

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VCX14FT

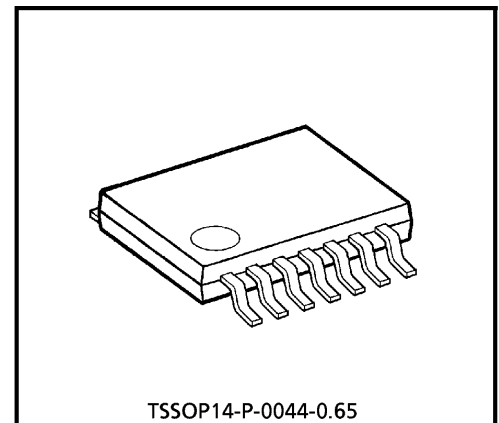
LOW-VOLTAGE HEX SCHMITT INVERTER WITH 3.6 V TOLERANT INPUTS AND OUTPUTS

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.



Weight : 0.06 g (Typ.)

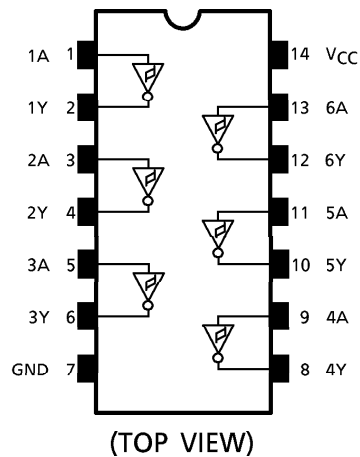
FEATURES

- Low voltage operation : $V_{CC} = 1.8 \sim 3.6 \text{ V}$
- High speed operation : $t_{pd} = 4.0 \text{ ns (max) at } V_{CC} = 3.0 \sim 3.6 \text{ V}$
 $t_{pd} = 4.3 \text{ ns (max) at } V_{CC} = 2.3 \sim 2.7 \text{ V}$
 $t_{pd} = 8.6 \text{ ns (max) at } V_{CC} = 1.8 \text{ V}$
- Output current : $I_{OH}/I_{OL} = \pm 24 \text{ mA (min) at } V_{CC} = 3.0 \text{ V}$
 $I_{OH}/I_{OL} = \pm 18 \text{ mA (min) at } V_{CC} = 2.3 \text{ V}$
 $I_{OH}/I_{OL} = \pm 6 \text{ mA (min) at } V_{CC} = 1.8 \text{ V}$
- Latch-up performance : $\pm 300 \text{ mA}$
- ESD performance : Human body model $> \pm 2000 \text{ V}$
Machine model $> \pm 200 \text{ V}$
- Package : TSSOP
(Thin Shrink Small Outline Package)
- Power down protection is provided on all inputs and outputs.

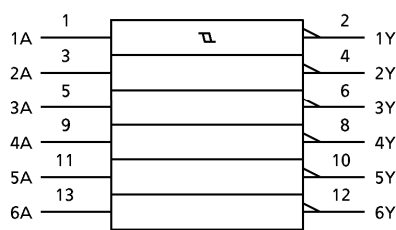
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PIN ASSIGNMENT



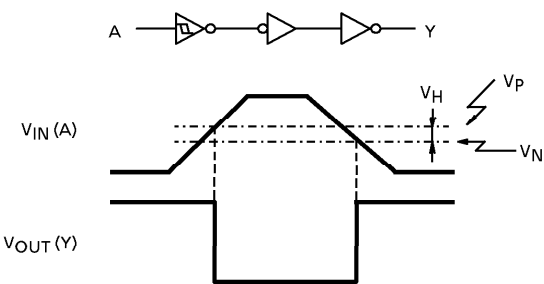
IEC LOGIC SYMBOL



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

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) : $V_{CC} = 0\text{ V}$

(Note 6) : High or Low State

(Note 7) : $V_{CC} = 3.0\sim 3.6\text{ V}$ (Note 8) : $V_{CC} = 2.3\sim 2.7\text{ V}$ (Note 9) : $V_{CC} = 1.8\text{ V}$

ELECTRICAL CHARACTERISTICS

DC characteristics ($T_a = -40\sim 85^\circ\text{C}$, $2.7\text{ V} < V_{CC} \leq 3.6\text{ V}$)

PARAMETER		SYMBOL	TEST CONDITION		V _{CC} (V)	Min	Max	UNIT
Input Voltage	“H” Level	V _P			3.6	—	2.2	V
					3.0	—	2.0	
	“L” Level	V _N			3.6	0.8	—	
					3.0	0.7	—	
Hysteresis Voltage		V _H			3.6	0.3	1.2	V
					3.0	0.3	1.2	
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 ($T_a = -40\sim 85^\circ\text{C}$, $2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$)

