



September 1983  
Revised May 2005

# MM74HC14

## Hex Inverting Schmitt Trigger

### General Description

The MM74HC14 utilizes advanced silicon-gate CMOS technology to achieve the low power dissipation and high noise immunity of standard CMOS, as well as the capability to drive 10 LS-TTL loads.

The 74HC logic family is functionally and pinout compatible with the standard 74LS logic family. All inputs are protected from damage due to static discharge by internal diode clamps to  $V_{CC}$  and ground.

### Features

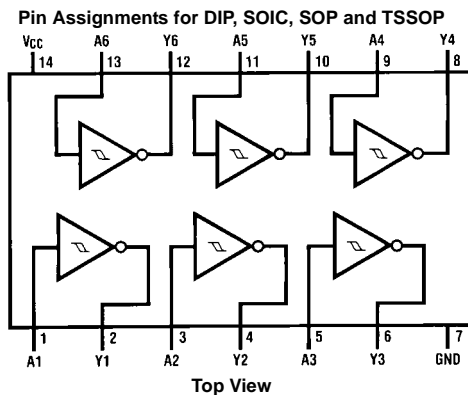
- Typical propagation delay: 13 ns
- Wide power supply range: 2–6V
- Low quiescent current: 20  $\mu$ A maximum (74HC Series)
- Low input current: 1  $\mu$ A maximum
- Fanout of 10 LS-TTL loads
- Typical hysteresis voltage: 0.9V at  $V_{CC} = 4.5V$

### Ordering Code:

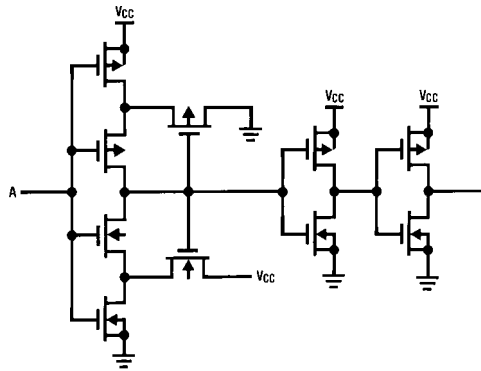
Order Number	Package Number	Package Description
MM74HC14M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
MM74HC14MX_NL	M14A	Pb-Free 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
MM74HC14SJ	M14D	Pb-Free 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
MM74HC14MTC	MTC14	14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
MM74HC14MTCX_NL	MTC14	Pb-Free 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
MM74HC14N	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
MM74HC14N_NL	N14A	Pb-Free 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.  
Pb-Free package per JEDEC J-STD-020B.

### Connection Diagram



### Logic Diagram



MM74HC14 Hex Inverting Schmitt Trigger

MM74HC14

**Absolute Maximum Ratings** (Note 1)

(Note 2)

Supply Voltage ( $V_{CC}$ )	-0.5 to +7.0V
DC Input Voltage ( $V_{IN}$ )	-1.5 to $V_{CC} + 1.5V$
DC Output Voltage ( $V_{OUT}$ )	-0.5 to $V_{CC} + 0.5V$
Clamp Diode Current ( $I_{IK}, I_{OK}$ )	$\pm 20$ mA
DC Output Current, per pin ( $I_{OUT}$ )	$\pm 25$ mA
DC $V_{CC}$ or GND Current, per pin ( $I_{CC}$ )	$\pm 50$ mA
Storage Temperature Range ( $T_{STG}$ )	-65°C to +150°C
Power Dissipation ( $P_D$ )	
(Note 3)	600 mW
S.O. Package only	500 mW
Lead Temperature ( $T_L$ )	
(Soldering 10 seconds)	260°C

**Recommended Operating Conditions**

	Min	Max	Units
Supply Voltage ( $V_{CC}$ )	2	6	V
DC Input or Output Voltage ( $V_{IN}, V_{OUT}$ )	0	$V_{CC}$	V
Operating Temperature Range ( $T_A$ )	-55	+125	°C

