

MC74HC14A

Hex Schmitt-Trigger Inverter

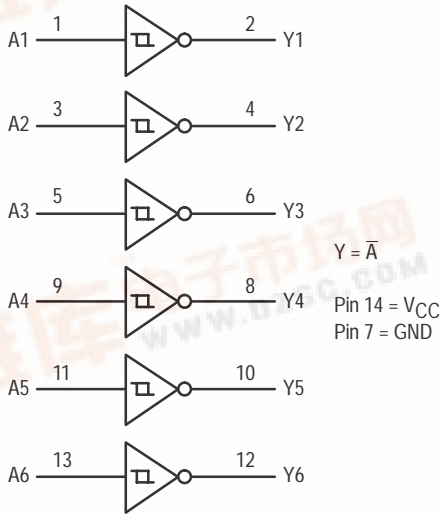
High-Performance Silicon-Gate CMOS

The MC74HC14A is identical in pinout to the LS14, LS04 and the HC04. The device inputs are compatible with Standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

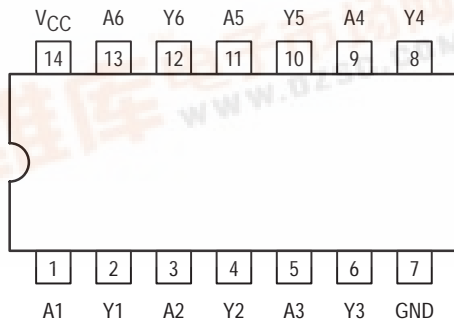
The HC14A is useful to “square up” slow input rise and fall times. Due to hysteresis voltage of the Schmitt trigger, the HC14A finds applications in noisy environments.

- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS and TTL
- Operating Voltage Range: 2 to 6V
- Low Input Current: 1µA
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance With the JEDEC Standard No. 7A Requirements
- Chip Complexity: 60 FETs or 15 Equivalent Gates

LOGIC DIAGRAM



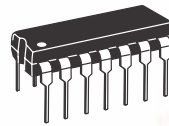
Pinout: 14-Lead Packages (Top View)



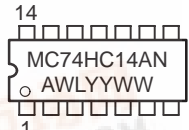
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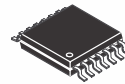
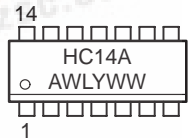
MARKING DIAGRAMS



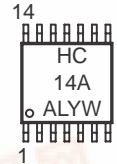
PDIP-14
N SUFFIX
CASE 646



SOIC-14
D SUFFIX
CASE 751A



TSSOP-14
DT SUFFIX
CASE 948G



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

FUNCTION TABLE

Inputs	Outputs
A	Y
L	H
H	L

ORDERING INFORMATION

Device	Package	Shipping
MC74HC14AN	PDIP-14	2000 / Box
MC74HC14AD	SOIC-14	55 / Rail
MC74HC14ADR2	SOIC-14	2500 / Reel
MC74HC14ADT	TSSOP-14	96 / Rail
MC74HC14ADTR2	TSSOP-14	2500 / Reel



MC74HC14A

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 Range	- 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 $GND \leq (V_{in} \text{ or } V_{out}) \leq V_{CC}$.

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.

*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

TSSOP Package: - 6.1 mW/°C from 65° to 125°C

For high frequency or heavy load considerations, see Chapter 2 of the Motorola 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 Range, All Package Types	- 55	+ 125	°C
t_r, t_f	Input Rise/Fall Time (Figure 1)			ns
	$V_{CC} = 2.0$ V	0	No Limit*	
	$V_{CC} = 4.5$ V	0	No Limit*	
	$V_{CC} = 6.0$ V	0	No Limit*	

*When $V_{in} = 50\% V_{CC}$, $I_{CC} > 1$ mA

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DC CHARACTERISTICS (Voltages Referenced to GND)

