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# 74AHC1G14; 74AHCT1G14

## Inverting Schmitt trigger

Rev. 06 — 18 May 2009

Product data sheet

## 1. General description

74AHC1G14 and 74AHCT1G14 are high-speed Si-gate CMOS devices. They provide an inverting buffer function with Schmitt trigger action. These devices are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

The AHC device has CMOS input switching levels and supply voltage range 2 V to 5.5 V.

The AHCT device has TTL input switching levels and supply voltage range 4.5 V to 5.5 V.

## 2. Features

- Symmetrical output impedance
- High noise immunity
- ESD protection:
  - ◆ HBM JESD22-A114E: exceeds 2000 V
  - ◆ MM JESD22-A115-A: exceeds 200 V
  - ◆ CDM JESD22-C101C: exceeds 1000 V
- Low power dissipation
- Balanced propagation delays
- SOT353-1 and SOT753 package options
- Specified from -40 °C to +125 °C

## 3. Applications

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators

## 4. Ordering information

Table 1. Ordering information

| Type number                 | Package           |        |                                                                           |          |
|-----------------------------|-------------------|--------|---------------------------------------------------------------------------|----------|
|                             | Temperature range | Name   | Description                                                               | Version  |
| 74AHC1G14GW<br>74AHCT1G14GW | -40 °C to +125 °C | TSSOP5 | plastic thin shrink small outline package; 5 leads;<br>body width 1.25 mm | SOT353-1 |
| 74AHC1G14GV<br>74AHCT1G14GV | -40 °C to +125 °C | SC-74A | plastic surface-mounted package; 5 leads                                  | SOT753   |

5. Marking

Table 2. Marking codes

| Type number  | Marking code |
|--------------|--------------|
| 74AHC1G14GW  | AF           |
| 74AHCT1G14GW | CF           |
| 74AHC1G14GV  | A14          |
| 74AHCT1G14GV | C14          |

6. Functional diagram

Fig 1. Logic symbol

Fig 2. IEC logic symbol

Fig 3. Logic diagram

7. Pinning information

7.1 Pinning

74AHC1G14  
74AHCT1G14

Fig 4. Pin configuration

7.2 Pin description

Table 3. Pin description

| Symbol          | Pin | Description    |
|-----------------|-----|----------------|
| n.c.            | 1   | not connected  |
| A               | 2   | data input     |
| GND             | 3   | ground (0 V)   |
| Y               | 4   | data output    |
| V <sub>CC</sub> | 5   | supply voltage |

## 8. Functional description

**Table 4. Function table**

*H = HIGH voltage level; L = LOW voltage level*

| Input | Output |
|-------|--------|
| A     | Y      |
| L     | H      |
| H     | L      |

## 9. Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| 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                           | -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          | $-0.5$ V $< V_O < V_{CC} + 0.5$ 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] - | 250  | mW   |

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

[2] For both TSSOP5 and SC-74A packages: above 87.5 °C the value of  $P_{tot}$  derates linearly with 4.0 mW/K.

## 10. Recommended operating conditions

**Table 6. Recommended operating conditions**

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

| Symbol    | Parameter           | Conditions | 74AHC1G14 |     |          | 74AHCT1G14 |     |          | 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   |

