

74VHC04 • 74VHCT04 Hex Inverter

General Description

The VHC/VHCT04 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.

The internal circuit is composed of 3 stages including buffer output, which provide high noise immunity and stable output. An input protection circuit ensures that 0V–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 back up. This circuit prevents device destruction due to mismatched supply and input voltages.

Features

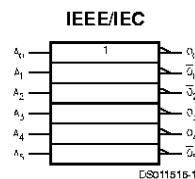
- High Speed:
VHC $t_{pd} = 3.8$ ns (typ) at $V_{CC} = 5V$
VHCT $t_{pd} = 4.7$ ns (typ) at $V_{CC} = 5V$
- High noise immunity:
VHC $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (Min)
VHCT $V_{IH} = 2.0V$, $V_{IL} = 0.8V$
- Power down protection:
VHC inputs only
VHCT inputs and outputs
- Low Noise:
VHC $V_{OLP} = 0.4V$ (typ)
VHCT $V_{OLP} = 0.8V$ (typ)
- Low power dissipation:
 $I_{CC} = 2 \mu A$ (Max) @ $T_A = 25^\circ C$
- Pin and function compatible with 74HC/HCT04

Ordering Code:

Commercial	Package Number	Package Description
74VHC04M	M14A	14-Lead Molded JEDEC SOIC
74VHC04SJ	M14D	14-Lead Molded EIAJ SOIC
74VHC04MTC	MTC14	14-Lead Molded JEDEC Type 1 TSSOP
74VHC04N	N14A	14-Lead Molded DIP
74VHCT04M	M14A	14-Lead Molded JEDEC SOIC
74VHCT04SJ	M14D	14-Lead Molded EIAJ SOIC
74VHCT04MTC	MTC14	14-Lead Molded JEDEC Type 1 TSSOP
74VHCT04N	N14A	14-Lead Molded DIP

Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter 'X' to the ordering code.

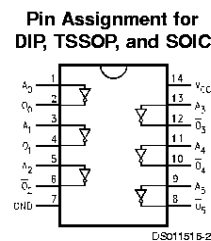
Logic Symbol



Pin Descriptions

Pin Names	Description
A_n	Inputs
O_n	Outputs

Connection Diagram



Truth Table

A	O
L	H
H	L

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Voltage (V_{IN})	−0.5V to +7.0V
DC Output Voltage (V_{OUT})	
VHC	−0.5V to $V_{CC} + 0.5V$
VHCT (Note 2)	−0.5V to 7.0V
Input Diode Current (I_{IK})	−20 mA
Output Diode Current (I_{OK})	
VHC	±20 mA
VHCT	−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})	
VHC	2.0V to +5.5V
VHCT	4.5V to +5.5V
Input Voltage (V_{IN})	0V to +5.5V
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_{OPR})	
74VHC/VHCT	−40°C to +85°C
Input Rise and Fall Time (t_r, t_f)	
$V_{CC} = 3.3V \pm 0.3V$ (VHC only)	0 ~ 100 ns/V
$V_{CC} = 5.0V \pm 0.5V$	0 ~ 20 ns/V

Note 1: 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 2: $V_{OUT} > V_{CC}$ only if output is in H state.

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

DC Electrical Characteristics for VHC

Symbol	Parameter	V_{CC} (V)	$T_A = 25^\circ C$			$T_A = -40^\circ C$ to $+85^\circ C$		Units	Conditions	
			Min	Typ	Max	Min	Max			
V_{IH}	High Level Input Voltage	2.0 3.0–5.5	1.50 0.7 V_{CC}			1.50 0.7 V_{CC}		V		
V_{IL}	Low Level Input Voltage	2.0 3.0–5.5		0.50 0.3 V_{CC}		0.50 0.3 V_{CC}		V		
V_{OH}	High Level Output Voltage	2.0	1.9	2.0		1.9		V	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50 \mu A$
		3.0	2.9	3.0		2.9		V		
		4.5	4.4	4.5		4.4		V		
		3.0	2.58			2.48		V		$I_{OH} = -4 \text{ mA}$
		4.5	3.94			3.80		V		$I_{OH} = -8 \text{ mA}$
V_{OL}	Low Level Output Voltage	2.0		0.0	0.1		0.1	V	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = +50 \mu A$
		3.0		0.0	0.1		0.1	V		
		4.5		0.0	0.1		0.1	V		
		3.0			0.36		0.44	V		$I_{OL} = 4 \text{ mA}$
		4.5			0.36		0.44	V		$I_{OL} = 8 \text{ mA}$
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	

