

74HC3G04; 74HCT3G04

Inverter

Rev. 4 — 2 October 2013

Product data sheet

1. General description

The 74HC3G04; 74HCT3G04 is a triple inverter. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and benefits

- Wide supply voltage range from 2.0 V to 6.0 V
- Input levels:
 - ◆ For 74HC3G04: CMOS level
 - ◆ For 74HCT3G04: TTL level
- Symmetrical output impedance
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- Multiple package options
- ESD protection:
 - ◆ HBM JESD22-A114E exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V
- 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. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|---------------------------|---|--------|---|----------|
| | Temperature range | Name | Description | Version |
| 74HC3G04DP 74HCT3G04DP | $-40\text{ }^{\circ}\text{C}$ 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 |
| 74HC3G04DC 74HCT3G04DC | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | VSSOP8 | plastic very thin shrink small outline package; 8 leads; body width 2.3 mm | SOT765-1 |
| 74HC3G04GD 74HCT3G04GD | $-40\text{ }^{\circ}\text{C}$ 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 |



4. Marking

Table 2. Marking codes

| Type number | Marking code ^[1] |
|-------------|-----------------------------|
| 74HC3G04DP | H04 |
| 74HCT3G04DP | T04 |
| 74HC3G04DC | H04 |
| 74HCT3G04DC | T04 |
| 74HC3G04GD | H04 |
| 74HCT3G04GD | T04 |

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

5. Functional diagram

Fig 1. Logic symbol

Fig 2. IEC logic symbol

Fig 3. Logic diagram (one gate)

6. Pinning information

6.1 Pinning

Fig 4. Pin configuration SOT505-2 (TSSOP8) and SOT765-1 (VSSOP8)

Fig 5. Pin configuration SOT996-2 (XSON8)

6.2 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 |

7. Functional description

Table 4. Function table^[1]

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

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

8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|------------------|---------------------------|---|---------|------|------|
| V _{CC} | supply voltage | | -0.5 | +7.0 | V |
| I _{IK} | input clamping current | V _I < -0.5 V or V _I > V _{CC} + 0.5 V | [1] - | ±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 | V _O = -0.5 V to (V _{CC} + 0.5 V) | [1] - | 25 | mA |
| I _{CC} | supply current | | [1] - | 50 | mA |
| I _{GND} | ground current | | [1] -50 | - | mA |
| T _{stg} | storage temperature | | -65 | +150 | °C |
| P _D | dynamic power dissipation | T _{amb} = -40 °C to +125 °C | [2] - | 300 | 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 with 2.5 mW/K.
 For VSSOP8 package: above 110 °C the value of P_{tot} derates linearly with 8 mW/K.
 For XSON8 package: above 45 °C the value of P_{tot} derates linearly with 2.4 mW/K.

9. Recommended operating conditions

Table 6. Recommended operating conditions

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

| Symbol | Parameter | Conditions | 74HC3G04 | | | 74HCT3G04 | | | Unit |
|------------------|-------------------------------------|-------------------------|----------|------|-----------------|-----------|------|-----------------|------|
| | | | Min | Typ | Max | Min | Typ | Max | |
| V _{CC} | supply voltage | | 2.0 | 5.0 | 6.0 | 4.5 | 5.0 | 5.5 | V |
| V _I | input voltage | | 0 | - | V _{CC} | 0 | - | V _{CC} | V |
| V _O | output voltage | | 0 | - | V _{CC} | 0 | - | V _{CC} | V |
| T _{amb} | ambient temperature | | -40 | +25 | +125 | -40 | +25 | +125 | °C |
| Δt/ΔV | input transition rise and fall rate | V _{CC} = 2.0 V | - | - | 625 | - | - | - | ns/V |
| | | V _{CC} = 4.5 V | - | 1.67 | 139 | - | 1.67 | 139 | ns/V |
| | | V _{CC} = 6.0 V | - | - | 83 | - | - | - | ns/V |

10. Static characteristics

Table 7. Static characteristics

Voltages are referenced to GND (ground = 0 V). All typical values are measured at T_{amb} = 25 °C.