Symbol	Parameter	Condition	V _{CC} V	Guaranteed Limit			Unit
				-55 to 25°C	≤85°C	≤125°C	
V _{T+} max	Maximum Positive-Going Input Threshold Voltage (Figure 3)	V _{out} = 0.1V I _{out} ≤ 20μA	2.0	1.50	1.50	1.50	V
			3.0	2.15	2.15	2.15	
			4.5	3.15	3.15	3.15	
			6.0	4.20	4.20	4.20	
V _{T+} min	Minimum Positive-Going Input Threshold Voltage (Figure 3)	V _{out} = 0.1V I _{out} ≤ 20μA	2.0	1.0	0.95	0.95	V
			3.0	1.5	1.45	1.45	
			4.5	2.3	2.25	2.25	
			6.0	3.0	2.95	2.95	
V _{T-} max	Maximum Negative-Going Input Threshold Voltage (Figure 3)	V _{out} = V _{CC} - 0.1V I _{out} ≤ 20μA	2.0	0.9	0.95	0.95	V
			3.0	1.4	1.45	1.45	
			4.5	2.0	2.05	2.05	
			6.0	2.6	2.65	2.65	
V _{T-} min	Minimum Negative-Going Input Threshold Voltage (Figure 3)	V _{out} = V _{CC} - 0.1V I _{out} ≤ 20μA	2.0	0.3	0.3	0.3	V
			3.0	0.5	0.5	0.5	
			4.5	0.9	0.9	0.9	
			6.0	1.2	1.2	1.2	
V _H max Note 2	Maximum Hysteresis Voltage (Figure 3)	V _{out} = 0.1V or V _{CC} - 0.1V I _{out} ≤ 20μA	2.0	1.20	1.20	1.20	V
			3.0	1.65	1.65	1.65	
			4.5	2.25	2.25	2.25	
			6.0	3.00	3.00	3.00	
V _H min Note 2	Minimum Hysteresis Voltage (Figure 3)	V _{out} = 0.1V or V _{CC} - 0.1V I _{out} ≤ 20μA	2.0	0.20	0.20	0.20	V
			3.0	0.25	0.25	0.25	
			4.5	0.40	0.40	0.40	
			6.0	0.50	0.50	0.50	
V _{OH}	Minimum High-Level Output Voltage	V _{in} ≤ V _{T-} min I _{out} ≤ 20μA	2.0	1.9	1.9	1.9	V
			4.5	4.4	4.4	4.4	
			6.0	5.9	5.9	5.9	
			V _{in} ≤ V _{T-} min	I _{out} ≤ 2.4mA	3.0	2.48	
	I _{out} ≤ 4.0mA	4.5	3.98	3.84	3.70		
	I _{out} ≤ 5.2mA	6.0	5.48	5.34	5.20		
V _{OL}	Maximum Low-Level Output Voltage	V _{in} ≥ V _{T+} max I _{out} ≤ 20μA	2.0	0.1	0.1	0.1	V
			4.5	0.1	0.1	0.1	
			6.0	0.1	0.1	0.1	
			V _{in} ≥ V _{T+} max	I _{out} ≤ 2.4mA	3.0	0.26	
	I _{out} ≤ 4.0mA	4.5	0.26	0.33	0.40		
	I _{out} ≤ 5.2mA	6.0	0.26	0.33	0.40		
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} = 0μA	6.0	1.0	10	40	μA

1. Information on typical parametric values along with frequency or heavy load considerations can be found in Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

2. V_Hmin > (V_{T+} min) - (V_{T-} max); V_Hmax = (V_{T+} max) - (V_{T-} min).

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AC CHARACTERISTICS ($C_L = 50\text{pF}$, Input $t_r = t_f = 6\text{ns}$)

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 or B to Output Y (Figures 1 and 2)	2.0	75	95	110	ns
		3.0	30	40	55	
		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	75	95	110	ns
		3.0	27	32	36	
		4.5	15	19	22	
		6.0	13	16	19	
C _{in}	Maximum Input Capacitance		10	10	10	pF

NOTE: For propagation delays with loads other than 50 pF, and information on typical parametric values, see Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

C _{PD}	Power Dissipation Capacitance (Per Inverter)*	Typical @ 25°C, V _{CC} = 5.0 V		pF
		22		

* 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 Motorola High-Speed CMOS Data Book (DL129/D).

