

# 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

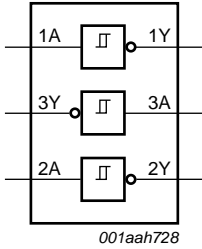
## 5. Marking

Table 2. Marking codes

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

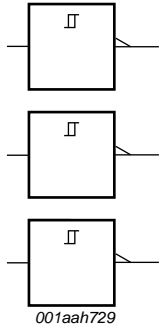
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

## 6. Functional diagram



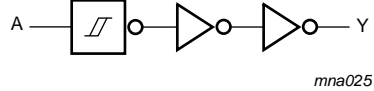
001aah728

**Fig 1. Logic symbol**



001aah729

**Fig 2. IEC logic symbol**

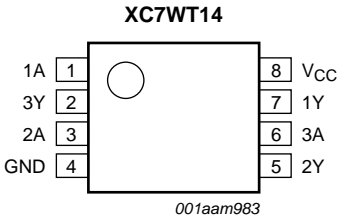


mna025

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

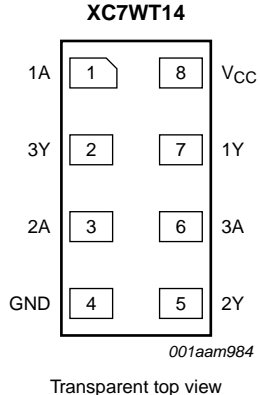
## 7. Pinning information

### 7.1 Pinning



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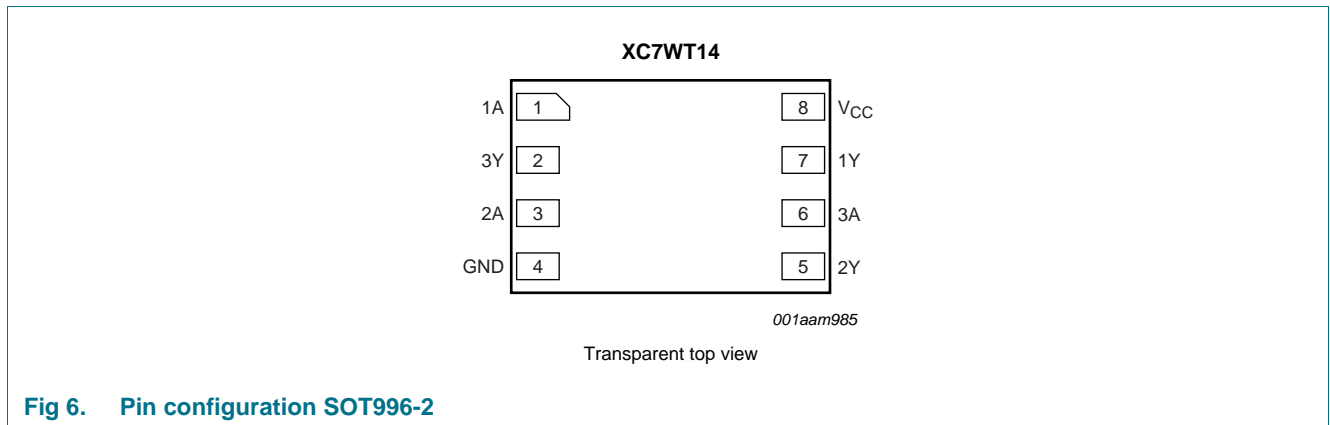
**Fig 4. Pin configuration SOT505-2 and SOT765-1**



001aam984

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 <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; 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; 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; other inputs at V <sub>CC</sub> or GND; 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; V <sub>I</sub> = GND to V <sub>CC</sub> <a href="#">[3]</a>	-	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).

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

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

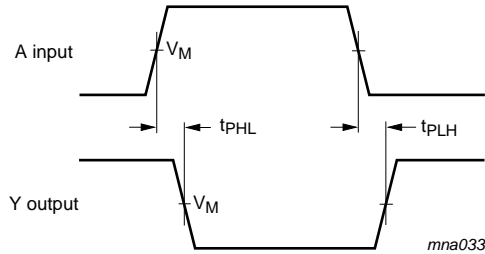
f<sub>o</sub> = output frequency in MHz;

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

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

Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs.

**13. Waveforms**

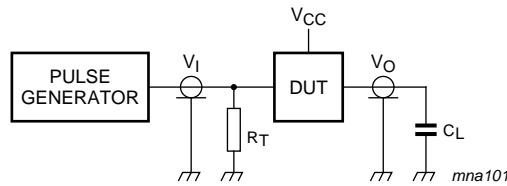


Measurement points are given in [Table 10](#).