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------|---------------------------|--|----------------|--|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC3G04 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 2.0 V | 1.5 | 1.2 | - | 1.5 | - | 1.5 | - | V |
| | | V _{CC} = 4.5 V | 3.15 | 2.4 | - | 3.15 | - | 3.15 | - | V |
| | | V _{CC} = 6.0 V | 4.2 | 3.2 | - | 4.2 | - | 4.2 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 2.0 V | - | 0.8 | 0.5 | - | 0.5 | - | 0.5 | V |
| | | V _{CC} = 4.5 V | - | 2.1 | 1.35 | - | 1.35 | - | 1.35 | V |
| | | V _{CC} = 6.0 V | - | 2.8 | 1.8 | - | 1.8 | - | 1.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = -20 μA; V _{CC} = 2.0 V | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | I _O = -20 μA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -20 μA; V _{CC} = 6.0 V | 5.9 | 6.0 | - | 5.9 | - | 5.9 | - | V |
| | | I _O = -4.0 mA; V _{CC} = 4.5 V | 4.18 | 4.32 | - | 4.13 | - | 3.7 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = 20 μA; V _{CC} = 2.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 μA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 μA; V _{CC} = 6.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 4.0 mA; V _{CC} = 4.5 V | - | 0.15 | 0.26 | - | 0.33 | - | 0.4 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 6.0 V | - | - | ±0.1 | - | ±1.0 | - | ±1.0 | μA |
| | | I _{CC} | supply current | per input pin; V _{CC} = 6.0 V; V _I = V _{CC} or GND; I _O = 0 A; | - | - | 1.0 | - | 10 | - |

Table 7. Static characteristics ...continued

Voltages are referenced to GND (ground = 0 V). All typical values are measured at $T_{amb} = 25\text{ }^{\circ}\text{C}$.

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|------------------|---------------------------|---|-------|------|-----------|------------------|-----------|-------------------|-----------|---------------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| C_i | input capacitance | | - | 1.5 | - | - | - | - | - | pF |
| 74HCT3G04 | | | | | | | | | | |
| V_{IH} | HIGH-level input voltage | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | 2.0 | 1.6 | - | 2.0 | - | 2.0 | - | V |
| V_{IL} | LOW-level input voltage | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ | - | 1.2 | 0.8 | - | 0.8 | - | 0.8 | V |
| V_{OH} | HIGH-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | | | | |
| | | $I_O = -20\text{ }\mu\text{A}; V_{CC} = 4.5\text{ V}$ | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O = -4.0\text{ mA}; V_{CC} = 4.5\text{ V}$ | 4.18 | 4.32 | - | 4.13 | - | 3.7 | - | V |
| V_{OL} | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | | | | |
| | | $I_O = 20\text{ }\mu\text{A}; V_{CC} = 4.5\text{ V}$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O = 4.0\text{ mA}; V_{CC} = 4.5\text{ V}$ | - | 0.15 | 0.26 | - | 0.33 | - | 0.4 | V |
| I_I | input leakage current | $V_I = V_{CC}$ or GND; $V_{CC} = 5.5\text{ V}$ | - | - | ± 0.1 | - | ± 1.0 | - | ± 1.0 | μA |
| I_{CC} | supply current | per input pin; $V_{CC} = 5.5\text{ V}; V_I = V_{CC}$ or GND; $I_O = 0\text{ A};$ | - | - | 1.0 | - | 10 | - | 20 | μA |
| ΔI_{CC} | additional supply current | per input; $V_{CC} = 4.5\text{ V to }5.5\text{ V}; V_I = V_{CC} - 2.1\text{ V}; I_O = 0\text{ A}$ | - | - | 300 | - | 375 | - | 410 | μA |
| C_i | input capacitance | | - | 1.5 | - | - | - | - | - | pF |

11. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); all typical values are measured at $T_{amb} = 25\text{ }^{\circ}\text{C}$; for test circuit see [Figure 7](#).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC3G04 | | | | | | | | | | |
| t_{pd} | propagation delay | nA to nY; see Figure 6 [1] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 22 | 75 | - | 90 | - | 110 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 8 | 15 | - | 18 | - | 22 | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 6 | 13 | - | 16 | - | 20 | ns |
| t_t | transition time | see Figure 6 [2] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 18 | 75 | - | 95 | - | 125 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 6 | 15 | - | 19 | - | 25 | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 5 | 13 | - | 16 | - | 20 | ns |
| C_{PD} | power dissipation capacitance | $V_I = \text{GND to } V_{CC}$ [3] | - | 9 | - | - | - | - | - | pF |

