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Kind regards,

Team Nexperia

74HC03-Q100; 74HCT03-Q100

Quad 2-input NAND gate

Rev. 1 — 4 July 2013

Product data sheet

1. General description

The 74HC03-Q100; 74HCT03-Q100 is a quad 2-input NAND gate with open-drain outputs. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - ◆ Specified from -40 °C to $+85\text{ °C}$ and from -40 °C to $+125\text{ °C}$
- Input levels:
 - ◆ For 74HC03-Q100: CMOS level
 - ◆ For 74HCT03-Q100: TTL level
- ESD protection:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\ \Omega$)
- Multiple package options

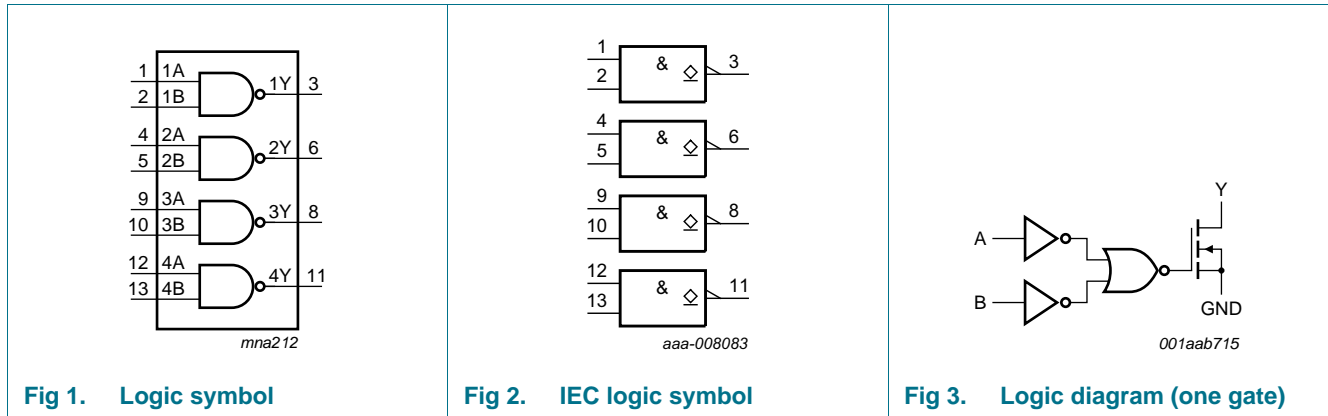
3. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|---------------------------------|-------------------------------------|---------|--|----------|
| | Temperature range | Name | Description | Version |
| 74HC03D-Q100 74HCT03D-Q100 | -40 °C to $+125\text{ °C}$ | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74HC03DB-Q100 74HCT03DB-Q100 | -40 °C to $+125\text{ °C}$ | SSOP14 | plastic shrink small outline package; 14 leads; body width 5.3 mm | SOT337-1 |
| 74HC03PW-Q100 74HCT03PW-Q100 | -40 °C to $+125\text{ °C}$ | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |

