

XC7SH14

Inverting Schmitt trigger

Rev. 01 — 1 September 2009

Product data sheet

1. General description

XC7SH14 is a high-speed Si-gate CMOS device. It provides an inverting buffer function with Schmitt trigger action. This device is capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

2. Features

- Symmetrical output impedance
- High noise immunity
- ESD protection:
 - ◆ HBM JESD22-A114E: exceeds 2000 V
 - ◆ MM JESD22-A115-A: exceeds 200 V
 - ◆ CDM JESD22-C101C: exceeds 1000 V
- Low power dissipation
- Balanced propagation delays
- SOT353-1 and SOT753 package options
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Applications

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators

4. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
XC7SH14GW	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP5	plastic thin shrink small outline package; 5 leads; body width 1.25 mm	SOT353-1
XC7SH14GV	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SC-74A	plastic surface-mounted package; 5 leads	SOT753

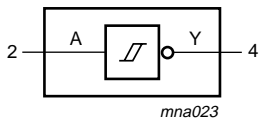
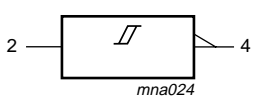
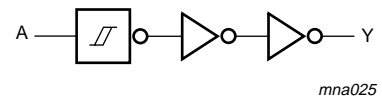
5. Marking

Table 2. Marking codes

Type number	Marking code ^[1]
XC7SH14GW	fF
XC7SH14GV	f14

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

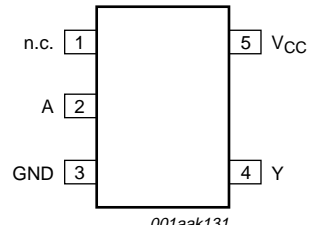
6. Functional diagram

 <p><i>mna023</i></p>	 <p><i>mna024</i></p>	 <p><i>mna025</i></p>
Fig 1. Logic symbol	Fig 2. IEC logic symbol	Fig 3. Logic diagram

7. Pinning information

7.1 Pinning

XC7SH14



001aak131

Fig 4. Pin configuration SOT353-1 and SOT753

7.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
n.c.	1	not connected
A	2	data input
GND	3	ground (0 V)
Y	4	data output
V _{CC}	5	supply voltage

8. Functional description

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level

Input	Output
A	Y
L	H
H	L

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 both TSSOP5 and SC-74A packages: above 87.5 °C the value of P_{tot} derates linearly with 4.0 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		2.0	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-}								
		I _O = -50 μA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -50 μA; V _{CC} = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I _O = -50 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -4.0 mA; V _{CC} = 3.0 V	2.58	-	-	2.48	-	2.40	-	V
		I _O = -8.0 mA; V _{CC} = 4.5 V	3.94	-	-	3.8	-	3.70	-	V
V _{OL}	LOW-level output voltage	V _I = V _{T+} or V _{T-}								
		I _O = 50 μA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 μA; V _{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 4.0 mA; V _{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
		I _O = 8.0 mA; V _{CC} = 4.5 V	-	-	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
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 7](#) and [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	
V _{T+}	positive-going threshold voltage	V _{CC} = 3.0 V	-	-	2.2	-	2.2	-	2.2	V
		V _{CC} = 4.5 V	-	-	3.15	-	3.15	-	3.15	V
		V _{CC} = 5.5 V	-	-	3.85	-	3.85	-	3.85	V
V _{T-}	negative-going threshold voltage	V _{CC} = 3.0 V	0.9	-	-	0.9	-	0.9	-	V
		V _{CC} = 4.5 V	1.35	-	-	1.35	-	1.35	-	V
		V _{CC} = 5.5 V	1.65	-	-	1.65	-	1.65	-	V
V _H	hysteresis voltage	V _{CC} = 3.0 V	0.3	-	1.2	0.3	1.2	0.25	1.2	V
		V _{CC} = 4.5 V	0.4	-	1.4	0.4	1.4	0.35	1.4	V
		V _{CC} = 5.5 V	0.5	-	1.6	0.5	1.6	0.45	1.6	V

12. Dynamic characteristics

Table 9. Dynamic characteristics

GND = 0 V. For waveform see [Figure 5](#). For test circuit see [Figure 6](#).