**Note 1:** Absolute Maximum Ratings are those values beyond which damage to the device may occur.

**Note 2:** Unless otherwise specified all voltages are referenced to ground.

**Note 3:** Power Dissipation temperature derating — plastic "N" package: -12 mW/°C from 65°C to 85°C.

**DC Electrical Characteristics** (Note 4)

Symbol	Parameter	Conditions	$V_{CC}$	$T_A = 25^\circ C$		$T_A = -40$ to $85^\circ C$	$T_A = -55$ to $125^\circ C$	Units
				Typ	Guaranteed Limits			
$V_{T+}$	Positive Going Threshold Voltage	Minimum	2.0V	1.2	1.0	1.0	1.0	V
			4.5V	2.7	2.0	2.0	2.0	V
			6.0V	3.2	3.0	3.0	3.0	V
		Maximum	2.0V	1.2	1.5	1.5	1.5	V
			4.5V	2.7	3.15	3.15	3.15	V
			6.0V	3.2	4.2	4.2	4.2	V
$V_{T-}$	Negative Going Threshold Voltage	Minimum	2.0V	0.7	0.3	0.3	0.3	V
			4.5V	1.8	0.9	0.9	0.9	V
			6.0V	2.2	1.2	1.2	1.2	V
		Maximum	2.0V	0.7	1.0	1.0	1.0	V
			4.5V	1.8	2.2	2.2	2.2	V
			6.0V	2.2	3.0	3.0	3.0	V
$V_H$	Hysteresis Voltage	Minimum	2.0V	0.5	0.2	0.2	0.2	V
			4.5V	0.9	0.4	0.4	0.4	V
			6.0V	1.0	0.5	0.5	0.5	V
		Maximum	2.0V	0.5	1.0	1.0	1.0	V
			4.5V	0.9	1.4	1.4	1.4	V
			6.0V	1.0	1.5	1.5	1.5	V
$V_{OH}$	Minimum HIGH Level Output Voltage	$V_{IN} = V_{IL}$ $ I_{OUT}  = 20 \mu A$	2.0V	2.0	1.9	1.9	1.9	V
			4.5V	4.5	4.4	4.4	4.4	V
			6.0V	6.0	5.9	5.9	5.9	V
		$V_{IN} = V_{IL}$ $ I_{OUT}  = 4.0$ mA $ I_{OUT}  = 5.2$ mA	4.5V	4.2	3.98	3.84	3.7	V
			6.0V	5.7	5.48	5.34	5.2	V
$V_{OL}$	Maximum LOW Level Output Voltage	$V_{IN} = V_{IH}$ $ I_{OUT}  = 20 \mu A$	2.0V	0	0.1	0.1	0.1	V
			4.5V	0	0.1	0.1	0.1	V
			6.0V	0	0.1	0.1	0.1	V
		$V_{IN} = V_{IH}$ $ I_{OUT}  = 4.0$ mA $ I_{OUT}  = 5.2$ mA	4.5V	0.2	0.26	0.33	0.4	V
			6.0V	0.2	0.26	0.33	0.4	V
$I_{IN}$	Maximum Input Current	$V_{IN} = V_{CC}$ or GND	6.0V		$\pm 0.1$	$\pm 1.0$	$\pm 1.0$	$\mu A$
$I_{CC}$	Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND $I_{OUT} = 0 \mu A$	6.0V		2.0	20	40	$\mu A$

**Note 4:** For a power supply of 5V  $\pm 10\%$  the worst case output voltages ( $V_{OH}$  and  $V_{OL}$ ) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case  $V_{IH}$  and  $V_{IL}$  occur at  $V_{CC} = 5.5V$  and 4.5V respectively. (The  $V_{IH}$  value at 5.5V is 3.85V.) The worst case leakage current ( $I_{IN}$ ,  $I_{CC}$ , and  $I_{OZ}$ ) occur for CMOS at the higher voltage and so the 6.0V values should be used.