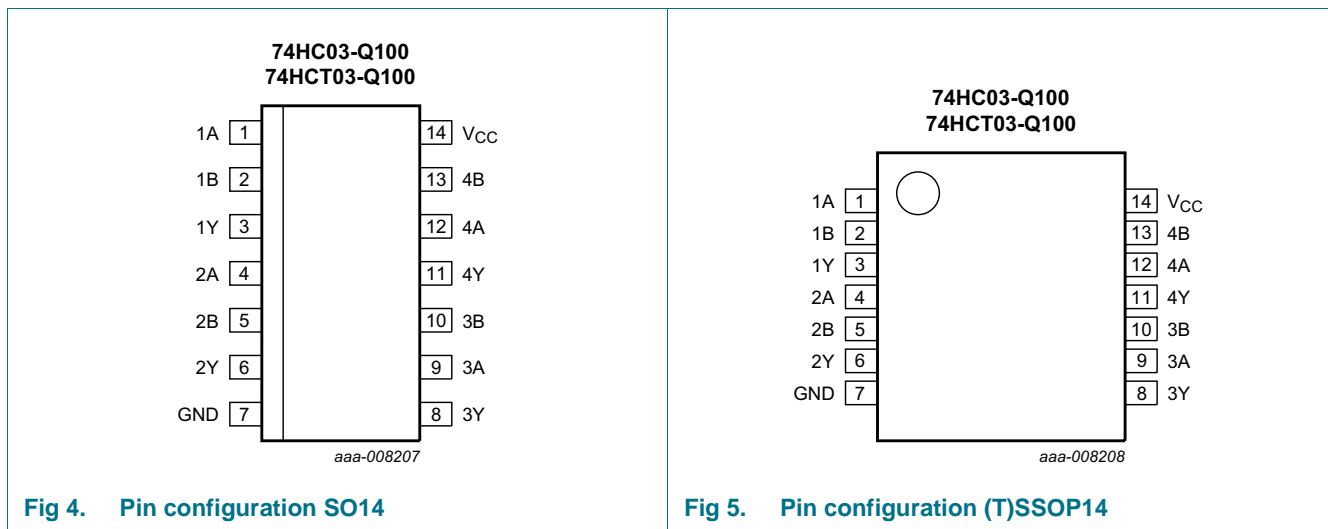


4. Functional diagram



5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|-----------------|--------------|----------------|
| 1A to 4A | 1, 4, 9, 12 | data input |
| 1B to 4B | 2, 5, 10, 13 | data input |
| 1Y to 4Y | 3, 6, 8, 11 | data output |
| GND | 7 | ground (0 V) |
| V _{CC} | 14 | supply voltage |

6. Functional description

Table 3. Function table^[1]

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

[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

7. Limiting values

Table 4. 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 | V |
| V_O | output voltage | | [1] -0.5 | +7 | V |
| I_{IK} | input clamping current | $V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ | [1] - | ± 20 | mA |
| I_{OK} | output clamping current | $V_O < -0.5\text{ V}$ | [1] - | -20 | mA |
| I_O | output current | $-0.5\text{ V} < V_O$ | - | -25 | mA |
| I_{CC} | supply current | | - | 50 | mA |
| I_{GND} | ground current | | -50 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | | [2] | | |
| | SO14 and (T)SSOP14 packages | | - | 500 | mW |

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] For SO14 package: P_{tot} derates linearly with 8 mW/K above 70 °C.
For (T)SSOP14 packages: P_{tot} derates linearly with 5.5 mW/K above 60 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

| Symbol | Parameter | Conditions | 74HC03-Q100 | | | 74HCT03-Q100 | | | 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 |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 2.0\text{ V}$ | - | - | 625 | - | - | - | ns/V |
| | | $V_{CC} = 4.5\text{ V}$ | - | 1.67 | 139 | - | 1.67 | 139 | ns/V |
| | | $V_{CC} = 6.0\text{ V}$ | - | - | 83 | - | - | - | ns/V |

9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions; 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 | |
| 74HC03-Q100 | | | | | | | | | | |
| 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 _{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 _O = 5.2 mA; V _{CC} = 6.0 V | - | 0.16 | 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 | - | ±1 | μA |
| I _{OZ} | OFF-state output current | per input pin; V _I = V _{IL} ; V _O = V _{CC} or GND; other inputs at V _{CC} or GND; V _{CC} = 6.0 V; I _O = 0 A | - | - | ±0.5 | - | ±5.0 | - | ±10 | μA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V | - | 2.0 | - | - | 20 | - | 40 | μA |
| C _I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |
| 74HCT03-Q100 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | 2.0 | 1.6 | - | 2.0 | - | 2.0 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | 1.2 | 0.8 | - | 0.8 | - | 0.8 | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V | | | | | | | | |
| | | I _O = 20 μA | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 4.0 mA | - | 0.15 | 0.26 | - | 0.33 | - | 0.4 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 5.5 V | - | - | ±0.1 | - | ±1 | - | ±1 | μA |
| I _{OZ} | OFF-state output current | per input pin; V _I = V _{IL} ; V _O = V _{CC} or GND; other inputs at V _{CC} or GND; V _{CC} = 5.5 V; I _O = 0 A | - | - | ±0.5 | - | ±5.0 | - | ±10 | μA |

Table 6. Static characteristics ...continued

At recommended operating conditions; 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 | |
| I_{CC} | supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V | - | - | 2.0 | - | 20 | - | 40 | μ A |
| ΔI_{CC} | additional supply current | per input pin; $V_I = V_{CC} - 2.1$ V; $I_O = 0$ A; other inputs at V_{CC} or GND; $V_{CC} = 4.5$ V to 5.5 V | - | 100 | 360 | - | 450 | - | 490 | μ A |
| C_I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |

10. Dynamic characteristics

Table 7. Dynamic characteristics

$GND = 0$ V; $C_L = 50$ pF; for load circuit, see [Figure 7](#).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +125 °C | | Unit |
|--------------------|-------------------------------|--|-------|-----|-----|-------------------|--------------|------|
| | | | Min | Typ | Max | Max (85 °C) | Max (125 °C) | |
| 74HC03-Q100 | | | | | | | | |
| t_{pd} | propagation delay | nA, nB to nY; see Figure 6 [1] | | | | | | |
| | | $V_{CC} = 2.0$ V | - | 28 | 95 | 120 | 145 | ns |
| | | $V_{CC} = 4.5$ V | - | 10 | 19 | 24 | 29 | ns |
| | | $V_{CC} = 5.0$ V; $C_L = 15$ pF | - | 8 | - | - | - | ns |
| | | $V_{CC} = 6.0$ V | - | 8 | 16 | 20 | 25 | ns |
| t_t | transition time | see Figure 6 [2] | | | | | | |
| | | $V_{CC} = 2.0$ V | - | 19 | 75 | 95 | 110 | ns |
| | | $V_{CC} = 4.5$ V | - | 7 | 15 | 19 | 22 | ns |
| | | $V_{CC} = 6.0$ V | - | 6 | 13 | 16 | 19 | ns |
| C_{PD} | power dissipation capacitance | per package; $V_I = GND$ to V_{CC} [3] | - | 4 | - | - | - | pF |

Table 7. Dynamic characteristics ...continued
 GND = 0 V; C_L = 50 pF; for load circuit, see [Figure 7](#).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +125 °C | | Unit | |
|---------------------|-------------------------------|--|-------|-----|-----|-------------------|--------------|------|----|
| | | | Min | Typ | Max | Max (85 °C) | Max (125 °C) | | |
| 74HCT03-Q100 | | | | | | | | | |
| t _{pd} | propagation delay | nA, nB to nY; see Figure 6 | [1] | | | | | | |
| | | V _{CC} = 4.5 V | - | 12 | 24 | 30 | 36 | ns | |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 10 | - | - | - | ns | |
| t _t | transition time | V _{CC} = 4.5 V; see Figure 6 | [2] | - | 7 | 15 | 19 | 22 | ns |
| C _{PD} | power dissipation capacitance | per package; V _I = GND to V _{CC} - 1.5 V | [3] | - | 4 | - | - | - | pF |

- [1] t_{pd} is the same as t_{PLZ} and t_{PZL}.
- [2] t_t is the same as t_{THL}.
- [3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum (C_L \times V_{CC}^2 \times f_o)$ 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;
 N = number of inputs switching;
 $\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11. Waveforms

