

74HC2G00-Q100; 74HCT2G00-Q100

Dual 2-input NAND gate

Rev. 1 — 7 November 2013

Product data sheet

1. General description

The 74HC2G00-Q100; 74HCT2G00-Q100 is a dual 2-input NAND gate. 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 $+85^{\circ}\text{C}$ and from -40°C to $+125^{\circ}\text{C}$
- Wide supply voltage range from 2.0 V to 6.0 V
- Input levels:
 - ◆ For 74HC2G00-Q100: CMOS level
 - ◆ For 74HCT2G00-Q100: TTL level
- Symmetrical output impedance
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- Multiple package options
- 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. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|------------------|---|--------|--|----------|
| | Temperature range | Name | Description | Version |
| 74HC2G00DP-Q100 | -40°C to $+125^{\circ}\text{C}$ | TSSOP8 | plastic thin shrink small outline package; 8 leads; body width 3 mm; lead length 0.5 mm | SOT505-2 |
| 74HCT2G00DP-Q100 | | | | |
| 74HC2G00DC-Q100 | -40°C to $+125^{\circ}\text{C}$ | VSSOP8 | plastic very thin shrink small outline package; 8 leads; body width 2.3 mm | SOT765-1 |
| 74HCT2G00DC-Q100 | | | | |



4. Marking

Table 2. Marking code

| Type number | Marking code ^[1] |
|------------------|-----------------------------|
| 74HC2G00DP-Q100 | H00 |
| 74HCT2G00DP-Q100 | T00 |
| 74HC2G00DC-Q100 | H00 |
| 74HCT2G00DC-Q100 | T00 |

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

5. Functional diagram

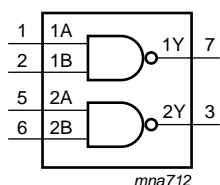


Fig 1. Logic symbol

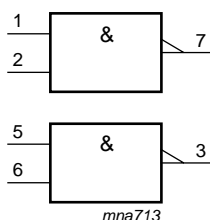


Fig 2. IEC logic symbol

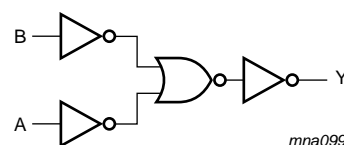


Fig 3. Logic diagram (one driver)

6. Pinning information

6.1 Pinning

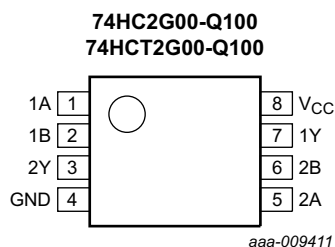


Fig 4. Pin configuration SOT505-2 (TSSOP8) and SOT765-1 (VSSOP8)

6.2 Pin description

Table 3. Pin description

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

7. Functional description

Table 4. Function table^[1]

| Input | | Output |
|-------|----|--------|
| nA | nB | nY |
| L | L | H |
| L | H | H |
| H | L | H |
| 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 | $V_I < -0.5 \text{ V}$ 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 | $V_O = -0.5 \text{ V}$ to $(V_{CC} + 0.5 \text{ V})$ | [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 | $T_{amb} = -40 \text{ °C}$ to $+125 \text{ °C}$ | [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.

9. Recommended operating conditions

Table 6. Recommended operating conditions

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

| Symbol | Parameter | Conditions | 74HC2G00-Q100 | | | 74HCT2G00-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 |

10. Static characteristics

Table 7. Static characteristics

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

| Symbol | Parameter | Conditions | −40 °C to +85 °C | | | −40 °C to +125 °C | | Unit |
|-----------------|---------------------------|---|------------------|------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | |
| 74HC2G00-Q100 | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 2.0 V | 1.5 | 1.2 | - | 1.5 | - | V |
| | | V _{CC} = 4.5 V | 3.15 | 2.4 | - | 3.15 | - | V |
| | | V _{CC} = 6.0 V | 4.2 | 3.2 | - | 4.2 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 2.0 V | - | 0.8 | 0.5 | - | 0.5 | V |
| | | V _{CC} = 4.5 V | - | 2.1 | 1.35 | - | 1.35 | V |
| | | V _{CC} = 6.0 V | - | 2.8 | 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 | - | V |
| | | I _O = −20 μA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | V |
| | | I _O = −20 μA; V _{CC} = 6.0 V | 5.9 | 6.0 | - | 5.9 | - | V |
| | | I _O = −4.0 mA; V _{CC} = 4.5 V | 4.13 | 4.32 | - | 3.7 | - | V |
| | | I _O = −5.2 mA; V _{CC} = 6.0 V | 5.63 | 5.81 | - | 5.2 | - | 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 | V |
| | | I _O = 20 μA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | V |
| | | I _O = 20 μA; V _{CC} = 6.0 V | - | 0 | 0.1 | - | 0.1 | V |
| | | I _O = 4.0 mA; V _{CC} = 4.5 V | - | 0.15 | 0.33 | - | 0.4 | V |
| | | I _O = 5.2 mA; V _{CC} = 6.0 V | - | 0.16 | 0.33 | - | 0.4 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 6.0 V | - | - | ±1.0 | - | ±1.0 | μA |
| I _{CC} | supply current | per input pin; V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V | - | - | 10 | - | 20 | μA |
| C _I | input capacitance | | - | 1.5 | - | - | - | pF |

