# DATA SHEET

For a complete data sheet, please also download:

- The IC06 74HC/HCT/HCU/HCMOS Logic Family Specifications
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Information
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Outlines

# 74HC/HCT132
# Quad 2-input NAND Schmitt trigger

Product specification
File under Integrated Circuits, IC06

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Philips Semiconductors

PHILIPS

# Quad 2-input NAND Schmitt trigger 74HC/HCT132

## FEATURES

- Output capability: standard
- $I_{CC}$ category: SSI

## GENERAL DESCRIPTION

The 74HC/HCT132 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 74HC/HCT132 contain four 2-input NAND gates which accept standard input signals. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

The gate switches at different points for positive and negative-going signals. The difference between the positive voltage $V_{T+}$ and the negative voltage $V_{T-}$ is defined as the hysteresis voltage $V_H$.

## 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, nB to nY | $C_L$ = 15 pF; $V_{CC}$ = 5 V | 11 | 17 | ns |
| $C_I$ | input capacitance | | 3.5 | 3.5 | pF |
| $C_{PD}$ | power dissipation capacitance per gate | notes 1 and 2 | 24 | 20 | pF |

### Notes

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

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

   $f_i$ = input frequency in MHz

   $f_o$ = output frequency in MHz

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

   $C_L$ = output load capacitance in pF

   $V_{CC}$ = supply voltage in V
2. For HC the condition is $V_I$ = GND to $V_{CC}$

   For HCT the condition is $V_I$ = GND to $V_{CC}$ − 1.5 V

## ORDERING INFORMATION

See *"74HC/HCT/HCU/HCMOS Logic Package Information"*.

## PIN DESCRIPTION

| PIN NO. | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1, 4, 9, 12 | 1A to 4A | data inputs |
| 2, 5, 10, 13 | 1B to 4B | data inputs |
| 3, 6, 8, 11 | 1Y to 4Y | data outputs |
| 7 | GND | ground (0 V) |
| 14 | $V_{CC}$ | positive supply voltage |

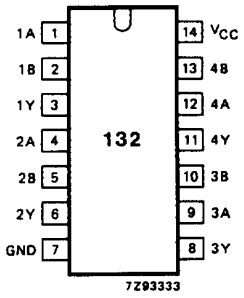



Fig.1 Pin configuration.

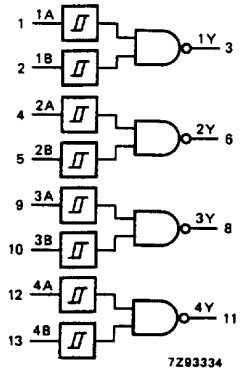



Fig.2 Logic symbol.

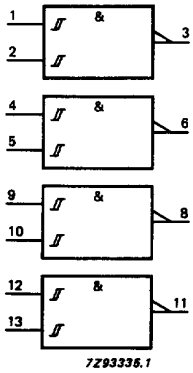



Fig.3 IEC logic symbol.

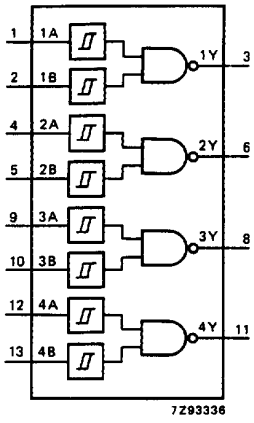



Fig.4 Functional diagram.

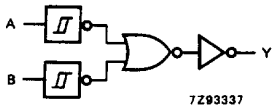



Fig.5 Logic diagram (one Schmitt trigger).

## FUNCTION TABLE

| INPUTS | | OUTPUT |
|---|---|---|
| nA | nB | nY |
| L | L | H |
| L | H | H |
| H | L | H |
| H | H | L |

**Notes**

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

## APPLICATIONS

- **Wave and pulse shapers**
- **Astable multivibrators**
- **Monostable multivibrators**

## DC CHARACTERISTICS FOR 74HC

For the DC characteristics see *"74HC/HCT/HCU/HCMOS Logic Family Specifications"*. Transfer characteristics are given below.