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	A to Y; [1]								
		V _{CC} = 3.0 V to 3.6 V [2]								
		C _L = 15 pF	-	4.2	12.8	1.0	15.0	1.0	16.5	ns
		C _L = 50 pF	-	6.0	16.3	1.0	18.5	1.0	20.5	ns
		V _{CC} = 4.5 V to 5.5 V [3]								
		C _L = 15 pF	-	3.2	8.6	1.0	10.0	1.0	11.0	ns
C _{PD}	power dissipation capacitance	C _L = 50 pF; f = 1 MHz; V _I = GND to V _{CC} [4]	-	12	-	-	-	-	-	pF

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

[2] Typical values are measured at V_{CC} = 3.3 V.

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

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

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

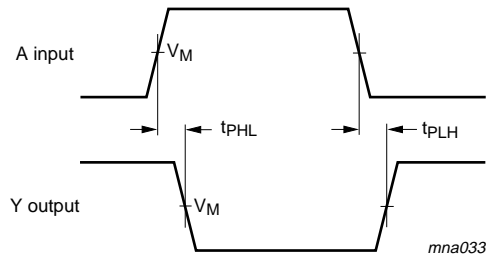
f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in Volts.

13. Waveforms

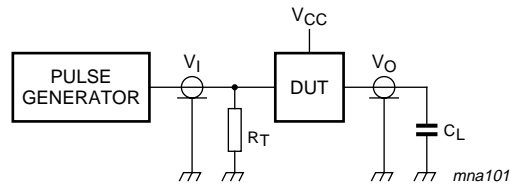


Measurement points are given in [Table 10](#).

Fig 5. The input (A) to output (Y) propagation delays

Table 10. Measurement points

Type number	Input		Output
	V _I	V _M	V _M
XC7SH14	GND to V _{CC}	0.5 × V _{CC}	0.5 × 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 6. Load circuitry for switching times

Table 11. Test data

Type	Input		Load	Test
	V _I	t _r , t _f	C _L	
XC7SH14	V _{CC}	≤ 3.0 ns	15 pF, 50 pF	t _{PLH} , t _{PHL}

13.1 Transfer characteristic waveforms

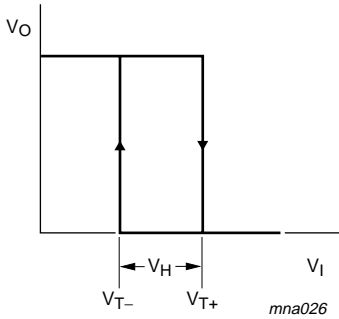


Fig 7. Transfer characteristic

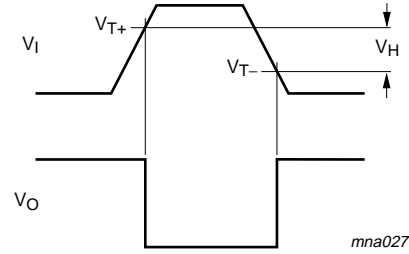
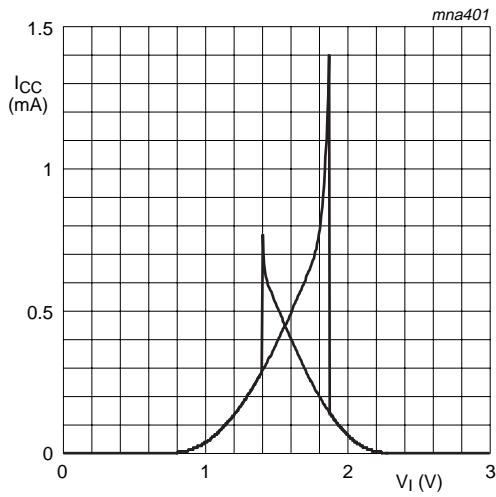
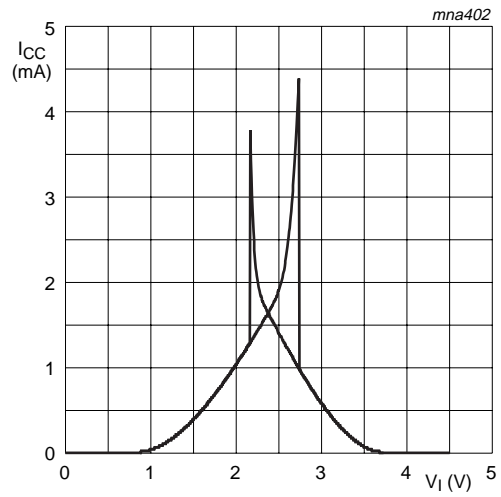


