

# 74HC2G02; 74HCT2G02

Dual 2-input NOR gate

Rev. 6 — 26 July 2018

Product data sheet

## 1. General description

The 74HC2G02; 74HCT2G02 is a dual 2-input NOR gate. 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 74HC2G02: CMOS level
  - For 74HCT2G02: TTL level
- Symmetrical output impedance
- High noise immunity
- Complies with JEDEC standard no. 7A (4.5 V to 5.5 V)
- 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 °C to +85 °C and -40 °C to +125 °C

## 3. Ordering information

Table 1. Ordering information

| Type number | Package           |        |  |          |
|-------------|-------------------|--------|--|----------|
|             | Temperature range | Name   | Description  | Version  |
| 74HC2G02DP  | -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 |
| 74HCT2G02DP |                   |        |  |          |
| 74HC2G02DC  | -40 °C to +125 °C | VSSOP8 | plastic very thin shrink small outline package;<br>8 leads; body width 2.3 mm              | SOT765-1 |
| 74HCT2G02DC |                   |        |  |          |

## 4. Marking

Table 2. Marking code

| Type number | Marking code [1] |
|-------------|------------------|
| 74HC2G02DP  | H02              |
| 74HCT2G02DP | T02              |
| 74HC2G02DC  | H02              |
| 74HCT2G02DC | T02              |

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

## 5. Functional diagram

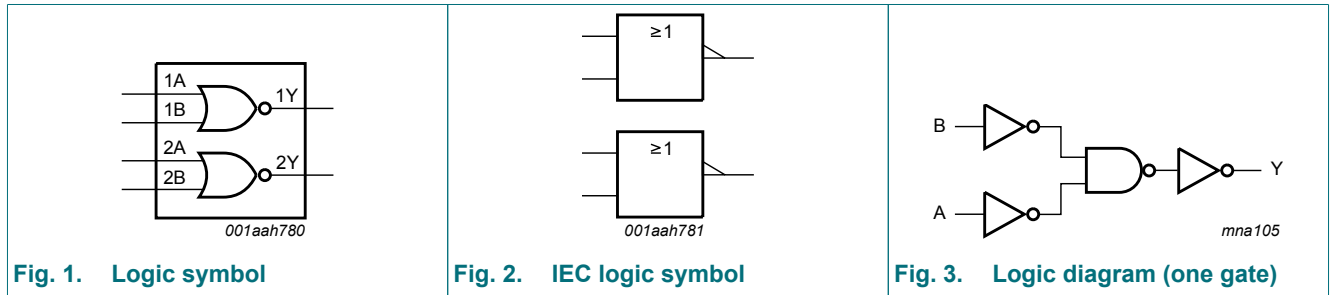


Fig. 1. Logic symbol

Fig. 2. IEC logic symbol

Fig. 3. Logic diagram (one gate)

## 6. Pinning information

### 6.1. Pinning

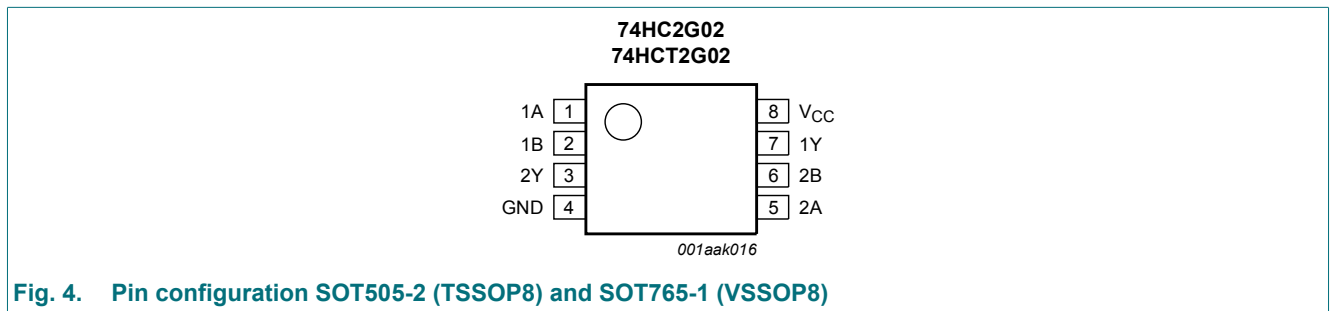


Fig. 4. Pin configuration SOT505-2 (TSSOP8) and SOT765-1 (VSSOP8)