Output capability: standard
$I_{CC}$ category: SSI

### Transfer characteristics for 74HC

Voltages are referenced to GND (ground = 0 V)

| SYMBOL | PARAMETER | $T_{amb}$ (°C) | | | | | | | UNIT | TEST CONDITIONS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 74HC | | | | | | | | $V_{CC}$ (V) | WAVEFORMS |
| | | +25 | | | –40 to +85 | | –40 to +125 | | | | |
| | | min. | typ. | max. | min. | max. | min. | max. | | | |
| $V_{T+}$ | positive-going threshold | 0.7 | 1.18 | 1.5 | 0.7 | 1.5 | 0.7 | 1.5 | V | 2.0 | Figs 6 and 7 |
| | | 1.7 | 2.38 | 3.15 | 1.7 | 3.15 | 1.7 | 3.15 | | 4.5 | |
| | | 2.1 | 3.14 | 4.2 | 2.1 | 4.2 | 2.1 | 4.2 | | 6.0 | |
| $V_{T-}$ | negative-going threshold | 0.3 | 0.63 | 1.0 | 0.3 | 1.0 | 0.3 | 1.0 | V | 2.0 | Figs 6 and 7 |
| | | 0.9 | 1.67 | 2.2 | 0.9 | 2.2 | 0.9 | 2.2 | | 4.5 | |
| | | 1.2 | 2.26 | 3.0 | 1.2 | 3.0 | 1.2 | 3.0 | | 6.0 | |
| $V_H$ | hysteresis ($V_{T+} - V_{T-}$) | 0.2 | 0.55 | 1.0 | 0.2 | 1.0 | 0.2 | 1.0 | V | 2.0 | Figs 6 and 7 |
| | | 0.4 | 0.71 | 1.4 | 0.4 | 1.4 | 0.4 | 1.4 | | 4.5 | |
| | | 0.6 | 0.88 | 1.6 | 0.6 | 1.6 | 0.6 | 1.6 | | 6.0 | |

## AC CHARACTERISTICS FOR 74HC

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

| SYMBOL | PARAMETER | $T_{amb}$ (°C) | | | | | | | UNIT | TEST CONDITIONS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 74HC | | | | | | | | $V_{CC}$ (V) | WAVEFORMS |
| | | +25 | | | –40 TO +85 | | –40 TO +125 | | | | |
| | | min. | typ. | max. | min. | max. | min. | max. | | | |
| $t_{PHL}$/ $t_{PLH}$ | propagation delay nA, nB to nY | | 36 | 125 | | 155 | | 190 | ns | 2.0 | Fig.13 |
| | | | 13 | 25 | | 31 | | 38 | | 4.5 | |
| | | | 10 | 21 | | 26 | | 32 | | 6.0 | |
| $t_{THL}$/ $t_{TLH}$ | output transition time | | 19 | 75 | | 95 | | 110 | ns | 2.0 | Fig.13 |
| | | | 7 | 15 | | 19 | | 22 | | 4.5 | |
| | | | 6 | 13 | | 16 | | 19 | | 6.0 | |

### DC CHARACTERISTICS FOR 74HCT

For the DC characteristics see *"74HC/HCT/HCU/HCMOS Logic Family Specifications"*. Transfer characteristics are given below.

Output capability: standard
$I_{CC}$ category: SSI

#### Notes to HCT types

The value of additional quiescent supply current ($\Delta I_{CC}$) for a unit load of 1 is given in the family specifications. To determine $\Delta I_{CC}$ per input, multiply this value by the unit load coefficient shown in the table below.

| INPUT | UNIT LOAD COEFFICIENT |
|---|---|
| nA, nB | 0.3 |

#### Transfer characteristics for 74HCT

Voltages are referenced to GND (ground = 0 V)

