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XC7SET14

Inverting Schmitt trigger

Rev. 01 — 31 August 2009

Product data sheet

1. General description

XC7SET14 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 impedances
- 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 | |
| XC7SET14GW | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | TSSOP5 | plastic thin shrink small outline package; 5 leads; body width 1.25 mm | SOT353-1 |
| XC7SET14GV | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SC-74A | plastic surface-mounted package; 5 leads | SOT753 |

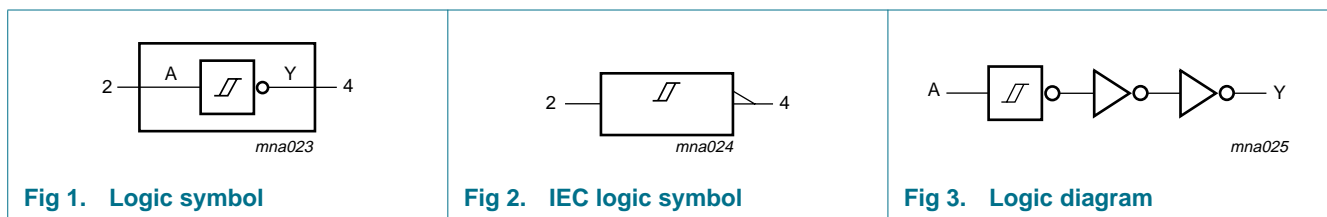
5. Marking

Table 2. Marking codes

| Type number | Marking code ^[1] |
|-------------|-----------------------------|
| XC7SET14GW | gF |
| XC7SET14GV | g14 |

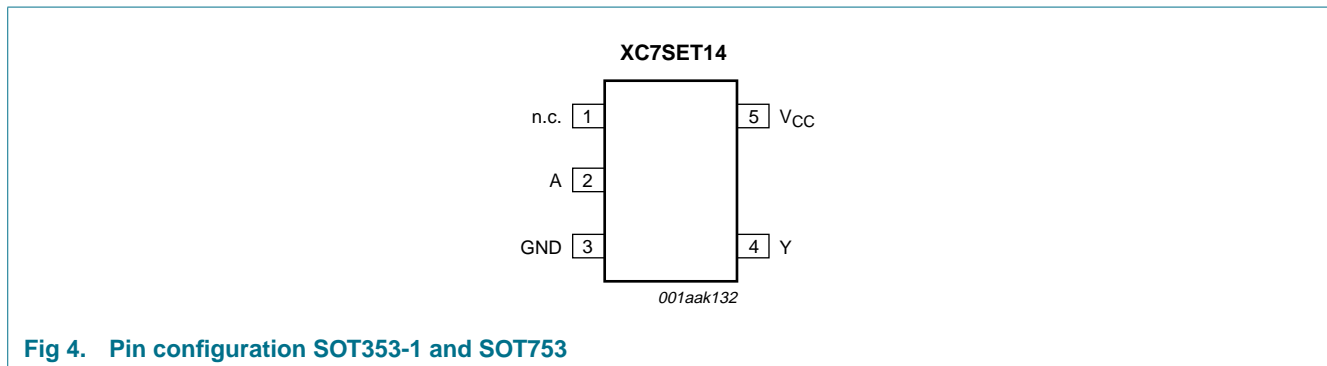
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

6. Functional diagram



7. Pinning information

7.1 Pinning



7.2 Pin description

Table 3. Pin description

| Symbol | Pin | Description |
|-----------------|-----|----------------|
| 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 | | 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 |
| ΔI _{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 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} = 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 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; V _{CC} = 4.5 V to 5.5 V | [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] | - | 13 | - | - | - | - | 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).

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

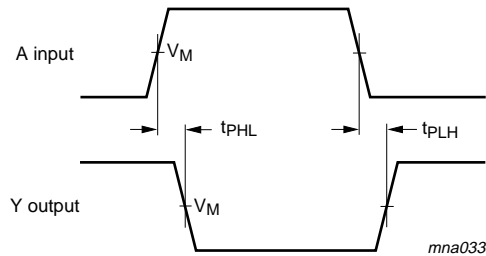
f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V.