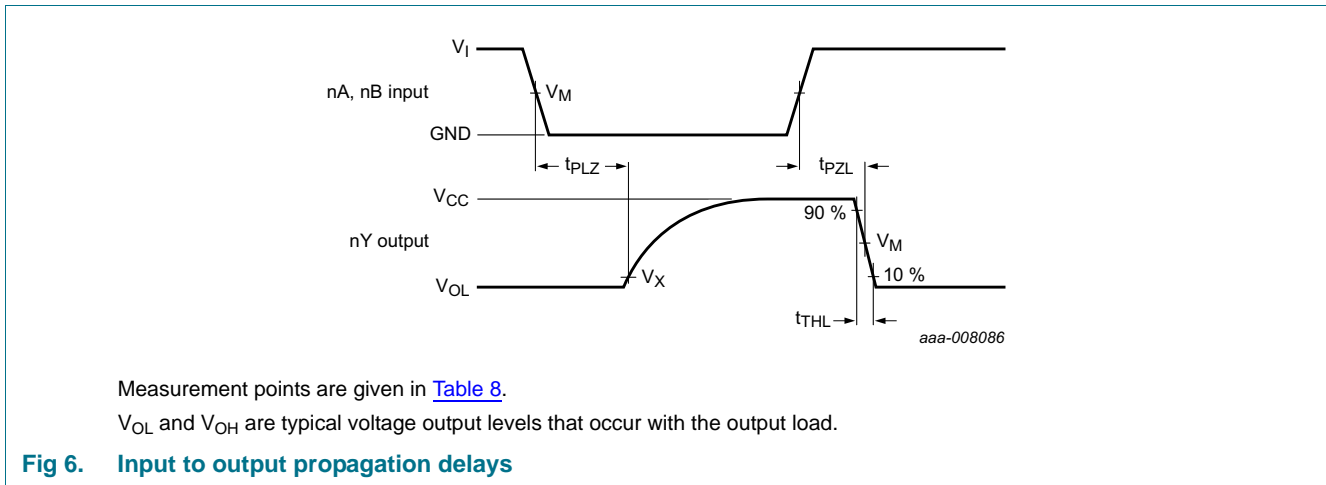


Table 8. Measurement points

| Type | Input | Output | |
|--------------|--------------------|--------------------|--------------------|
| | V _M | V _M | V _X |
| 74HC03-Q100 | 0.5V _{CC} | 0.5V _{CC} | 0.1V _{CC} |
| 74HCT03-Q100 | 1.3 V | 1.3 V | 0.1V _{CC} |