| SYMBOL | PARAMETER | $T_{amb}$ (°C) | | | | | | | UNIT | TEST CONDITIONS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 74HCT | | | | | | | | $V_{CC}$ (V) | WAVEFORMS |
| | | +25 | | | −40 to +85 | | −40 to +125 | | | | |
| | | min. | typ. | max. | min. | max. | min. | max. | | | |
| $V_{T+}$ | positive-going threshold | 1.2 | 1.41 | 1.9 | 1.2 | 1.9 | 1.2 | 1.9 | V | 4.5 | Figs 6 and 7 |
| | | 1.4 | 1.59 | 2.1 | 1.4 | 2.1 | 1.4 | 2.1 | | 5.5 | |
| $V_{T-}$ | negative-going threshold | 0.5 | 0.85 | 1.2 | 0.5 | 1.2 | 0.5 | 1.2 | V | 4.5 | Figs 6 and 7 |
| | | 0.6 | 0.99 | 1.4 | 0.6 | 1.4 | 0.6 | 1.4 | | 5.5 | |
| $V_H$ | hysteresis ($V_{T+} - V_{T-}$) | 0.4 | 0.56 | – | 0.4 | – | 0.4 | – | V | 4.5 | Figs 6 and 7 |
| | | 0.4 | 0.60 | – | 0.4 | – | 0.4 | – | | 5.5 | |

### AC CHARACTERISTICS FOR 74HCT

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

| SYMBOL | PARAMETER | $T_{amb}$ (°C) | | | | | | | UNIT | TEST CONDITIONS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 74HCT | | | | | | | | $V_{CC}$ (V) | WAVEFORMS |
| | | +25 | | | −40 to +85 | | −40 to +125 | | | | |
| | | min. | typ. | max. | min. | max. | min. | max. | | | |
| $t_{PHL}/ t_{PLH}$ | propagation delay nA, nB to nY | | 20 | 33 | | 41 | | 50 | ns | 4.5 | Fig.13 |
| $t_{THL}/ t_{TLH}$ | output transition time | | 7 | 15 | | 19 | | 22 | ns | 4.5 | Fig.13 |

**TRANSFER CHARACTERISTIC WAVEFORMS**

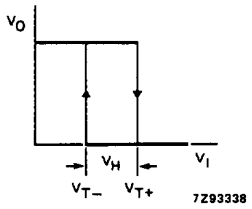



Fig.6 Transfer characteristic.

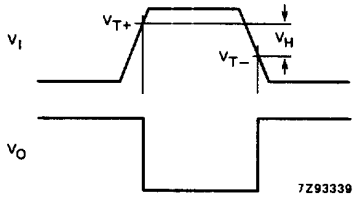



Fig.7 Waveforms showing the definition of $V_{T+}$, $V_{T-}$ and $V_H$; where $V_{T+}$ and $V_{T-}$ are between limits of 20% and 70%.

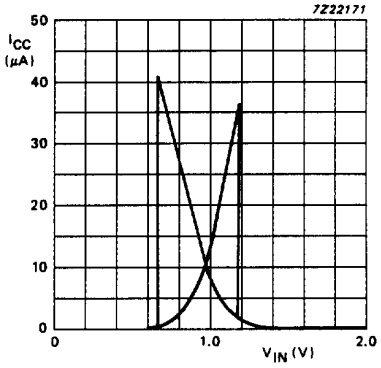



Fig.8 Typical HC transfer characteristics; $V_{CC}$ = 2 V.

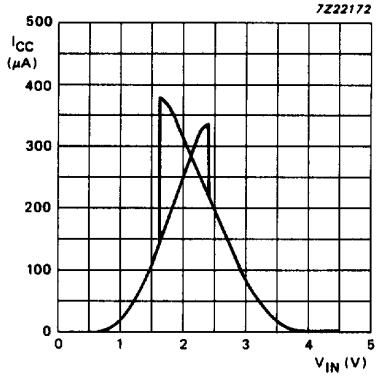



Fig.9 Typical HC transfer characteristics; $V_{CC}$ = 4.5 V.

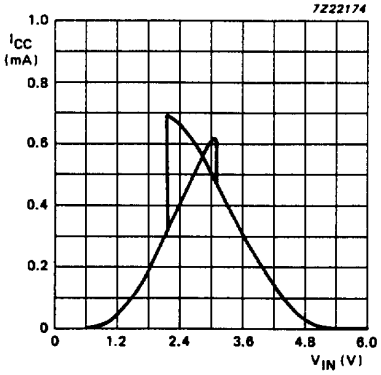



Fig.10 Typical HC transfer characteristics; $V_{CC}$ = 6 V.