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 | –40 °C to +85 °C | | | –40 °C to +125 °C | | Unit |
|------------------|---------------------------|---|------------------|------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | |
| 74HCT2G00-Q100 | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | 2.0 | 1.6 | - | 2.0 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | 1.2 | 0.8 | - | 0.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | |
| | | I _O = –20 µA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | V |
| | | I _O = –4.0 mA; V _{CC} = 4.5 V | 4.13 | 4.32 | - | 3.7 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | |
| | | I _O = 20 µA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | V |
| | | I _O = 4.0 mA; V _{CC} = 4.5 V | - | 0.15 | 0.33 | - | 0.4 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 5.5 V | - | - | ±1.0 | - | ±1.0 | µA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V | - | - | 10 | - | 20 | µA |
| ΔI _{CC} | additional supply current | per input; V _{CC} = 4.5 V to 5.5 V; V _I = V _{CC} – 2.1 V; I _O = 0 A | - | - | 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 6](#).

| Symbol | Parameter | Conditions | –40 °C to +85 °C | | | –40 °C to +125 °C | | Unit |
|-----------------|-------------------------------|---|---------------------|-----|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | |
| 74HC2G00-Q100 | | | | | | | | |
| t _{pd} | propagation delay | nA and nB to nY; see Figure 5 | [1] | | | | | |
| | | V _{CC} = 2.0 V | - | 25 | 95 | - | 110 | ns |
| | | V _{CC} = 4.5 V | - | 9 | 19 | - | 22 | ns |
| | | V _{CC} = 6.0 V | - | 7 | 16 | - | 20 | ns |
| t _t | transition time | see Figure 5 | [2] | | | | | |
| | | V _{CC} = 2.0 V | - | 18 | 95 | - | 125 | ns |
| | | V _{CC} = 4.5 V | - | 6 | 19 | - | 25 | ns |
| | | V _{CC} = 6.0 V | - | 5 | 16 | - | 20 | ns |
| C _{PD} | power dissipation capacitance | V _I = GND to V _{CC} | [3] | - | 10 | - | - | 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 6](#).

| Symbol | Parameter | Conditions | –40 °C to +85 °C | | | –40 °C to +125 °C | | Unit | |
|-----------------|-------------------------------|---|---------------------|-----|-----|-------------------|-----|------|----|
| | | | Min | Typ | Max | Min | Max | | |
| 74HCT2G00-Q100 | | | | | | | | | |
| t _{pd} | propagation delay | nA and nB to nY; see Figure 5 | [1] | | | | | | |
| | | V _{CC} = 4.5 V | - | 12 | 24 | - | 29 | ns | |
| t _t | transition time | V _{CC} = 4.5 V; see Figure 5 | [2] | - | 6 | 19 | - | 22 | ns |
| C _{PD} | power dissipation capacitance | V _I = GND to V _{CC} – 1.5 V | [3] | - | 10 | - | - | - | 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;

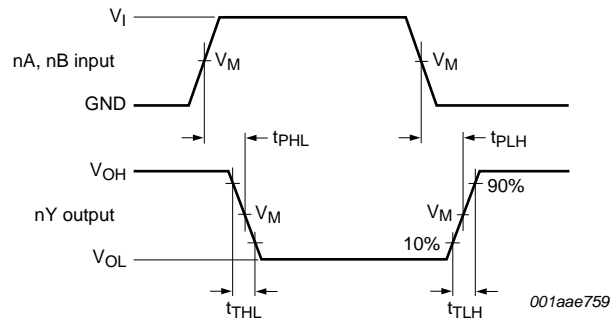
C_L = output load capacitance in pF;

