INTEGRATED CIRCUITS

# DATA SHEET

# 74HC14; 74HCT14
## Hex inverting Schmitt trigger

Product specification
Supersedes data of 1997 Aug 26

2003 Oct 30

Philips
Semiconductors

PHILIPS

## FEATURES

- Applications:
  - Wave and pulse shapers
  - Astable multivibrators
  - Monostable multivibrators.
- Complies with JEDEC standard no. 7A
- ESD protection:
  HBM EIA/JESD22-A114-A exceeds 2000 V
  MM EIA/JESD22-A115-A exceeds 200 V.
- Specified from –40 to +85 °C and –40 to +125 °C.

## DESCRIPTION

The 74HC14 and 74HCT14 are high-speed Si-gate CMOS devices and are pin compatible with low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no. 7A.

The 74HC14 and 74HCT14 provide six inverting buffers with Schmitt-trigger action. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

## QUICK REFERENCE DATA

GND = 0 V; $T_{amb}$ = 25 °C; $t_r = t_f$ = 6 ns

| SYMBOL | PARAMETER | CONDITIONS | TYPICAL | | UNIT |
|---|---|---|---|---|---|
| | | | HC | HCT | |
| $t_{PHL}/t_{PLH}$ | propagation delay nA to nY | $C_L$ = 15 pF; $V_{CC}$ = 5 V | 12 | 17 | ns |
| $C_I$ | input capacitance | | 3.5 | 3.5 | pF |
| $C_{PD}$ | power dissipation capacitance per gate | notes 1 and 2 | 7 | 8 | pF |

### Notes

1. $C_{PD}$ is used to determine the dynamic power dissipation ($P_D$ in μW):

   $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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 = total load switching outputs;

   $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.
2. For type 74HC14 the condition is $V_I$ = GND to $V_{CC}$.
   For type 74HCT14 the condition is $V_I$ = GND to $V_{CC}$ – 1.5 V.

## FUNCTION TABLE

| INPUT | OUTPUT |
|---|---|
| nA | nY |
| L | H |
| H | L |

**Note**

1. H = HIGH voltage level;
   L = LOW voltage level.

## ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | | | |
|---|---|---|---|---|---|
| | TEMPERATURE RANGE | PINS | PACKAGE | MATERIAL | CODE |
| 74HC14D | –40 to +125 °C | 14 | SO14 | plastic | SOT108-1 |
| 74HCT14D | –40 to +125 °C | 14 | SO14 | plastic | SOT108-1 |
| 74HC14DB | –40 to +125 °C | 14 | SSOP14 | plastic | SOT337-1 |
| 74HCT14DB | –40 to +125 °C | 14 | SSOP14 | plastic | SOT337-1 |
| 74HC14N | –40 to +125 °C | 14 | DIP14 | plastic | SOT27-1 |
| 74HCT14N | –40 to +125 °C | 14 | DIP14 | plastic | SOT27-1 |
| 74HC14PW | –40 to +125 °C | 14 | TSSOP14 | plastic | SOT402-1 |
| 74HCT14PW | –40 to +125 °C | 14 | TSSOP14 | plastic | SOT402-1 |
| 74HC14BQ | –40 to +125 °C | 14 | DHVQFN14 | plastic | SOT762-1 |
| 74HCT14BQ | –40 to +125 °C | 14 | DHVQFN14 | plastic | SOT762-1 |

## PINNING

| PIN | SYMBOL | DESCRIPTION |
|---|---|---|
| 1 | 1A | data input |
| 2 | 1Y | data output |
| 3 | 2A | data input |
| 4 | 2Y | data output |
| 5 | 3A | data input |
| 6 | 3Y | data output |
| 7 | GND | ground (0 V) |
| 8 | 4Y | data output |
| 9 | 4A | data input |
| 10 | 5Y | data output |
| 11 | 5A | data input |
| 12 | 6Y | data output |
| 13 | 6A | data input |
| 14 | $V_{CC}$ | supply voltage |

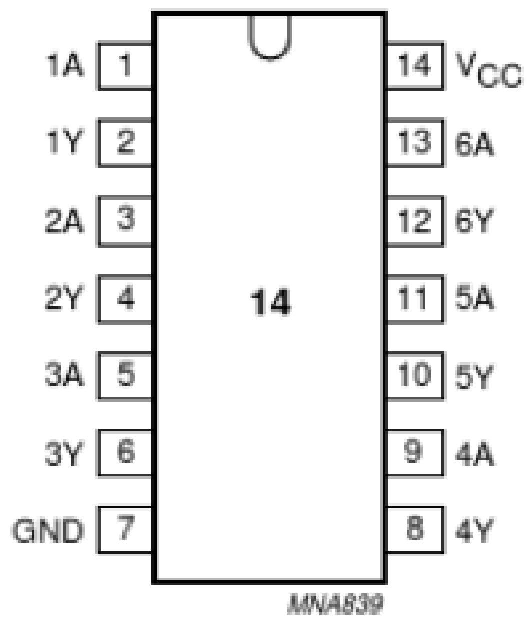
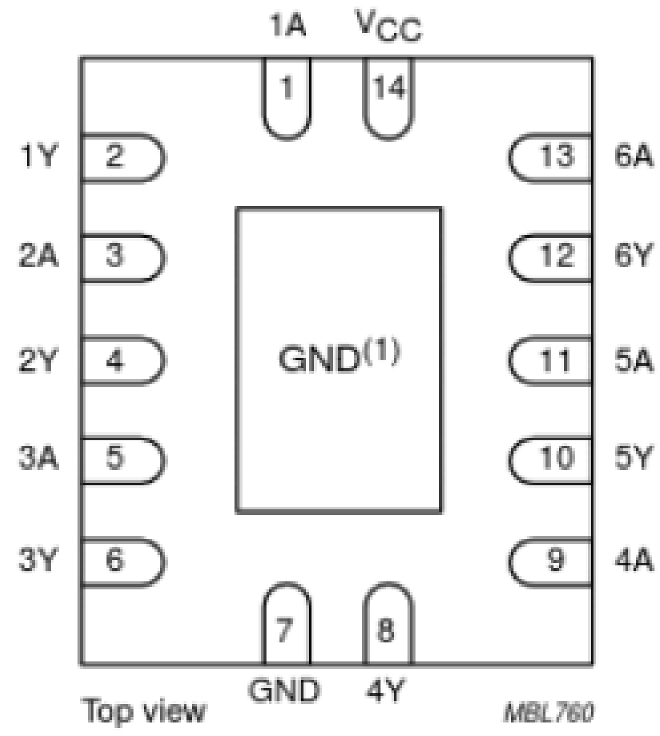



Fig.1 Pin configuration.




(1) The die substrate is attached to this pad using conductive die attach material. It can not be used as a supply pin or input.

Fig.2 Pin configuration DHVQFN14.

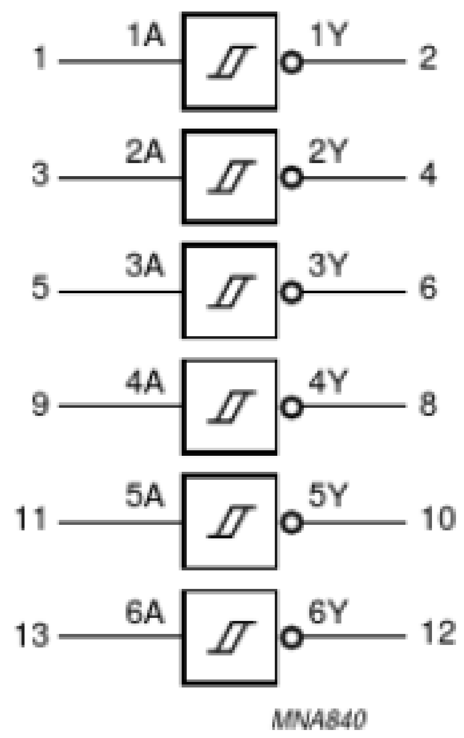



Fig.3 Logic symbol.

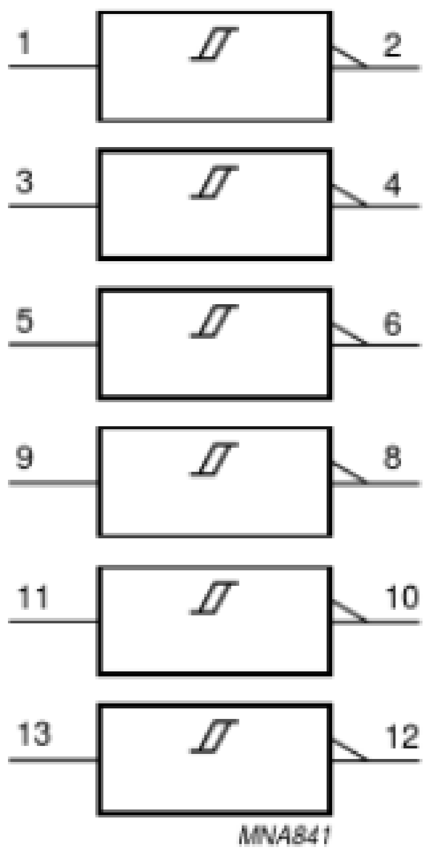



Fig.4 IEC logic symbol.

