

# 74AHC00; 74AHCT00

## Quad 2-input NAND gate

Rev. 5 — 26 May 2020

Product data sheet

## 1. General description

The 74AHC00; 74AHCT00 are quad 2-input NAND gates. Inputs are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

## 2. Features

- Wide supply voltage range from 2.0 V to 5.5 V
- Input levels:
  - For 74AHC00: CMOS level
  - For 74AHCT00: TTL level
- Balanced propagation delays
- All inputs have Schmitt-trigger actions
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- CMOS low power dissipation
- ESD protection:
  - HBM EIA/JESD22-A114E exceeds 2000 V
  - MM EIA/JESD22-A115-A exceeds 200 V
  - CDM EIA/JESD22-C101C exceeds 1000 V
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level A
- Multiple package options
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

## 3. Ordering information

Table 1. Ordering information

| Type number | Package           |          |  |          |
|-------------|-------------------|----------|--|----------|
|             | Temperature range | Name     | Description  | Version  |
| 74AHC00D    | -40 °C to +125 °C | SO14     | plastic small outline package; 14 leads;<br>body width 3.9 mm  | SOT108-1 |
| 74AHCT00D   |                   |          |  |          |
| 74AHC00PW   | -40 °C to +125 °C | TSSOP14  | plastic thin shrink small outline package; 14 leads;<br>body width 4.4 mm  | SOT402-1 |
| 74AHCT00PW  |                   |          |  |          |
| 74AHC00BQ   | -40 °C to +125 °C | DHVQFN14 | plastic dual in-line compatible thermal<br>enhanced very thin quad flat package; no leads;<br>14 terminals; body 2.5 × 3 × 0.85 mm | SOT762-1 |
| 74AHCT00BQ  |                   |          |  |          |

### 4. Functional diagram



### 5. Pinning information

#### 5.1. Pinning



#### 5.2. Pin description

Table 2. Pin description

| Symbol          | Pin          | Description    |
|-----------------|--------------|----------------|
| 1A, 2A, 3A, 4A  | 1, 4, 9, 12  | data inputs    |
| 1B, 2B, 3B, 4B  | 2, 5, 10, 13 | data inputs    |
| 1Y, 2Y, 3Y, 4Y  | 3, 6, 8, 11  | data outputs   |
| GND             | 7            | ground (0 V)   |
| V <sub>CC</sub> | 14           | supply voltage |

## 6. Functional description

**Table 3. Function selection**

H = HIGH voltage level; L = LOW voltage level; X = don't care.

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

## 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 | +7.0 | V    |
| $V_I$     | input voltage           |  | -0.5 | +7.0 | V    |
| $I_{IK}$  | input clamping current  | $V_I < -0.5$ V [1]                           | -20  | -    | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V [1] | -20  | +20  | mA   |
| $I_O$     | output current          | $V_O = -0.5$ V to $(V_{CC} + 0.5)$ V         | -25  | +25  | mA   |
| $I_{CC}$  | supply current          |  | -    | +75  | mA   |
| $I_{GND}$ | ground current          |  | -75  | -    | mA   |
| $T_{stg}$ | storage temperature     |  | -65  | +150 | °C   |
| $P_{tot}$ | total power dissipation | $T_{amb} = -40$ °C to +125 °C [2]            | -    | 500  | mW   |

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

[2] For SOT108-1 (SO14) package:  $P_{tot}$  derates linearly with 10.1 mW/K above 100 °C.

For SOT402-1 (TSSOP14) package:  $P_{tot}$  derates linearly with 7.3 mW/K above 81 °C.

For SOT762-1 (DHVQFN14) package:  $P_{tot}$  derates linearly with 9.6 mW/K above 98 °C.

