

74AHCT14A

Hex inverting Schmitt trigger

Rev. 2 — 26 October 2016

Product data sheet

1. General description

The 74AHCT14A is a hexadecimal inverter with Schmitt-trigger inputs, capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

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

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 3.7 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 | | | Version |
|-------------|-------------------|---------|--|----------|
| | Temperature range | Name | Description | |
| 74AHCT14APW | -40 °C to +125 °C | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |

4. Functional diagram

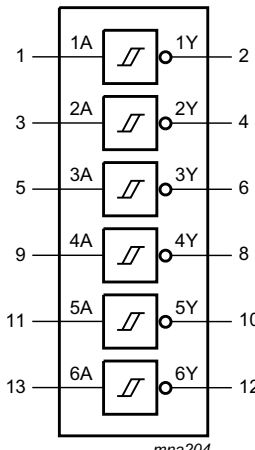


Fig 1. Logic symbol

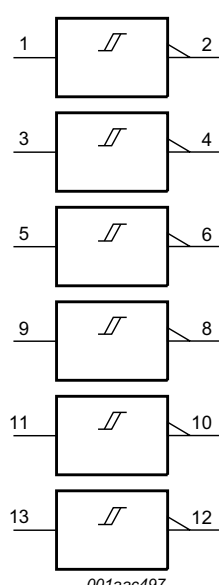


Fig 2. IEC logic symbol

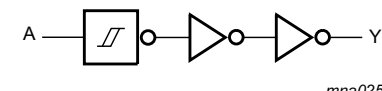


Fig 3. Logic diagram (one Schmitt-trigger)

5. Pinning information

5.1 Pinning

74AHCT14A

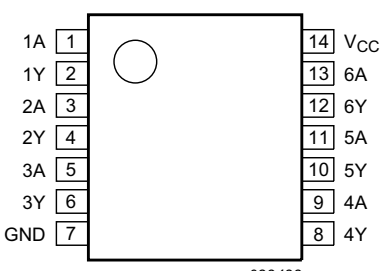


Fig 4. Pin configuration TSSOP14

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 | output HIGH or LOW state | -0.5 | V _{CC} + 0.5 | V |
| | | output power-down | -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] If the input current ratings are observed, the minimum input voltage ratings may be exceeded.
 [2] If the output current ratings are observed, the output voltage ratings may be exceeded.
 [3] This value is limited to 7 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 | Typ | Max | Unit |
|---------------------|-------------------------------------|--|-----|-----|----------|------|
| V_{CC} | supply voltage | | 4.5 | 5.0 | 5.5 | V |
| V_I | input voltage | | 0 | - | 5.5 | V |
| V_O | output voltage | output HIGH or LOW state | 0 | - | V_{CC} | V |
| | | output power-down | 0 | - | 5.5 | V |
| T_{amb} | ambient temperature | | -40 | +25 | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$ | - | - | 1 | ms/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_{T+} | positive-going threshold voltage | $V_{CC} = 4.5 \text{ V}$ | - | - | 1.9 | - | 1.9 | - | 1.9 | V |
| | | $V_{CC} = 5.5 \text{ V}$ | - | - | 2.1 | - | 2.1 | - | 2.1 | V |
| V_{T-} | negative-going threshold voltage | $V_{CC} = 4.5 \text{ V}$ | 0.5 | - | - | 0.5 | - | 0.5 | - | V |
| | | $V_{CC} = 5.5 \text{ V}$ | 0.6 | - | - | 0.6 | - | 0.6 | - | V |
| V_H | hysteresis voltage | $V_{CC} = 4.5 \text{ V}$ | 0.4 | - | 1.4 | 0.4 | 1.4 | 0.4 | 1.4 | V |
| | | $V_{CC} = 5.5 \text{ V}$ | 0.4 | - | 1.5 | 0.4 | 1.5 | 0.4 | 1.5 | V |
| V_{OH} | HIGH-level output voltage | $V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 4.5 \text{ V}$ | | | | | | | | |
| | | $I_O = -50 \mu\text{A}$ | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O = -8 \text{ mA}$ | 3.94 | - | - | 3.8 | - | 3.7 | - | V |
| V_{OL} | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 4.5 \text{ V}$ | | | | | | | | |
| | | $I_O = 50 \mu\text{A}$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O = 8 \text{ mA}$ | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| I_{OFF} | power-off leakage current | V_I or $V_O = \text{GND to } 5.5 \text{ V};$ $V_{CC} = 0 \text{ V}$ | - | - | 0.5 | - | 5 | - | 5 | μA |
| I_I | input leakage current | $V_I = V_{CC}$ or GND; $V_{CC} = 0 \text{ V to } 5.5 \text{ V}$ | - | - | ± 0.1 | - | ± 1 | - | ± 1 | μA |
| I_{CC} | supply current | $V_I = V_{CC}$ or GND; $I_O = 0 \text{ A};$ $V_{CC} = 5.5 \text{ V}$ | - | - | 2 | - | 20 | - | 20 | μA |
| ΔI_{CC} | additional supply current | per input pin; $V_I = 3.4 \text{ V};$ $I_O = 0 \text{ A};$ other pins at V_{CC} or GND; $V_{CC} = 5.5 \text{ V}$ | - | - | 1.35 | - | 1.5 | - | 1.5 | mA |