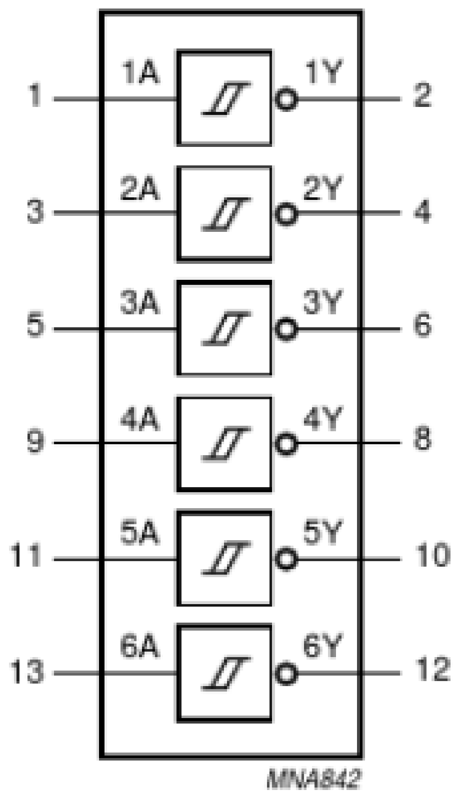



Fig.5 Functional diagram.

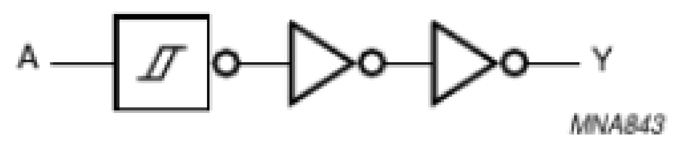



Fig.6 Logic diagram (one Schmitt trigger).

## RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | CONDITIONS | 74HC14 | | | 74HCT14 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. | |
| $V_{CC}$ | supply voltage | | 2.0 | 5.0 | 6.0 | 4.5 | 5.0 | 5.5 | V |
| $V_I$ | input voltage | | 0 | – | $V_{CC}$ | 0 | – | $V_{CC}$ | V |
| $V_O$ | output voltage | | 0 | – | $V_{CC}$ | 0 | – | $V_{CC}$ | V |
| $T_{amb}$ | operating ambient temperature | see DC and AC characteristics per device | −40 | +25 | +85 | −40 | +25 | +85 | °C |
| | | | −40 | – | +125 | −40 | – | +125 | °C |

## LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 60134); voltages are referenced to GND (ground = 0 V).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{CC}$ | supply voltage | | −0.5 | +7 | V |
| $I_{IK}$ | input diode current | $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V | – | ±20 | mA |
| $I_{OK}$ | output diode current | $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V | – | ±20 | mA |
| $I_O$ | output source or sink current | $-0.5\ V < V_O < V_{CC} + 0.5$ V | – | ±25 | mA |
| $I_{CC}$; $I_{GND}$ | $V_{CC}$ or GND current | | – | 50 | mA |
| $T_{stg}$ | storage temperature | | −65 | +150 | °C |
| $P_{tot}$ | power dissipation | $T_{amb}$ = −40 to +125 °C | | | |
| | | DIP14 packages; note 1 | – | 750 | mW |
| | | Other packages; note 2 | – | 500 | mW |

### Notes

1. For DIP14 packages: above 70 °C the value of $P_D$ derates linearly with 12 mW/K.
2. For SO14 packages: above 70 °C the value of $P_D$ derates linearly with 8 mW/K.
   For (T)SSOP14 packages: above 60 °C the value of $P_D$ derates linearly with 5.5 mW/K.
   For DHVQFN14 packages: above 60 °C the value of $P_D$ derates linearly with 4.5 mW/K.

## DC CHARACTERISTICS

### Type 74HC14

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| SYMBOL | PARAMETER | TEST CONDITIONS | | MIN. | TYP.[1] | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| | | OTHER | $V_{CC}$ (V) | | | | |
| **$T_{amb}$ = 25 °C** | | | | | | | |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O$ = –20 μA | 2.0 | 1.9 | 2.0 | – | V |
| | | $I_O$ = –20 μA | 4.5 | 4.4 | 4.5 | – | V |
| | | $I_O$ = –20 μA | 6.0 | 5.9 | 6.0 | – | V |
| | | $I_O$ = –4.0 mA | 4.5 | 3.98 | 4.32 | – | V |
| | | $I_O$ = –5.2 mA | 6.0 | 5.48 | 5.81 | – | V |
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O$ = 20 μA | 2.0 | – | 0 | 0.1 | V |
| | | $I_O$ = 20 μA | 4.5 | – | 0 | 0.1 | V |
| | | $I_O$ = 20 μA | 6.0 | – | 0 | 0.1 | V |
| | | $I_O$ = 4.0 mA | 4.5 | – | 0.15 | 0.26 | V |
| | | $I_O$ = 5.2 mA | 6.0 | – | 0.16 | 0.26 | V |
| $I_{LI}$ | input leakage current | $V_I = V_{CC}$ or GND | 6.0 | – | – | 0.1 | μA |
| $I_{CC}$ | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O$ = 0 | 6.0 | – | – | 2.0 | μA |
| **$T_{amb}$ = –40 to +85 °C** | | | | | | | |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O$ = –20 μA | 2.0 | 1.9 | – | – | V |
| | | $I_O$ = –20 μA | 4.5 | 4.4 | – | – | V |
| | | $I_O$ = –20 μA | 6.0 | 5.9 | – | – | V |
| | | $I_O$ = –4.0 mA | 4.5 | 3.84 | – | – | V |
| | | $I_O$ = –5.2 mA | 6.0 | 5.34 | – | – | V |
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O$ = 20 μA | 2.0 | – | – | 0.1 | V |
| | | $I_O$ = 20 μA | 4.5 | – | – | 0.1 | V |
| | | $I_O$ = 20 μA | 6.0 | – | – | 0.1 | V |
| | | $I_O$ = 4.0 mA | 4.5 | – | – | 0.33 | V |
| | | $I_O$ = 5.2 mA | 6.0 | – | – | 0.33 | V |
| $I_{LI}$ | input leakage current | $V_I = V_{CC}$ or GND | 6.0 | – | – | 1.0 | μA |
| $I_{CC}$ | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O$ = 0 | 6.0 | – | – | 20 | μA |

| SYMBOL | PARAMETER | TEST CONDITIONS | | MIN. | TYP.[1] | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| | | OTHER | $V_{CC}$ (V) | | | | |
| **$T_{amb}$ = −40 to +125 °C** | | | | | | | |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O$ = −20 μA | 2.0 | 1.9 | – | – | V |
| | | $I_O$ = −20 μA | 4.5 | 4.4 | – | – | V |
| | | $I_O$ = −20 μA | 6.0 | 5.9 | – | – | V |
| | | $I_O$ = −4.0 mA | 4.5 | 3.7 | – | – | V |
| | | $I_O$ = −5.2 mA | 6.0 | 5.2 | – | – | V |
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O$ = 20 μA | 2.0 | – | – | 0.1 | V |
| | | $I_O$ = 20 μA | 4.5 | – | – | 0.1 | V |
| | | $I_O$ = 20 μA | 6.0 | – | – | 0.1 | V |
| | | $I_O$ = 4.0 mA | 4.5 | – | – | 0.4 | V |
| | | $I_O$ = 5.2 mA | 6.0 | – | – | 0.4 | V |
| $I_{LI}$ | input leakage current | $V_I = V_{CC}$ or GND | 6.0 | – | – | 1.0 | μA |
| $I_{CC}$ | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 6.0 | – | – | 40 | μA |

**Note**

1. All typical values are measured at $T_{amb}$ = 25 °C.

**Type 74HCT14**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| SYMBOL | PARAMETER | TEST CONDITIONS | | MIN. | TYP.[1] | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| | | OTHER | $V_{CC}$ (V) | | | | |
| **$T_{amb}$ = 25 °C** | | | | | | | |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O = -20$ μA | 4.5 | 4.4 | 4.5 | – | V |
| | | $I_O = -4.0$ mA | 4.5 | 3.98 | 4.32 | – | V |
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O = 20$ μA | 4.5 | – | 0 | 0.1 | V |
| | | $I_O = 4.0$ mA | 4.5 | – | 0.15 | 0.26 | V |
| $I_{LI}$ | input leakage current | $V_I = V_{CC}$ or GND | 5.5 | – | – | 0.1 | μA |
| $I_{CC}$ | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 5.5 | – | – | 2.0 | μA |
| $\Delta I_{CC}$ | additional supply current per input | $V_I = V_{CC} - 2.1$ V; $I_O = 0$ | 4.5 to 5.5 | – | 30 | 108 | μA |
| **$T_{amb}$ = –40 to +85 °C** | | | | | | | |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O = -20$ μA | 4.5 | 4.4 | – | – | V |
| | | $I_O = -4.0$ mA | 4.5 | 3.84 | – | – | V |
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O = 20$ μA | 4.5 | – | – | 0.1 | V |
| | | $I_O = 4.0$ mA | 4.5 | – | – | 0.33 | V |
| $I_{LI}$ | input leakage current | $V_I = V_{CC}$ or GND | 5.5 | – | – | 1.0 | μA |
| $I_{CC}$ | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 5.5 | – | – | 20 | μA |
| $\Delta I_{CC}$ | additional supply current per input | $V_I = V_{CC} - 2.1$ V; $I_O = 0$ | 4.5 to 5.5 | – | – | 135 | μA |
| **$T_{amb}$ = –40 to +125 °C** | | | | | | | |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O = -20$ μA | 4.5 | 4.4 | – | – | V |
| | | $I_O = -4.0$ mA | 4.5 | 3.7 | – | – | V |
| $V_{OL}$ | LOW-level output voltage | $V_I = V_{IH}$ or $V_{IL}$ | | | | | |
| | | $I_O = 20$ μA | 4.5 | – | – | 0.1 | V |
| | | $I_O = 4.0$ mA | 4.5 | – | – | 0.4 | V |
| $I_{LI}$ | input leakage current | $V_I = V_{CC}$ or GND | 5.5 | – | – | 1.0 | μA |
| $I_{CC}$ | quiescent supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ | 5.5 | – | – | 40 | μA |
| $\Delta I_{CC}$ | additional supply current per input | $V_I = V_{CC} - 2.1$ V; $I_O = 0$ | 4.5 to 5.5 | – | – | 147 | μA |

