

DATA SHEET

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

HEF4011UB

gates

Quadruple 2-input NAND gate

Product specification
File under Integrated Circuits, IC04

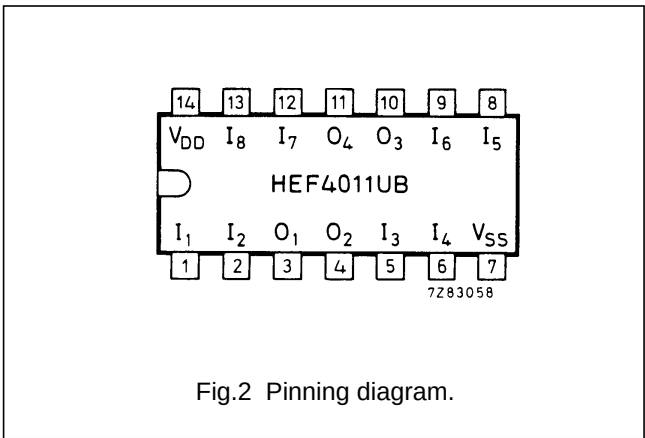
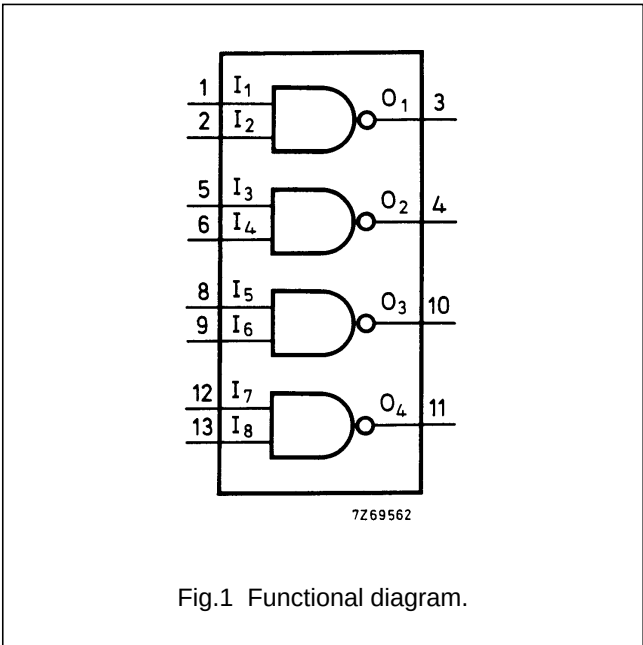
January 1995

Quadruple 2-input NAND gate

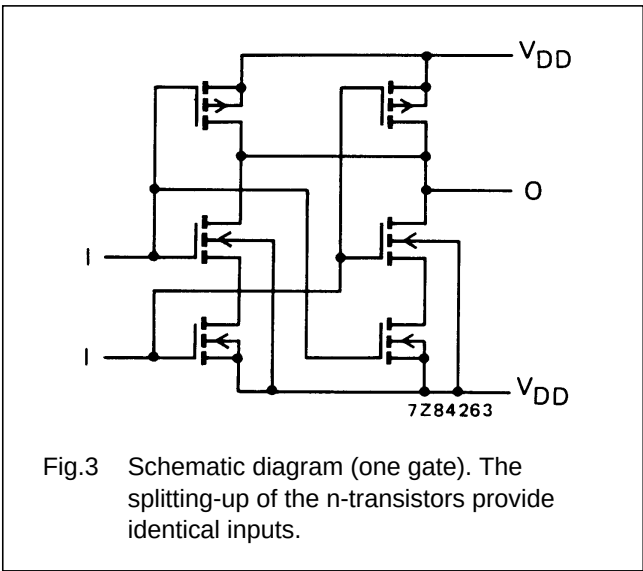
HEF4011UB
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DESCRIPTION

The HEF4011UB is a quadruple 2-input NAND gate. This unbuffered single stage version provides a direct implementation of the NAND function. The output impedance and output transition time depends on the input voltage and input rise and fall times applied.