**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.

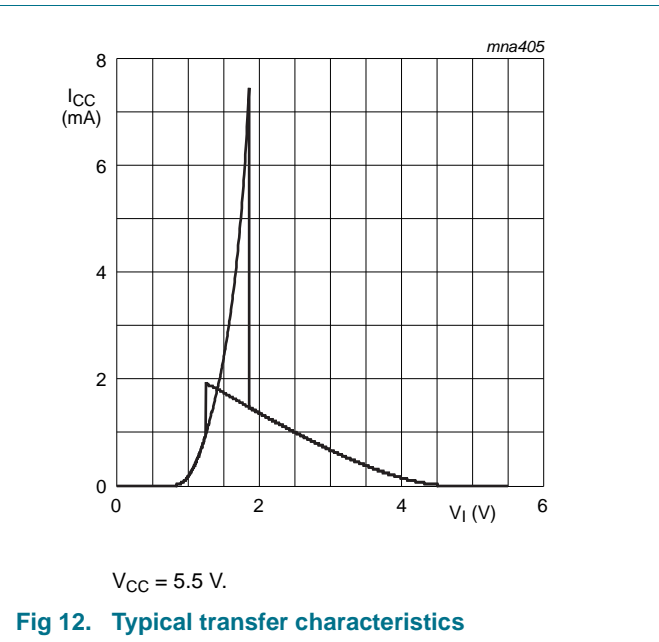
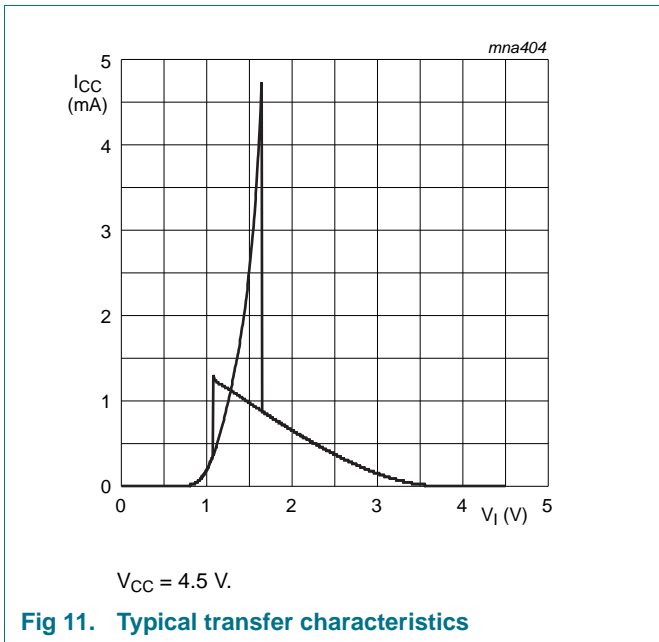
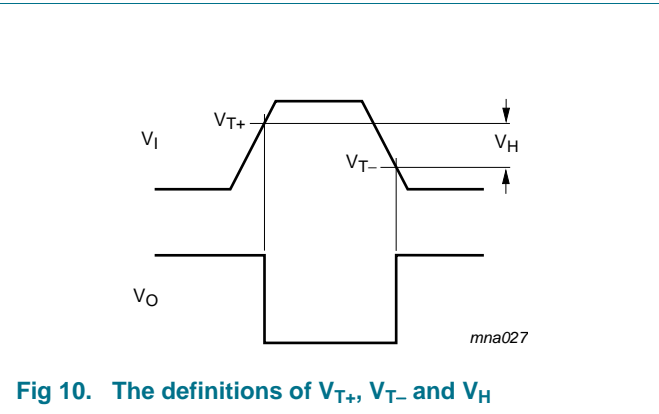
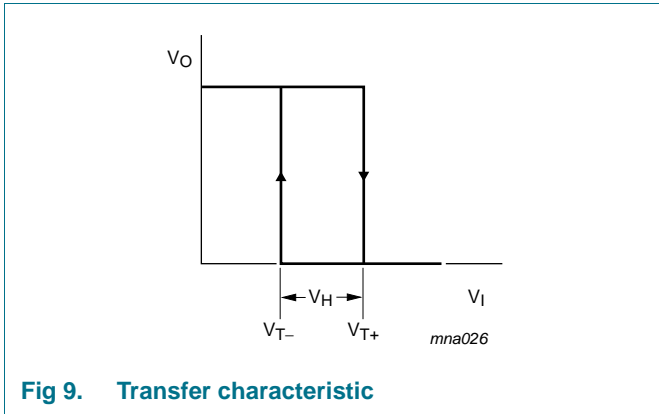
$R_T$  = Termination resistance should be equal to output impedance  $Z_o$  of the pulse generator.

