

HEX INVERTER

FEATURES

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

GENERAL DESCRIPTION

The 74HCU04 is a high-speed Si-gate CMOS device and is pin compatible with low power Schottky TTL (LSSTTL). It is specified in compliance with JEDEC standard no. 7A.

The 74HCU04 is a general purpose hex inverter. Each of the six inverters is a single stage.

FUNCTION TABLE

INPUT	OUTPUT
nA	nY
L	H
H	L

H = HIGH voltage level
L = LOW voltage level

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT
t _{PHL} / t _{PLH}	propagation delay nA to nY	C _L = 15 pF V _{CC} = 5 V	5	ns
C _I	input capacitance		3.5	pF
CPD	power dissipation capacitance per inverter	note 1	10	pF

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

Note

1. CPD is used to determine the dynamic power dissipation (P_D in μW):

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

f_i = input frequency in MHz
f_o = output frequency in MHz
Σ (C_L × V_{CC}² × f_o) = sum of outputs

C_L = output load capacitance in pF
V_{CC} = supply voltage in V

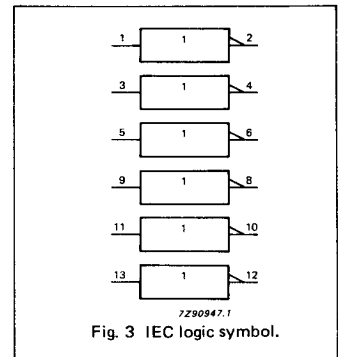
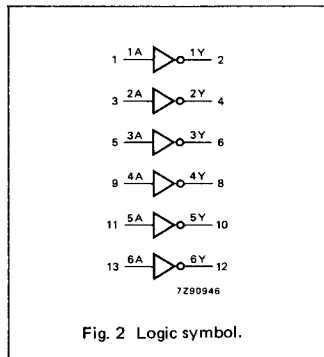
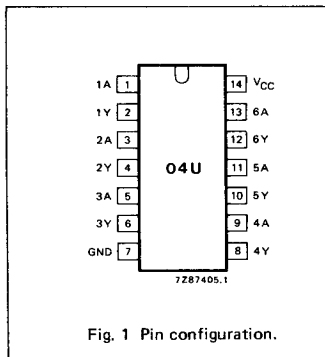
ORDERING INFORMATION/PACKAGE OUTLINES

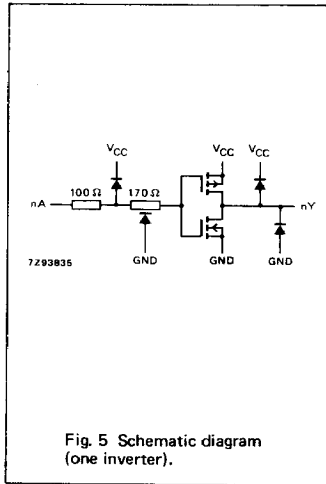
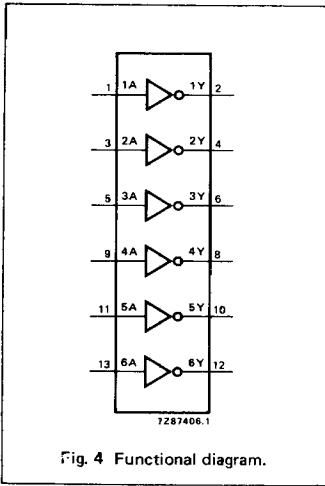
PC74HCU04P: 14-lead DIL; plastic (SOT-27).

PC74HCU04T: 14-lead mini-pack; plastic (SO-14; SOT-108A).

