# 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 °C to +85 °C and –40 °C to +125 °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 °C to +125 °C | TSSOP8 | plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm | SOT505-2 |
| XC7WT14DC | –40 °C to +125 °C | VSSOP8 | plastic very thin shrink small outline package; 8 leads; body width 2.3 mm | SOT765-1 |
| XC7WT14GT | –40 °C to +125 °C | XSON8 | plastic extremely thin small outline package; no leads; 8 terminals; body 1 × 1.95 × 0.5 mm | SOT833-1 |
| XC7WT14GD | –40 °C to +125 °C | XSON8 | plastic extremely thin small outline package; no leads; 8 terminals; body 3 × 2 × 0.5 mm | SOT996-2 |

## 5. Marking

**Table 2. Marking codes**

| Type number | Marking code[1] |
|---|---|
| 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

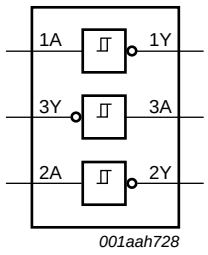



**Fig 1. Logic symbol**

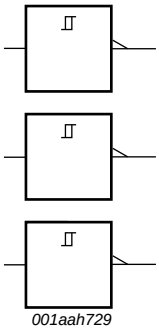



**Fig 2. IEC logic symbol**

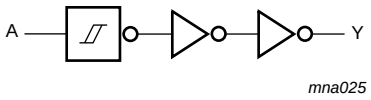



**Fig 3. Logic diagram (one Schmitt trigger)**

## 7. Pinning information

### 7.1 Pinning

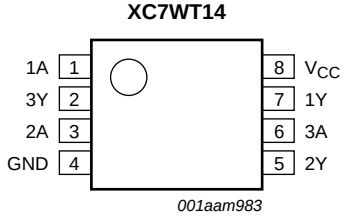
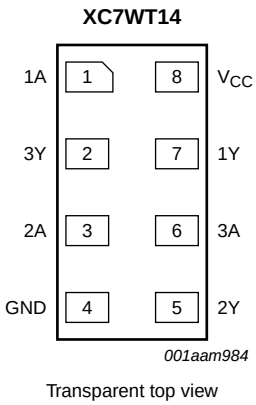



**Fig 4. Pin configuration SOT505-2 and SOT765-1**




Transparent top view

**Fig 5. Pin configuration SOT833-1**

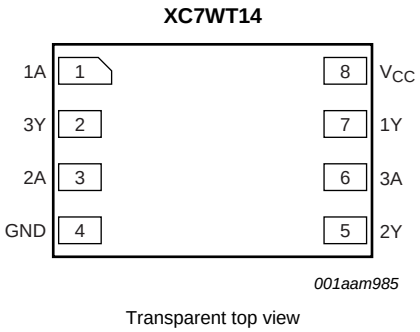



**Fig 6. Pin configuration SOT996-2**

## 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 |
| $V_{CC}$ | 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 | |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{T+}$ or $V_{T-}$; $V_{CC}$ = 4.5 V | | | | | | | | |
| | | $I_O$ = –50 μA | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O$ = –8.0 mA | 3.94 | - | - | 3.8 | - | 3.70 | - | V |
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{T+}$ or $V_{T-}$; $V_{CC}$ = 4.5 V | | | | | | | | |
| | | $I_O$ = 50 μA | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O$ = 8.0 mA | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| $I_I$ | input leakage current | $V_I$ = 5.5 V or GND; $V_{CC}$ = 0 V to 5.5 V | - | - | 0.1 | - | 1.0 | - | 2.0 | μA |
| $I_{CC}$ | supply current | $V_I = V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 5.5 V | - | - | 1.0 | - | 10 | - | 40 | μA |
| $\Delta I_{CC}$ | additional supply current | per input pin; $V_I$ = 3.4 V; other inputs at $V_{CC}$ or GND; $I_O$ = 0 A; $V_{CC}$ = 5.5 V | - | - | 1.35 | - | 1.5 | - | 1.5 | mA |
| $C_I$ | 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 | |
| $V_{T+}$ | positive-going threshold voltage | $V_{CC}$ = 4.5 V | - | - | 2.0 | - | 2.0 | - | 2.0 | V |
| | | $V_{CC}$ = 5.5 V | - | - | 2.0 | - | 2.0 | - | 2.0 | V |
| $V_{T-}$ | negative-going threshold voltage | $V_{CC}$ = 4.5 V | 0.5 | - | - | 0.5 | - | 0.5 | - | V |
| | | $V_{CC}$ = 5.5 V | 0.6 | - | - | 0.6 | - | 0.6 | - | V |
| $V_H$ | hysteresis voltage | $V_{CC}$ = 4.5 V | 0.4 | - | 1.4 | 0.4 | 1.4 | 0.35 | 1.4 | V |
| | | $V_{CC}$ = 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.*