13. Waveforms

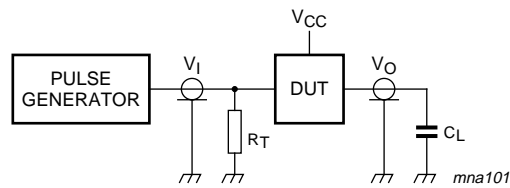


Measurement points are given in [Table 10](#).

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

Table 10. Measurement points

| Type number | Input | | Output |
|-------------|----------------|----------------|-----------------------|
| | V _I | V _M | V _M |
| XC7SET14 | GND to 3.0 V | 1.5 V | 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 | |
| XC7SET14 | 3.0 V | ≤ 3.0 ns | 15 pF, 50 pF | t _{PLH} , t _{PHL} |

13.1 Transfer characteristic waveforms

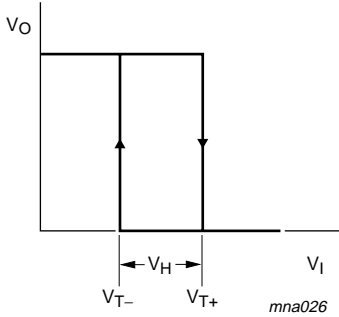


Fig 7. Transfer characteristic

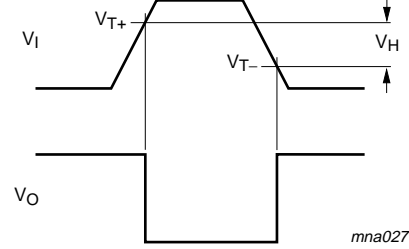


Fig 8. The definitions of V_{T+} , V_{T-} and V_H

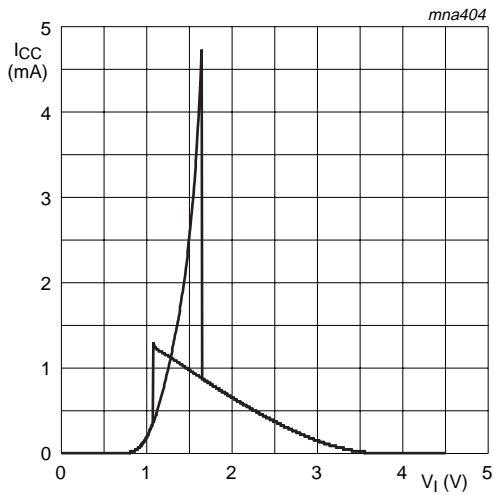


Fig 9. Typical characteristics; $V_{CC} = 4.5\text{ V}$

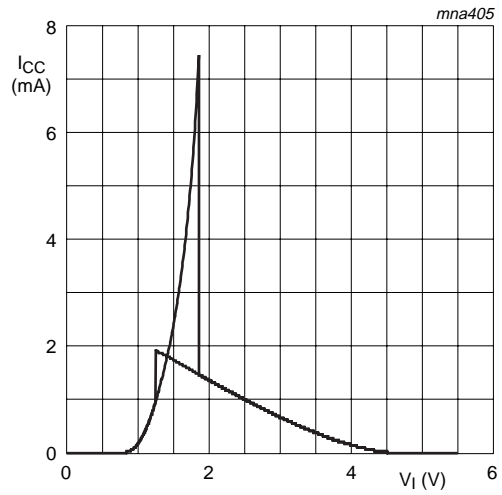


Fig 10. Typical transfer characteristics; $V_{CC} = 5.5\text{ V}$

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_{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 %;

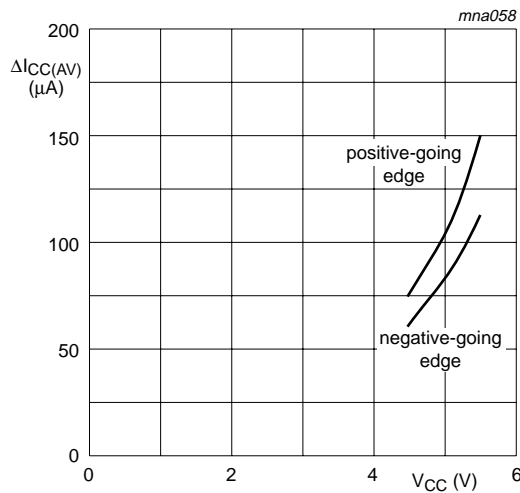
$\Delta I_{\text{CC(AV)}}$ = average additional supply current (μA).