PIN DESCRIPTION

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





DC CHARACTERISTICS FOR 74HCU

Voltages are referenced to GND (ground = 0 V)

SYMBOL	PARAMETER	T _{amb} (°C)						UNIT	TEST CONDITIONS			
		74HCU							V _{CC} V	V _I	OTHER	
		+25			-40 to +85		-40 to +125					
		min.	typ.	max.	min.	max.	min.		max.			
V _{IH}	HIGH level input voltage	1.7 3.6 4.8	1.4 2.6 3.4		1.7 3.6 4.8		1.7 3.6 4.8	V	2.0 4.5 6.0			
V _{IL}	LOW level input voltage		0.6 1.9 2.6	0.3 0.9 1.2		0.3 0.9 1.2		0.3 0.9 1.2	V	2.0 4.5 6.0		
V _{OH}	HIGH level output voltage	1.8 4.0 5.5	2.0 4.5 6.0		1.8 4.0 5.5		1.8 4.0 5.5	V	2.0 4.5 6.0	V _{IH} or V _{IL}	-I _O = 20 μA -I _O = 20 μA -I _O = 20 μA	
V _{OH}	HIGH level output voltage	3.98 5.48	4.32 5.81		3.84 5.34		3.7 5.2	V	4.5 6.0	V _{CC} or GND	-I _O = 4.0 mA -I _O = 5.2 mA	
V _{OL}	LOW level output voltage		0 0 0	0.2 0.5 0.5		0.2 0.5 0.5		0.2 0.5 0.5	V	2.0 4.5 6.0	V _{IH} or V _{IL}	I _O = 20 μA I _O = 20 μA I _O = 20 μA
V _{OL}	LOW level output voltage		0.15 0.16	0.26 0.26		0.33 0.33		0.4 0.4	V	4.5 6.0	V _{CC} or GND	I _O = 4.0 mA I _O = 5.2 mA
±I _I	input leakage current			0.1		1.0		1.0	μA	6.0	V _{CC} or GND	
I _{CC}	quiescent supply current			2.0		20.0		40.0	μA	6.0	V _{CC} or GND	I _O = 0

AC CHARACTERISTICS FOR 74HCU

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

SYMBOL	PARAMETER	T _{amb} (°C)						UNIT	TEST CONDITIONS		
		74HCU							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 to nY		19 7 6	70 14 12		90 18 15		105 21 18	ns	2.0 4.5 6.0	Fig. 6
t _{THL} / t _{TLH}	output transition time		19 7 6	75 15 13		95 19 16		110 22 19	ns	2.0 4.5 6.0	Fig. 6

AC WAVEFORMS

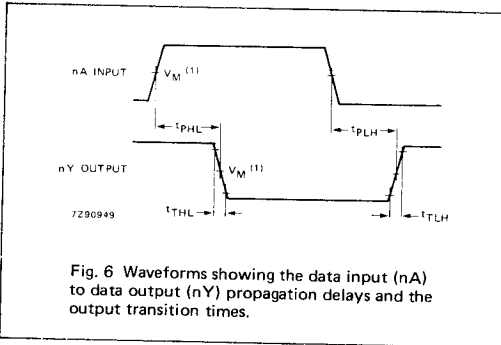


Fig. 6 Waveforms showing the data input (nA) to data output (nY) propagation delays and the output transition times.

Note to AC waveforms

(1) $V_M = 50\%$; $V_I = \text{GND to } V_{CC}$.