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

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

| Symbol              | Parameter                           | Conditions                   | 74AHC00 |     |          | 74AHCT00 |     |          | Unit |
|---------------------|-------------------------------------|------------------------------|---------|-----|----------|----------|-----|----------|------|
|                     |                                     |                              | Min     | Typ | Max      | Min      | Typ | Max      |      |
| $V_{CC}$            | supply voltage                      |                              | 2.0     | 5.0 | 5.5      | 4.5      | 5.0 | 5.5      | V    |
| $V_I$               | input voltage                       |                              | 0       | -   | 5.5      | 0        | -   | 5.5      | 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 | $V_{CC} = 3.3$ V $\pm$ 0.3 V | -       | -   | 100      | -        | -   | -        | ns/V |
|                     |                                     | $V_{CC} = 5.0$ V $\pm$ 0.5 V | -       | -   | 20       | -        | -   | 20       | 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  |      |
| <b>74AHC00</b>  |                           |   |                |   |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 2.0 V   | 1.5            | -   | -    | 1.5              | -    | 1.5               | -    | V    |
|                 |                           | V <sub>CC</sub> = 3.0 V   | 2.1            | -   | -    | 2.1              | -    | 2.1               | -    | V    |
|                 |                           | V <sub>CC</sub> = 5.5 V   | 3.85           | -   | -    | 3.85             | -    | 3.85              | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 2.0 V   | -              | -   | 0.5  | -                | 0.5  | -                 | 0.5  | V    |
|                 |                           | V <sub>CC</sub> = 3.0 V   | -              | -   | 0.9  | -                | 0.9  | -                 | 0.9  | V    |
|                 |                           | V <sub>CC</sub> = 5.5 V   | -              | -   | 1.65 | -                | 1.65 | -                 | 1.65 | 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> = -50 µA; V <sub>CC</sub> = 2.0 V  | 1.9            | 2.0   | -    | 1.9              | -    | 1.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -50 µA; V <sub>CC</sub> = 3.0 V  | 2.9            | 3.0   | -    | 2.9              | -    | 2.9               | -    | V    |
|                 |                           | I <sub>O</sub> = -50 µA; V <sub>CC</sub> = 4.5 V  | 4.4            | 4.5   | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 3.0 V   | 2.58           | -   | -    | 2.48             | -    | 2.40              | -    | 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> = 50 µA; V <sub>CC</sub> = 2.0 V   | -              | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 50 µA; V <sub>CC</sub> = 3.0 V   | -              | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 50 µA; V <sub>CC</sub> = 4.5 V   | -              | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V  | -              | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
| I <sub>I</sub>  | input leakage current     | V <sub>I</sub> = 5.5 V or GND;<br>V <sub>CC</sub> = 0 V to 5.5 V                          | -              | -   | 0.1  | -                | 1.0  | -                 | 2.0  | µA   |
|                 |                           | I <sub>CC</sub>   | supply current | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 5.5 V | -    | -                | 2.0  | -                 | 20   | -    |
| C <sub>I</sub>  | input capacitance         | V <sub>I</sub> = V <sub>CC</sub> or GND   | -              | 3.0   | 10   | -                | 10   | -                 | 10   | pF   |
| <b>74AHCT00</b> |                           |   |                |   |      |                  |      |                   |      |      |
| V <sub>IH</sub> | HIGH-level input voltage  | V <sub>CC</sub> = 4.5 V to 5.5 V  | 2.0            | -   | -    | 2.0              | -    | 2.0               | -    | V    |
| V <sub>IL</sub> | LOW-level input voltage   | V <sub>CC</sub> = 4.5 V to 5.5 V  | -              | -   | 0.8  | -                | 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> ; V <sub>CC</sub> = 4.5 V             |                |   |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = -50 µA   | 4.4            | 4.5   | -    | 4.4              | -    | 4.4               | -    | V    |
|                 |                           | I <sub>O</sub> = -8.0 mA  | 3.94           | -   | -    | 3.80             | -    | 3.70              | -    | V    |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V             |                |   |      |                  |      |                   |      |      |
|                 |                           | I <sub>O</sub> = 50 µA  | -              | 0   | 0.1  | -                | 0.1  | -                 | 0.1  | V    |
|                 |                           | I <sub>O</sub> = 8.0 mA   | -              | -   | 0.36 | -                | 0.44 | -                 | 0.55 | V    |
| I <sub>I</sub>  | input leakage current     | V <sub>I</sub> = 5.5 V or GND;<br>V <sub>CC</sub> = 0 V to 5.5 V                          | -              | -   | 0.1  | -                | 1.0  | -                 | 2.0  | µA   |
| I <sub>CC</sub> | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 5.5 V | -              | -   | 2.0  | -                | 20   | -                 | 40   | µA   |