- HEF4011UBP(N): 14-lead DIL; plastic (SOT27-1)
- HEF4011UBD(F): 14-lead DIL; ceramic (cerdip) (SOT73)
- HEF4011UBT(D): 14-lead SO; plastic (SOT108-1)
- (): Package Designator North America



FAMILY DATA, I_{DD} LIMITS category GATES

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

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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 $I_n \rightarrow O_n$ HIGH to LOW	5	t_{PHL}	60	120	ns	25 ns + (0,70 ns/pF) C_L
	10		25	50	ns	12 ns + (0,27 ns/pF) C_L
	15		20	40	ns	10 ns + (0,20 ns/pF) C_L
LOW to HIGH	5	t_{PLH}	35	70	ns	8 ns + (0,55 ns/pF) C_L
	10		20	40	ns	9 ns + (0,23 ns/pF) C_L
	15		17	35	ns	9 ns + (0,16 ns/pF) C_L
Output transition times HIGH to LOW	5	t_{THL}	75	150	ns	15 ns + (1,20 ns/pF) C_L
	10		30	60	ns	6 ns + (0,48 ns/pF) C_L
	15		20	40	ns	4 ns + (0,32 ns/pF) C_L
LOW to HIGH	5	t_{TLH}	60	110	ns	10 ns + (1,00 ns/pF) C_L
	10		30	60	ns	9 ns + (0,42 ns/pF) C_L
	15		20	40	ns	6 ns + (0,28 ns/pF) C_L
Input capacitance		C_{IN}		10	pF	

	V_{DD} V	TYPICAL FORMULA FOR P (μ W)	
Dynamic power dissipation per package (P)	5	$500 f_i + \sum (f_o C_L) \times V_{DD}^2$	where f_i = input freq. (MHz) f_o = output freq. (MHz) C_L = load capacitance (pF) $\sum (f_o C_L)$ = sum of outputs V_{DD} = supply voltage (V)
	10	$5\,000 f_i + \sum (f_o C_L) \times V_{DD}^2$	
	15	$25\,000 f_i + \sum (f_o C_L) \times V_{DD}^2$	

Quadruple 2-input NAND gate

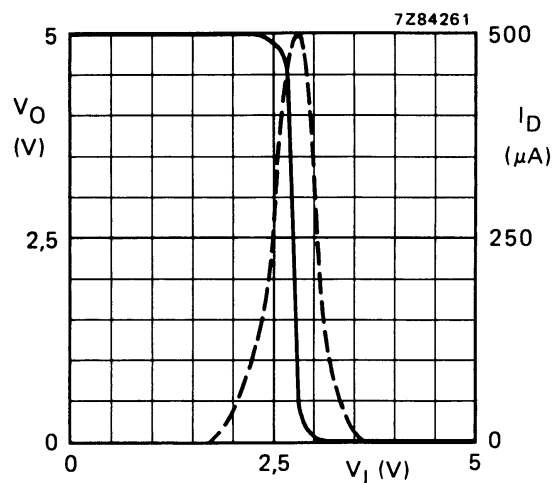
HEF4011UB
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Fig.4 Typical transfer characteristics; one input, the other input connected to V_{DD} ;

— V_O ;
 --- I_D (drain current);
 $I_O = 0$; $V_{DD} = 5$ V.

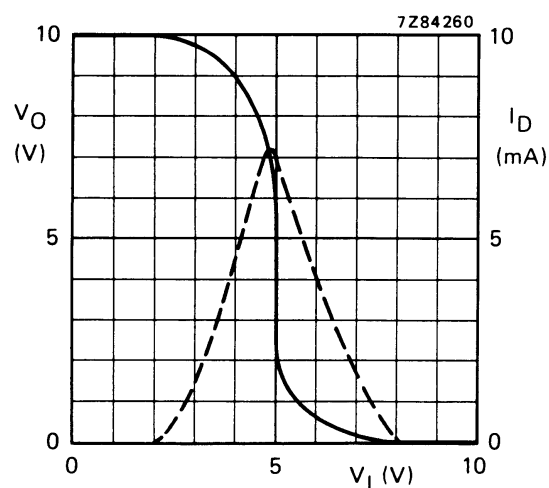


Fig.5 Typical transfer characteristics; one input, the other input connected to V_{DD} ;

— V_O ;
 --- I_D (drain current);
 $I_O = 0$; $V_{DD} = 10$ V.

