

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

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  $\mu\text{W}$ ):

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

$f_i$  = 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

# Hex inverter

# 74HCU04

## 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 <sub>CC</sub>	positive supply voltage

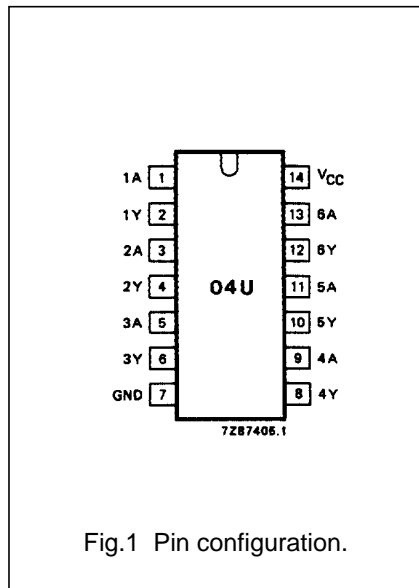


Fig.1 Pin configuration.

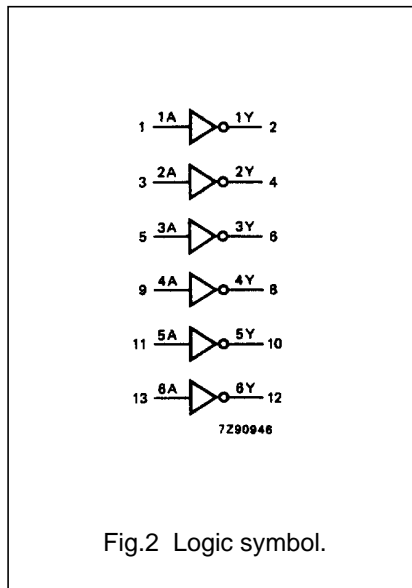


Fig.2 Logic symbol.

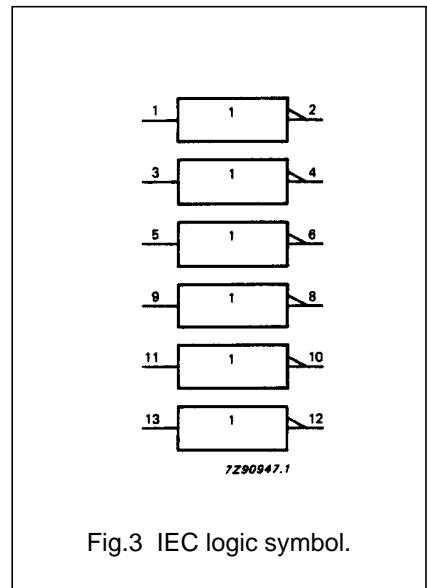


Fig.3 IEC logic symbol.

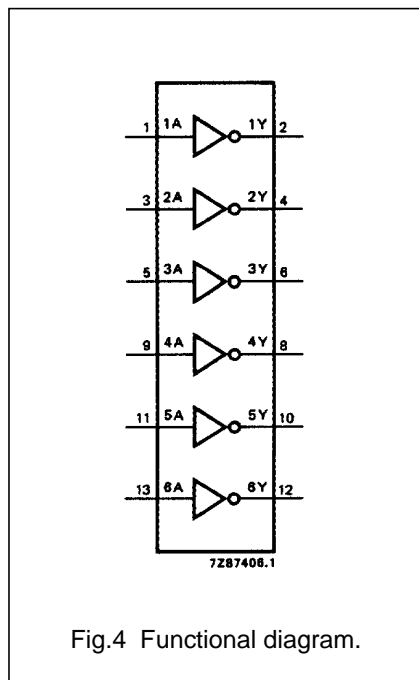


Fig.4 Functional diagram.