Table 8. Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V); all typical values are measured at $T_{amb} = 25\text{ }^{\circ}\text{C}$; for test circuit see [Figure 7](#).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|------------------|-------------------------------|---|-------|-----|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HCT3G04 | | | | | | | | | | |
| t_{pd} | propagation delay | nA to nY; see Figure 6 [1] $V_{CC} = 4.5\text{ V}$ | - | 10 | 18 | - | 23 | - | 29 | ns |
| t_t | transition time | $V_{CC} = 4.5\text{ V}$; see Figure 6 [2] | - | 6 | 15 | - | 19 | - | 22 | ns |
| C_{PD} | power dissipation capacitance | $V_I = \text{GND to } V_{CC} - 1.5\text{ V}$ [3] | - | 9 | - | - | - | - | - | pF |

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

[2] t_t is the same as t_{TLH} and t_{THL} .

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

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

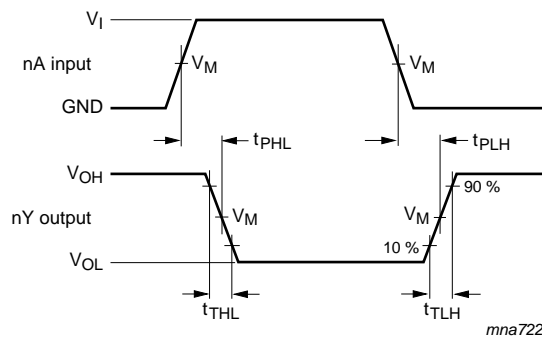
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

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

12. Waveforms



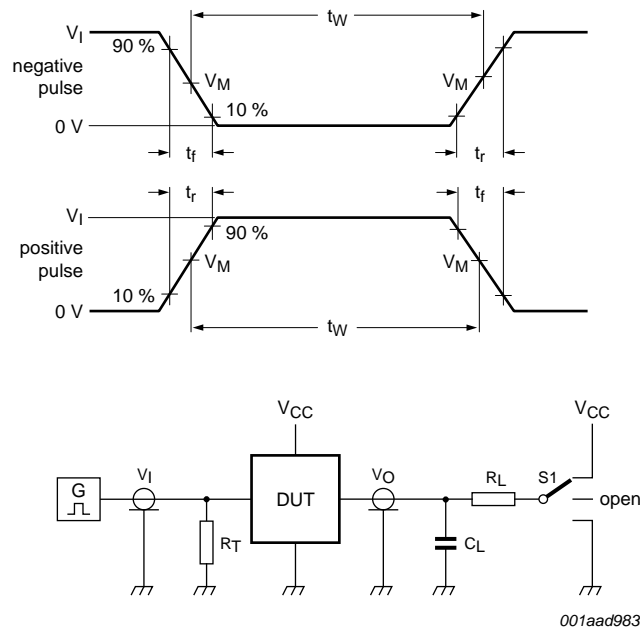
Measurement points are given in [Table 9](#).

Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 6. The data input (nA) to output (nY) propagation delays

Table 9. Measurement points

| Type | Input | Output |
|-----------|---------------------|---------------------|
| | V_M | V_M |
| 74HC3G04 | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT3G04 | 1.3 V | 1.3 V |



Test data is given in [Table 10](#).

Definitions for test circuit:

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

C_L = Load capacitance including jig and probe capacitance.

R_L = Load resistance.

S1 = Test selection switch.

