

74AHC14; 74AHCT14

Hex inverting Schmitt trigger

Rev. 05 — 4 May 2009

Product data sheet

1. General description

The 74AHC14; 74AHCT14 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7A.

The 74AHC14; 74AHCT14 provides six inverting buffers with Schmitt-trigger action. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

2. Features

- Balanced propagation delays
- All inputs have Schmitt-trigger actions
- Inputs accept voltages higher than V_{CC}
- Input levels:
 - ◆ For 74AHC14: CMOS level
 - ◆ For 74AHCT14: TTL level
- ESD protection:
 - ◆ HBM EIA/JESD22-A114E exceeds 2000 V
 - ◆ MM EIA/JESD22-A115-A exceeds 200 V
 - ◆ CDM EIA/JESD22-C101C exceeds 1000 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 | | | Version |
|-----------------|-------------------|----------|--|----------|
| | Temperature range | Name | Description | |
| 74AHC14 | | | | |
| 74AHC14D | -40 °C to +125 °C | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74AHC14PW | -40 °C to +125 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74AHC14BQ | -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 |
| 74AHCT14 | | | | |
| 74AHCT14D | -40 °C to +125 °C | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| 74AHCT14PW | -40 °C to +125 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |
| 74AHCT14BQ | -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 |

4. Functional diagram

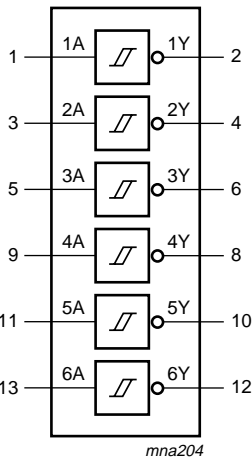


Fig 1. Logic symbol

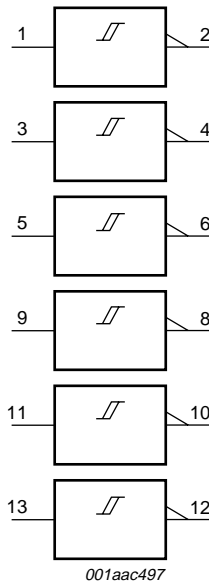


Fig 2. IEC logic symbol

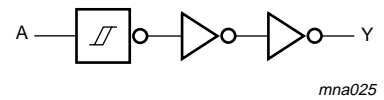
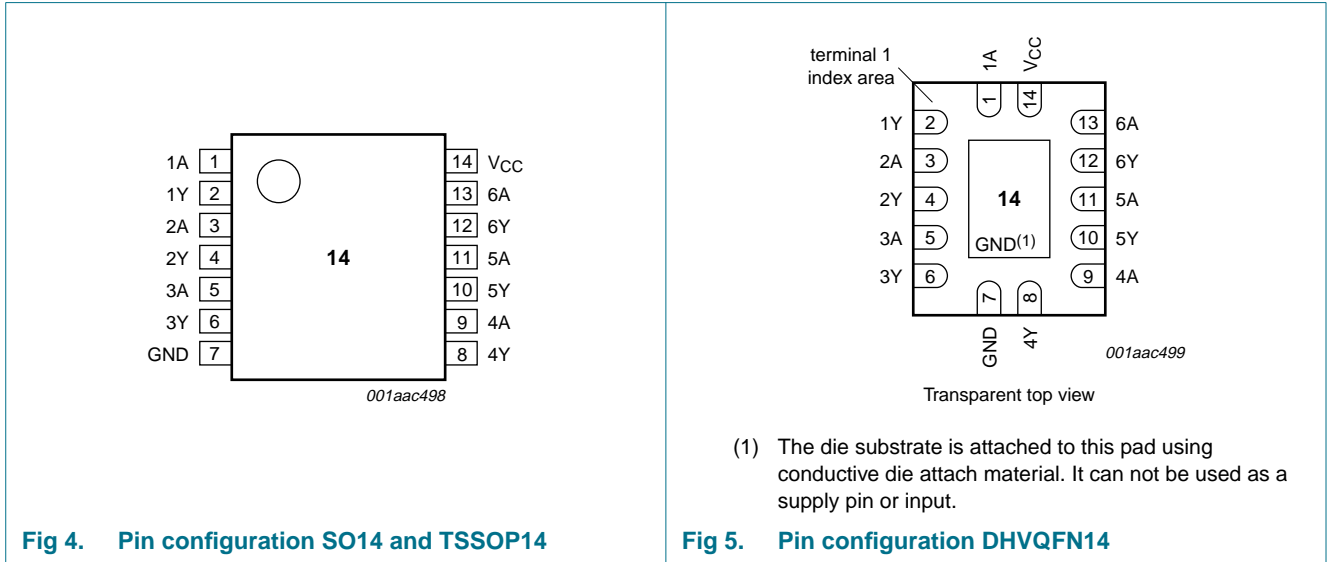