TYPICAL TRANSFER CHARACTERISTICS

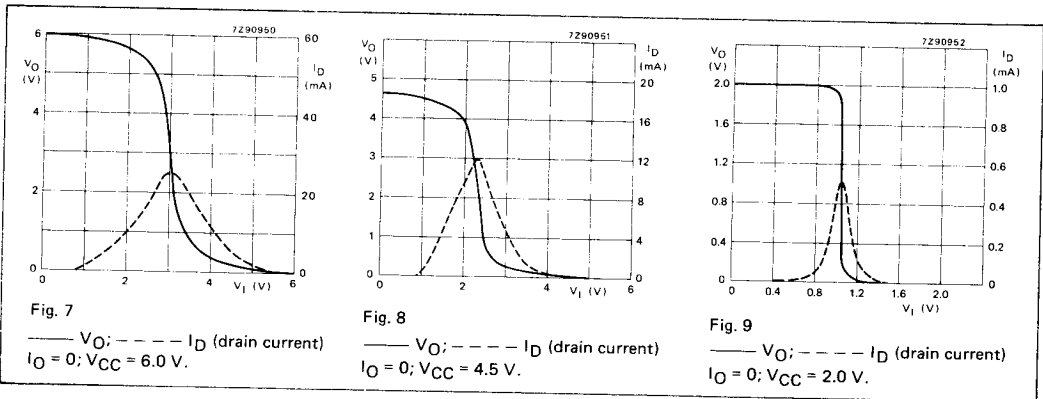
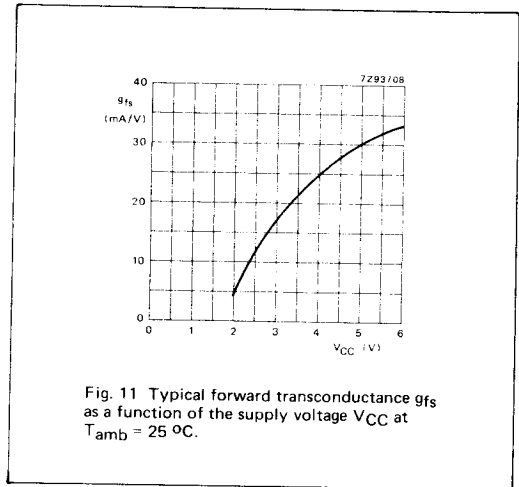
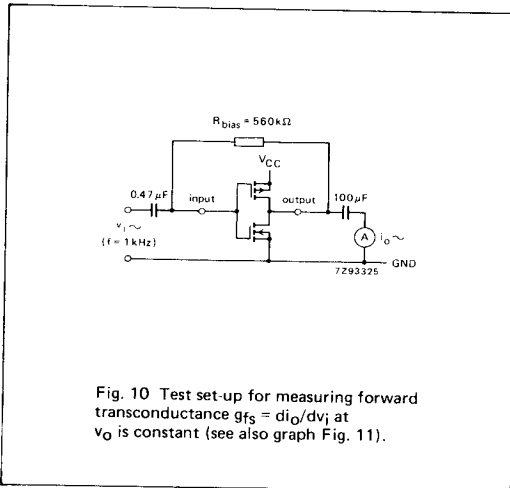


Fig. 7
— V_O ; - - - I_D (drain current)
 $I_O = 0$; $V_{CC} = 6.0$ V.

Fig. 8
— V_O ; - - - I_D (drain current)
 $I_O = 0$; $V_{CC} = 4.5$ V.

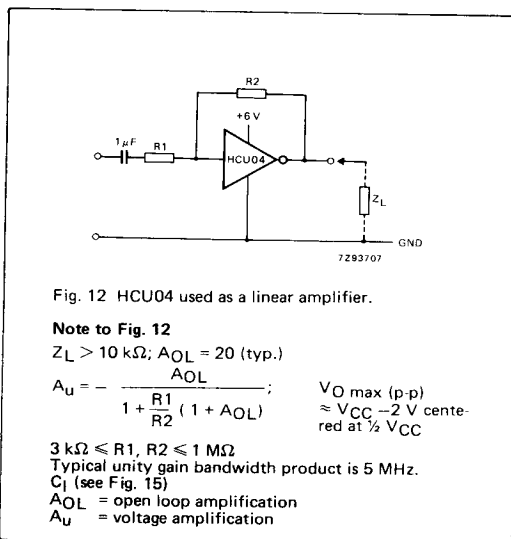
Fig. 9
— V_O ; - - - I_D (drain current)
 $I_O = 0$; $V_{CC} = 2.0$ V.



APPLICATION INFORMATION

Some applications for the "HCU04" are:

- Linear amplifier (see Fig. 12)
- In crystal oscillator designs (see Fig. 13)
- Astable multivibrator (see Fig. 14)



APPLICATION INFORMATION (Cont'd)

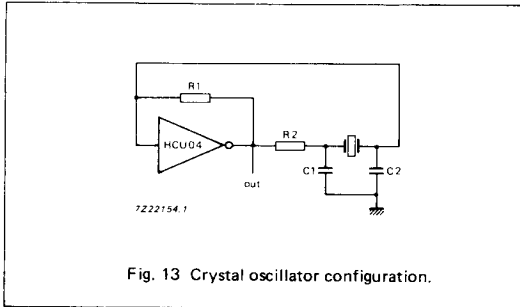


Fig. 13 Crystal oscillator configuration.