Average additional I_{CC} differs with positive or negative input transitions, as shown in [Figure 11](#).

For XC7SET14 used in relaxation oscillator circuit, see [Figure 12](#).

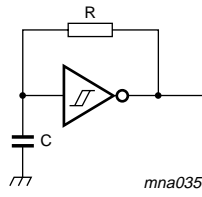
Note to the application information:

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 11. Average additional I_{CC}



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

Fig 12. Relaxation oscillator using the XC7SET14

15. Package outline

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

SOT353-1

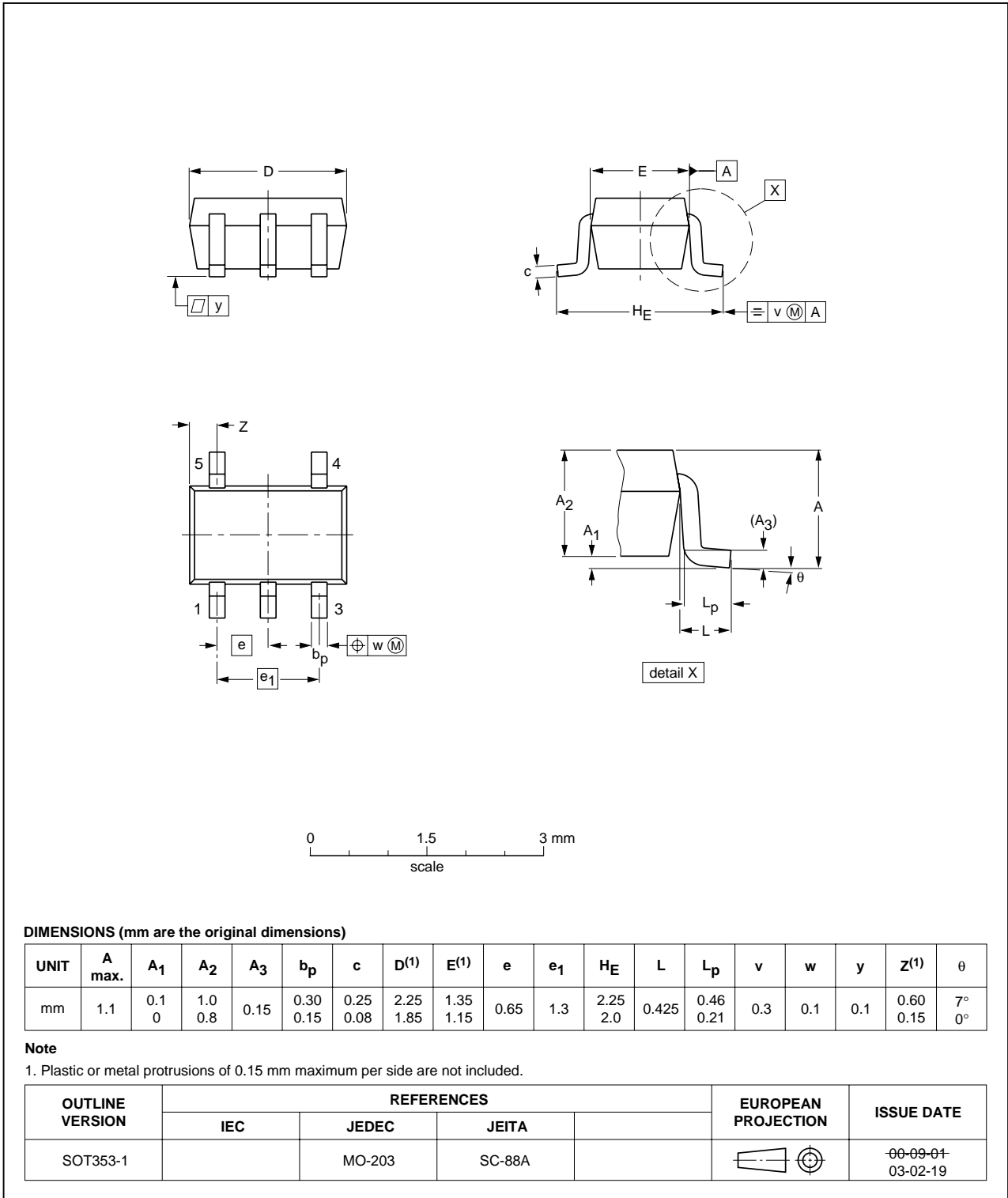