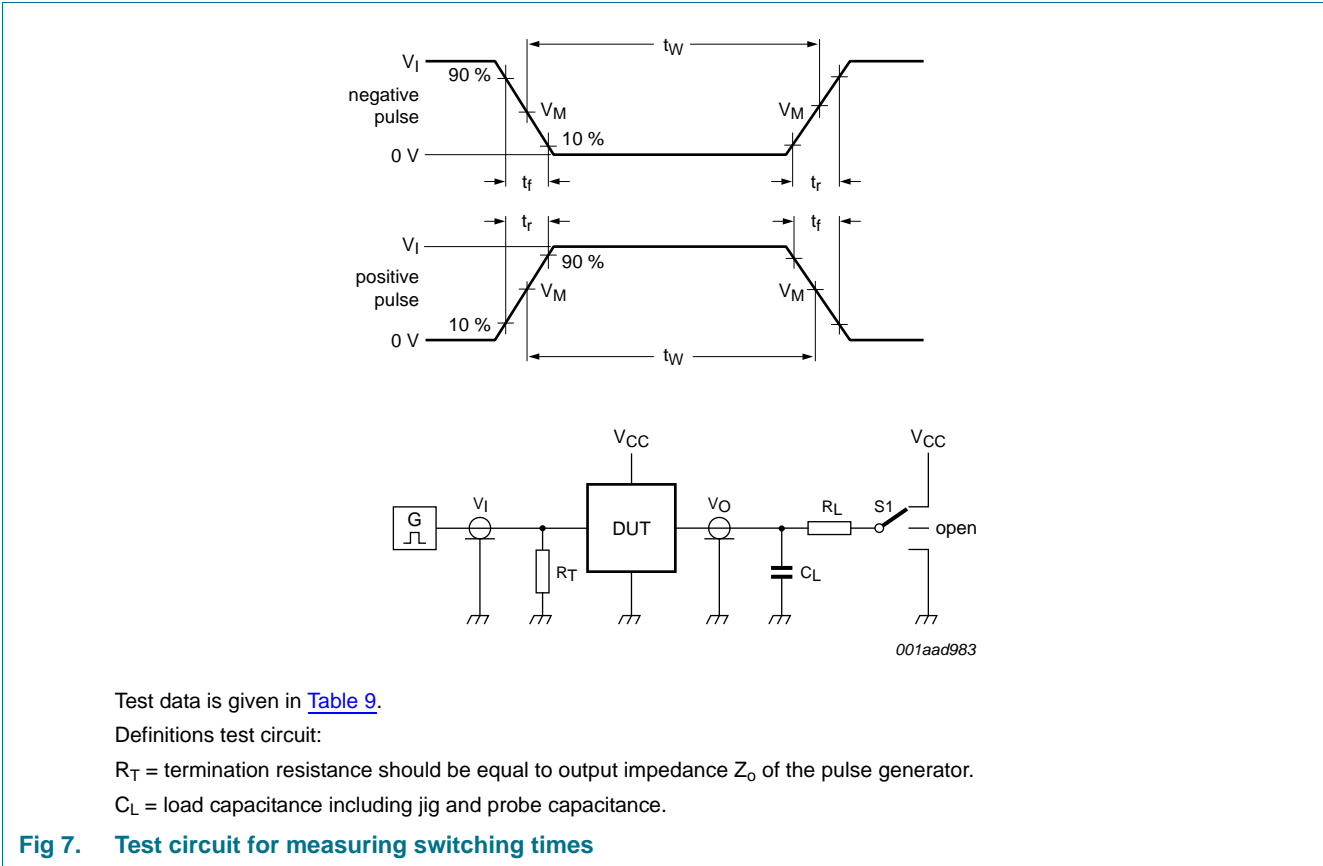


Table 9. Test data

| Type | Input | | Load | | S1 position |
|--------------|----------|------------|--------------|--------------|--------------------|
| | V_I | t_r, t_f | C_L | R_L | t_{PZL}, t_{PLZ} |
| 74HC03-Q100 | V_{CC} | 6 ns | 15 pF, 50 pF | 1 k Ω | V_{CC} |
| 74HCT03-Q100 | 3.0 V | 6 ns | 15 pF, 50 pF | 1 k Ω | V_{CC} |

12. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

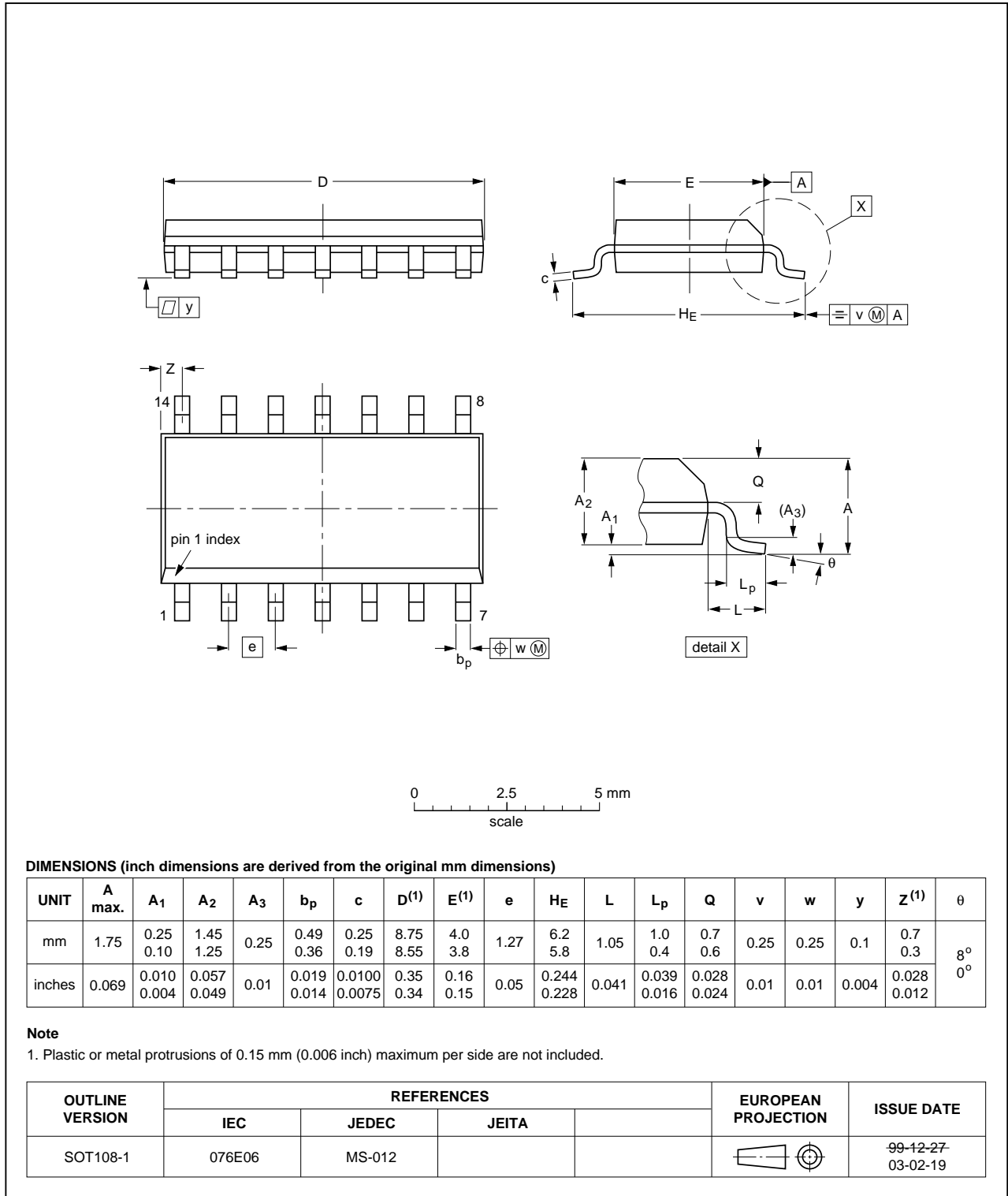


Fig 8. Package outline SOT108-1 (SO14)