9.1 Transfer characteristics waveforms

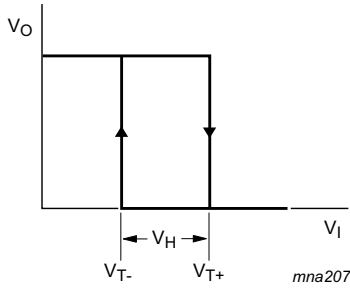


Fig 5. Transfer characteristics

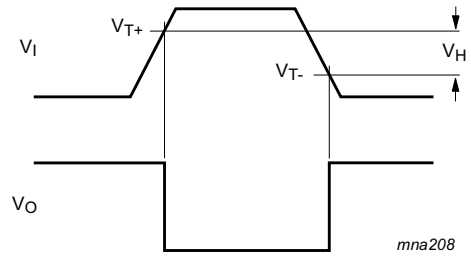
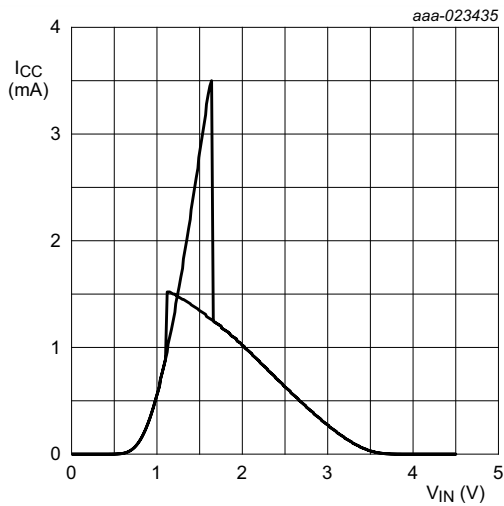
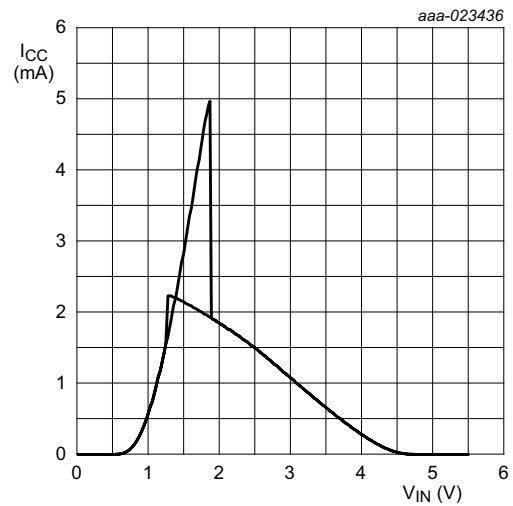


Fig 6. Transfer characteristics definitions



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



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

Fig 7. Typical transfer characteristics

10. Dynamic characteristics

Table 7. Dynamic characteristics
GND = 0 V. For test circuit, see [Figure 9](#).

| 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 8 ^[2] | | | | | | | | |
| | | V _{CC} = 4.5 V to 5.5 V | | | | | | | | |
| | | C _L = 15 pF | - | 3.7 | 7.6 | 1 | 9 | 1 | 9.7 | ns |
| | | C _L = 50 pF | - | 5 | 9.6 | 1 | 11 | 1 | 11.9 | 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 |
| C _{PD} | power dissipation capacitance | per buffer; ^[3] C _L = 0 pF; f = 10 MHz; V _I = GND to V _{CC} | - | 10 | - | - | - | - | - | 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 (μW).

