FAIRCHILD SEMICONDUCTOR®

July 1993
Revised February 2005

74VHCU04
Hex Inverter

General Description

The VHCU04 is an advanced high speed CMOS Inverter fabricated with silicon gate CMOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

Since the internal circuit is composed of a single stage inverter, it can be used in analog applications such as crystal oscillators. An input protection circuit ensures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

Features

- High Speed: t_{PD} = 3.5 ns (typ) at V_{CC} = 5V
- Low Power Dissipation: I_{CC} = 2 μA (Max) @ T_A = 25°C
- High Noise Immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC} (Min)
- Power down protection is provided on all inputs
- Low Noise: V_{OLP} = 0.8V (Max)
- Pin and Function Compatible with 74HCU04

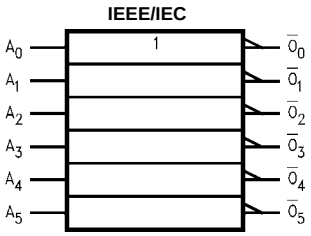
Ordering Code:

Order Number	Package Number	Package Description
74VHCU04M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHCU04MX_NL (Note 1)	M14A	Pb-Free 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHCU04SJ	M14D	Pb-Free 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74VHCU04MTC	MTC14	14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74VHCU04MTCX_NL (Note 1)	MTC14	Pb-Free 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74VHCU04N	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

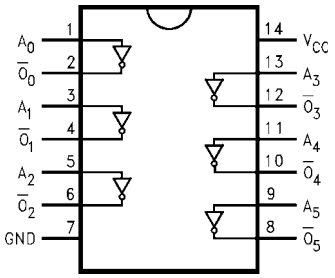
Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.
Pb-Free package per JEDEC J-STD-020B.

Note 1: "_NL" indicates Pb-Free package (per JEDEC J-STD-020B). Device available in Tape and Reel only.

Logic Symbol



Connection Diagram



Pin Descriptions

Pin Names	Description
A_n	Inputs
$\overline{O}_n$	Outputs

Truth Table

A	$\overline{O}$
L	H
H	L

Absolute Maximum Ratings (Note 2)

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Voltage (V_{IN})	−0.5V to +7.0V
DC Output Voltage (V_{OUT})	−0.5V to V_{CC} + 0.5V
Input Diode Current (I_{IK})	−20 mA
Output Diode Current (I_{OK})	±20 mA
DC Output Current (I_{OUT})	±25 mA
DC V_{CC}/GND Current (I_{CC})	±50 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C

Recommended Operating Conditions (Note 3)

Supply Voltage (V_{CC})	2.0V to +5.5V
Input Voltage (V_{IN})	0V to +5.5V
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_{OPR})	−40°C to +85°C

Note 2: Absolute Maximum Ratings are values beyond which the device may be damaged or have its useful life impaired. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation outside databook specifications.

Note 3: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	T_A = 25°C			T_A = −40°C to +85°C		Units	Conditions	
			Min	Typ	Max	Min	Max			
V_{IH}	HIGH Level Input Voltage	2.0	1.70			1.70		V		
		3.0 – 5.5	0.8 V_{CC}			0.8 V_{CC}				
V_{IL}	LOW Level Input Voltage	2.0			0.30		0.30	V		
		3.0 – 5.5			0.20 V_{CC}		0.20 V_{CC}			
V_{OH}	HIGH Level Output Voltage	2.0	1.8	2.0		1.8		V	V_{IN} = V_{IL}	I_{OH} = −50 μA
		3.0	2.7	3.0		2.7				
		4.5	4.0	4.5		4.0				
		3.0	2.58			2.48		V	V_{IN} = GND	I_{OH} = −4 mA
		4.5	3.94			3.80				I_{OH} = −8 mA
V_{OL}	LOW Level Output Voltage	2.0		0.0	0.2		0.2	V	V_{IN} = V_{IH}	I_{OL} = 50 μA
		3.0		0.0	0.3		0.3			
		4.5		0.0	0.5		0.5			
		3.0			0.36		0.44	V	V_{IN} = V_{CC}	I_{OL} = 4 mA
		4.5			0.36		0.44			I_{OL} = 8 mA
I_{IN}	Input Leakage Current	0 – 5.5			±0.1		±1.0	μA	V_{IN} = 5.5V or GND	
I_{CC}	Quiescent Supply Current	5.5			2.0		20.0	μA	V_{IN} = V_{CC} or GND	