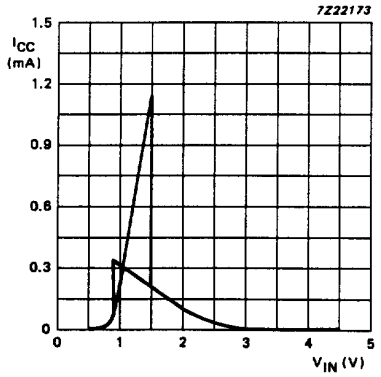



Fig.11 Typical HCT transfer characteristics; $V_{CC}$ = 4.5 V.

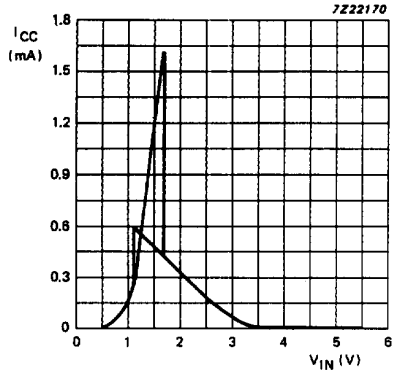
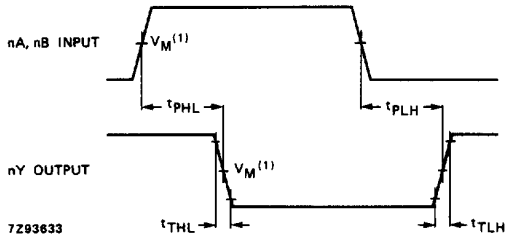



Fig.12 Typical HCT transfer characteristics; $V_{CC}$ = 5.5 V.

**AC WAVEFORMS**




(1) HC : $V_M$ = 50%; $V_I$ = GND to $V_{CC}$.
HCT: $V_M$ = 1.3 V; $V_I$ = GND to 3 V.

Fig.13 Waveforms showing the input (nA, nB) to output (nY) propagation delays and the output transition times.

### Application information

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

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

**Where:**

| | |
|---|---|
| $P_{ad}$ | = additional power dissipation (μW) |
| $f_i$ | = input frequency (MHz) |
| $t_r$ | = input rise time (ns); 10% – 90% |
| $t_f$ | = input fall time (ns); 10% – 90% |
| $I_{CCa}$ | = average additional supply current (μA) |

Average $I_{CCa}$ differs with positive or negative input transitions, as shown in Figs 14 and 15.

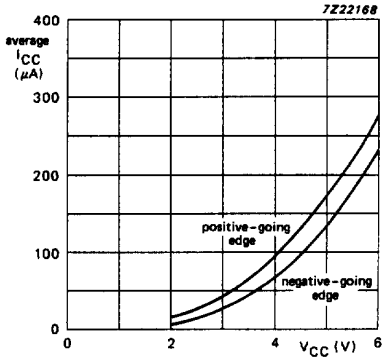



Fig.14 Average $I_{CC}$ for HC Schmitt trigger devices; linear change of $V_i$ between 0.1 $V_{CC}$ to 0.9 $V_{CC}$.

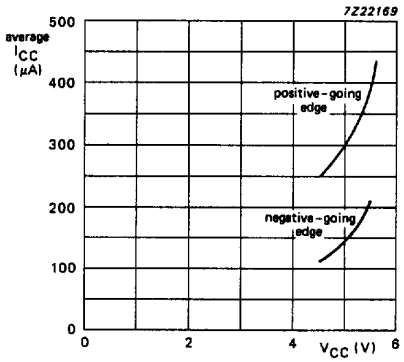



Fig.15 Average $I_{CC}$ for HCT Schmitt trigger devices; linear change of $V_i$ between 0.1 $V_{CC}$ to 0.9 $V_{CC}$.

HC/HCT132 used in a relaxation oscillator circuit, see Fig.16.

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

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

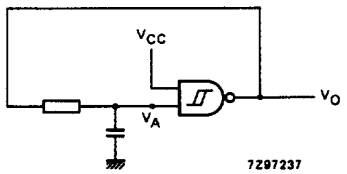



Fig.16 Relaxation oscillator using HC/HCT132.

### Note to Application information

All values given are typical unless otherwise specified.

### PACKAGE OUTLINES

See *"74HC/HCT/HCU/HCMOS Logic Package Outlines"*.