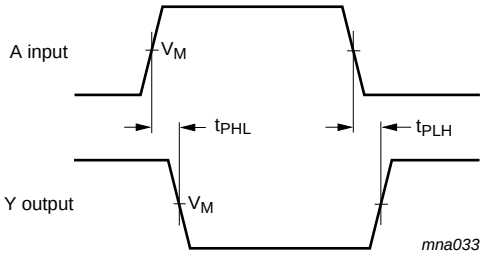
| Symbol | Parameter | Conditions | | 25 °C | | | –40 °C to +85 °C | | –40 °C to +125 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| $t_{pd}$ | propagation delay | nA to nY; Figure 7 | [1] [2] | | | | | | | | |
| | | $C_L$ = 15 pF | | - | 4.1 | 7.0 | 1.0 | 8.0 | 1.0 | 9.0 | ns |
| | | $C_L$ = 50 pF | | - | 5.9 | 8.5 | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| $C_{PD}$ | power dissipation capacitance | per buffer; $V_I$ = GND to $V_{CC}$ | [3] | - | 12 | - | - | - | - | - | pF |

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

[2] Typical values are measured at $V_{CC}$ = 5.0 V.

[3] $C_{PD}$ is used to determine the dynamic power dissipation $P_D$ (μW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
$f_i$ = input frequency in MHz;
$f_o$ = output frequency in MHz;
$C_L$ = output load capacitance in pF;
$V_{CC}$ = supply voltage in V;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

## 13. Waveforms

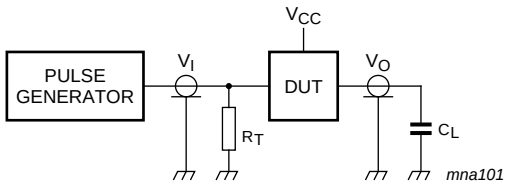



Measurement points are given in Table 10.

**Fig 7. The input (nA) to output (nY) propagation delays**

**Table 10. Measurement points**

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




Test data is given in Table 11.

Definitions for test circuit:

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

$R_T$ = Termination resistance should be equal to output impedance $Z_o$ of the pulse generator.

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

**Table 11. Test data**

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

## 13.1 Transfer characteristic waveforms

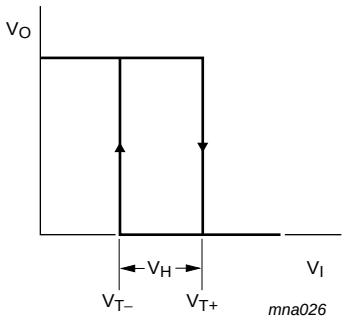



Fig 9. Transfer characteristic

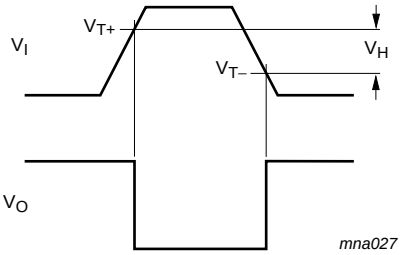
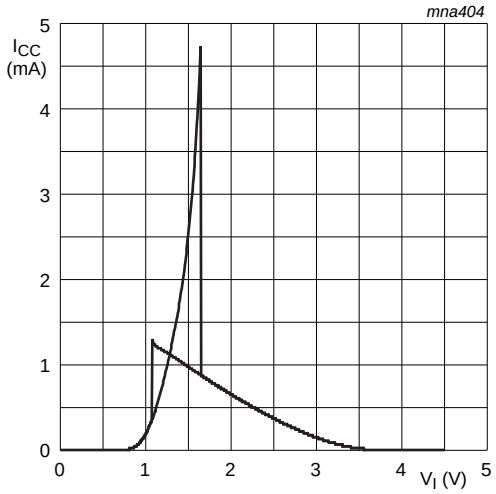
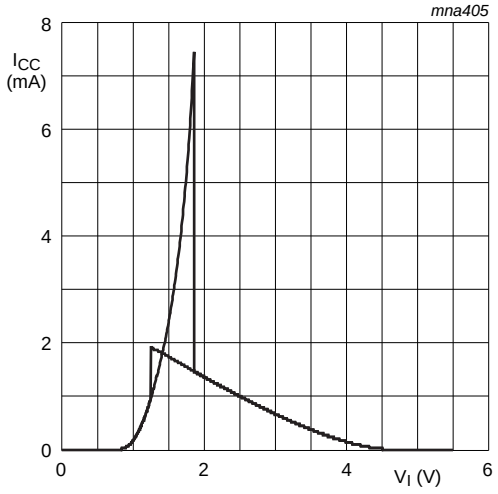