**Note**

1. All typical values are measured at $T_{amb}$ = 25 °C.

### TRANSFER CHARACTERISTICS

**Type 74HC**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| SYMBOL | PARAMETER | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| | | WAVEFORMS | $V_{CC}$ (V) | | | | |
| **$T_{amb}$ = 25 °C;** note 1 | | | | | | | |
| $V_{T+}$ | positive-going threshold | Figs 7 and 8 | 2.0 | 0.7 | 1.18 | 1.5 | V |
| | | | 4.5 | 1.7 | 2.38 | 3.15 | V |
| | | | 6.0 | 2.1 | 3.14 | 4.2 | V |
| $V_{T-}$ | negative-going threshold | Figs 7 and 8 | 2.0 | 0.3 | 0.52 | 0.90 | V |
| | | | 4.5 | 0.9 | 1.40 | 2.00 | V |
| | | | 6.0 | 1.2 | 1.89 | 2.60 | V |
| $V_H$ | hysteresis ($V_{T+} - V_{T-}$) | Figs 7 and 8 | 2.0 | 0.2 | 0.66 | 1.0 | V |
| | | | 4.5 | 0.4 | 0.98 | 1.4 | V |
| | | | 6.0 | 0.6 | 1.25 | 1.6 | V |
| **$T_{amb}$ = −40 to +85 °C** | | | | | | | |
| $V_{T+}$ | positive-going threshold | Figs 7 and 8 | 2.0 | 0.7 | – | 1.5 | V |
| | | | 4.5 | 1.7 | – | 3.15 | V |
| | | | 6.0 | 2.1 | – | 4.2 | V |
| $V_{T-}$ | negative-going threshold | Figs 7 and 8 | 2.0 | 0.3 | – | 0.90 | V |
| | | | 4.5 | 0.90 | – | 2.00 | V |
| | | | 6.0 | 1.20 | – | 2.60 | V |
| $V_H$ | hysteresis ($V_{T+} - V_{T-}$) | Figs 7 and 8 | 2.0 | 0.2 | – | 1.0 | V |
| | | | 4.5 | 0.4 | – | 1.4 | V |
| | | | 6.0 | 0.6 | – | 1.6 | V |
| **$T_{amb}$ = −40 to +125 °C** | | | | | | | |
| $V_{T+}$ | positive-going threshold | Figs 7 and 8 | 2.0 | 0.7 | – | 1.5 | V |
| | | | 4.5 | 1.7 | – | 3.15 | V |
| | | | 6.0 | 2.1 | – | 4.2 | V |
| $V_{T-}$ | negative-going threshold | Figs 7 and 8 | 2.0 | 0.30 | – | 0.90 | V |
| | | | 4.5 | 0.90 | – | 2.00 | V |
| | | | 6.0 | 1.2 | – | 2.60 | V |
| $V_H$ | hysteresis ($V_{T+} - V_{T-}$) | Figs 7 and 8 | 2.0 | 0.2 | – | 1.0 | V |
| | | | 4.5 | 0.4 | – | 1.4 | V |
| | | | 6.0 | 0.6 | – | 1.6 | V |

**Note**

1. All typical values are measured at $T_{amb}$ = 25 °C.

**Family 74HCT**

At recommended operating conditions: voltages are referenced to GND (ground = 0 V)

| SYMBOL | PARAMETER | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| | | WAVEFORMS | $V_{CC}$ (V) | | | | |
| **$T_{amb}$ = 25 °C;** note 1 | | | | | | | |
| $V_{T+}$ | positive-going threshold | Figs 7 and 8 | 4.5 | 1.2 | 1.41 | 1.9 | V |
| | | | 5.5 | 1.4 | 1.59 | 2.1 | V |
| $V_{T-}$ | negative-going threshold | Figs 7 and 8 | 4.5 | 0.5 | 0.85 | 1.2 | V |
| | | | 5.5 | 0.6 | 0.99 | 1.4 | V |
| $V_H$ | hysteresis ($V_{T+} - V_{T-}$) | Figs 7 and 8 | 4.5 | 0.4 | 0.56 | – | V |
| | | | 5.5 | 0.4 | 0.60 | – | V |
| **$T_{amb}$ = –40 to +85 °C** | | | | | | | |
| $V_{T+}$ | positive-going threshold | Figs 7 and 8 | 4.5 | 1.2 | – | 1.9 | V |
| | | | 5.5 | 1.4 | – | 2.1 | V |
| $V_{T-}$ | negative-going threshold | Figs 7 and 8 | 4.5 | 0.5 | – | 1.2 | V |
| | | | 5.5 | 0.6 | – | 1.4 | V |
| $V_H$ | hysteresis ($V_{T+} - V_{T-}$) | Figs 7 and 8 | 4.5 | 0.4 | – | – | V |
| | | | 5.5 | 0.4 | – | – | V |
| **$T_{amb}$ = –40 to +125 °C** | | | | | | | |
| $V_{T+}$ | positive-going threshold | Figs 7 and 8 | 4.5 | 1.2 | – | 1.9 | V |
| | | | 5.5 | 1.4 | – | 2.1 | V |
| $V_{T-}$ | negative-going threshold | Figs 7 and 8 | 4.5 | 0.5 | – | 1.2 | V |
| | | | 5.5 | 0.6 | – | 1.4 | V |
| $V_H$ | hysteresis ($V_{T+} - V_{T-}$) | Figs 7 and 8 | 4.5 | 0.4 | – | – | V |
| | | | 5.5 | 0.4 | – | – | V |

**Note**

1. All typical values are measured at $T_{amb}$ = 25 °C.

### AC CHARACTERISTICS

**Type 74HC**

GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF

| SYMBOL | PARAMETER | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| | | WAVEFORMS | $V_{CC}$ (V) | | | | |
| **$T_{amb}$ = 25 °C;** note 1 | | | | | | | |
| $t_{PHL}/t_{PLH}$ | propagation delay nA to nY | see Fig.9 | 2.0 | – | 41 | 125 | ns |
| | | | 4.5 | – | 15 | 25 | ns |
| | | | 6.0 | – | 12 | 21 | ns |
| $t_{THL}/t_{TLH}$ | output transition time | see Fig.9 | 2.0 | – | 19 | 75 | ns |
| | | | 4.5 | – | 7 | 15 | ns |
| | | | 6.0 | – | 6 | 13 | ns |
| **$T_{amb}$ = −40 to +85 °C** | | | | | | | |
| $t_{PHL}/t_{PLH}$ | propagation delay nA to nY | see Fig.9 | 2.0 | – | – | 155 | ns |
| | | | 4.5 | – | – | 31 | ns |
| | | | 6.0 | – | – | 26 | ns |
| $t_{THL}/t_{TLH}$ | output transition time | see Fig.9 | 2.0 | – | – | 95 | ns |
| | | | 4.5 | – | – | 19 | ns |
| | | | 6.0 | – | – | 15 | ns |
| **$T_{amb}$ = −40 to +125 °C** | | | | | | | |
| $t_{PHL}/t_{PLH}$ | propagation delay nA to nY | see Fig.9 | 2.0 | – | – | 190 | ns |
| | | | 4.5 | – | – | 38 | ns |
| | | | 6.0 | – | – | 32 | ns |
| $t_{THL}/t_{TLH}$ | output transition time | see Fig.9 | 2.0 | – | – | 110 | ns |
| | | | 4.5 | – | – | 22 | ns |
| | | | 6.0 | – | – | 19 | ns |

**Note**

1. All typical values are measured at $T_{amb}$ = 25 °C.

**Type 74HCT**

GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF

| SYMBOL | PARAMETER | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| | | WAVEFORMS | $V_{CC}$ (V) | | | | |
| **$T_{amb}$ = 25 °C;** note 1 | | | | | | | |
| $t_{PHL}/t_{PLH}$ | propagation delay nA to nY | see Fig.9 | 4.5 | – | 20 | 34 | ns |
| $t_{THL}/t_{TLH}$ | output transition time | see Fig.9 | 4.5 | – | 7 | 15 | ns |
| **$T_{amb}$ = –40 to +85 °C** | | | | | | | |
| $t_{PHL}/t_{PLH}$ | propagation delay nA to nY | see Fig.9 | 4.5 | 43 | – | – | ns |
| $t_{THL}/t_{TLH}$ | output transition time | see Fig.9 | 4.5 | 19 | – | – | ns |
| **$T_{amb}$ = –40 to +125 °C** | | | | | | | |
| $t_{PHL}/t_{PLH}$ | propagation delay nA to nY | see Fig.9 | 4.5 | – | – | 51 | ns |
| $t_{THL}/t_{TLH}$ | output transition time | see Fig.9 | 4.5 | – | – | 22 | ns |

