

Hex Inverter (Unbuffered)

The MC74VHCU04 is an advanced high speed CMOS unbuffered inverter fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The inputs tolerate voltages up to 7V, allowing the interface of 5V systems to 3V systems.

- High Speed: $t_{PD} = 3.5 \text{ns}$ (Typ) at $V_{CC} = 5 \text{V}$
- Low Power Dissipation: $I_{CC} = 2\mu A$ (Max) at $T_A = 25$ °C
- High Noise Immunity: $V_{NIH} = V_{NIL} = 10\% V_{CC}$ (Min.)
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2V to 5.5V Operating Range
- Low Noise: $V_{OLP} = 0.8V$ (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300mA
- ESD Performance: HBM > 2000V; Machine Model > 200V
- Chip Complexity: 12 FETs or 3 Equivalent Gates

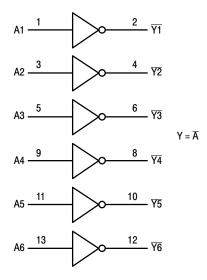


Figure 1. Logic Diagram

MC74VHCU04



D SUFFIX 14–LEAD SOIC PACKAGE CASE 751A–03



DT SUFFIX 14-LEAD TSSOP PACKAGE CASE 948G-01



M SUFFIX 14-LEAD SOIC EIAJ PACKAGE CASE 965-01

ORDERING INFORMATION

MC74VHCUXXD SOIC
MC74VHCUXXDT TSSOP
MC74VHCUXXM SOIC EIAJ

FUNCTION TABLE					
Inputs Outputs					
Α	Y				
L	Н				
Н	L				

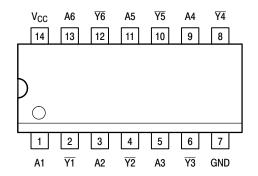


Figure 2. Pinout: 14-Lead Packages (Top View)

MAXIMUM RATINGS*

Symbol	Parameter		Value	Unit
V _{CC}	DC Supply Voltage		-0.5 to + 7.0	V
V _{in}	DC Input Voltage		-0.5 to + 7.0	V
V _{out}	DC Output Voltage	-0.5 to V _{CC} + 0.5	V	
I _{IK}	Input Diode Current	-20	mA	
lok	Output Diode Current	± 20	mA	
l _{out}	DC Output Current, per Pin		± 25	mA
Icc	DC Supply Current, V _{CC} and GN	D Pins	± 50	mA
P _D	Power Dissipation in Still Air,	SOIC Packages† TSSOP Package†	500 450	mW
T _{stg}	Storage Temperature		- 65 to + 150	°C

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_{in} and V_{out} should be constrained to the range GND \leq $(V_{in}$ or $V_{out}) \leq$ V_{CC} .

†Derating — SOIC Packages: – 7 mW/°C from 65° to 125°C TSSOP Package: – 6.1 mW/°C from 65° to 125°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V _{CC}	DC Supply Voltage	2.0	5.5	V
V _{in}	DC Input Voltage	0	5.5	V
V _{out}	DC Output Voltage	0	V _{CC}	V
T _A	Operating Temperature	-40	+ 85	°C

DC ELECTRICAL CHARACTERISTICS

			v _{cc}		T _A = 25°C	:	T _A = -40	to 85°C	
Symbol				Min	Тур	Max	Min	Max	Unit
V _{IH}	Minimum High-Level Input Voltage		2.0 3.0 to 5.5	1.70 V _{CC} x 0.8			1.70 V _{CC} x 0.8		V
V _{IL}	Maximum Low–Level Input Voltage		2.0 3.0 to 5.5			0.30 V _{CC} x 0.2		0.30 V _{CC} x 0.2	V
V _{OH}	Minimum High-Level Output Voltage	$V_{in} = V_{IL}$ $I_{OH} = -50\mu A$	2.0 3.0 4.5	1.8 2.7 4.0	2.0 3.0 4.5		1.8 2.7 4.0		V
		$V_{in} = GND$ $I_{OH} = -4mA$ $I_{OH} = -8mA$	3.0 4.5	2.58 3.94			2.48 3.80		
V _{OL}	Maximum Low–Level Output Voltage	$V_{in} = V_{IH}$ $I_{OL} = 50\mu A$	2.0 3.0 4.5		0.0 0.0 0.0	0.2 0.3 0.5		0.2 0.3 0.5	V
		$V_{in} = V_{CC}$ $I_{OL} = 4mA$ $I_{OL} = 8mA$	3.0 4.5			0.36 0.36		0.44 0.44	

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

^{*} Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute—maximum—rated conditions is not implied.