Fig 3. Logic diagram (one Schmitt-trigger)

5. Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|-----------------|-----|----------------|
| 1A | 1 | data input 1 |
| 1Y | 2 | data output 1 |
| 2A | 3 | data input 2 |
| 2Y | 4 | data output 2 |
| 3A | 5 | data input 3 |
| 3Y | 6 | data output 3 |
| GND | 7 | ground (0 V) |
| 4Y | 8 | data output 4 |
| 4A | 9 | data input 4 |
| 5Y | 10 | data output 5 |
| 5A | 11 | data input 5 |
| 6Y | 12 | data output 6 |
| 6A | 13 | data input 6 |
| 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 |
| 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 SO14 packages: above 70 °C the value of P_{tot} derates linearly at 8 mW/K.
For TSSOP14 packages: above 60 °C the value of P_{tot} derates linearly at 5.5 mW/K.
For DHVQFN14 packages: above 60 °C the value of P_{tot} derates linearly at 4.5 mW/K.

8. Recommended operating conditions

Table 5. Operating conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------------|---------------------|------------|-----|-----|----------|------|
| 74AHC14 | | | | | | |
| V_{CC} | supply voltage | | 2.0 | 5.0 | 5.5 | V |
| V_I | input voltage | | 0 | - | 5.5 | V |
| V_O | output voltage | | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | +25 | +125 | °C |
| 74AHCT14 | | | | | | |
| V_{CC} | supply voltage | | 4.5 | 5.0 | 5.5 | V |
| V_I | input voltage | | 0 | - | 5.5 | V |
| V_O | output voltage | | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | +25 | +125 | °C |

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 | |
| 74AHC14 | | | | | | | | | | |
| V _{OH} | HIGH-level output voltage | V _I = V _{T+} or V _{T-} | | | | | | | | |
| | | 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 | - | 2.40 | - | V |
| | | I _O = -8.0 mA; V _{CC} = 4.5 V | 3.94 | - | - | 3.80 | - | 3.70 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{T+} or V _{T-} | | | | | | | | |
| | | 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 | 10 | - | 10 | - | 10 | pF |
| C _O | output capacitance | | - | 4 | - | - | - | - | - | pF |
| 74AHCT14 | | | | | | | | | | |
| V _{OH} | HIGH-level output voltage | V _I = V _{T+} or V _{T-} | | | | | | | | |
| | | I _O = -50 μA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -8.0 mA; V _{CC} = 4.5 V | 3.94 | - | - | 3.80 | - | 3.70 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{T+} or V _{T-} | | | | | | | | |
| | | I _O = 50 μA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | 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 |
| ΔI _{CC} | additional supply current | per input pin; V _I = V _{CC} - 2.1 V; other pins at V _{CC} or GND; I _O = 0 A; V _{CC} = 4.5 V to 5.5 V | - | - | 1.35 | - | 1.5 | - | 1.5 | mA |
| C _I | input capacitance | | - | 3 | 10 | - | 10 | - | 10 | pF |
| C _O | output capacitance | | - | 4 | - | - | - | - | - | pF |

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see [Figure 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 | |
| 74AHC14 | | | | | | | | | | |
| t _{pd} | propagation delay | nA to nY; see Figure 6 [2] | | | | | | | | |
| | | V _{CC} = 3.0 V to 3.6 V | | | | | | | | |
| | | C _L = 15 pF | - | 4.3 | 12.8 | 1.0 | 15.0 | 1.0 | 16.0 | ns |
| | | C _L = 50 pF | - | 5.8 | 16.3 | 1.0 | 18.0 | 1.0 | 20.5 | ns |
| | | V _{CC} = 4.5 V to 5.5 V | | | | | | | | |
| | | C _L = 15 pF | - | 3.2 | 8.6 | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| | | C _L = 50 pF | - | 4.2 | 10.6 | 1.0 | 12.0 | 1.0 | 13.5 | ns |
| C _{PD} | power dissipation capacitance | f _i = 1 MHz; V _I = GND to V _{CC} [3] | - | 10 | - | - | - | - | - | pF |
| 74AHCT14 | | | | | | | | | | |
| t _{pd} | propagation delay | nA to nY; see Figure 6 [2] | | | | | | | | |
| | | V _{CC} = 4.5 V to 5.5 V | | | | | | | | |
| | | C _L = 15 pF | - | 4.0 | 7.0 | 1.0 | 8.0 | 1.0 | 9.0 | ns |
| | | C _L = 50 pF | - | 5.4 | 8.0 | 1.0 | 9.0 | 1.0 | 10.0 | ns |
| C _{PD} | power dissipation capacitance | f _i = 1 MHz; V _I = GND to V _{CC} [3] | - | 12 | - | - | - | - | - | pF |