Fig 10. The definitions of $V_{T+}$, $V_{T-}$ and $V_H$




$V_{CC}$ = 4.5 V.

Fig 11. Typical transfer characteristics




$V_{CC}$ = 5.5 V.

Fig 12. Typical transfer characteristics

## 14. Application information

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

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

$P_{add}$ = additional power dissipation (μW);

$f_i$ = input frequency (MHz);

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

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

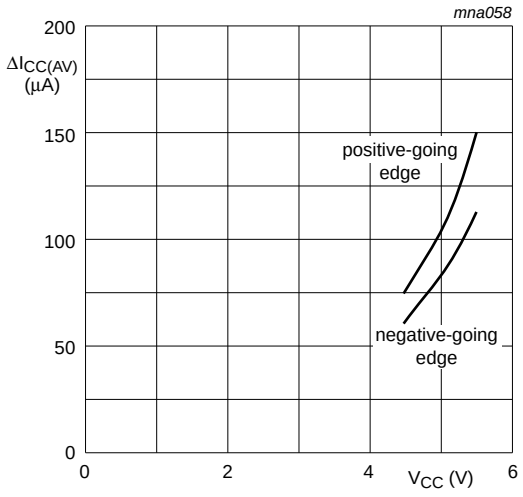
$\Delta I_{CC(AV)}$ = average additional supply current (μA).

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

For XC7WT14 used in relaxation oscillator circuit, see Figure 14.

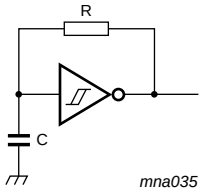
**Note to the application information:**