Fig 7. Load circuit for measuring switching times

Table 10. Test data

| Type | Input | | Load | | S1 position |
|-----------|----------|-------------|-------|--------------|--------------------|
| | V_I | t_r, t_f | C_L | R_L | t_{PHL}, t_{PLH} |
| 74HC3G04 | V_{CC} | ≤ 6 ns | 50 pF | 1 k Ω | open |
| 74HCT3G04 | 3 V | ≤ 6 ns | 50 pF | 1 k Ω | open |

13. Package outline

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

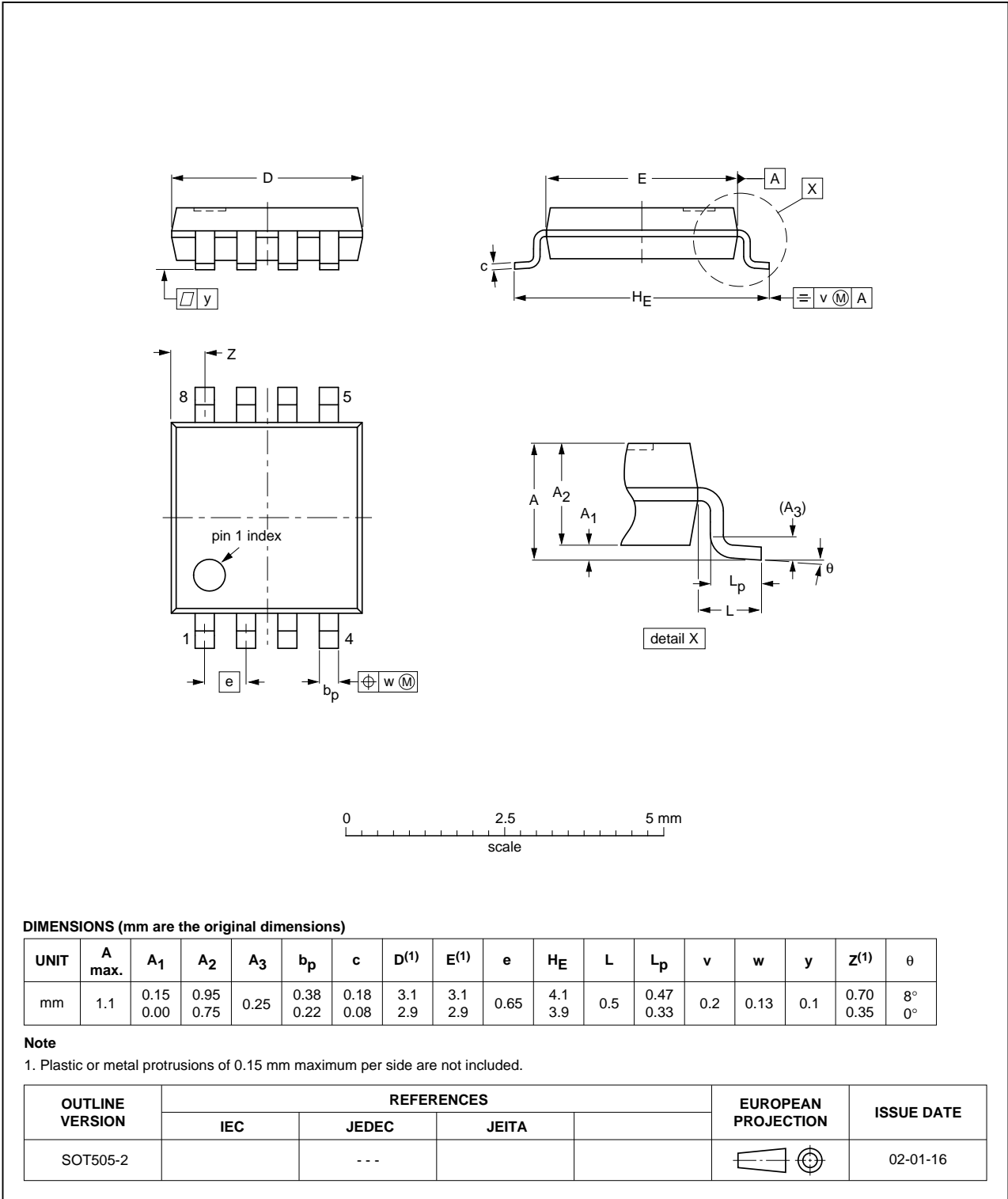


Fig 8. Package outline SOT505-2 (TSSOP8)

