

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

74HCU04 Hex inverter

Product specification
File under Integrated Circuits, IC06

September 1993

Hex inverter

74HCU04

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 (LSTTL). 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

QUICK REFERENCE DATA

GND = 0 V; $T_{amb} = 25^{\circ}\text{C}$; $t_r = t_f = 6\text{ ns}$

SYMBOL	PARAMETER	CONDITIONS	TYP.	UNIT
t_{PHL}/t_{PLH}	propagation delay nA to nY	$C_L = 15\text{ pF}$; $V_{CC} = 5\text{ V}$	5	ns
C_I	input capacitance		3.5	pF
C_{PD}	power dissipation capacitance per inverter	note 1	10	pF

Note

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

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

f_i = input frequency in MHz

f_o = output frequency in MHz

C_L = output load capacitance in pF

V_{CC} = supply voltage in V

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

ORDERING INFORMATION

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

FUNCTION TABLE

INPUT	OUTPUT
nA	nY
L	H
H	L

Note

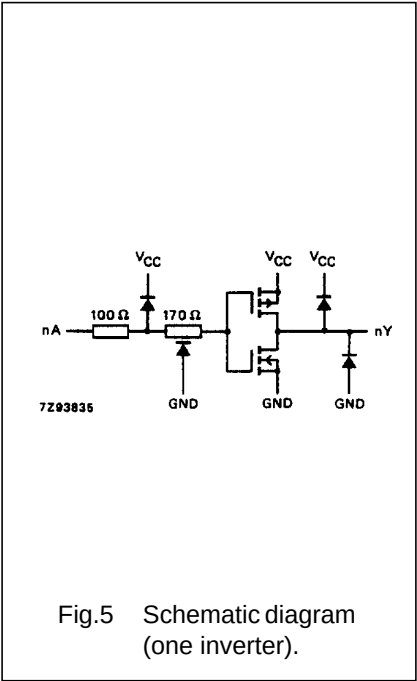
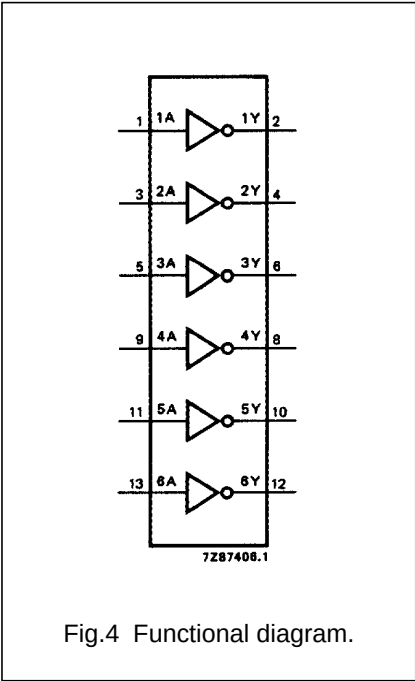
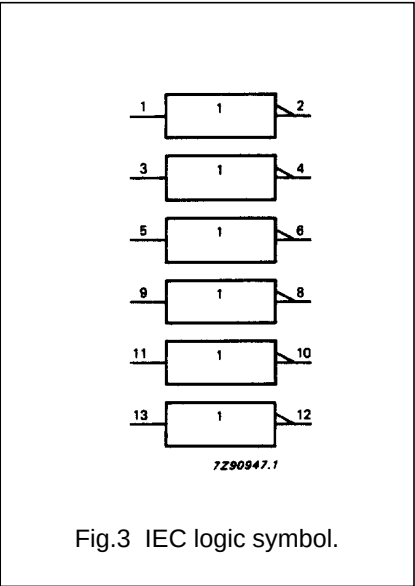
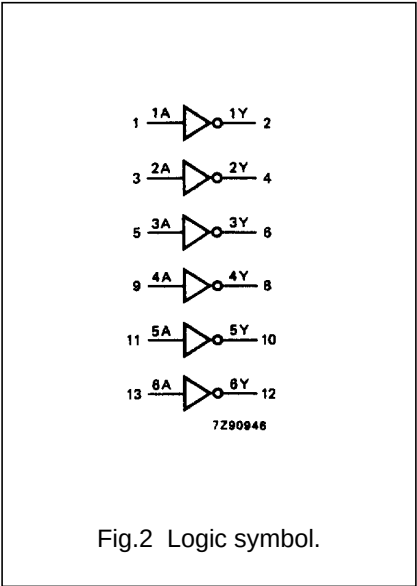
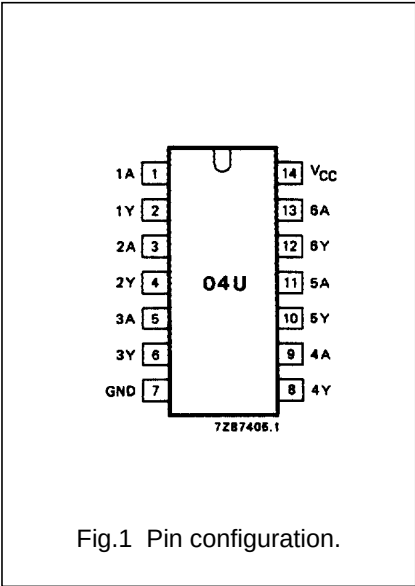
1. H = HIGH voltage level
L = LOW voltage level

