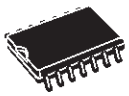
74VHCU04

HEX INVERTER (SINGLE STAGE)

PRELIMINARY DATA

- HIGH SPEED: t_{PD} = 3.5 ns (TYP.) at V_{CC} = 5V
- LOW POWER DISSIPATION:
  I_{CC} = 2 µA (MAX.) at T_A = 25 °C
- HIGH NOISE IMMUNITY:
  $V_{NIH} = V_{NIL}$ = 10% V_{CC} (MIN.)
- POWER DOWN PROTECTION ON INPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}| = I_{OL}$ = 8 mA (MIN)
- BALANCED PROPAGATION DELAYS:
  $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:
  V_{CC} (OPR) = 2V to 5.5V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 04
- IMPROVED LATCH-UP IMMUNITY
- LOW NOISE V_{OLP} = 0.8V (Max.)



M
(Micro Package)

T
(TSSOP Package)

ORDER CODES :
74VHCU04M

DESCRIPTION

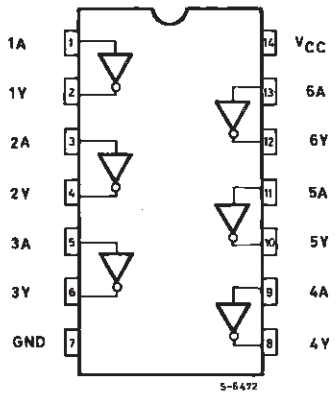
The 74VHCU04 is an advanced high-speed CMOS HEX INVERTER fabricated with sub-micron silicon gate and double-layer metal wiring C^2MOS technology. It has similar high speed performance of equivalent Bipolar Schottky TTL combined with true CMOS low power dissipation.

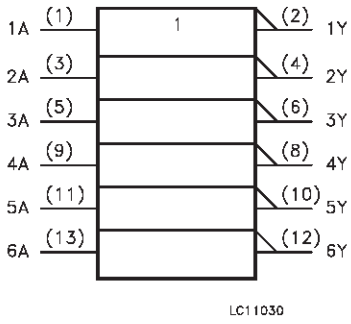
As the internal circuit is composed of a single stage inverter, it can be used in analog applications such as crystal oscillator.

Power down protection is provided on all inputs and 0 to 7V can be accepted on inputs with no regard to the supply voltage. This device can be used to interface 5V to 3V.

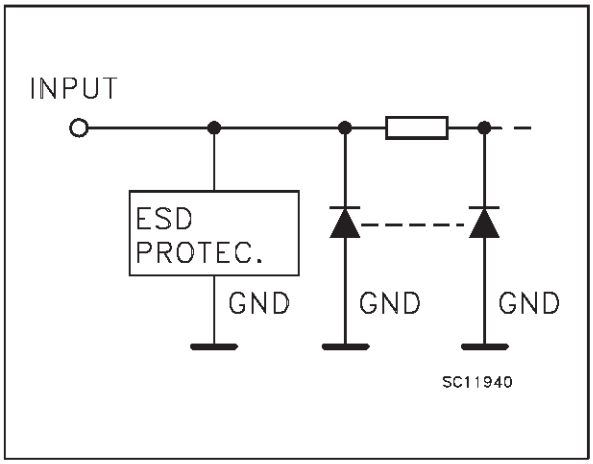
All inputs and outputs are equipped with protection circuits against static discharge, giving them 2kV ESD immunity and transient excess voltage.

PIN CONNECTION AND IEC LOGIC SYMBOLS





INPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

PIN No	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_{CC}	Positive Supply Voltage

TRUTH TABLE

A	Y
L	H
H	L

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to +7.0	V
V_I	DC Input Voltage	-0.5 to +7.0	V
V_O	DC Output Voltage	-0.5 to V_{CC} + 0.5	V
I_{IK}	DC Input Diode Current	- 20	mA
I_{OK}	DC Output Diode Current	$\pm$ 20	mA
I_O	DC Output Current	$\pm$ 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	$\pm$ 50	mA
T_{stg}	Storage Temperature	-65 to +150	^oC
T_L	Lead Temperature (10 sec)	300	^oC

