

# HEX INVERTER (OPEN DRAIN)

- HIGH SPEED:  $t_{PD} = 3.8 \text{ns}$  (TYP.) at  $V_{CC} = 5 \text{V}$
- LOW POWER DISSIPATION:  $I_{CC} = 2 \mu A \text{ (MAX.)}$  at  $T_A = 25 \text{°C}$
- HIGH NOISE IMMUNITY: V<sub>NIH</sub> = V<sub>NIL</sub> = 28% V<sub>CC</sub> (MIN.)
- POWER DOWN PROTECTION ON INPUTS
- OPERATING VOLTAGE RANGE: V<sub>CC</sub>(OPR) = 2V to 5.5V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 05
- IMPROVED LATCH-UP IMMUNITY
- LOW NOISE: V<sub>OLP</sub> = 0.8V (MAX.)

#### **DESCRIPTION**

The 74VHC05 is an advanced high-speed CMOS OPEN DRAIN HEX INVERTER fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology.

The internal circuit is composed of 3 stages including buffer output, which provides high noise immunity and stable output.

Power down protection is provided on all inputs and 0 to 7V can be accepted on inputs with no

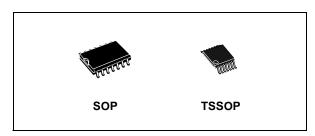


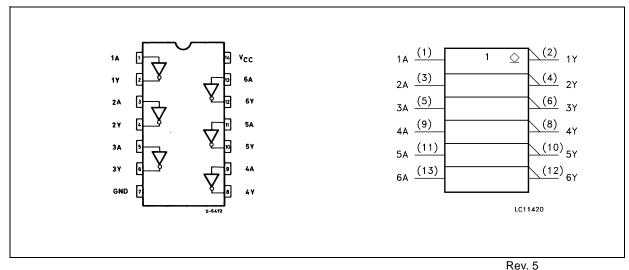
Table 1: Order Codes

PACKAGE	T & R
SOP	74VHC05MTR
TSSOP	74VHC05TTR

regard to the supply voltage. This device can be used to interface 5V to 3V.

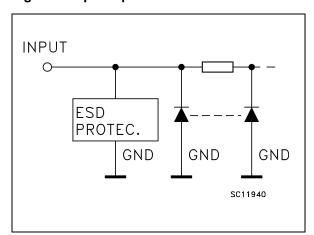
All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

Figure 1: Pin Connection And IEC Logic Symbols



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Figure 2: Input Equivalent Circuit



**Table 2: Pin Description** 

PIN N°	SYMBOL	NAME AND FUNCTION
1, 3, 5, 9, 11, 13	1A to 6A	Data Inputs
2, 4, 6, 8, 10, 12	1Y to 6Y	Data Outputs
7	GND	Ground (0V)
14	V <sub>CC</sub>	Positive Supply Voltage

**Table 3: Truth Table** 

Α	Υ
L	Z
Н	L

Z: High Impedance

**Table 4: Absolute Maximum Ratings** 

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	-0.5 to +7.0	V
V <sub>I</sub>	DC Input Voltage	-0.5 to +7.0	V
Vo	DC Output Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current	- 20	mA
I <sub>OK</sub>	DC Output Diode Current	± 20	mA
I <sub>O</sub>	DC Output Current	± 25	mA
I <sub>CC</sub> or I <sub>GND</sub>	DC V <sub>CC</sub> or Ground Current	± 75	mA
T <sub>stg</sub>	Storage Temperature	-65 to +150	°C
T <sub>L</sub>	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied

**Table 5: Recommended Operating Conditions** 

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	2 to 5.5	V
V <sub>I</sub>	Input Voltage	0 to 5.5	V
V <sub>O</sub>	Output Voltage	0 to V <sub>CC</sub>	V
T <sub>op</sub>	Operating Temperature	-55 to 125	°C
dt/dv	Input Rise and Fall Time (note 1) ( $V_{CC}$ = 3.3 $\pm$ 0.3V) ( $V_{CC}$ = 5.0 $\pm$ 0.5V)	0 to 100 0 to 20	ns/V

