

74HC10; 74HCT10

Triple 3-input NAND gate

Rev. 4 — 8 January 2021

Product data sheet

1. General description

The 74HC10; 74HCT10 is a triple 3-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} .

2. Features and benefits

- Complies with JEDEC standard JESD7A
- Input levels:
 - For 74HC10: CMOS level
 - For 74HCT10: TTL level
- Complies with JEDEC standard no. 7A
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|-------------|---|---------|---|----------|
| | Temperature range | Name | Description | Version |
| 74HC10D | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74HCT10D | | | | |
| 74HC10PW | $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74HCT10PW | | | | |

4. Functional diagram

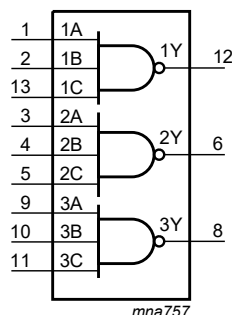


Fig. 1. Logic symbol

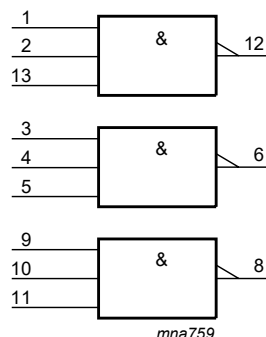


Fig. 2. IEC logic symbol

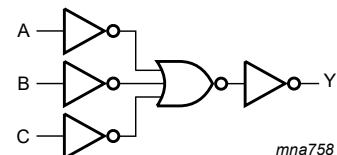
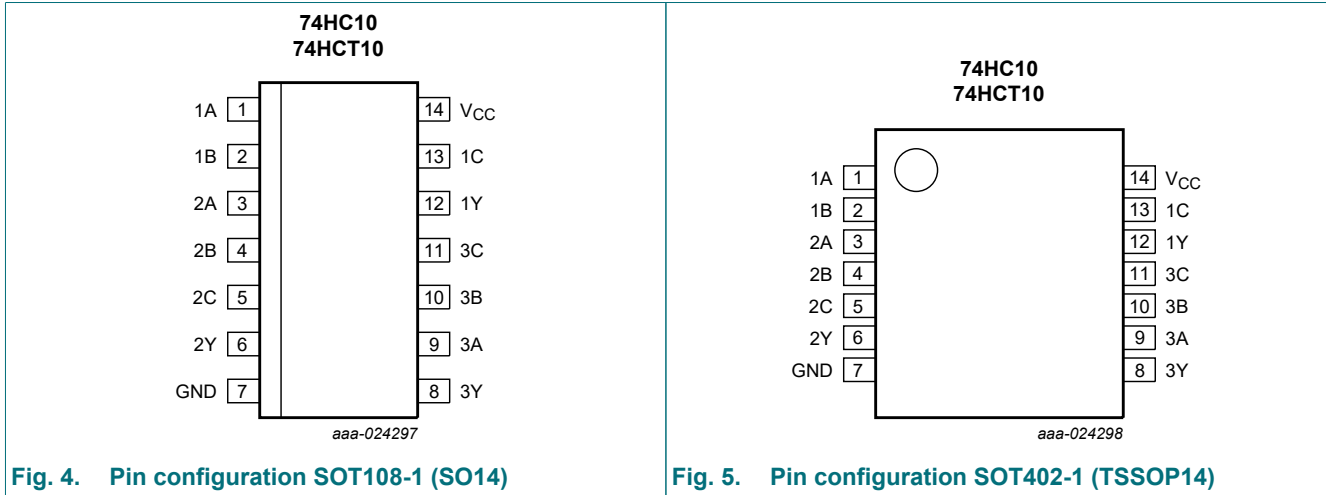


Fig. 3. Logic diagram (one gate)

5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|-----------------|-----------|----------------|
| 1A, 2A, 3A | 1, 3, 9 | data input |
| 1B, 2B, 3B | 2, 4, 10 | data input |
| GND | 7 | ground (0 V) |
| 1C, 2C, 3C | 13, 5, 11 | data input |
| 1Y, 2Y, 3Y | 12, 6, 8 | data output |
| V _{CC} | 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 | nC | nY |
| L | X | X | H |
| X | L | X | H |
| X | X | L | H |
| 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 | 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 | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$ | - | ± 25 | mA |
| I_{CC} | supply current | | - | 50 | mA |
| I_{GND} | ground current | | -50 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | [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.