## 11. Static characteristics

**Table 7. 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 |      |

### For type 74AHC1G14

|                 |                           |                                                                                           |      |     |      |      |      |      |      |    |
|-----------------|---------------------------|-------------------------------------------------------------------------------------------|------|-----|------|------|------|------|------|----|
| V <sub>OH</sub> | HIGH-level output voltage | V <sub>I</sub> = V <sub>T+</sub> or V <sub>T–</sub>                                       |      |     |      |      |      |      |      |    |
|                 |                           | I <sub>O</sub> = –50 µA; V <sub>CC</sub> = 2.0 V                                          | 1.9  | 2.0 | -    | 1.9  | -    | 1.9  | -    | V  |
|                 |                           | I <sub>O</sub> = –50 µA; V <sub>CC</sub> = 3.0 V                                          | 2.9  | 3.0 | -    | 2.9  | -    | 2.9  | -    | V  |
|                 |                           | I <sub>O</sub> = –50 µA; V <sub>CC</sub> = 4.5 V                                          | 4.4  | 4.5 | -    | 4.4  | -    | 4.4  | -    | V  |
|                 |                           | I <sub>O</sub> = –4.0 mA; V <sub>CC</sub> = 3.0 V                                         | 2.58 | -   | -    | 2.48 | -    | 2.40 | -    | V  |
|                 |                           | I <sub>O</sub> = –8.0 mA; V <sub>CC</sub> = 4.5 V                                         | 3.94 | -   | -    | 3.8  | -    | 3.70 | -    | V  |
| V <sub>OL</sub> | LOW-level output voltage  | V <sub>I</sub> = V <sub>T+</sub> or V <sub>T–</sub>                                       |      |     |      |      |      |      |      |    |
|                 |                           | I <sub>O</sub> = 50 µA; V <sub>CC</sub> = 2.0 V                                           | -    | 0   | 0.1  | -    | 0.1  | -    | 0.1  | V  |
|                 |                           | I <sub>O</sub> = 50 µA; V <sub>CC</sub> = 3.0 V                                           | -    | 0   | 0.1  | -    | 0.1  | -    | 0.1  | V  |
|                 |                           | I <sub>O</sub> = 50 µA; V <sub>CC</sub> = 4.5 V                                           | -    | 0   | 0.1  | -    | 0.1  | -    | 0.1  | V  |
|                 |                           | I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V                                          | -    | -   | 0.36 | -    | 0.44 | -    | 0.55 | V  |
|                 |                           | I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V                                          | -    | -   | 0.36 | -    | 0.44 | -    | 0.55 | V  |
| I <sub>I</sub>  | input leakage current     | V <sub>I</sub> = 5.5 V or GND;<br>V <sub>CC</sub> = 0 V to 5.5 V                          | -    | -   | 0.1  | -    | 1.0  | -    | 2.0  | µA |
| I <sub>CC</sub> | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 5.5 V | -    | -   | 1.0  | -    | 10   | -    | 40   | µA |
| C <sub>I</sub>  | input capacitance         |                                                                                           | -    | 1.5 | 10   | -    | 10   | -    | 10   | pF |

### For type 74AHCT1G14

|                  |                           |                                                                                                                                    |      |     |      |     |      |      |      |    |
|------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------|------|-----|------|-----|------|------|------|----|
| V <sub>OH</sub>  | HIGH-level output voltage | V <sub>I</sub> = V <sub>T+</sub> or V <sub>T–</sub> ; V <sub>CC</sub> = 4.5 V                                                      |      |     |      |     |      |      |      |    |
|                  |                           | I <sub>O</sub> = –50 µA                                                                                                            | 4.4  | 4.5 | -    | 4.4 | -    | 4.4  | -    | V  |
|                  |                           | I <sub>O</sub> = –8.0 mA                                                                                                           | 3.94 | -   | -    | 3.8 | -    | 3.70 | -    | V  |
| V <sub>OL</sub>  | LOW-level output voltage  | V <sub>I</sub> = V <sub>T+</sub> or V <sub>T–</sub> ; V <sub>CC</sub> = 4.5 V                                                      |      |     |      |     |      |      |      |    |
|                  |                           | I <sub>O</sub> = 50 µA                                                                                                             | -    | 0   | 0.1  | -   | 0.1  | -    | 0.1  | V  |
|                  |                           | I <sub>O</sub> = 8.0 mA                                                                                                            | -    | -   | 0.36 | -   | 0.44 | -    | 0.55 | V  |
| I <sub>I</sub>   | input leakage current     | V <sub>I</sub> = 5.5 V or GND;<br>V <sub>CC</sub> = 0 V to 5.5 V                                                                   | -    | -   | 0.1  | -   | 1.0  | -    | 2.0  | µA |
| I <sub>CC</sub>  | supply current            | V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;<br>V <sub>CC</sub> = 5.5 V                                          | -    | -   | 1.0  | -   | 10   | -    | 40   | µA |
| ΔI <sub>CC</sub> | additional supply current | per input pin; V <sub>I</sub> = 3.4 V;<br>other inputs at V <sub>CC</sub> or GND;<br>I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V | -    | -   | 1.35 | -   | 1.5  | -    | 1.5  | mA |
| C <sub>I</sub>   | input capacitance         |                                                                                                                                    | -    | 1.5 | 10   | -   | 10   | -    | 10   | pF |

