Hex Inverter

High-Performance Silicon-Gate CMOS

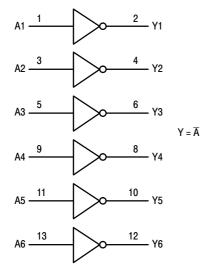
The MC74HC04A is identical in pinout to the LS04 and the MC14069. The device inputs are compatible with Standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

The device consists of six three-stage inverters.

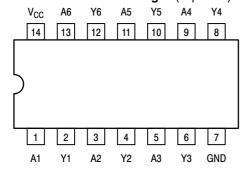
Features

- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS and TTL
- Operating Voltage Range: 2.0 to 6.0 V
- Low Input Current: 1 μA
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance With the JEDEC Standard No. 7A Requirements
- Chip Complexity: 36 FETs or 9 Equivalent Gates
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant

LOGIC DIAGRAM



Pinout: 14-Lead Packages (Top View)





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MARKING DIAGRAMS

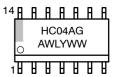


PDIP-14 N SUFFIX CASE 646





SOIC-14 D SUFFIX CASE 751A



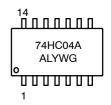


TSSOP-14 DT SUFFIX CASE 948G





SOEIAJ-14 F SUFFIX CASE 965



A = Assembly Location

L, WL = Wafer Lot Y, YY = Year W, WW = Work Week G or = Pb-Free Package

(Note: Microdot may be in either location)

FUNCTION TABLE

Inputs	Outputs
Α	Υ
L	Н
Н	L

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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
l _{out}	DC Output Current, per Pin	± 25	mA
Icc	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

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

†Derating – Plastic DIP: – 10 mW/°C from 65° to 125°C SOIC Package: – 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 (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 $V_{CC} = 2.0 \text{ V}$ (Figure 1) $V_{CC} = 4.5 \text{ V}$ $V_{CC} = 6.0 \text{ V}$	0 0 0	1000 500 400	ns

ORDERING INFORMATION

Device	Package	Shipping [†]
MC74HC04ANG	PDIP-14 (Pb-Free)	25 / Rail
MC74HC04ADG	SOIC-14 (Pb-Free)	55 / Rail
MC74HC04ADR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel
MC74HC04ADTR2G	TSSOP-14*	2500 / Tape & Reel
MC74HC04AFG	SOEIAJ-14 (Pb-Free)	50 / Rail
MC74HC04AFELG	SOEIAJ-14 (Pb-Free)	2000 / Tape & Reel

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

^{*}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} . 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. †Derating – Plastic DIP: – 10 mW/°C from 65° to 125°C

^{*}This package is inherently Pb-Free.

DC CHARACTERISTICS (Voltages Referenced to GND)

				V _{CC}	Guara	nteed Lin	nit	
Symbol	Parameter	Conditi	on	V	-55 to 25°C	≤ 85°C	≤125°C	Unit
V _{IH}	Minimum High-Level Input Voltage	$V_{out} = 0.1V \text{ or } V_{CC}$ $ I_{out} \le 20\mu A$	-0.1V	2.0 3.0 4.5 6.0	1.50 2.10 3.15 4.20	1.50 2.10 3.15 4.20	1.50 2.10 3.15 4.20	V
V _{IL}	Maximum Low-Level Input Voltage	$V_{out} = 0.1 V \text{ or } V_{CC}$ $ I_{out} \le 20 \mu A$	- 0.1V	2.0 3.0 4.5 6.0	0.50 0.90 1.35 1.80	0.50 0.90 1.35 1.80	0.50 0.90 1.35 1.80	V
V _{OH}	Minimum High-Level Output Voltage	$V_{in} = V_{IH} \text{ or } V_{IL}$ $ I_{out} \le 20 \mu A$		2.0 4.5 6.0	1.9 4.4 5.9	1.9 4.4 5.9	1.9 4.4 5.9	V
		V _{in} =V _{IH} or V _{IL}	$\begin{aligned} & \left I_{out}\right \leq 2.4 \text{mA} \\ & \left I_{out}\right \leq 4.0 \text{mA} \\ & \left I_{out}\right \leq 5.2 \text{mA} \end{aligned}$	3.0 4.5 6.0	2.48 3.98 5.48	2.34 3.84 5.34	2.20 3.70 5.20	
V _{OL}	Maximum Low-Level Output Voltage	$V_{in} = V_{IH} \text{ or } V_{IL}$ $ I_{out} \le 20 \mu A$		2.0 4.5 6.0	0.1 0.1 0.1	0.1 0.1 0.1	0.1 0.1 0.1	V
		V _{in} = V _{IH} or V _{IL}	$\begin{aligned} & \left I_{out}\right \leq 2.4 \text{mA} \\ & \left I_{out}\right \leq 4.0 \text{mA} \\ & \left I_{out}\right \leq 5.2 \text{mA} \end{aligned}$	3.0 4.5 6.0	0.26 0.26 0.26	0.33 0.33 0.33	0.40 0.40 0.40	
l _{in}	Maximum Input Leakage Current	V _{in} = V _{CC} or GND		6.0	± 0.1	± 1.0	± 1.0	μΑ
I _{CC}	Maximum Quiescent Supply Current (per Package)	$V_{in} = V_{CC}$ or GND $I_{out} = 0\mu A$		6.0	1.0	10	40	μΑ