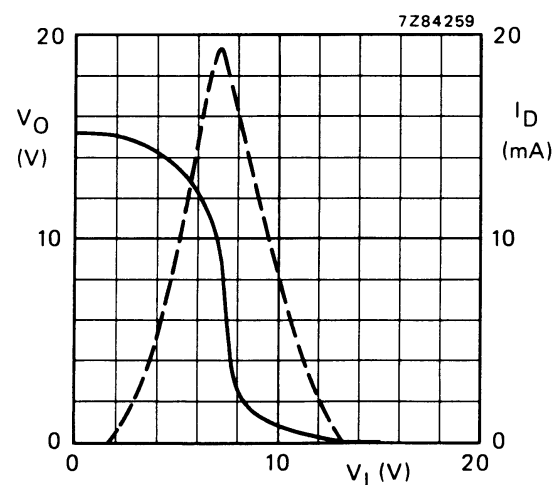


Fig.6 Typical transfer characteristics; one input, the other input connected to V_{DD} ;

— V_O ;
 --- I_D (drain current);
 $I_O = 0$; $V_{DD} = 15$ V.

Quadruple 2-input NAND gate

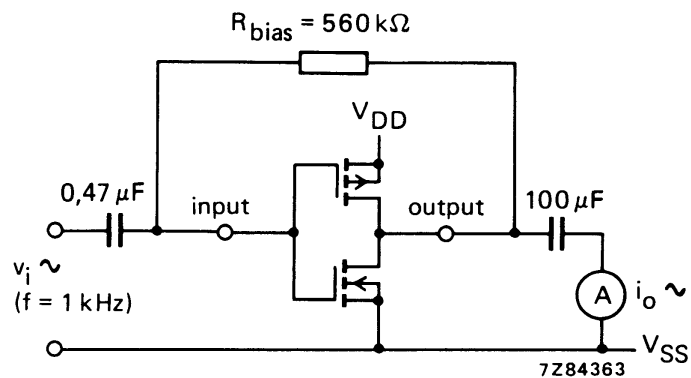
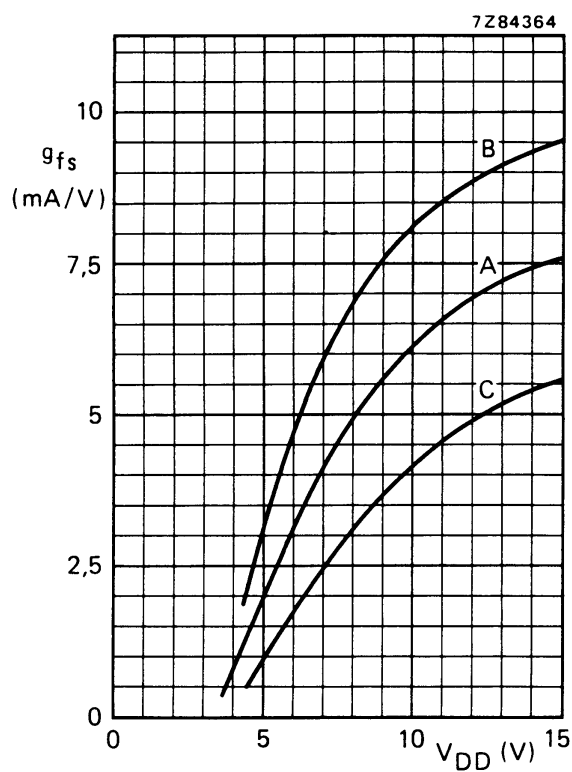
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Fig.7 Test set-up for measuring forward transconductance $g_{fs} = di_o/dv_i$ at v_o is constant (see also graph Fig.8).



A : average,
 B : average + 2 s,
 C : average - 2 s, where 's' is the observed standard deviation.

Fig.8 Typical forward transconductance g_{fs} as a function of the supply voltage at $T_{amb} = 25^\circ\text{C}$.