## 11.1 Transfer characteristics

**Table 8. Transfer characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V). See [Figure 7](#) and [Figure 8](#).

| Symbol              | Parameter                        | Conditions              | 25 °C |     |      | −40 °C to +85 °C |      | −40 °C to +125 °C |      | Unit |
|---------------------|----------------------------------|-------------------------|-------|-----|------|------------------|------|-------------------|------|------|
|                     |                                  |                         | Min   | Typ | Max  | Min              | Max  | Min               | Max  |      |
| For type 74AHC1G14  |                                  |                         |       |     |      |                  |      |                   |      |      |
| V <sub>T+</sub>     | positive-going threshold voltage | V <sub>CC</sub> = 3.0 V | -     | -   | 2.2  | -                | 2.2  | -                 | 2.2  | V    |
|                     |                                  | V <sub>CC</sub> = 4.5 V | -     | -   | 3.15 | -                | 3.15 | -                 | 3.15 | V    |
|                     |                                  | V <sub>CC</sub> = 5.5 V | -     | -   | 3.85 | -                | 3.85 | -                 | 3.85 | V    |
| V <sub>T−</sub>     | negative-going threshold voltage | V <sub>CC</sub> = 3.0 V | 0.9   | -   | -    | 0.9              | -    | 0.9               | -    | V    |
|                     |                                  | V <sub>CC</sub> = 4.5 V | 1.35  | -   | -    | 1.35             | -    | 1.35              | -    | V    |
|                     |                                  | V <sub>CC</sub> = 5.5 V | 1.65  | -   | -    | 1.65             | -    | 1.65              | -    | V    |
| V <sub>H</sub>      | hysteresis voltage               | V <sub>CC</sub> = 3.0 V | 0.3   | -   | 1.2  | 0.3              | 1.2  | 0.25              | 1.2  | V    |
|                     |                                  | V <sub>CC</sub> = 4.5 V | 0.4   | -   | 1.4  | 0.4              | 1.4  | 0.35              | 1.4  | V    |
|                     |                                  | V <sub>CC</sub> = 5.5 V | 0.5   | -   | 1.6  | 0.5              | 1.6  | 0.45              | 1.6  | V    |
| For type 74AHCT1G14 |                                  |                         |       |     |      |                  |      |                   |      |      |
| V <sub>T+</sub>     | positive-going threshold voltage | V <sub>CC</sub> = 4.5 V | -     | -   | 2.0  | -                | 2.0  | -                 | 2.0  | V    |
|                     |                                  | V <sub>CC</sub> = 5.5 V | -     | -   | 2.0  | -                | 2.0  | -                 | 2.0  | V    |
| V <sub>T−</sub>     | negative-going threshold voltage | V <sub>CC</sub> = 4.5 V | 0.5   | -   | -    | 0.5              | -    | 0.5               | -    | V    |
|                     |                                  | V <sub>CC</sub> = 5.5 V | 0.6   | -   | -    | 0.6              | -    | 0.6               | -    | V    |
| V <sub>H</sub>      | hysteresis voltage               | V <sub>CC</sub> = 4.5 V | 0.4   | -   | 1.4  | 0.4              | 1.4  | 0.35              | 1.4  | V    |
|                     |                                  | V <sub>CC</sub> = 5.5 V | 0.4   | -   | 1.6  | 0.4              | 1.6  | 0.35              | 1.6  | V    |

## 12. Dynamic characteristics

**Table 9. Dynamic characteristics**

$GND = 0\text{ V}$ ;  $t_r = t_f \leq 3.0\text{ ns}$ . For waveform see [Figure 5](#). For test circuit see [Figure 6](#).

| Symbol | Parameter | Conditions | 25 °C |     |     | –40 °C to +85 °C |     | –40 °C to +125 °C |     | Unit |
|--------|-----------|------------|-------|-----|-----|------------------|-----|-------------------|-----|------|
|        |           |            | Min   | Typ | Max | Min              | Max | Min               | Max |      |

### For type 74AHC1G14

|          |                               |                                                                                                                |   |     |      |     |      |     |      |    |
|----------|-------------------------------|----------------------------------------------------------------------------------------------------------------|---|-----|------|-----|------|-----|------|----|
| $t_{pd}$ | propagation delay             | A to Y; <a href="#">[1]</a>                                                                                    |   |     |      |     |      |     |      |    |
|          |                               | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ <a href="#">[2]</a>                                                    |   |     |      |     |      |     |      |    |
|          |                               | $C_L = 15\text{ pF}$                                                                                           | - | 4.2 | 12.8 | 1.0 | 15.0 | 1.0 | 16.5 | ns |
|          |                               | $C_L = 50\text{ pF}$                                                                                           | - | 6.0 | 16.3 | 1.0 | 18.5 | 1.0 | 20.5 | ns |
|          |                               | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ <a href="#">[3]</a>                                                    |   |     |      |     |      |     |      |    |
|          |                               | $C_L = 15\text{ pF}$                                                                                           | - | 3.2 | 8.6  | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| $C_{PD}$ | power dissipation capacitance | $C_L = 50\text{ pF}$                                                                                           | - | 4.6 | 10.6 | 1.0 | 12.0 | 1.0 | 13.5 | ns |
|          |                               | per buffer; <a href="#">[4]</a><br>$C_L = 50\text{ pF}$ ; $f = 1\text{ MHz}$ ;<br>$V_I = GND\text{ to }V_{CC}$ | - | 12  | -    | -   | -    | -   | -    | pF |

