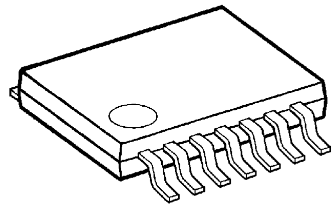
TENTATIVE TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VCX14FT

LOW-VOLTAGE HEX SCHMITT INVERTER WITH 3.6 V TOLERANT INPUTS AND OUTPUTS

The TC74VCX14FT is a high performance CMOS schmitt inverter. Designed for use in 1.8, 2.5 or 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.
It is also designed with over voltage tolerant inputs and outputs up to 3.6 V.
Pin configuration and function are the same as the TC74VCX04 but the inputs have hysteresis and with its schmitt trigger function, the TC74VCX14 can be used as a line receivers which will receive slow input signals.
All inputs are equipped with protection circuits against static discharge.



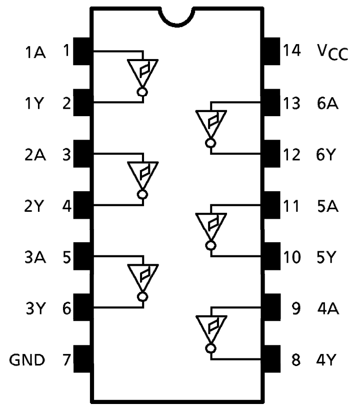
TSSOP14-P-0044-0.65

Weight : 0.06 g (Typ.)

FEATURES

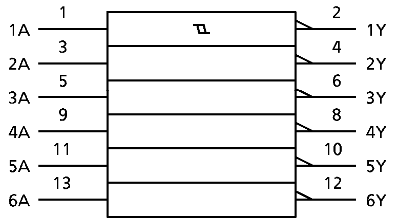
- Low voltage operation : V_{CC} = 1.8~3.6 V
- High speed operation : t_{pd} = TBD (max) at V_{CC} = 3.0~3.6 V
  t_{pd} = TBD (max) at V_{CC} = 2.3~2.7 V
  t_{pd} = TBD (max) at V_{CC} = 1.8 V
- Output current : I_{OH}/I_{OL} = ±24 mA (min) at V_{CC} = 3.0 V
  I_{OH}/I_{OL} = ±18 mA (min) at V_{CC} = 2.3 V
  I_{OH}/I_{OL} = ±6 mA (min) at V_{CC} = 1.8 V
- Latch-up performance : ±300 mA
- ESD performance : Human body model > ±2000 V
  Machine model > ±200 V
- Package : TSSOP
  (Thin Shrink Small Outline Package)
- Power down protection is provided on all inputs and outputs.

PIN ASSIGNMENT



(TOP VIEW)

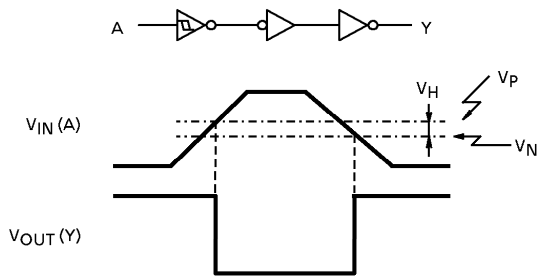
IEC LOGIC SYMBOL



TRUTH TABLE

INPUTS	OUTPUTS
A	Y
L	H
H	L

SYSTEM DIAGRAM, WAVEFORM



MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{CC}	−0.5~4.6	V
DC Input Voltage	V_{IN}	−0.5~4.6	V
DC Output Voltage	V_{OUT}	−0.5~4.6 (Note 1)	V
		−0.5~V_{CC} + 0.5 (Note 2)	
Input Diode Current	I_{IK}	−50	mA
Output Diode Current	I_{OK}	±50 (Note 3)	mA
DC Output Current	I_{OUT}	±50	mA
Power Dissipation	P_D	180	mW
DC V_{CC}/Ground Current	I_{CC}/I_{GND}	±100	mA
Storage Temperature	T_{stg}	−65~150	°C