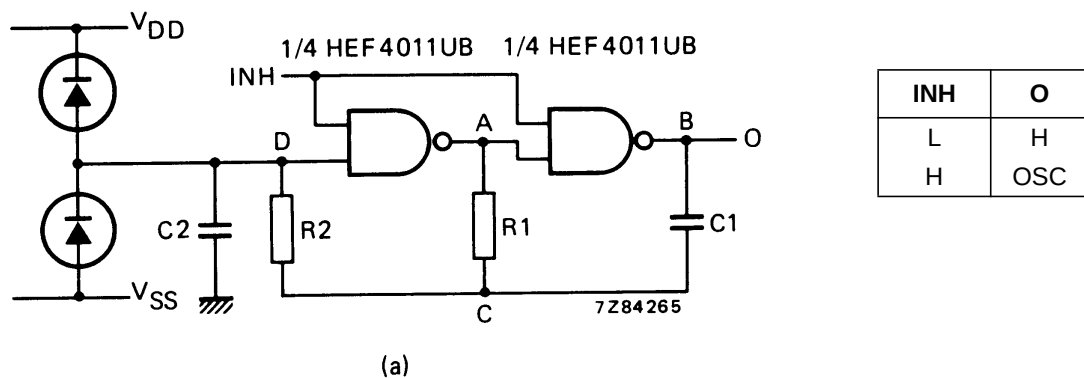
Quadruple 2-input NAND gate

HEF4011UB gates

APPLICATION INFORMATION

Some examples of applications for the HEF4011UB are shown below.

Because of the fact that this circuit is unbuffered, it is suitable for use in (partly) analogue circuits.



In Fig.9 the oscillation frequency is mainly determined by $R1C1$, provided $R1 \ll R2$ and $R2C2 \ll R1C1$. 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

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

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

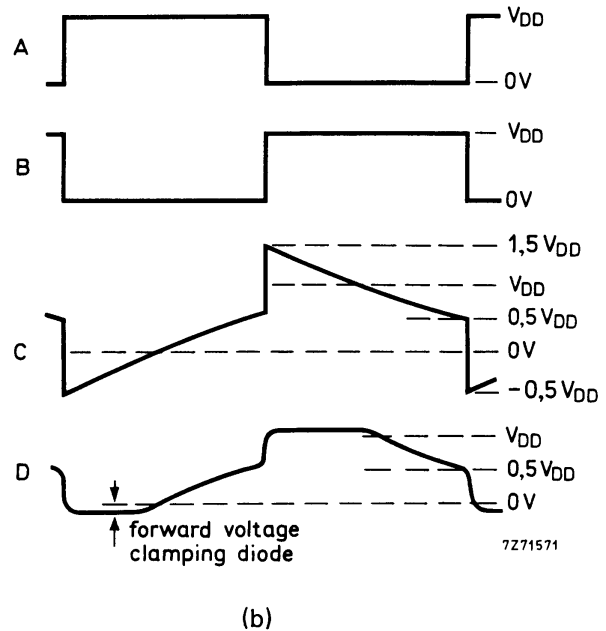


Fig.9 (a) Astable relaxation oscillator using two HEF4011UB gates; the diodes may be BAW62; $C2$ is a parasitic capacitance.
(b) Waveforms at the points marked A, B, C and D in the circuit diagram.

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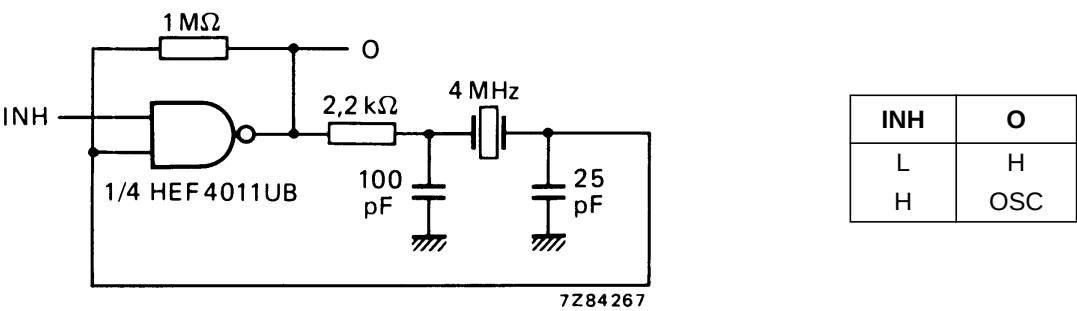


Fig.10 Example of a crystal oscillator using one HEF4011UB gate.