### 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  | L      |
| H     | L  | L      |
| 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] | -    | $\pm 20$ | mA   |
| $I_{OK}$  | output clamping current   | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1] | -    | $\pm 20$ | 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              | 74HC2G02 |      |          | 74HCT2G02 |      |          | 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).

| Symbol          | Parameter                | Conditions              | -40 °C to +85 °C |         |      | -40 °C to +125 °C |      | Unit |
|-----------------|--------------------------|-------------------------|------------------|---------|------|-------------------|------|------|
|                 |                          |                         | Min              | Typ [1] | Max  | Min               | Max  |      |
| <b>74HC2G02</b> |                          |                         |                  |         |      |                   |      |      |
| $V_{IH}$        | HIGH-level input voltage | $V_{CC} = 2.0\text{ V}$ | 1.5              | 1.2     | -    | 1.5               | -    | V    |
|                 |                          | $V_{CC} = 4.5\text{ V}$ | 3.15             | 2.4     | -    | 3.15              | -    | V    |
|                 |                          | $V_{CC} = 6.0\text{ V}$ | 4.2              | 3.2     | -    | 4.2               | -    | V    |
| $V_{IL}$        | LOW-level input voltage  | $V_{CC} = 2.0\text{ V}$ | -                | 0.8     | 0.5  | -                 | 0.5  | V    |
|                 |                          | $V_{CC} = 4.5\text{ V}$ | -                | 2.1     | 1.35 | -                 | 1.35 | V    |
|                 |                          | $V_{CC} = 6.0\text{ V}$ | -                | 2.8     | 1.8  | -                 | 1.8  | V    |

| Symbol           | Parameter                 | Conditions  | -40 °C to +85 °C |         |      | -40 °C to +125 °C |      | Unit |
|------------------|---------------------------|---|------------------|---------|------|-------------------|------|------|
|                  |                           |   | Min              | Typ [1] | Max  | Min               | Max  |      |
| 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    |
|                  |                           | I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V   | 5.63             | 5.81    | -    | 5.2               | -    | 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>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V  | -                | 0.16    | 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   | -                 | 20   | µA   |
| C <sub>I</sub>   | input capacitance         |   | -                | 1.5     | -    | -                 | -    | pF   |
| <b>74HCT2G02</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   |

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); for test circuit, see Fig. 6.

| Symbol           | Parameter                     | Conditions  | -40 °C to +85 °C |         |     | -40 °C to +125 °C |     | Unit |
|------------------|-------------------------------|---|------------------|---------|-----|-------------------|-----|------|
|                  |                               |   | Min              | Typ [1] | Max | Min               | Max |      |
| <b>74HC2G02</b>  |                               |   |                  |         |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay             | nA and nB to nY; see Fig. 5 [2]                     |                  |         |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                             | -                | 26      | 95  | -                 | 110 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                             | -                | 9       | 19  | -                 | 22  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF     | -                | 9       | -   | -                 | -   | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                             | -                | 8       | 16  | -                 | 20  | ns   |
| t <sub>t</sub>   | transition time               | see Fig. 5 [3]                                      |                  |         |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 2.0 V                             | -                | 19      | 95  | -                 | 125 | ns   |
|                  |                               | V <sub>CC</sub> = 4.5 V                             | -                | 7       | 19  | -                 | 25  | ns   |
|                  |                               | V <sub>CC</sub> = 6.0 V                             | -                | 5       | 16  | -                 | 20  | ns   |
| C <sub>PD</sub>  | power dissipation capacitance | V <sub>I</sub> = GND to V <sub>CC</sub> [4]         | -                | 10      | -   | -                 | -   | pF   |
| <b>74HCT2G02</b> |                               |   |                  |         |     |                   |     |      |
| t <sub>pd</sub>  | propagation delay             | nA and nB to nY; see Fig. 5 [2]                     |                  |         |     |                   |     |      |
|                  |                               | V <sub>CC</sub> = 4.5 V                             | -                | 12      | 24  | -                 | 29  | ns   |
|                  |                               | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF     | -                | 12      | -   | -                 | -   | ns   |
| t <sub>t</sub>   | transition time               | V <sub>CC</sub> = 4.5 V; see Fig. 5 [3]             | -                | 6       | 19  | -                 | 22  | ns   |
| C <sub>PD</sub>  | power dissipation capacitance | V <sub>I</sub> = GND to V <sub>CC</sub> - 1.5 V [4] | -                | 10      | -   | -                 | -   | pF   |

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

[2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.