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

		v _{cc}	Gua	aranteed Lin	nit	
Symbol	Parameter	V	-55 to 25°C	≤ 85°C	≤125°C	Unit
t _{PLH} , t _{PHL}	Maximum Propagation Delay, Input A or B to Output Y (Figures 1 and 2)	2.0 3.0 4.5 6.0	75 30 15 13	95 40 19 16	110 55 22 19	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

		Typical @ 25°C, V _{CC} = 5.0 V	
C_{PD}	Power Dissipation Capacitance (Per Inverter)*	20	рF

^{*}Used to determine the no–load dynamic power consumption: $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$.

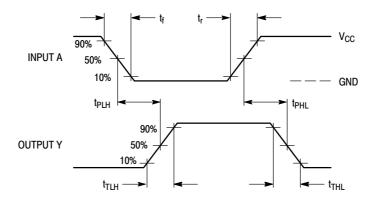
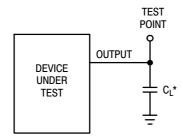


Figure 1. Switching Waveforms



*Includes all probe and jig capacitance

Figure 2. Test Circuit

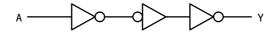
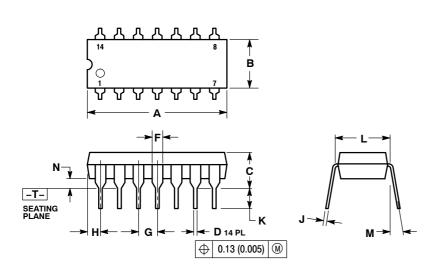


Figure 3. Expanded Logic Diagram (1/6 of the Device Shown)

PACKAGE DIMENSIONS

PDIP-14 **N SUFFIX** CASE 646-06 ISSUE P

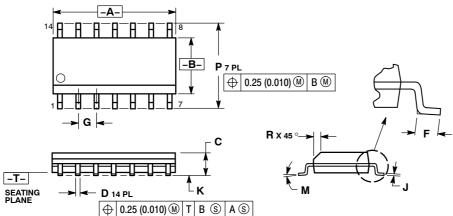


- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
 4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
 5. ROUNDED CORNERS OPTIONAL.

	INC	HES	MILLIM	IETERS
DIM	MIN	MAX	MIN	MAX
Α	0.715	0.770	18.16	19.56
В	0.240	0.260	6.10	6.60
С	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
Н	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	0.290	0.310	7.37	7.87
М		10 °		10 °
N	0.015	0.039	0.38	1.01

PACKAGE DIMENSIONS

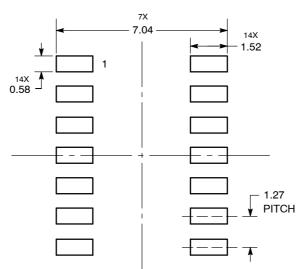
SOIC-14 **D SUFFIX** CASE 751A-03 **ISSUE J**



- 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 B DOES NOT INCLUDE.
 - 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.

