0.4   | -   | 1.6 | 0.4              | 1.6 | 0.35              | 1.6 | V    |

## 12. Dynamic characteristics

**Table 9. Dynamic characteristics**

GND = 0 V; for test circuit see [Figure 8](#).

| Symbol          | Parameter                     | Conditions                                                                 | 25 °C |     |     | –40 °C to +85 °C |      | –40 °C to +125 °C |      | Unit |
|-----------------|-------------------------------|----------------------------------------------------------------------------|-------|-----|-----|------------------|------|-------------------|------|------|
|                 |                               |                                                                            | Min   | Typ | Max | Min              | Max  | Min               | Max  |      |
| t <sub>pd</sub> | propagation delay             | nA to nY; <a href="#">Figure 7</a> <a href="#">[1]</a> <a href="#">[2]</a> |       |     |     |                  |      |                   |      |      |
|                 |                               | C <sub>L</sub> = 15 pF                                                     | -     | 4.1 | 7.0 | 1.0              | 8.0  | 1.0               | 9.0  | ns   |
|                 |                               | C <sub>L</sub> = 50 pF                                                     | -     | 5.9 | 8.5 | 1.0              | 10.0 | 1.0               | 11.0 | ns   |
| C <sub>PD</sub> | power dissipation capacitance | per buffer; <a href="#">[3]</a><br>V <sub>I</sub> = GND to V <sub>CC</sub> | -     | 12  | -   | -                | -    | -                 | -    | pF   |

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

[2] Typical values are measured at V<sub>CC</sub> = 5.0 V.

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

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

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

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

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

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

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

13. Waveforms

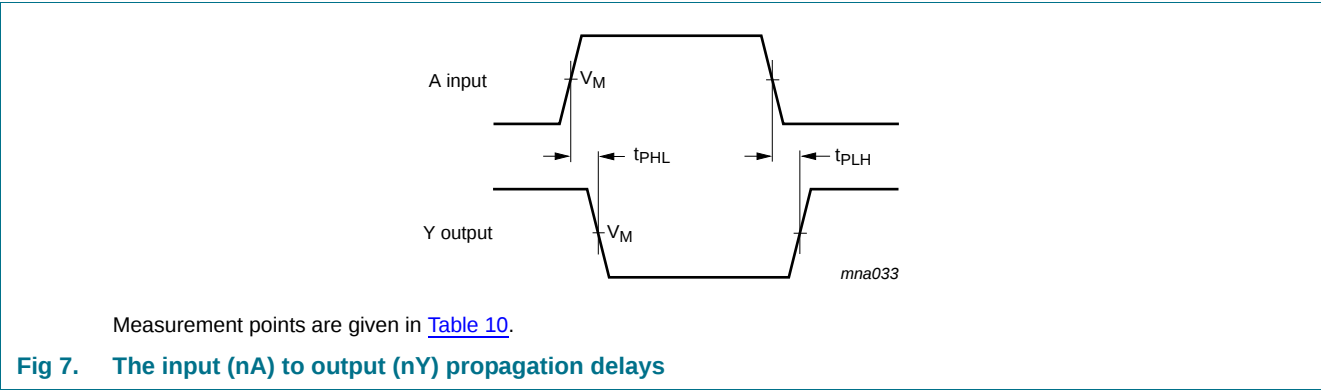


Table 10. Measurement points

| Type number | Input        |       | Output              |
|-------------|--------------|-------|---------------------|
|             | $V_I$        | $V_M$ | $V_M$               |
| XC7WT14     | GND to 3.0 V | 1.5 V | $0.5 \times V_{CC}$ |

