

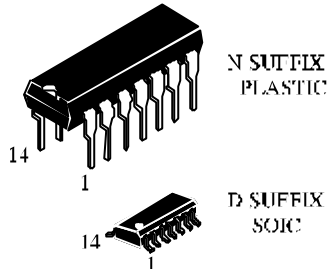
**IN74HCU04**

**Hex Unbuffered Inverter**  
**High-Performance Silicon-Gate CMOS**

The IN74HCU04A is identical in pinout to the LS/ALS04. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LS/ALSTTL outputs.

This device consists of six single-stage inverters. These inverters are well suited for use as oscillators, pulse shapers, and in many other applications requiring a high-input impedance amplifier. For digital applications, the HC04 is recommended.

- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2.0 to 6.0 V; 2.5 to 6 V in Oscillator Configurations.
- Low Input Current: 1.0  $\mu$ A
- High Noise Immunity Characteristic of CMOS Devices

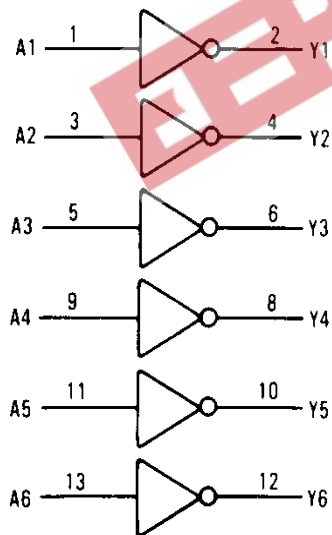


**ORDERING INFORMATION**

IN74HCU04N	Plastic
IN74HCU04D	SOIC
IZ74HCU04	Chip

$T_A = -55^\circ$  to  $125^\circ$  C for all packages

**LOGIC DIAGRAM**



$Y = \bar{A}$

PIN 14 =  $V_{CC}$   
 PIN 7 = GND

**PIN ASSIGNMENT**

A1	1	14	$V_{CC}$
Y1	2	13	A6
A2	3	12	Y6
Y2	4	11	A5
A3	5	10	Y5
Y3	6	9	A4
GND	7	8	Y4

**FUNCTION TABLE**

Inputs	Output
A	Y
L	H
H	L

**MAXIMUM RATINGS\***

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	-0.5 to +7.0	V
V <sub>IN</sub>	DC Input Voltage (Referenced to GND)	-1.5 to V <sub>CC</sub> +1.5	V
V <sub>OUT</sub>	DC Output Voltage (Referenced to GND)	-0.5 to V <sub>CC</sub> +0.5	V
I <sub>IN</sub>	DC Input Current, per Pin	±20	mA
I <sub>OUT</sub>	DC Output Current, per Pin	±25	mA
I <sub>CC</sub>	DC Supply Current, V <sub>CC</sub> and GND Pins	±50	mA
P <sub>D</sub>	Power Dissipation in Still Air, Plastic DIP ** SOIC Package **	750 500	mW
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds (Plastic DIP or SOIC Package)	260	°C

\*Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

\*\* Derating - Plastic DIP: - 10 mW/°C from 65° to 125°C  
SOIC Package: - 7 mW/°C from 65° to 125°C

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	DC Supply Voltage (Referenced to GND)	2.0	6.0	V
V <sub>IN</sub> , V <sub>OUT</sub>	DC Input Voltage, Output Voltage (Referenced to GND)	0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature, All Package Types	-55	+125	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time (Figure 1)			
	V <sub>CC</sub> =2.0 Å	-	1000	ns
	V <sub>CC</sub> =4.5 Å		500	
	V <sub>CC</sub> =6.0 Å		400	

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V<sub>IN</sub> and V<sub>OUT</sub> should be constrained to the range GND ≤ (V<sub>IN</sub> or V<sub>OUT</sub>) ≤ V<sub>CC</sub>.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V<sub>CC</sub>). Unused outputs must be left open.

**DC ELECTRICAL CHARACTERISTICS**(Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	Guaranteed Limit			Unit
				25 °C to -55°C	≤85 °C	≤125 °C	
V <sub>IH</sub>	Minimum High-Level Input Voltage	V <sub>OUT</sub> =0.1 V *  I <sub>OUT</sub>   ≤ 20 μA	2.0	1.7	1.7	1.7	V
			4.5	3.6	3.6	3.6	
			6.0	4.8	4.8	4.8	
V <sub>IL</sub>	Maximum Low - Level Input Voltage	V <sub>OUT</sub> = V <sub>CC</sub> -0.1 V *  I <sub>OUT</sub>   ≤ 20 μA	2.0	0.3	0.3	0.3	V
			4.5	0.8	0.8	0.8	
			6.0	1.1	1.1	1.1	
V <sub>OH</sub>	Minimum High-Level Output Voltage	V <sub>IN</sub> =V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 20 μA	2.0	1.8	1.8	1.8	V
			4.5	4.0	4.0	4.0	
		V <sub>IN</sub> =V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 4.0 mA  I <sub>OUT</sub>   ≤ 5.2 mA	4.5	3.98	3.84	3.7	
			6.0	5.48	5.34	5.2	
V <sub>OL</sub>	Maximum Low-Level Output Voltage	V <sub>IN</sub> =V <sub>IH</sub>  I <sub>OUT</sub>   ≤ 20 μA	2.0	0.2	0.2	0.2	V
			4.5	0.5	0.5	0.5	
		V <sub>IN</sub> =V <sub>IH</sub>  I <sub>OUT</sub>   ≤ 4.0 mA  I <sub>OUT</sub>   ≤ 5.2 mA	4.5	0.26	0.33	0.4	
			6.0	0.26	0.33	0.4	
I <sub>IN</sub>	Maximum Input Leakage Current	V <sub>IN</sub> =V <sub>CC</sub> or GND	6.0	±0.1	±1.0	±1.0	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current (per Package)	V <sub>IN</sub> =V <sub>CC</sub> or GND I <sub>OUT</sub> =0μA	6.0	2.0	20	40	μA

