

# 74VHCU04

## Hex Inverter

### Features

- High Speed:  $t_{PD} = 3.5\text{ns}$  (typ.) at  $V_{CC} = 5\text{V}$
- Low Power Dissipation:  $I_{CC} = 2\mu\text{A}$  (max.) @  $T_A = 25^\circ\text{C}$
- High Noise Immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min.)
- Power down protection is provided on all inputs
- Low Noise:  $V_{OLP} = 0.8\text{V}$  (max.)
- Pin and Function Compatible with 74HCU04

### 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.

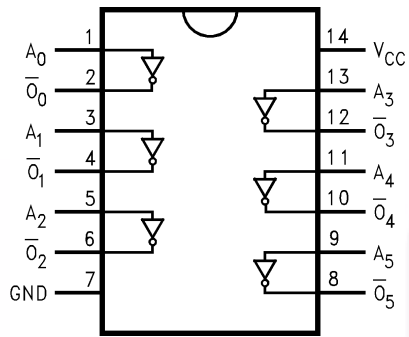
### Ordering Information

Order Number	Package Number	Package Description
74VHCU04M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHCU04SJ	M14D	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

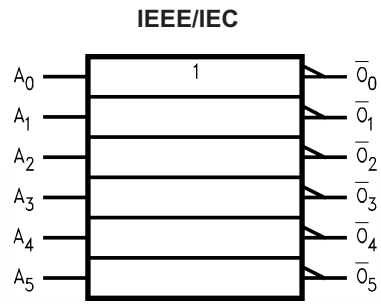
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.

 All packages are lead free per JEDEC: J-STD-020B standard.

**Connection Diagram**



**Logic Symbol**



**Pin Description**

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

**Truth Table**

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



## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

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

## Recommended Operating Conditions<sup>(1)</sup>

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Rating
$V_{CC}$	Supply Voltage	2.0V to +5.5V
$V_{IN}$	Input Voltage	0V to +5.5V
$V_{OUT}$	Output Voltage	0V to $V_{CC}$
$T_{OPR}$	Operating Temperature	-40°C to +85°C

### Note:

- Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions		T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Units
					Min.	Typ.	Max.	Min.	Max.	
V <sub>IH</sub>	HIGH Level Input Voltage	2.0			1.70			1.70		V
		3.0–5.5			0.8 x V <sub>CC</sub>			0.8 x V <sub>CC</sub>		
V <sub>IL</sub>	LOW Level Input Voltage	2.0					0.30		0.30	V
		3.0–5.5					0.2 x V <sub>CC</sub>		0.2 x V <sub>CC</sub>	
V <sub>OH</sub>	HIGH Level Output Voltage	2.0	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -50μA	1.8	2.0		1.8		V
		3.0			2.7	3.0		2.7		
		4.5			4.0	4.5		4.0		
		3.0	V <sub>IN</sub> = GND	I <sub>OH</sub> = -4mA	2.58			2.48		
		4.5			I <sub>OH</sub> = -8mA	3.94			3.80	
V <sub>OL</sub>	LOW Level Output Voltage	2.0	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 50μA			0.0	0.2		0.2
		3.0				0.0	0.3		0.3	
		4.5				0.0	0.5		0.5	
		3.0	V <sub>IN</sub> = V <sub>CC</sub>	I <sub>OL</sub> = 4mA			0.36		0.44	
		4.5			I <sub>OL</sub> = 8mA			0.36		0.44
I <sub>IN</sub>	Input Leakage Current	0–5.5	V <sub>IN</sub> = 5.5V or GND					±0.1		±1.0
I <sub>CC</sub>	Quiescent Supply Current	5.5	V <sub>IN</sub> = V <sub>CC</sub> or GND				2.0		20.0	μA

## Noise Characteristics

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = 25°C		Units
				Typ.	Limits	
V <sub>OLP</sub> <sup>(2)</sup>	Quiet Output Maximum Dynamic V <sub>OL</sub>	5.0	C <sub>L</sub> = 50pF	0.5	0.8	V
V <sub>OLV</sub> <sup>(2)</sup>	Quiet Output Minimum Dynamic V <sub>OL</sub>	5.0	C <sub>L</sub> = 50pF	-0.5	-0.8	V
V <sub>IHD</sub> <sup>(2)</sup>	Minimum HIGH Level Dynamic Input Voltage	5.0	C <sub>L</sub> = 50pF		4.0	V
V <sub>ILD</sub> <sup>(2)</sup>	Maximum LOW Level Dynamic Input Voltage	5.0	C <sub>L</sub> = 50pF		1.0	V

