

74AHCT04A

Hex inverter

Rev. 1 — 22 March 2017

Product data sheet

1 General description

The 74AHCT04A is a hex inverter.

Designed to operate over a V_{CC} range from 4.5 V to 5.5 V, the inputs are TTL compatible, which allows the device to be used to translate from 3.3 V to 5 V.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

This device is fully specified for partial Power-down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

2 Features and benefits

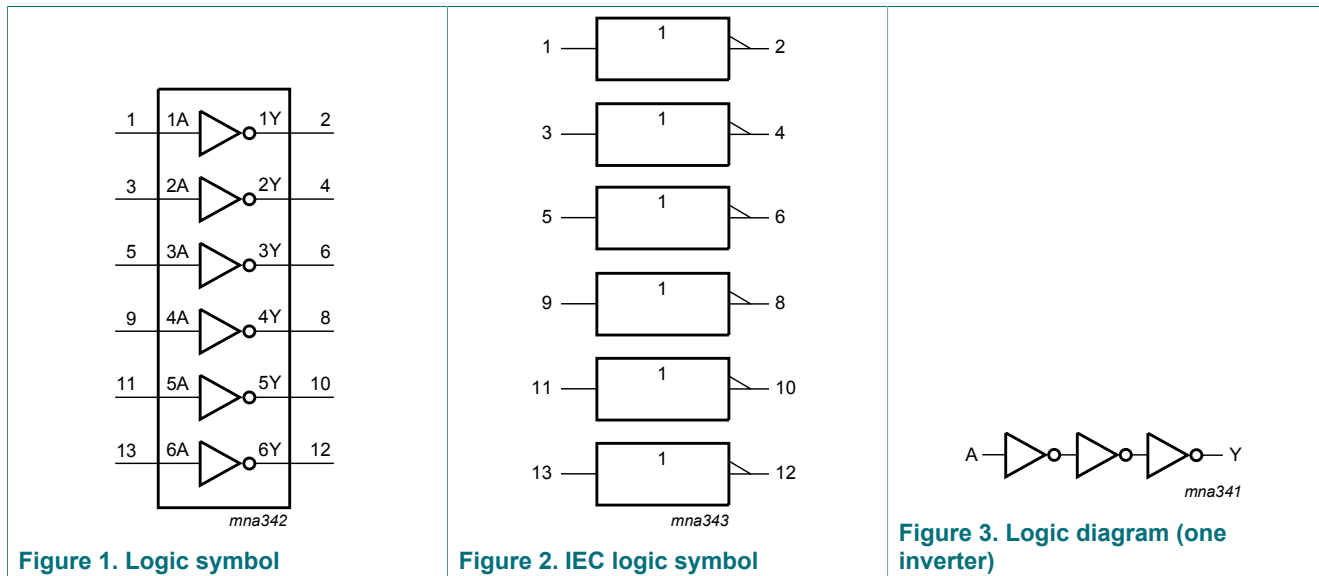
- Direct interface with TTL levels
- Supply voltage range from 4.5 V to 5.5 V
- Typical t_{pd} of 3.1 ns at 5 V
- Typical $V_{OL(p)} < 0.8$ V at $V_{CC} = 5$ V, $T_{amb} = 25$ °C
- Typical $V_{OH(v)} > 2.3$ V at $V_{CC} = 5$ V, $T_{amb} = 25$ °C
- Supports mixed-mode voltage operation on all ports
- I_{OFF} circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA per JESD 78 Class II
- ESD protection:
 - HBM ANSI/ESDA/JEDEC JS-001 Class 2 exceeds 3 kV
 - MM JESD22-A115-A exceeds 200 V
 - CDM JESD22-C101E exceeds 2 kV
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3 Ordering information