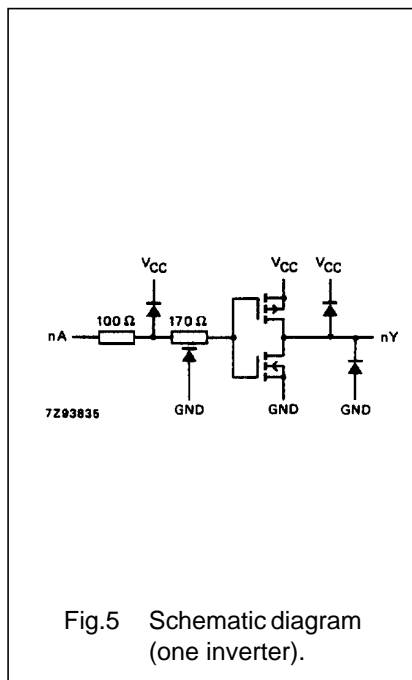


Fig.5 Schematic diagram (one inverter).

## Hex inverter

## 74HCU04

**DC CHARACTERISTICS FOR 74HCU**

Voltages are referenced to GND (ground = 0 V)

SYMBOL	PARAMETER	$T_{amb}(^{\circ}C)$							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 $V_{IL}$	$-I_O = 20 \mu A$ $-I_O = 20 \mu A$ $-I_O = 20 \mu A$
$V_{OH}$	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	$-I_O = 4.0 \text{ mA}$ $-I_O = 5.2 \text{ mA}$
$V_{OL}$	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 $V_{IL}$	$I_O = 20 \mu A$ $I_O = 20 \mu A$ $I_O = 20 \mu A$
$V_{OL}$	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	$I_O = 4.0 \text{ mA}$ $I_O = 5.2 \text{ mA}$
$\pm I_I$	input leakage current			0.1		1.0		1.0	$\mu A$	6.0	$V_{CC}$ or GND	
$I_{CC}$	quiescent supply current			2.0		20.0		40.0	$\mu A$	6.0	$V_{CC}$ or GND	$I_O = 0$