1)  $V_{\text{IN}}$  from 30% to 70% of  $V_{\text{CC}}$ 

**Table 6: DC Specifications** 

		Т	est Condition	Value							
Symbol	Parameter	v <sub>cc</sub>		T,	T <sub>A</sub> = 25°C		-40 to 85°C		-55 to 125°C		Unit
		(V)		Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
V <sub>IH</sub>	High Level Input	2.0		1.5			1.5		1.5		
	Voltage	3.0 to 5.5		0.7V <sub>CC</sub>			0.7V <sub>CC</sub>		0.7V <sub>CC</sub>		V
V <sub>IL</sub>	Low Level Input	2.0				0.5		0.5		0.5	
	Voltage	3.0 to 5.5				0.3V <sub>CC</sub>		0.3V <sub>CC</sub>		0.3V <sub>CC</sub>	V
V <sub>OL</sub>	Low Level Output	2.0	I <sub>O</sub> =50 μA		0.0	0.1		0.1		0.1	
	Voltage	3.0	I <sub>O</sub> =50 μA		0.0	0.1		0.1		0.1	
		4.5	I <sub>O</sub> =50 μA		0.0	0.1		0.1		0.1	V
		3.0	I <sub>O</sub> =4 mA			0.36		0.44		0.55	
		4.5	I <sub>O</sub> =8 mA			0.36		0.44		0.55	
I <sub>OZ</sub>	High Impedance Output Leakage Current	5.5	$V_I = V_{IH} \text{ or } V_{IL}$ $V_O = V_{CC} \text{ or GND}$			±0.25		± 2.5		± 2.5	μΑ
I <sub>I</sub>	Input Leakage Current	0 to 5.5	V <sub>I</sub> = 5.5V or GND			± 0.1		± 1		± 1	μΑ
I <sub>CC</sub>	Quiescent Supply Current	5.5	$V_I = V_{CC}$ or GND			2		20		20	μΑ

Table 7: AC Electrical Characteristics (Input  $t_r = t_f = 3ns$ )

				Test Condition			Value					
Symbol Parameter		Vcc	CL		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		Unit
		(V)	(pF)	Min.	Тур.	Max.	Min.	Max.	Min.	Max.		
t <sub>PZL</sub>	Output Enable	3.3 <sup>(*)</sup>	15	$R_L = 1 \text{ K}\Omega$		5.0	7.1	1.0	8.5	1.0	8.5	
	Time	3.3 <sup>(*)</sup>	50	$R_L = 1 K\Omega$		7.5	10.6	1.0	12.0	1.0	12.0	nc
		5.0 <sup>(**)</sup>	15	$R_L = 1 K\Omega$		3.8	5.5	1.0	6.5	1.0	6.5	ns
		5.0 <sup>(**)</sup>	50	$R_L = 1 K\Omega$		5.3	7.5	1.0	8.5	1.0	8.5	
to	Output Disable	3.3 <sup>(*)</sup>	50	$R_L = 1 K\Omega$		7.5	10.6	1.0	12.0	1.0	12.0	ns
t <sub>PLZ</sub>	Time	5.0 <sup>(**)</sup>	50	$R_L = 1 \text{ K}\Omega$		5.3	7.5	1.0	8.5	1.0	8.5	113

<sup>(\*)</sup> Voltage range is  $3.3\text{V} \pm 0.3\text{V}$  (\*\*) Voltage range is  $5.0\text{V} \pm 0.5\text{V}$ 

**Table 8: Capacitive Characteristics** 

		Test Condition		Value						
Symbol	Parameter		Т	<sub>A</sub> = 25°	С	-40 to	85°C	-55 to	125°C	Unit
			Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
C <sub>IN</sub>	Input Capacitance			6	10		10		10	pF
C <sub>OUT</sub>	Output Capacitance			8						pF
C <sub>PD</sub>	Power Dissipation Capacitance (note 1)			3						pF

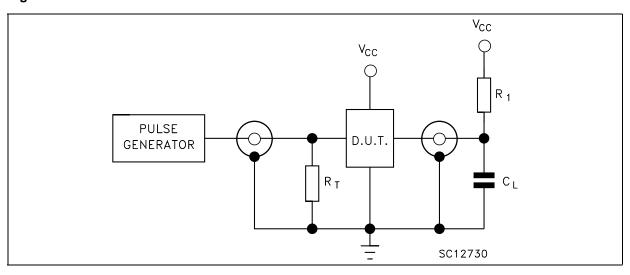
<sup>1)</sup>  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/6$  (per gate)