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

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.

Table 8. Noise characteristics
 GND = 0 V. For test circuit, see [Figure 9](#).

| 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 |

11. Waveforms

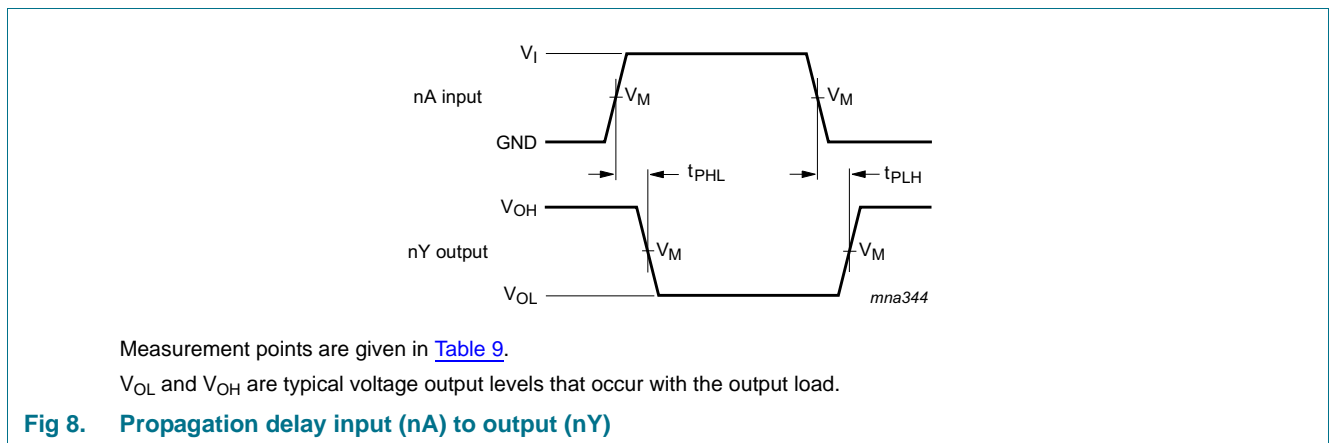
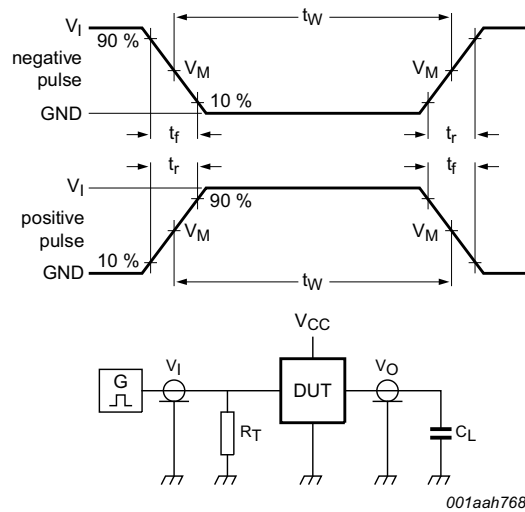


