MC74HCU04A

Hex Unbuffered Inverter

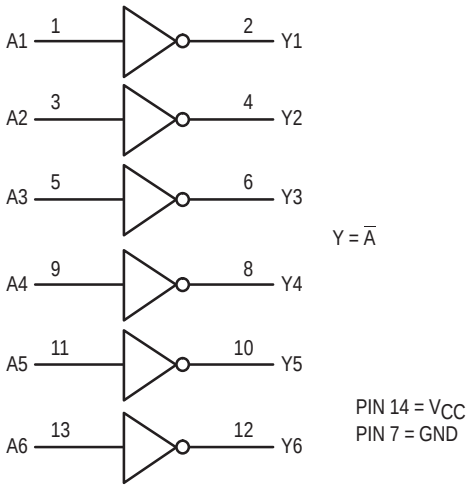
High–Performance Silicon–Gate CMOS

The MC74HCU04A is identical in pinout to the LS04 and the MC14069UB. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL 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 HC04A is recommended.

- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2 to 6 V; 2.5 to 6 V in Oscillator Configurations
- Low Input Current: 1 μA
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- Chip Complexity: 12 FETs or 3 Equivalent Gates

LOGIC DIAGRAM



FUNCTION TABLE

Inputs A	Outputs Y
L	H
H	L

ON Semiconductor

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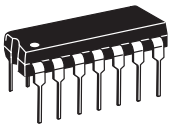
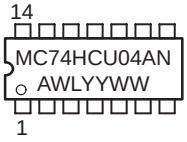
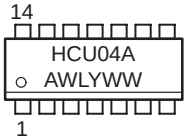
MARKING DIAGRAMS

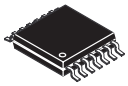


PDIP–14
N SUFFIX
CASE 646

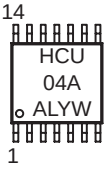


SOIC–14
D SUFFIX
CASE 751A



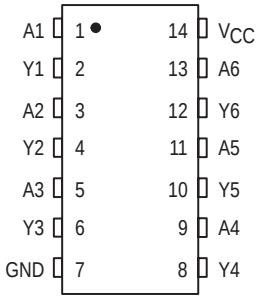


TSSOP–14
DT SUFFIX
CASE 948G



A = Assembly Location
WL or L = Wafer Lot
YY or Y = Year
WW or W = Work Week

PIN ASSIGNMENT



ORDERING INFORMATION

Device	Package	Shipping
MC74HCU04AN	PDIP–14	2000 / Box
MC74HCU04AD	SOIC–14	55 / Rail
MC74HCU04ADR2	SOIC–14	2500 / Reel
MC74HCU04ADT	TSSOP–14	96 / Rail
MC74HCU04ADTR2	TSSOP–14	2500 / Reel

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MAXIMUM RATINGS*

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	– 0.5 to + 7.0	V
V_{in}	DC Input Voltage (Referenced to GND)	– 0.5 to V_{CC} + 0.5	V
V_{out}	DC Output Voltage (Referenced to GND)	– 0.5 to V_{CC} + 0.5	V
I_{in}	DC Input Current, per Pin	± 20	mA
I_{out}	DC Output Current, per Pin	± 25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins	± 50	mA
P_D	Power Dissipation in Still Air Plastic DIP† SOIC Package† TSSOP Package†	750 500 450	mW
T_{stg}	Storage Temperature	– 65 to + 150	°C
T_L	Lead Temperature, 1 mm from case for 10 Seconds Plastic DIP, SOIC or TSSOP Package	260	°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 ≤ (V_{in} or V_{out}) ≤ V_{CC}.

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.

*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: –10mW/°C from 65° to 125°C
SOIC Package: –7mW/°C from 65° to 125°C
TSSOP Package: – 6.1 mW/°C from 65° to 125°C
For high frequency or heavy load considerations, see Chapter 2 of the ON Semiconductor High–Speed CMOS Data Book (DL129/D).