| Symbol          | Parameter                 | Conditions   | 25 °C |     |      | -40 °C to +85 °C |     | -40 °C to +125 °C |     | Unit |
|-----------------|---------------------------|--|-------|-----|------|------------------|-----|-------------------|-----|------|
|                 |                           |  | Min   | Typ | Max  | Min              | Max | Min               | Max |      |
| $\Delta I_{CC}$ | additional supply current | per input pin;<br>$V_I = V_{CC} - 2.1 \text{ V}$ ; $I_O = 0 \text{ A}$ ;<br>other pins at $V_{CC}$ or GND;<br>$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ | -     | -   | 1.35 | -                | 1.5 | -                 | 1.5 | mA   |
| $C_I$           | input capacitance         | $V_I = V_{CC}$ or GND  | -     | 3.0 | 10   | -                | 10  | -                 | 10  | pF   |

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7.

| Symbol          | Parameter                     | Conditions   | 25 °C |        |      | -40 °C to +85 °C |      | -40 °C to +125 °C |      | Unit |
|-----------------|-------------------------------|--|-------|--------|------|------------------|------|-------------------|------|------|
|                 |                               |  | Min   | Typ[1] | Max  | Min              | Max  | Min               | Max  |      |
| <b>74AHC00</b>  |                               |  |       |        |      |                  |      |                   |      |      |
| $t_{pd}$        | propagation delay             | nA, nB to nY; see Fig. 6 [2]   |       |        |      |                  |      |                   |      |      |
|                 |                               | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$   |       |        |      |                  |      |                   |      |      |
|                 |                               | $C_L = 15 \text{ pF}$  | -     | 4.5    | 7.9  | 1.0              | 9.5  | 1.0               | 10.0 | ns   |
|                 |                               | $C_L = 50 \text{ pF}$  | -     | 6.0    | 11.4 | 1.0              | 13.0 | 1.0               | 14.5 | ns   |
|                 |                               | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$   |       |        |      |                  |      |                   |      |      |
|                 |                               | $C_L = 15 \text{ pF}$  | -     | 3.2    | 5.5  | 1.0              | 6.5  | 1.0               | 7.0  | ns   |
|                 |                               | $C_L = 50 \text{ pF}$  | -     | 4.5    | 7.5  | 1.0              | 8.5  | 1.0               | 9.5  | ns   |
| $C_{PD}$        | power dissipation capacitance | $C_L = 50 \text{ pF}$ ; $f_i = 1 \text{ MHz}$ ;<br>$V_I = \text{GND to } V_{CC}$ [3] | -     | 7.0    | -    | -                | -    | -                 | -    | pF   |
| <b>74AHCT00</b> |                               |  |       |        |      |                  |      |                   |      |      |
| $t_{pd}$        | propagation delay             | nA, nB to nY; see Fig. 6 [2]   |       |        |      |                  |      |                   |      |      |
|                 |                               | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$   |       |        |      |                  |      |                   |      |      |
|                 |                               | $C_L = 15 \text{ pF}$  | -     | 3.3    | 6.9  | 1.0              | 8.0  | 1.0               | 9.0  | ns   |
|                 |                               | $C_L = 50 \text{ pF}$  | -     | 4.5    | 7.9  | 1.0              | 9.0  | 1.0               | 10.0 | ns   |
| $C_{PD}$        | power dissipation capacitance | $C_L = 50 \text{ pF}$ ; $f_i = 1 \text{ MHz}$ ;<br>$V_I = \text{GND to } V_{CC}$ [3] | -     | 7.0    | -    | -                | -    | -                 | -    | pF   |

[1] Typical values are measured at nominal supply voltage ( $V_{CC} = 3.3 \text{ V}$  and  $V_{CC} = 5.0 \text{ V}$ ).

[2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .

[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 the outputs.