**Note**

1. All typical values are measured at $T_{amb}$ = 25 °C.

**TRANSFER CHARACTERISTIC WAVEFORMS**

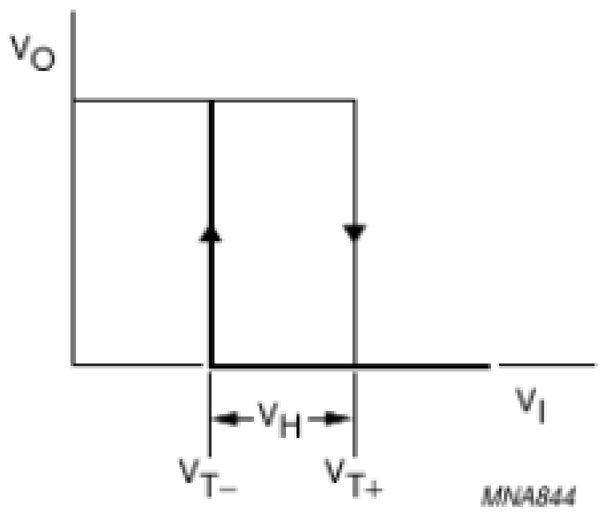
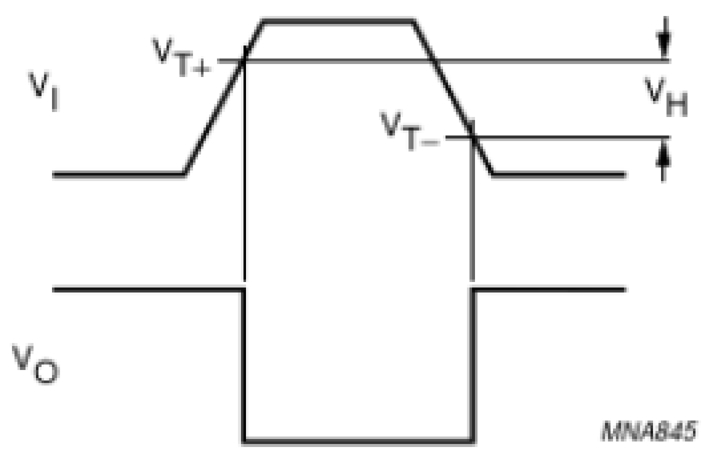
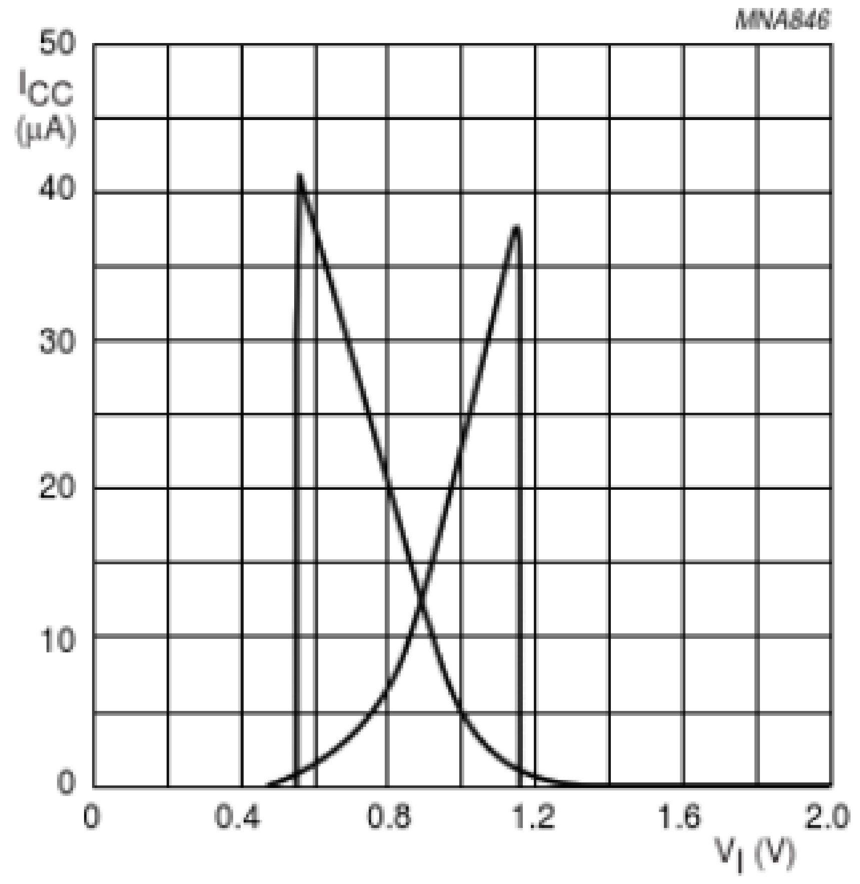



Fig.7 Transfer characteristic.



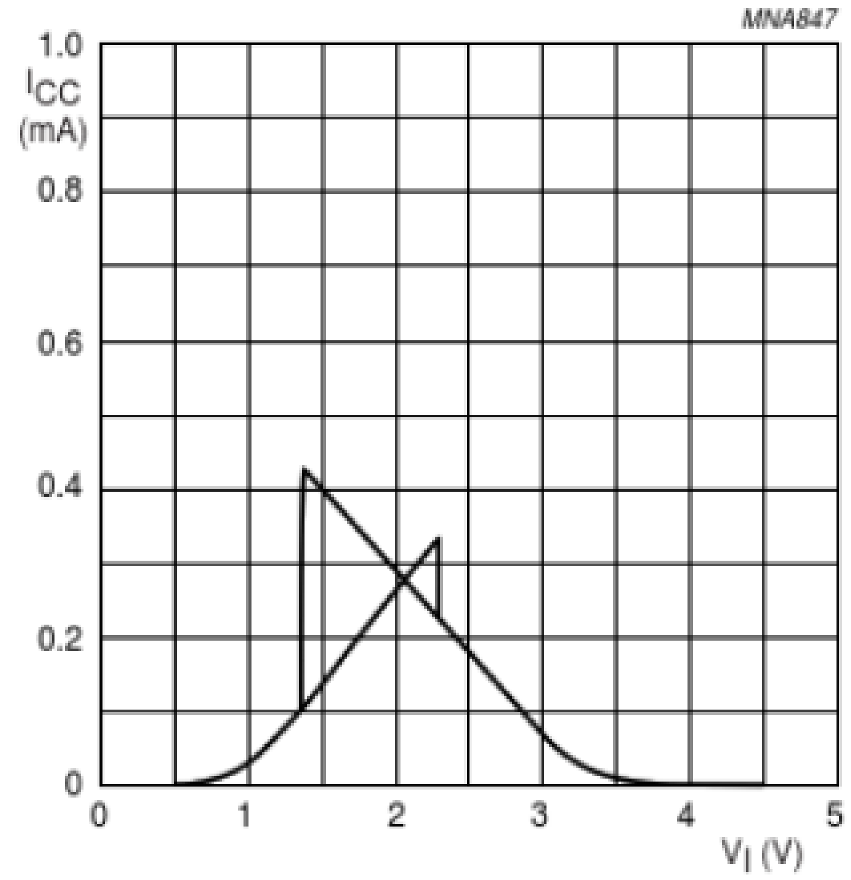

$V_{T+}$ and $V_{T-}$ are between limits of 20% and 70%.

Fig.8 The definitions of $V_{T+}$, $V_{T-}$ and $V_H$.



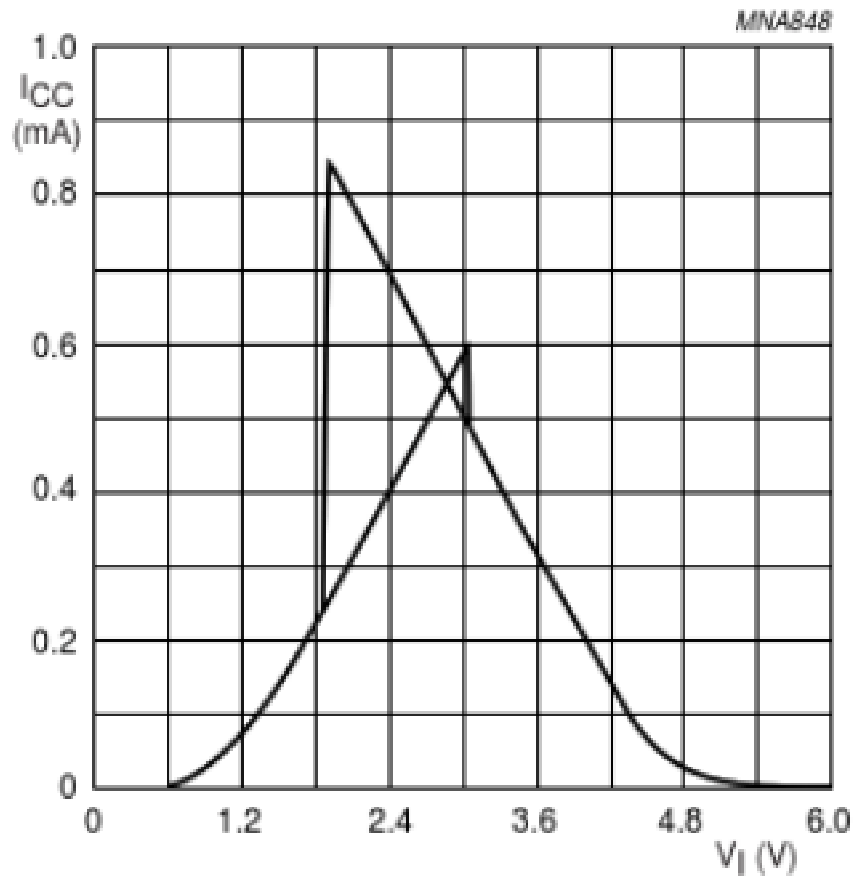

$V_{CC}$ = 2 V.