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	2.0	6.0	V
V_{in}, V_{out}	DC Input Voltage, Output Voltage (Referenced to GND)	0	V_{CC}	V
T_A	Operating Temperature, All Package Types	– 55	+ 125	°C
t_r, t_f	Input Rise and Fall Time (Figure 1)	—	No Limit	ns

DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	V_{CC} V	Guaranteed Limit			Unit
				– 55 to 25°C	≤ 85°C	≤ 125°C	
V_{IH}	Minimum High–Level Input Voltage	V_{out} = 0.5 V* $\|I_{out}\|$ ≤ 20 μA	2.0 3.0 4.5 6.0	1.7 2.5 3.6 4.8	1.7 2.5 3.6 4.8	l.7 2.5 3.6 4.8	V
V_{IL}	Maximum Low–Level Input Voltage	V_{out} = V_{CC} – 0.5 V* $\|I_{out}\|$ ≤ 20 μA	2.0 3.0 4.5 6.0	0.3 0.5 0.8 1.1	0.3 0.5 0.8 1.1	0.3 0.5 0.8 1.1	V
V_{OH}	Minimum High–Level Output Voltage	V_{in} = GND $\|I_{out}\|$ ≤ 20 μA	2.0 4.5 6.0	1.8 4.0 5.5	1.8 4.0 5.5	1.8 4.0 5.5	V
		V_{in} = GND $\|I_{out}\|$ ≤ 2.4 mA $\|I_{out}\|$ ≤ 4.0 mA $\|I_{out}\|$ ≤ 5.2 mA	3.0 4.5 6.0	2.36 3.86 5.36	2.26 3.76 5.26	2.20 3.70 5.20	
V_{OL}	Maximum Low–Level Output Voltage	V_{in} = V_{CC} $\|I_{out}\|$ ≤ 20 μA	2.0 4.5 6.0	0.2 0.5 0.5	0.2 0.5 0.5	0.2 0.5 0.5	V
		V_{in} = V_{CC} $\|I_{out}\|$ ≤ 2.4 mA $\|I_{out}\|$ ≤ 4.0 mA $\|I_{out}\|$ ≤ 5.2 mA	3.0 4.5 6.0	0.32 0.32 0.32	0.32 0.37 0.37	0.32 0.40 0.40	

DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	V_{CC} V	Guaranteed Limit			Unit
				– 55 to 25°C	≤ 85°C	≤ 125°C	
I_{in}	Maximum Input Leakage Current	$V_{in} = V_{CC}$ or GND	6.0	± 0.1	± 1.0	± 1.0	μA
I_{CC}	Maximum Quiescent Supply Current (per Package)	$V_{in} = V_{CC}$ or GND I_{out} = 0 μA	6.0	1	10	40	μA

NOTE: Information on typical parametric values can be found in Chapter 2 of the ON Semiconductor High–Speed CMOS Data Book (DL129/D).
*For V_{CC} = 2.0 V, V_{out} = 0.2 V or V_{CC} – 0.2 V.

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input $t_r = t_f$ = 6 ns)

Symbol	Parameter	V_{CC} V	Guaranteed Limit			Unit
			– 55 to 25°C	≤ 85°C	≤ 125°C	
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Input A to Output Y (Figures 1 and 2)	2.0 3.0 4.5 6.0	70 40 14 12	90 45 18 15	105 50 21 18	ns
t_{TLH}, t_{THL}	Maximum Output Transition Time, Any Output (Figures 1 and 2)	2.0 3.0 4.5 6.0	75 27 15 13	95 32 19 16	110 36 22 19	ns
C_{in}	Maximum Input Capacitance	—	10	10	10	pF

NOTES:
1. For propagation delays with loads other than 50 pF, see Chapter 2 of the ON Semiconductor High–Speed CMOS Data Book (DL129/D).
2. Information on typical parametric values can be found in Chapter 2 of the ON Semiconductor High–Speed CMOS Data Book (DL129/D).

		Typical @ 25°C, V_{CC} = 5.0 V	
C_{PD}	Power Dissipation Capacitance (Per Inverter)*	15	pF

* Used to determine the no–load dynamic power consumption: $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$. For load considerations, see Chapter 2 of the ON Semiconductor High–Speed CMOS Data Book (DL129/D).