[3] t<sub>t</sub> is the same as t<sub>TLH</sub> and t<sub>THL</sub>.

[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> 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<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in V;

N = number of inputs switching;

Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

11.1. Waveforms and test circuit

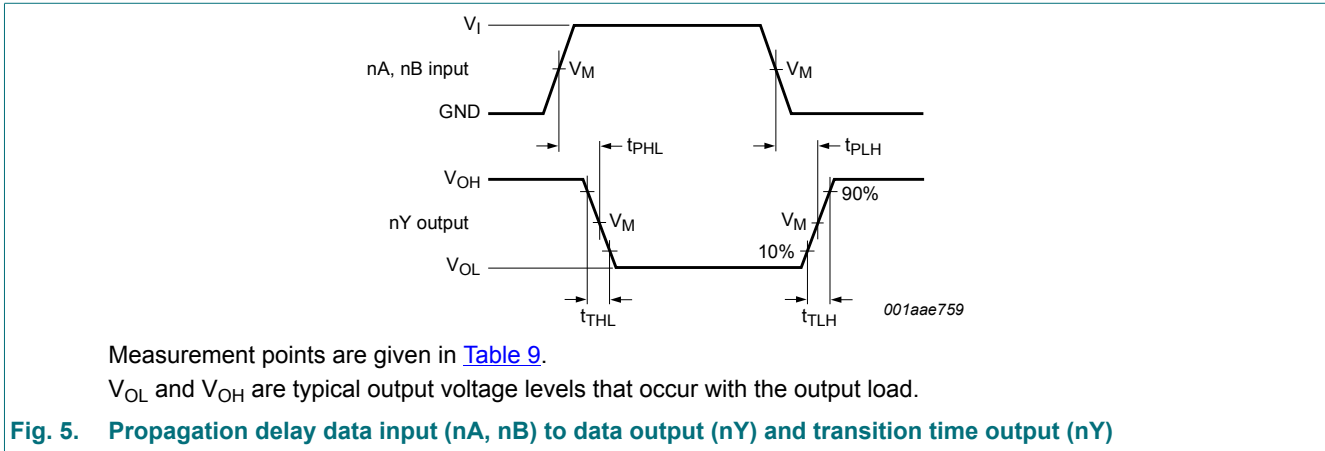
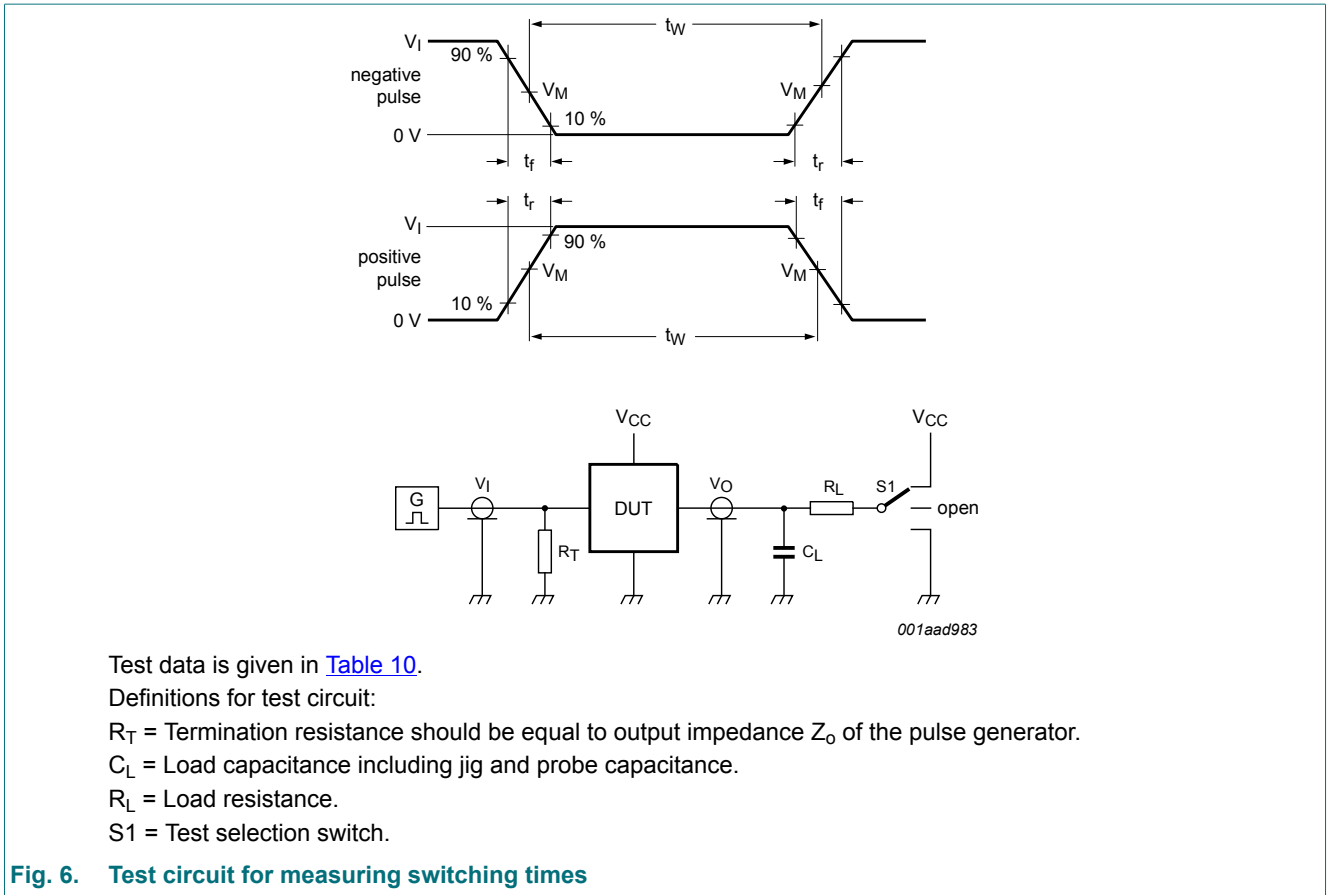


