

74HC7014-Q100

Hex non-inverting precision Schmitt-trigger

Rev. 1 — 26 May 2014

Product data sheet

1. General description

The 74HC7014-Q100 is a hex buffer with precision Schmitt-trigger inputs. The precisely defined trigger levels are lying in a window between $0.55 \times V_{CC}$ and $0.65 \times V_{CC}$. It makes the circuit suitable to operate in a highly noisy environment. Input shorts are allowed to -1.5 V and $+16\text{ V}$ without disturbing other channels. Inputs include clamp diodes that enable the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} . Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

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 $+125\text{ °C}$
- Operating voltage 3.0 V to 6.0 V
- Complies with JEDEC standard no. 7A
- ESD protection:
 - ◆ MIL-STD-883, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\ \Omega$)

3. Applications

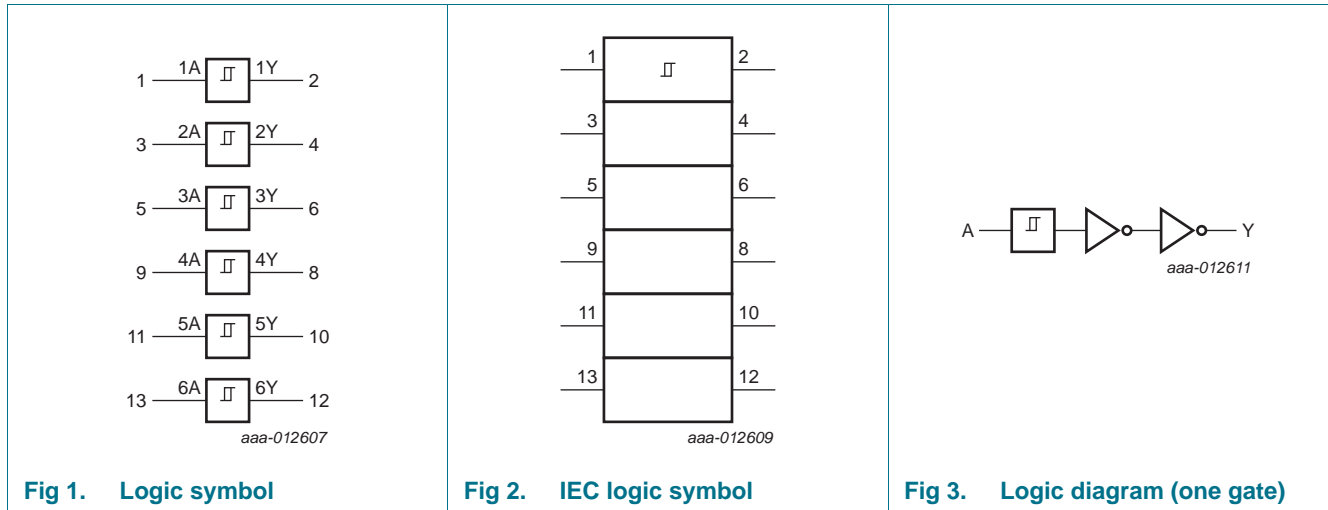
- Wave and pulse shapers for highly noisy environments