DC Electrical Characteristics for VHC

Symbol	Parameter	V_{CC} (V)	$T_A = 25^\circ C$		Units	Conditions
			Typ	Limits		
V_{OLP} (Note 4)	Quiet Output Maximum Dynamic V_{OL}	5.0	0.4	0.8	V	$C_L = 50 \text{ pF}$
V_{OLV} (Note 4)	Quiet Output Minimum Dynamic V_{OL}	5.0	−0.4	−0.8	V	$C_L = 50 \text{ pF}$
V_{IHD} (Note 4)	Minimum High Level Dynamic Input Voltage	5.0		3.5	V	$C_L = 50 \text{ pF}$
V_{ILD} (Note 4)	Maximum Low Level Dynamic Input Voltage	5.0		1.5	V	$C_L = 50 \text{ pF}$

Note 4: Parameter guaranteed by design.

DC Electrical Characteristics for VHCT

Symbol	Parameter	V _{CC} (V)	T _A = 25°C			Units	Conditions	
			Min	Typ	Max			
V _{IH}	High Level Input Voltage	4.5 5.5	2.0 2.0			V		
V _{IL}	Low Level Input Voltage	4.5 5.5			0.8 0.8	V		
V _{OH}	High Level Output Voltage	4.5	3.15 2.5	3.65		V	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -50 µA I _{OH} = -8 mA
V _{OL}	Low Level Output Voltage	4.5		0.0 0.36	0.1	V	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50 µA I _{OL} = 8 mA
I _{IN}	Input Leakage Current	0-5.5		±0.1		µA	V _{IN} = 5.5V or GND	
I _{CC}	Quiescent Supply Current	5.5		2.0		µA	V _{IN} = V _{CC} or GND	
I _{CCT}	Maximum I _{CC} /Input	5.5		1.35		mA	V _{IN} = 3.4V Other Inputs = V _{CC} or GND	
I _{OPD}	Output Leakage Current (Power Down State)	0.0		+0.5		µA	V _{OUT} = 5.5V	

DC Electrical Characteristics for VHCT

Symbol	Parameter	V _{CC} (V)	T _A = 25°C		Units	Conditions
			Typ	Limits		
V _{OLP} (Note 5)	Quiet Output Maximum Dynamic V _{OL}	5.0	0.8	1.0	V	C _L = 50 pF
V _{OLV} (Note 5)	Quiet Output Minimum Dynamic V _{OL}	5.0	-0.8	1.0	V	C _L = 50 pF
V _{IHD} (Note 5)	Minimum High Level Dynamic Input Voltage	5.0		2.0	V	C _L = 50 pF
V _{ILD} (Note 5)	Maximum Low Level Dynamic Input Voltage	5.0		0.8	V	C _L = 50 pF

Note 5: Parameter guaranteed by design

AC Electrical Characteristics for VHC

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	7.1	1.0	8.5	ns	C _L = 15 pF
				7.5	10.6	1.0	12.0		C _L = 50 pF
		5.0 ±0.5		3.8	5.5	1.0	6.5	ns	C _L = 15 pF
				5.3	7.5	1.0	8.5		C _L = 50 pF
C _{IN}	Input Capacitance			4	10		10	pF	V _{CC} = OPEN
C _{PD}	Power Dissipation Capacitance			18				pF	(Note 6)

Note 6: 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)

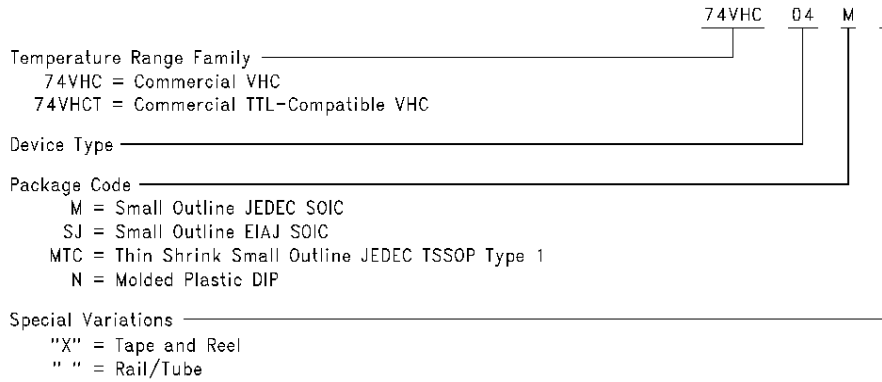
AC Electrical Characteristics for VHCT

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	5.0 ±0.5		4.7	6.7	1.0	7.5	ns	C _L = 15 pF
				5.5	7.7	1.0	8.5		C _L = 50 pF
C _{IN}	Input Capacitance			4	10		10	pF	V _{CC} = OPEN
C _{PD}	Power Dissipation Capacitance			14				pF	(Note 7)