\* For V<sub>CC</sub> = 2.0 V, V<sub>OUT</sub> = 0.2 V or V<sub>CC</sub> - 0.2 V.

**AC ELECTRICAL CHARACTERISTICS** ( $C_L=50\text{pF}$ , Input  $t_r=t_f=6.0\text{ ns}$ )

Symbol	Parameter	$V_{CC}$ V	Guaranteed Limit			Unit
			25 °C to -55°C	≤85°C	≤125°C	
$t_{PLH}, t_{PHL}$	Maximum Propagation Delay, Input A to Output Y (Figures 1 and 2)	2.0	75	95	110	ns
		4.5	15	19	22	
		6.0	13	16	19	
$t_{TLH}, t_{THL}$	Maximum Output Transition Time, Any Output (Figures 1 and 2)	2.0	70	85	100	ns
		4.5	15	18	22	
		6.0	13	16	19	
$C_{IN}$	Maximum Input Capacitance	-	10	10	10	pF
$C_{PD}$	Power Dissipation Capacitance (Per Inverter)	$T_A=25^\circ\text{C}, V_{CC}=5.0\text{ V}$				pF
	Used to determine the no-load dynamic power consumption: $P_D=C_{PD}V_{CC}^2f+I_{CC}V_{CC}$ For load considerations, see Chapter 4.	15				

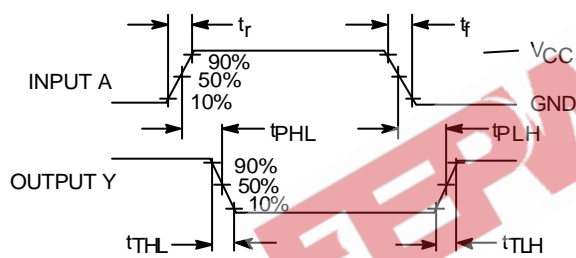
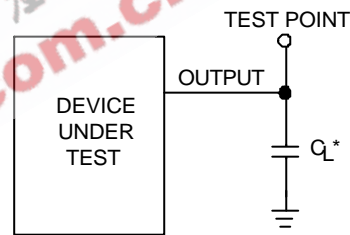


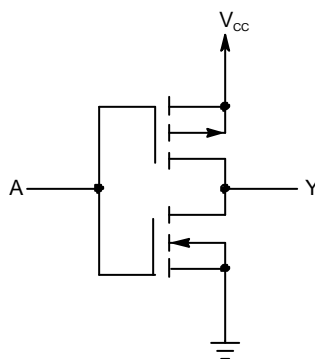
Figure 1. Switching Waveforms.