Noise Characteristics

Symbol	Parameter	V_{CC} (V)	$T_A = 25°C$		Units	Conditions
			Typ	Limits		
V_{OLP} (Note 4)	Quiet Output Maximum Dynamic V_{OL}	5.0	0.5	0.8	V	$C_L = 50$ pF
V_{OLV} (Note 4)	Quiet Output Minimum Dynamic V_{OL}	5.0	−0.5	−0.8	V	$C_L = 50$ pF
V_{IHD} (Note 4)	Minimum HIGH Level Dynamic Input Voltage	5.0		4.0	V	$C_L = 50$ pF
V_{ILD} (Note 4)	Maximum LOW Level Dynamic Input Voltage	5.0		1.0	V	$C_L = 50$ pF

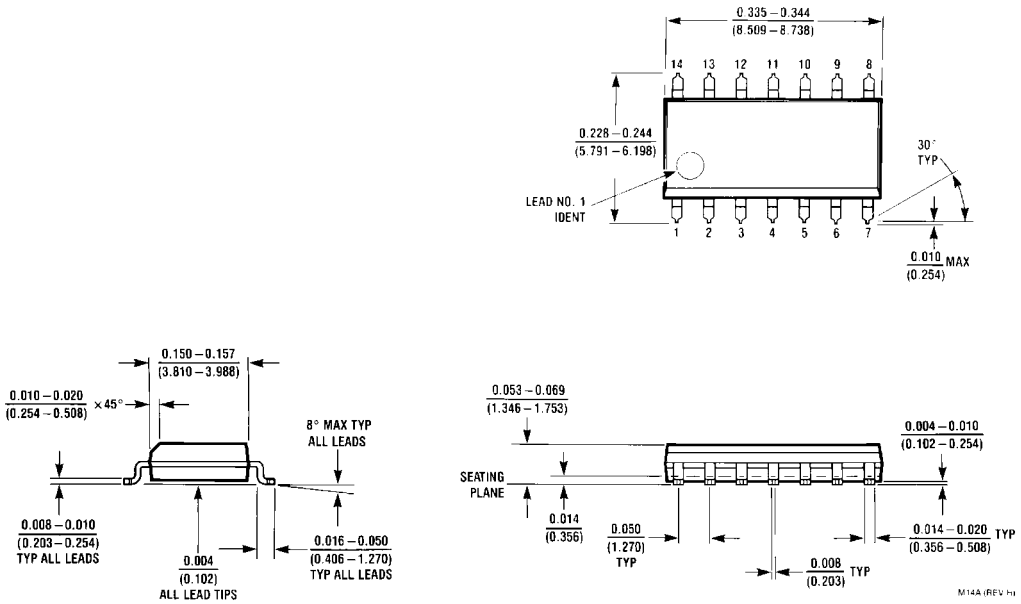
Note 4: Parameter guaranteed by design.

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V)	$T_A = 25°C$			$T_A = -40°C$ to $+85°C$		Units	Conditions
			Min	Typ	Max	Min	Max		
t_{PHL} t_{PLH}	Propagation Delay	3.3 ± 0.3		5.0	8.9	1.0	10.5	ns	$C_L = 15$ pF
				7.5	11.4	1.0	13.0		$C_L = 50$ pF
		5.0 ± 0.5		3.5	5.5	1.0	6.5	ns	$C_L = 15$ pF
				5.0	7.0	1.0	8.0		$C_L = 50$ pF
C_{IN}	Input Capacitance			5	10		10	pF	V_{CC} = Open
C_{PD}	Power Dissipation Capacitance			9				pF	(Note 5)