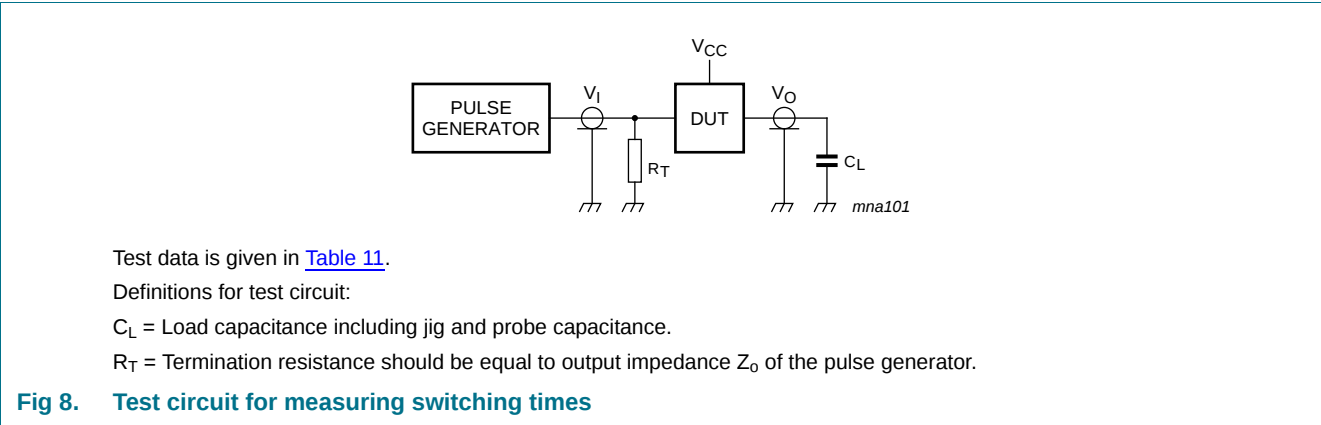
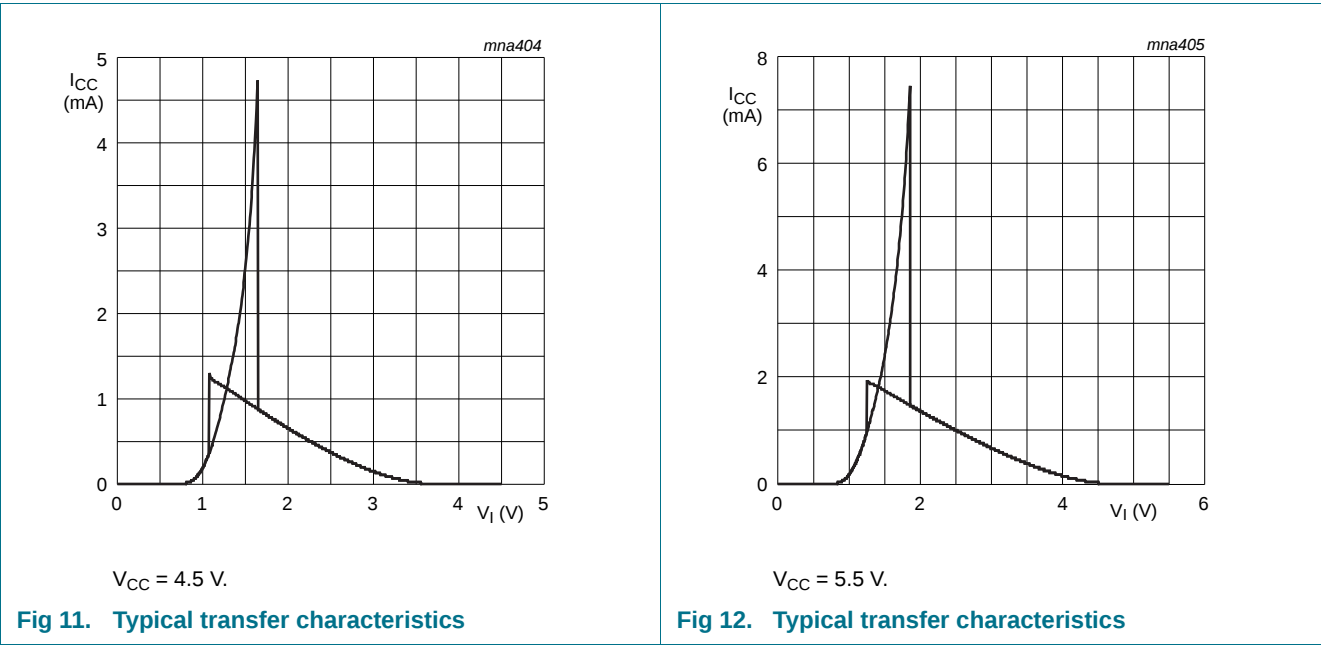
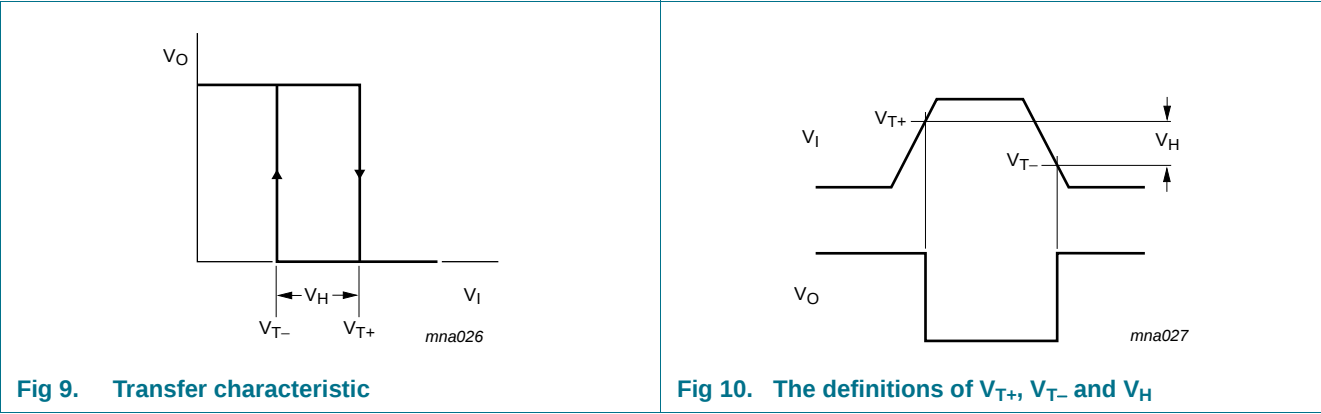