(Note 1) : V_{CC} = 0 V
(Note 2) : High or Low State. I_{OUT} absolute maximum rating must be observed.
(Note 3) : V_{OUT} < GND, V_{OUT} > V_{CC}

RECOMMENDED OPERATING RANGE

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	1.8~3.6	V
		1.2~3.6 (Note 4)	
Input Voltage	V_{IN}	−0.3~3.6	V
Output Voltage	V_{OUT}	0~3.6 (Note 5)	V
		0~ V_{CC} (Note 6)	
Output Current	I_{OH} / I_{OL}	±24 (Note 7)	mA
		±18 (Note 8)	
		±6 (Note 9)	
Operating Temperature	T_{opr}	−40~85	°C

(Note 4) : Data Retention Only
(Note 5) : V_{CC} = 0 V
(Note 6) : High or Low State
(Note 7) : V_{CC} = 3.0~3.6 V
(Note 8) : V_{CC} = 2.3~2.7 V
(Note 9) : V_{CC} = 1.8 V

ELECTRICAL CHARACTERISTICS
DC characteristics (Ta = −40~85°C, 2.7 V < V_{CC} ≦ 3.6 V)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN	MAX	UNIT
Input Voltage	"H" Level	V_P			3.6	—	TBD	V
					3.0	—	TBD	
	"L" Level	V_{IN}			3.6	TBD	—	
					3.0	TBD	—	
Hysteresis Voltage		V_H			3.6	TBD	TBD	V
					3.0	TBD	TBD	
Output Voltage	"H" Level	V_{OH}	V_{IN} = V_{IL}	I_{OH} = −100 μA	2.7~3.6	V_{CC} − 0.2	—	V
				I_{OH} = −12 mA	2.7	2.2	—	
				I_{OH} = −18 mA	3.0	2.4	—	
				I_{OH} = −24 mA	3.0	2.2	—	
	"L" Level	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 100 μA	2.7~3.6	—	0.2	
				I_{OL} = 12 mA	2.7	—	0.4	
				I_{OL} = 18 mA	3.0	—	0.4	
				I_{OL} = 24 mA	3.0	—	0.55	
Input Leakage Current		I_{IN}	V_{IN} = 0~3.6 V		2.7~3.6	—	±5.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent Supply Current		I_{CC}	V_{IN} = V_{CC} or GND		2.7~3.6	—	20.0	μA
			V_{CC} ≦ V_{IN} ≦ 3.6 V		2.7~3.6	—	±20.0	
Increase In I_{CC} Per Input		ΔI_{CC}	V_{IH} = V_{CC} − 0.6 V		2.7~3.6	—	750	μA

DC characteristics (Ta = −40~85°C, 2.3 V ≦ V_{CC} ≦ 2.7 V)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN	MAX	UNIT
Input Voltage	"H" Level	V_P			2.3	—	TBD	V
	"L" Level	V_N			2.3	TBD	—	
Hysteresis Voltage		V_H			2.3	TBD	TBD	V
Output Voltage	"H" Level	V_{OH}	$V_{IN} = V_{IL}$	$I_{OH} = -100\ \mu A$	2.3~2.7	V_{CC} − 0.2	—	V
				$I_{OH} = -6$ mA	2.3	2.0	—	
				$I_{OH} = -12$ mA	2.3	1.8	—	
				$I_{OH} = -18$ mA	2.3	1.7	—	
	"L" Level	V_{OL}	$V_{IN} = V_{IH}$	$I_{OL} = 100\ \mu A$	2.3~2.7	—	0.2	
				$I_{OL} = 12$ mA	2.3	—	0.4	
				$I_{OL} = 18$ mA	2.3	—	0.6	
Input Leakage Current		I_{IN}	V_{IN} = 0~3.6 V		2.3~2.7	—	±5.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent Supply Current		I_{CC}	$V_{IN} = V_{CC}$ or GND		2.3~2.7	—	20.0	μA
			$V_{CC} \leqq V_{IN} \leqq 3.6$ V		2.3~2.7	—	±20.0	