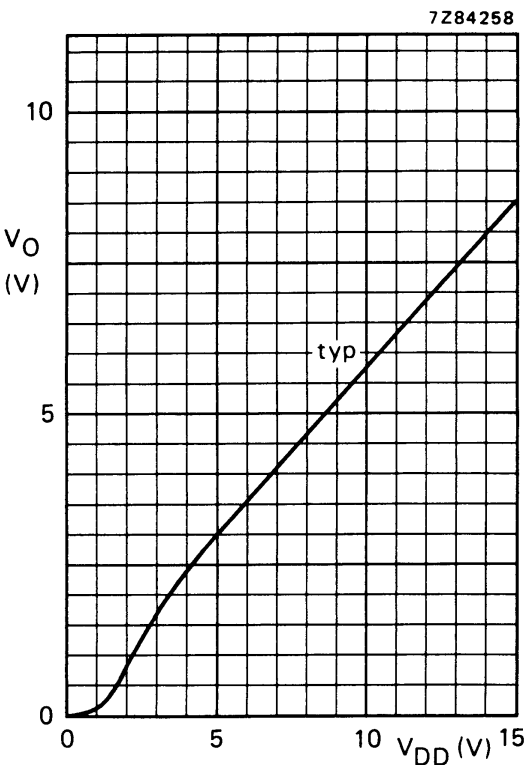


Fig.11 Output voltage as a function of supply voltage.

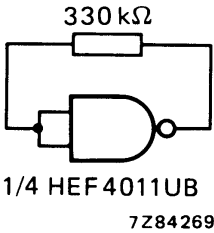


Fig.12 Test set-up for measuring graph of Fig.11.
Condition: all other inputs connected to ground.

