# DATA SHEET

For a complete data sheet, please also download:

- The IC04 LOCMOS HE4000B Logic Family Specifications HEF, HEC
- The IC04 LOCMOS HE4000B Logic Package Outlines/Information HEF, HEC

# HEF4093B
# gates
## Quadruple 2-input NAND Schmitt trigger

Product specification
File under Integrated Circuits, IC04

January 1995

Philips Semiconductors

PHILIPS

# Quadruple 2-input NAND Schmitt trigger

# HEF4093B gates

## DESCRIPTION

The HEF4093B consists of four Schmitt-trigger circuits. Each circuit functions as a two-input NAND gate with Schmitt-trigger action on both inputs. The gate switches at different points for positive and negative-going signals. The difference between the positive voltage ($V_P$) and the negative voltage ($V_N$) is defined as hysteresis voltage ($V_H$).

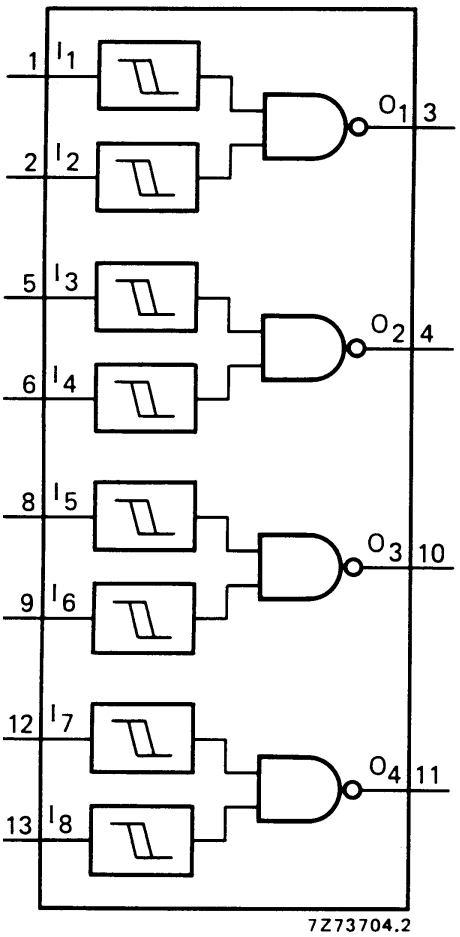



Fig.1 Functional diagram.

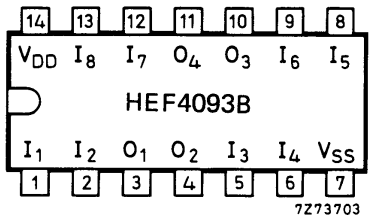



Fig.2 Pinning diagram.

HEF4093BP(N): 14-lead DIL; plastic (SOT27-1)

HEF4093BD(F): 14-lead DIL; ceramic (cerdip) (SOT73)

HEF4093BT(D): 14-lead SO; plastic (SOT108-1)

( ): Package Designator North America

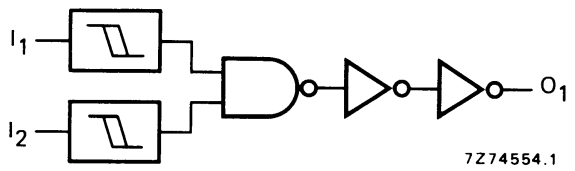



Fig.3 Logic diagram (one gate).

**FAMILY DATA, $I_{DD}$ LIMITS category GATES**

See Family Specifications

**DC CHARACTERISTICS**

$V_{SS}$ = 0 V; $T_{amb}$ = 25 °C

| | $V_{DD}$ V | SYMBOL | MIN. | TYP. | MAX. | |
|---|---|---|---|---|---|---|
| Hysteresis | 5 | | 0,4 | 0,7 | – | V |
| voltage | 10 | $V_H$ | 0,6 | 1,0 | – | V |
| | 15 | | 0,7 | 1,3 | – | V |
| Switching levels | 5 | | 1,9 | 2,9 | 3,5 | V |
| positive-going | 10 | $V_P$ | 3,6 | 5,2 | 7 | V |
| input voltage | 15 | | 4,7 | 7,3 | 11 | V |
| negative-going | 5 | | 1,5 | 2,2 | 3,1 | V |
| input voltage | 10 | $V_N$ | 3 | 4,2 | 6,4 | V |
| | 15 | | 4 | 6,0 | 10,3 | V |

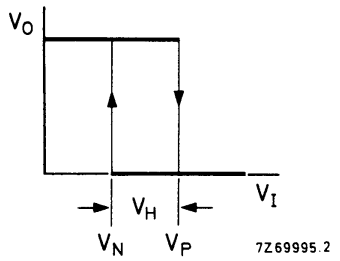



Fig.4 Transfer characteristic.