Table 1. Ordering information

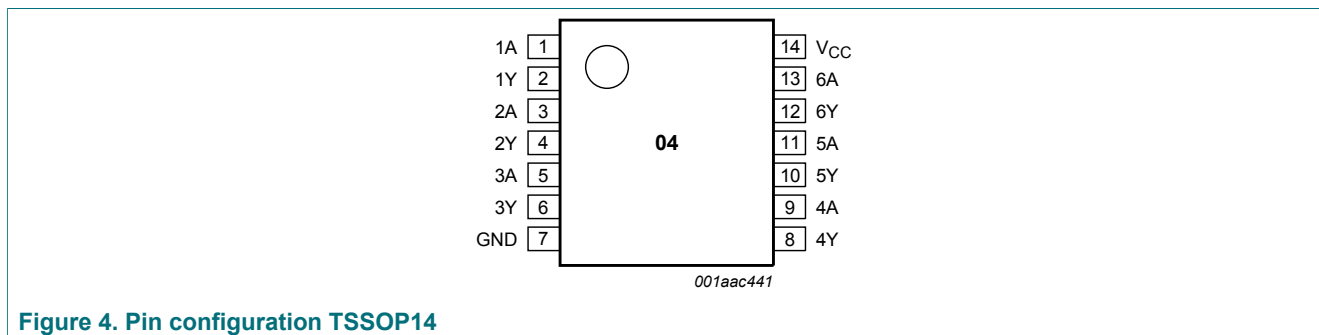
| Type number | Package | | | |
|-------------|-------------------|---------|------------------------------------------------------------------------|----------|
| | Temperature range | Name | Description | Version |
| 74AHCT04APW | -40 °C to +125 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |

4 Functional diagram



5 Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|------------------------|--------------------|----------------|
| 1A, 2A, 3A, 4A, 5A, 6A | 1, 3, 5, 9, 11, 13 | data input |
| 1Y, 2Y, 3Y, 4Y, 5Y, 6Y | 2, 4, 6, 8, 10, 12 | data output |
| GND | 7 | ground (0 V) |
| V _{CC} | 14 | supply voltage |

6 Functional description

Table 3. Function table ^[1]

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

[1] H = HIGH voltage level; L = LOW voltage level

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 |
| V _O | output voltage | active mode | -0.5 | V _{CC} + 0.5 | V |
| | | power-down or 3-state mode | -0.5 | +7.0 | V |
| I _{IK} | input clamping current | V _I < 0 V | -20 | - | mA |
| I _{OK} | output clamping current | V _O < 0 V | -20 | - | mA |
| I _O | output current | V _O = 0 V to V _{CC} | - | ±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 | - | 500 | mW |

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

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

[3] This value is limited to 7.0 V maximum.

[4] For TSSOP14 packages: above 75 °C, the value of P_{tot} derates linearly at 7 mW/K.

8 Recommended operating conditions

Table 5. Recommended operating conditions

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|------------------|-------------------------------------|---------------------------------|-----|-----------------|------|
| V _{CC} | supply voltage | | 4.5 | 5.5 | V |
| V _I | input voltage | | 0 | 5.5 | V |
| V _O | output voltage | active mode | 0 | V _{CC} | V |
| | | power-down or 3-state mode | 0 | 5.5 | V |
| T _{amb} | ambient temperature | | -40 | +125 | °C |
| Δt/ΔV | input transition rise and fall rate | V _{CC} = 5.0 V ± 0.5 V | - | 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 | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | 2 | - | - | 2 | - | 2 | - | 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 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 mA | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| I _{OFF} | power-off leakage current | V _I or V _O = GND to 5.5 V; V _{CC} = 0 V | - | - | 0.5 | - | 5 | - | 5 | μA |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 0 V to 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 | - | 20 | - | 20 | μA |
| ΔI _{CC} | additional supply current | per input pin; V _I = 3.4 V; other pins at V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V | - | - | 1.35 | - | 1.5 | - | 1.5 | mA |

10 Dynamic characteristics

Table 7. Dynamic characteristics

 GND = 0 V. For test circuit see [Figure 6](#).

