

# 74HC2G00-Q100; 74HCT2G00-Q100

Dual 2-input NAND gate

Rev. 2 — 20 November 2018

Product data sheet

## 1. General description

The 74HC2G00-Q100; 74HCT2G00-Q100 is a dual 2-input NAND gate. Inputs include clamp diodes. This enables 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 °C and from -40 °C to +125 °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
- 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 pF; R = 0 Ω)

## 3. Ordering information

Table 1. Ordering information

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

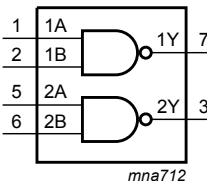
## 4. Marking

Table 2. Marking code

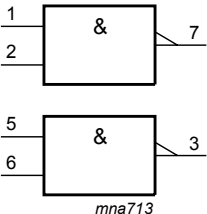
| Type number      | Marking code <sup>[1]</sup> |
|------------------|-----------------------------|
| 74HC2G00DP-Q100  | H00                         |
| 74HCT2G00DP-Q100 | T00                         |
| 74HC2G00DC-Q100  | H00                         |
| 74HCT2G00DC-Q100 | T00                         |

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

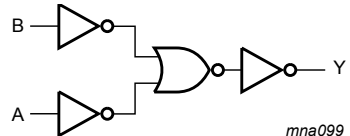
## 5. Functional diagram



**Fig. 1. Logic symbol**



**Fig. 2. IEC logic symbol**

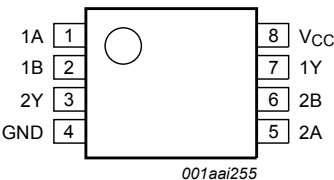


**Fig. 3. Logic diagram (one driver)**

## 6. Pinning information

### 6.1. Pinning

**74HC2G00**  
**74HCT2G00**



**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 <sub>CC</sub> | 8    | supply voltage |

## 7. Functional description

**Table 4. Function table**

*H = HIGH voltage level; L = LOW voltage level.*

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

## 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  |      |
| <b>74HC2G00-Q100</b>  |                           |   |                  |   |      |                   |      |      |
| V <sub>IH</sub>       | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V   | 1.5              | 1.2   | -    | 1.5               | -    | V    |
|                       |                           | V <sub>CC</sub> = 4.5 V   | 3.15             | 2.4   | -    | 3.15              | -    | V    |
|                       |                           | V <sub>CC</sub> = 6.0 V   | 4.2              | 3.2   | -    | 4.2               | -    | V    |
| V <sub>IL</sub>       | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V   | -                | 0.8   | 0.5  | -                 | 0.5  | V    |
|                       |                           | V <sub>CC</sub> = 4.5 V   | -                | 2.1   | 1.35 | -                 | 1.35 | V    |
|                       |                           | V <sub>CC</sub> = 6.0 V   | -                | 2.8   | 1.8  | -                 | 1.8  | V    |
| V <sub>OH</sub>       | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>   |                  |   |      |                   |      |      |
|                       |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V  | 1.9              | 2.0   | -    | 1.9               | -    | V    |
|                       |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V  | 4.4              | 4.5   | -    | 4.4               | -    | V    |
|                       |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V  | 5.9              | 6.0   | -    | 5.9               | -    | V    |
|                       |                           | I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V   | 4.13             | 4.32  | -    | 3.7               | -    | V    |
| V <sub>OL</sub>       | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>   |                  |   |      |                   |      |      |
|                       |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V   | -                | 0   | 0.1  | -                 | 0.1  | V    |
|                       |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V   | -                | 0   | 0.1  | -                 | 0.1  | V    |
|                       |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V   | -                | 0   | 0.1  | -                 | 0.1  | V    |
|                       |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V  | -                | 0.15  | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>        | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V  | -                | -   | ±1.0 | -                 | ±1.0 | μA   |
|                       |                           | I <sub>CC</sub>   | supply current   | per input pin; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V | -    | -                 | 10   | -    |
| C <sub>I</sub>        | input capacitance         |   | -                | 1.5   | -    | -                 | -    | pF   |
| <b>74HCT2G00-Q100</b> |                           |   |                  |   |      |                   |      |      |
| V <sub>IH</sub>       | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V  | 2.0              | 1.6   | -    | 2.0               | -    | V    |
| V <sub>IL</sub>       | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V  | -                | 1.2   | 0.8  | -                 | 0.8  | V    |
| V <sub>OH</sub>       | HIGH-level output voltage | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>   |                  |   |      |                   |      |      |
|                       |                           | I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V  | 4.4              | 4.5   | -    | 4.4               | -    | V    |
|                       |                           | I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V   | 4.13             | 4.32  | -    | 3.7               | -    | V    |
| V <sub>OL</sub>       | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>   |                  |   |      |                   |      |      |
|                       |                           | I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V   | -                | 0   | 0.1  | -                 | 0.1  | V    |
|                       |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V  | -                | 0.15  | 0.33 | -                 | 0.4  | V    |
| I <sub>I</sub>        | input leakage current     | V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V  | -                | -   | ±1.0 | -                 | ±1.0 | μA   |
| I <sub>CC</sub>       | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V                      | -                | -   | 10   | -                 | 20   | μA   |
| ΔI <sub>CC</sub>      | additional supply current | per input; V <sub>CC</sub> = 4.5 V to 5.5 V; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; I <sub>O</sub> = 0 A | -                | -   | 375  | -                 | 410  | μA   |
| C <sub>I</sub>        | 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  $T_{amb} = 25\text{ °C}$ ; for test circuit see Fig. 6.