SSOP14: plastic shrink small outline package; 14 leads; body width 5.3 mm

SOT337-1

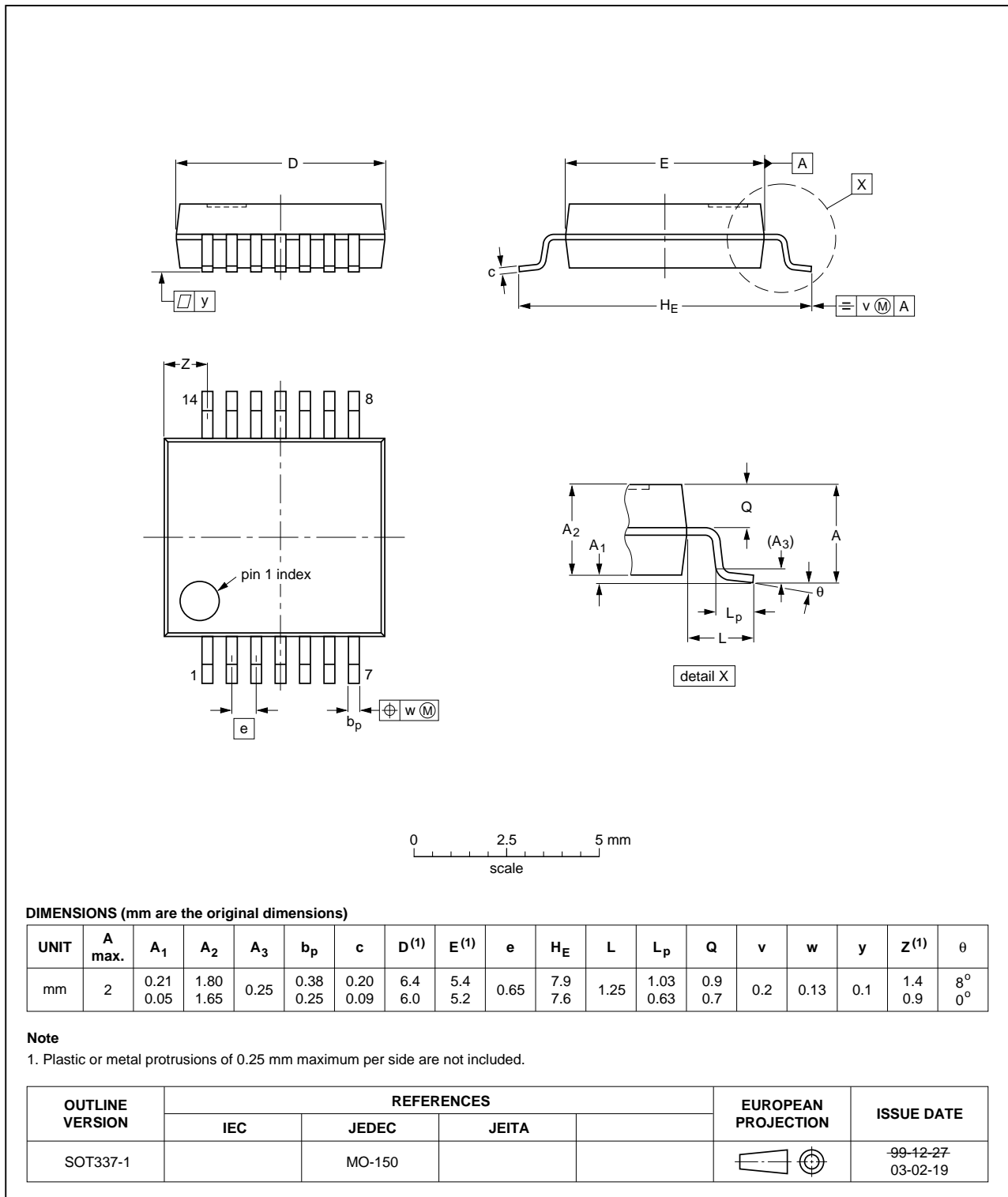


Fig 9. Package outline SOT337-1 (SSOP14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1