AC Electrical Characteristics							
$V_{CC} = 5V, T_A = 25^\circ C, C_L = 15 pF, t_r = t_f = 6 ns$							
Symbol	Parameter	Conditions	Typ	Guaranteed Limit		Units	
$t_{PHL}, t_{PLH}$	Maximum Propagation Delay		12	22		ns	

AC Electrical Characteristics									
$V_{CC} = 2.0V \text{ to } 6.0V, C_L = 50 pF, t_r = t_f = 6 ns \text{ (unless otherwise specified)}$									
Symbol	Parameter	Conditions	$V_{CC}$	$T_A = 25^\circ C$		$T_A = -40 \text{ to } 85^\circ C$		$T_A = -55 \text{ to } 125^\circ C$	Units
				Typ	Guaranteed Limits				
$t_{PHL}, t_{PLH}$	Maximum Propagation Delay		2.0V	60	125	156	188	ns	
			4.5V	13	25	31	38		
			6.0V	11	21	26	32		
$t_{TLH}, t_{THL}$	Maximum Output Rise and Fall Time		2.0V	30	75	95	110	ns	
			4.5V	8	15	19	22		
			6.0V	7	13	16	19		
$C_{PD}$	Power Dissipation Capacitance (Note 5)	(per gate)		27					pF
$C_{IN}$	Maximum Input Capacitance			5	10	10	10		pF

**Note 5:**  $C_{PD}$  determines the no load dynamic power consumption,  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ , and the no load dynamic current consumption,  $I_S = C_{PD} V_{CC} f + I_{CC}$ .

### Typical Performance Characteristics

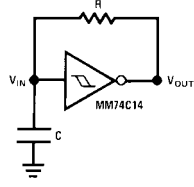
**Input Threshold,  $V_{T+}$ ,  $V_{T-}$ , vs Power Supply Voltage**

**Propagation Delay vs Power Supply**

MM74HC14

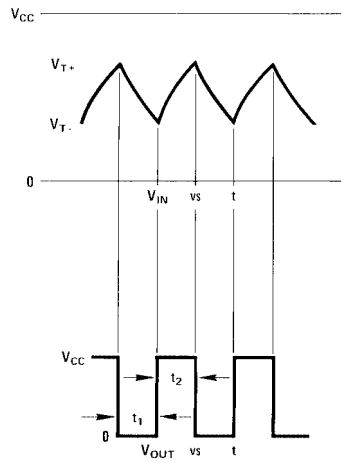
### Typical Applications

Low Power Oscillator



$$t_1 \approx RC \ln \frac{V_{T+}}{V_{T-}}$$

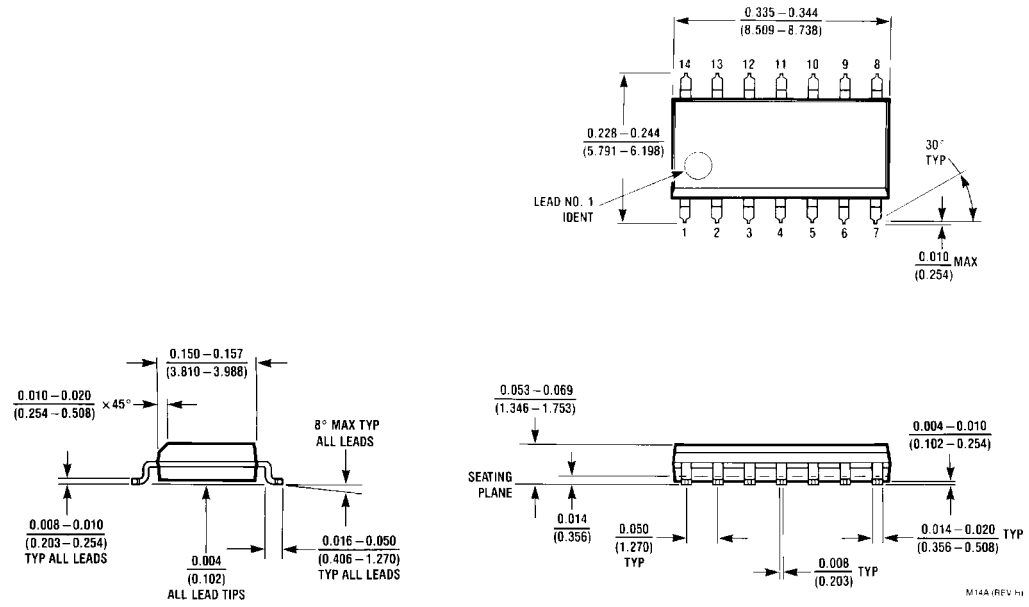
$$t_2 \approx RC \ln \frac{V_{CC} - V_{T-}}{V_{CC} - V_{T+}}$$



$$f \approx \frac{1}{RC \ln \frac{V_{T+}(V_{CC} - V_{T-})}{V_{T-}(V_{CC} - V_{T+})}}$$