**Note:**

2. Parameter guaranteed by design.

## AC Electrical Characteristics

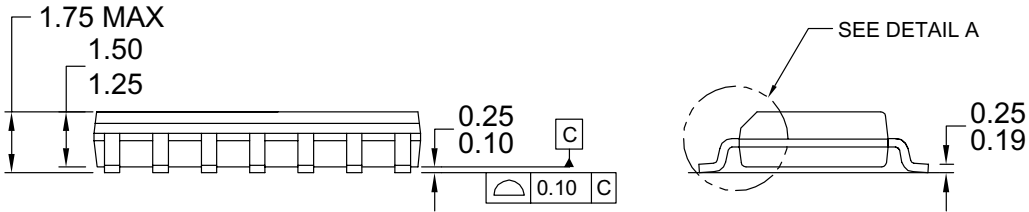
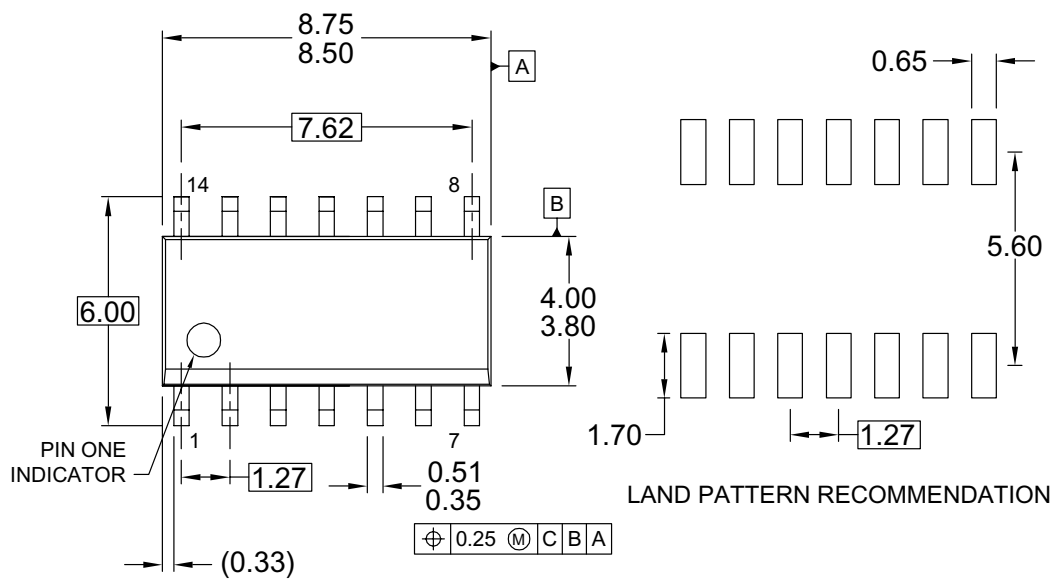
Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay	3.3 ± 0.3	C <sub>L</sub> = 15pF		5.0	8.9	1.0	10.5	ns
			C <sub>L</sub> = 50pF		7.5	11.4	1.0	13.0	
		5.0 ± 0.5	C <sub>L</sub> = 15pF		3.5	5.5	1.0	6.5	ns
			C <sub>L</sub> = 50pF		5.0	7.0	1.0	8.0	
C <sub>IN</sub>	Input Capacitance		V <sub>CC</sub> = Open		5	10		10	pF
C <sub>PD</sub>	Power Dissipation Capacitance		<sup>(3)</sup>		9				pF

**Note:**

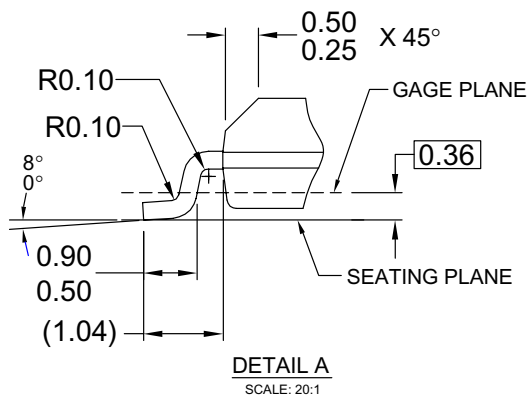
3. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 6 \text{ (per gate).}$$

