

# 74HC1G04; 74HCT1G04

## Inverter

Rev. 5 — 25 September 2013

Product data sheet

## 1. General description

The 74HC1G04; 74HCT1G04 is a single inverter. Inputs include clamp diodes that enable 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 74HC1G04: CMOS level
  - ◆ For 74HCT1G04: TTL level
- Symmetrical output impedance
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from  $-40\text{ °C}$  to  $+85\text{ °C}$  and  $-40\text{ °C}$  to  $+125\text{ °C}$

## 3. Ordering information

Table 1. Ordering information

| Type number               | Package                             |        |   |          |
|---------------------------|-------------------------------------|--------|---|----------|
|                           | Temperature range                   | Name   | Description   | Version  |
| 74HC1G04GW<br>74HCT1G04GW | $-40\text{ °C}$ to $+125\text{ °C}$ | TSSOP5 | plastic thin shrink small outline package; 5 leads;<br>body width 1.25 mm | SOT353-1 |
| 74HC1G04GV<br>74HCT1G04GV | $-40\text{ °C}$ to $+125\text{ °C}$ | SC-74A | plastic surface-mounted package; 5 leads                                  | SOT753   |

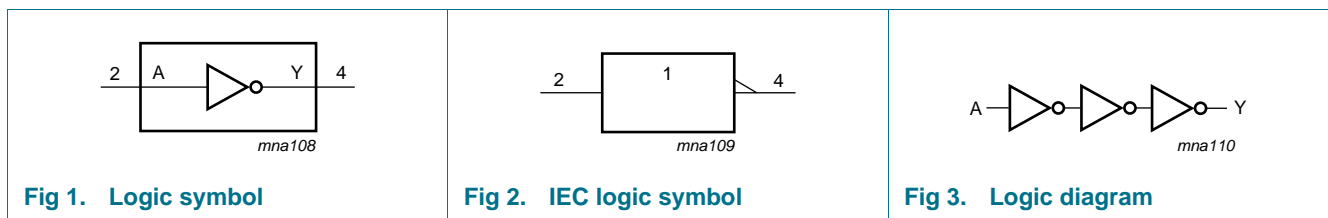
## 4. Marking

Table 2. Marking codes

| Type number | Marking <sup>[1]</sup> |
|-------------|------------------------|
| 74HC1G04GW  | HC                     |
| 74HCT1G04GW | TC                     |
| 74HC1G04GV  | H04                    |
| 74HCT1G04GV | T04                    |

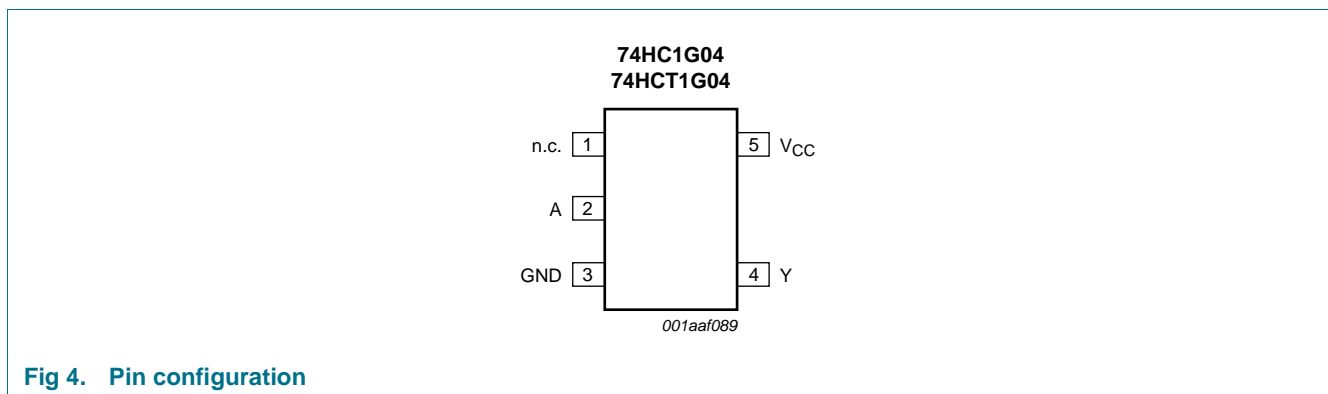
[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