[1] Typical values are measured at nominal supply voltage (V_{CC} = 3.3 V and V_{CC} = 5.0 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;

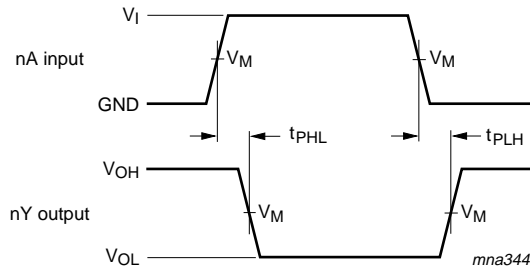
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

Σ(C_L × V_{CC}² × f_o) = sum of the outputs.

11. Waveforms

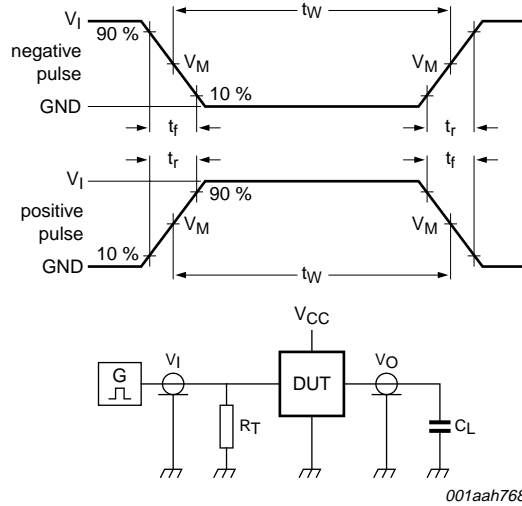


Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 6. Input to output propagation delays

Table 8. Measurement points

| Type | Input | Output |
|----------|---------------------|---------------------|
| | V_M | V_M |
| 74AHC14 | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74AHCT14 | 1.5 V | $0.5 \times V_{CC}$ |



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. Load circuitry for measuring switching times

Table 9. Test data

| Type | Input | | Load | Test |
|----------|----------|---------------|--------------|--------------------|
| | V_I | t_r, t_f | C_L | |
| 74AHC14 | V_{CC} | ≤ 3.0 ns | 50 pF, 15 pF | t_{PLH}, t_{PHL} |
| 74AHCT14 | 3.0 V | ≤ 3.0 ns | 50 pF, 15 pF | t_{PLH}, t_{PHL} |