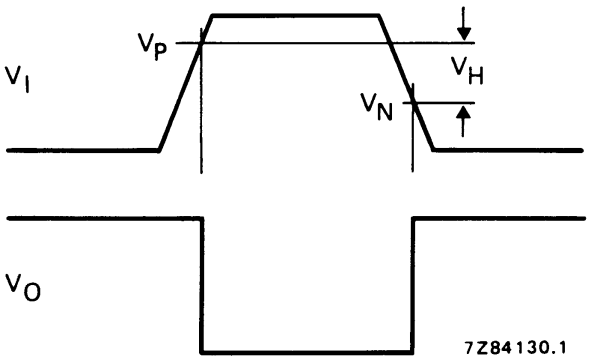



Fig.5 Waveforms showing definition of $V_P$, $V_N$ and $V_H$; where $V_N$ and $V_P$ are between limits of 30% and 70%.

## AC CHARACTERISTICS

$V_{SS}$ = 0 V; $T_{amb}$ = 25 °C; $C_L$ = 50 pF; input transition times ≤ 20 ns

| | $V_{DD}$ V | SYMBOL | TYP. | MAX. | | TYPICAL EXTRAPOLATION FORMULA |
|---|---|---|---|---|---|---|
| Propagation delays | 5 | | 90 | 185 | ns | 63 ns + (0,55 ns/pF) $C_L$ |
| $I_n \rightarrow O_n$ | 10 | $t_{PHL}$ | 40 | 80 | ns | 29 ns + (0,23 ns/pF) $C_L$ |
| HIGH to LOW | 15 | | 30 | 60 | ns | 22 ns + (0,16 ns/pF) $C_L$ |
| | 5 | | 85 | 170 | ns | 58 ns + (0,55 ns/pF) $C_L$ |
| LOW to HIGH | 10 | $t_{PLH}$ | 40 | 80 | ns | 29 ns + (0,23 ns/pF) $C_L$ |
| | 15 | | 30 | 60 | ns | 22 ns + (0,16 ns/pF) $C_L$ |
| Output transition times | 5 | | 60 | 120 | ns | 10 ns + (1,0 ns/pF) $C_L$ |
| HIGH to LOW | 10 | $t_{THL}$ | 30 | 60 | ns | 9 ns + (0,42 ns/pF) $C_L$ |
| | 15 | | 20 | 40 | ns | 6 ns + (0,28 ns/pF) $C_L$ |
| | 5 | | 60 | 120 | ns | 10 ns + (1,0 ns/pF) $C_L$ |
| LOW to HIGH | 10 | $t_{TLH}$ | 30 | 60 | ns | 9 ns + (0,42 ns/pF) $C_L$ |
| | 15 | | 20 | 40 | ns | 6 ns + (0,28 ns/pF) $C_L$ |

| | $V_{DD}$ V | TYPICAL FORMULA FOR P (μW) | |
|---|---|---|---|
| Dynamic power | 5 | $1300\ f_i + \sum(f_o C_L) \times V_{DD}^2$ | where |
| dissipation per | 10 | $6400\ f_i + \sum(f_o C_L) \times V_{DD}^2$ | $f_i$ = input freq. (MHz) |
| package (P) | 15 | $18\ 700\ f_i + \sum(f_o C_L) \times V_{DD}^2$ | $f_o$ = output freq. (MHz) |
| | | | $C_L$ = load capacitance (pF) |
| | | | $\sum (f_o C_L)$ = sum of outputs |
| | | | $V_{DD}$ = supply voltage (V) |