## 5. Functional diagram



## 6. Pinning information

### 6.1 Pinning



### 6.2 Pin description

Table 3. Pin description

| Symbol          | Pin | Description    |
|-----------------|-----|----------------|
| n.c.            | 1   | not connected  |
| A               | 2   | data input     |
| GND             | 3   | ground (0 V)   |
| Y               | 4   | data output    |
| V <sub>CC</sub> | 5   | supply voltage |

## 7. Functional description

**Table 4. Function table**

H = HIGH voltage level; L = LOW voltage level

| Input | Output |
|-------|--------|
| A     | Y      |
| 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). [\[1\]](#)

| 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 $V_I > V_{CC} + 0.5\text{ V}$ | -                     | $\pm 20$   | mA   |
| $I_{OK}$  | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ | -                     | $\pm 20$   | mA   |
| $I_O$     | output current          | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$          | -                     | $\pm 12.5$ | mA   |
| $I_{CC}$  | supply current          |  | -                     | 25         | mA   |
| $I_{GND}$ | ground current          |  | -25                   | -          | mA   |
| $T_{stg}$ | storage temperature     |  | -65                   | +150       | °C   |
| $P_{tot}$ | total power dissipation | $T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$          | <a href="#">[2]</a> - | 200        | mW   |

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

[2] Above 55 °C, the value of  $P_{tot}$  derates linearly with 2.5 mW/K.

## 9. Recommended operating conditions

**Table 6. Recommended operating conditions**

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

| Symbol              | Parameter                           | Conditions              | 74HC1G04 |     |          | 74HCT1G04 |     |          | 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 |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ | -        | -   | 139      | -         | -   | 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  $T_{amb} = 25\text{ °C}$ .

| Symbol                    | Parameter                 | Conditions   | -40 °C to +85 °C |      |      | -40 °C to +125 °C |      | Unit |
|---------------------------|---------------------------|--|------------------|------|------|-------------------|------|------|
|                           |                           |  | Min              | Typ  | Max  | Min               | Max  |      |
| <b>For type 74HC1G04</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> = -2.0 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> = 2.0 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   |
|                           |                           | 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>For type 74HCT1G04</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> = -2.0 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> = 2.0 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   |

**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 |               |
| $I_{CC}$        | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ;<br>$V_{CC} = 5.5\text{ V}$                                       | -                | -   | 10  | -                 | 20  | $\mu\text{A}$ |
| $\Delta I_{CC}$ | additional supply current | per input; $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$ ;<br>$V_I = V_{CC} - 2.1\text{ V}$ ; $I_O = 0\text{ A}$ | -                | -   | 500 | -                 | 850 | $\mu\text{A}$ |
| $C_I$           | input capacitance         |  | -                | 1.5 | -   | -                 | -   | pF            |

## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

$GND = 0\text{ V}$ ;  $t_r = t_f \leq 6.0\text{ ns}$ ; 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 |      |

### For type 74HC1G04

|          |                               |  |     |    |     |   |     |    |
|----------|-------------------------------|--|-----|----|-----|---|-----|----|
| $t_{pd}$ | propagation delay             | A to Y; see <a href="#">Figure 5</a>           | [1] |    |     |   |     |    |
|          |                               | $V_{CC} = 2.0\text{ V}$ ; $C_L = 50\text{ pF}$ | -   | 25 | 105 | - | 135 | ns |
|          |                               | $V_{CC} = 4.5\text{ V}$ ; $C_L = 50\text{ pF}$ | -   | 9  | 21  | - | 27  | ns |
|          |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$ | -   | 7  | -   | - | -   | ns |
| $C_{PD}$ | power dissipation capacitance | $V_I = GND$ to $V_{CC}$                        | [2] | 16 | -   | - | -   | pF |