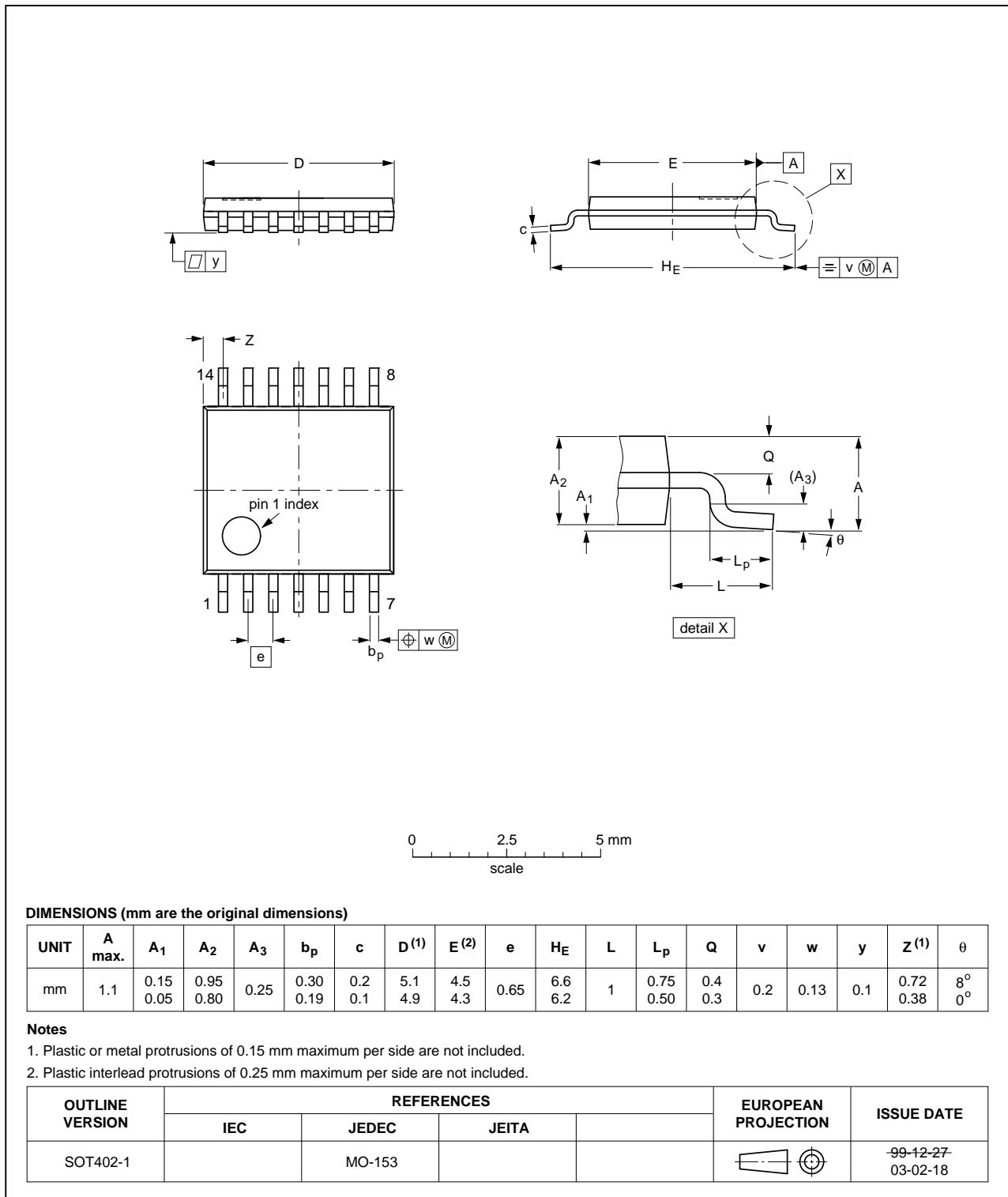


Fig 10. Package outline SOT402-1 (TSSOP14)

13. Abbreviations

Table 10. Abbreviations

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

14. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---------------------|--------------|--------------------|---------------|------------|
| 74HC_HCT03_Q100 v.1 | 20130704 | Product data sheet | - | - |

15. Legal information

15.1 Data sheet status

| Document status ^{[1][2]} | Product status ^[3] | Definition |
|-----------------------------------|-------------------------------|---|
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