**Physical Dimensions**



NOTES: UNLESS OTHERWISE SPECIFIED



- A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AB, ISSUE C,
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) LANDPATTERN STANDARD: SOIC127P600X145-14M
- E) DRAWING CONFORMS TO ASME Y14.5M-1994
- F) DRAWING FILE NAME: M14AREV13

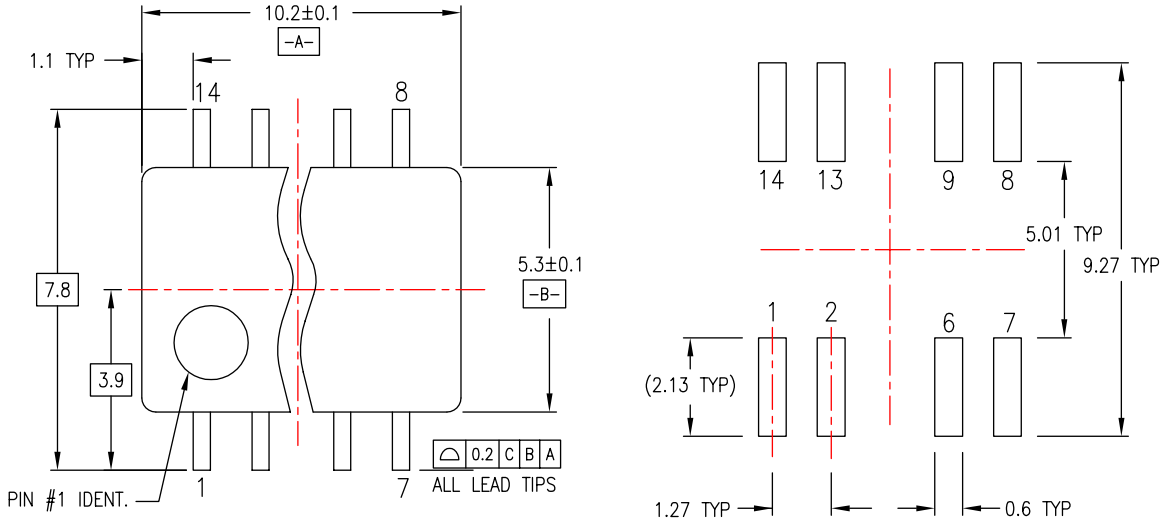
**Figure 1. 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow**

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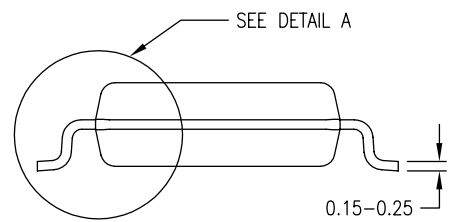
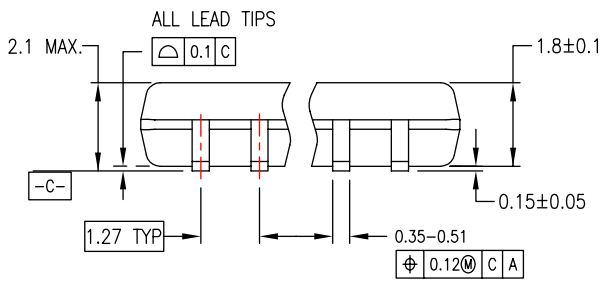
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**Physical Dimensions (Continued)**

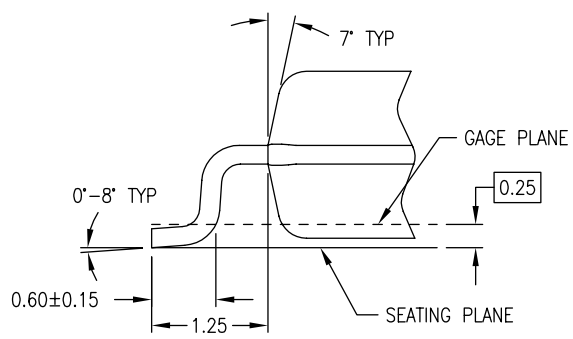


LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS

- 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.