**Note:** The equations assume  $t_1 + t_2 \gg t_{pd0} + t_{pd1}$

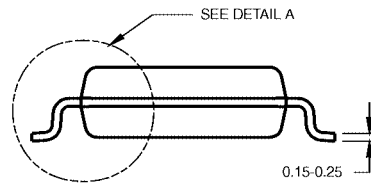
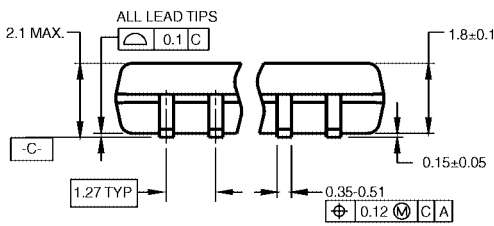
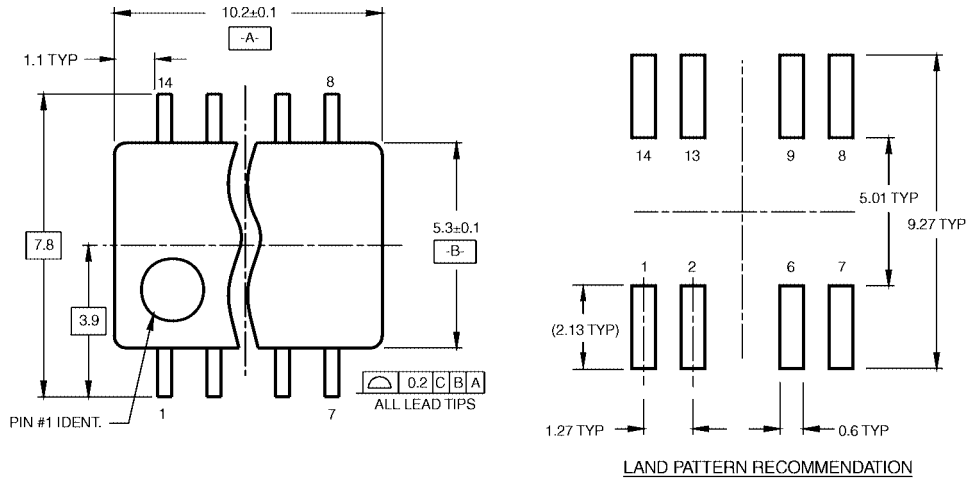
**Physical Dimensions** inches (millimeters) unless otherwise noted



**14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow  
Package Number M14A**

MM74HC14

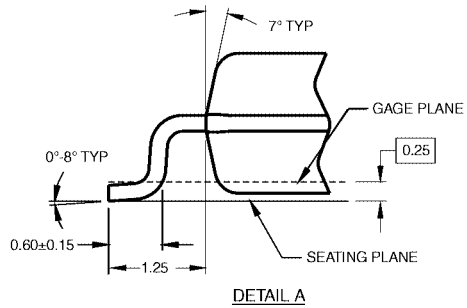
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