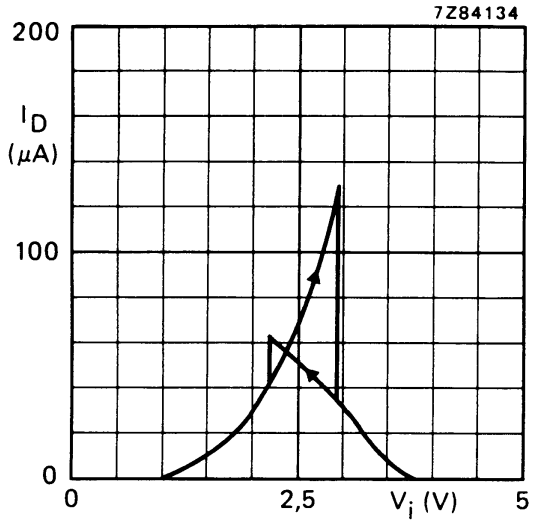



Fig.6 Typical drain current as a function of input voltage; $V_{DD}$ = 5 V; $T_{amb}$ = 25 °C.

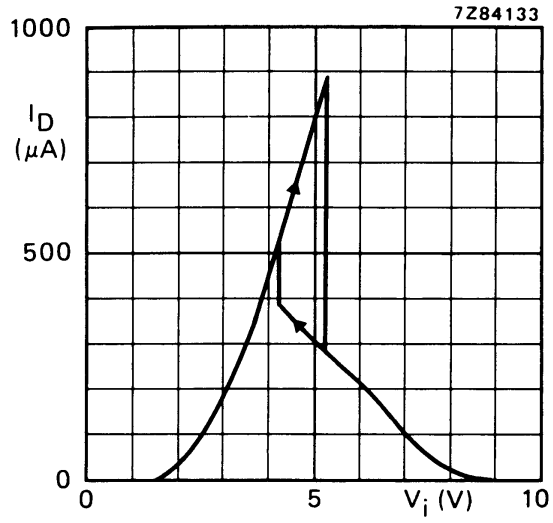



Fig.7 Typical drain current as a function of input voltage; $V_{DD}$ =10 V; $T_{amb}$ = 25 °C.

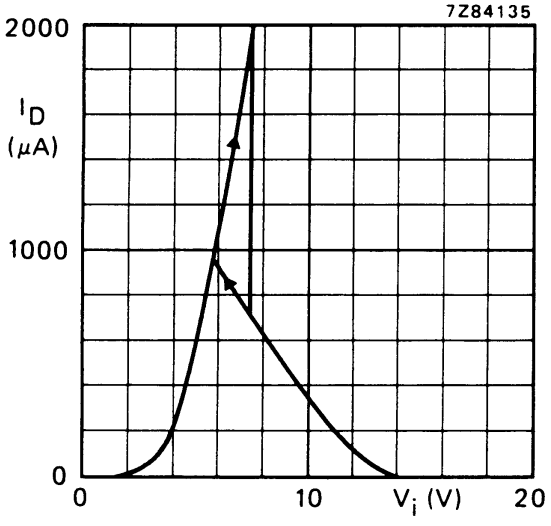



Fig.8 Typical drain current as a function of input voltage; $V_{DD}$ = 15 V; $T_{amb}$ = 25 °C.

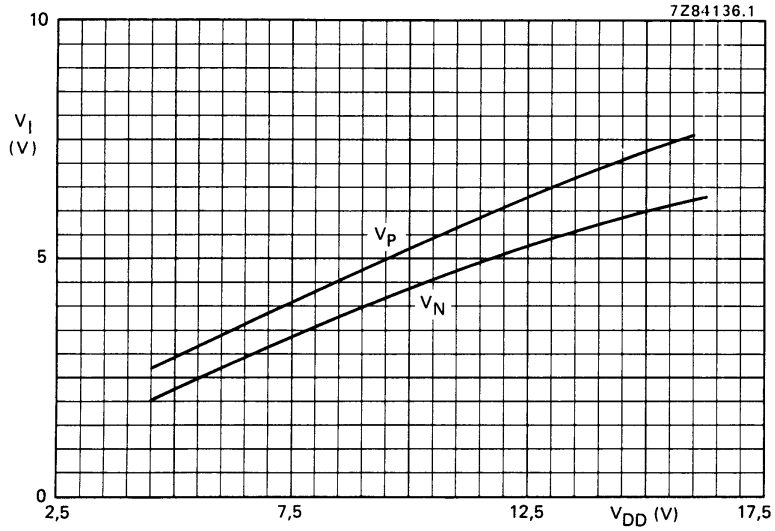



Fig.9 Typical switching levels as a function of supply voltage $V_{DD}$; $T_{amb}$ = 25 °C.

