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

HEF4069UB gates
Hex inverter

Product specification
File under Integrated Circuits, IC04

January 1995

Philips Semiconductors

PHILIPS

DESCRIPTION

The HEF4069UB is a general purpose hex inverter. Each of the six inverters is a single stage.

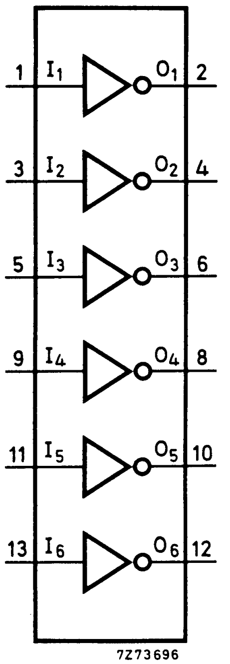


Fig.1 Functional diagram.

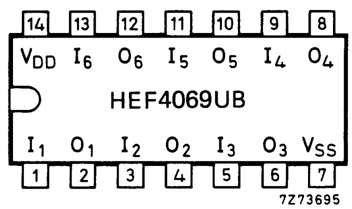


Fig.2 Pinning diagram.

HEF4069UBP(N):	14-lead DIL; plastic (SOT27-1)
HEF4069UBD(F):	14-lead DIL; ceramic (cerdip) (SOT73)
HEF4069UBT(D):	14-lead SO; plastic (SOT108-1)

( ): Package Designator North America

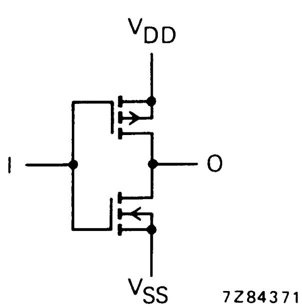


Fig.3 Schematic diagram (one inverter).

FAMILY DATA, I_{DD} LIMITS category GATES

See Family Specifications for V_{IH}/V_{IL} unbuffered stages

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		45	90	ns	18 ns + (0,55 ns/pF) C_L
$I_n \rightarrow O_n$	10	t_{PHL}	20	40	ns	9 ns + (0,23 ns/pF) C_L
HIGH to LOW	15		15	25	ns	7 ns + (0,16 ns/pF) C_L
	5		40	80	ns	13 ns + (0,55 ns/pF) C_L
LOW to HIGH	10	t_{PLH}	20	40	ns	9 ns + (0,23 ns/pF) C_L
	15		15	30	ns	7 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	$600\ f_i + \sum (f_o C_L) \times V_{DD}^2$	where
dissipation per	10	$4\ 000\ f_i + \sum (f_o C_L) \times V_{DD}^2$	f_i = input freq. (MHz)
package (P)	15	$22\ 000\ f_i + \sum (f_o C_L) \times V_{DD}^2$	f_o = output freq. (MHz)
			C_L = load capacitance (pF)
			$\sum (f_o C_L)$ = sum of outputs
			V_{DD} = supply voltage (V)

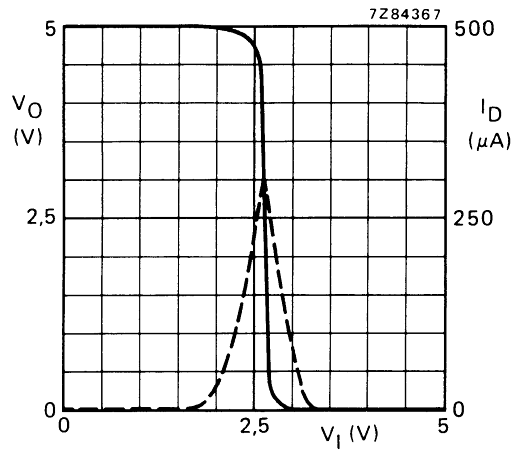


Fig.4 Typical transfer characteristics;
___ V_O;
_ _ _ I_D (drain current);
$I_O = 0$; $V_{DD} = 5$ V.

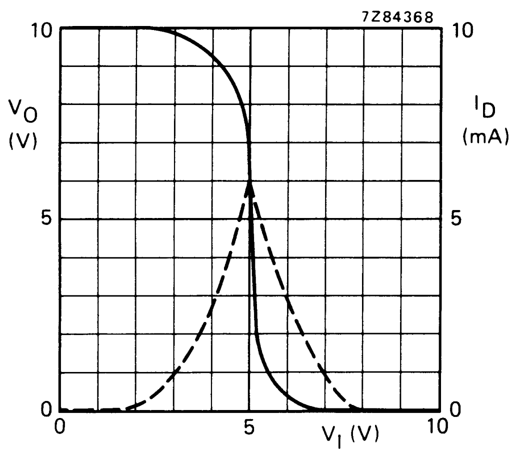


Fig.5 Typical transfer characteristics;
___ V_O;
_ _ _ I_D (drain current);
$I_O = 0$; $V_{DD} = 10$ V.