# Hex inverter

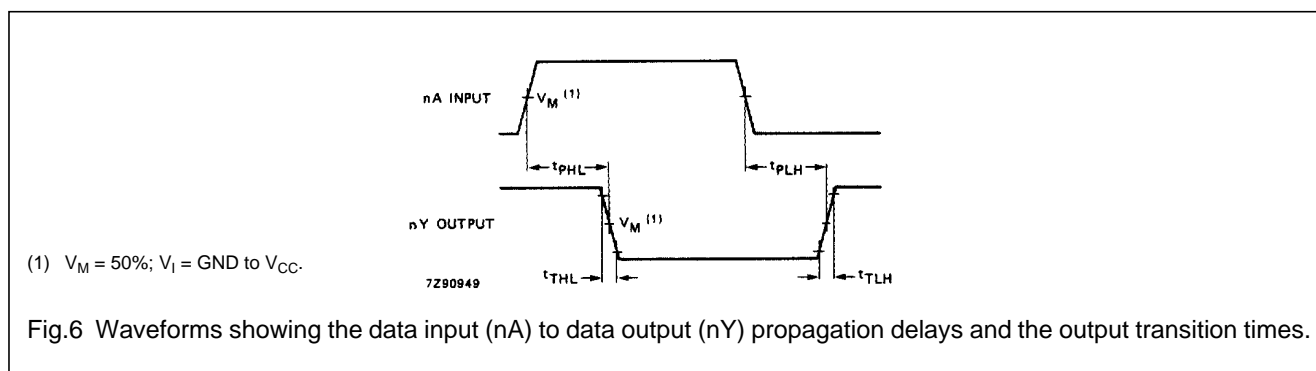
# 74HCU04

## AC CHARACTERISTICS FOR 74HCU

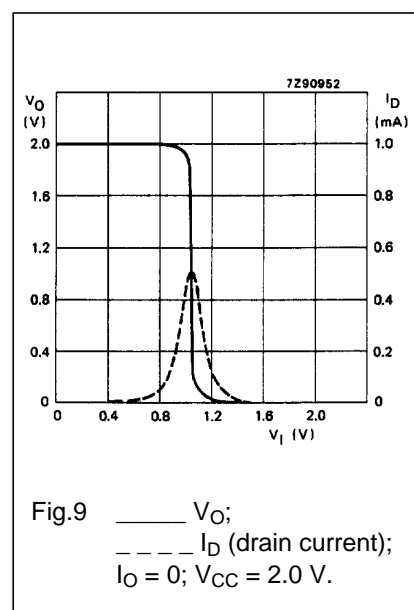
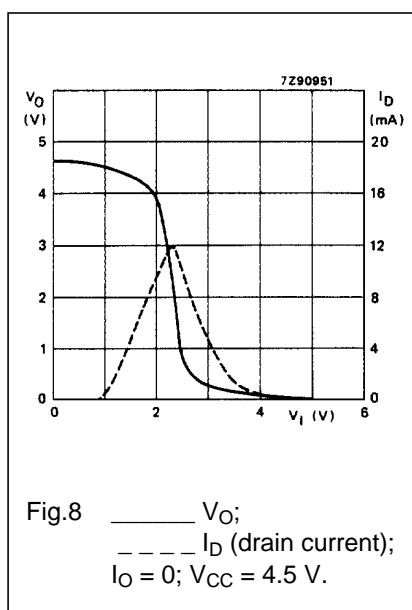
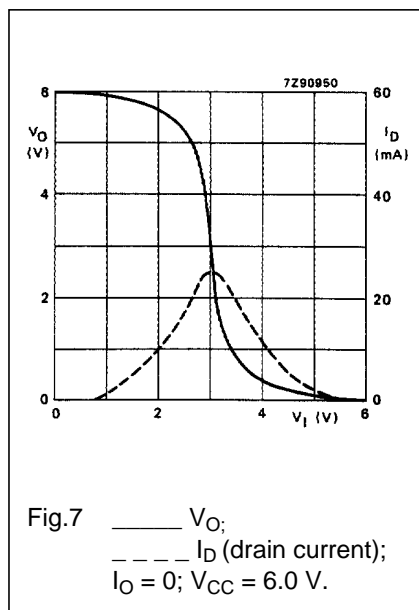
GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF

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

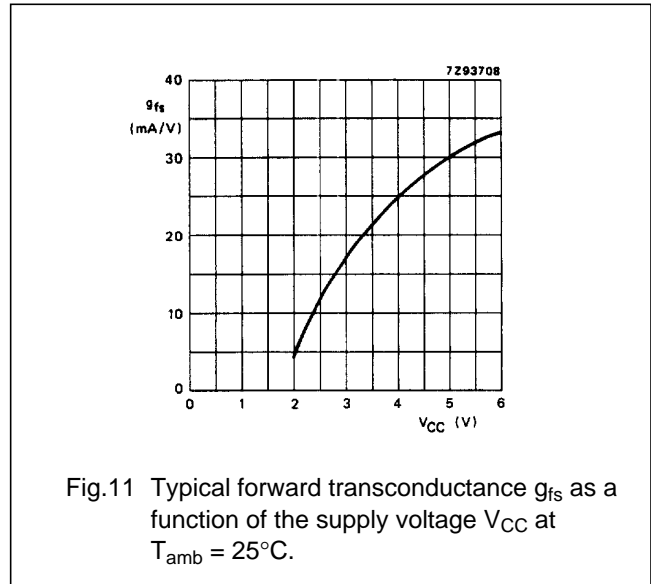
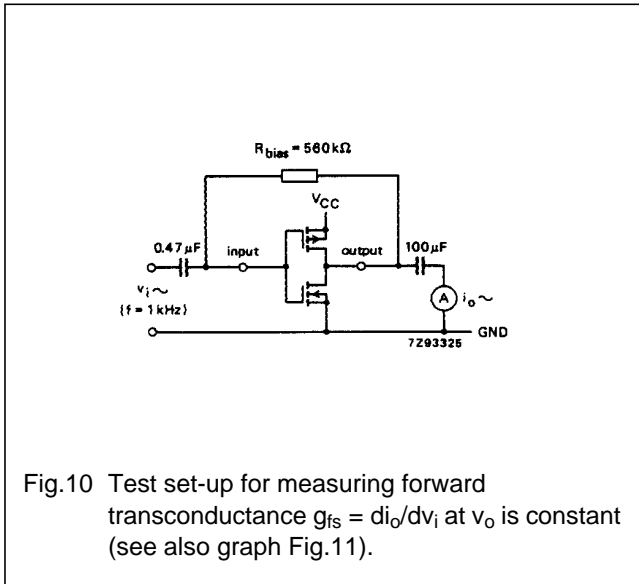