Table 11. Test data

| Type    | Input |               | Load         | Test               |
|---------|-------|---------------|--------------|--------------------|
|         | $V_I$ | $t_r, t_f$    | $C_L$        |                    |
| XC7WT14 | 3.0 V | $\leq 3.0$ ns | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |

13.1 Transfer characteristic waveforms



## 14. Application information

The slow input rise and fall times cause additional power dissipation, which can be calculated using the following formula:

$$P_{\text{add}} = f_i \times (t_r \times \Delta I_{\text{CC(AV)}} + t_f \times \Delta I_{\text{CC(AV)}}) \times V_{\text{CC}} \text{ where:}$$

$P_{\text{add}}$  = additional power dissipation ( $\mu\text{W}$ );

$f_i$  = input frequency (MHz);

$t_r$  = input rise time (ns); 10 % to 90 %;

$t_f$  = input fall time (ns); 90 % to 10 %;

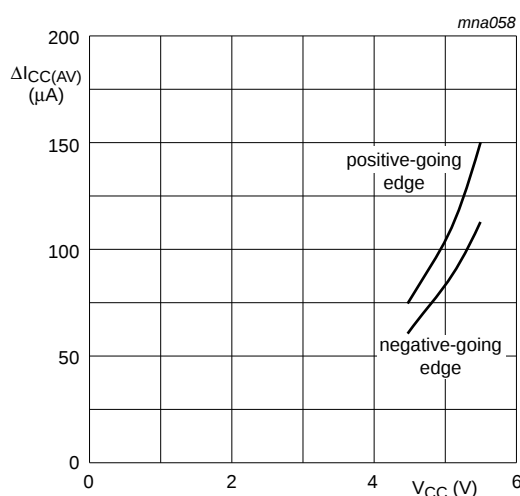
$\Delta I_{\text{CC(AV)}}$  = average additional supply current ( $\mu\text{A}$ ).

$\Delta I_{\text{CC(AV)}}$  differs with positive or negative input transitions, as shown in [Figure 13](#).

For XC7WT14 used in relaxation oscillator circuit, see [Figure 14](#).