**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	$\leq 3.0$ 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:

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

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 %;

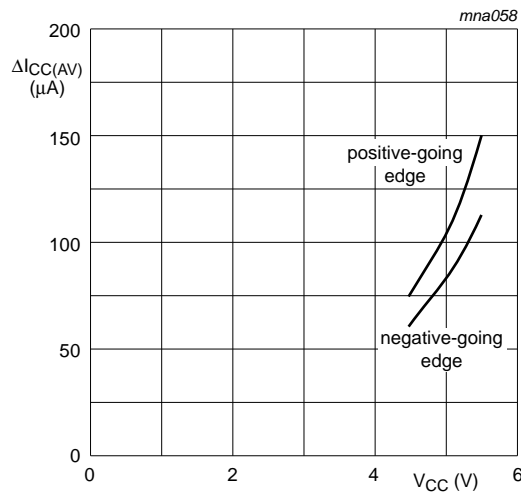
$\Delta I_{\text{CC(AV)}}$  = average additional supply current ( $\mu\text{A}$ ).

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

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

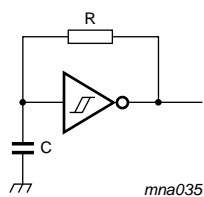
### Note to the application information:

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

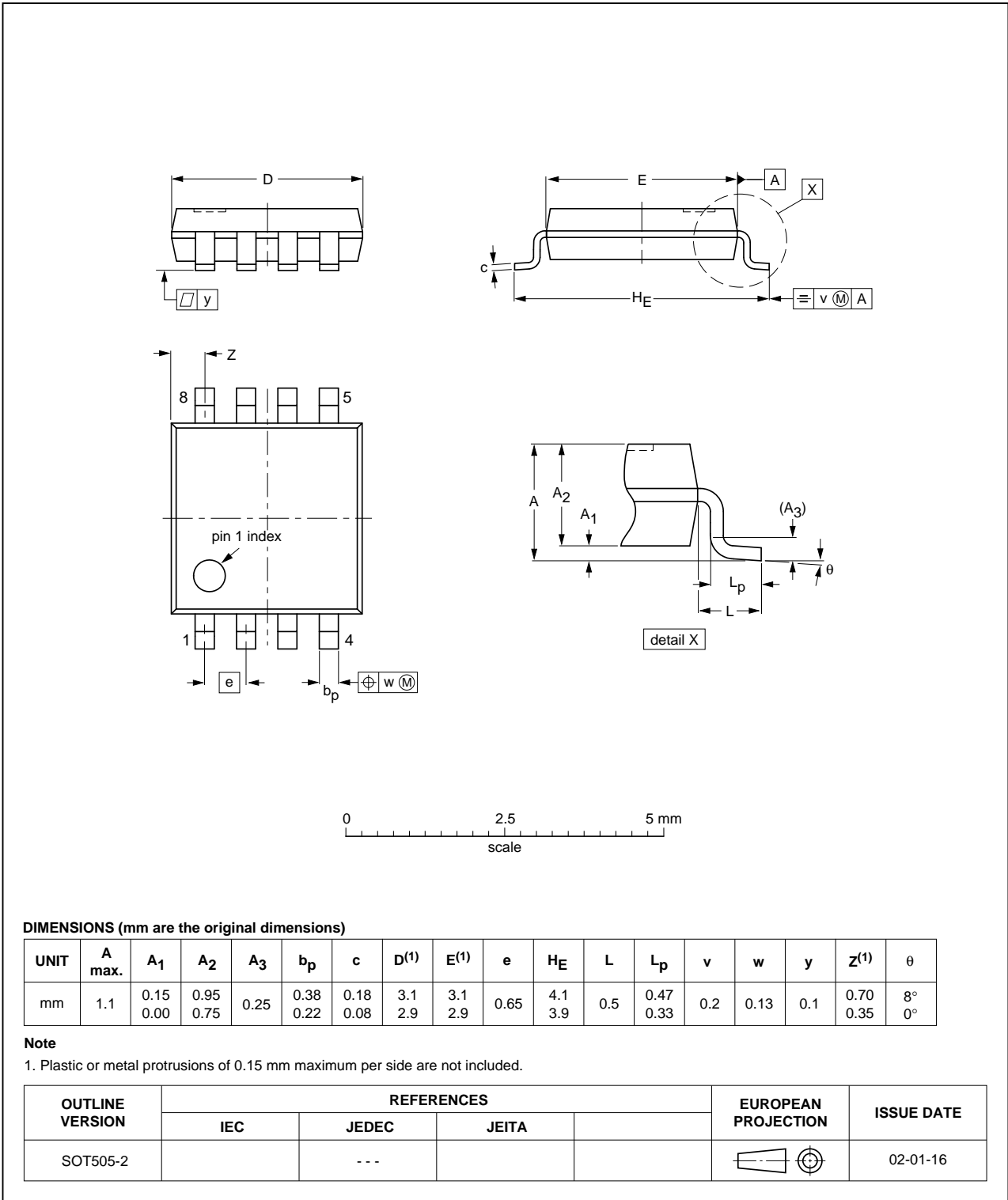


Fig 15. Package outline SOT505-2 (TSSOP8)