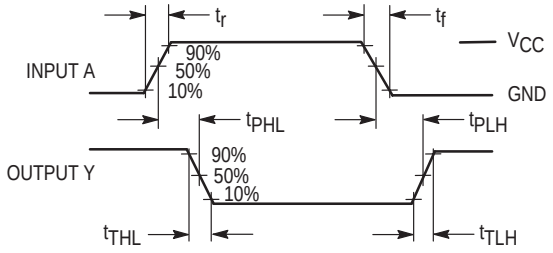
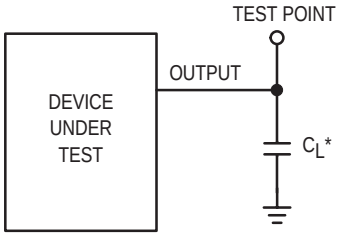


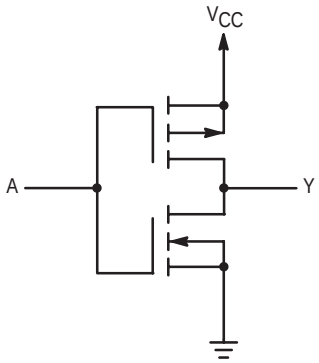
Figure 1. Switching Waveforms



*Includes all probe and jig capacitance

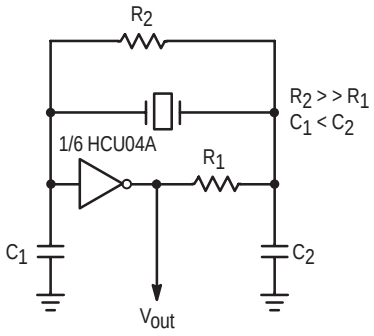
Figure 2. Test Circuit

LOGIC DETAIL
(1/6 of Device Shown)

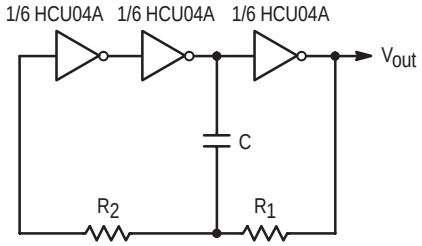


TYPICAL APPLICATIONS

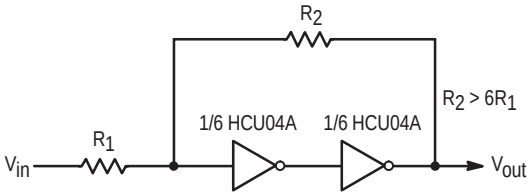
Crystal Oscillator



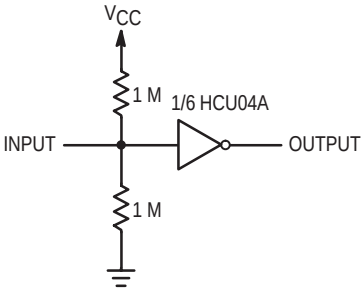
Stable RC Oscillator



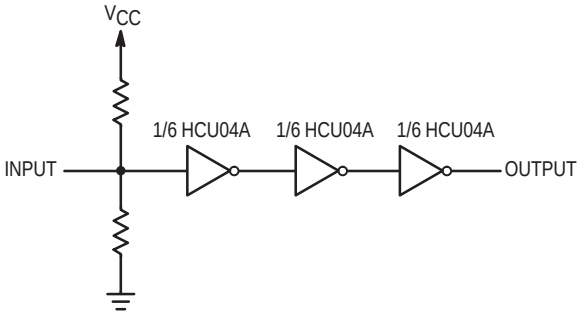
Schmitt Trigger



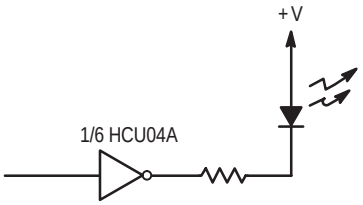
High Input Impedance Single–Stage Amplifier with a 2 to 6 V Supply Range