| Symbol                | Parameter                     | Conditions                                       | -40 °C to +85 °C |     |     | -40 °C to +125 °C |     | Unit |
|-----------------------|-------------------------------|--|------------------|-----|-----|-------------------|-----|------|
|                       |                               |  | Min              | Typ | Max | Min               | Max |      |
| <b>74HC2G00-Q100</b>  |                               |  |                  |     |     |                   |     |      |
| $t_{pd}$              | propagation delay             | nA and nB to nY; see Fig. 5 [1]                  |                  |     |     |                   |     |      |
|                       |                               | $V_{CC} = 2.0\text{ V}$                          | -                | 25  | 95  | -                 | 110 | ns   |
|                       |                               | $V_{CC} = 4.5\text{ V}$                          | -                | 9   | 19  | -                 | 22  | ns   |
|                       |                               | $V_{CC} = 6.0\text{ V}$                          | -                | 7   | 16  | -                 | 20  | ns   |
| $t_t$                 | transition time               | see Fig. 5 [2]                                   |                  |     |     |                   |     |      |
|                       |                               | $V_{CC} = 2.0\text{ V}$                          | -                | 18  | 95  | -                 | 125 | ns   |
|                       |                               | $V_{CC} = 4.5\text{ V}$                          | -                | 6   | 19  | -                 | 25  | ns   |
|                       |                               | $V_{CC} = 6.0\text{ V}$                          | -                | 5   | 16  | -                 | 20  | ns   |
| $C_{PD}$              | power dissipation capacitance | $V_I = \text{GND to } V_{CC}$ [3]                | -                | 10  | -   | -                 | -   | pF   |
| <b>74HCT2G00-Q100</b> |                               |  |                  |     |     |                   |     |      |
| $t_{pd}$              | propagation delay             | nA and nB to nY; see Fig. 5 [1]                  |                  |     |     |                   |     |      |
|                       |                               | $V_{CC} = 4.5\text{ V}$                          | -                | 12  | 24  | -                 | 29  | ns   |
| $t_t$                 | transition time               | $V_{CC} = 4.5\text{ V}$ ; see Fig. 5 [2]         | -                | 6   | 19  | -                 | 22  | ns   |
| $C_{PD}$              | power dissipation capacitance | $V_I = \text{GND to } V_{CC} - 1.5\text{ V}$ [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  $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