PARAMETER		SYMBOL	TEST CONDITION			Min	Max	UNIT
			V _{CC} (V)					
Input Voltage	“H” Level	V _P	2.3			—	1.6	V
	“L” Level	V _N	2.3			0.5	—	
Hysteresis Voltage		V _H	2.3			0.3	1.0	V
Output Voltage	“H” Level	V _{OH}	V _{IN} = V _{IL}	I _{OH} = - 100 μA	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 μA	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} ≤ V _{IN} ≤ 3.6 V		2.3~2.7	—	± 20.0	

DC characteristics ($T_a = -40\sim 85^\circ\text{C}$, $1.8\text{ V} \leq V_{CC} < 2.3\text{ V}$)

PARAMETER		SYMBOL	TEST CONDITION			Min	Max	UNIT	
			V _{CC} (V)						
Input Voltage	"H" Level	V _P	1.8			—	1.4	V	
	"L" Level	V _N	1.8			0.25	—		
Hysteresis Voltage		V _H	1.8			0.2	0.95	V	
Output Voltage	"H" Level	V _{OH}	V _{IN} = V _{IL}	I _{OH} = − 100 μA	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 μA	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} ≤ V _{IN} ≤ 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, $R_L = 500 \Omega$)

PARAMETER	SYMBOL	TEST CONDITION	V _{CC} (V)	Min	Max	UNIT
Propagation Delay Time	t_{pLH} t_{pHL}	(Fig. 1, 2)	1.8	1.0	8.6	ns
			2.5 ± 0.2	0.8	4.3	
			3.3 ± 0.3	0.6	4.0	
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

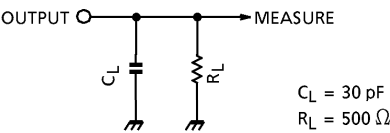
(Note 12) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

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

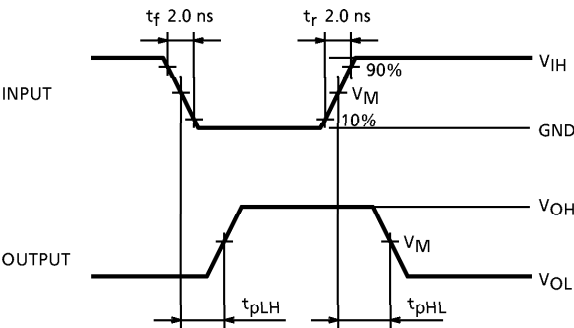
TEST CIRCUIT

Fig.1



AC WAVEFORM

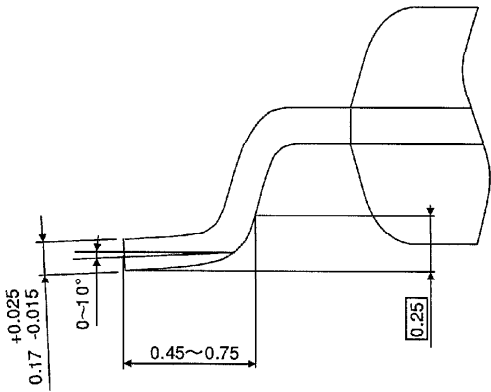
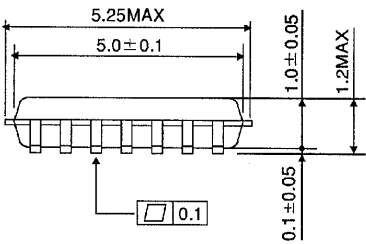
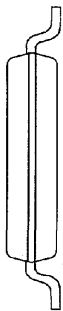
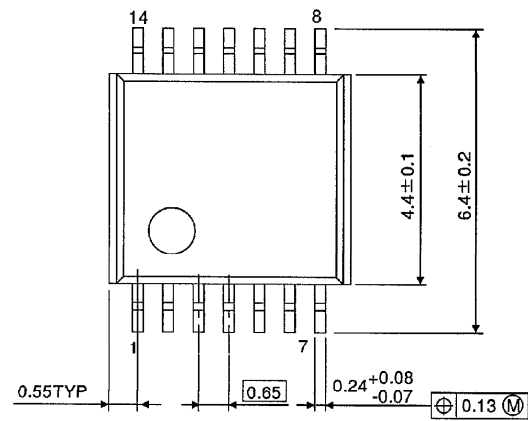
Fig.2 t_{pLH} , t_{pHL}



SYMBOL	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$

PACKAGE DIMENSIONS
TSSOP14-P-0044-0.65

Unit : mm



Weight : 0.06 g (Typ.)