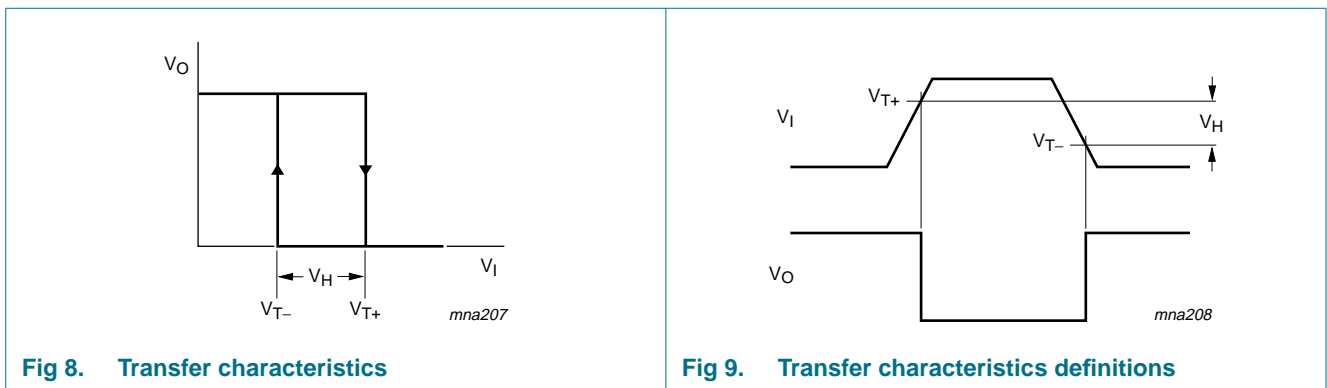
12. Transfer characteristics

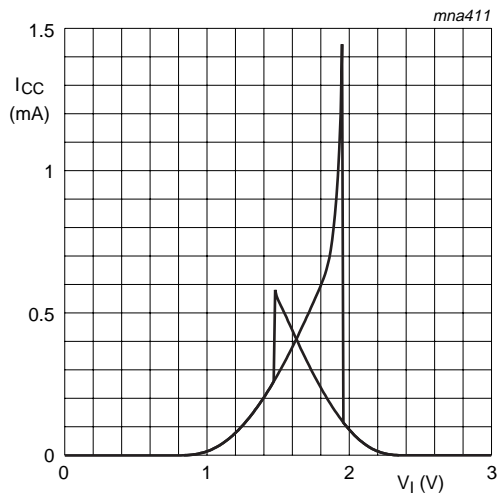
Table 10. Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see Figure 8 and Figure 9.

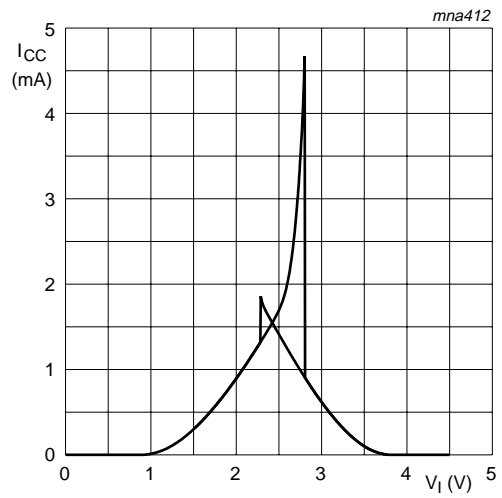
| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-----------------|----------------------------------|------------------|-------|-----|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74AHC14 | | | | | | | | | | |
| V_{T+} | positive-going threshold voltage | $V_{CC} = 3.0$ V | - | - | 2.2 | - | 2.2 | - | 2.2 | V |
| | | $V_{CC} = 4.5$ V | - | - | 3.15 | - | 3.15 | - | 3.15 | V |
| | | $V_{CC} = 5.5$ V | - | - | 3.85 | - | 3.85 | - | 3.85 | V |
| V_{T-} | negative-going threshold voltage | $V_{CC} = 3.0$ V | 0.9 | - | - | 0.9 | - | 0.9 | - | V |
| | | $V_{CC} = 4.5$ V | 1.35 | - | - | 1.35 | - | 1.35 | - | V |
| | | $V_{CC} = 5.5$ V | 1.65 | - | - | 1.65 | - | 1.65 | - | V |
| V_H | hysteresis voltage | $V_{CC} = 3.0$ V | 0.3 | - | 1.2 | 0.3 | 1.2 | 0.25 | 1.2 | V |
| | | $V_{CC} = 4.5$ V | 0.4 | - | 1.4 | 0.4 | 1.4 | 0.35 | 1.4 | V |
| | | $V_{CC} = 5.5$ V | 0.5 | - | 1.6 | 0.5 | 1.6 | 0.45 | 1.6 | V |
| 74AHCT14 | | | | | | | | | | |
| V_{T+} | positive-going threshold voltage | $V_{CC} = 4.5$ V | - | - | 1.9 | - | 1.9 | - | 1.9 | V |
| | | $V_{CC} = 5.5$ V | - | - | 2.1 | - | 2.1 | - | 2.1 | V |
| V_{T-} | negative-going threshold voltage | $V_{CC} = 4.5$ V | 0.5 | - | - | 0.5 | - | 0.5 | - | V |
| | | $V_{CC} = 5.5$ V | 0.6 | - | - | 0.6 | - | 0.6 | - | V |
| V_H | hysteresis voltage | $V_{CC} = 4.5$ V | 0.4 | - | 1.4 | 0.4 | 1.4 | 0.35 | 1.4 | V |
| | | $V_{CC} = 5.5$ V | 0.4 | - | 1.5 | 0.4 | 1.5 | 0.35 | 1.5 | V |