1. All values given are typical unless otherwise specified.




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

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

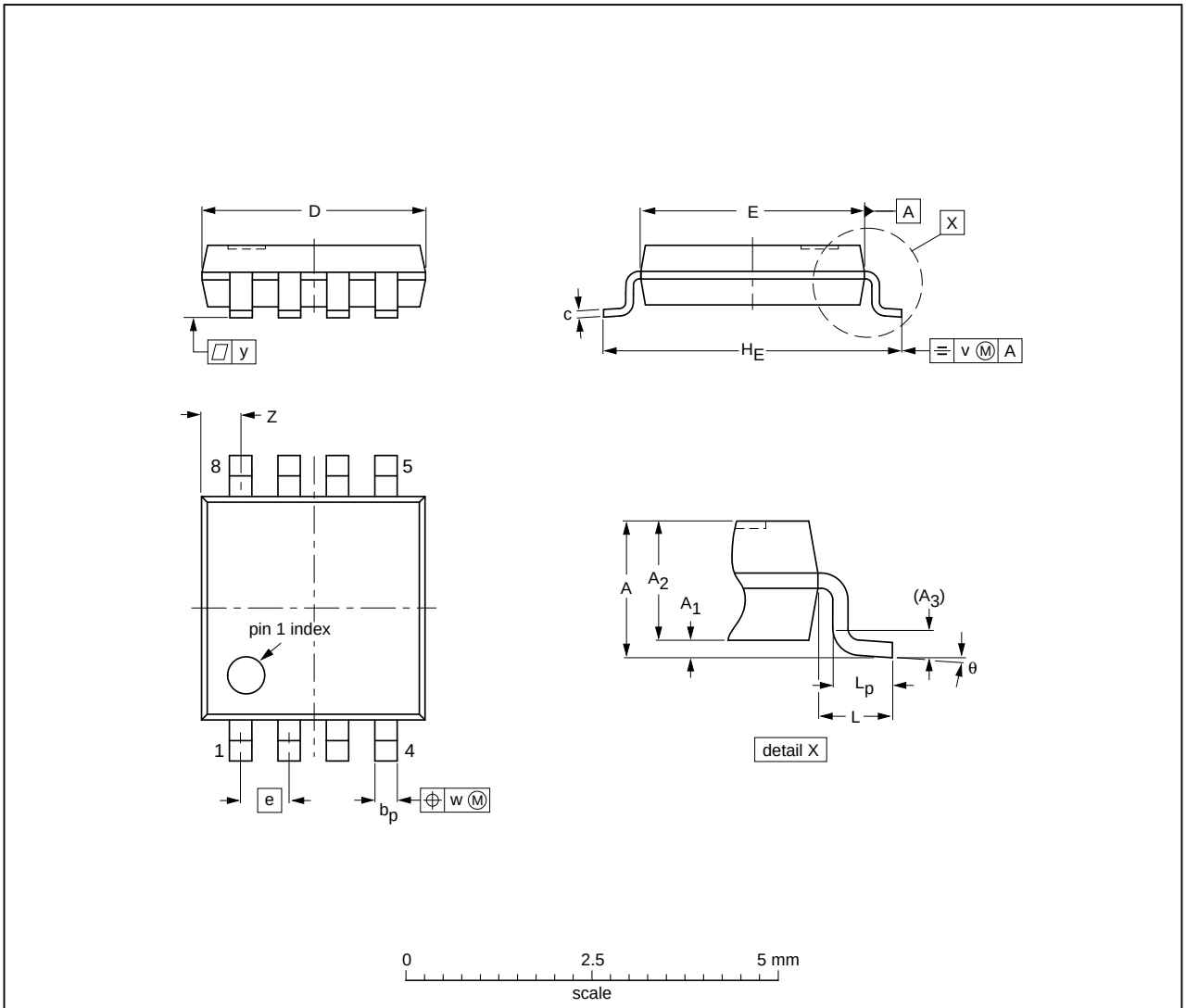



$$f = \frac{1}{T} \approx \frac{1}{0.60 \times RC}$$

**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**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $H_E$ | L | $L_p$ | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1 | 0.15<br>0.00 | 0.95<br>0.75 | 0.25 | 0.38<br>0.22 | 0.18<br>0.08 | 3.1<br>2.9 | 3.1<br>2.9 | 0.65 | 4.1<br>3.9 | 0.5 | 0.47<br>0.33 | 0.2 | 0.13 | 0.1 | 0.70<br>0.35 | 8°<br>0° |

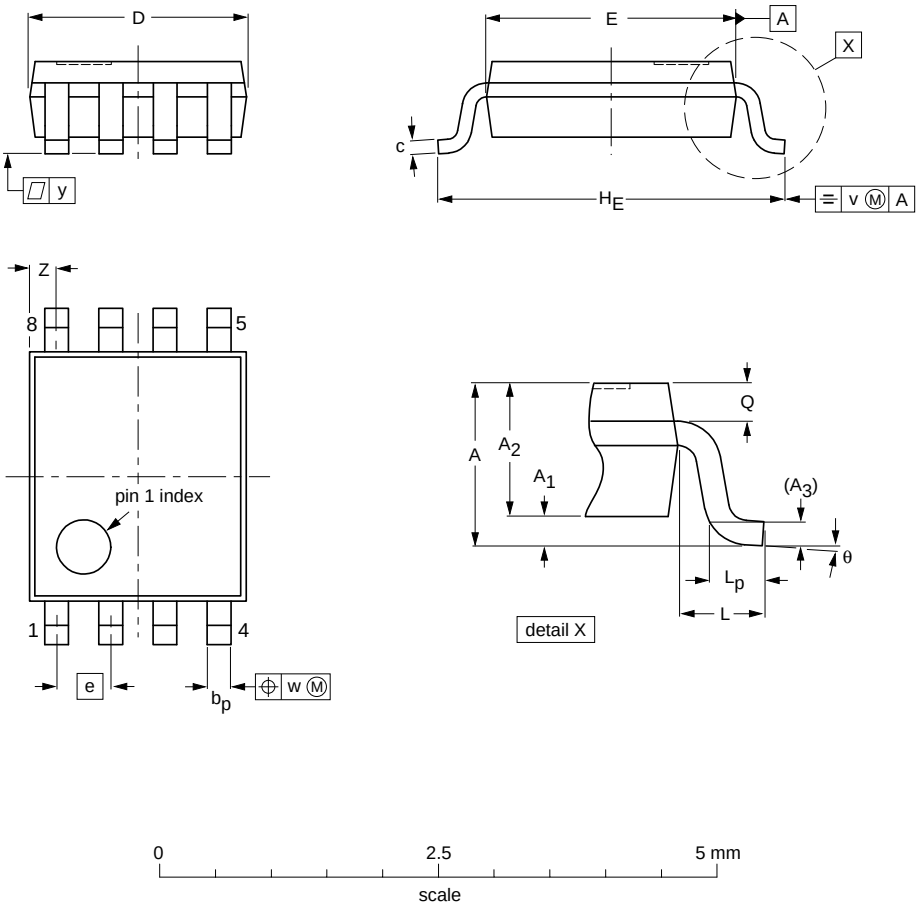
**Note**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT505-2 | | - - - | | | | 02-01-16 |