4. Ordering information

Table 1. Ordering information

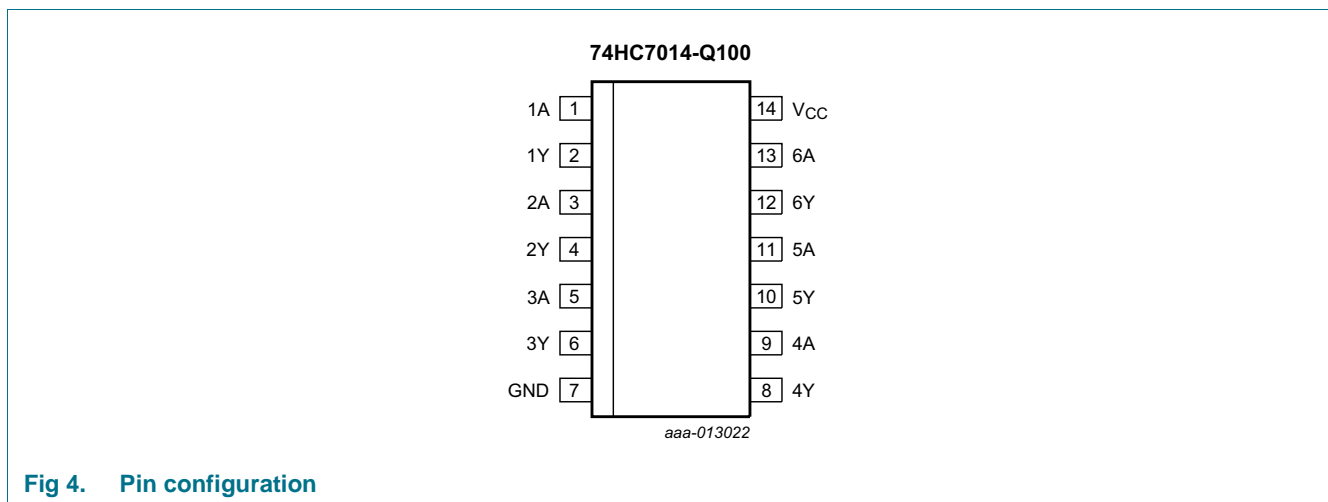
| Type number | Package | | | |
|----------------|-------------------------------------|------|--|----------|
| | Temperature range | Name | Description | Version |
| 74HC7014D-Q100 | -40 °C to $+125\text{ °C}$ | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |

5. Functional diagram



6. Pinning information

6.1 Pinning



6.2 Pin description

Table 2. Pin description

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

7. Functional description

Table 3. Functional table^[1]

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

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

8. 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 |
| 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 | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ ^[1] | - | ±20 | mA |
| I_O | output current | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$ | - | 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 | | - | 500 | mW |

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

[2] For SO14 packages: P_{tot} derates linearly with 5.5 mW/K above 60 °C.

9. Recommended operating conditions

Table 5. 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 | 6.0 | V |
| V_I | input voltage | | 0 | - | V_{CC} | V |
| V_O | output voltage | | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | - | +125 | °C |

10. Static characteristics

Table 6. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | T _{amb} = 25 °C | | | T _{amb} = -40 °C to +85 °C | | T _{amb} = -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 = -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 | 3.98 | 4.32 | - | 3.84 | - | 3.7 | - | V |
| | | I _O = -5.2 mA; V _{CC} = 6.0 V | 5.48 | 5.81 | - | 5.34 | - | 5.2 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{T+} or V _{T-} | | | | | | | | |
| | | 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 _{CC} = 6.00 V; V _I = V _{CC} or GND | - | - | 0.1 | 1.0 | - | 1.0 | - | μA |
| | | V _{CC} = 3.00 V to 6.00 V; V _I = 16 V or GND | - | - | 0.5 | 5.0 | - | 5.0 | - | μA |
| I _{CC} | supply current | V _{CC} = 3.00 V | - | 0.7 | 1.4 | - | 1.8 | - | 2.1 | mA |
| | | V _{CC} = 5.25 V | - | 3.0 | 6.0 | - | 7.5 | - | 7.5 | mA |
| | | V _{CC} = 6.00 V | - | 3.7 | 7.4 | - | 10.0 | - | 13.0 | mA |
| C _I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |

11. Dynamic characteristics

Table 7. Dynamic characteristics

$GND = 0\text{ V}$; for test circuit, see [Figure 6](#).