**Table 9: Dynamic Switching Characteristics** 

			Test Condition		Value						
Symbol	Symbol Parameter	v <sub>cc</sub>		T <sub>A</sub> = 25°C			-40 to	85°C	-55 to	-55 to 125°C	
		(V)		Min.	Тур.	Max.	Min.	Max.	Min.	Max.	
V <sub>OLP</sub>	Dynamic Low	- 0			0.4	0.8					.,
V <sub>OLV</sub>	Voltage Quiet Output (note 1, 2)	5.0		-0.8	-0.4						V
V <sub>IHD</sub>	Dynamic High Voltage Input (note 1, 3)	5.0	C <sub>L</sub> = 50 pF	3.5							V
V <sub>ILD</sub>	Dynamic Low Voltage Input (note 1, 3)	5.0				1.5					V

<sup>1)</sup> Worst case package.

Figure 3: Test Circuit

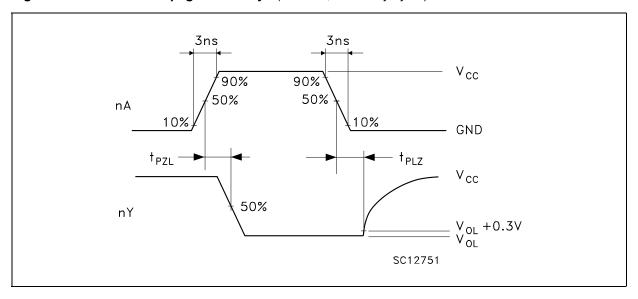


 $C_L$  = 15/50pF or equivalent (includes jig and probe capacitance)  $R_L$  = R1 = 1K $\Omega$  or equivalent  $R_T$  =  $Z_{OUT}$  of pulse generator (typically 50 $\Omega$ )

<sup>2)</sup> Max number of outputs defined as (n). Data inputs are driven 0V to 5.0V, (n-1) outputs switching and one output at GND.

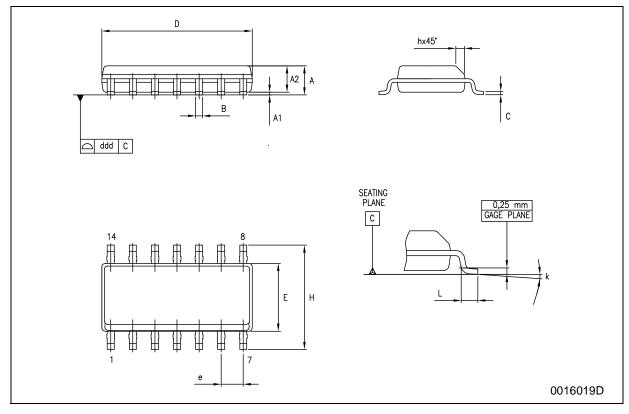
3) Max number of data inputs (n) switching. (n-1) switching 0V to 5.0V. Inputs under test switching: 5.0V to threshold (V<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>), f=1MHz.

Figure 4: Waveform - Propagation Delays (f=1MHz; 50% duty cycle)



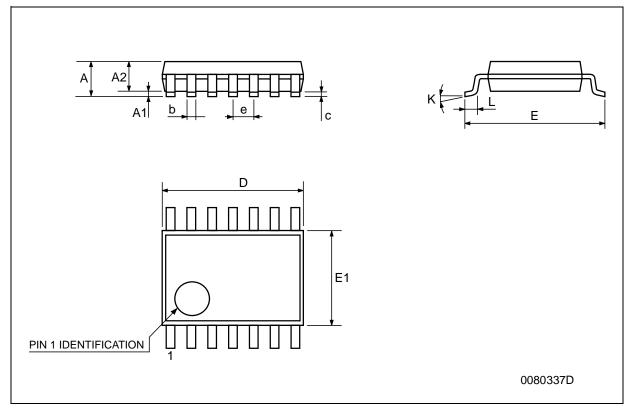
### **SO-14 MECHANICAL DATA**

DIM.		mm.		inch					
DIWI.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.			
Α	1.35		1.75	0.053		0.069			
A1	0.1		0.25	0.004		0.010			
A2	1.10		1.65	0.043		0.065			
В	0.33		0.51	0.013		0.020			
С	0.19		0.25	0.007		0.010			
D	8.55		8.75	0.337		0.344			
E	3.8		4.0	0.150		0.157			
е		1.27			0.050				
Н	5.8		6.2	0.228		0.244			
h	0.25		0.50	0.010		0.020			
L	0.4		1.27	0.016		0.050			
k	0°		8°	0°		8°			
ddd			0.100			0.004			