13. Transfer characteristics waveforms

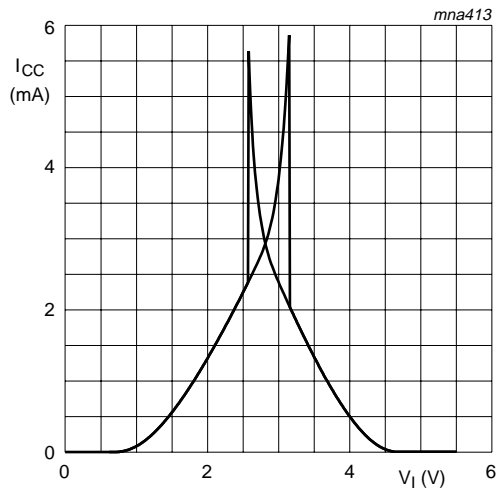




a. $V_{CC} = 3.0\text{ V}$



b. $V_{CC} = 4.5\text{ V}$



c. $V_{CC} = 5.5\text{ V}$

Fig 10. Typical 74AHC transfer characteristics

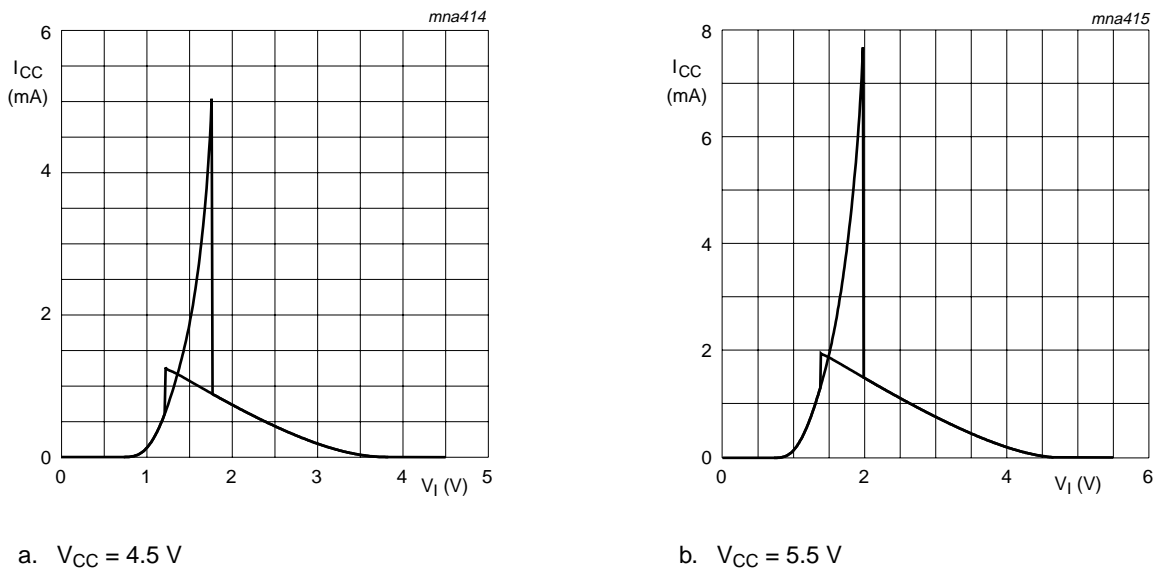
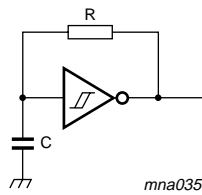