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

SOT765-1

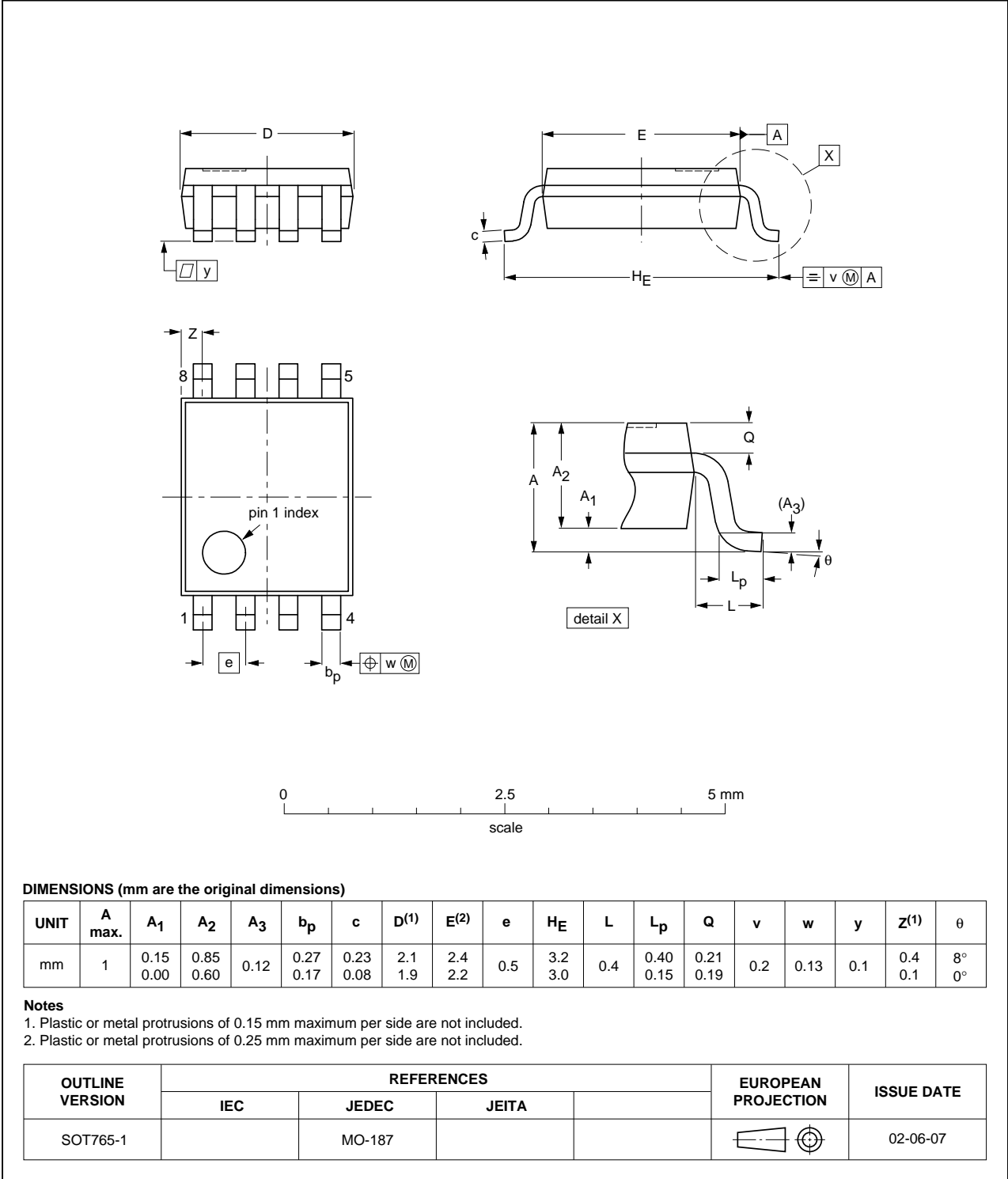


Fig 9. Package outline SOT765-1 (VSSOP8)