### For type 74AHCT1G14

|          |                               |                                                                 |   |     |     |     |      |     |      |    |
|----------|-------------------------------|-----------------------------------------------------------------|---|-----|-----|-----|------|-----|------|----|
| $t_{pd}$ | propagation delay             | A to Y; <a href="#">[1]</a>                                     |   |     |     |     |      |     |      |    |
|          |                               | $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ <a href="#">[3]</a>     |   |     |     |     |      |     |      |    |
|          |                               | $C_L = 15\text{ pF}$                                            | - | 4.1 | 7.0 | 1.0 | 8.0  | 1.0 | 9.0  | ns |
| $C_{PD}$ | power dissipation capacitance | $C_L = 50\text{ pF}$                                            | - | 5.9 | 8.5 | 1.0 | 10.0 | 1.0 | 11.0 | ns |
|          |                               | per buffer; <a href="#">[4]</a><br>$V_I = GND\text{ to }V_{CC}$ | - | 13  | -   | -   | -    | -   | -    | pF |

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

[2] Typical values are measured at  $V_{CC} = 3.3\text{ V}$ .

[3] Typical values are measured at  $V_{CC} = 5.0\text{ V}$ .

[4]  $C_{PD}$  is used to determine the dynamic power dissipation  $P_D$  ( $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in Volts.

13. Waveforms

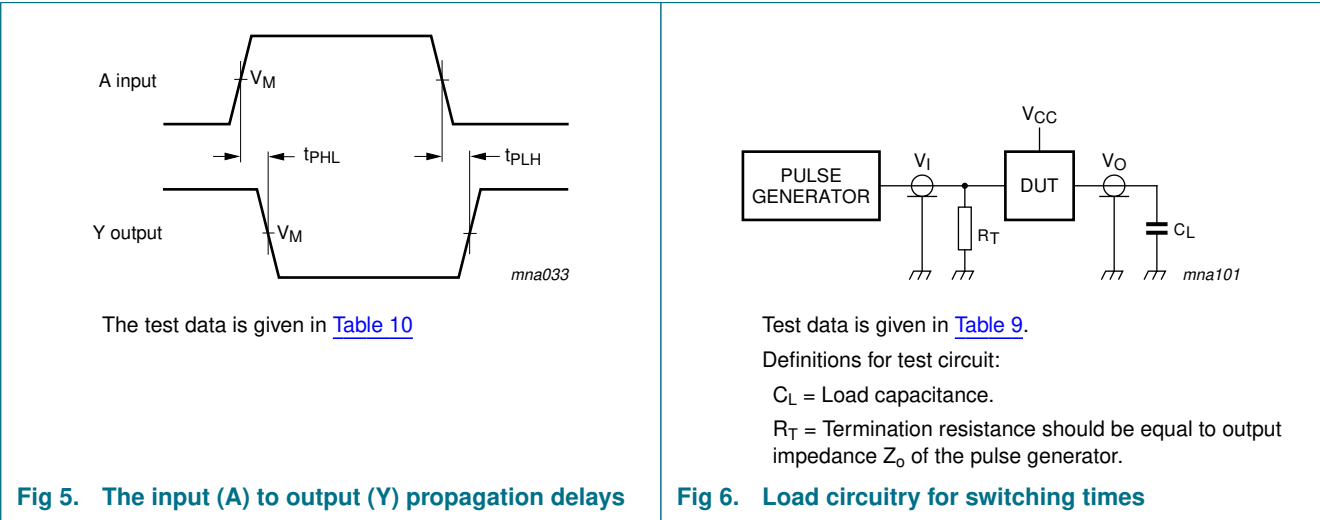
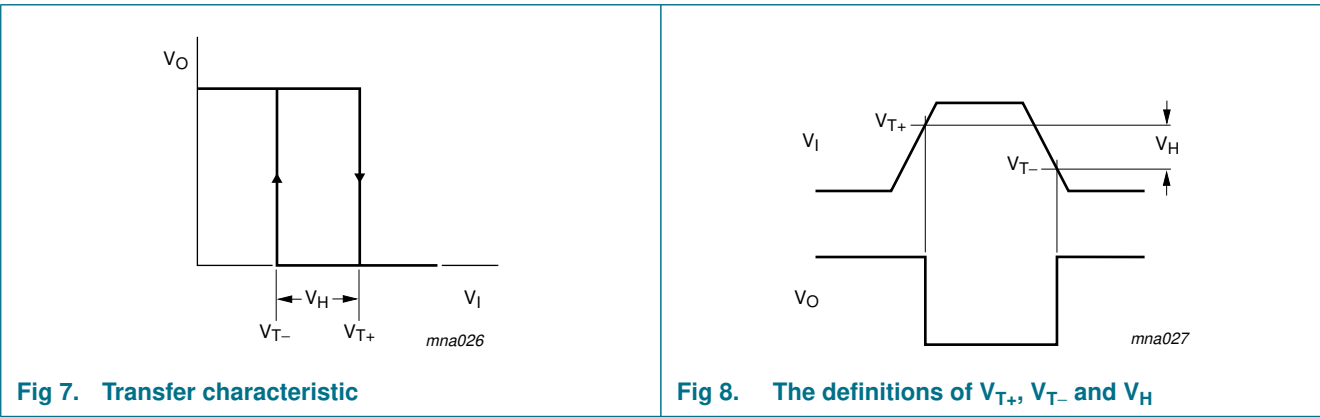