Fig 11. Typical 74AHCT transfer characteristics

14. Application information



For 74AHC14: $f = \frac{1}{T} \approx \frac{1}{0.55 \times RC}$

For 74AHCT14: $f = \frac{1}{T} \approx \frac{1}{0.60 \times RC}$

Fig 12. Relaxation oscillator

15. Package outline

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

SOT108-1

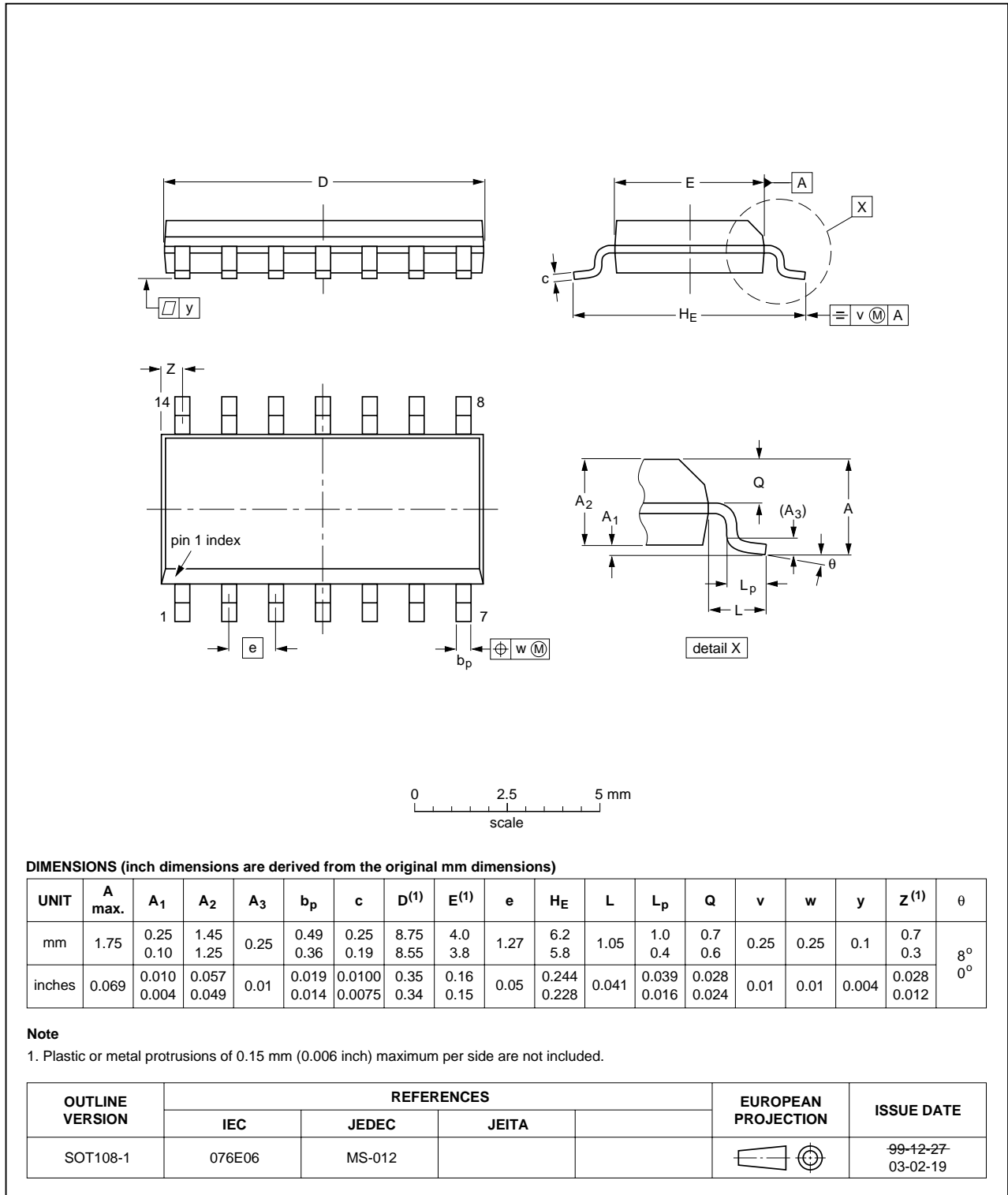


Fig 13. Package outline SOT108-1 (SO14)