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

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	2.0 to 5.5	V
V_I	Input Voltage	0 to 5.5	V
V_O	Output Voltage	0 to V_{CC}	V
T_{op}	Operating Temperature	-40 to +85	^oC
dt/dv	Input Rise and Fall Time (see note 1) (V_{CC} = 3.3 $\pm$ 0.3V) (V_{CC} = 5.0 $\pm$ 0.5V)	0 to 100 0 to 20	ns/V ns/V

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

DC SPECIFICATIONS

Symbol	Parameter	Test Conditions		Value					Unit
		V_{CC} (V)		T_A = 25 °C			-40 to 85 °C		
				Min.	Typ.	Max.	Min.	Max.	
V_{IH}	High Level Input Voltage	2.0		1.7			1.7		V
		3.0 to 5.5		0.8V_{CC}			0.8V_{CC}		
V_{IL}	Low Level Input Voltage	2.0				0.3		0.3	V
		3.0 to 5.5				0.2V_{CC}		0.2V_{CC}	
V_{OH}	High Level Output Voltage	2.0	I_O=-50 µA	1.8	2.0		1.8		V
		3.0	I_O=-50 µA	2.7	3.0		2.7		
		4.5	I_O=-50 µA	4.0	4.5		4.0		
		3.0	I_O=-4 mA	2.58			2.48		
		4.5	I_O=-8 mA	3.94			3.8		
V_{OL}	Low Level Output Voltage	2.0	I_O=50 µA		0.0	0.2		0.2	V
		3.0	I_O=50 µA		0.0	0.3		0.3	
		4.5	I_O=50 µA		0.0	0.5		0.5	
		3.0	I_O=4 mA			0.36		0.44	
		4.5	I_O=8 mA			0.36		0.44	
I_I	Input Leakage Current	0 to 5.5	V_I = 5.5V or GND			±0.1		±1.0	µA
I_{CC}	Quiescent Supply Current	5.5	V_I = V_{CC} or GND			2		20	µA

AC ELECTRICAL CHARACTERISTICS (Input t_r = t_f =3 ns)

Symbol	Parameter	Test Condition			Value					Unit
		V_{CC} (V)	C_L (pF)		T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay Time	3.3(*)	15			5.0	8.9	1.0	10.5	ns
		3.3(*)	50			7.5	11.4	1.0	13.0	
		5.0(**)	15			3.5	5.5	1.0	6.5	
		5.0(**)	50			5.0	7.0	1.0	8.0	

(*) Voltage range is 3.3V ± 0.3V
(**) Voltage range is 5V ± 0.5V

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions	Value					Unit
			T_A = 25 °C			-40 to 85 °C		
			Min.	Typ.	Max.	Min.	Max.	
C_{IN}	Input Capacitance			5	10		10	pF
C_{PD}	Power Dissipation Capacitance (note 1)			9				pF

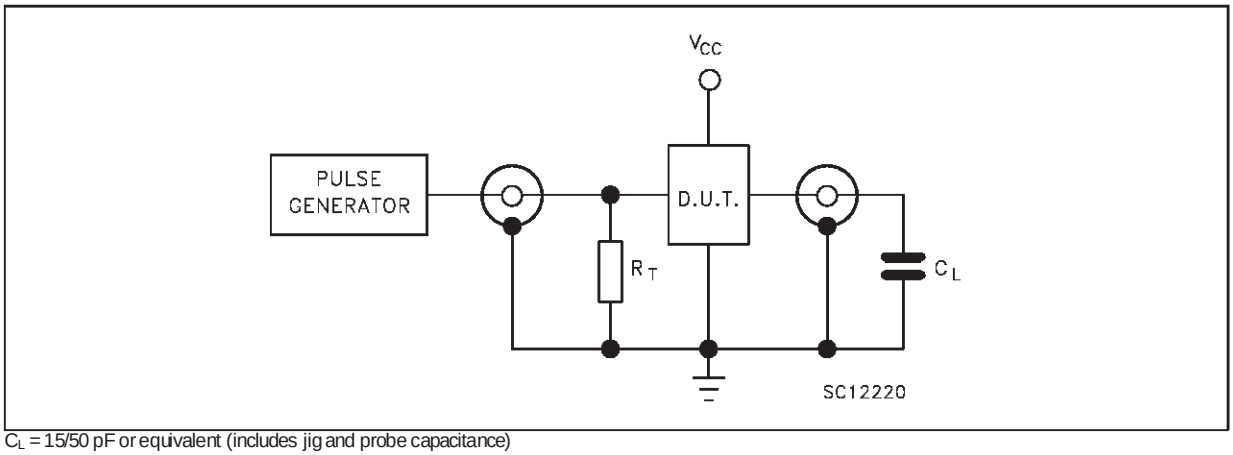
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}/6$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