Note 7: 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)

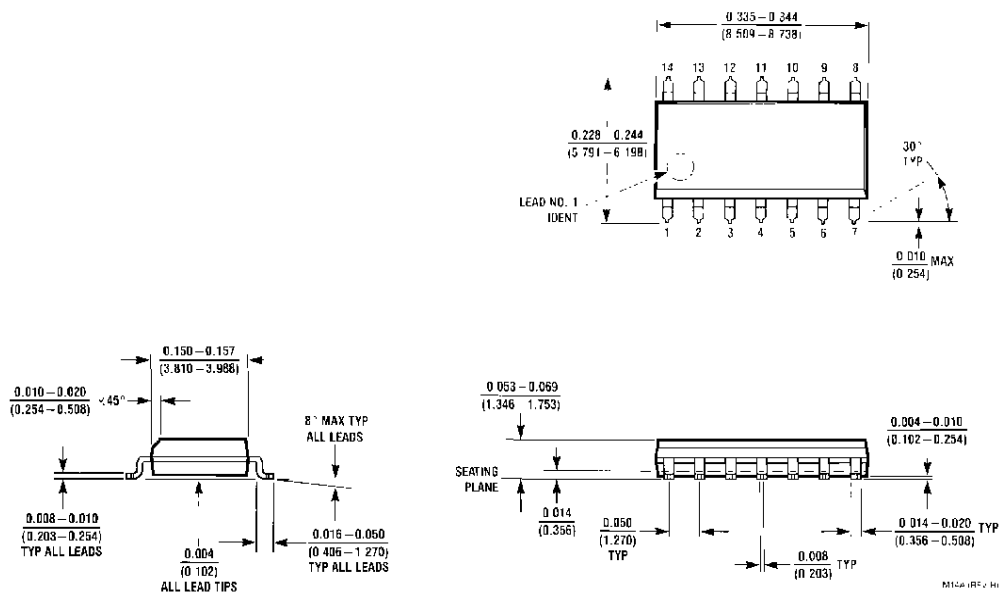
Ordering Information

The device number is used to form part of a simplified purchasing code, where the package type and temperature range are defined as follows:



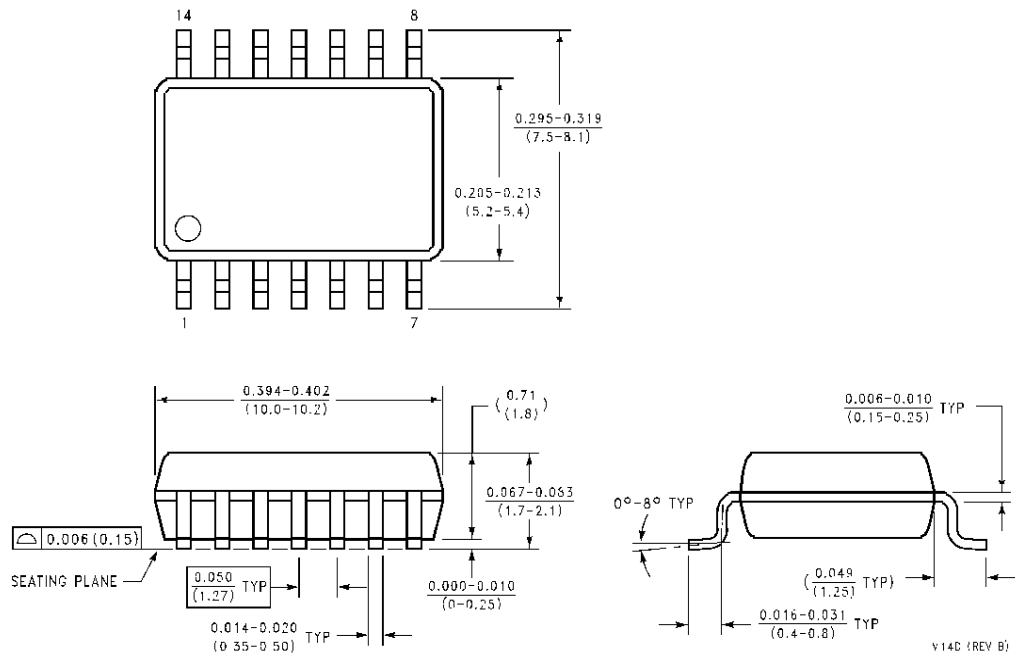
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Physical Dimensions inches (millimeters) unless otherwise noted