Fig 13. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

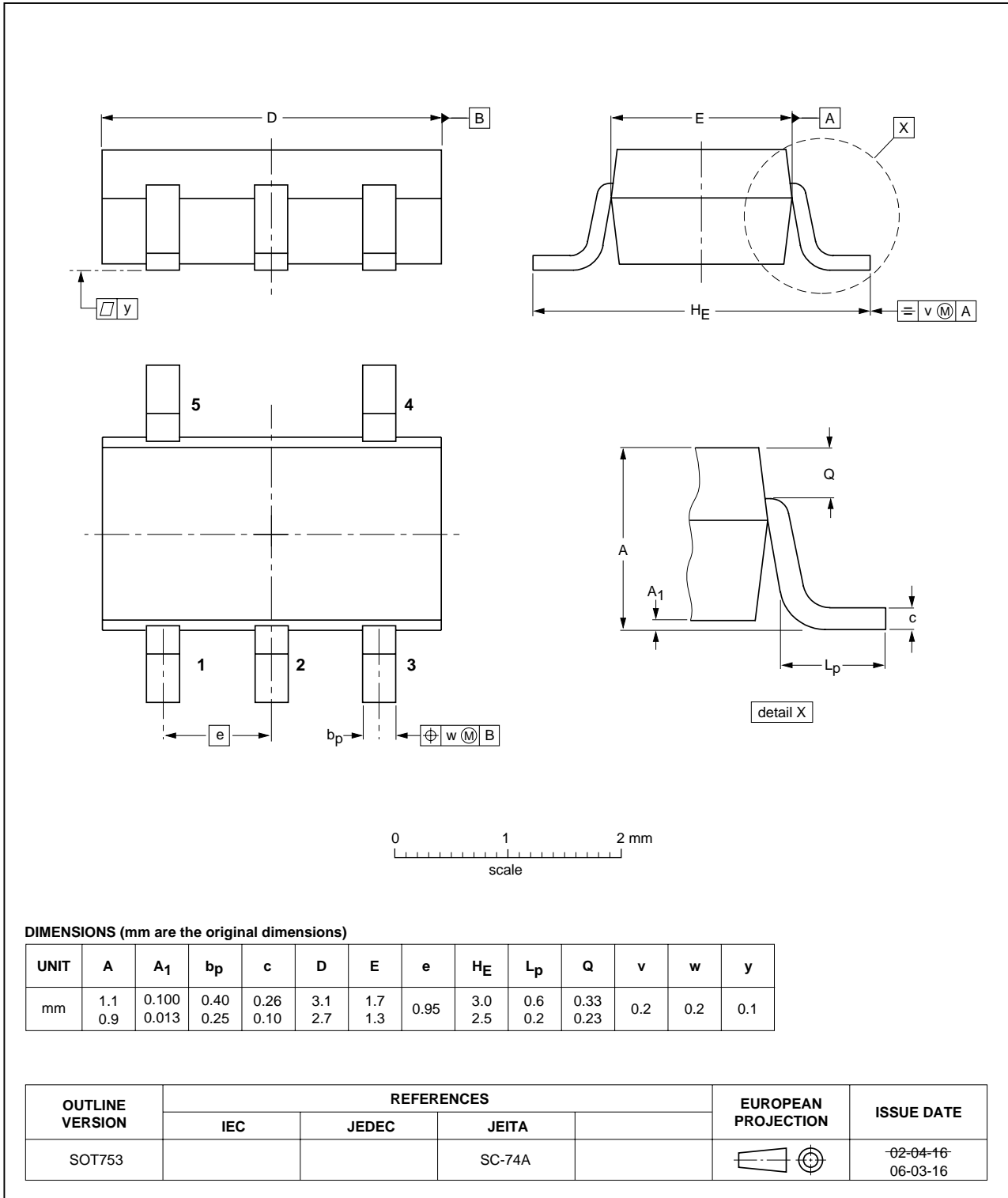


Fig 14. Package outline SOT753 (SC-74A)

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 |

17. Revision history

Table 13. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-------------|--------------|--------------------|---------------|------------|
| XC7SET14_1 | 20090831 | 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. |
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[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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