## TYPICAL TRANSFER CHARACTERISTICS



# Hex inverter

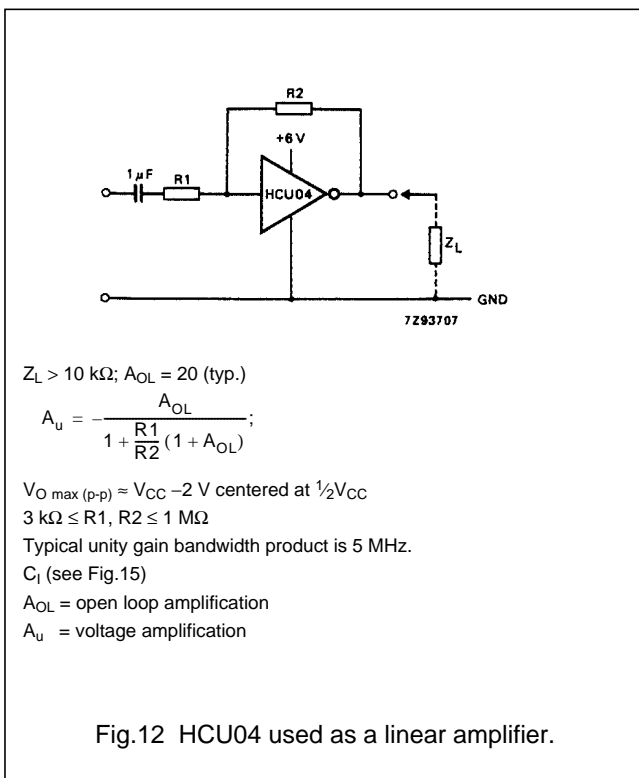
# 74HCU04



## APPLICATION INFORMATION

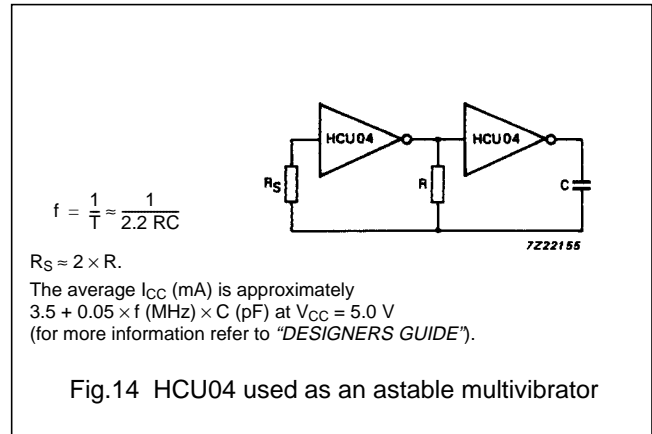
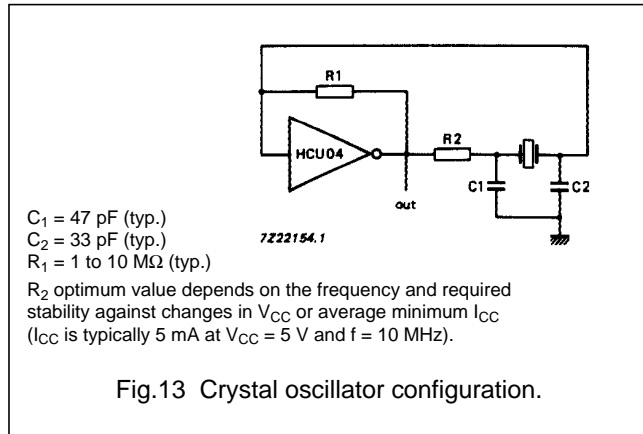
Some applications for the “HCU04” are:

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



# Hex inverter

# 74HCU04



### OPTIMUM VALUE FOR $R_2$

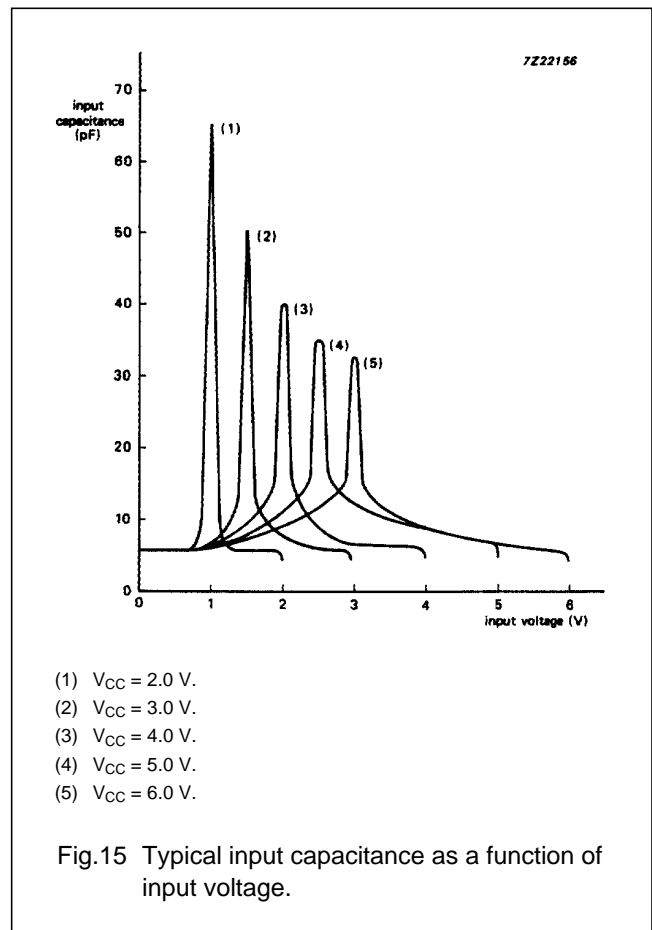
FREQUENCY (MHz)	$R_2$ (k $\Omega$ )	OPTIMUM FOR
3	2 8	minimum required $I_{CC}$ minimum influence due to change in $V_{CC}$
6	1 4.7	minimum $I_{CC}$ minimum influence by $V_{CC}$
10	0.5 2	minimum $I_{CC}$ minimum influence by $V_{CC}$
14	0.5 1	minimum $I_{CC}$ minimum influence by $V_{CC}$
> 14	replace $R_2$ by $C_3$ with a typical value of 35 pF	

### EXTERNAL COMPONENTS FOR RESONATOR ( $f < 1 \text{ MHz}$ )

FREQUENCY (kHz)	$R_1$ (M $\Omega$ )	$R_2$ (k $\Omega$ )	$C_1$ (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.



#### Note to Application information

All values given are typical unless otherwise specified.

#### PACKAGE OUTLINES

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