Table 10. Test data

| Type number | Input           |                     | Output              |
|-------------|-----------------|---------------------|---------------------|
|             | $V_I$           | $V_M$               | $V_M$               |
| 74AHC1G14   | GND to $V_{CC}$ | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 74AHCT1G14  | GND to 3.0 V    | 1.5 V               | $0.5 \times V_{CC}$ |

13.1 Transfer characteristic waveforms



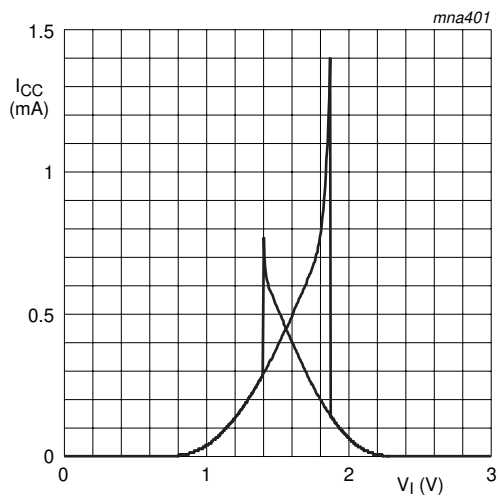


Fig 9. Typical 74AHC1G14 transfer characteristics;  $V_{CC} = 3.0\text{ V}$

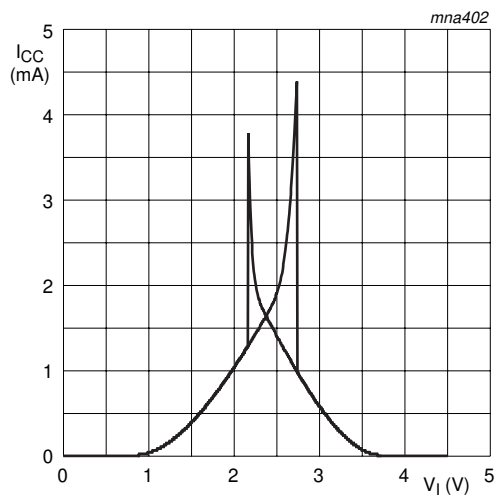


Fig 10. Typical 74AHC1G14 transfer characteristics;  $V_{CC} = 4.5\text{ V}$

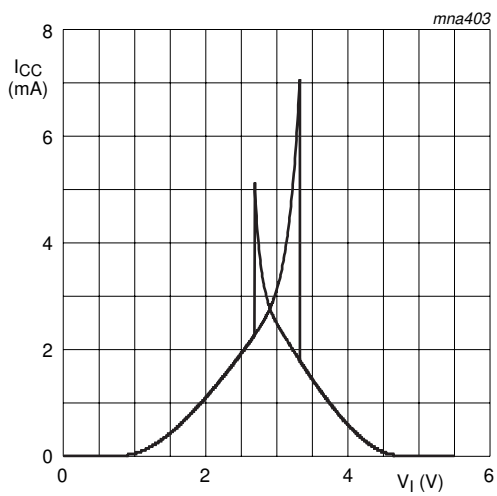


Fig 11. Typical 74AHC1G14 transfer characteristics;  $V_{CC} = 5.5\text{ V}$

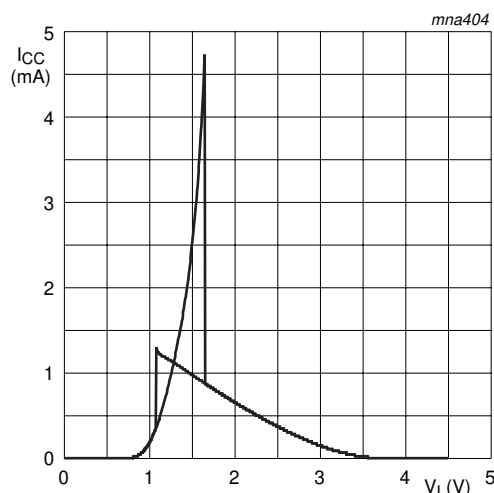


Fig 12. Typical 74AHCT1G14 transfer characteristics;  
 $V_{CC} = 4.5\text{ V}$

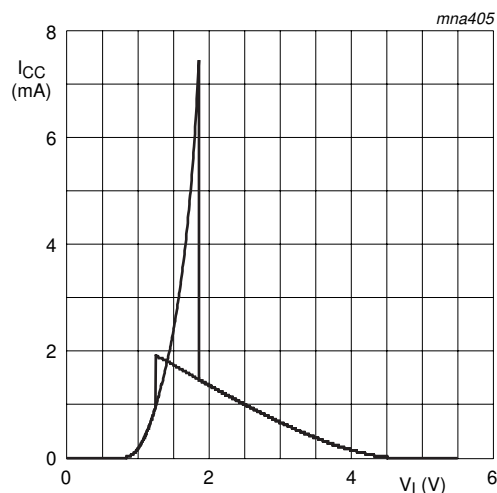


Fig 13. Typical 74AHCT1G14 transfer characteristics;  
 $V_{CC} = 5.5\text{ V}$

## 14. Application information

The slow input rise and fall times cause additional power dissipation, which can be calculated using the following formula:

$P_{add} = f_i \times (t_r \times \Delta I_{CC(AV)} + t_f \times \Delta I_{CC(AV)}) \times V_{CC}$  where:

$P_{add}$  = additional power dissipation ( $\mu\text{W}$ );

$f_i$  = input frequency (MHz);

$t_r$  = input rise time (ns); 10 % to 90 %;

$t_f$  = input fall time (ns); 90 % to 10 %;

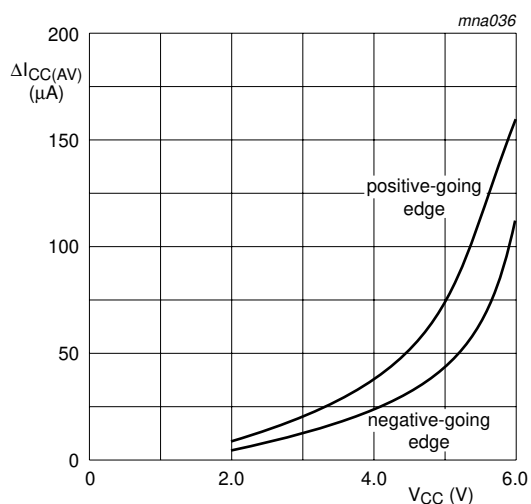
$\Delta I_{CC(AV)}$  = average additional supply current ( $\mu\text{A}$ ).

Average additional  $I_{CC}$  differs with positive or negative input transitions, as shown in [Figure 14](#) and [Figure 15](#).

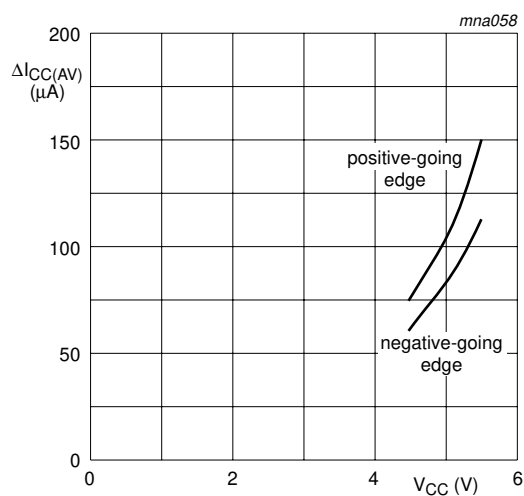
For 74AHC1G14 and 74AHCT1G14 used in relaxation oscillator circuit, see [Figure 16](#).

### Note to the application information:

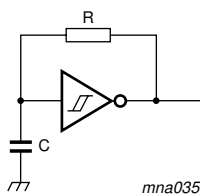
1. All values given are typical unless otherwise specified.



**Fig 14.** Average additional  $I_{CC}$  for 74AHC1G14 Schmitt trigger devices; linear change of  $V_I$  between  $0.1V_{CC}$  to  $0.9V_{CC}$



**Fig 15.** Average additional  $I_{CC}$  for 74AHCT1G14 Schmitt trigger devices; linear change of  $V_I$  between  $0.1V_{CC}$  to  $0.9V_{CC}$