**APPLICATION INFORMATION**

Some examples of applications for the HEF4093B are:

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

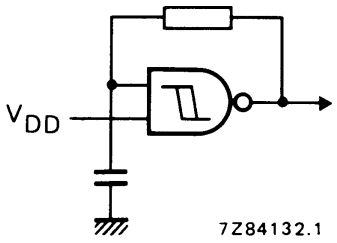



Fig.10 The HEF4093B used as a astable multivibrator.

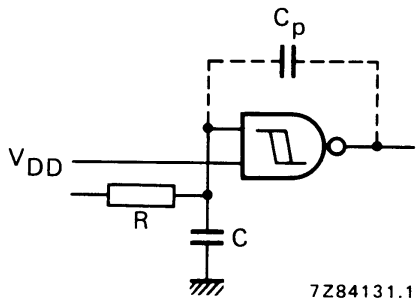



Fig.11 Schmitt trigger driven via a high impedance ($R > 1\ k\Omega$).

If a Schmitt trigger is driven via a high impedance ($R > 1\ k\Omega$) then it is necessary to incorporate a capacitor C of such value that:

$$\frac{C}{C_p} > \frac{V_{DD} - V_{SS}}{V_H}$$, otherwise oscillation can occur on the edges of a pulse.

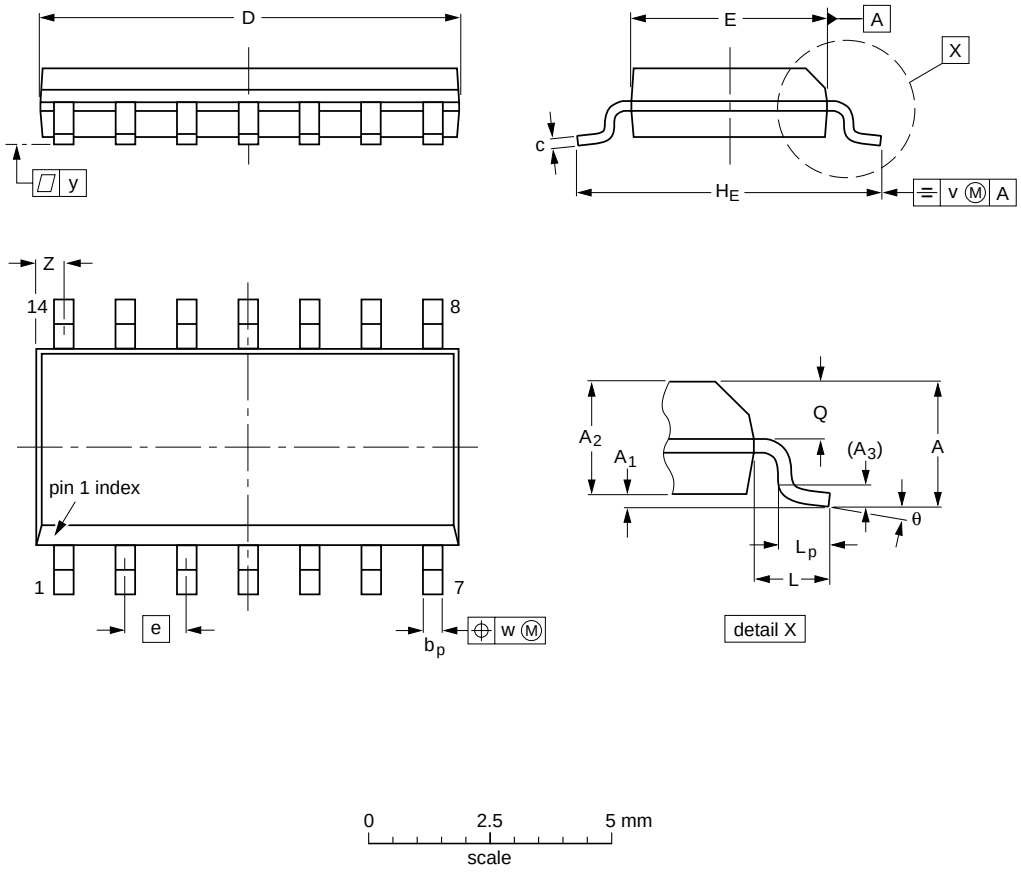
$C_p$ is the external parasitic capacitance between inputs and output; the value depends on the circuit board layout.