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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



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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

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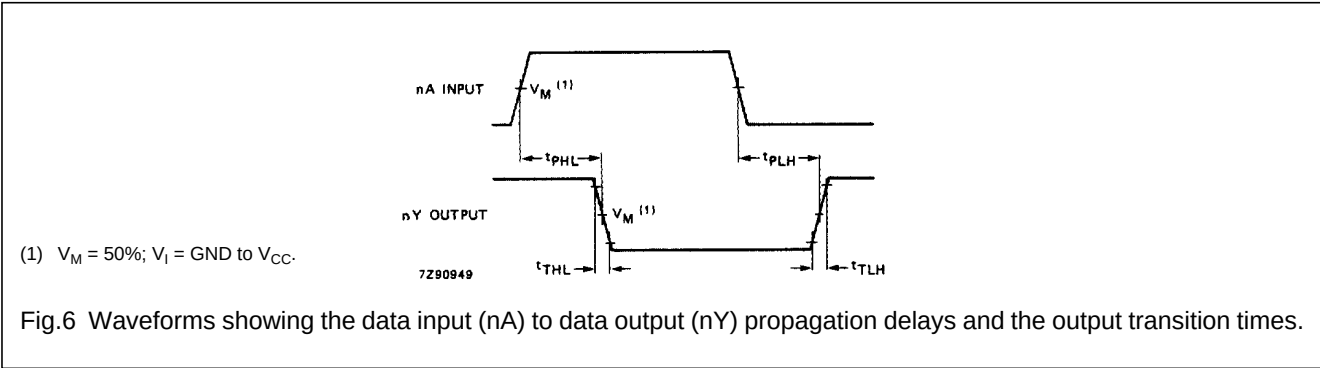
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AC CHARACTERISTICS FOR 74HCU