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



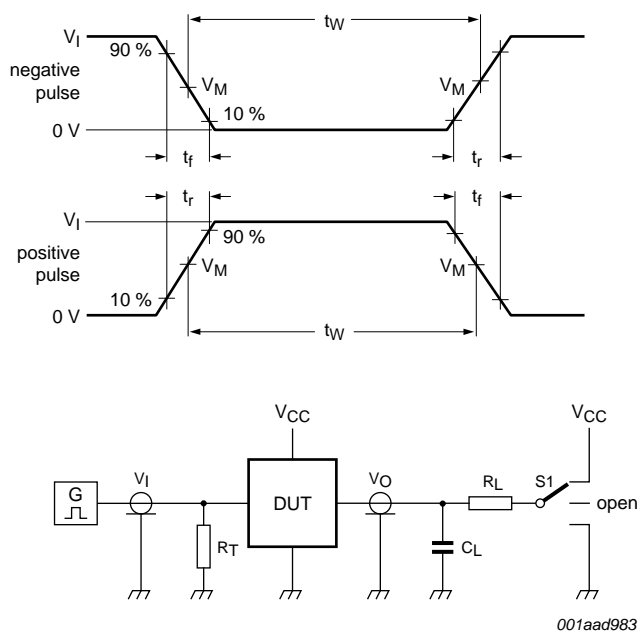
Measurement points are given in [Table 9](#).

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

Fig 5. Propagation delay data input (nA, nB) to data output (nY) and transition time output (nY)

Table 9. Measurement points

| Type | Input | Output |
|----------------|---------------------|---------------------|
| | V_M | V_M |
| 74HC2G00-Q100 | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT2G00-Q100 | 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 6. Test 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} |
| 74HC2G00-Q100 | V_{CC} | ≤ 6 ns | 50 pF | 1 k Ω | open |
| 74HCT2G00-Q100 | 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

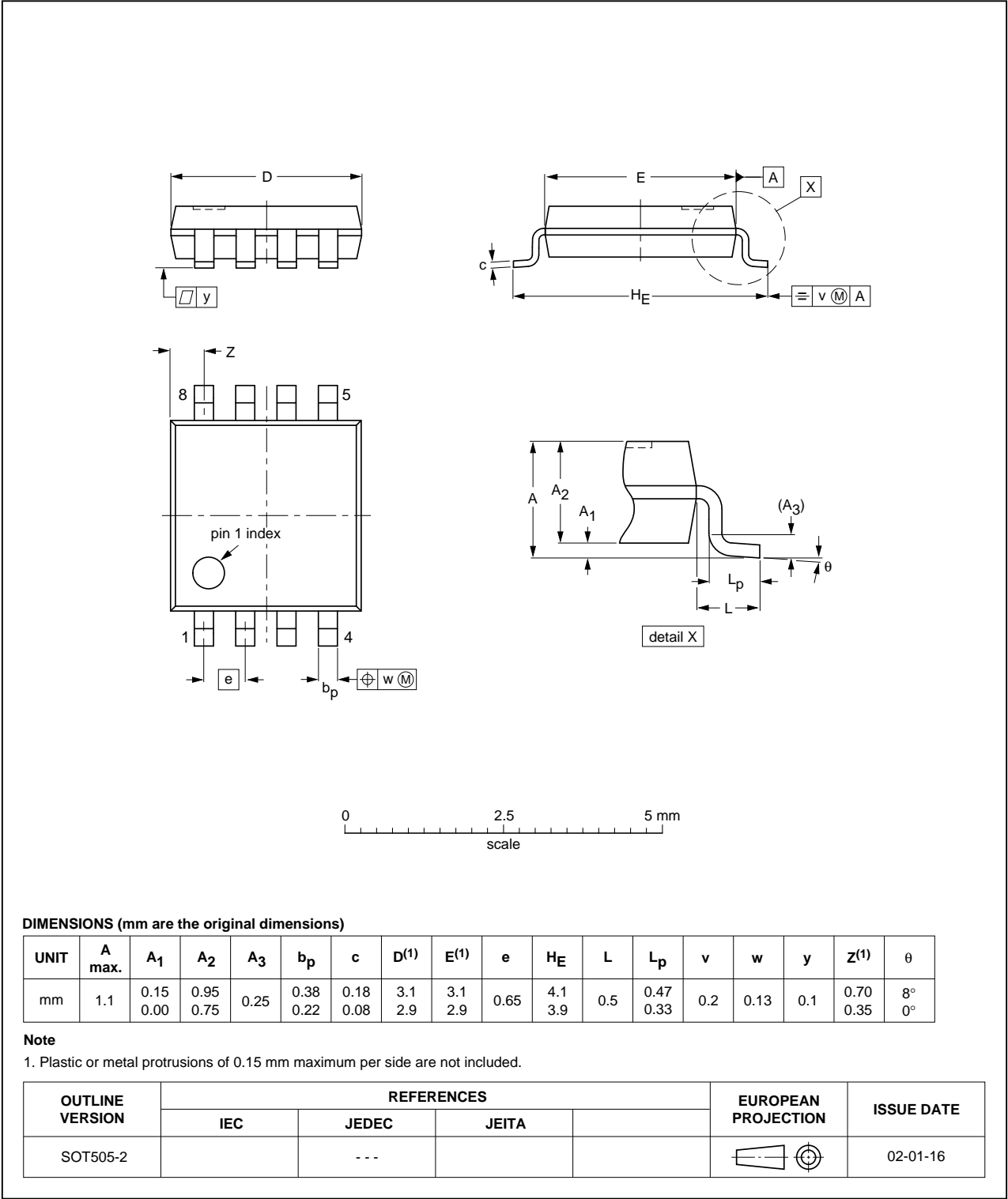


Fig 7. Package outline SOT505-2 (TSSOP8)