\* Includes all probe and jig capacitance

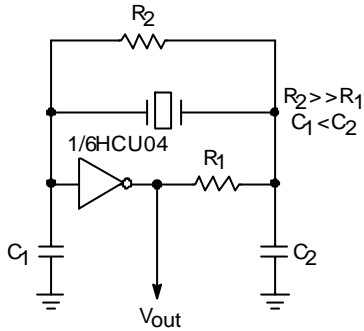
Figure 2. Test Circuit

**LOGIC DETAIL**  
(1/6 of Device Show)

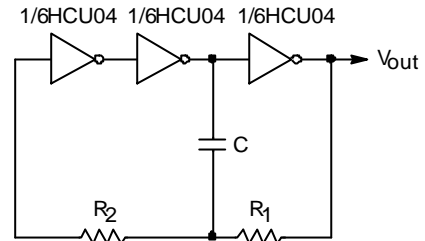


TYPICAL APPLICATIONS

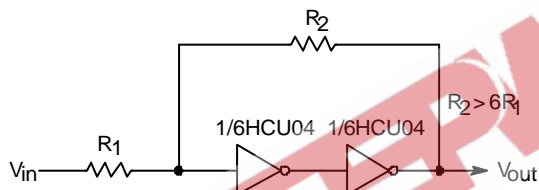
Crystal Oscillator



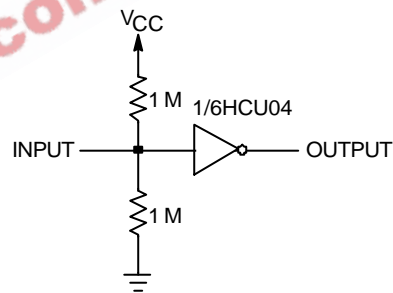
Stable RC Oscillator



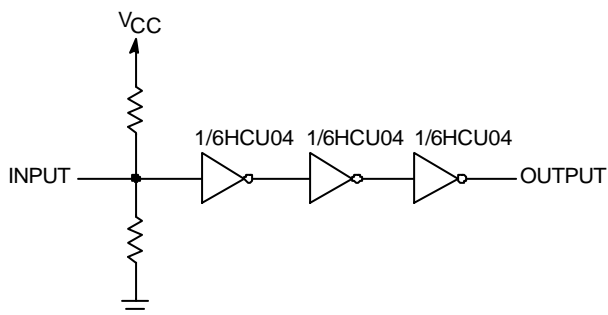
Schmitt Trigger



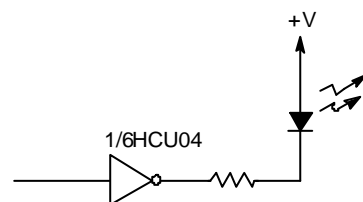
High Input Single-Stage Amplifier with a 2 to 6 V Supply Range



Multi-Stage Amplifier

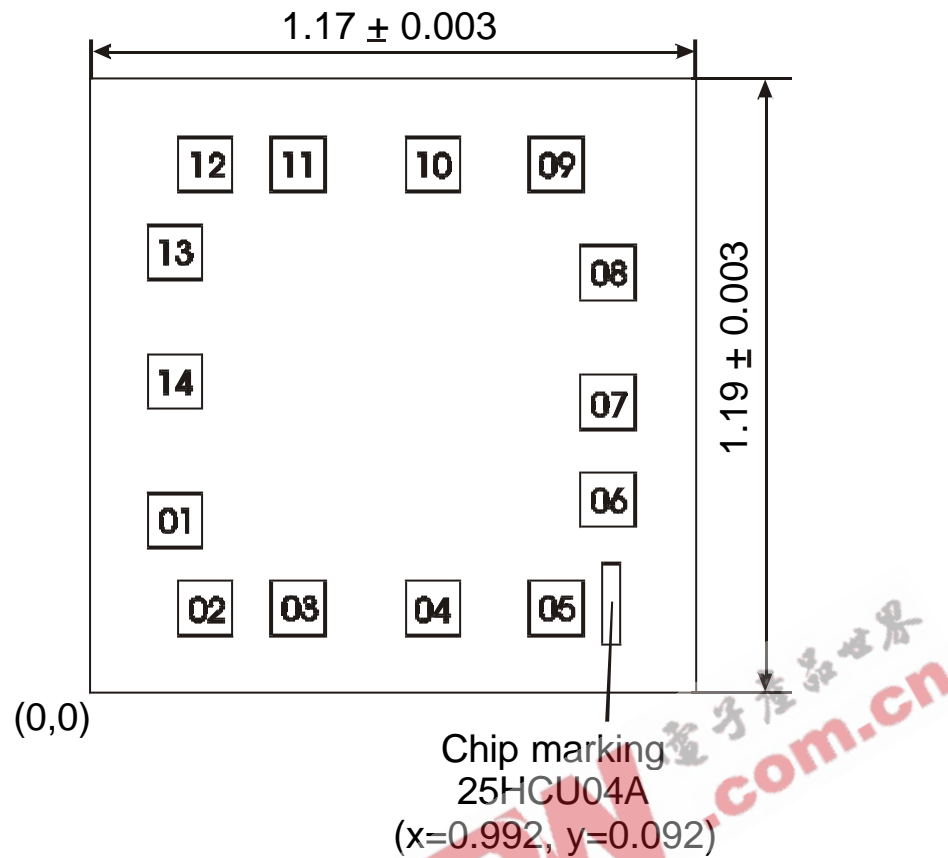


LED Driver



For reduced power supply current, use high-efficiency LEDs such as the Hewlett-Packard HLMP series or equivalent

## CHIP PAD DIAGRAM IZ74HCU04



Thickness of chip  $0.46 \pm 0.02$  mm

## PAD LOCATION

Pad No	Symbol	X	Y	Pad size*, mm
01	A1	0.110	0.280	0.105x0.105
02	Y1	0.170	0.110	0.105x0.105
03	A2	0.350	0.110	0.105x0.105
04	Y2	0.610	0.110	0.105x0.105
05	A3	0.850	0.110	0.105x0.105
06	Y3	0.950	0.320	0.105x0.105
07	GND	0.950	0.510	0.105x0.105
08	Y4	0.950	0.760	0.105x0.105
09	A4	0.850	0.970	0.105x0.105
10	Y5	0.610	0.970	0.105x0.105
11	A5	0.350	0.970	0.105x0.105
12	Y6	0.170	0.970	0.105x0.105
13	A6	0.110	0.800	0.105x0.105
14	V <sub>CC</sub>	0.110	0.550	0.105x0.105

\* Pad size is given as per metallization layer