

74AHC08; 74AHCT08

Quad 2-input AND gate

Rev. 4 — 26 May 2020

Product data sheet

1. General description

The 74AHC08; 74AHCT08 are quad 2-input AND gates. Inputs are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

2. Features and benefits

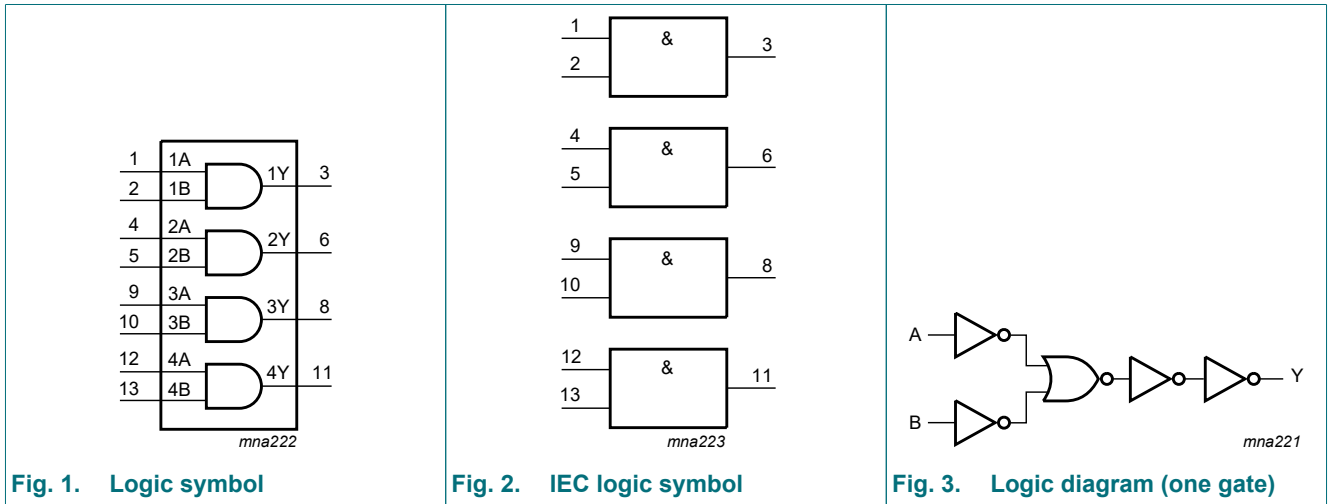
- Wide supply voltage range from 2.0 V to 5.5 V
- Input levels:
 - For 74AHC08: CMOS level
 - For 74AHCT08: TTL level
- Balanced propagation delays
- All inputs have a Schmitt-trigger action
- Overvoltage tolerant inputs to 5.5 V
- High noise immunity
- CMOS low power dissipation
- ESD protection:
 - 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

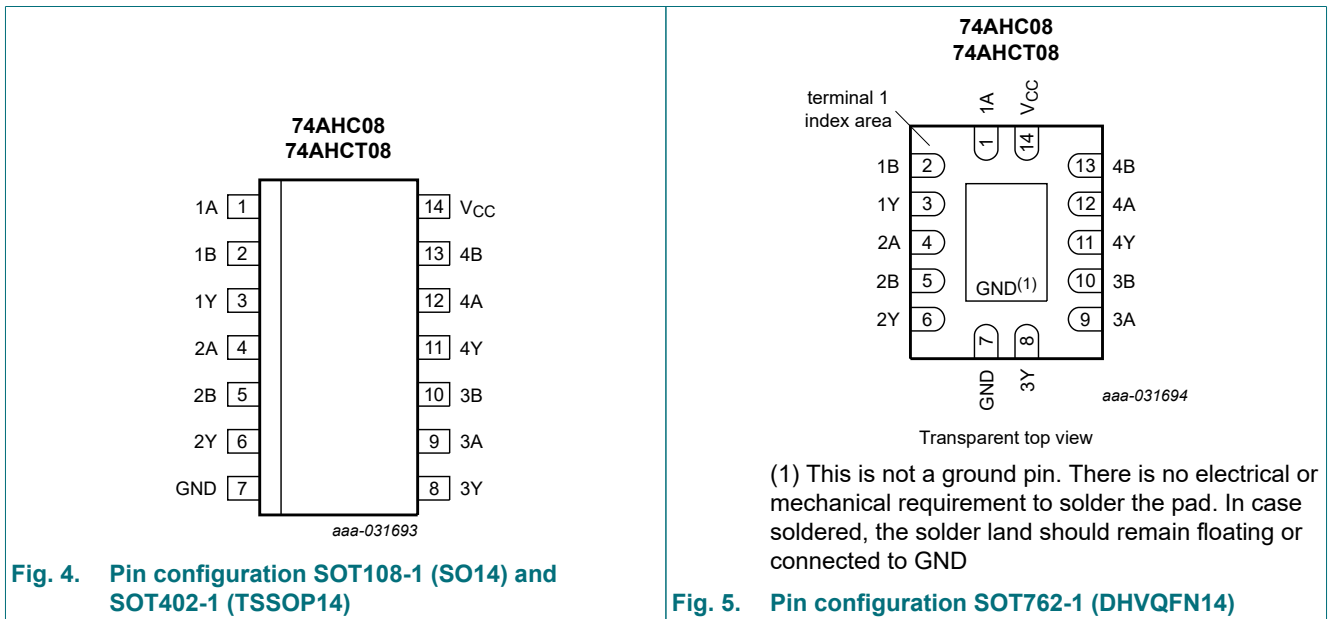
| Type number | Package | | | |
|-------------|-------------------|----------|--|----------|
| | Temperature range | Name | Description | Version |
| 74AHC08D | -40 °C to +125 °C | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74AHCT08D | | | | |
| 74AHC08PW | -40 °C to +125 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74AHCT08PW | | | | |
| 74AHC08BQ | -40 °C to +125 °C | DHVQFN14 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 × 3 × 0.85 mm | SOT762-1 |
| 74AHCT08BQ | | | | |