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------|--------------------|-------------------------------------------------------------------|-------|--------------------|-----|------------------|-----|-------------------|------|------|
| | | | Min | Typ ^[1] | Max | Min | Max | Min | Max | |
| t _{pd} | propagation delay | nA to nY; see Figure 5 ^[2] | | | | | | | | |
| | | V _{CC} = 4.5 V to 5.5 V | | | | | | | | |
| | | C _L = 15 pF | - | 3.1 | 6.7 | 1 | 7.5 | 1 | 8.5 | ns |
| | | C _L = 50 pF | - | 4.8 | 7.7 | 1 | 8.5 | 1 | 10.0 | ns |
| C _I | input capacitance | V _I = V _{CC} or GND; V _{CC} = 5 V | - | 2 | 6 | - | 6 | - | 6 | pF |
| C _O | output capacitance | V _O = V _{CC} or GND; V _{CC} = 5 V | - | 5 | - | - | - | - | - | pF |

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------|-------------------------------|----------------------------------------------------------------------------------------------|-------|--------------------|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ ^[1] | Max | Min | Max | Min | Max | |
| C _{PD} | power dissipation capacitance | per buffer; C _L = 0 pF; f = 10 MHz; V _I = GND to V _{CC} | - | 9.3 | - | - | - | - | - | pF |

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 5 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).

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

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

Table 8. Noise characteristics

GND = 0 V. For test circuit see [Figure 6](#).

| Symbol | Parameter | Conditions | T _{amb} = 25 °C | | | Unit |
|-----------------------------------------------|------------------------------------|------------|--------------------------|------|-----|------|
| | | | Min | Typ | Max | |
| V _{CC} = 5 V; C _L = 50 pF | | | | | | |
| V _{OL(p)} | LOW-level output voltage (peak) | | - | 0.4 | 0.8 | V |
| V _{OL(v)} | LOW-level output voltage (valley) | | -0.8 | -0.2 | - | V |
| V _{OH(v)} | HIGH-level output voltage (valley) | | - | 4.5 | - | V |
| V _{IH(AC)} | AC HIGH-level input voltage | | 2 | - | - | V |
| V _{IL(AC)} | AC LOW-level input voltage | | - | - | 0.8 | V |

10.1 Waveforms and test circuit

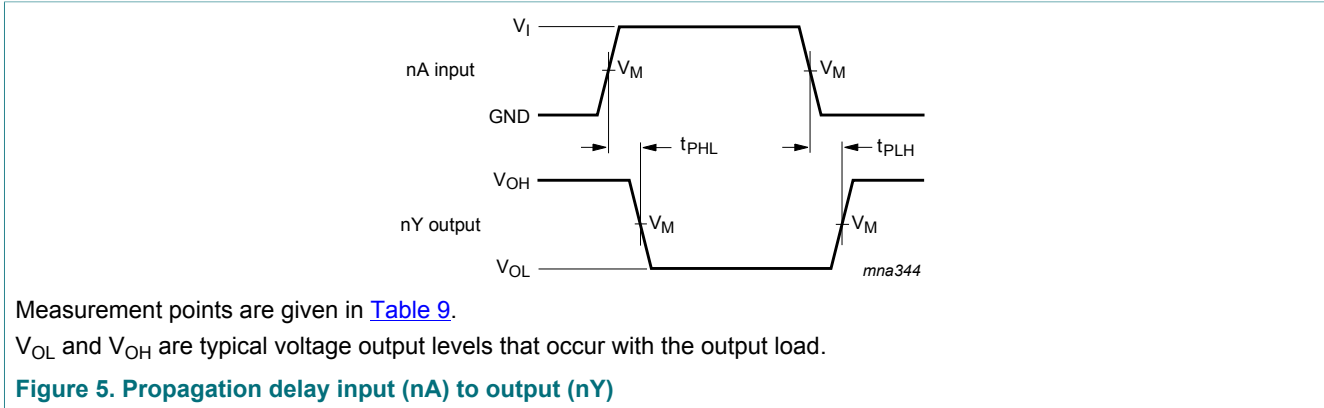
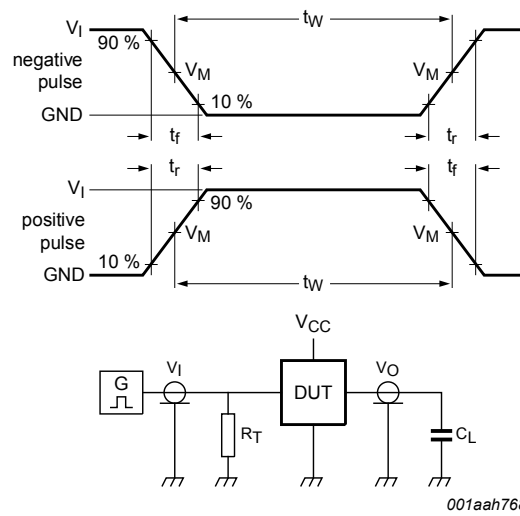