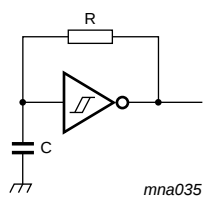
### Note to the application information:

1. All values given are typical unless otherwise specified.



Linear change of  $V_I$  between  $0.1V_{\text{CC}}$  to  $0.9V_{\text{CC}}$

**Fig 13. Average additional  $I_{\text{CC}}$**



$$f = \frac{1}{T} \approx \frac{1}{0.60 \times RC}$$

Fig 14. Relaxation oscillator using the XC7WT14

15. Package outline

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

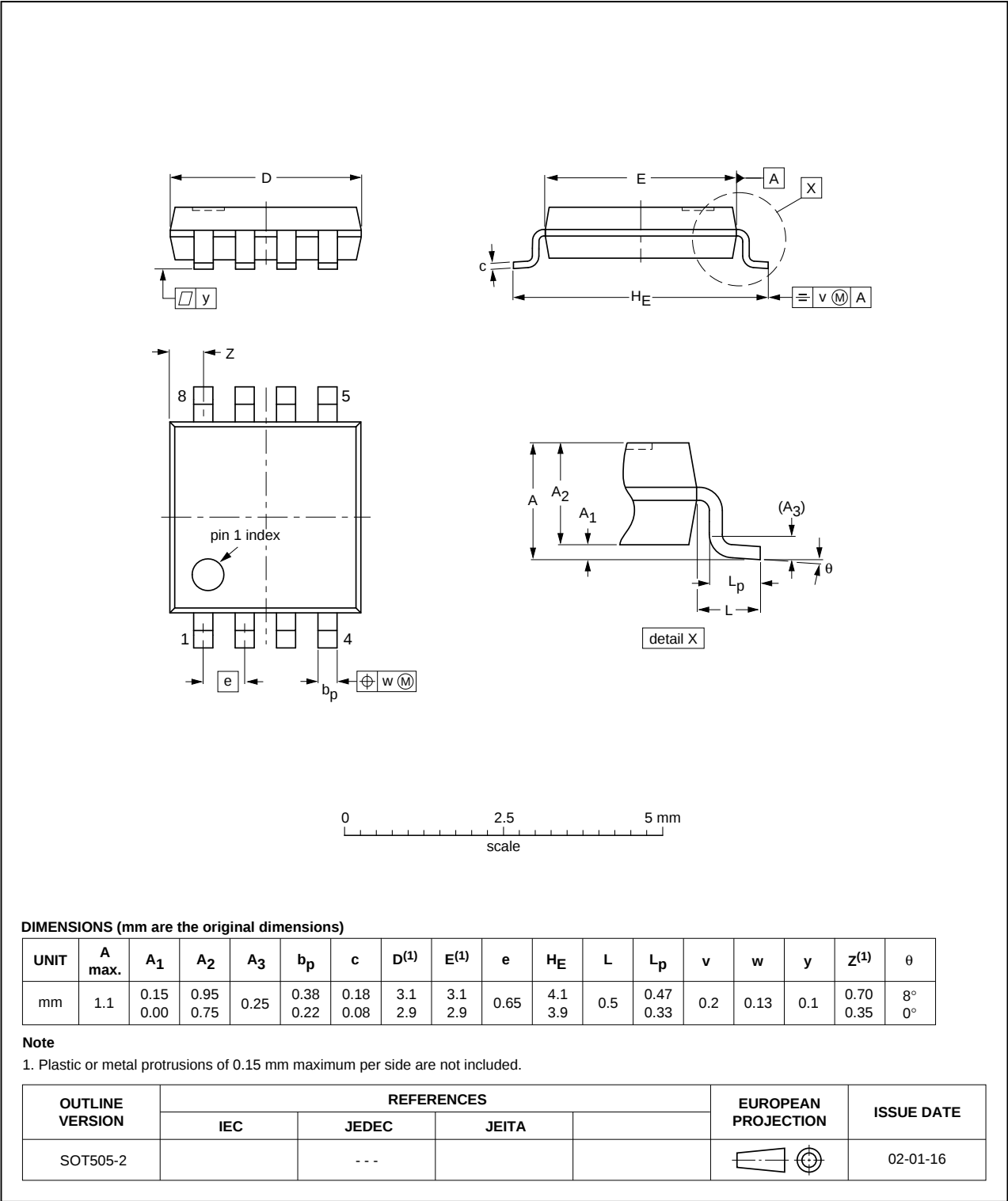


Fig 15. Package outline SOT505-2 (TSSOP8)