DC characteristics (Ta = −40~85°C, 1.8 V ≦ V_{CC} < 2.3 V)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN	MAX	UNIT
Input Voltage	"H" Level	V_P			1.8	—	TBD	V
	"L" Level	V_N			1.8	TBD	—	
Hysteresis Voltage		V_H			1.8	TBD	TBD	V
Output Voltage	"H" Level	V_{OH}	$V_{IN} = V_{IL}$	$I_{OH} = -100\ \mu A$	1.8	V_{CC} − 0.2	—	V
				$I_{OH} = -6$ mA	1.8	1.4	—	
	"L" Level	V_{OL}	$V_{IN} = V_{IH}$	$I_{OL} = 100\ \mu A$	1.8	—	0.2	
				$I_{OL} = 6$ mA	1.8	—	0.3	
Input Leakage Current		I_{IN}	V_{IN} = 0~3.6 V		1.8	—	±5.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent Supply Current		I_{CC}	$V_{IN} = V_{CC}$ or GND		1.8	—	20.0	μA
			$V_{CC} \leqq V_{IN} \leqq 3.6$ V		1.8	—	±20.0	

AC characteristics (Ta = −40~85°C, Input t_r = t_f = 2.0 ns, C_L = 30 pF, R_L = 500 Ω)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	MIN	MAX	UNIT
Propagation Delay Time	t_{pLH} t_{pHL}	(Fig. 1, 2)	1.8	1.0	TBD	ns
			2.5 ± 0.2	0.8	TBD	
			3.3 ± 0.3	0.6	TBD	
Output To Output Skew	t_{osLH} t_{osHL}	(Note 10)	1.8	—	0.5	ns
			2.5 ± 0.2	—	0.5	
			3.3 ± 0.3	—	0.5	

For C_L = 50 pF, add approximately 300 ps to the AC maximum specification.

(Note 10) : Parameter guaranteed by design.
($t_{osLH} = |t_{pLHm} - t_{pLHn}|$, $t_{osHL} = |t_{pHLm} - t_{pHLn}|$)

Dynamic switching characteristics (Ta = 25°C, Input t_r = t_f = 2.0 ns, C_L = 30 pF)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	TYP.	UNIT
Quiet Output Maximum Dynamic V_{OL}	V_{OLP}	V_{IH} = 1.8 V, V_{IL} = 0 V (Note 11)	1.8	0.25	V
		V_{IH} = 2.5 V, V_{IL} = 0 V (Note 11)	2.5	0.6	
		V_{IH} = 3.3 V, V_{IL} = 0 V (Note 11)	3.3	0.8	
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	V_{IH} = 1.8 V, V_{IL} = 0 V (Note 11)	1.8	−0.25	V
		V_{IH} = 2.5 V, V_{IL} = 0 V (Note 11)	2.5	−0.6	
		V_{IH} = 3.3 V, V_{IL} = 0 V (Note 11)	3.3	−0.8	
Quiet Output Minimum Dynamic V_{OH}	V_{OHV}	V_{IH} = 1.8 V, V_{IL} = 0 V (Note 11)	1.8	1.5	V
		V_{IH} = 2.5 V, V_{IL} = 0 V (Note 11)	2.5	1.9	
		V_{IH} = 3.3 V, V_{IL} = 0 V (Note 11)	3.3	2.2	

(Note 11) : Parameter guaranteed by design.

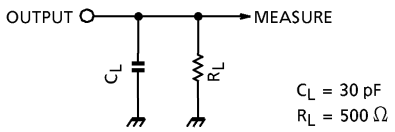
Capacitive characteristics (Ta = 25°C)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	TYP.	UNIT
Input Capacitance	C_{IN}		1.8, 2.5, 3.3	6	pF
Power Dissipation Capacitance	C_{PD}	f_{IN} = 10 MHz (Note 12)	1.8, 2.5, 3.3	20	pF

(Note 12) : 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 :
$I_{CC(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6$ (Per gate)