**Fig 15. Package outline SOT505-2 (TSSOP8)**

**VSSOP8: plastic very thin shrink small outline package; 8 leads; body width 2.3 mm** **SOT765-1**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(2)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1 | 0.15<br>0.00 | 0.85<br>0.60 | 0.12 | 0.27<br>0.17 | 0.23<br>0.08 | 2.1<br>1.9 | 2.4<br>2.2 | 0.5 | 3.2<br>3.0 | 0.4 | 0.40<br>0.15 | 0.21<br>0.19 | 0.2 | 0.13 | 0.1 | 0.4<br>0.1 | 8°<br>0° |

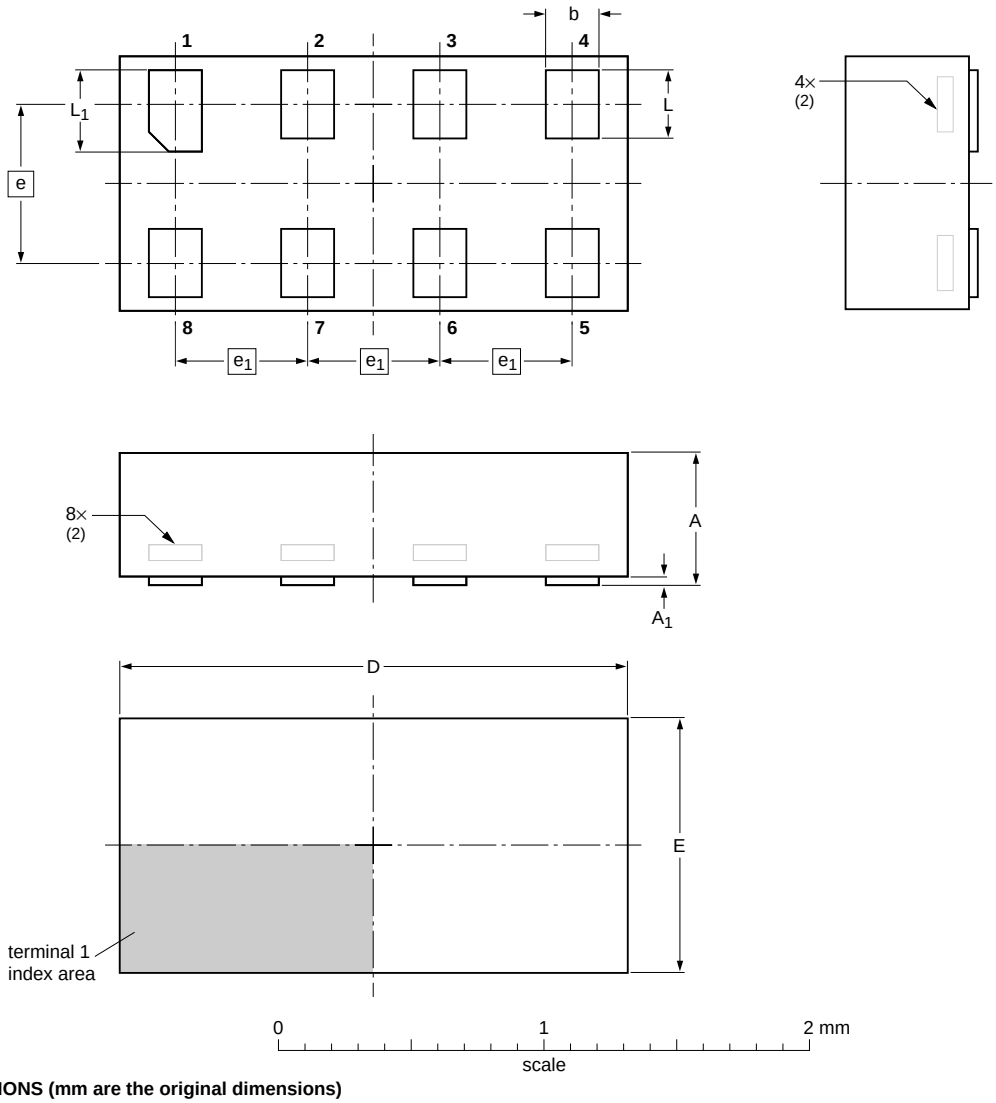
**Notes**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT765-1 | | MO-187 | | | | 02-06-07 |