For 74AHC1G14:  $f = \frac{1}{T} \approx \frac{1}{0.55 \times RC}$

For 74AHCT1G14:  $f = \frac{1}{T} \approx \frac{1}{0.60 \times RC}$

**Fig 16.** Relaxation oscillator using the 74AHC1G14 and 74AHCT1G14

15. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mmSOT353-1

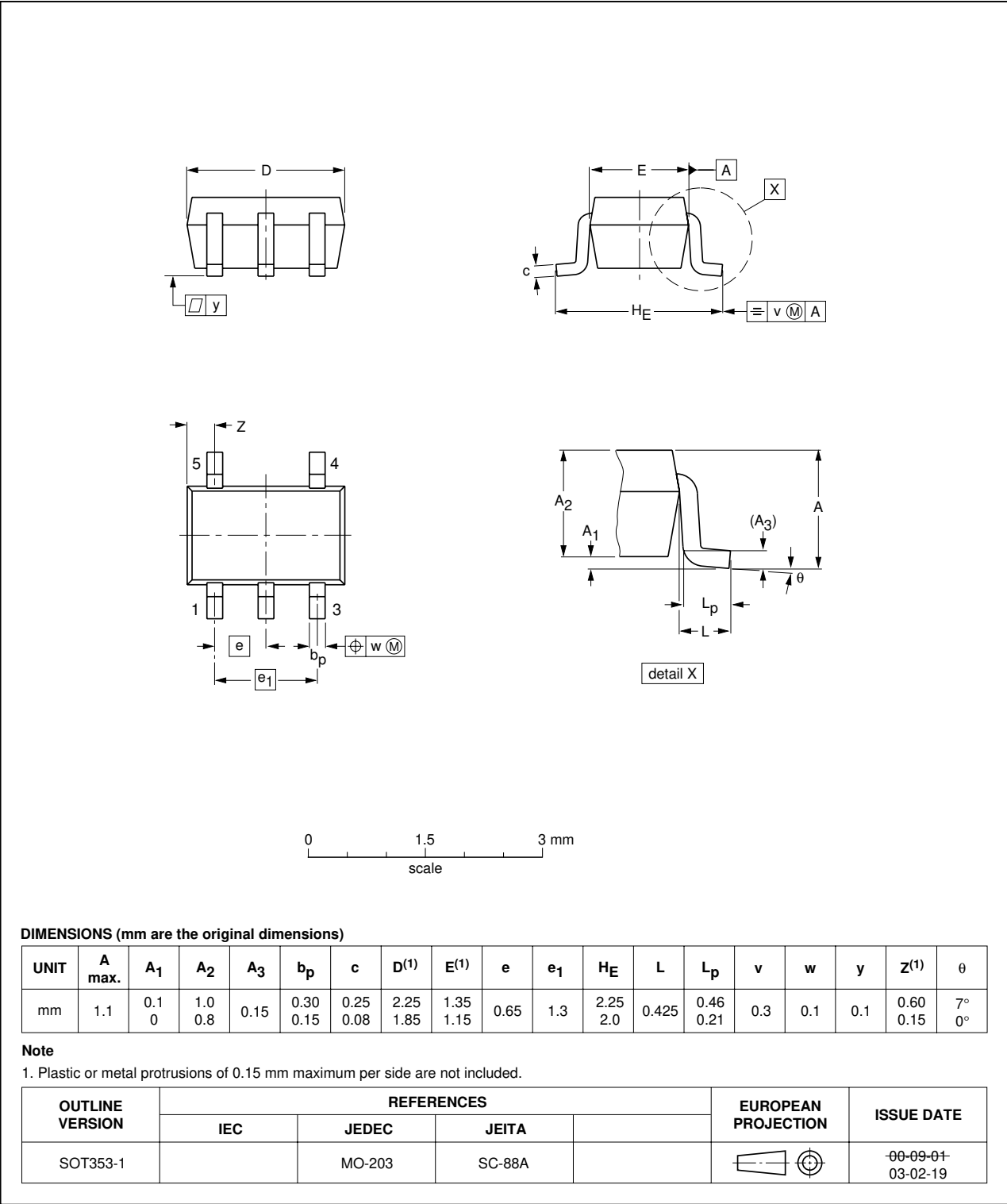


Fig 17. Package outline SOT353-1 (TSSOP5)