10.1. Waveforms

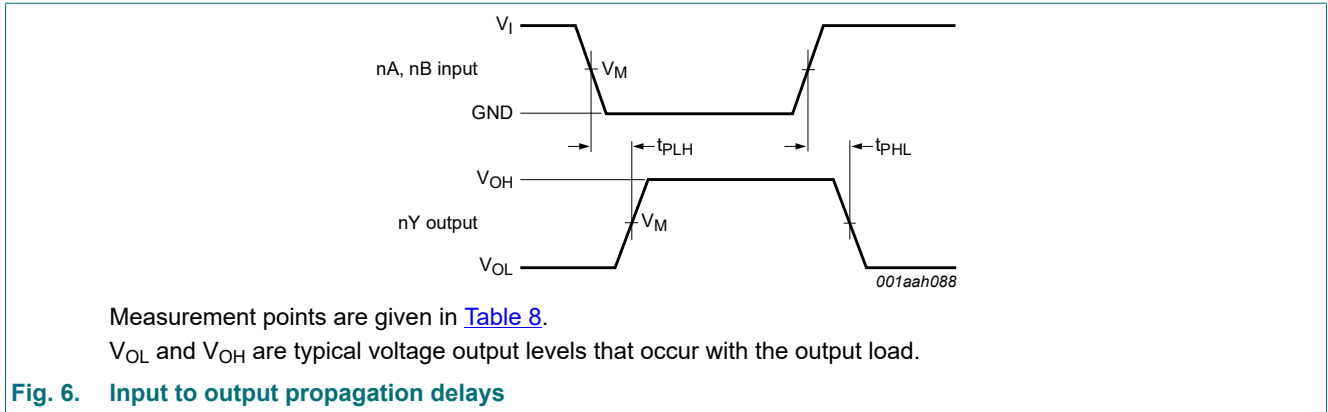


Table 8. Measurement points

| Type     | Input               |  | Output              |
|----------|---------------------|--|---------------------|
|          | $V_M$               |  | $V_M$               |
| 74AHC00  | $0.5 \times V_{CC}$ |  | $0.5 \times V_{CC}$ |
| 74AHCT00 | 1.5 V               |  | $0.5 \times V_{CC}$ |