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

SOT765-1

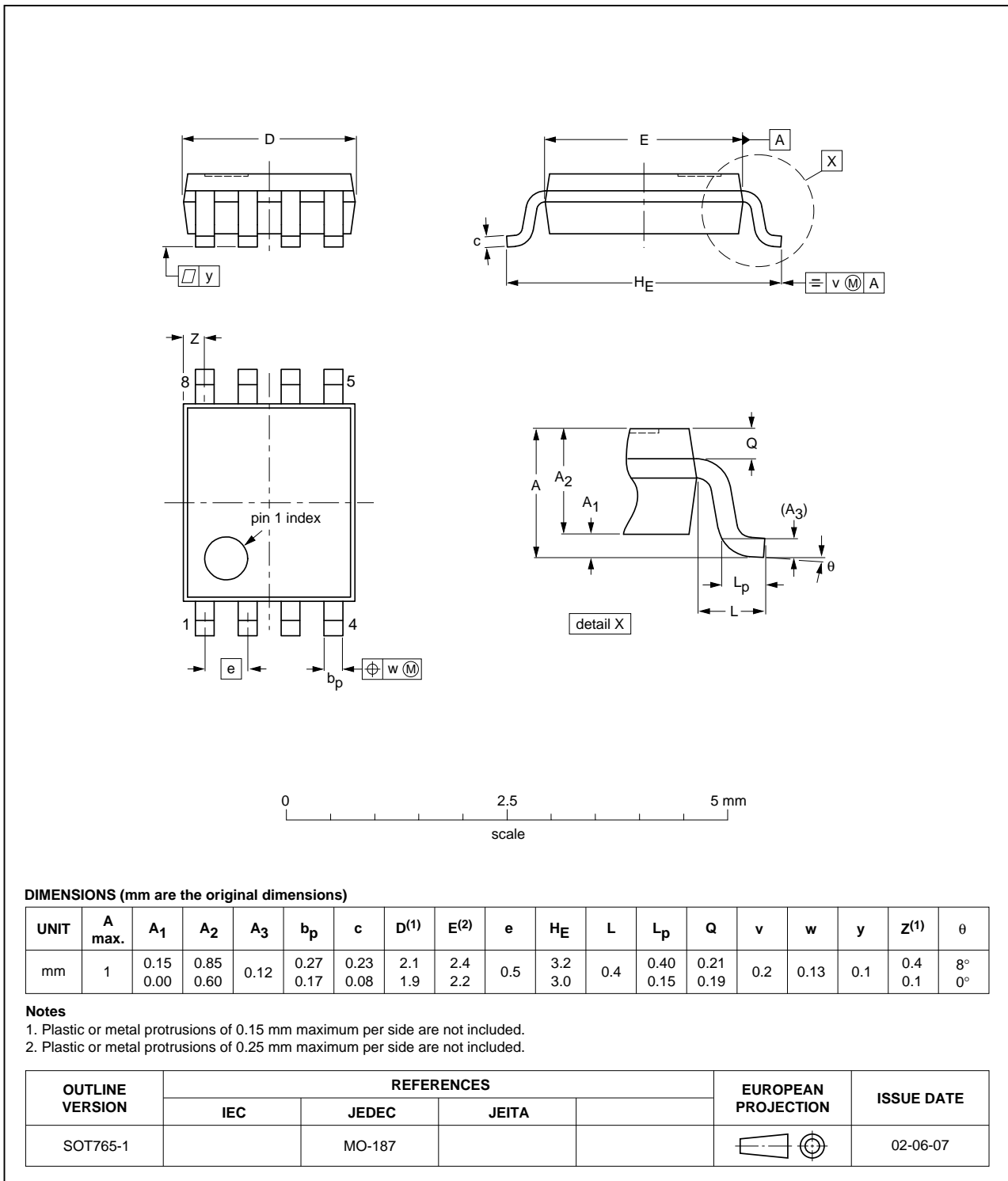


Fig 16. Package outline SOT765-1 (VSSOP8)