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

SOT765-1

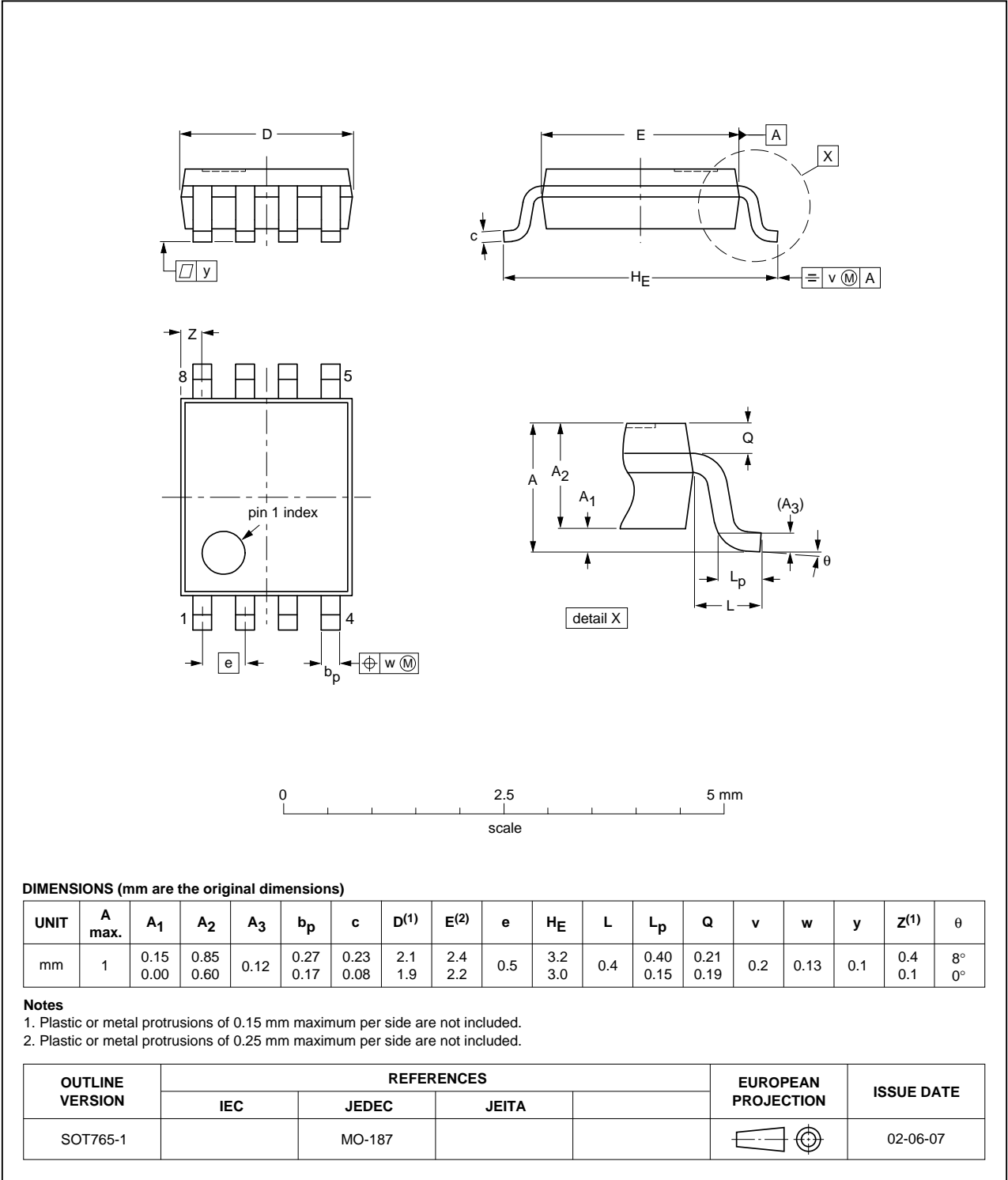


Fig 8. Package outline SOT765-1 (VSSOP8)

14. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|---|
| CMOS | Complementary Metal-Oxide Semiconductor |
| 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_HCT2G00_Q100 v.1 | 20131107 | Product data sheet | - | - |

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16.1 Data sheet status

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