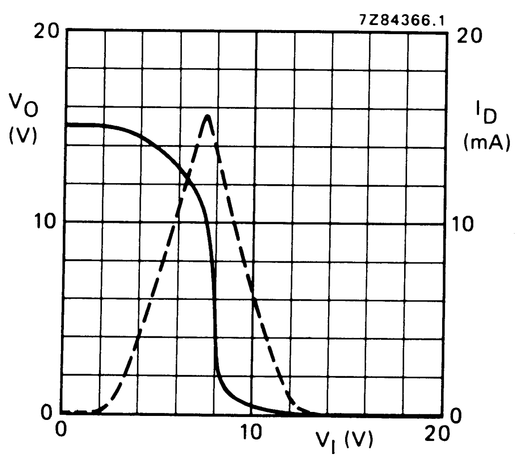


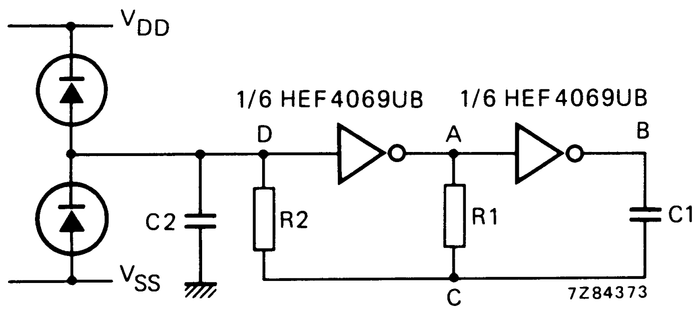
Fig.6 Typical transfer characteristics;
___ V_O;
_ _ _ I_D (drain current);
$I_O = 0$; $V_{DD} = 15$ V.

APPLICATION INFORMATION

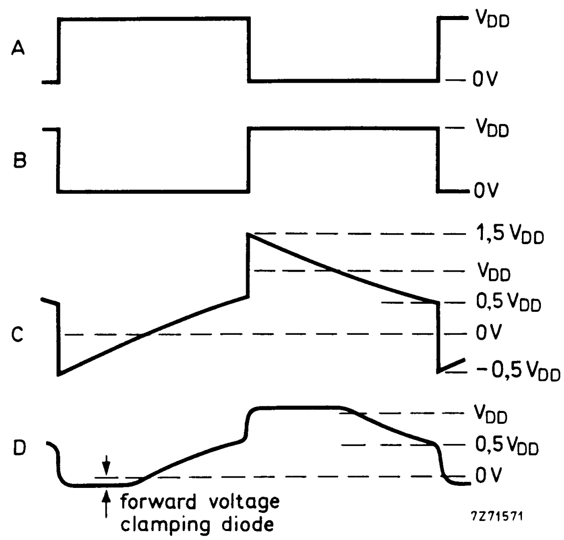
Some examples of applications for the HEF4069UB are shown below.

In Fig.7 an astable relaxation oscillator is given. The oscillation frequency is mainly determined by R1C1, provided R1 << R2 and R2C2 << R1C1.

(a)



(b)

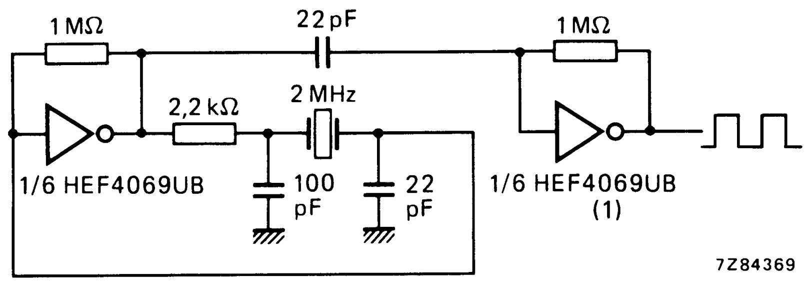


The function of R2 is to minimize the influence of the forward voltage across the protection diodes on the frequency; C2 is a stray (parasitic) capacitance. The period T_p is given by $T_p = T_1 + T_2$, in which

$$T_1 = R1C1 \ln\frac{V_{DD} + V_{ST}}{V_{ST}} \text{ and } T_2 = R1C1 \ln\frac{2\,V_{DD} - V_{ST}}{V_{DD} - V_{ST}} \text{ where}$$

V_{ST} is the signal threshold level of the inverter. The period is fairly independent of V_{DD}, V_{ST} and temperature. The duty factor, however, is influenced by V_{ST}.

Fig.7 (a) Astable relaxation oscillator using two HEF4069UB inverters; the diodes may be BAW62; C2 is a parasitic capacitance. (b) Waveforms at the points marked A, B, C and D in the circuit diagram.



(1) This inverter is added to amplify the oscillator output voltage to a level sufficient to drive other LOCMOS circuits.

Fig.8 Crystal oscillator for frequencies up to 10 MHz, using two HEF4069UB inverters.