DIMENSIONS ARE IN MILLIMETERS

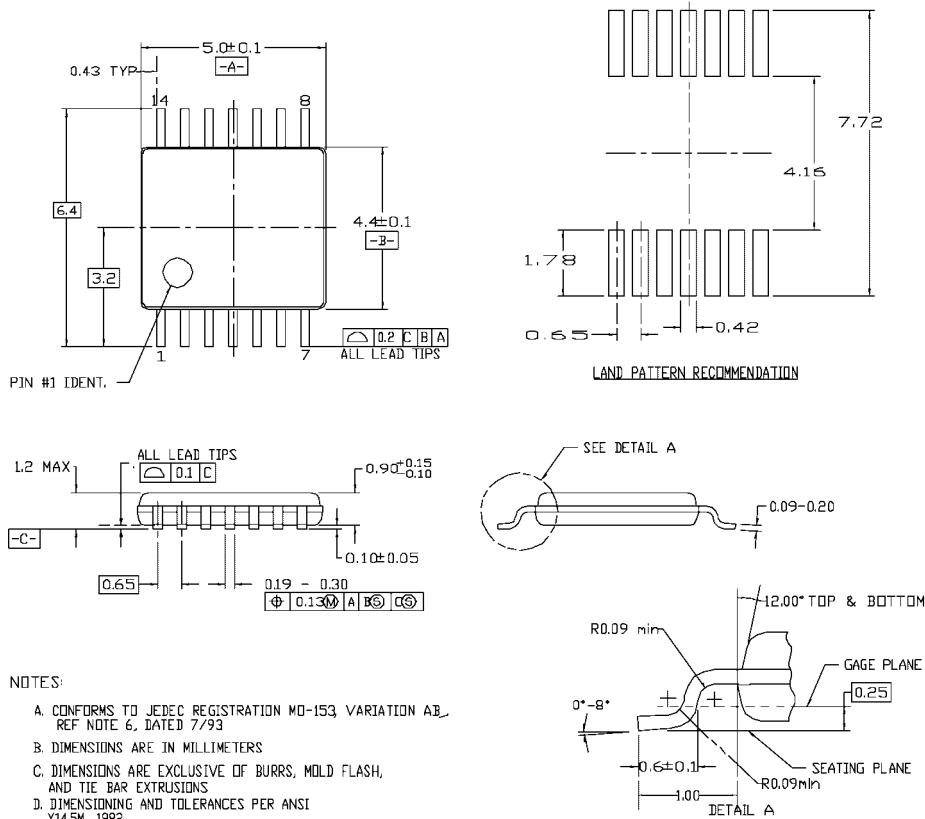
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 B. DIMENSIONS ARE IN MILLIMETERS.  
 C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M14DRevB1



**Pb-Free 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
 Package Number M14D**

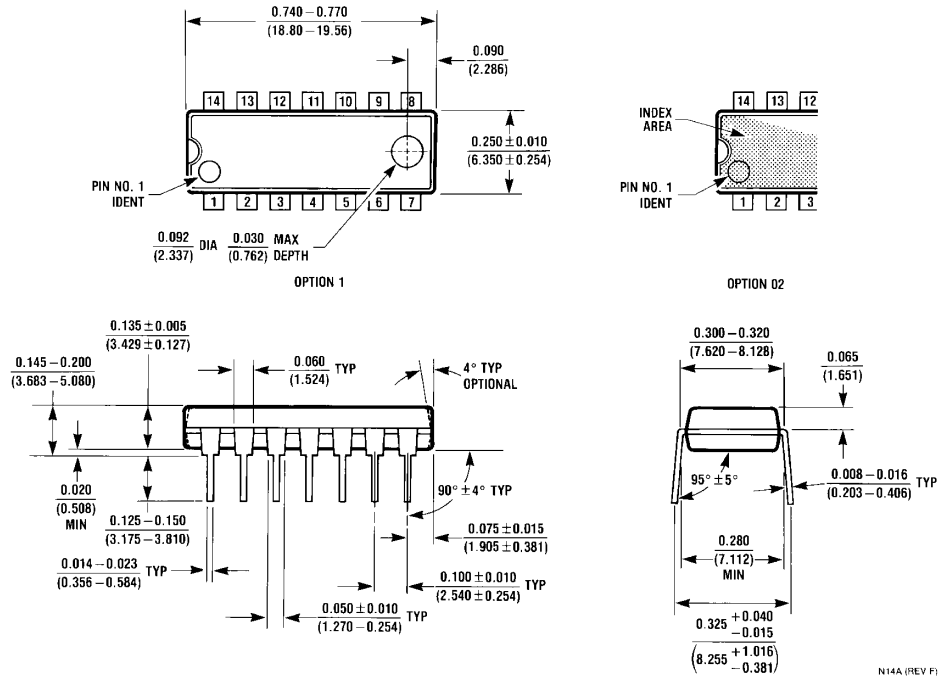
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



MTC14revD

**14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC14**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide Package Number N14A

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