DC ELECTRICAL CHARACTERISTICS

			V _{CC}		$T_A = -40 \text{ to } 85^{\circ}\text{C}$) to 85°C		
Symbol	Parameter	Test Conditions	V	Min	Тур	Max	Min	Max	Unit
l _{in}	Maximum Input Leakage Current	V _{in} = 5.5 or GND	0 to 5.5			± 0.1		± 1.0	μА
lcc	Maximum Quiescent Supply Current	V _{in} = V _{CC} or GND	5.5			2.0		20.0	μА

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0 \text{ns}$)

				T _A = 25°C		T _A = -40 to 85°C			
Symbol	Parameter	Test Condi	tions	Min	Тур	Max	Min	Max	Unit
t _{PLH} , t _{PHL}	Maximum Propagation Delay, A or B to ₹	$V_{CC} = 3.3 \pm 0.3 V$	$C_L = 15pF$ $C_L = 50pF$		5.0 7.5	8.9 11.4	1.0 1.0	10.5 13.0	ns
		$V_{CC} = 5.0 \pm 0.5 V$	$C_L = 15pF$ $C_L = 50pF$		3.5 5.0	5.5 7.0	1.0 1.0	6.5 8.0	
C _{in}	Maximum Input Capacitance				5	10		10	pF

		Typical @ 25°C, V _{CC} = 5.0V	
C _{PD}	Power Dissipation Capacitance (Per Inverter) (Note 1.)	9	pF

C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I_{CC(OPR)} = C_{PD} • V_{CC} • f_{in} + I_{CC}/6 (per buffer). C_{PD} is used to determine the no–load dynamic power consumption; P_D = C_{PD} • V_{CC}² • f_{in} + I_{CC} • V_{CC}.

NOISE CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns, $C_L = 50$ pF, $V_{CC} = 5.0$ V)

		T _A = 25°C		
Symbol	Characteristic		Max	Unit
V _{OLP}	Quiet Output Maximum Dynamic V _{OL}	0.5	0.8	V
V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	-0.5	-0.8	V
V _{IHD}	Minimum High Level Dynamic Input Voltage		4.0	V
V _{ILD}	Maximum Low Level Dynamic Input Voltage		1.0	V

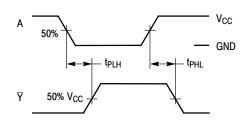
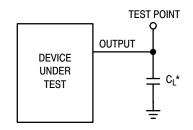


Figure 3. Switching Waveforms



*Includes all probe and jig capacitance

Figure 4. Test Circuit

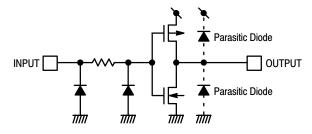
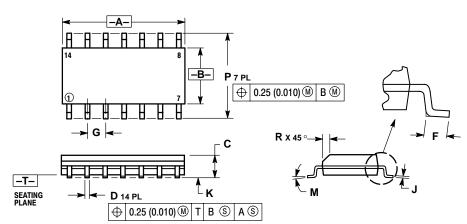


Figure 5. Input Equivalent Circuit

OUTLINE DIMENSIONS

D SUFFIX SOIC-14 CASE 751A-03 **ISSUE F**

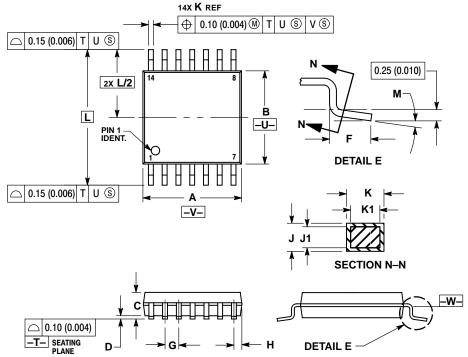


- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
 4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
 5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIN	IETERS	INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	8.55	8.75	0.337	0.344	
В	3.80	4.00	0.150	0.157	
C	1.35	1.75	0.054	0.068	
D	0.35	0.49	0.014	0.019	
F	0.40	1.25	0.016	0.049	
G	1.27	BSC	0.050 BSC		
7	0.19	0.25	0.008	0.009	
K	0.10	0.25	0.004	0.009	
M	0 °	7°	0 °	7°	
P	5.80	6.20	0.228	0.244	
R	0.25	0.50	0.010	0.019	