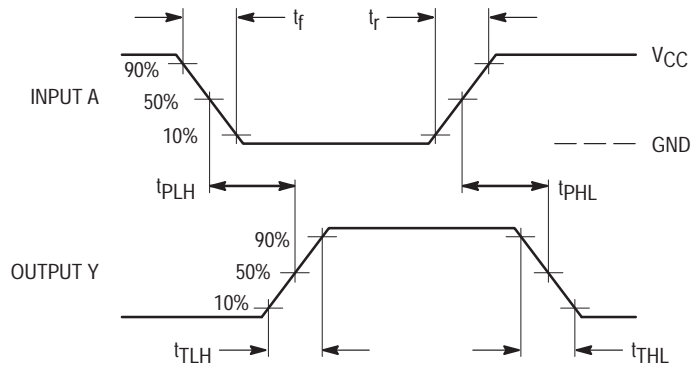
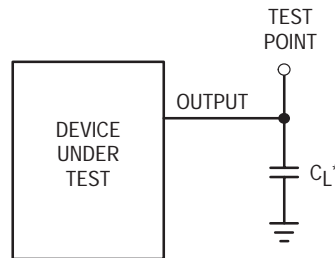


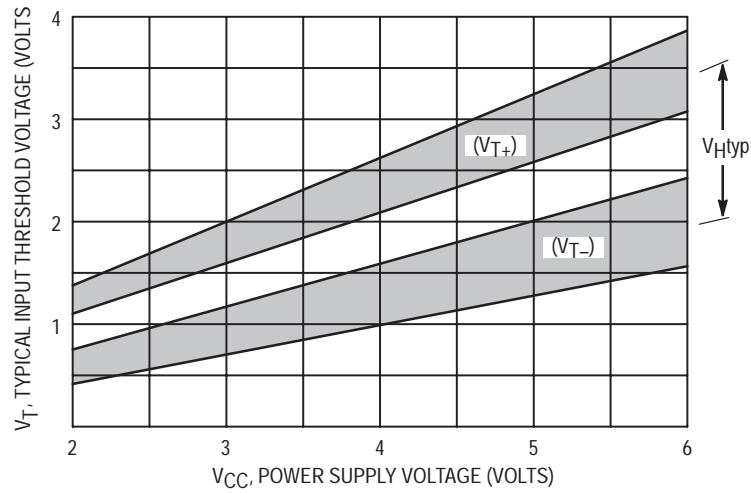
Figure 1. Switching Waveforms



*Includes all probe and jig capacitance

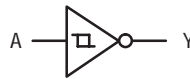
Figure 2. Test Circuit

MC74HC14A

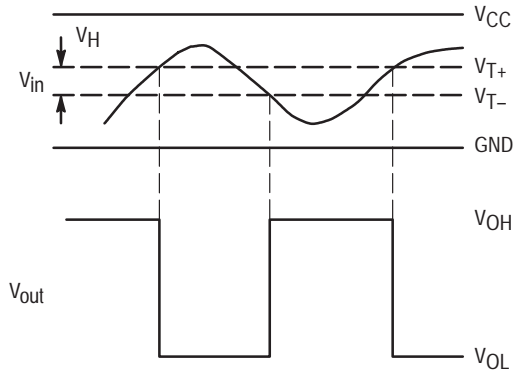


$$V_{HTyp} = (V_{T+ typ}) - (V_{T- typ})$$

Figure 3. Typical Input Threshold, V_{T+} , V_{T-} versus Power Supply Voltage



(a) A Schmitt-Trigger Squares Up Inputs With Slow Rise and Fall Times



(b) A Schmitt-Trigger Offers Maximum Noise Immunity

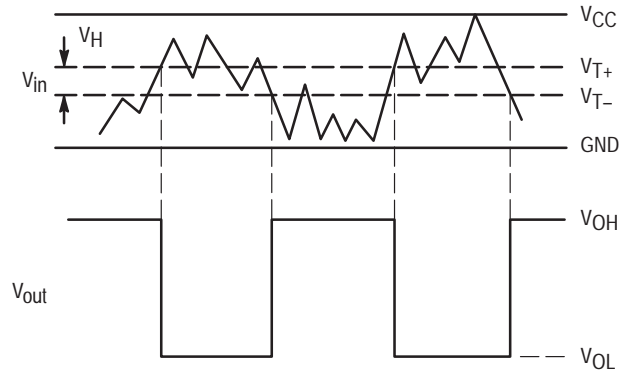
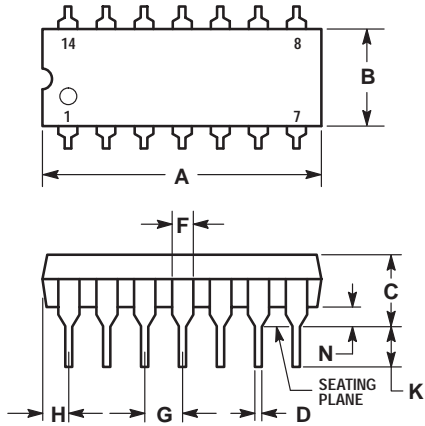