**Note**

The two inputs may be connected together, but this will result in a larger through-current at the moment of switching.

## SO

### 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 | $8^o$<br>$0^o$ |
| 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 | 0.050 | 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 | |

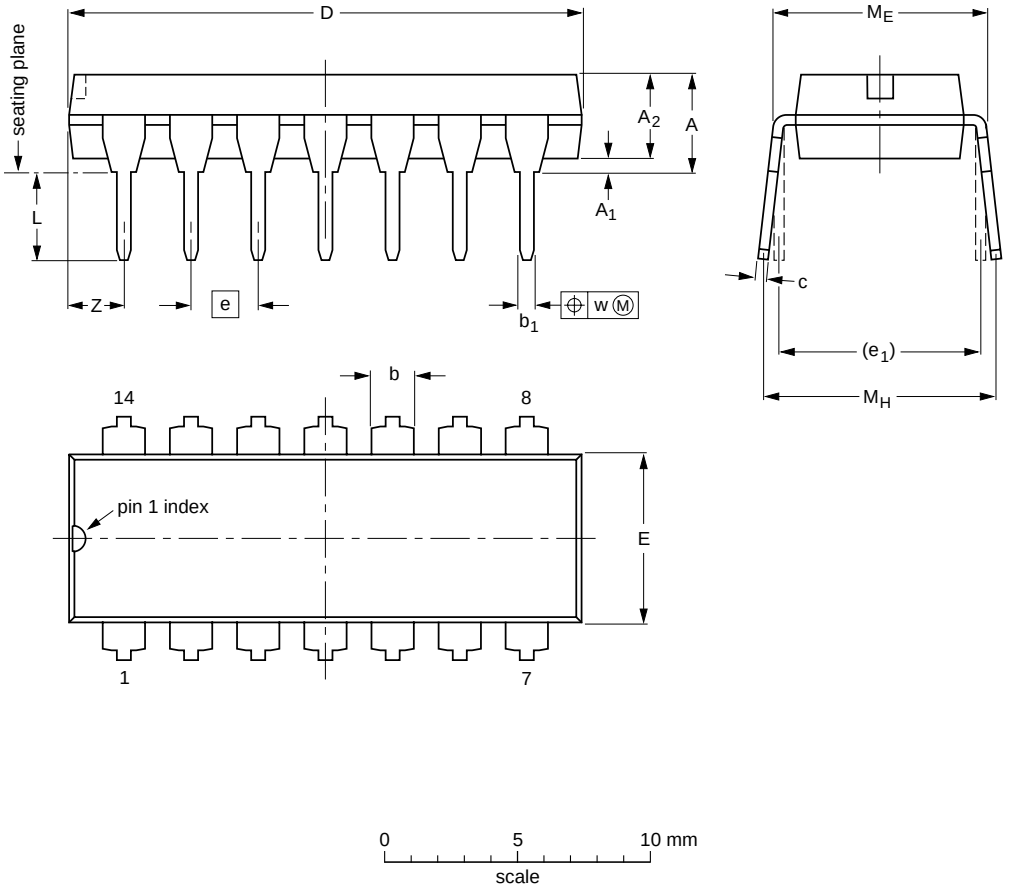
**Note**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT108-1 | 076E06S | MS-012AB | | | | ~~95-01-23~~<br>97-05-22 |

## DIP

### 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 | 0.020 | 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 | 0.10 | 0.30 | 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 maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT27-1 | 050G04 | MO-001AA | | | | ~~92-11-17~~<br>95-03-11 |