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 _{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 | nY |
| L | X | L |
| X | L | L |
| H | H | H |

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 | mA |
| I_O | output current | $V_O = -0.5$ V to $(V_{CC} + 0.5$ V) | - | ± 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 | 74AHC08 | | | 74AHCT08 | | | 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

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 | |
| 74AHC08 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 2.0 V | 1.5 | - | - | 1.5 | - | 1.5 | - | V |
| | | V _{CC} = 3.0 V | 2.1 | - | - | 2.1 | - | 2.1 | - | V |
| | | V _{CC} = 5.5 V | 3.85 | - | - | 3.85 | - | 3.85 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 2.0 V | - | - | 0.5 | - | 0.5 | - | 0.5 | V |
| | | V _{CC} = 3.0 V | - | - | 0.9 | - | 0.9 | - | 0.9 | V |
| | | V _{CC} = 5.5 V | - | - | 1.65 | - | 1.65 | - | 1.65 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = -50 μA; V _{CC} = 2.0 V | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | I _O = -50 μA; V _{CC} = 3.0 V | 2.9 | 3.0 | - | 2.9 | - | 2.9 | - | V |
| | | I _O = -50 μA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -4.0 mA; V _{CC} = 3.0 V | 2.58 | - | - | 2.48 | - | 2.4 | - | V |
| I _O = -8.0 mA; V _{CC} = 4.5 V | 3.94 | - | - | 3.8 | - | 3.7 | - | V | | |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = 50 μA; V _{CC} = 2.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 50 μA; V _{CC} = 3.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 50 μA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 4.0 mA; V _{CC} = 3.0 V | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| I _O = 8.0 mA; V _{CC} = 4.5 V | - | - | 0.36 | - | 0.44 | - | 0.55 | V | | |
| I _I | input leakage current | V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V | - | - | 0.1 | - | 1.0 | - | 2.0 | 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 |
| C _I | input capacitance | | - | 3.0 | 10 | - | 10 | - | 10 | pF |
| 74AHCT08 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | 2.0 | - | - | 2.0 | - | 2.0 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | - | 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 = -50 μA | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -8.0 mA | 3.94 | - | - | 3.8 | - | 3.7 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V | | | | | | | | |
| | | I _O = 50 μA | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 8.0 mA | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| I _I | input leakage current | V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V | - | - | 0.1 | - | 1.0 | - | 2.0 | 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 |