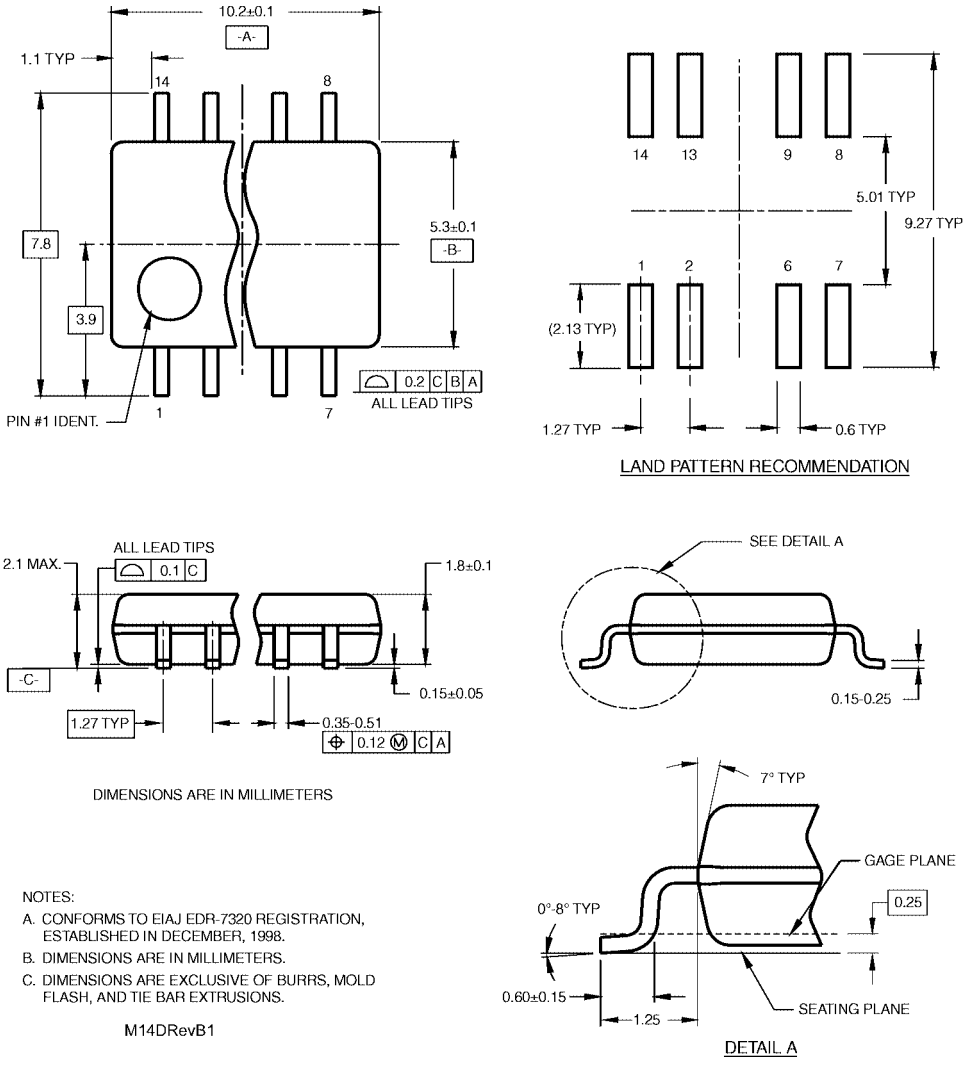
Note 5: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I_{CC} (opr.) = $C_{PD} * V_{CC} * f_{IN} + I_{CC}/6$ (per gate).

Physical Dimensions inches (millimeters) unless otherwise noted



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

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



NOTES:

A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.