MILLIN	IETERS	INCHES	
MIN	MAX	MIN	MAX
8.55	8.75	0.337	0.344
3.80	4.00	0.150	0.157
1.35	1.75	0.054	0.068
0.35	0.49	0.014	0.019
0.40	1.25	0.016	0.049
1.27	BSC	0.050	BSC
0.19	0.25	0.008	0.009
0.10	0.25	0.004	0.009
0 °	7°	0 °	7°
5.80	6.20	0.228	0.244
0.25	0.50	0.010	0.019
	MIN 8.55 3.80 1.35 0.35 0.40 1.27 0.19 0.10 0 ° 5.80	8.55 8.75 3.80 4.00 1.35 1.75 0.35 0.49 0.40 1.25 1.27 BSC 0.19 0.25 0.0 0.25 0 0 7 ° 5.80 6.20	MIN MAX MIN 8.55 8.75 0.337 3.80 4.00 0.150 1.35 1.75 0.054 0.35 0.49 0.014 0.40 1.25 0.016 1.27 BSC 0.05c 0.19 0.25 0.008 0.10 0.25 0.004 0° 7° 0° 5.80 6.20 0.228

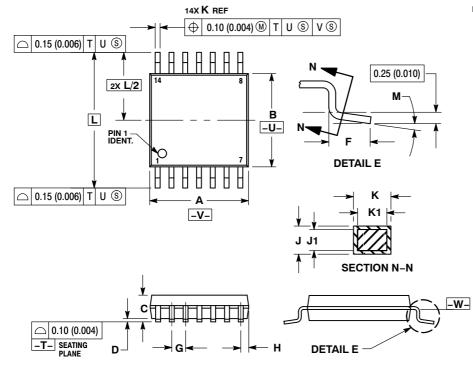
SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

PACKAGE DIMENSIONS

TSSOP-14 **DT SUFFIX** CASE 948G-01 **ISSUE B**



NOTES:

- OTES:

 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. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.

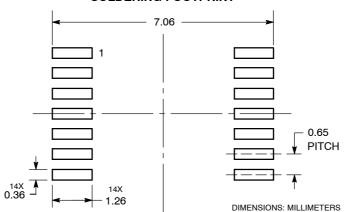
 5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION. SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION K DISCUSSES OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.

 6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.

 7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE —W—.

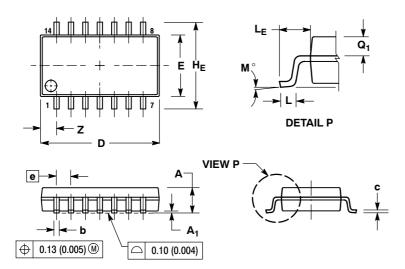
	MILLIN	IETERS	INCHES	
DIM	MIN	MAX	MIN	MAX
Α	4.90	5.10	0.193	0.200
В	4.30	4.50	0.169	0.177
c		1.20		0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65	BSC	0.026	BSC
Η	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40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

SOLDERING FOOTPRINT



PACKAGE DIMENSIONS

SOEIAJ-14 **F SUFFIX** CASE 965-01 **ISSUE B**



- DIMENSIONING AND TOLERANCING PER ANSI
- DIMENSIONING AND ...
 Y14.5M, 1982.
 CONTROLLING DIMENSION: MILLIMETER.
 MAENSIONS D AND E DO NOT INCLUDE
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 AND ARE DIMENSIONS DIAND E DO NOT INCLUDE
 MOLD FLASH OR PROTRUSIONS AND ARE
 MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15
- OR PROTRUSIONS SHALL NOT EXCEED 0.15
 (0.006) PER SIDE.
 4. 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 PROTRIJISIONS AND ADJACENT LEAD BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

	MILLIN	IETERS	INC	HES
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	0.10	0.20	0.004	0.008
D	9.90	10.50	0.390	0.413
Ε	5.10	5.45	0.201	0.215
е	1.27	BSC	0.050	BSC
HE	7.40	8.20	0.291	0.323
L	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	
Z		1.42		0.056

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