Fig.9 Typical 74HC14 transfer characteristics.



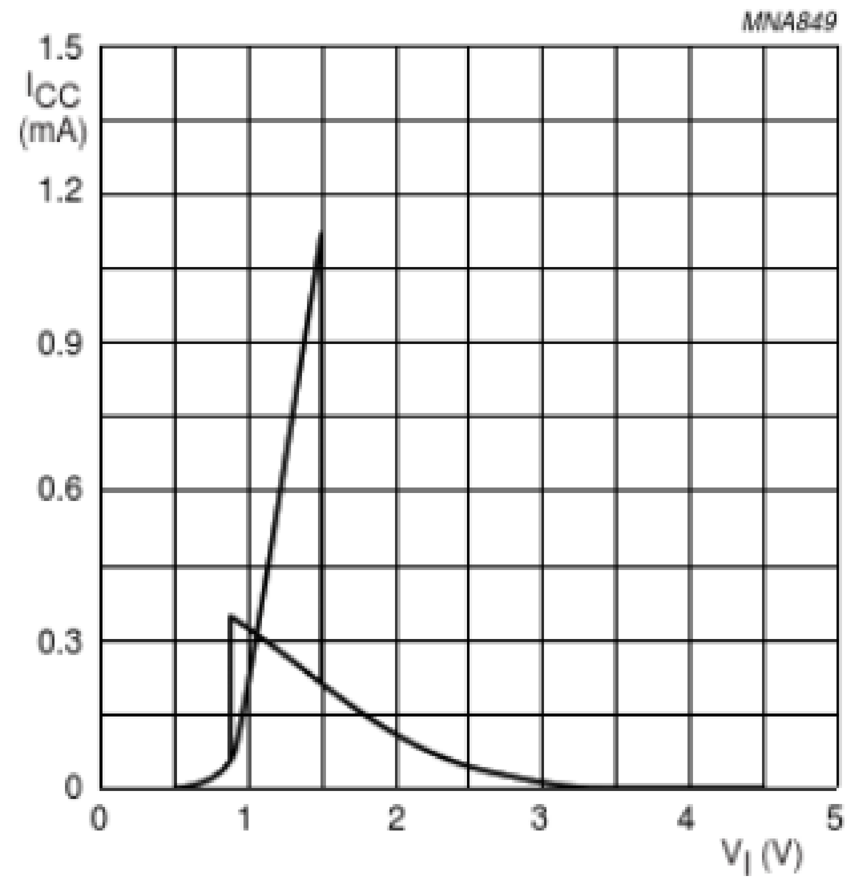

$V_{CC}$ = 4.5 V.

Fig.10 Typical 74HC14 transfer characteristics.



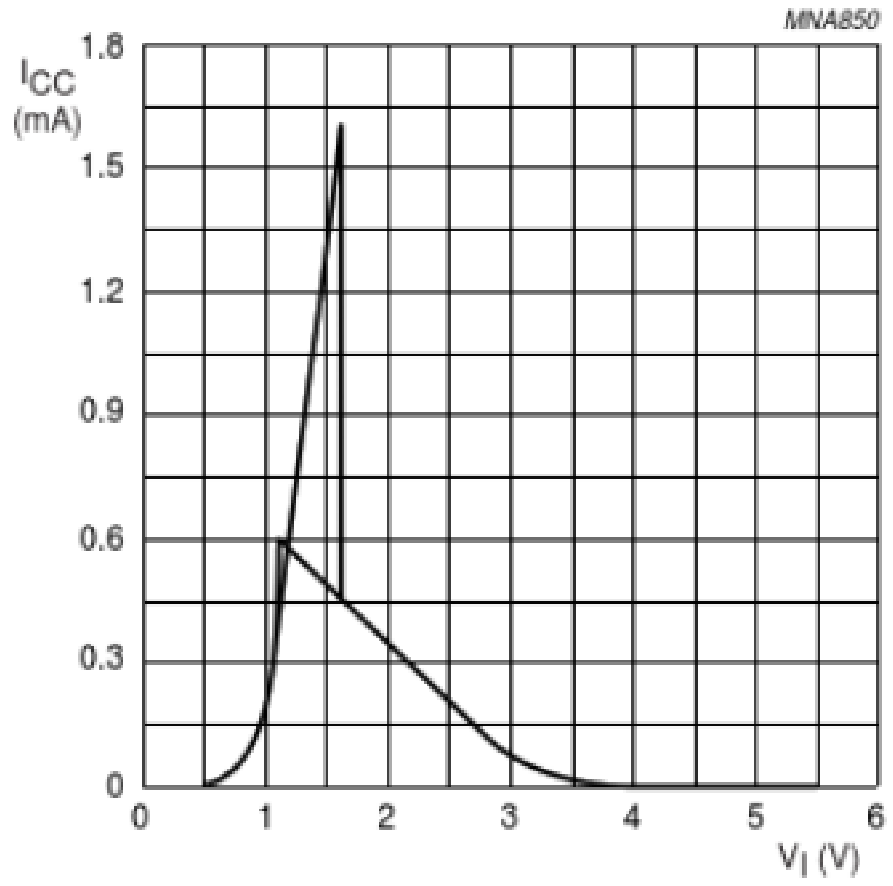

$V_{CC}$ = 6 V.

Fig.11 Typical 74HC14 transfer characteristics.




$V_{CC}$ = 4.5 V.

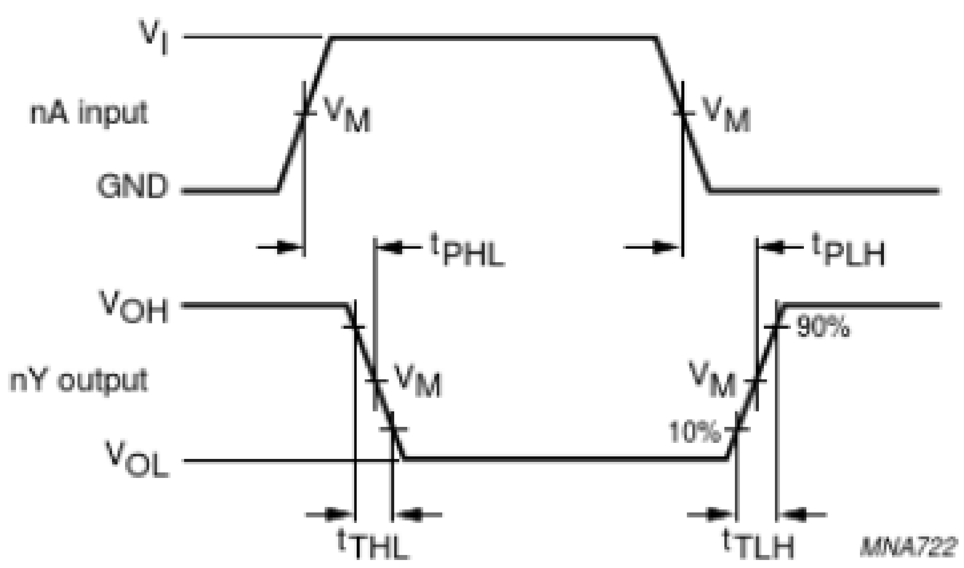
Fig.12 Typical 74HCT14 transfer characteristics.




$V_{CC}$ = 5.5 V.

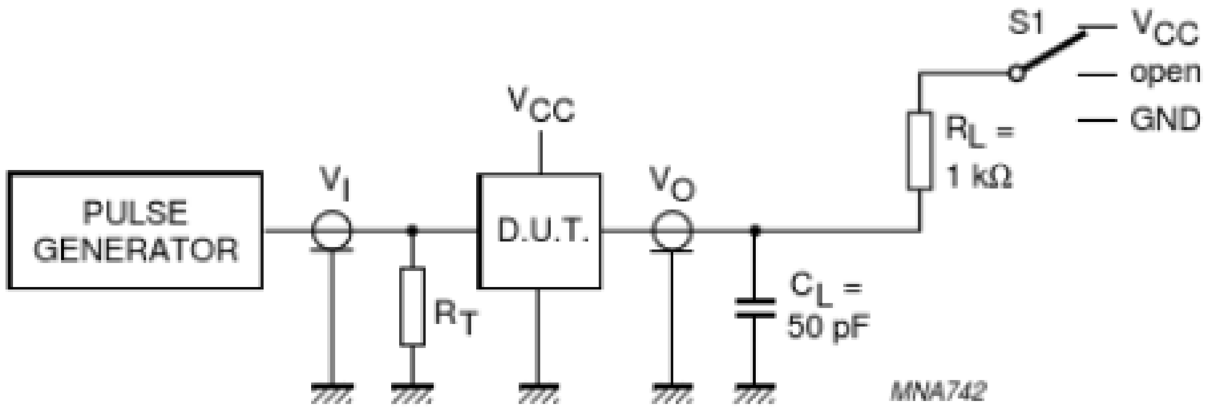
Fig.13 Typical 74HCT14 transfer characteristics.