Multi–Stage Amplifier



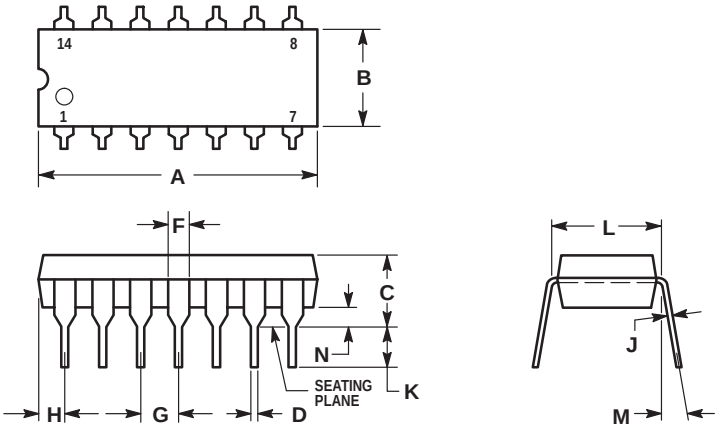
LED Driver



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

PACKAGE DIMENSIONS

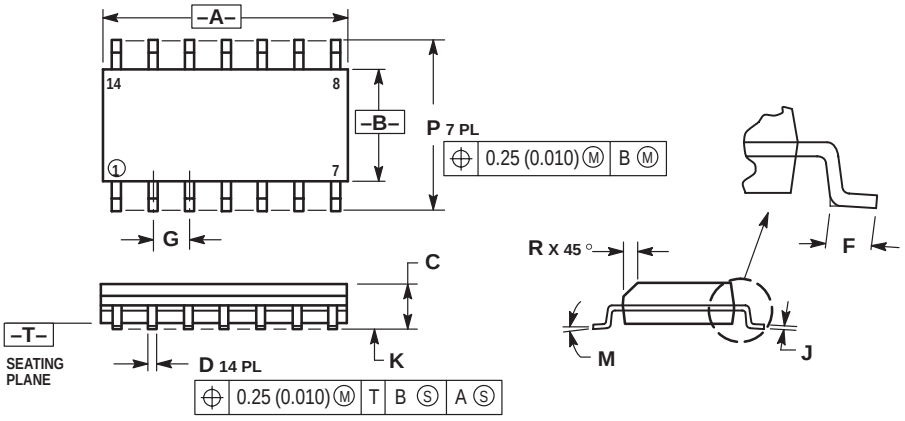
PDIP–14
N SUFFIX
CASE 646–06
ISSUE L



NOTES:
1. LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
4. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	19.56
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.300 BSC		7.62 BSC	
M	0 °	10°	0 °	10 °
N	0.015	0.039	0.39	1.01

SOIC–14
D SUFFIX
CASE 751A–03
ISSUE F

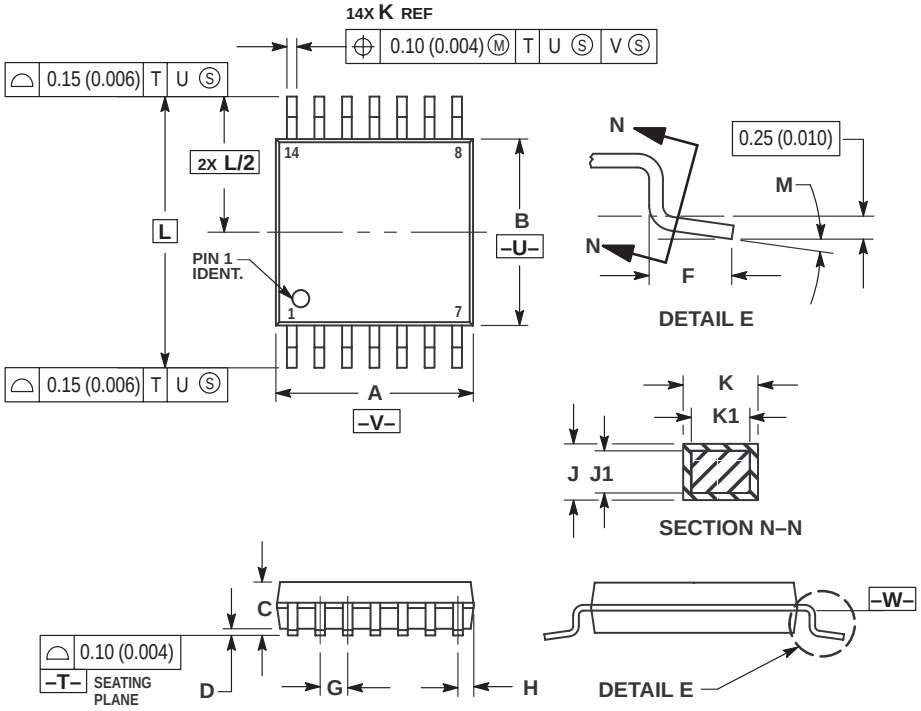


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005)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

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	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	
J	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

PACKAGE DIMENSIONS

TSSOP–14
DT SUFFIX
CASE 948G–01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH 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 (0.003) 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–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	—	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	
H	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°

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