### For type 74HCT1G04

|          |                               |  |     |    |    |   |    |    |
|----------|-------------------------------|--|-----|----|----|---|----|----|
| $t_{pd}$ | propagation delay             | A to Y; see <a href="#">Figure 5</a>           | [1] |    |    |   |    |    |
|          |                               | $V_{CC} = 4.5\text{ V}$ ; $C_L = 50\text{ pF}$ | -   | 10 | 24 | - | 27 | ns |
|          |                               | $V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$ | -   | 8  | -  | - | -  | ns |
| $C_{PD}$ | power dissipation capacitance | $V_I = GND$ to $V_{CC} - 1.5\text{ V}$         | [2] | 18 | -  | - | -  | pF |

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

[2]  $C_{PD}$  is used to determine the dynamic power dissipation  $P_D$  ( $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz

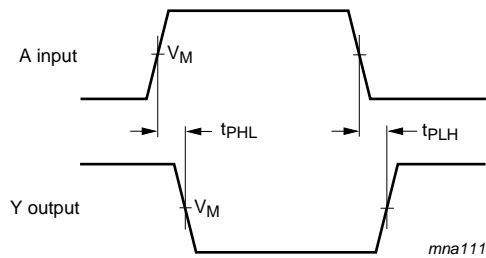
$f_o$  = output frequency in MHz

$C_L$  = output load capacitance in pF

$V_{CC}$  = supply voltage in Volts

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

## 12. Waveforms

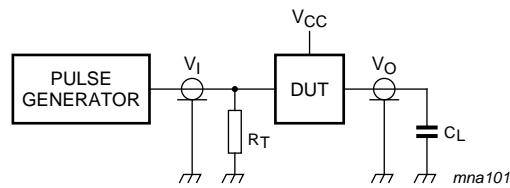


Measurement points are given in [Table 9](#).

**Fig 5. The input (A) to output (Y) propagation delays**

**Table 9. Measurement points**

| Type      | $V_I$           | $V_M$               |
|-----------|-----------------|---------------------|
| 74HC1G04  | GND to $V_{CC}$ | $0.5 \times V_{CC}$ |
| 74HCT1G04 | GND to 03 V     | 1.3 V               |



Test data is given in [Table 8](#). 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

**Fig 6. Load circuitry for switching times**

13. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm

SOT353-1



Fig 7. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753



Fig 8. Package outline SOT753 (SC-74A)



## 14. Abbreviations

Table 10. Abbreviations

| Acronym | Description                 |
|---------|-----------------------------|
| DUT     | Device Under Test           |
| TTL     | Transistor-Transistor Logic |

## 15. Revision history

Table 11. Revision history

| Document ID      | Release date   | Data sheet status         | Change notice | Supersedes       |
|------------------|--|---------------------------|---------------|------------------|
| 74HC_HCT1G04 v.5 | 20130925   | Product data sheet        | -             | 74HC_HCT1G04 v.4 |
| Modifications:   | <ul style="list-style-type: none"> <li>• <a href="#">Section 1 “General description”</a> updated.</li> </ul>   |                           |               |                  |
| 74HC_HCT1G04 v.4 | 20070716   | Product data sheet        | -             | 74HC_HCT1G04 v.3 |
| Modifications:   | <ul style="list-style-type: none"> <li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>• Legal texts have been adapted to the new company name where appropriate.</li> <li>• Package SOT353 changed to SOT353-1 in <a href="#">Table 1</a> and <a href="#">Figure 7</a>.</li> <li>• Quick Reference Data and Soldering sections removed.</li> <li>• <a href="#">Section 2 “Features and benefits”</a> updated.</li> </ul> |                           |               |                  |
| 74HC_HCT1G04 v.3 | 20020517   | Product specification     | -             | 74HC_HCT1G04 v.2 |
| 74HC_HCT1G04 v.2 | 20010302   | Product specification     | -             | 74HC_HCT1G04 v.1 |
| 74HC_HCT1G04 v.1 | 19980831   | Preliminary specification | -             | -                |

## 16. Legal information

### 16.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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 URL <http://www.nexperia.com>.

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