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

SOT765-1

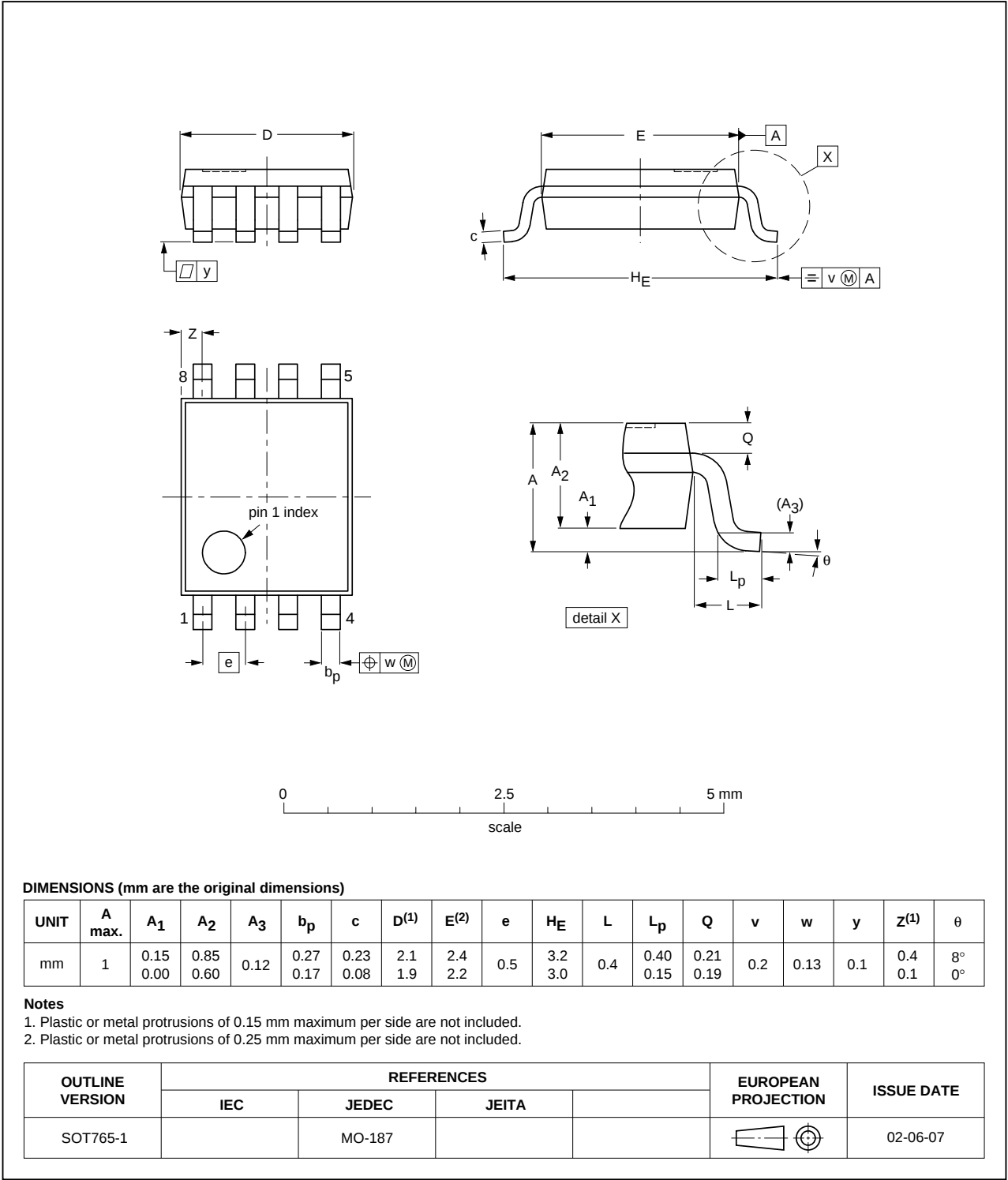


Fig 16. Package outline SOT765-1 (VSSOP8)