**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**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A(1) max | A1 max | b | D | E | e | e1 | L | L1 |
|---|---|---|---|---|---|---|---|---|---|
| mm | 0.5 | 0.04 | 0.25<br>0.17 | 2.0<br>1.9 | 1.05<br>0.95 | 0.6 | 0.5 | 0.35<br>0.27 | 0.40<br>0.32 |

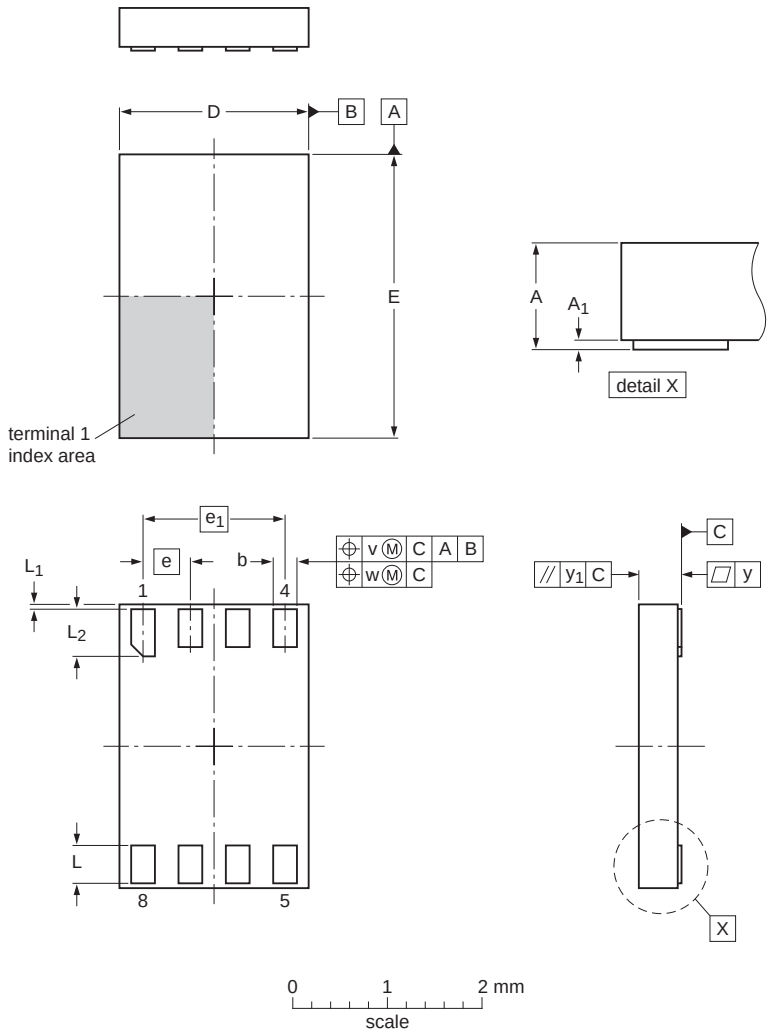
**Notes**

1. Including plating thickness.
2. Can be visible in some manufacturing processes.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT833-1 | - - - | MO-252 | - - - | | | ~~07-11-14~~<br>07-12-07 |

**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**




Dimensions (mm are the original dimensions)

| Unit[1] | | A | $A_1$ | b | D | E | e | $e_1$ | L | $L_1$ | $L_2$ | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 0.5 | 0.05 | 0.35 | 2.1 | 3.1 | 0.5 | 1.5 | 0.5 | 0.15 | 0.6 | 0.1 | 0.05 | 0.05 | 0.1 |
| | nom | | | | | | | | | | | | | | |
| | min | | 0.00 | 0.15 | 1.9 | 2.9 | | | 0.3 | 0.05 | 0.4 | | | | |

*sot996-2_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT996-2 | | | | | | ~~07-12-21~~ 12-11-20 |

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

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

## 18.2 Definitions

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