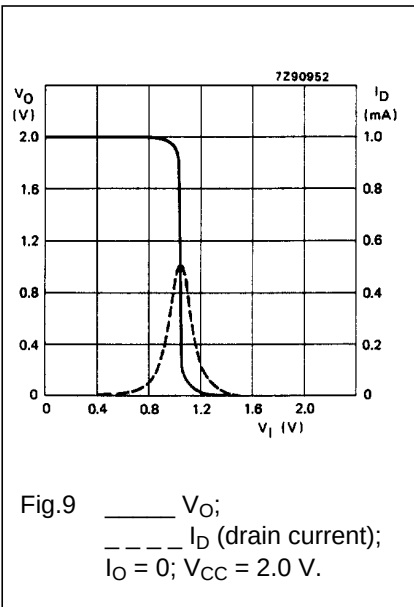
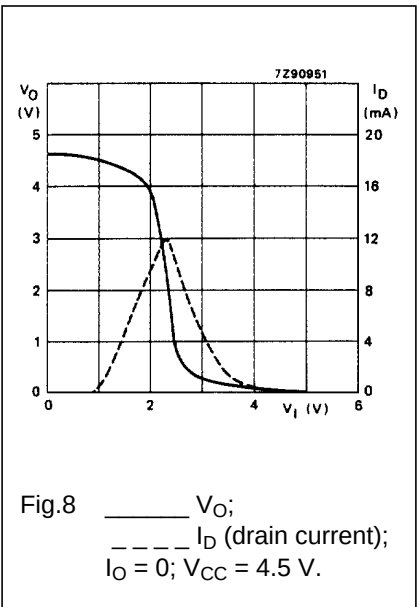
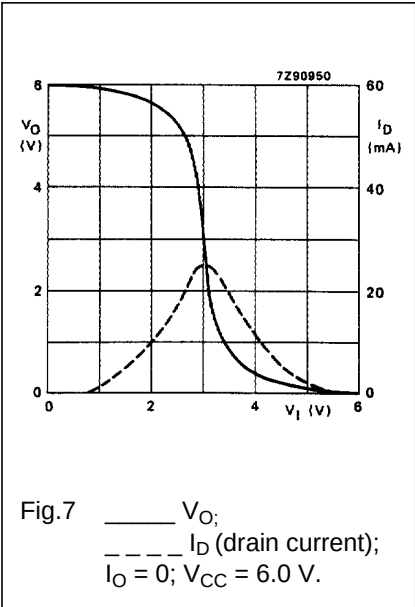
GND = 0 V; $t_r = t_f = 6\text{ ns}$; $C_L = 50\text{ pF}$

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



TYPICAL TRANSFER CHARACTERISTICS



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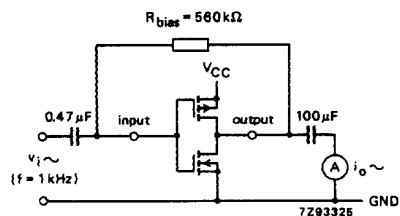


Fig.10 Test set-up for measuring forward transconductance $g_{fs} = di_o/dv_i$ at v_o is constant (see also graph Fig.11).

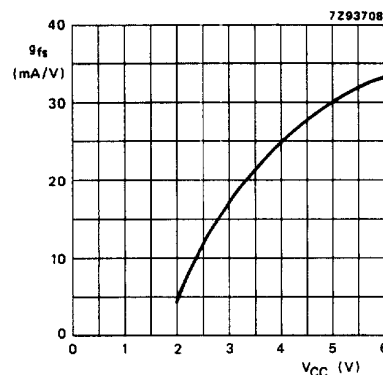
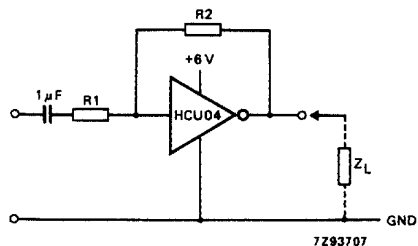


Fig.11 Typical forward transconductance g_{fs} as a function of the supply voltage V_{CC} at $T_{amb} = 25^\circ\text{C}$.

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)



$Z_L > 10 \text{ k}\Omega$; $A_{OL} = 20$ (typ.)

$$A_u = -\frac{A_{OL}}{1 + \frac{R_1}{R_2}(1 + A_{OL})};$$

$V_{O \text{ max (p-p)}} \approx V_{CC} - 2 \text{ V}$ centered at $\frac{1}{2}V_{CC}$

$3 \text{ k}\Omega \leq R_1, R_2 \leq 1 \text{ M}\Omega$

Typical unity gain bandwidth product is 5 MHz.

C_i (see Fig.15)

A_{OL} = open loop amplification

A_u = voltage amplification

Fig.12 HCU04 used as a linear amplifier.