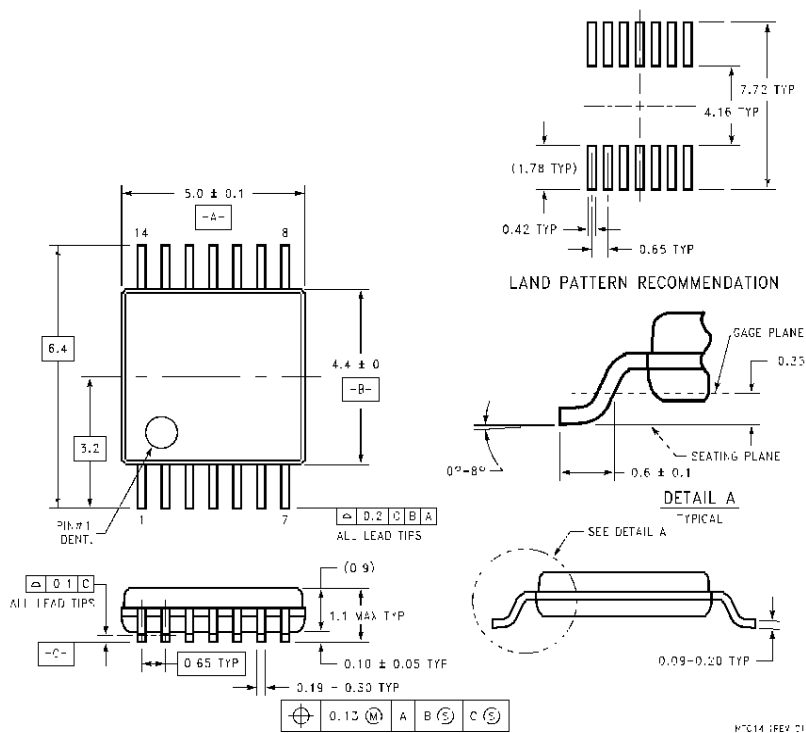


**14-Lead Small Outline Integrated Circuit JEDEC SOIC (M)
Package Number M14A**

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

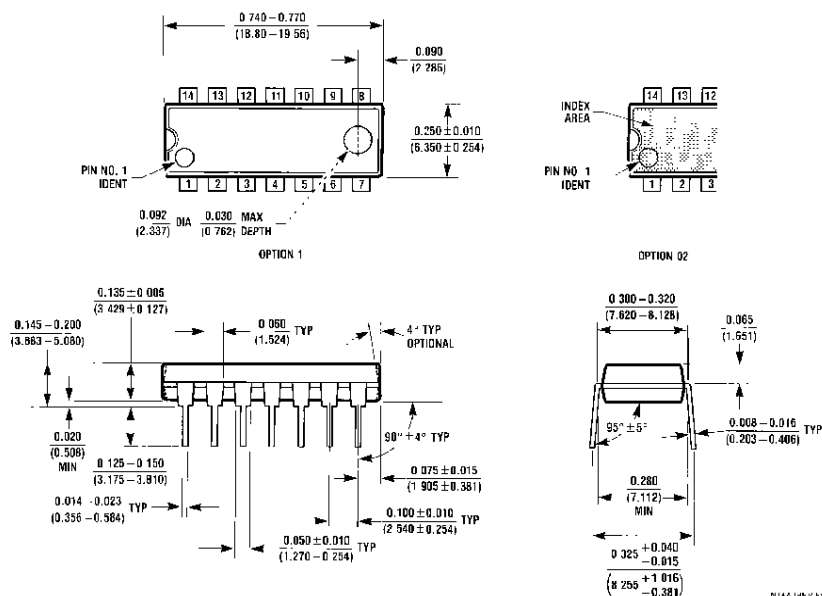


**14-Lead Small Outline Package—EIAJ SOIC (SJ)
Package Number M14D**

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

**14-Lead Plastic JEDEC TSSOP Type I (MTC)
Package Number MTC14**

PCC14 1FEV 21

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

14-Lead Molded DIP
Package Number N14A

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