**AC WAVEFORMS**




74HC14: $V_M$ = 50%; $V_I$ = GND to $V_{CC}$.
74HCT14: $V_M$ = 1.3 V; $V_I$ = GND to 3.0 V.

Fig.14 The input (nA) to output (nY) propagation delays and output transitions times.




| TEST | S1 |
|---|---|
| $t_{PLH}/t_{PHL}$ | open |
| $t_{PLZ}/t_{PZL}$ | $V_{CC}$ |
| $t_{PHZ}/t_{PZH}$ | GND |

Definitions for test circuit:

$R_L$ = Load resistor.

$C_L$ = load capacitance including jig and probe capacitance.

$R_T$ = termination resistance should be equal to the output impedance $Z_o$ of the pulse generator.

Fig.15 Load circuitry for switching times.

## APPLICATION INFORMATION

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

$P_{ad} = f_i \times (t_r \times I_{CC(AV)} + t_f \times I_{CC(AV)}) \times V_{CC}$.

Where:

$P_{ad}$ = additional power dissipation (μW);

$f_i$ = input frequency (MHz);

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

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

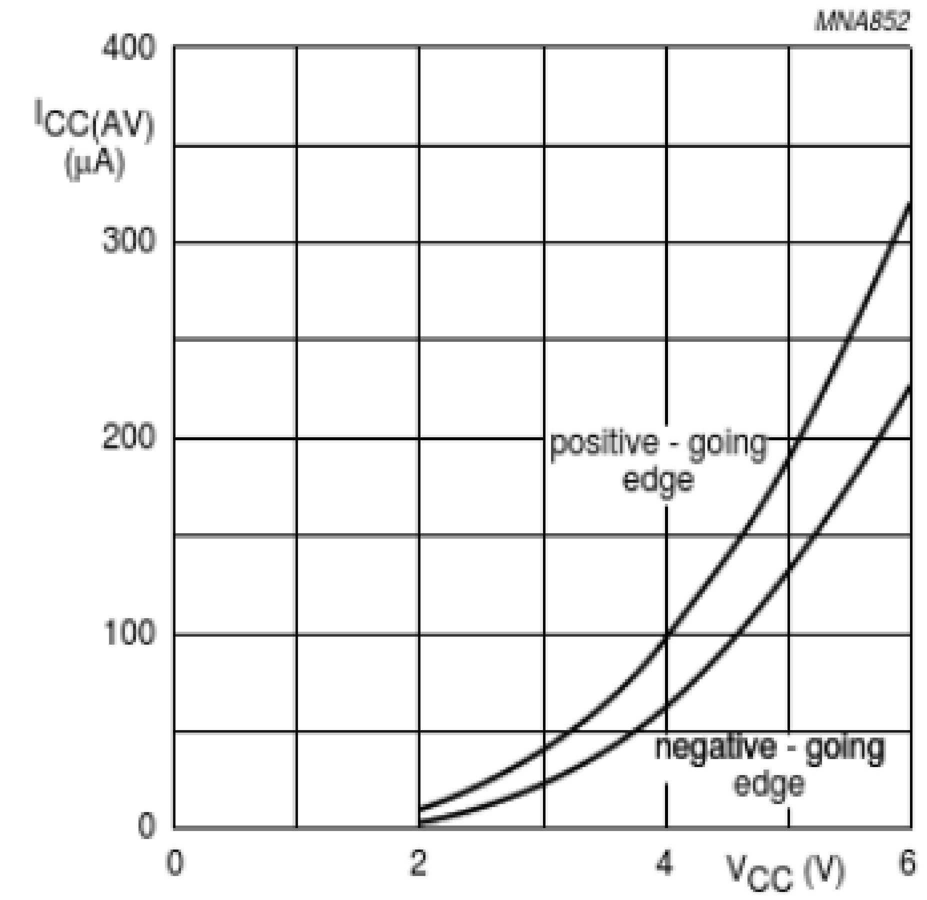
$I_{CC(AV)}$ = average additional supply current (μA).

$I_{CC(AV)}$ differs with positive or negative input transitions, as shown in Figs 16 and 17.

For 74HC/HCT14 used in a relaxation oscillator circuit, see Fig.18.

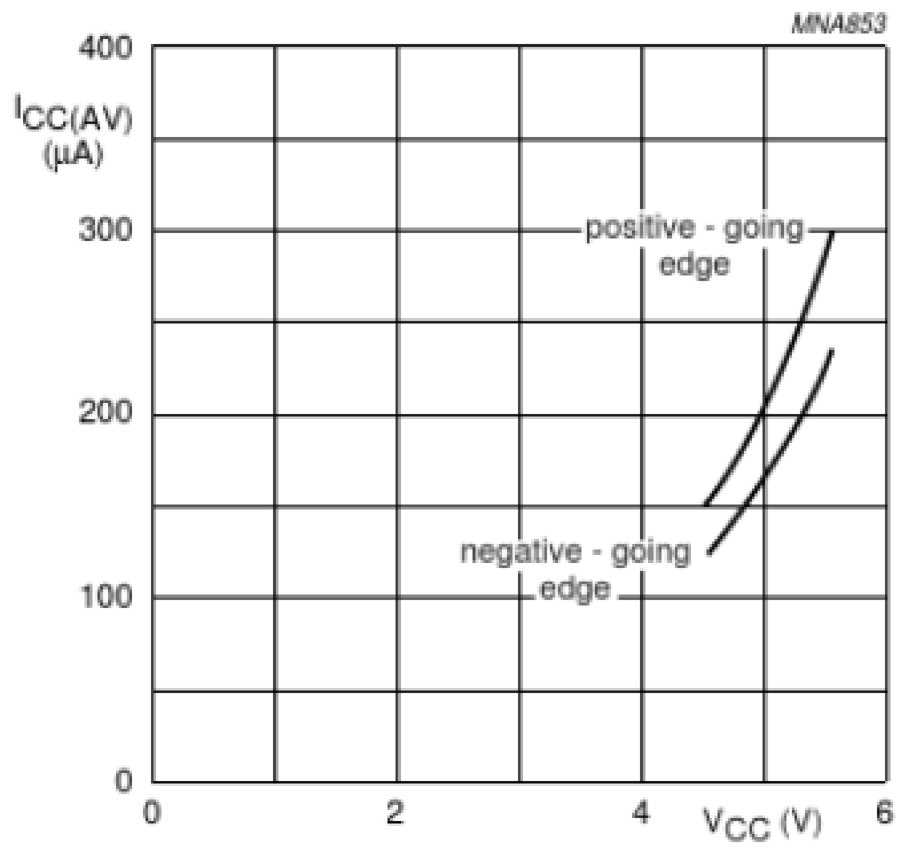
### Note to application information

All values given are typical unless otherwise specified.



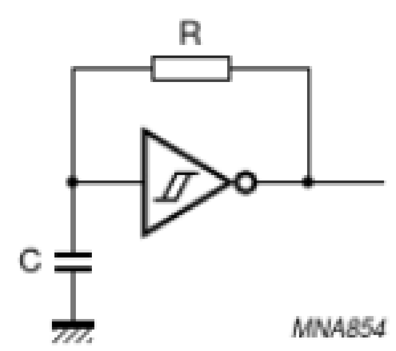

Linear change of $V_I$ between $0.1V_{CC}$ to $0.9V_{CC}$

Fig.16 Average $I_{CC}$ for 74HC14 Schmitt trigger devices.




Linear change of $V_I$ between $0.1V_{CC}$ to $0.9V_{CC}$.

Fig.17 Average $I_{CC}$ for HCT Schmitt trigger devices.