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

SOT833-1

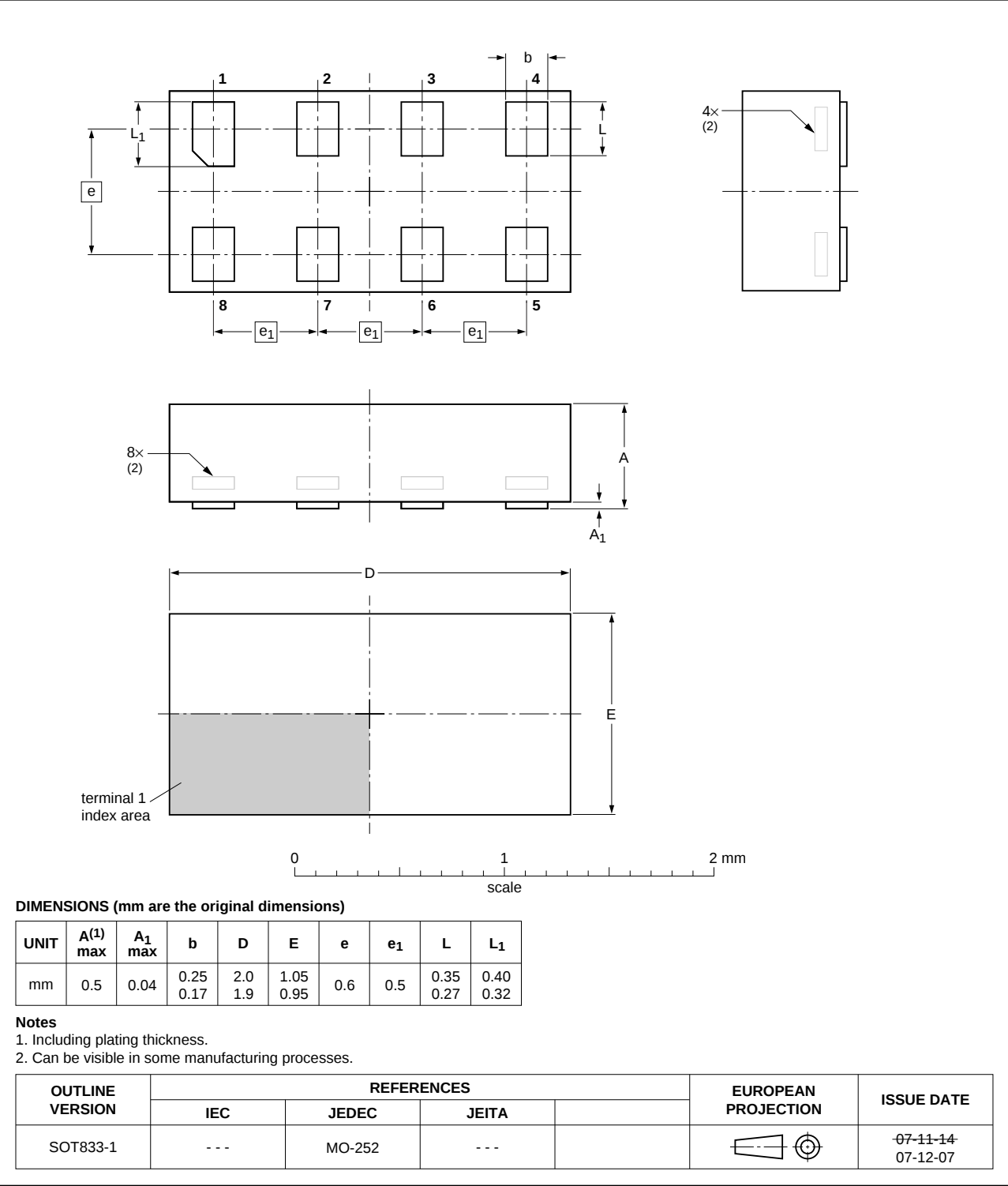


Fig 17. Package outline SOT833-1 (XSON8)

XSON8: plastic extremely thin small outline package; no leads;  
8 terminals; body 3 x 2 x 0.5 mm