8. Recommended operating conditions

Table 5. Recommended operating conditions

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

| Symbol | Parameter | Conditions | 74HC10 | | | 74HCT10 | | | 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 | - | +125 | -40 | - | +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 |

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 | |
| 74HC10 | | | | | | | | | | |
| V_{IH} | HIGH-level input voltage | $V_{CC} = 2.0\text{ V}$ | 1.5 | 1.2 | - | 1.5 | - | 1.5 | - | V |
| | | $V_{CC} = 4.5\text{ V}$ | 3.15 | 2.4 | - | 3.15 | - | 3.15 | - | V |
| | | $V_{CC} = 6.0\text{ V}$ | 4.2 | 3.2 | - | 4.2 | - | 4.2 | - | V |
| V_{IL} | LOW-level input voltage | $V_{CC} = 2.0\text{ V}$ | - | 0.8 | 0.5 | - | 0.5 | - | 0.5 | V |
| | | $V_{CC} = 4.5\text{ V}$ | - | 2.1 | 1.35 | - | 1.35 | - | 1.35 | V |
| | | $V_{CC} = 6.0\text{ V}$ | - | 2.8 | 1.8 | - | 1.8 | - | 1.8 | V |

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|------------------|---------------------------|---|-------|------|------|------------------|------|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 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 | - | 1.9 | - | V |
| | | I _O = -20 µA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -20 µA; V _{CC} = 6.0 V | 5.9 | 6.0 | - | 5.9 | - | 5.9 | - | V |
| | | I _O = -4.0 mA; V _{CC} = 4.5 V | 3.98 | 4.32 | - | 3.84 | - | 3.7 | - | V |
| | | I _O = -5.2 mA; V _{CC} = 6.0 V | 5.48 | 5.81 | - | 5.34 | - | 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 | - | 0.1 | V |
| | | I _O = 20 µA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 µA; V _{CC} = 6.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 4.0 mA; V _{CC} = 4.5 V | - | 0.15 | 0.26 | - | 0.33 | - | 0.4 | V |
| | | I _O = 5.2 mA; V _{CC} = 6.0 V | - | 0.16 | 0.26 | - | 0.33 | - | 0.4 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 6.0 V | - | - | ±0.1 | - | ±1 | - | ±1 | µA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V | - | - | 2.0 | - | 20 | - | 40 | µA |
| C _I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |
| 74HCT10 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | 2.0 | 1.6 | - | 2.0 | - | 2.0 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | 1.2 | 0.8 | - | 0.8 | - | 0.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V | | | | | | | | |
| | | I _O = -20 µA | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -4.0 mA | 3.98 | 4.32 | - | 3.84 | - | 3.7 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V | | | | | | | | |
| | | I _O = 20 µA | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 4 µA | - | 0.15 | 0.26 | - | 0.33 | - | 0.4 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 5.5 V | - | - | ±0.1 | - | ±1 | - | ±1 | µA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V | - | - | 2.0 | - | 20 | - | 40 | µA |
| ΔI _{CC} | additional supply current | per input pin; V _I = V _{CC} - 2.1 V; I _O = 0 A; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V | - | 150 | 540 | - | 675 | - | 735 | µA |
| C _I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |

10. Dynamic characteristics

Table 7. Dynamic characteristics

$GND = 0\text{ V}$; $C_L = 50\text{ pF}$; for test circuit, see [Fig. 7](#).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | -40 °C to +125 °C | Unit |
|----------------|-------------------------------|--|-------|-----|-----|---------------------|----------------------|------|
| | | | Min | Typ | Max | Max | Max | |
| 74HC10 | | | | | | | | |
| t_{pd} | propagation delay | nA, nB to nY; see Fig. 6 [1] | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 30 | 95 | 120 | 145 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 11 | 19 | 24 | 29 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 9 | - | - | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 9 | 16 | 20 | 25 | ns |
| t_t | transition time | see Fig. 6 [2] | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 19 | 75 | 95 | 110 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 7 | 15 | 19 | 22 | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 6 | 13 | 16 | 19 | ns |
| C_{PD} | power dissipation capacitance | per package; $V_I = GND$ to V_{CC} [3] | - | 12 | - | - | - | pF |
| 74HCT10 | | | | | | | | |
| t_{pd} | propagation delay | nA, nB to nY; see Fig. 6 [1] | | | | | | |
| | | $V_{CC} = 4.5\text{ V}$ | - | 14 | 24 | 30 | 36 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 11 | - | - | - | ns |
| t_t | transition time | $V_{CC} = 4.5\text{ V}$; see Fig. 6 [2] | - | 7 | 15 | 19 | 22 | ns |
| C_{PD} | power dissipation capacitance | per package; $V_I = GND$ to $V_{CC} - 1.5\text{ V}$ [3] | - | 14 | - | - | - | pF |

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

[2] t_t is the same as t_{THL} and t_{TLH} .

[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.

10.1. Waveforms and test circuit

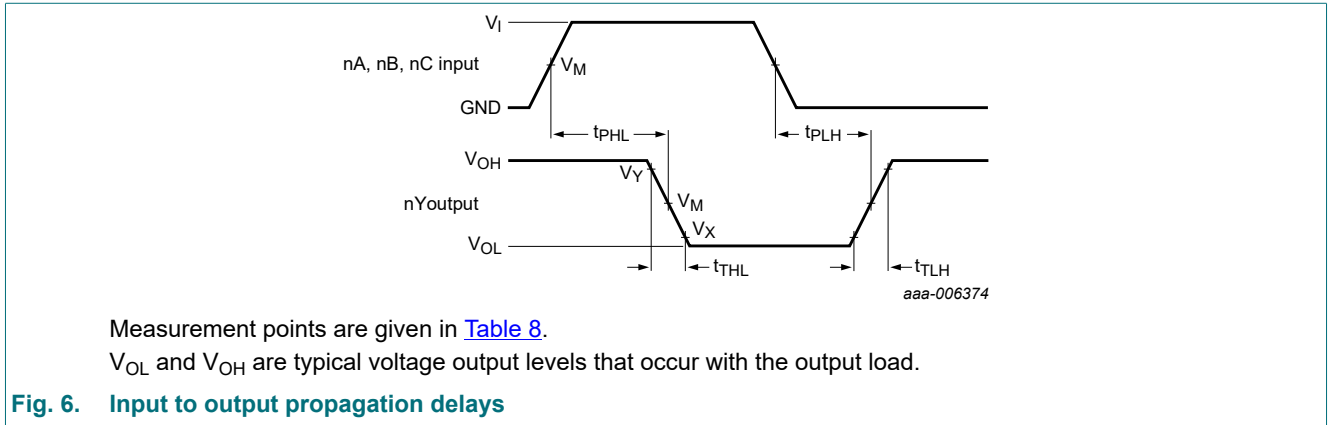


Table 8. Measurement points

| Type | Input | Output | | |
|---------|-------------|-------------|-------------|-------------|
| | V_M | V_M | V_X | V_Y |
| 74HC10 | $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1V_{CC}$ | $0.9V_{CC}$ |
| 74HCT10 | 1.3 V | 1.3 V | $0.1V_{CC}$ | $0.9V_{CC}$ |