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

SOT402-1

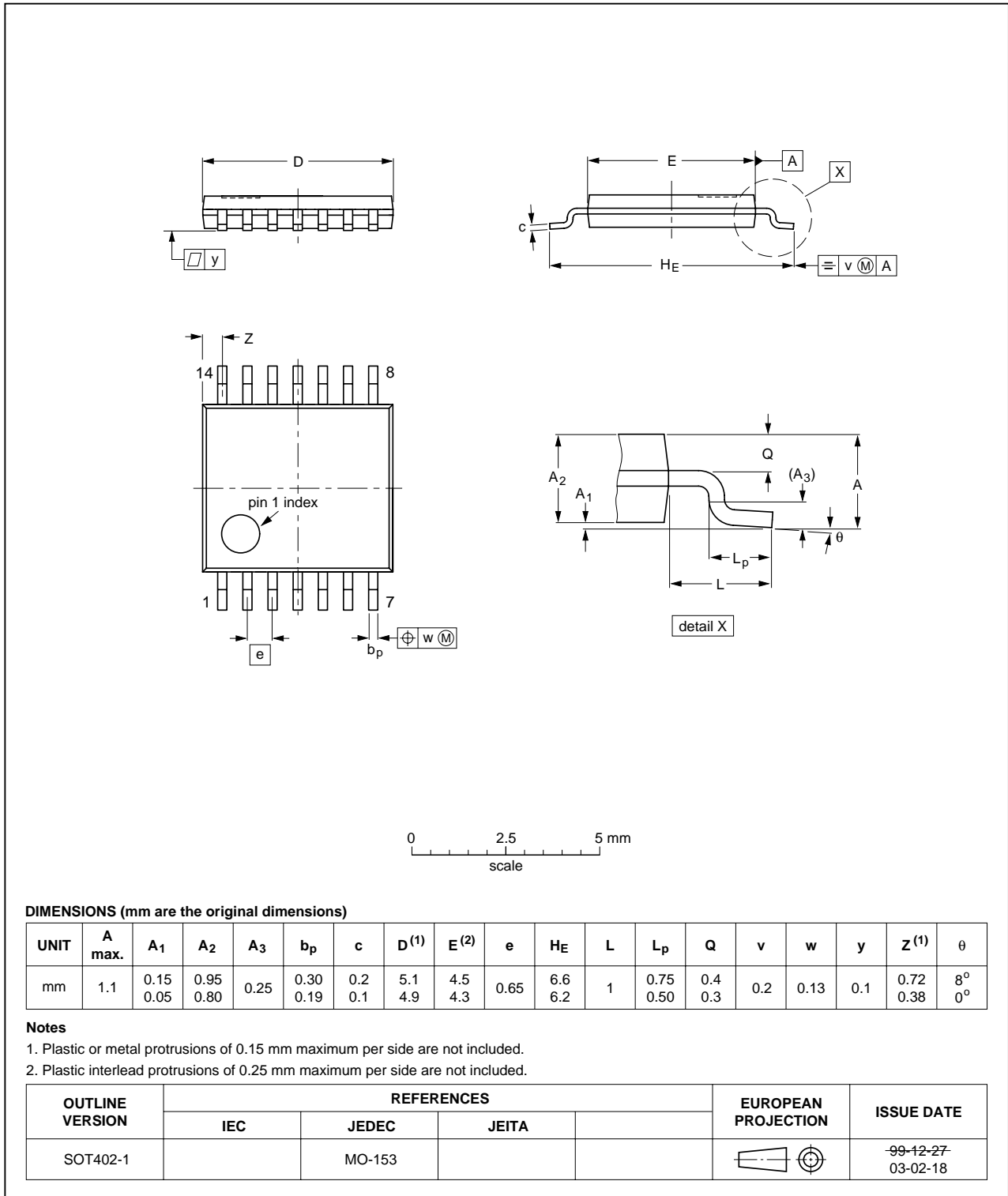


Fig 14. Package outline SOT402-1 (TSSOP14)