Table 9. Measurement points

| Input | Output |
|-------|-------------|
| V_M | V_M |
| 1.5 V | $0.5V_{CC}$ |



001aah768

Test data is given in [Table 10](#).

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

S1 = Test selection switch

Figure 6. Test circuit for measuring switching times

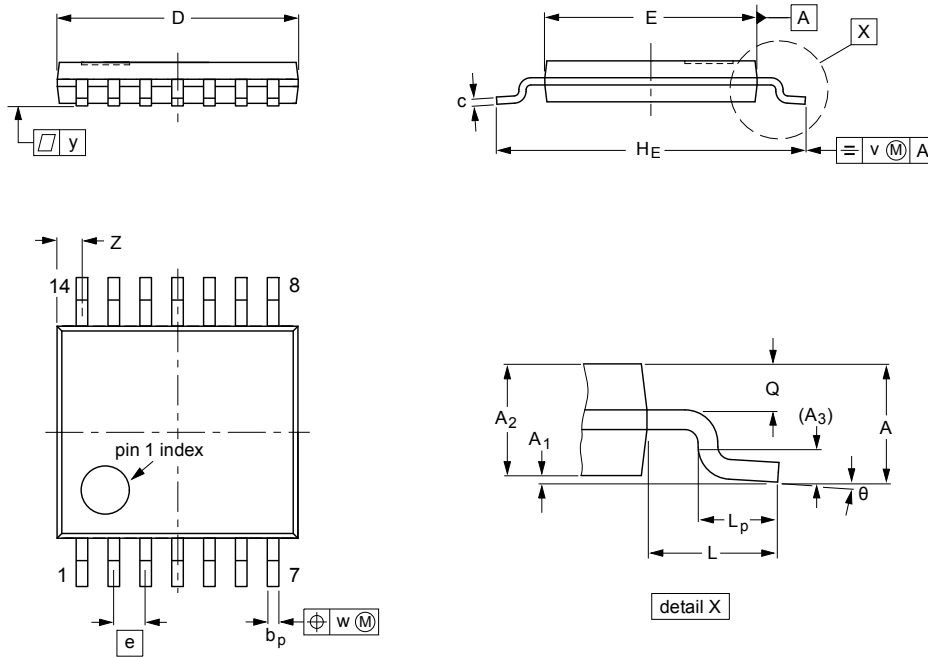
Table 10. Test data

| Input | | Load | Test |
|------------|------------|--------------|--------------------|
| V_I | t_r, t_f | C_L | |
| GND to 3 V | 3.0 ns | 15 pF, 50 pF | t_{PLH}, t_{PHL} |

11 Package outline

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

SOT402-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽²⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|---|----------------|------------|-----|------|-----|------------------|----------|
| mm | 1.1 | 0.15 0.05 | 0.95 0.80 | 0.25 | 0.30 0.19 | 0.2 0.1 | 5.1 4.9 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1 | 0.75 0.50 | 0.4 0.3 | 0.2 | 0.13 | 0.1 | 0.72 0.38 | 8° 0° |

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|-------|--|---------------------|----------------------|
| | IEC | JEDEC | JEITA | | | |
| SOT402-1 | | MO-153 | | | | 99-12-27 03-02-18 |

Figure 7. Package outline SOT402-1 (TSSOP14)

12 Abbreviations

Table 11. Abbreviations

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

13 Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---------------|--------------|--------------------|---------------|------------|
| 74AHCT04A v.1 | 20170322 | Product data sheet | - | - |

14 Legal information

14.1 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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