DYNAMIC SWITCHING CHARACTERISTICS

Symbol	Parameter	Test Conditions		Value					Unit
		V_{CC} (V)		T_A = 25 °C			-40 to 85 °C		
				Min.	Typ.	Max.	Min.	Max.	
V_{OLP}	Dynamic Low Voltage Quiet Output (note 1, 2)	5.0	C_L = 50 pF		0.5	0.8			V
V_{OLV}				-0.8	-0.5				
V_{IHD}	Dynamic High Voltage Input (note 1, 3)	5.0		4.0					
V_{ILD}	Dynamic Low Voltage Input (note 1, 3)	5.0				1.0			

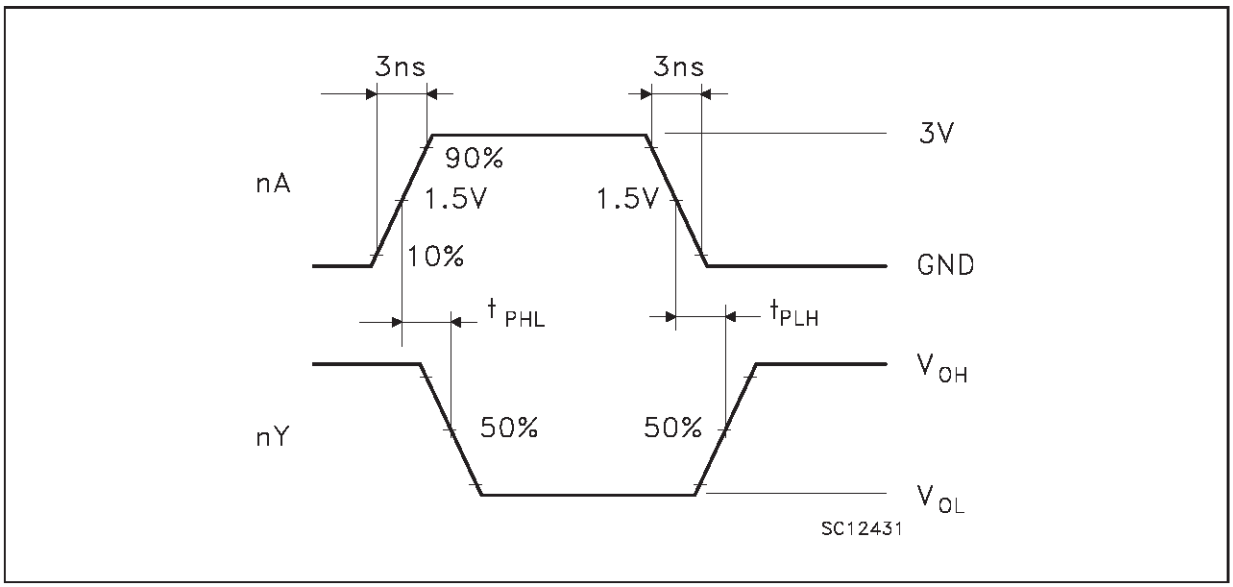
1) Worst case package.
2) Max number of outputs defined as (n). Data inputs are driven 0V to 5.0V, (n -1) outputs switching and one output at GND.
3) Max number of data inputs (n) switching. (n-1) switching 0V to 5.0V. Inputs under test switching: 5.0V to threshold (V_{ILD}), 0V to threshold (V_{IHD}), f=1MHz.