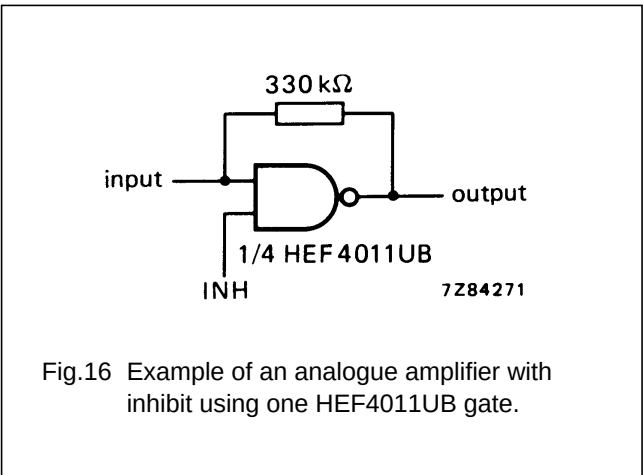
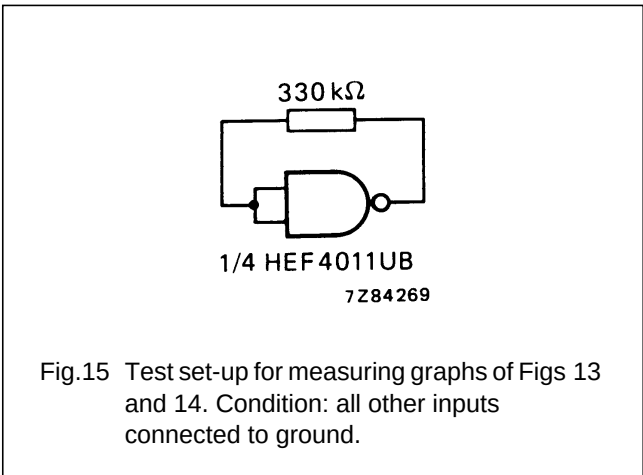
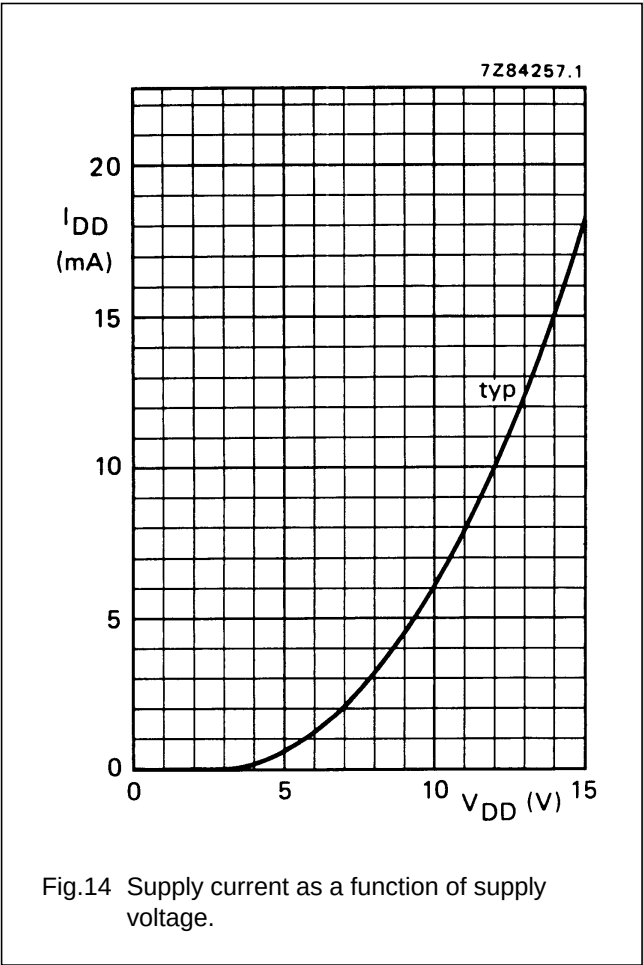
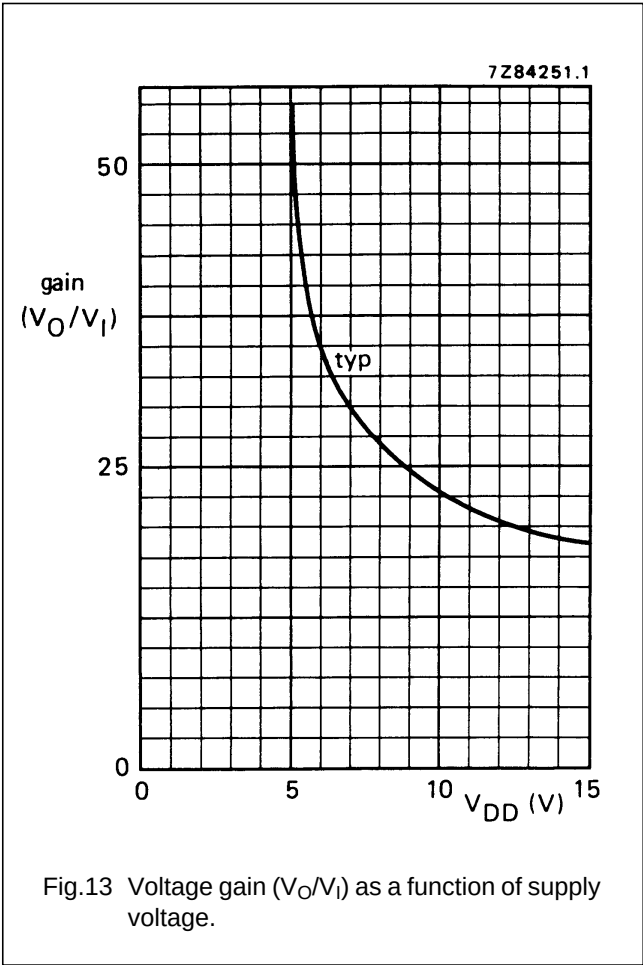
NOTES

If a gate is just used as an amplifying inverter, there are two possibilities:

- Connecting the inputs together gives simpler wiring, but makes the device output not completely symmetrical.
- Connecting one input to V_{DD} will give the device a symmetrical output.

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