| Symbol | Parameter | Conditions | $T_{\text{amb}} = 25\text{ °C}$ | | | $T_{\text{amb}} = -40\text{ °C to }+125\text{ °C}$ | | Unit |
|------------------|-------------------------------|---|---------------------------------|-----|-----|--|--------------|------|
| | | | Min | Typ | Max | Max (85 °C) | Max (125 °C) | |
| t_{PHL} | HIGH to LOW propagation delay | nA to nY; see Figure 5 | | | | | | |
| | | $V_{\text{CC}} = 3.00\text{ V}$ | - | 95 | 475 | | 715 | ns |
| | | $V_{\text{CC}} = 4.75\text{ V}$ | - | 38 | 115 | - | 175 | ns |
| | | $V_{\text{CC}} = 6.00\text{ V}$ | - | 27 | 73 | 93 | 112 | ns |
| t_{PLH} | LOW to HIGH propagation delay | nA to nY; see Figure 5 | | | | | | |
| | | $V_{\text{CC}} = 3.00\text{ V}$ | - | 47 | 175 | 220 | 260 | ns |
| | | $V_{\text{CC}} = 4.75\text{ V}$ | - | 23 | 52 | 65 | 78 | ns |
| | | $V_{\text{CC}} = 6.00\text{ V}$ | - | 18 | 46 | 58 | 70 | ns |
| t_{t} | transition time | see Figure 5 [1] | | | | | | |
| | | $V_{\text{CC}} = 3.00\text{ V}$ | - | 12 | 20 | 25 | 30 | ns |
| | | $V_{\text{CC}} = 4.75\text{ V}$ | - | 7 | 15 | 19 | 22 | ns |
| | | $V_{\text{CC}} = 6.00\text{ V}$ | - | 6 | 13 | 16 | 19 | ns |
| C_{PD} | power dissipation capacitance | per gate; $V_{\text{I}} = GND$ to V_{CC} [2] | - | 9 | - | - | - | pF |

[1] t_{t} is the same as t_{THL} and t_{TLH} .

[2] C_{PD} is used to determine the dynamic power dissipation (P_{D} in μW).

$$P_{\text{D}} = C_{\text{PD}} \times V_{\text{CC}}^2 \times f_{\text{i}} \times N + \Sigma(C_{\text{L}} \times V_{\text{CC}}^2 \times f_{\text{o}}) \text{ where:}$$

f_{i} = input frequency in MHz;

f_{o} = output frequency in MHz;

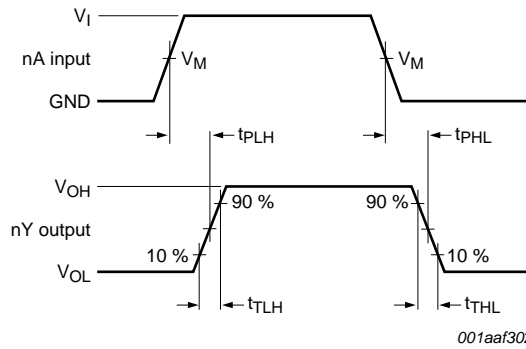
C_{L} = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

$\Sigma(C_{\text{L}} \times V_{\text{CC}}^2 \times f_{\text{o}})$ = sum of outputs.

12. Waveforms

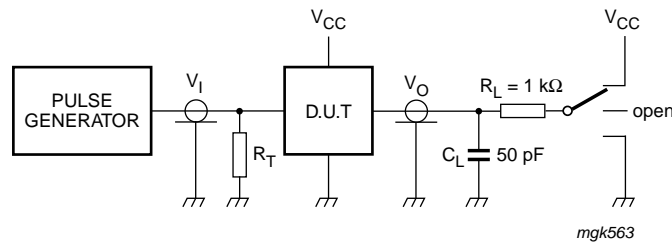


Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 5. The input (nA) to output (nY) propagation delays and output transition times

Table 8. Measurement points

| Type | Input | Output |
|---------------|-------------|-------------|
| | V_M | V_M |
| 74HC7014-Q100 | $0.5V_{CC}$ | $0.5V_{CC}$ |



Test data is given in [Table 9](#).
 Definitions test circuit:
 R_L = Load resistance.
 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. Test circuit for measuring switching times

Table 9. Test data

| Type | Input | t_r, t_f | Test |
|---------------|-----------------|------------|--------------------|
| | V_I | | t_{PHL}, t_{PLH} |
| 74HC7014-Q100 | GND to V_{CC} | 6 ns | open |