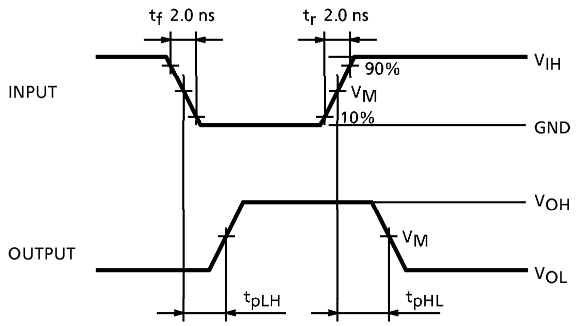
TEST CIRCUIT

Fig.1



AC WAVEFORM

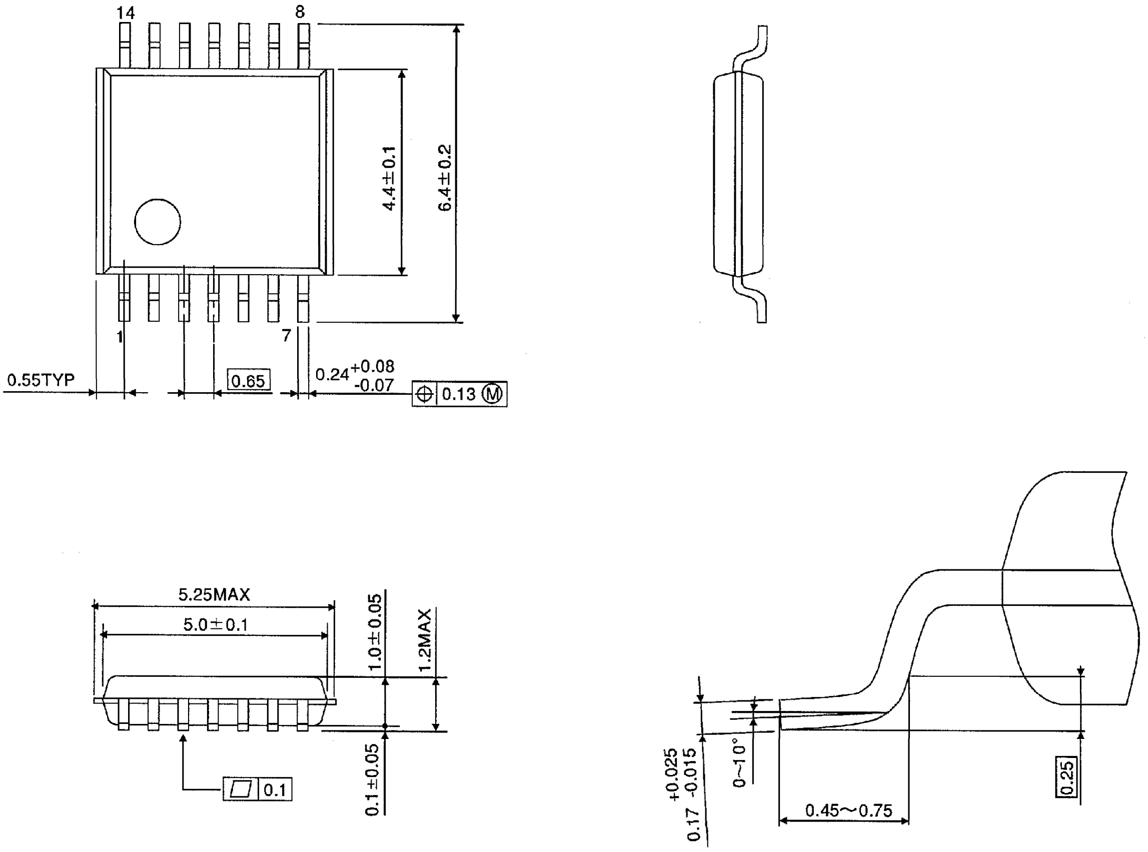
Fig.2 t_{pLH}, t_{pHL}



SYMBOL	V_{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	V_{CC} / 2	V_{CC} / 2

OUTLINE DRAWING

TSSOP14-P-0044-0.65 Unit : mm



Weight : 0.06 g (Typ.)