Table 9. Measurement points

| 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

Fig 9. 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} |

12. Package outline

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

SOT402-1

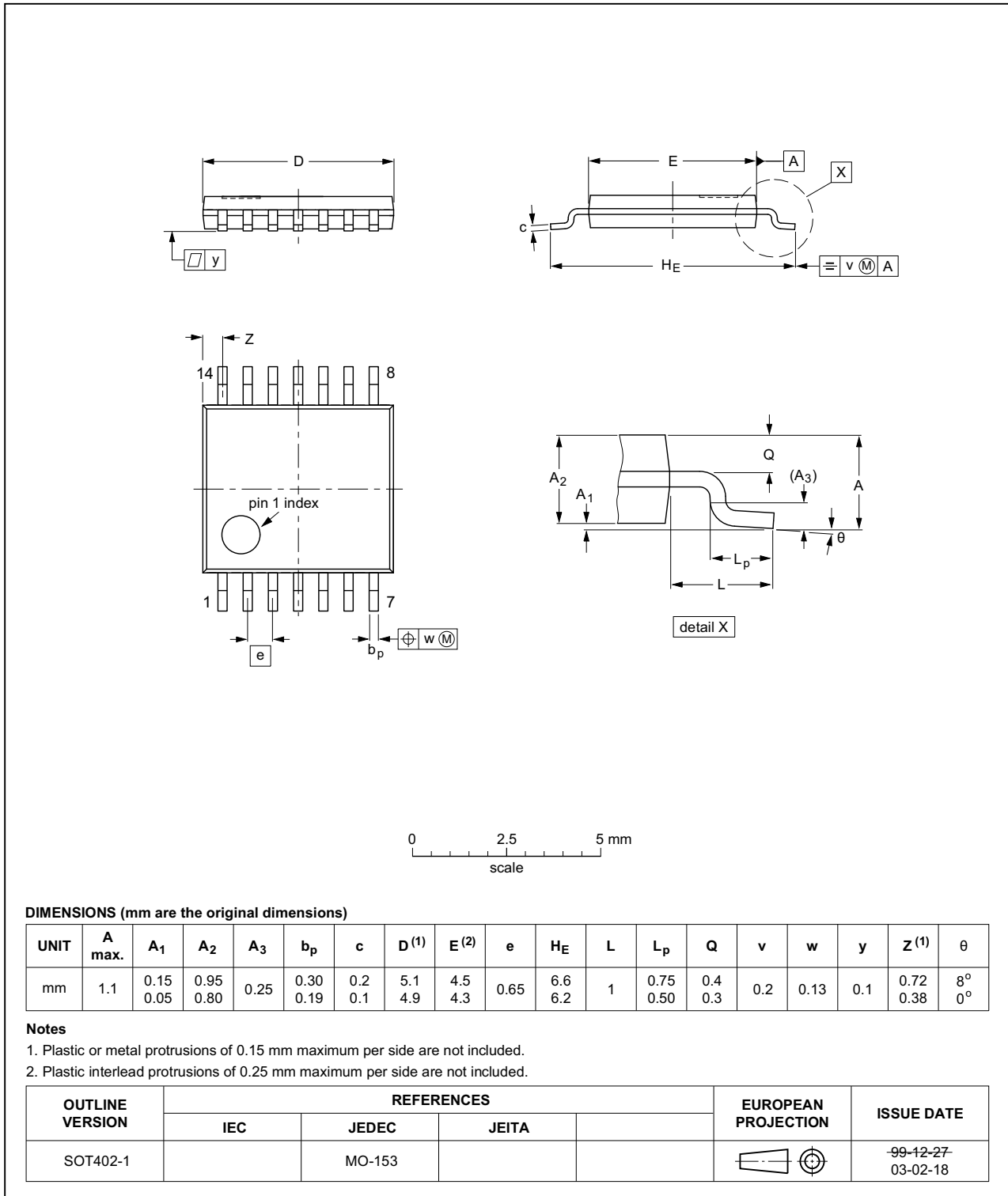


Fig 10. Package outline SOT402-1 (TSSOP14)

13. 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 |

14. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|--------------------|---------------|---------------|
| 74AHCT14A v.2 | 20161026 | Product data sheet | - | 74AHCT14A v.1 |
| Modifications: | • Type numbers 74AHCT14AD and 74AHCT14ABQ removed. | | | |
| 74AHCT14A v.1 | 20160614 | Product data sheet | - | - |

15. Legal information

15.1 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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17. Contents

| | | |
|-----------|---|-----------|
| 1 | General description | 1 |
| 2 | Features and benefits | 1 |
| 3 | Ordering information | 2 |
| 4 | Functional diagram | 2 |
| 5 | Pinning information | 2 |
| 5.1 | Pinning | 2 |
| 5.2 | Pin description | 3 |
| 6 | Functional description | 3 |
| 7 | Limiting values | 3 |
| 8 | Recommended operating conditions | 4 |
| 9 | Static characteristics | 4 |
| 9.1 | Transfer characteristics waveforms | 5 |
| 10 | Dynamic characteristics | 6 |
| 11 | Waveforms | 7 |
| 12 | Package outline | 9 |
| 13 | Abbreviations | 10 |
| 14 | Revision history | 10 |
| 15 | Legal information | 11 |
| 15.1 | Data sheet status | 11 |
| 15.2 | Definitions | 11 |
| 15.3 | Disclaimers | 11 |
| 15.4 | Trademarks | 12 |
| 16 | Contact information | 12 |
| 17 | Contents | 13 |