OUTLINE DIMENSIONS

DT SUFFIX TSSOP CASE 948G-01 **ISSUE 0**

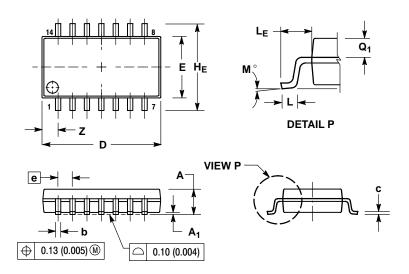


- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI
- DIMENSIONING AND TOLERANDING PER ANSI Y14.5M, 1982.
 CONTROLLING DIMENSION: MILLIMETER.
 DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15
- OR GATE BURRS SHALL NOT EXCEED 0.15
 (0.006) PER SIDE.
 4. DIMENSION B DOES NOT INCLUDE INTERLEAD
 FLASH OR PROTRUSION. INTERLEAD FLASH OR
 PROTRUSION SHALL NOT EXCEED
 0.25 (0.010) PER SIDE.
 5. DIMENSION K DOES NOT INCLUDE DAMBAR
 PROTRUSION. ALLOWABLE DAMBAR
 PROTRUSION SHALL BE 0.08 (0.03) TOTAL IN
 EXCESS OF THE K DIMENSION AT MAXIMUM
 MATERIAL CONDITION.
 6. TERMINAL NUMBERS ARE SHOWN FOR
 REFERENCE ONLY.
 7. DIMENSION A AND B ARE TO BE DETERMINED
 AT DATUM PLANE-W-

	MILLIN	IETERS	INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	4.90	5.10	0.193	0.200	
В	4.30	4.50	0.169	0.177	
С		1.20		0.047	
D	0.05	0.15	0.002	0.006	
F	0.50	0.75	0.020	0.030	
G	0.65	BSC	0.026 BSC		
Н	0.50	0.60	0.020	0.024	
J	0.09	0.20	0.004	0.008	
J1	0.09	0.16	0.004	0.006	
K	0.19	0.30	0.007	0.012	
K1	0.19	0.25	0.007	0.010	
L	6.40 BSC		0.252 BSC		
M	0°	8°	0°	8°	

OUTLINE DIMENSIONS

M SUFFIX SO-14 **CASE 965-01 ISSUE 0**



- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTR
- PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006)
 PER SIDE.

 1 TERMINAL NUMBERS ARE SHOWN FOR
 REFERENCE ONLY.

 5. THE LEAD WIDTH DIMENSION (b) DOES NOT
 INCLUDE DAMBAR PROTRUSION. ALLOWABLE
 DAMBAR PROTRUSION SHALL BE 0.08 (0.003)
 TOTAL IN EXCESS OF THE LEAD WIDTH
 DIMENSION AT MAXIMUM MATERIAL CONDITION.
 DAMBAR CANNOT BE LOCATED ON THE LOWER
 RADIUS OR THE FOOT. MINIMUM SPACE
 BETWEEN PROTRUSIONS AND ADJACENT LEAD
 TO BE 0.46 (0.018). TO BE 0.46 (0.018).

	MILLIN	IETERS	RS INCHES		
DIM	MIN	MAX	MIN	MAX	
Α		2.05		0.081	
A ₁	0.05	0.20	0.002	0.008	
b	0.35	0.50	0.014	0.020	
С	0.18	0.27	0.007	0.011	
D	9.90	10.50	0.390	0.413	
E	5.10	5.45	0.201	0.215	
е	1.27	BSC	0.050 BSC		
HE	7.40	8.20	0.291	0.323	
0.50	0.50	0.85	0.020	0.033	
LE	1.10	1.50	0.043	0.059	
M	0 °	10°	0 °	10°	
Q ₁	0.70	0.90	0.028	0.035	
7		1 42		0.056	

Notes

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