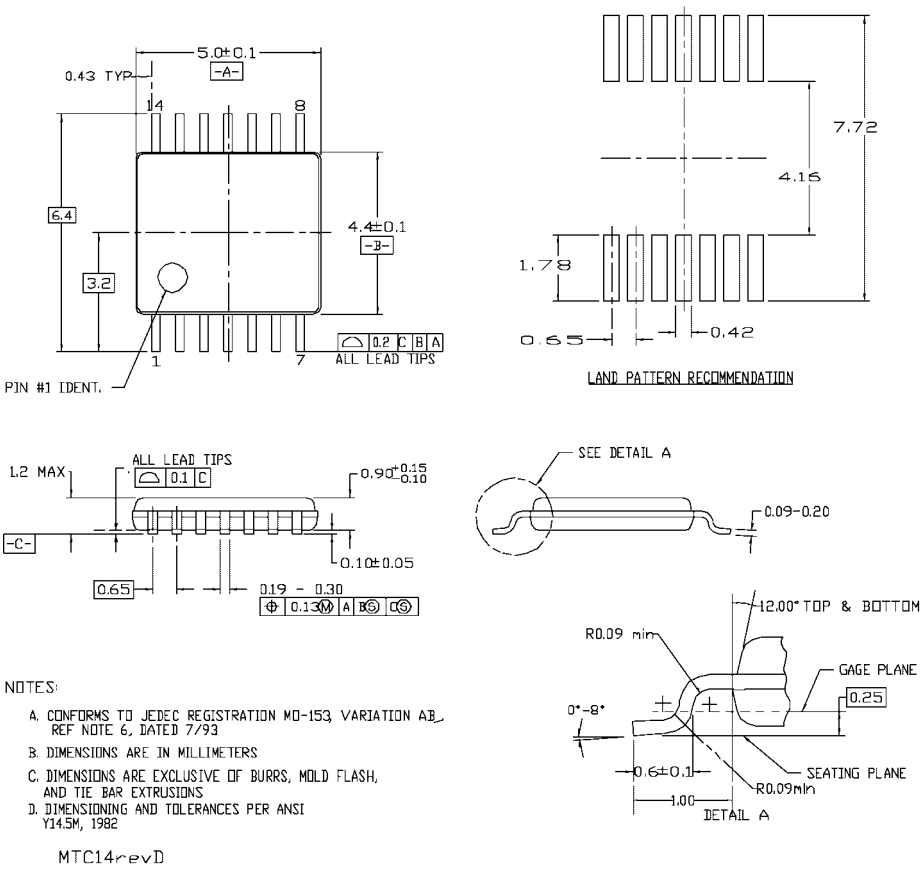
B. DIMENSIONS ARE IN MILLIMETERS.

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)



NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6, DATED 7/93

B. DIMENSIONS ARE IN MILLIMETERS

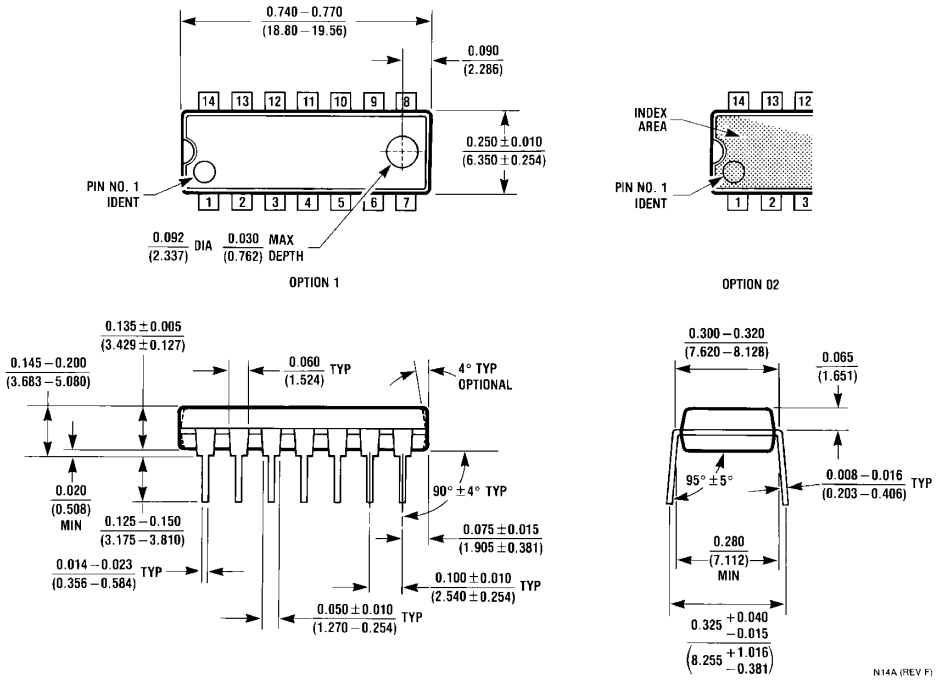
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS

D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1982

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