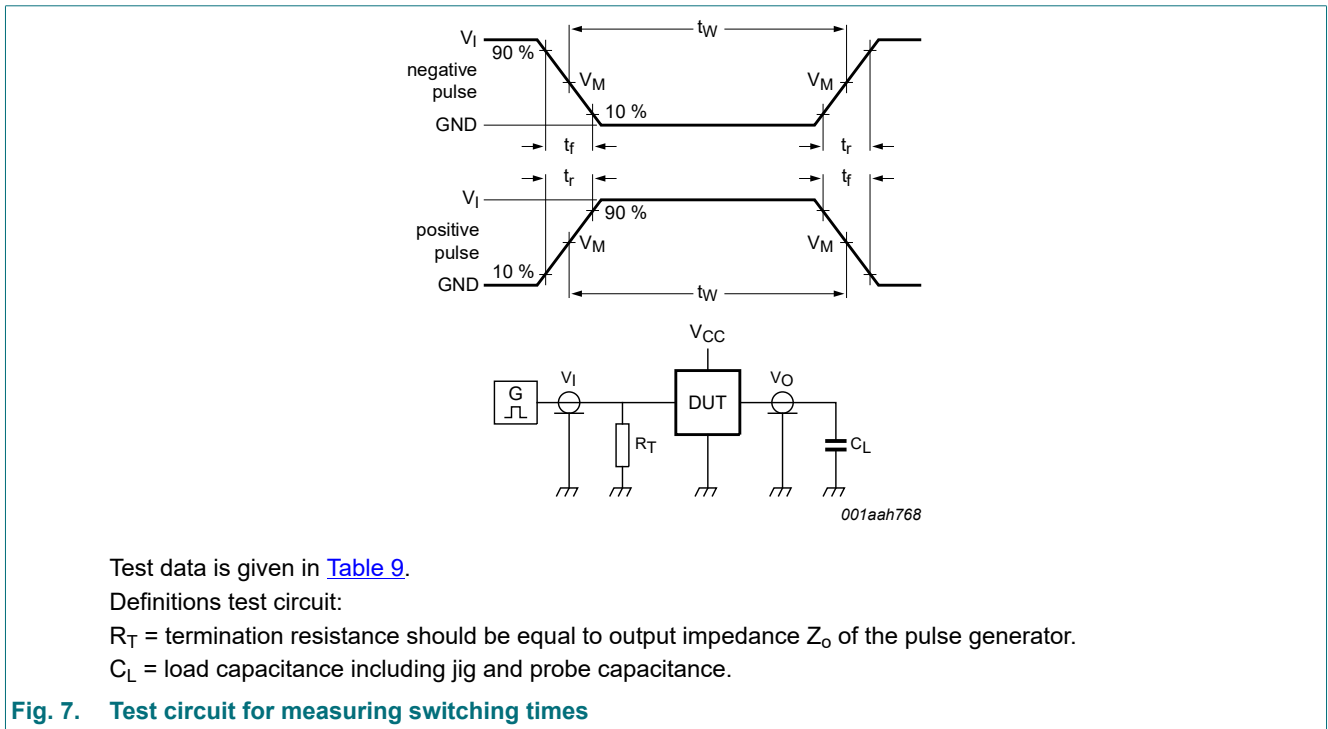


Table 9. Test data

| Type | Input | | Load | Test |
|---------|----------|------------|--------------|--------------------|
| | V_I | t_r, t_f | C_L | |
| 74HC10 | V_{CC} | 6.0 ns | 15 pF, 50 pF | t_{PLH}, t_{PHL} |
| 74HCT10 | 3.0 V | 6.0 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)

12. Abbreviations

Table 10. 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 |

13. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|--------------------|---|-----------------------|---------------|--------------------|
| 74HC_HCT10 v.4 | 20210108 | Product data sheet | - | 74HC_HCT10 v.3 |
| Modifications: | <ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Type numbers 74HC10DB and 74HCT10DB (SOT337-1 / SSOP14) removed. Section 7: Derating values for P_{tot} total power dissipation have been updated. | | | |
| 74HC_HCT10 v.3 | 20160805 | Product data sheet | - | 74HC_HCT10_CNV v.2 |
| Modifications: | <ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate. | | | |
| 74HC_HCT10_CNV v.2 | 19901201 | Product specification | - | - |

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| Document status [1][2] | Product status [3] | Definition |
|--------------------------------|--------------------|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
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