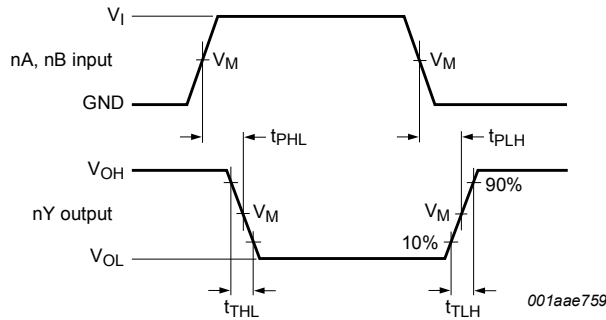
$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in V;

$N$  = number of inputs switching;

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

11.1. Waveforms and test circuit



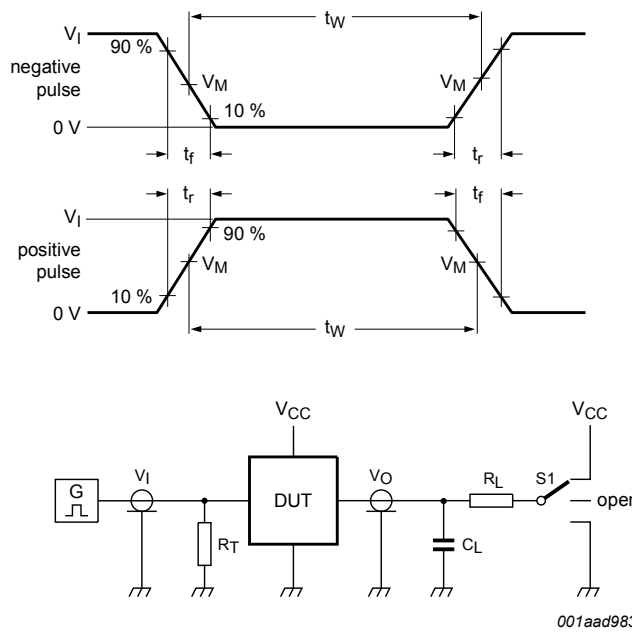
Measurement points are given in Table 9.

$V_{OL}$  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.

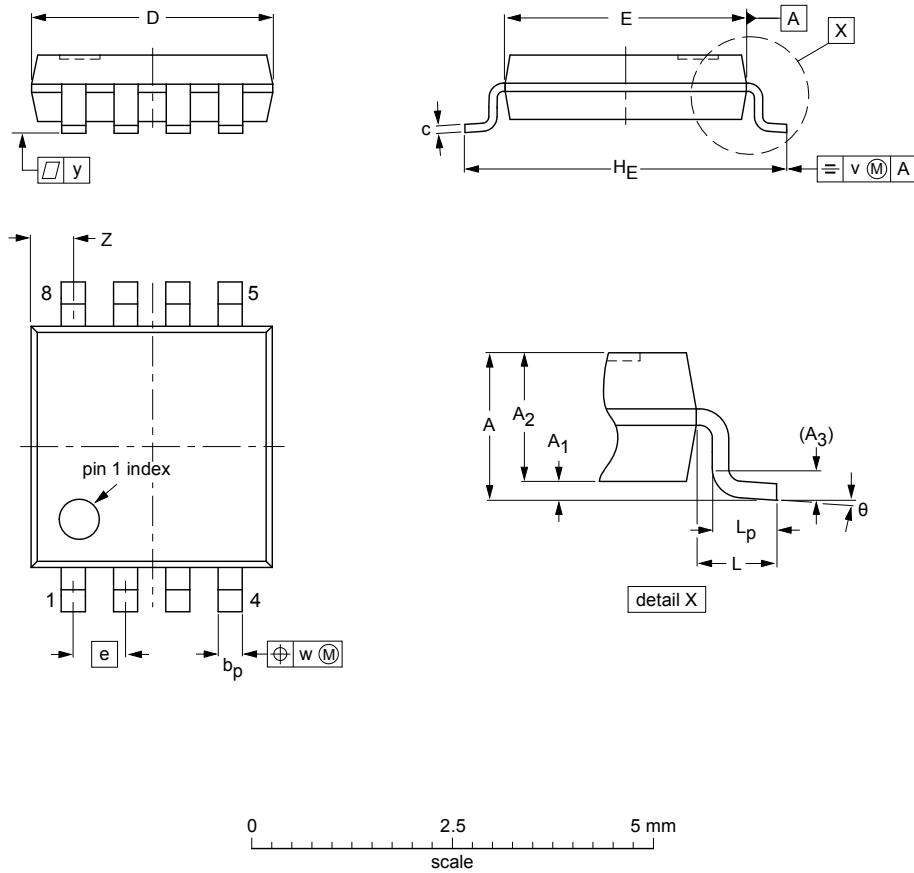
Fig. 6. Test circuit for measuring switching times