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

SOT833-1

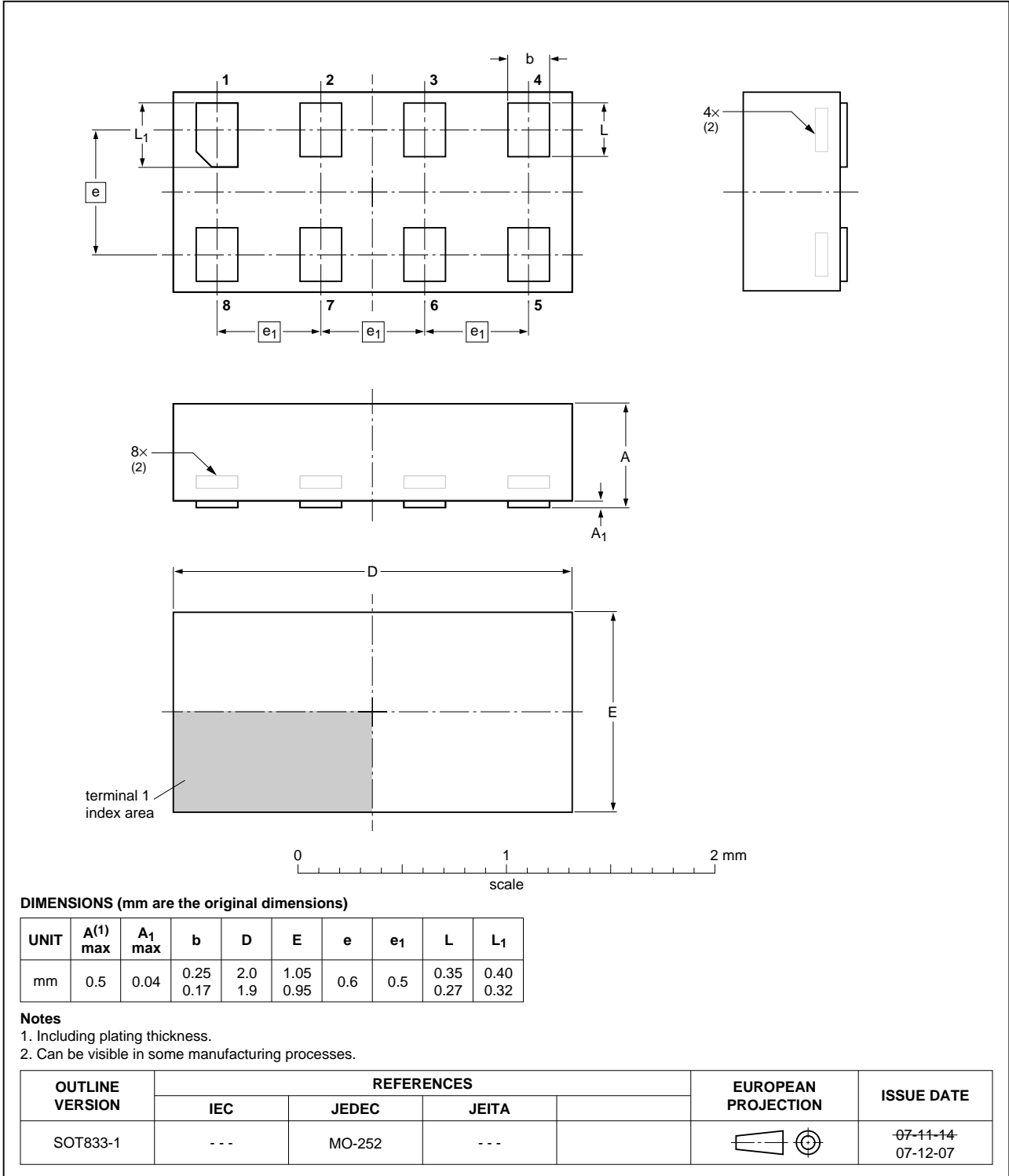


Fig 17. Package outline SOT833-1 (XSON8)