Plastic surface-mounted package; 5 leads

SOT753

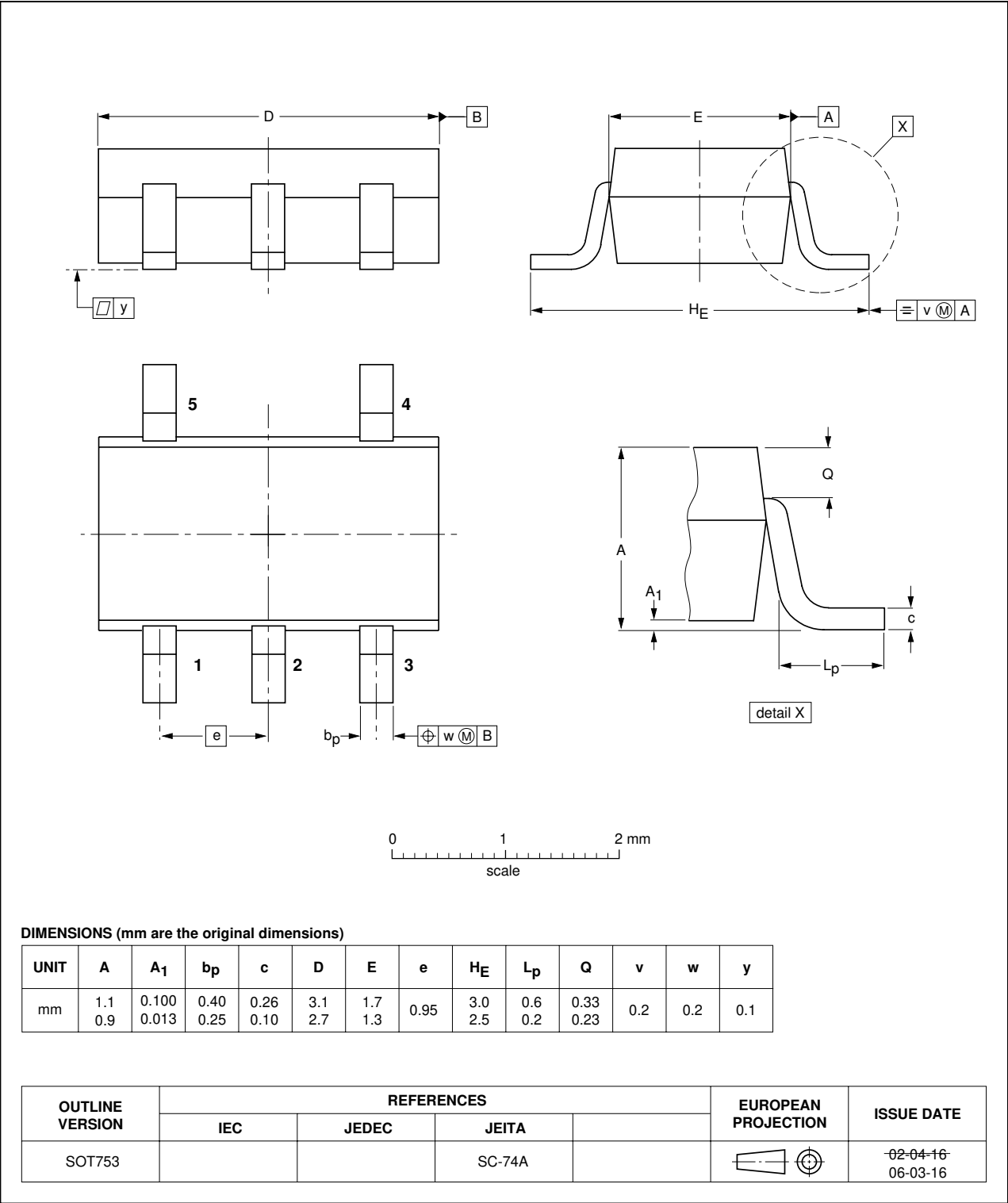


Fig 18. Package outline SOT753 (SC-74A)

## 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                        |
| MM      | Machine Model                           |
| TTL     | Transistor-Transistor Logic             |

## 17. Revision history

Table 12. Revision history

| Document ID      | Release date                                                                                                                                                            | Data sheet status     | Change notice | Supersedes       |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|------------------|
| 74AHC_AHCT1G14_6 | 20090518                                                                                                                                                                | Product data sheet    | -             | 74AHC_AHCT1G14_5 |
| Modifications:   | <ul style="list-style-type: none"><li>• <a href="#">Table 7</a>: the conditions for HIGH-level output voltage and LOW-level output voltage have been changed.</li></ul> |                       |               |                  |
| 74AHC_AHCT1G14_5 | 20070629                                                                                                                                                                | Product data sheet    | -             | 74AHC_AHCT1G14_4 |
| 74AHC_AHCT1G14_4 | 20020528                                                                                                                                                                | Product specification | -             | 74AHC_AHCT1G14_3 |
| 74AHC_AHCT1G14_3 | 20020218                                                                                                                                                                | Product specification | -             | 74AHC_AHCT1G14_2 |
| 74AHC_AHCT1G14_2 | 20010222                                                                                                                                                                | Product specification | -             | 74AHC_AHCT1G14_1 |
| 74AHC_AHCT1G14_1 | 19990805                                                                                                                                                                | Product specification | -             | -                |

## 18. Legal information

### 18.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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