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  | $V_{CC}$ | $\leq 6$ ns | 50 pF | 1 k $\Omega$ | open               |
| 74HCT2G00-Q100 | 3 V      | $\leq 6$ ns | 50 pF | 1 k $\Omega$ | open               |

## 12. Package outline

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



**DIMENSIONS** (mm are the original dimensions)

| UNIT | A max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c            | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | H <sub>E</sub> | L   | L <sub>p</sub> | v   | w    | y   | Z <sup>(1)</sup> | θ        |
|------|--------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|------|----------------|-----|----------------|-----|------|-----|------------------|----------|
| mm   | 1.1    | 0.15<br>0.00   | 0.95<br>0.75   | 0.25           | 0.38<br>0.22   | 0.18<br>0.08 | 3.1<br>2.9       | 3.1<br>2.9       | 0.65 | 4.1<br>3.9     | 0.5 | 0.47<br>0.33   | 0.2 | 0.13 | 0.1 | 0.70<br>0.35     | 8°<br>0° |

**Note**

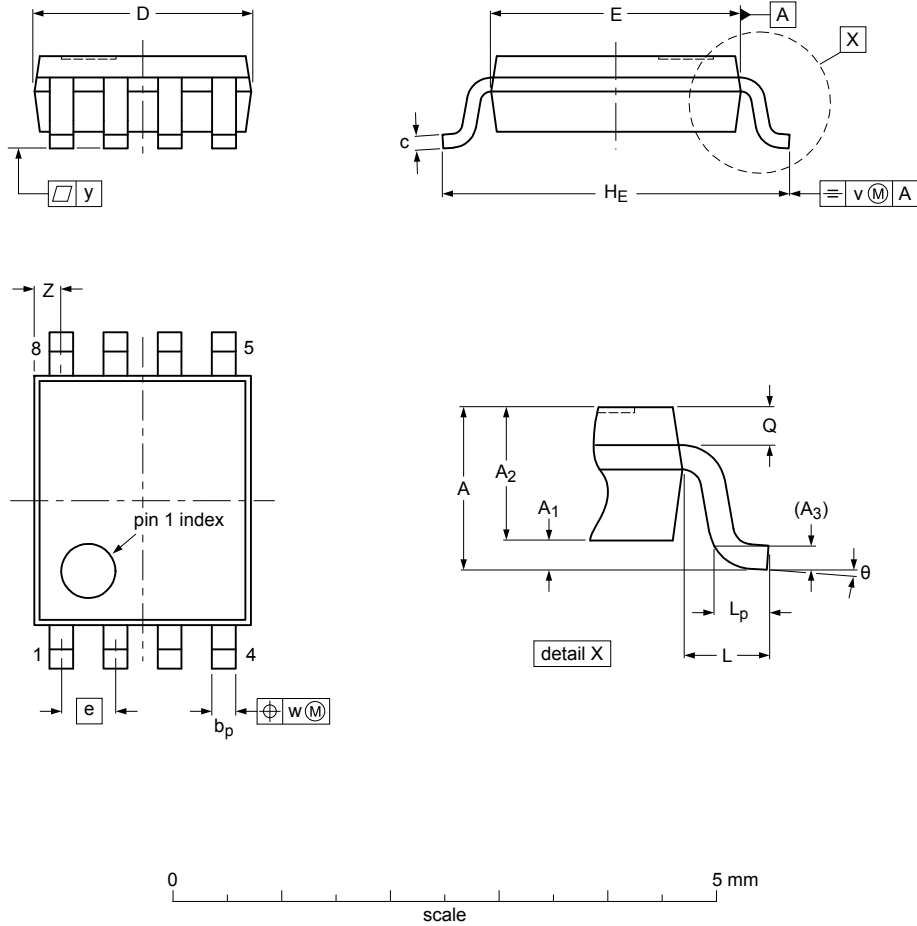
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES |       |       |  | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|-------|-------|--|---------------------|------------|
|                 | IEC        | JEDEC | JEITA |  |                     |            |
| SOT505-2        |            | ---   |       |  |                     | 02-01-16   |