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

10. Dynamic characteristics

Table 7. Dynamic characteristics

$GND = 0 \text{ V}$; 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 | |
| 74AHC08 | | | | | | | | | | |
| t_{pd} | propagation delay | nA, nB to nY; see Fig. 6 [2] | | | | | | | | |
| | | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$ | | | | | | | | |
| | | $C_L = 15 \text{ pF}$ | - | 4.0 | 8.8 | 1.0 | 10.5 | 1.0 | 11.0 | ns |
| | | $C_L = 50 \text{ pF}$ | - | 5.6 | 12.3 | 1.0 | 14 | 1.0 | 15.5 | ns |
| | | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ | | | | | | | | |
| | | $C_L = 15 \text{ pF}$ | - | 3.0 | 5.9 | 1.0 | 7.0 | 1.0 | 7.5 | ns |
| | | $C_L = 50 \text{ pF}$ | | 4.2 | 7.9 | 1.0 | 9.0 | 1.0 | 10.0 | ns |
| C_{PD} | power dissipation capacitance | $C_L = 50 \text{ pF}$; $f_i = 1 \text{ MHz}$; $V_i = GND \text{ to } V_{CC}$ [3] | - | 10.0 | - | - | - | - | - | pF |
| 74AHCT08 | | | | | | | | | | |
| t_{pd} | propagation delay | nA, nB to nY; see Fig. 6 [2] | | | | | | | | |
| | | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ | | | | | | | | |
| | | $C_L = 15 \text{ pF}$ | - | 3.2 | 6.9 | 1.0 | 8.0 | 1.0 | 9.0 | ns |
| | | $C_L = 50 \text{ pF}$ | - | 4.2 | 7.9 | 1.0 | 9.0 | 1.0 | 10.0 | ns |
| C_{PD} | power dissipation capacitance | $C_L = 50 \text{ pF}$; $f_i = 1 \text{ MHz}$; $V_i = GND \text{ to } V_{CC}$ [3] | - | 12.0 | - | - | - | - | - | 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 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

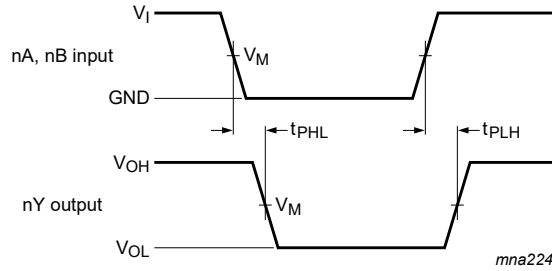
C_L = output load capacitance in pF

V_{CC} = supply voltage in Volts

N = number of inputs switching

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

10.1. Waveform and test circuit



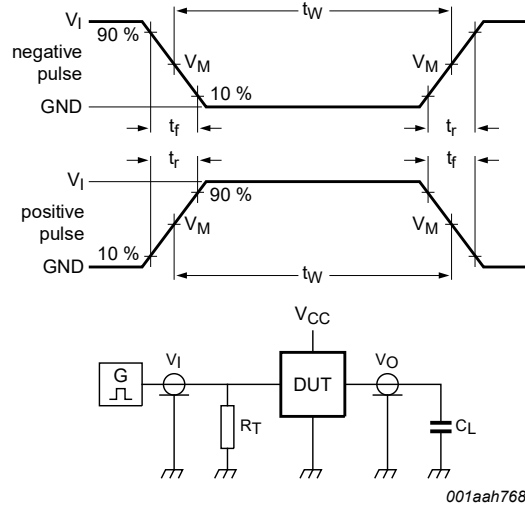
Measurement points are given in [Table 8](#).

V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig. 6. The input (nA, nB) to output (nY) propagation delays

Table 8. Measurement points

| Type | Input | Output |
|----------|-------------|-------------|
| | V_M | V_M |
| 74AHC08 | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 74AHCT08 | 1.5 V | $0.5V_{CC}$ |



Test data is given in [Table 9](#).

Definitions 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. 7. Test circuit for measuring switching times

Table 9. Test data

| Type | Input | | Load | Test |
|----------|----------|---------------|--------------|--------------------|
| | V_I | t_r, t_f | C_L | |
| 74AHC08 | V_{CC} | ≤ 3.0 ns | 15 pF, 50 pF | t_{PLH}, t_{PHL} |
| 74AHCT08 | 3.0 V | ≤ 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 |
|---------|---|
| CMOS | Complementary Metal Oxide Semiconductor |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| MM | Machine Model |
| CDM | Charged Device Model |
| TTL | Transistor-Transistor Logic |

13. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------|---|-----------------------|---------------|------------------|
| 74AHC_AHCT08 v.4 | 20200526 | Product data sheet | - | 74AHC_AHCT08 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. Section 1 and Section 2 updated. Section 7: Derating values for P_{tot} total power dissipation have been updated. Fig. 7: Test circuit corrected (Errata). Package outline drawing of SOT762-1 (Fig. 10) updated. | | | |
| 74AHC_AHCT08 v.3 | 20071114 | Product data sheet | - | 74AHC_AHCT08 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. Section 3: DHVQFN14 package added. Section 7: derating values added for DHVQFN14 package. Section 11: outline drawing added for DHVQFN14 package. | | | |
| 74AHC_AHCT08 v.2 | 19990924 | Product specification | - | 74AHC_AHCT08 v.1 |
| 74AHC_AHCT08 v.1 | 19981218 | 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. |
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