13. Transfer characteristics

Table 10. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see [Figure 7](#) and [Figure 8](#).

| Symbol | Parameter | Conditions | $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$ | | | $T_{\text{amb}} = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ | | $T_{\text{amb}} = -40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | | Unit |
|----------------|-------------------------------------|---------------------------------|---|------|------|--|------|---|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| V_{T+} | positive-going threshold voltage | $V_{\text{CC}} = 3.00\text{ V}$ | - | 1.86 | 1.95 | - | 1.95 | - | 1.95 | V |
| | | $V_{\text{CC}} = 4.75\text{ V}$ | - | 2.94 | 3.08 | - | 3.08 | - | 3.08 | V |
| | | $V_{\text{CC}} = 5.00\text{ V}$ | - | 3.10 | 3.25 | - | 3.25 | - | 3.25 | V |
| | | $V_{\text{CC}} = 5.25\text{ V}$ | - | 3.25 | 3.41 | - | 3.41 | - | 3.41 | V |
| | | $V_{\text{CC}} = 6.00\text{ V}$ | - | 3.72 | 3.90 | - | 3.90 | - | 3.90 | V |
| V_{T-} | negative-going threshold voltage | $V_{\text{CC}} = 3.00\text{ V}$ | 1.65 | 1.74 | - | 1.65 | - | 1.65 | - | V |
| | | $V_{\text{CC}} = 4.75\text{ V}$ | 2.62 | 2.76 | - | 2.62 | - | 2.62 | - | V |
| | | $V_{\text{CC}} = 5.00\text{ V}$ | 2.75 | 2.90 | - | 2.75 | - | 2.75 | - | V |
| | | $V_{\text{CC}} = 5.25\text{ V}$ | 2.89 | 3.05 | - | 2.89 | - | 2.89 | - | V |
| | | $V_{\text{CC}} = 6.00\text{ V}$ | 3.30 | 3.48 | - | 3.30 | - | 3.30 | - | V |
| V_{H} | hysteresis voltage | $V_{\text{CC}} = 3.00\text{ V}$ | 50 | 120 | - | 50 | - | 50 | - | V |
| | | $V_{\text{CC}} = 4.75\text{ V}$ | 100 | 180 | - | 100 | - | 100 | - | V |
| | | $V_{\text{CC}} = 5.00\text{ V}$ | 120 | 200 | - | 120 | - | 120 | - | V |
| | | $V_{\text{CC}} = 5.25\text{ V}$ | 130 | 210 | - | 130 | - | 130 | - | V |
| | | $V_{\text{CC}} = 6.00\text{ V}$ | 160 | 240 | - | 160 | - | 160 | - | V |

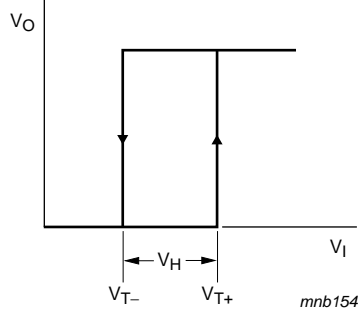
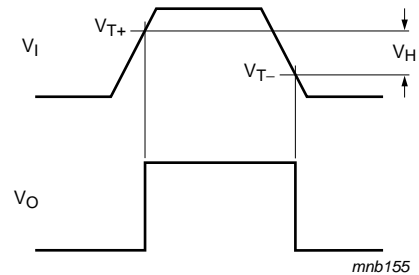


Fig 7. Transfer characteristic



V_{T+} and V_{T-} limits at 70 % and 20 %.