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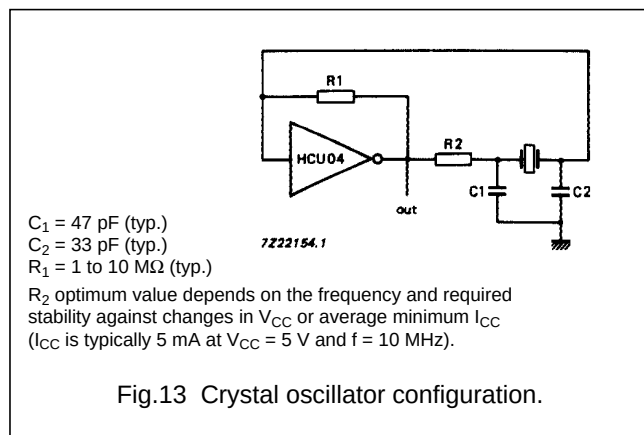


Fig.13 Crystal oscillator configuration.

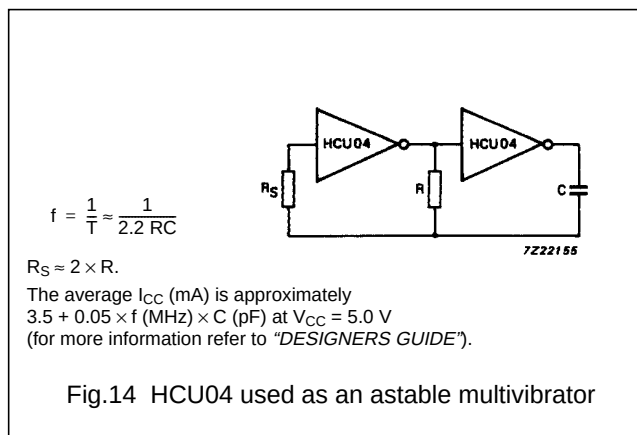


Fig.14 HCU04 used as an astable multivibrator

OPTIMUM VALUE FOR R_2

FREQUENCY (MHz)	R_2 (k Ω)	OPTIMUM FOR
3	2 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	0.5 2	minimum I_{CC} minimum influence by V_{CC}
14	0.5 1	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
($f < 1 \text{ MHz}$)

FREQUENCY (kHz)	R_1 (M Ω)	R_2 (k Ω)	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

Note

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

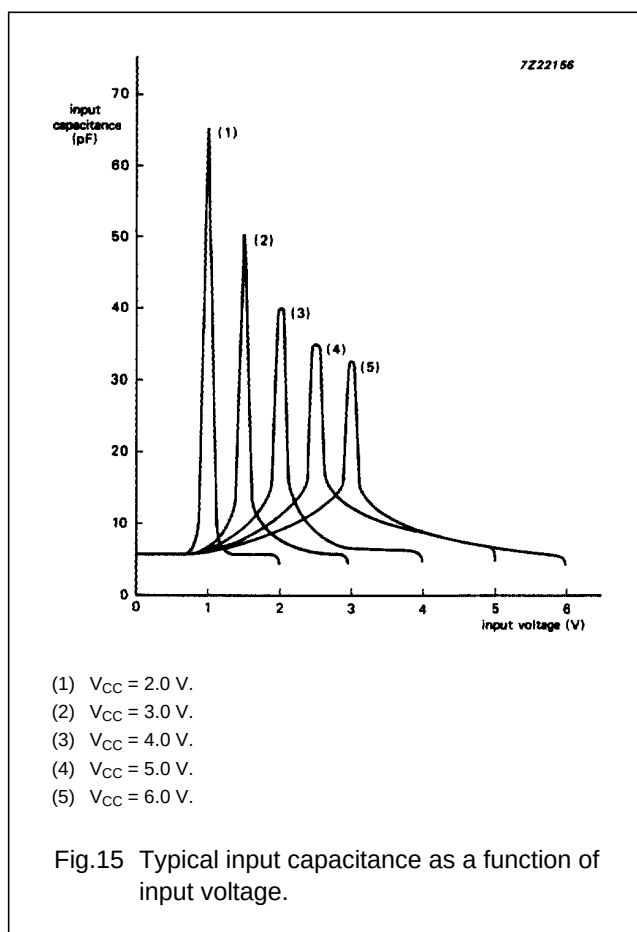


Fig.15 Typical input capacitance as a function of input voltage.

Note to Application information

All values given are typical unless otherwise specified.

PACKAGE OUTLINES

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