Figure 4. Typical Schmitt-Trigger Applications

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PACKAGE DIMENSIONS

PDIP-14
N SUFFIX
CASE 646-06
ISSUE L

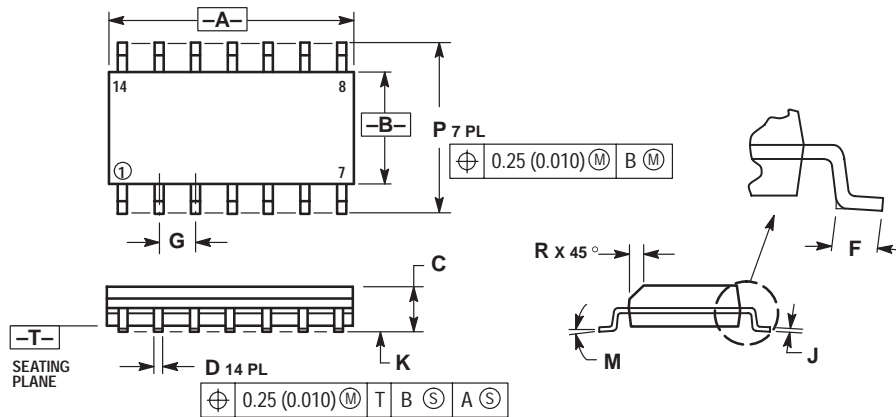


NOTES:

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

DIM	INCHES		MILLIMETERS	
	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:

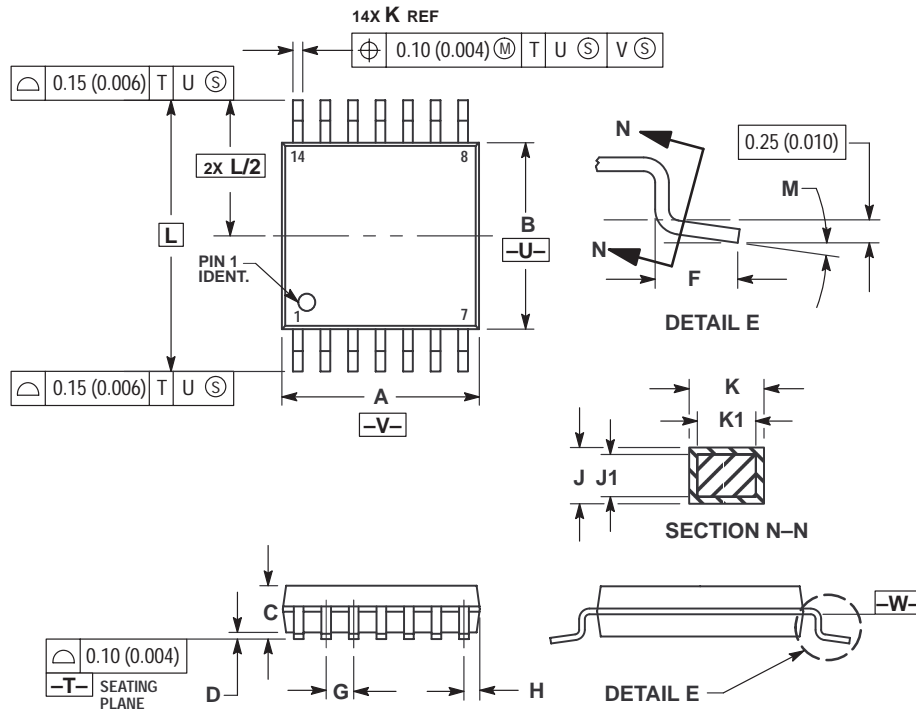
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
- DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN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

DIM	MILLIMETERS		INCHES	
	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

MC74HC14A

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-.

DIM	MILLIMETERS		INCHES	
	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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