Fig 8. Definition of V_{T+} , V_{T-} and V_{H}

14. Package outline

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

SOT108-1

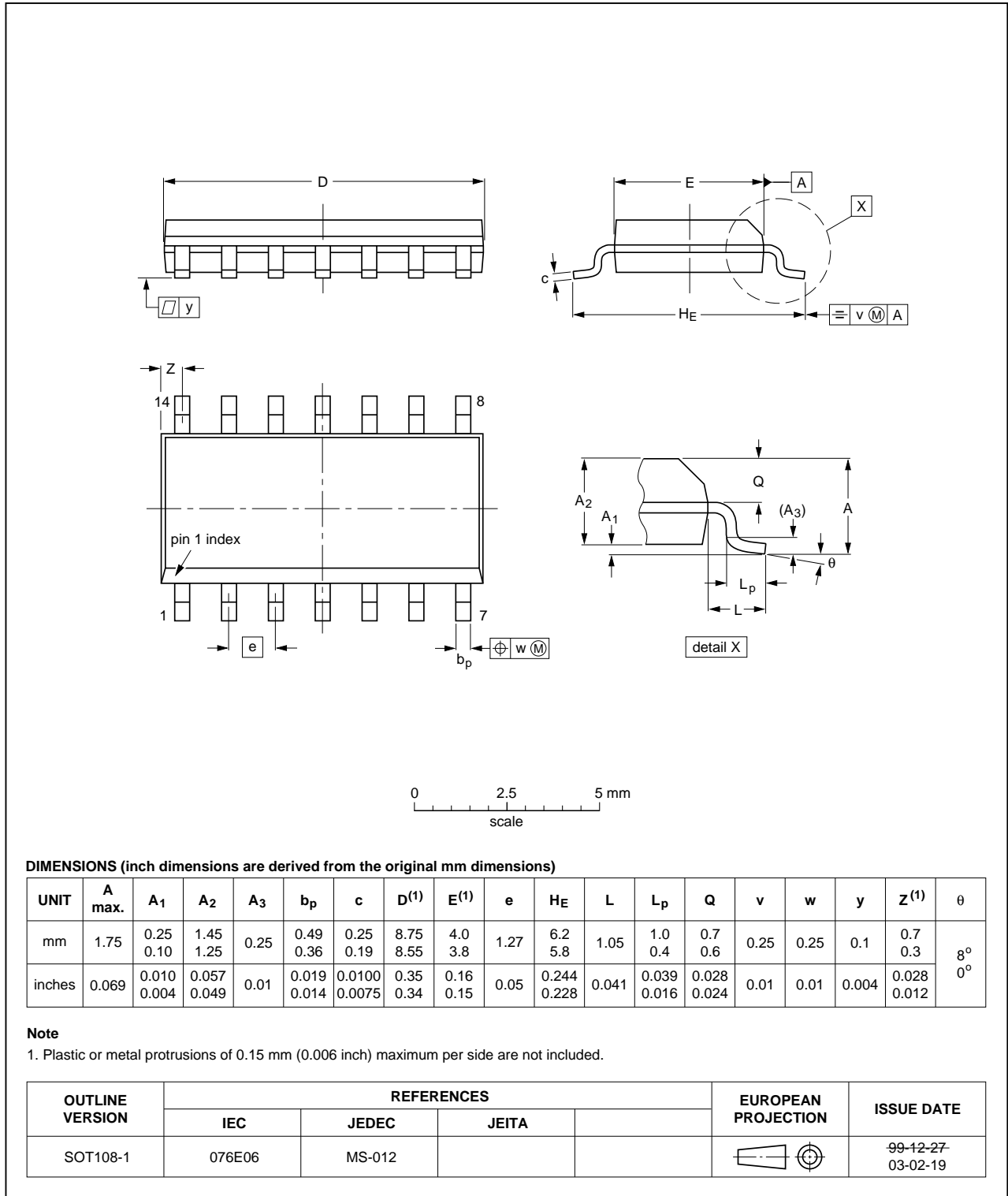


Fig 9. Package outline SOT108-1 (SO14)

15. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|-------------------------|
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MIL | Military |
| MM | Machine Model |

16. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-------------------|--------------|--------------------|---------------|------------|
| 74HC7014_Q100 v.1 | 20140526 | Product data sheet | - | - |

17. Legal information

17.1 Data sheet status

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