DETAIL A

M14DREVC

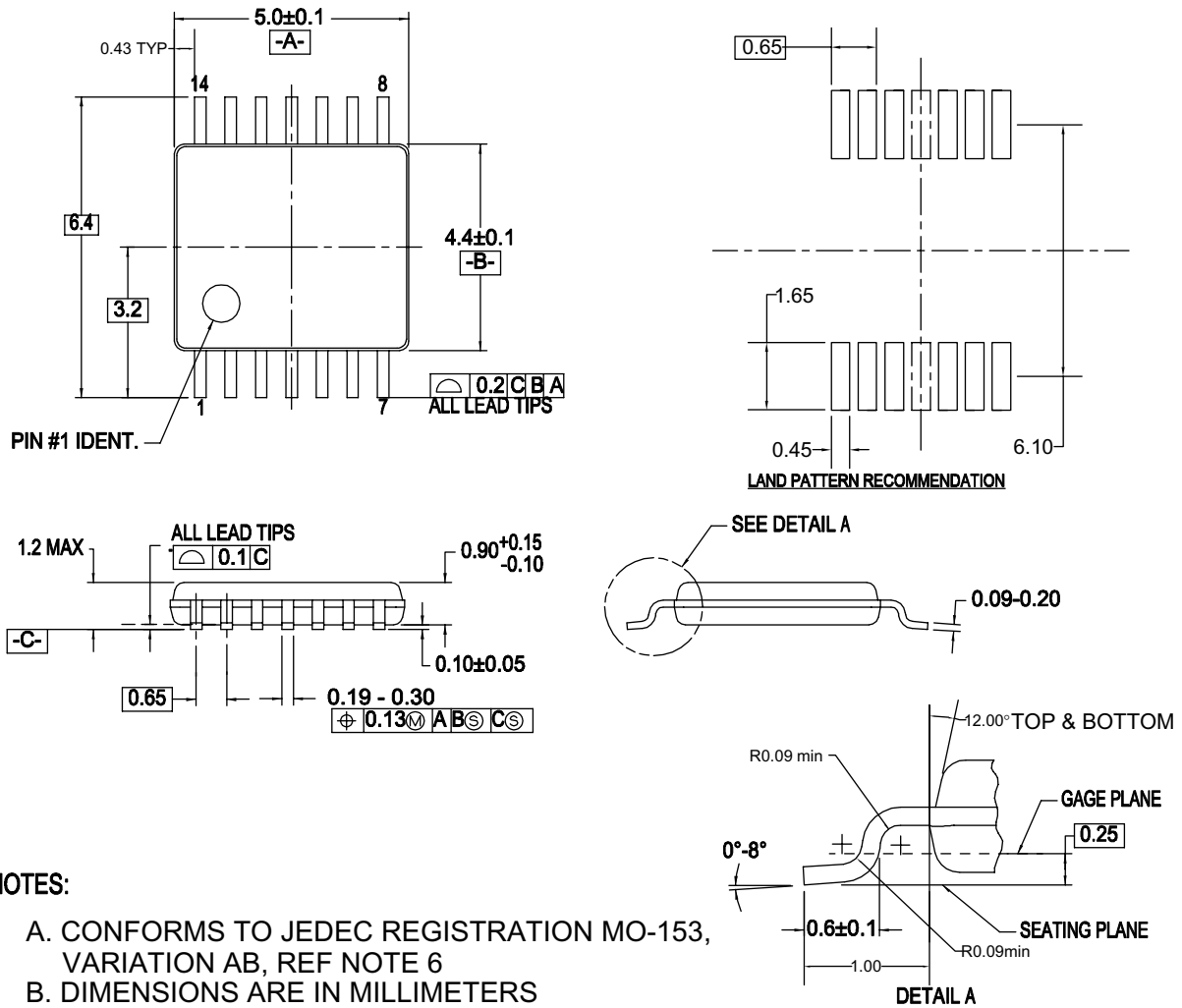
**Figure 2. 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide**

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Physical Dimensions (Continued)



NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6
- 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
- E. LANDPATTERN STANDARD: SOP65P640X110-14M
- F. DRAWING FILE NAME: MTC14REV6

Figure 3. 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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

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