Note to Fig. 13

- C₁ = 47 pF (typ.)
- C₂ = 33 pF (typ.)
- R₁ = 1 to 10 MΩ (typ.)

R₂ optimum value depends on the frequency and required stability against changes in V_{CC} or average minimum I_{CC} (I_{CC} is typically 5 mA at V_{CC} = 5 V and f = 10 MHz).

OPTIMUM VALUE FOR R₂

FREQUENCY (MHz)	R ₂ (kΩ)	OPTIMUM FOR
3	1 8	minimum required I _{CC} minimum influence due to change in V _{CC}
6	1 4.7	minimum I _{CC} minimum influence by V _{CC}
10	1 8	minimum I _{CC} minimum influence by V _{CC}
14	1 4.7	minimum I _{CC} minimum influence by V _{CC}
> 14	replace R ₂ by C ₃ with a typical value of 35 pF	

EXTERNAL COMPONENTS FOR RESONATOR (f < 1 MHz)

FREQUENCY (kHz)	R ₁ (MΩ)	R ₂ (kΩ)	C ₁ (pF)	C ₂ (pF)
10 to 15.9	22	220	56	20
16 to 24.9	22	220	56	10
25 to 54.9	22	100	56	10
55 to 129.9	22	100	47	5
130 to 199.9	22	47	47	5
200 to 349.9	10	47	47	5
350 to 600	10	47	47	5

Where:

All values given are typical and must be used as an initial set-up.

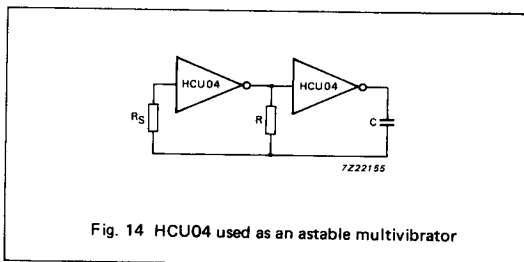


Fig. 14 HCU04 used as an astable multivibrator

Note to Fig. 14

$$f = \frac{1}{T} \approx \frac{1}{2.2 RC}$$

$$R_S \approx 2 \times R.$$

The average I_{CC} (mA) is approximately $3.5 + 0.05 \times f$ (MHz) \times C (pF) at $V_{CC} = 5.0$ V (for more information refer to DESIGNERS GUIDE).

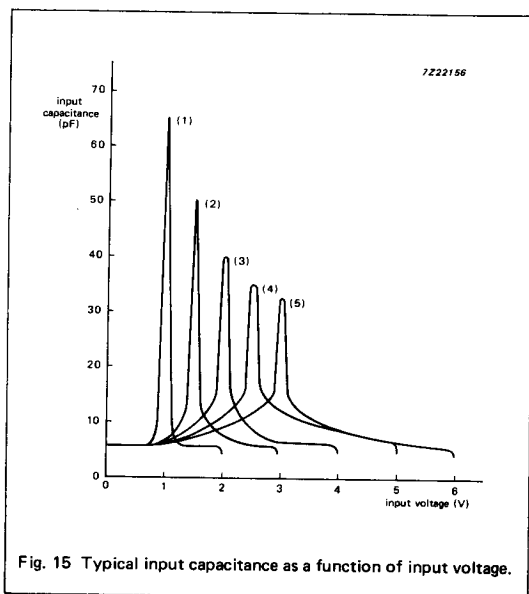


Fig. 15 Typical input capacitance as a function of input voltage.

Note to Fig. 15

1. $V_{CC} = 2.0$ V.
2. $V_{CC} = 3.0$ V.
3. $V_{CC} = 4.0$ V.
4. $V_{CC} = 5.0$ V.
5. $V_{CC} = 6.0$ V.

Note to Application information

All values given are typical unless otherwise specified.