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

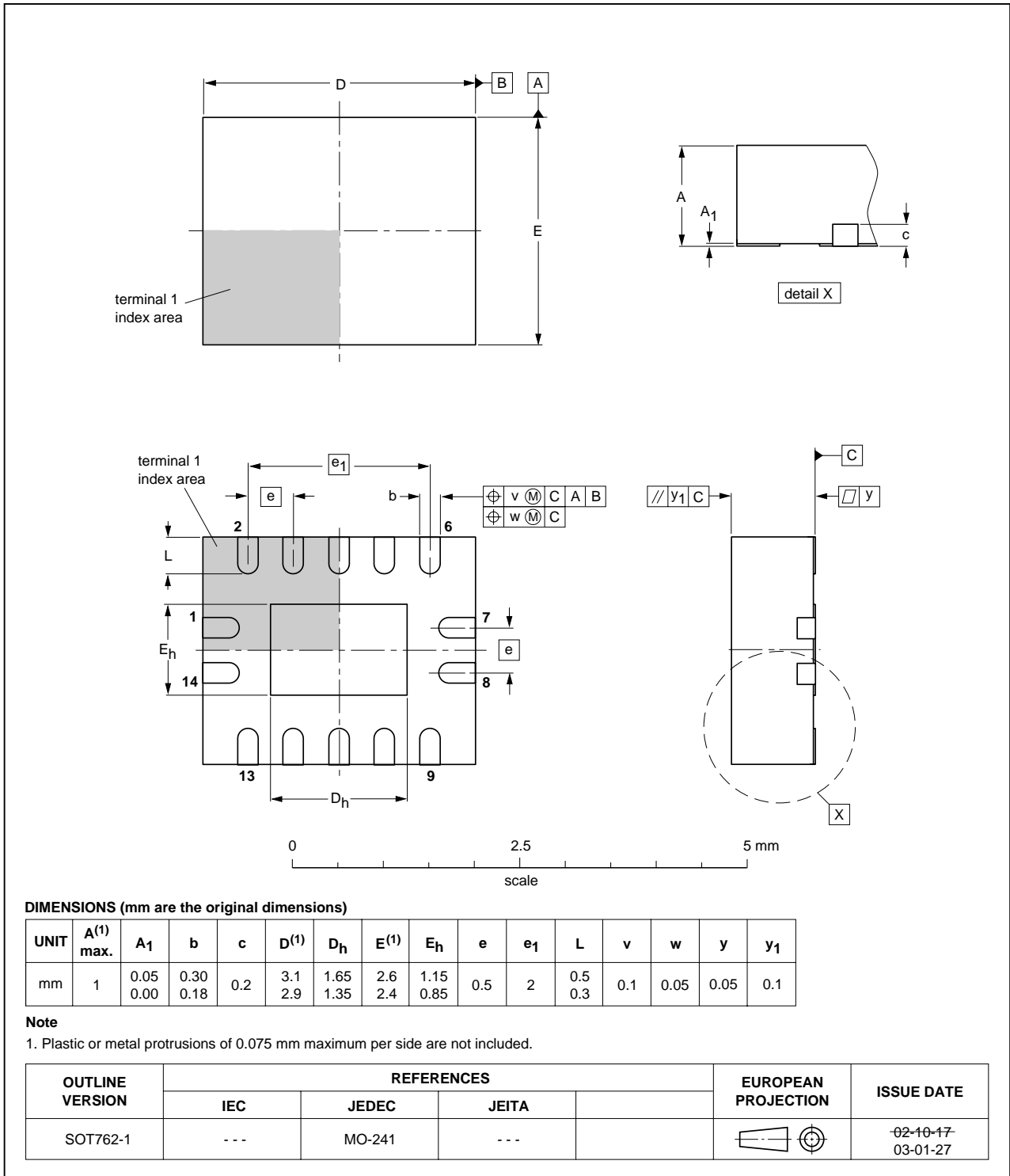


Fig 15. Package outline SOT762-1 (DHVQFN14)

16. Abbreviations

Table 11. Abbreviations

| Acronym | Description |
|---------|--|
| CDM | Charged Device Model |
| CMOS | Complementary Metal-Oxide Semiconductor |
| DUT | Device Under Test |
| ESD | ElectroStatic Discharge |
| HBM | Human Body Model |
| LSTTL | Low-power Schottky Transistor-Transistor Logic |
| MM | Machine Model |

17. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------|---|---------------------------|---------------|------------------|
| 74AHC_AHCT14_5 | 20090504 | Product data sheet | - | 74AHC_AHCT14_4 |
| Modifications: | <ul style="list-style-type: none"> • Table 6: the conditions for HIGH-level output voltage and LOW-level output voltage have been changed. | | | |
| 74AHC_AHCT14_4 | 20080425 | Product data sheet | - | 74AHC_AHCT14_3 |
| 74AHC_AHCT14_3 | 20030526 | Product specification | - | 74AHC_AHCT14_2 |
| 74AHC_AHCT14_2 | 19990927 | Product specification | - | 74AHC_AHCT14_N_1 |
| 74AHC_AHCT14_N_1 | 19990111 | Preliminary specification | - | - |

18. Legal information

18.1 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".

[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.nxp.com>.

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20. Contents

| | | |
|-----------|---|-----------|
| 1 | General description | 1 |
| 2 | Features | 1 |
| 3 | Ordering information | 2 |
| 4 | Functional diagram | 2 |
| 5 | Pinning information | 3 |
| 5.1 | Pinning | 3 |
| 5.2 | Pin description | 3 |
| 6 | Functional description | 4 |
| 7 | Limiting values | 4 |
| 8 | Recommended operating conditions | 4 |
| 9 | Static characteristics | 5 |
| 10 | Dynamic characteristics | 6 |
| 11 | Waveforms | 7 |
| 12 | Transfer characteristics | 8 |
| 13 | Transfer characteristics waveforms | 8 |
| 14 | Application information | 10 |
| 15 | Package outline | 11 |
| 16 | Abbreviations | 14 |
| 17 | Revision history | 14 |
| 18 | Legal information | 15 |
| 18.1 | Data sheet status | 15 |
| 18.2 | Definitions | 15 |
| 18.3 | Disclaimers | 15 |
| 18.4 | Trademarks | 15 |
| 19 | Contact information | 15 |
| 20 | Contents | 16 |



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Date of release: 4 May 2009

Document identifier: 74AHC_AHCT14_5