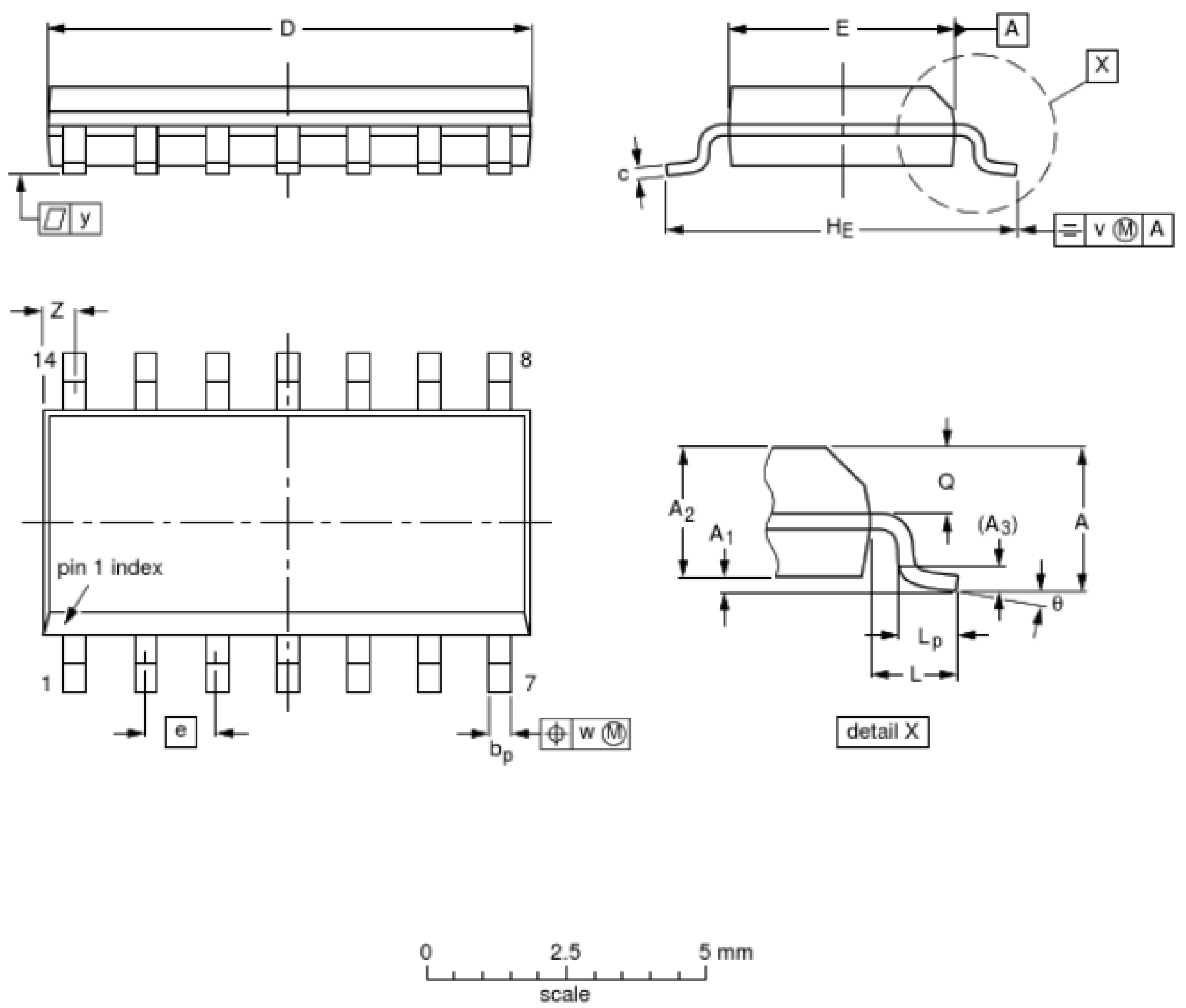

$$74HC14 : f = \frac{1}{T} \approx \frac{1}{0.8\ RC}$$

$$74HCT14 : f = \frac{1}{T} \approx \frac{1}{0.67\ RC}$$

Fig.18 Relaxation oscillator using 74HC/HCT14.

## PACKAGE OUTLINES

**SO14: plastic small outline package; 14 leads; body width 3.9 mm** **SOT108-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

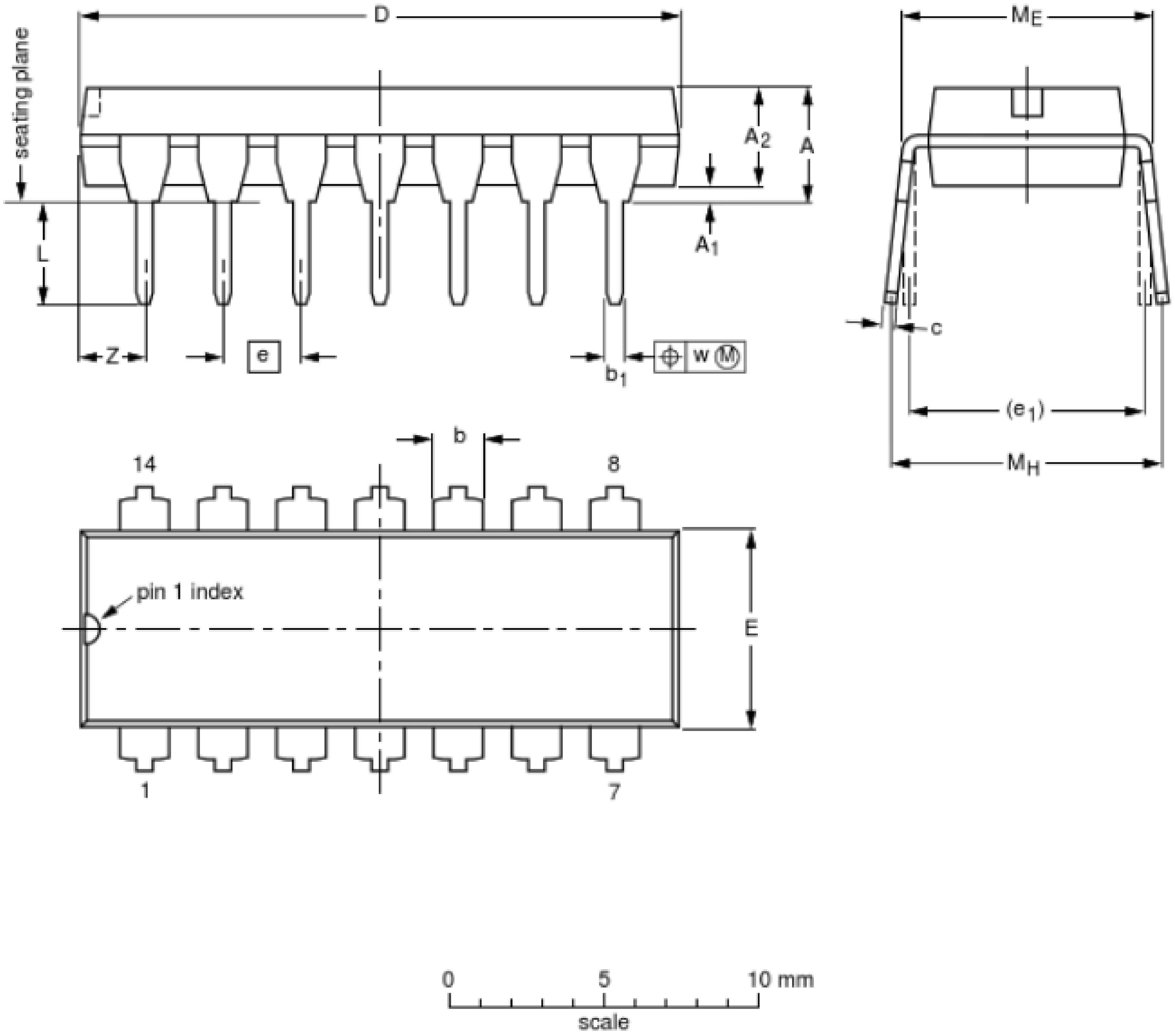
| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(1)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.75 | 0.25<br>0.10 | 1.45<br>1.25 | 0.25 | 0.49<br>0.36 | 0.25<br>0.19 | 8.75<br>8.55 | 4.0<br>3.8 | 1.27 | 6.2<br>5.8 | 1.05 | 1.0<br>0.4 | 0.7<br>0.6 | 0.25 | 0.25 | 0.1 | 0.7<br>0.3 | 8°<br>0° |
| inches | 0.069 | 0.010<br>0.004 | 0.057<br>0.049 | 0.01 | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.35<br>0.34 | 0.16<br>0.15 | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012 | |

**Note**

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT108-1 | 076E06 | MS-012 | | | | ~~99-12-27~~<br>03-02-19 |