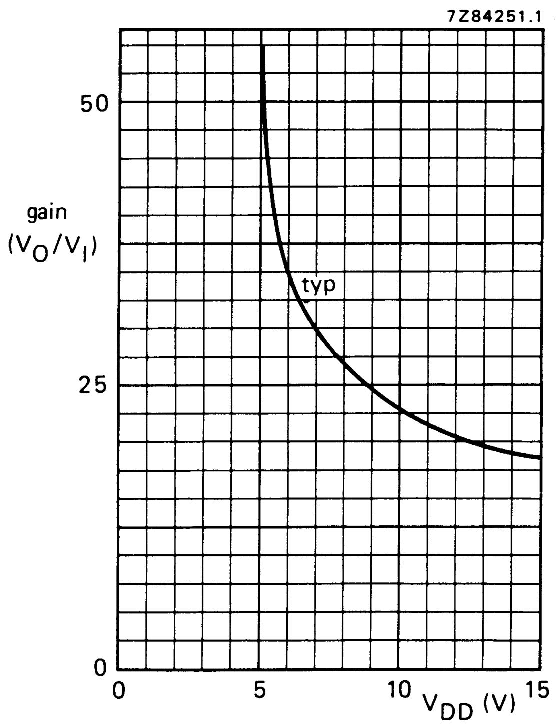


Fig.9 Voltage gain (V_O/V_I) as a function of supply voltage.

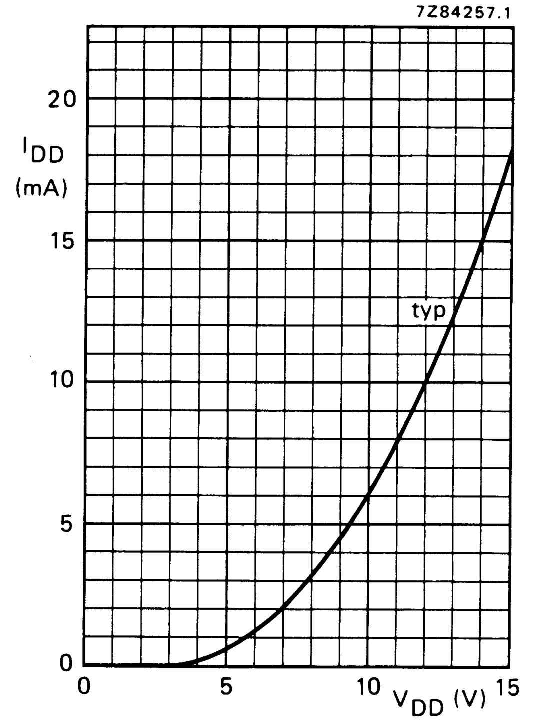
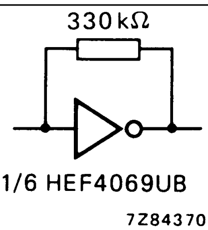


Fig.10 Supply current as a function of supply voltage.



It is also an example of an analogue amplifier using one HEF4069UB.

Fig.11 Test set-up for measuring graphs of Figs 9 and 10.

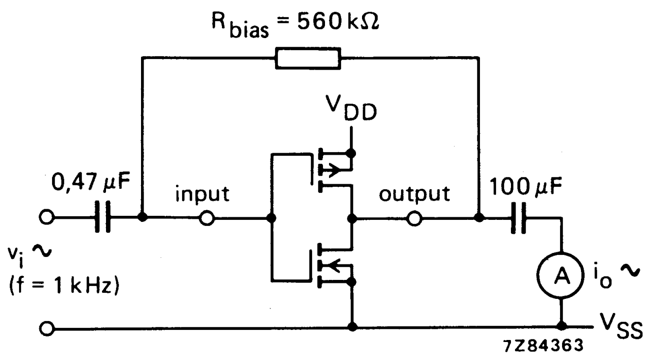
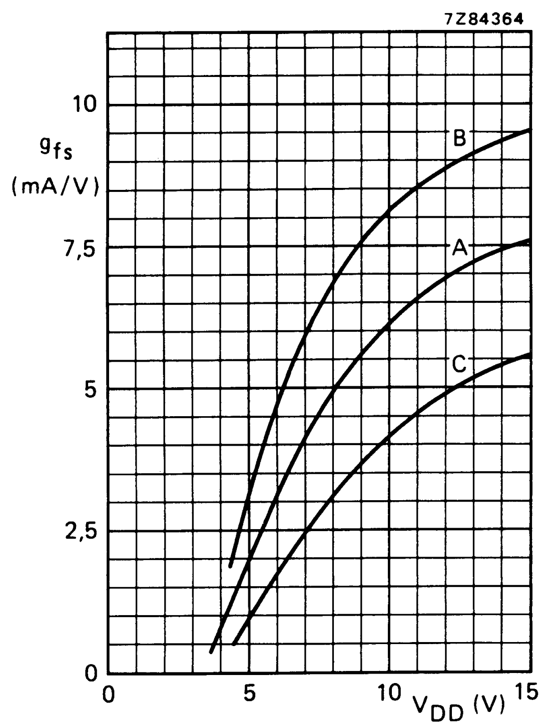


Fig.12 Test set-up for measuring forward transconductance $g_{fs} = di_o/dv_i$ at v_o is constant (see also graph Fig.13).



A : average,

B : average + 2 s,

C : average – 2 s, where:

‘s’ is the observed standard deviation.

Fig.13 Typical forward transconductance g_{fs} as a function of the supply voltage at T_{amb} = 25 °C.