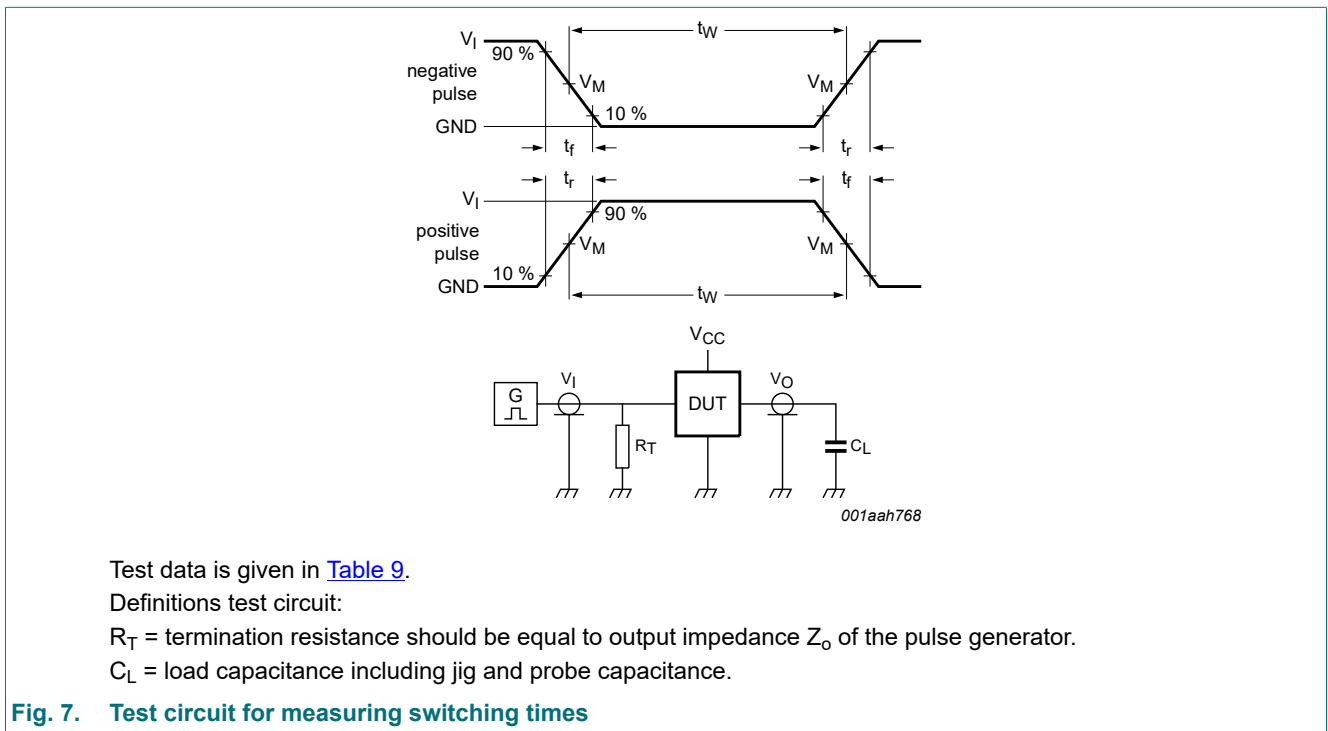


Table 9. Test data

| Type     | Input    |               | Load         | Test               |
|----------|----------|---------------|--------------|--------------------|
|          | $V_I$    | $t_r, t_f$    | $C_L$        |                    |
| 74AHC00  | $V_{CC}$ | $\leq 3.0$ ns | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |
| 74AHCT00 | 3.0 V    | $\leq 3.0$ ns | 15 pF, 50 pF | $t_{PLH}, t_{PHL}$ |

### 11. Package outline

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

SOT108-1



Fig. 8. Package outline SOT108-1 (SO14)

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

SOT402-1



Fig. 9. Package outline SOT402-1 (TSSOP14)



DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm

SOT762-1



Fig. 10. Package outline SOT762-1 (DHVQFN14)

## 12. Abbreviations

Table 10. Abbreviations

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

## 13. Revision history

Table 11. Revision history

| Document ID      | Release date  | Data sheet status     | Change notice | Supersedes       |
|------------------|---|-----------------------|---------------|------------------|
| 74AHC_AHCT00 v.5 | 20200526  | Product data sheet    | -             | 74AHC_AHCT00 v.4 |
| 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><a href="#">Section 1</a> and <a href="#">Section 2</a> updated.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation have been updated.</li> <li>Package outline drawing of SOT762-1 (<a href="#">Fig. 10</a>) updated.</li> </ul> |                       |               |                  |
| 74AHC_AHCT00 v.4 | 20080428  | Product data sheet    | -             | 74AHC_AHCT00 v.3 |
| Modifications:   | <ul style="list-style-type: none"> <li><a href="#">Table 6</a>: the conditions for input leakage current have been changed.</li> </ul>  |                       |               |                  |
| 74AHC_AHCT00 v.3 | 20080108  | Product data sheet    | -             | 74AHC_AHCT00 v.2 |
| 74AHC_AHCT00 v.2 | 19990923  | Product specification | -             | 74AHC_AHCT00 v.1 |
| 74AHC_AHCT00 v.1 | 19981209  | Product specification | -             | -                |

## 14. 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>.

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## Contents

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|  |           |
|--|-----------|
| <b>1. General description</b> .....              | <b>1</b>  |
| <b>2. Features</b> .....                         | <b>1</b>  |
| <b>3. Ordering information</b> .....             | <b>1</b>  |
| <b>4. Functional diagram</b> .....               | <b>2</b>  |
| <b>5. Pinning information</b> .....              | <b>2</b>  |
| 5.1. Pinning.....                                | 2         |
| 5.2. Pin description.....                        | 2         |
| <b>6. Functional description</b> .....           | <b>3</b>  |
| <b>7. Limiting values</b> .....                  | <b>3</b>  |
| <b>8. Recommended operating conditions</b> ..... | <b>3</b>  |
| <b>9. Static characteristics</b> .....           | <b>4</b>  |
| <b>10. Dynamic characteristics</b> .....         | <b>5</b>  |
| 10.1. Waveforms.....                             | 6         |
| <b>11. Package outline</b> .....                 | <b>7</b>  |
| <b>12. Abbreviations</b> .....                   | <b>10</b> |
| <b>13. Revision history</b> .....                | <b>10</b> |
| <b>14. Legal information</b> .....               | <b>11</b> |

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For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: [salesaddresses@nexperia.com](mailto:salesaddresses@nexperia.com)

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#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.