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

SOT996-2

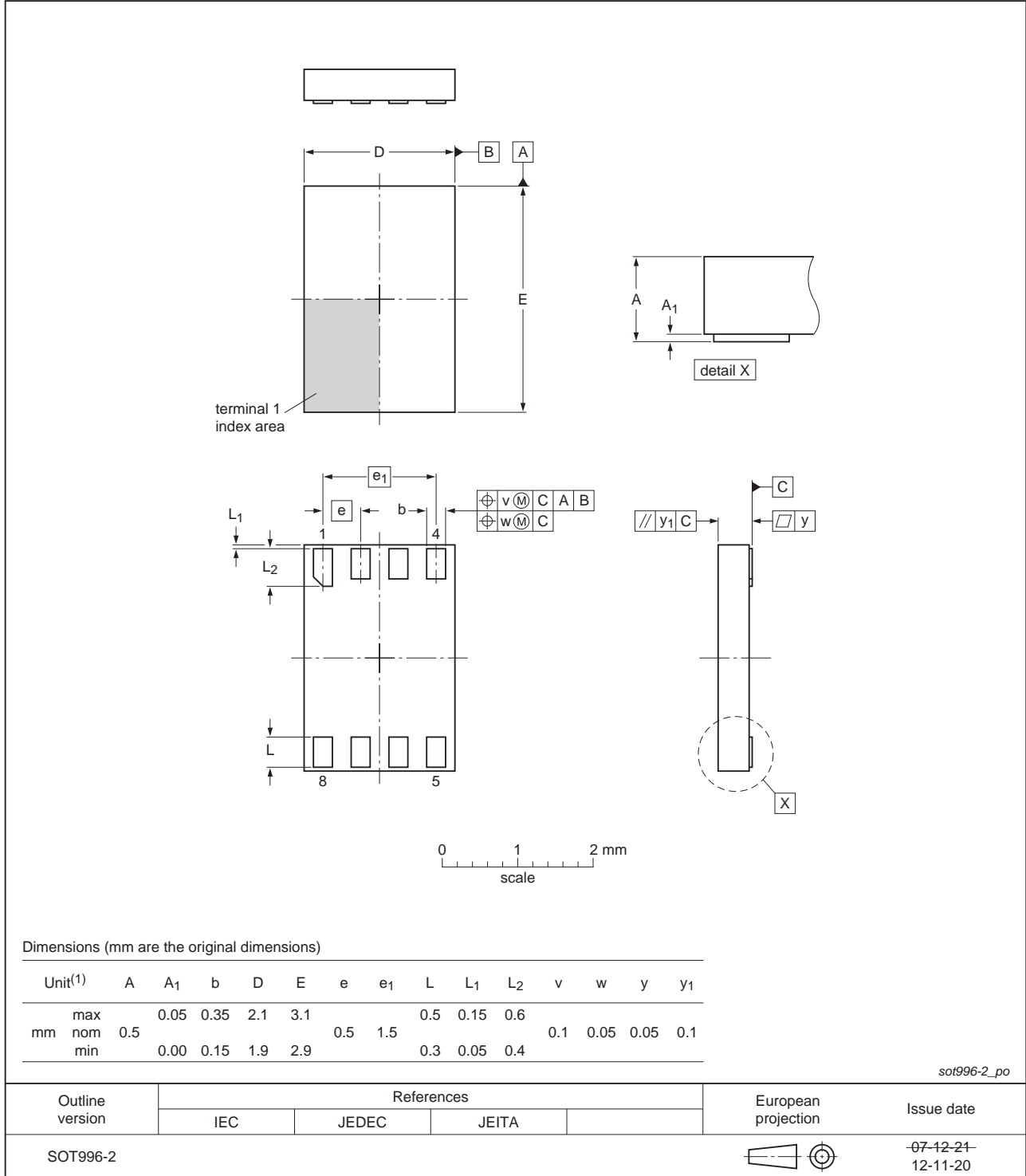


Fig 10. Package outline SOT996-2 (XSON8)

14. Abbreviations

Table 11. Abbreviations

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

15. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------|--|-----------------------|---------------|------------------|
| 74HC_HCT3G04 v.4 | 20131002 | Product data sheet | - | 74HC_HCT3G04 v.3 |
| Modifications: | • For type numbers 74HC3G04GD and 74HCT3G04GD XSON8U has changed to XSON8. | | | |
| 74HC_HCT3G04 v.3 | 20080702 | Product data sheet | - | 74HC_HCT3G04 v.2 |
| 74HC_HCT3G04 v.2 | 20031030 | Product specification | - | 74HC_HCT3G04 v.1 |
| 74HC_HCT3G04 v.1 | 20020726 | Product specification | - | - |

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16.1 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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Date of release: 2 October 2013

Document identifier: 74HC_HCT3G04