**Fig. 7. Package outline SOT505-2 (TSSOP8)**

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

SOT765-1



Dimensions (mm are the original dimensions)

| Unit | A <sup>A</sup><br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c    | D <sup>(1)</sup> | E <sup>(2)</sup> | e | H <sub>E</sub> | L   | L <sub>p</sub> | Q    | v   | w    | y   | Z <sup>(1)</sup> | θ  |
|------|------------------------|----------------|----------------|----------------|----------------|------|------------------|------------------|---|----------------|-----|----------------|------|-----|------|-----|------------------|----|
| mm   | max                    | 0.15           | 0.85           |                | 0.27           | 0.23 | 2.1              | 2.4              |   | 3.2            |     | 0.40           | 0.21 |     |      |     | 0.4              | 8° |
|      | nom                    | 1              |                | 0.12           |                |      |                  | 0.5              |   |                | 0.4 |                |      | 0.2 | 0.08 | 0.1 |                  |    |
|      | min                    |                | 0.00           | 0.60           | 0.17           | 0.08 | 1.9              | 2.2              |   | 3.0            |     | 0.15           | 0.19 |     |      |     | 0.1              | 0° |

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

sot765-1\_po

| Outline version | References |        |       | European projection | Issue date        |
|-----------------|------------|--------|-------|---------------------|-------------------|
|                 | IEC        | JEDEC  | JEITA |                     |                   |
| SOT765-1        |            | MO-187 |       |                     | 07-06-02-16-05-31 |

Fig. 8. Package outline SOT765-1 (VSSOP8)



## 13. Abbreviations

Table 11. Abbreviations

| Acronym | Description                             |
|---------|---|
| CMOS    | Complementary Metal-Oxide Semiconductor |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| MIL     | Military                                |
| MM      | Machine Model                           |
| TTL     | Transistor-Transistor Logic             |

## 14. Revision history

Table 12. Revision history

| Document ID           | Release date  | Data sheet status  | Change notice | Supersedes            |
|-----------------------|---|--------------------|---------------|-----------------------|
| 74HC_HCT2G00_Q100 v.2 | 20181120  | Product data sheet | -             | 74HC_HCT2G00_Q100 v.1 |
| Modifications:        | <ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul> |                    |               |                       |
| 74HC_HCT2G00_Q100 v.1 | 20131107  | Product data sheet | -             | -                     |

## 15. Legal information

### 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.                       |
| Product [short] data sheet     | Production         | This document contains the product specification.                                     |

- [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".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

### Definitions

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## Contents

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|  |           |
|--|-----------|
| <b>1. General description</b> .....              | <b>1</b>  |
| <b>2. Features and benefits</b> .....            | <b>1</b>  |
| <b>3. Ordering information</b> .....             | <b>1</b>  |
| <b>4. Marking</b> .....                          | <b>2</b>  |
| <b>5. Functional diagram</b> .....               | <b>2</b>  |
| <b>6. Pinning information</b> .....              | <b>2</b>  |
| 6.1. Pinning.....                                | 2         |
| 6.2. Pin description.....                        | 2         |
| <b>7. Functional description</b> .....           | <b>3</b>  |
| <b>8. Limiting values</b> .....                  | <b>3</b>  |
| <b>9. Recommended operating conditions</b> ..... | <b>3</b>  |
| <b>10. Static characteristics</b> .....          | <b>4</b>  |
| <b>11. Dynamic characteristics</b> .....         | <b>5</b>  |
| 11.1. Waveforms and test circuit.....            | 6         |
| <b>12. Package outline</b> .....                 | <b>7</b>  |
| <b>13. Abbreviations</b> .....                   | <b>9</b>  |
| <b>14. Revision history</b> .....                | <b>9</b>  |
| <b>15. Legal information</b> .....               | <b>10</b> |

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