Fig 8. The definitions of V_{T+} , V_{T-} and V_H



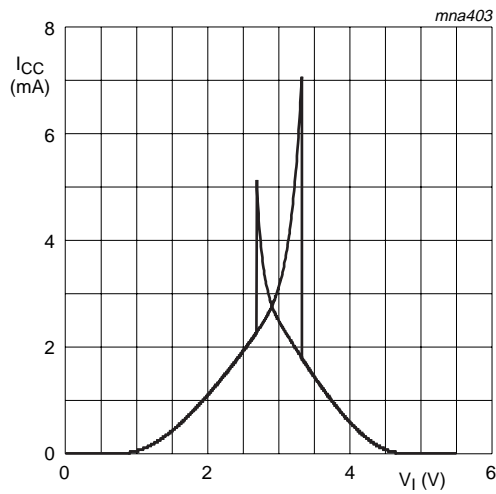
$V_{CC} = 3.0\text{ V}$.

Fig 9. Typical transfer characteristics



$V_{CC} = 4.5\text{ V}$.

Fig 10. Typical transfer characteristics



V_{CC} = 5.5 V.

Fig 11. 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:

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

P_{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 %;

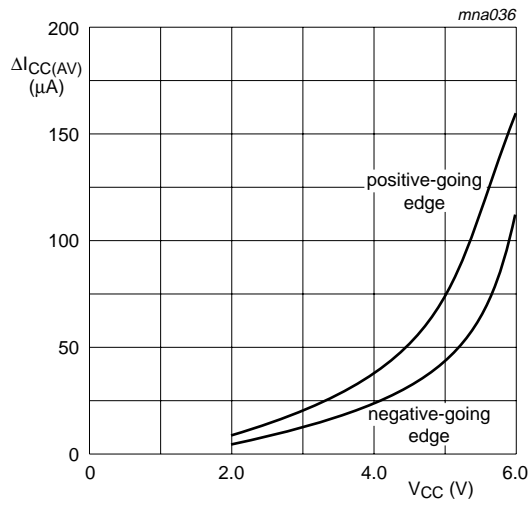
$\Delta I_{\text{CC(AV)}}$ = average additional supply current (μA).

Average additional I_{CC} differs with positive or negative input transitions, as shown in [Figure 12](#).

For XC7SH14 used in relaxation oscillator circuit, see [Figure 13](#).

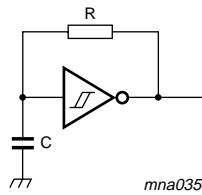
Note to the application information:

1. All values given are typical unless otherwise specified.



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

Fig 12. Average additional I_{CC}



$$f = \frac{1}{T} \approx \frac{1}{0.55 \times RC}$$

Fig 13. Relaxation oscillator using the XC7SH14

15. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm

SOT353-1

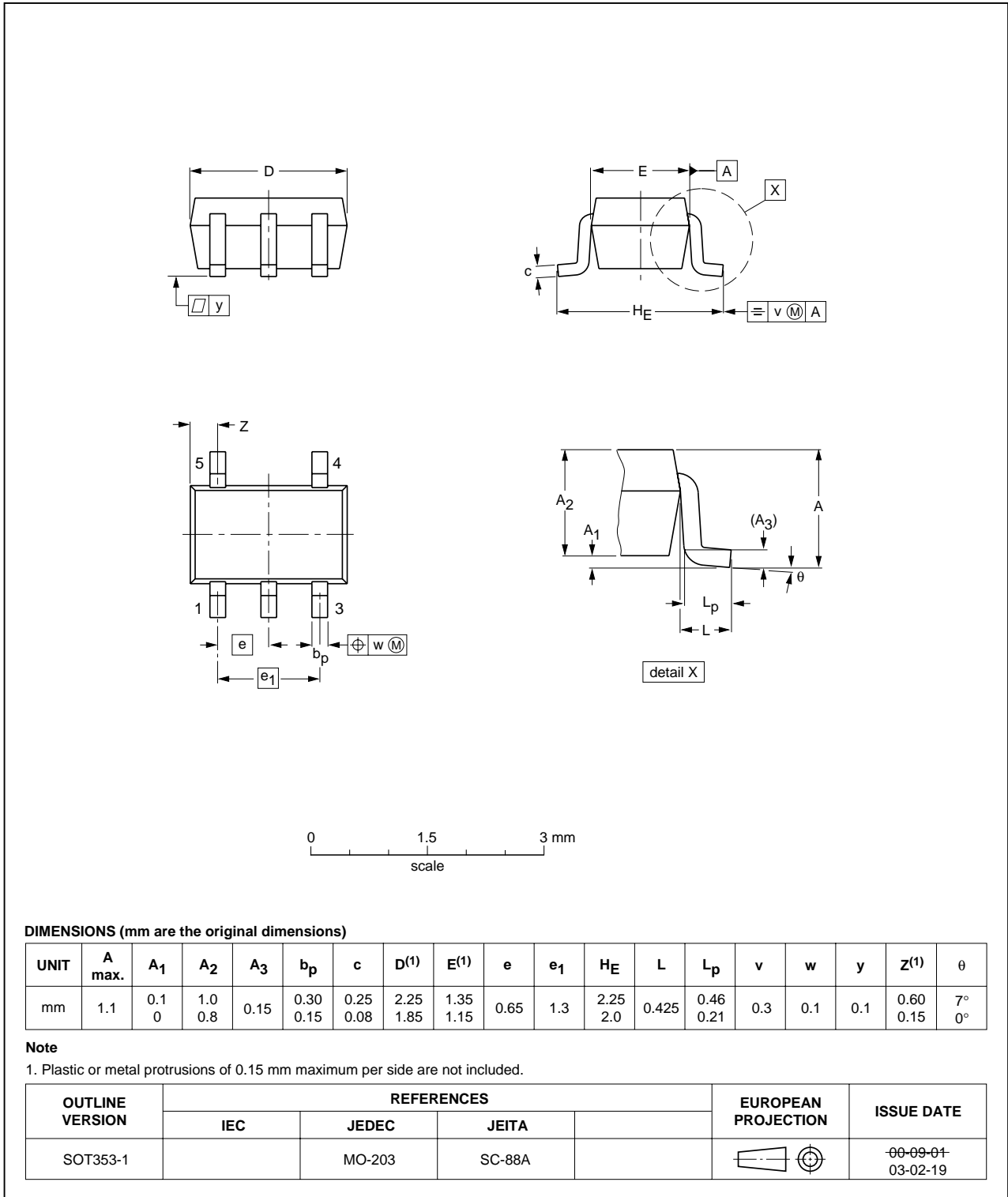


Fig 14. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

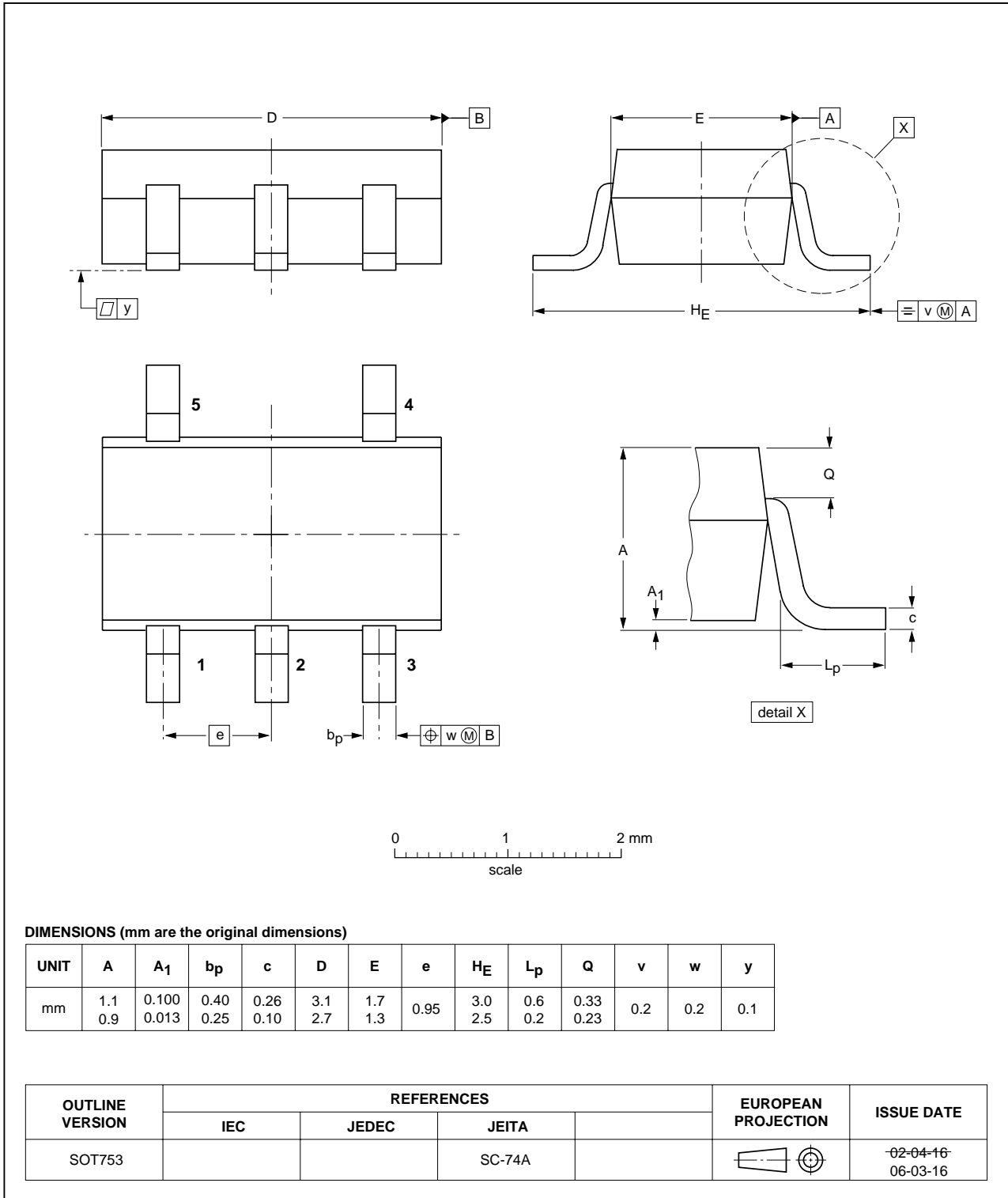


Fig 15. Package outline SOT753 (SC-74A)

16. Abbreviations

Table 12. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

17. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
XC7SH14_1	20090901	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".

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20. Contents

1 **General description** 1

2 **Features** 1

3 **Applications** 1

4 **Ordering information** 1

5 **Marking** 2

6 **Functional diagram** 2

7 **Pinning information** 2

7.1 Pinning 2

7.2 Pin description 2

8 **Functional description** 3

9 **Limiting values** 3

10 **Recommended operating conditions** 3

11 **Static characteristics** 4

11.1 Transfer characteristics 5

12 **Dynamic characteristics** 5

13 **Waveforms** 6

13.1 Transfer characteristic waveforms 7

14 **Application information** 8

15 **Package outline** 10

16 **Abbreviations** 12

17 **Revision history** 12

18 **Legal information** 13

18.1 Data sheet status 13

18.2 Definitions 13

18.3 Disclaimers 13

18.4 Trademarks 13

19 **Contact information** 13

20 **Contents** 14

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