SOT996-2

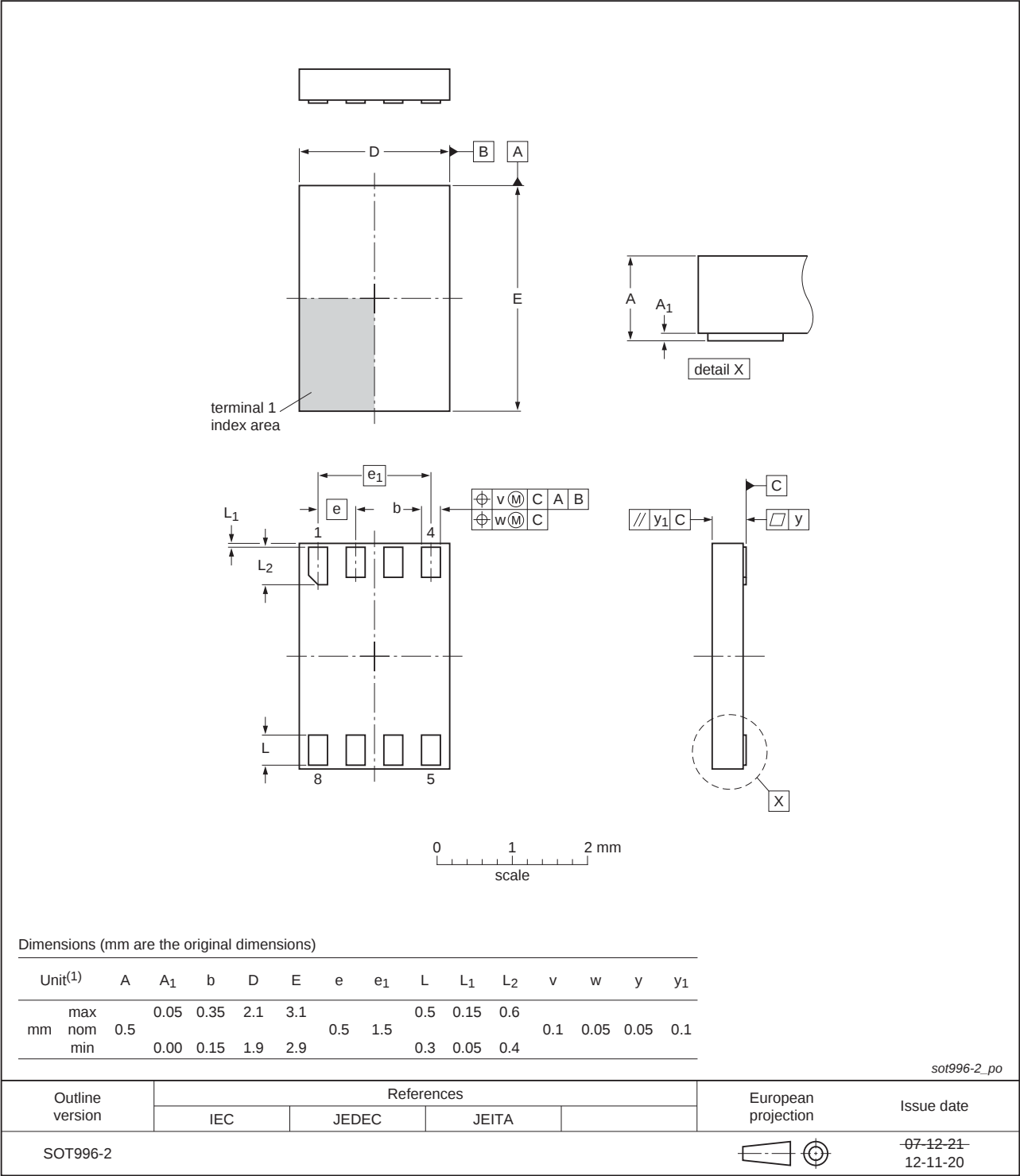


Fig 18. Package outline SOT996-2 (XSON8)

## 16. Abbreviations

Table 12. Abbreviations

| Acronym | Description                             |
|---------|-----------------------------------------|
| CMOS    | Complementary Metal-Oxide Semiconductor |
| DUT     | Device Under Test                       |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| MM      | Machine Model                           |

## 17. Revision history

Table 13. Revision history

| Document ID    | Release date                                             | Data sheet status  | Change notice | Supersedes  |
|----------------|----------------------------------------------------------|--------------------|---------------|-------------|
| XC7WT14 v.3    | 20130123                                                 | Product data sheet | -             | XC7WT14 v.2 |
| Modifications: | • For type number XC7WT14GD XSON8U has changed to XSON8. |                    |               |             |
| XC7WT14 v.2    | 20111103                                                 | Product data sheet | -             | XC7WT14 v.1 |
| XC7WT14 v.1    | 20110119                                                 | Product data sheet | -             | -           |

## 18. Legal information

### 18.1 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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