TEST CIRCUIT



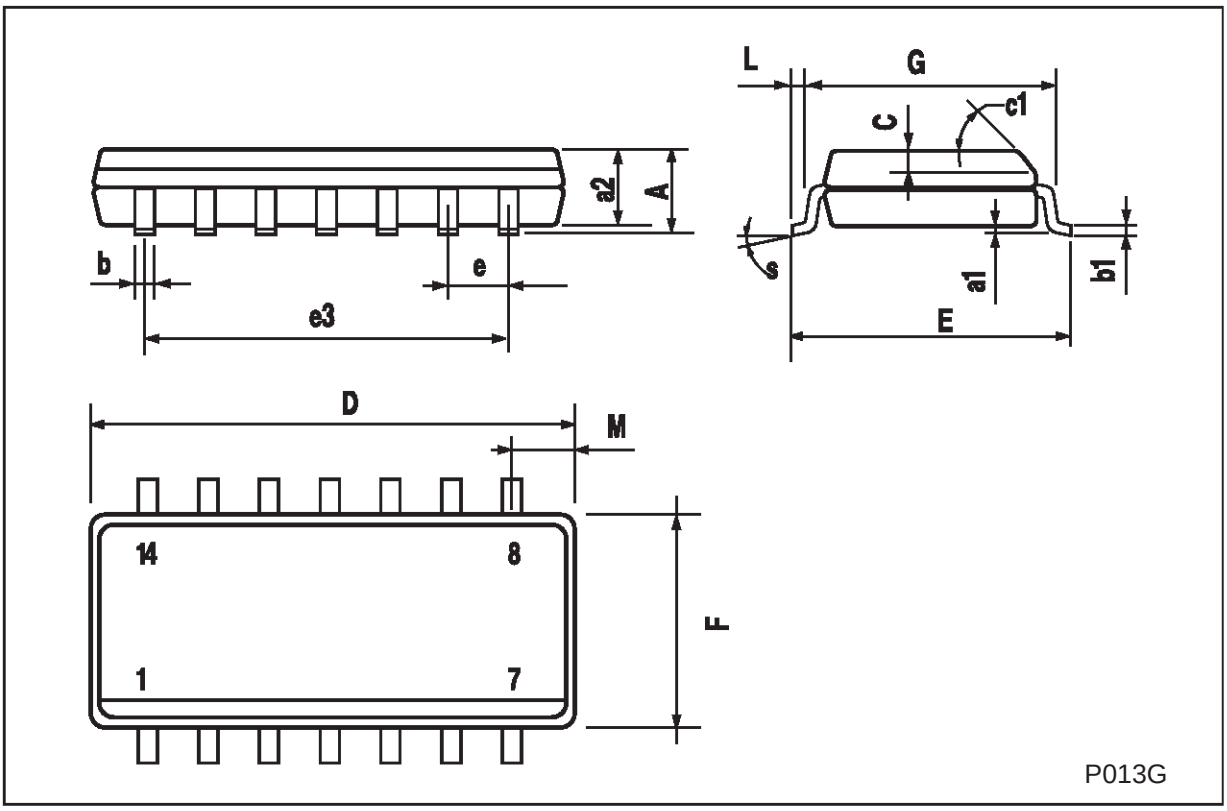
C_L = 15/50 pF or equivalent (includes jig and probe capacitance)
R_T = Z_{OUT} of pulse generator (typically 50Ω)

WAVEFORM: PROPAGATION DELAYS (f=1MHz; 50% duty cycle)



SO-14 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45 (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8 (max.)					



P013G

TSSOP14 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.1			0.433
A1	0.05	0.10	0.15	0.002	0.004	0.006
A2	0.85	0.9	0.95	0.335	0.354	0.374
b	0.19		0.30	0.0075		0.0118
c	0.09		0.20	0.0035		0.0079
D	4.9	5	5.1	0.193	0.197	0.201
E	6.25	6.4	6.5	0.246	0.252	0.256
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0^o	4^o	8^o	0^o	4^o	8^o
L	0.50	0.60	0.70	0.020	0.024	0.028