**DIP14: plastic dual in-line package; 14 leads (300 mil)** **SOT27-1**

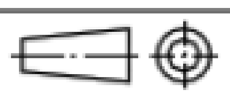



**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

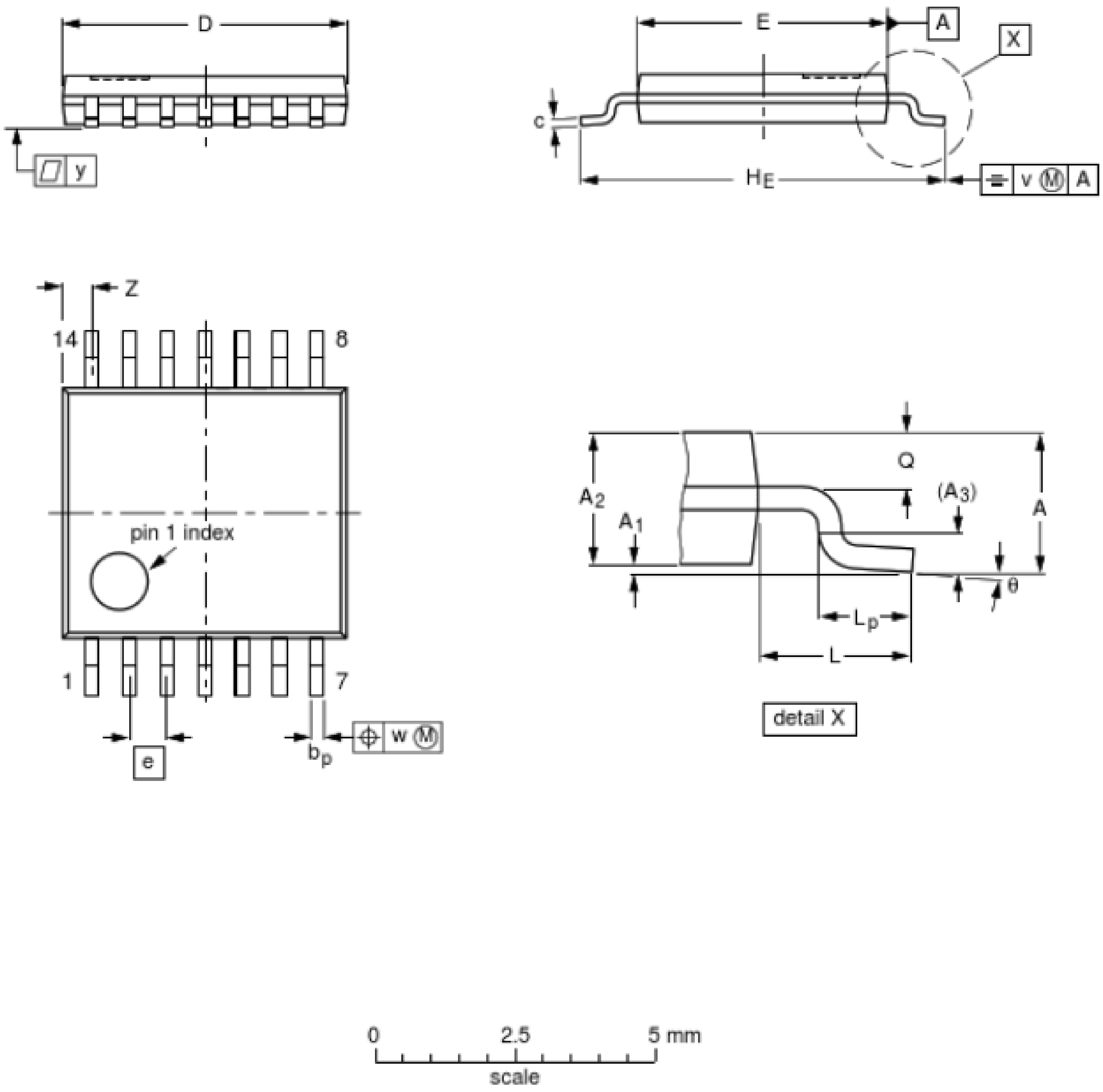
| UNIT | A max. | $A_1$ min. | $A_2$ max. | b | $b_1$ | c | D (1) | E (1) | e | $e_1$ | L | $M_E$ | $M_H$ | w | Z (1) max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.2 | 0.51 | 3.2 | 1.73<br>1.13 | 0.53<br>0.38 | 0.36<br>0.23 | 19.50<br>18.55 | 6.48<br>6.20 | 2.54 | 7.62 | 3.60<br>3.05 | 8.25<br>7.80 | 10.0<br>8.3 | 0.254 | 2.2 |
| inches | 0.17 | 0.02 | 0.13 | 0.068<br>0.044 | 0.021<br>0.015 | 0.014<br>0.009 | 0.77<br>0.73 | 0.26<br>0.24 | 0.1 | 0.3 | 0.14<br>0.12 | 0.32<br>0.31 | 0.39<br>0.33 | 0.01 | 0.087 |

**Note**

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT27-1 | 050G04 | MO-001 | SC-501-14 | |  | ~~99-12-27~~<br>03-02-13 |

**TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm** **SOT402-1**

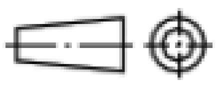



**DIMENSIONS (mm are the original dimensions)**

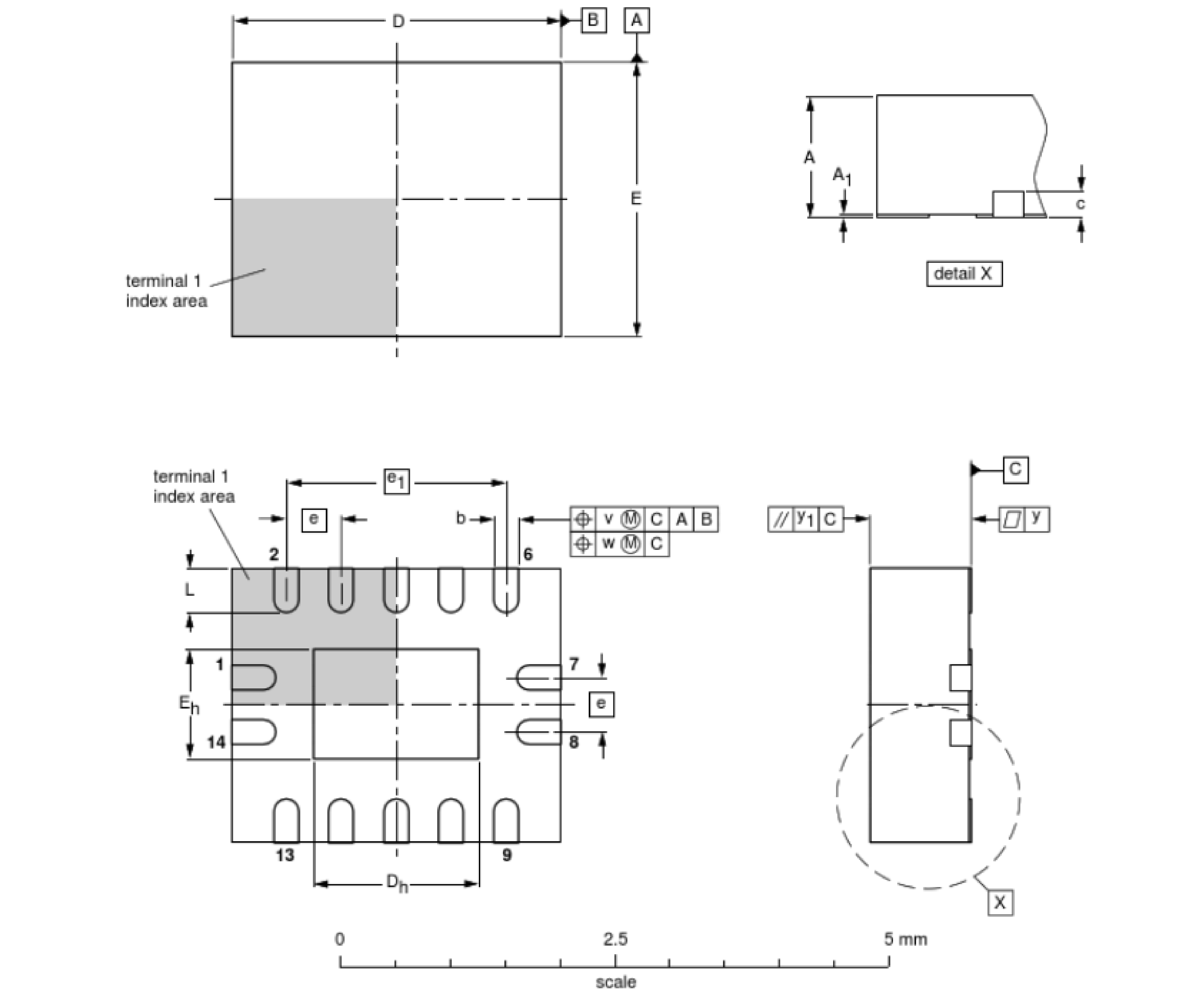
| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | D (1) | E (2) | e | $H_E$ | L | $L_p$ | Q | v | w | y | Z (1) | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1 | 0.15<br>0.05 | 0.95<br>0.80 | 0.25 | 0.30<br>0.19 | 0.2<br>0.1 | 5.1<br>4.9 | 4.5<br>4.3 | 0.65 | 6.6<br>6.2 | 1 | 0.75<br>0.50 | 0.4<br>0.3 | 0.2 | 0.13 | 0.1 | 0.72<br>0.38 | 8°<br>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~~<br>03-02-18 |

**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**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | $A^{(1)}$ max. | $A_1$ | b | c | $D^{(1)}$ | $D_h$ | $E^{(1)}$ | $E_h$ | e | $e_1$ | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1 | 0.05<br>0.00 | 0.30<br>0.18 | 0.2 | 3.1<br>2.9 | 1.65<br>1.35 | 2.6<br>2.4 | 1.15<br>0.85 | 0.5 | 2 | 0.5<br>0.3 | 0.1 | 0.05 | 0.05 | 0.1 |

**Note**

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT762-1 | - - - | MO-241 | - - - | | | ~~02-10-17~~<br>03-01-27 |

## DATA SHEET STATUS

| LEVEL | DATA SHEET STATUS[1] | PRODUCT STATUS[2][3] | DEFINITION |
|---|---|---|---|
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3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**Contact information**

For additional information please visit **http://www.semiconductors.philips.com**. Fax: **+31 40 27 24825**
For sales offices addresses send e-mail to: **sales.addresses@www.semiconductors.philips.com**.



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