Table 9. Measurement points

| Type      | Input               | Output              |
|-----------|---------------------|---------------------|
|           | $V_M$               | $V_M$               |
| 74HC2G02  | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT2G02 | 1.3 V               | 1.3 V               |



**Fig. 6. Test circuit for measuring switching times**

**Table 10. Test data**

| Type      | Input           |             | Load         |              | S1 position        |
|-----------|-----------------|-------------|--------------|--------------|--------------------|
|           | $V_I$           | $t_r, t_f$  | $C_L$        | $R_L$        | $t_{PHL}, t_{PLH}$ |
| 74HC2G02  | GND to $V_{CC}$ | $\leq 6$ ns | 15 pF, 50 pF | 1 k $\Omega$ | open               |
| 74HCT2G02 | GND to 3 V      | $\leq 6$ ns | 15 pF, 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



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)

## 13. 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             |

## 14. Revision history

Table 12. Revision history

| Document ID      | Release date   | Data sheet status     | Change notice | Supersedes       |
|------------------|--|-----------------------|---------------|------------------|
| 74HC_HCT2G02 v.6 | 20180726   | Product data sheet    | -             | 74HC_HCT2G02 v.5 |
| 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> <li>Type numbers 74HC2G02GD and 74HCT2G02GD (SOT996-2) removed.</li> </ul> |                       |               |                  |
| 74HC_HCT2G02 v.5 | 20130927   | Product data sheet    | -             | 74HC_HCT2G02 v.4 |
| Modifications:   | <ul style="list-style-type: none"> <li>For type numbers 74HC2G02GD and 74HCT2G02GD XSON8U has changed to XSON8.</li> </ul>   |                       |               |                  |
| 74HC_HCT2G02 v.4 | 20090511   | Product data sheet    | -             | 74HC_HCT2G02 v.3 |
| 74HC_HCT2G02 v.3 | 20030514   | Product data sheet    | -             | 74HC_HCT2G02 v.2 |
| 74HC_HCT2G02 v.2 | 20030203   | Product specification | -             | 74HC_HCT2G02 v.1 |
| 74HC_HCT2G02 v.1 | 20020710   | Product specification | -             | -                |

## 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".
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