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

SOT996-2

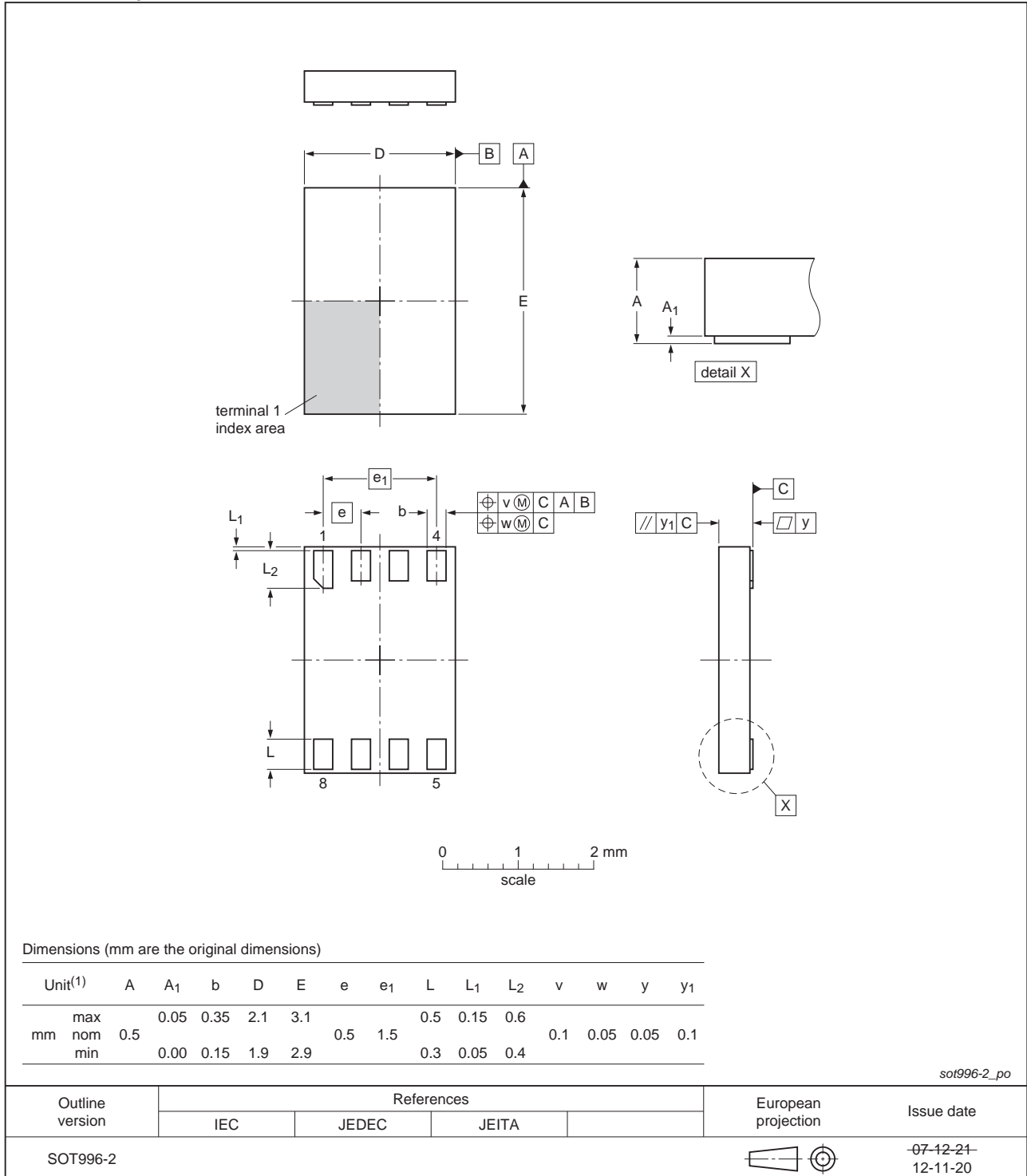


Fig 18. Package outline SOT996-2 (XSON8)

## 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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