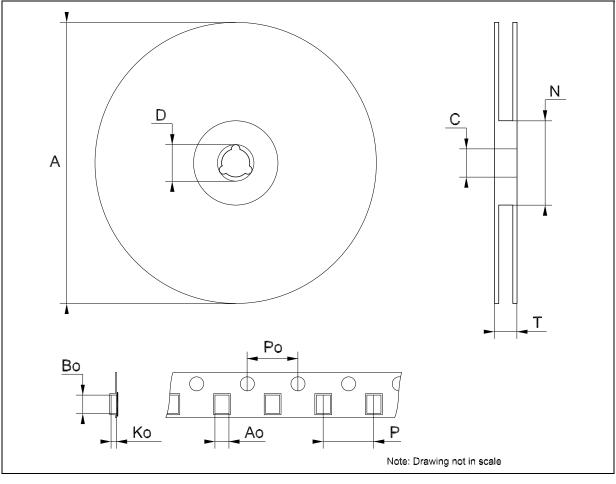
## **TSSOP14 MECHANICAL DATA**

DIM		mm.		inch				
DIM.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.		
А			1.2			0.047		
A1	0.05		0.15	0.002	0.004	0.006		
A2	0.8	1	1.05	0.031	0.039	0.041		
b	0.19		0.30	0.007		0.012		
С	0.09		0.20	0.004		0.0089		
D	4.9	5	5.1	0.193	0.197	0.201		
Е	6.2	6.4	6.6	0.244	0.252	0.260		
E1	4.3	4.4	4.48	0.169	0.173	0.176		
е		0.65 BSC			0.0256 BSC			
К	0°		8°	0°		8°		
L	0.45	0.60	0.75	0.018	0.024	0.030		



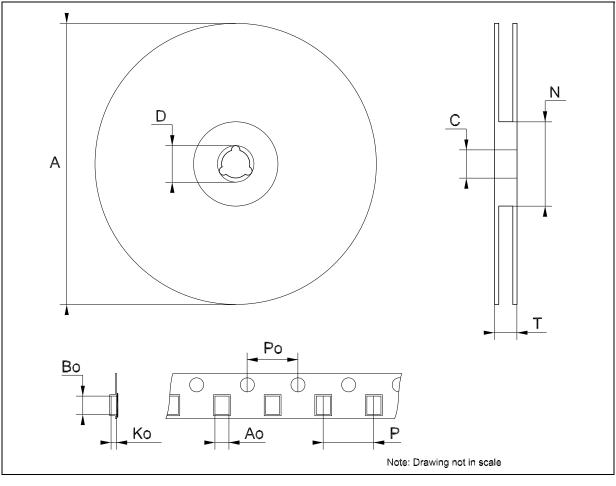
## Tape & Reel SO-14 MECHANICAL DATA

	mm.		inch				
MIN.	TYP	MAX.	MIN.	TYP.	MAX.		
		330			12.992		
12.8		13.2	0.504		0.519		
20.2			0.795				
60			2.362				
		22.4			0.882		
6.4		6.6	0.252		0.260		
9		9.2	0.354		0.362		
2.1		2.3	0.082		0.090		
3.9		4.1	0.153		0.161		
7.9		8.1	0.311		0.319		
	12.8 20.2 60 6.4 9 2.1 3.9	MIN. TYP  12.8  20.2  60  6.4  9  2.1  3.9	MIN.         TYP         MAX.           330         12.8         13.2           20.2         60         22.4           6.4         6.6         9           9         9.2           2.1         2.3           3.9         4.1	MIN.         TYP         MAX.         MIN.           330         12.8         13.2         0.504           20.2         0.795         0.795           60         2.362         22.4           6.4         6.6         0.252           9         9.2         0.354           2.1         2.3         0.082           3.9         4.1         0.153	MIN.         TYP         MAX.         MIN.         TYP.           12.8         13.2         0.504         0.795		



## Tape & Reel TSSOP14 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
А			330			12.992
С	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
Т			22.4			0.882
Ao	6.7		6.9	0.264		0.272
Во	5.3		5.5	0.209		0.217
Ko	1.6		1.8	0.063		0.071
Po	3.9		4.1	0.153		0.161
Р	7.9		8.1	0.311		0.319



#### **Table 10: Revision History**

Date	Revision	Description of Changes
12-Nov-2004	5	Order Codes Revision - pag. 1.

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