TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74LCX04F, TC74LCX04FK

Low-Voltage Hex Inverter with 5-V Tolerant Inputs and Outputs

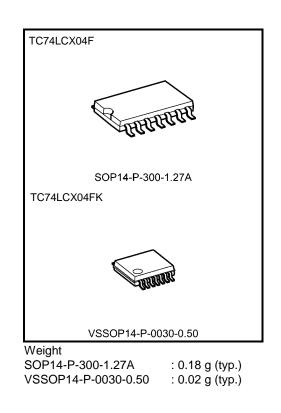
The TC74LCX04 is a high-performance CMOS inverter. Designed for use in 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

The device is designed for low-voltage $(3.3 \text{ V}) \text{ V}_{CC}$ applications, but it could be used to interface to 5-V supply environment for inputs.

All inputs are equipped with protection circuits against static discharge.

Features

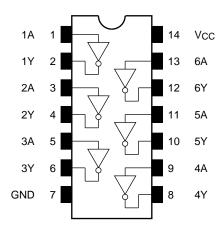
- Low-voltage operation: VCC = 1.65 to 3.6 V
- High-speed operation: $t_{pd} = 5.2 \text{ ns} (\text{max}) (V_{CC} = 3.0 \text{ to } 3.6 \text{ V})$
- Output current: $|I_{OH}|/I_{OL} = 24 \text{ mA} (\text{min}) (V_{CC} = 3.0 \text{ V})$
- Available in JEITA SOP, VSSOP (US)
- Power-down protection provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 04 type



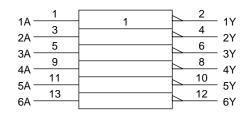
Note: The Electrical Characteristics of V_{CC} = 1.8 ± 0.15 V is only applicable for products which manufactured from January 2009 onward.

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Pin Assignment (top view)



IEC Logic Symbol



Truth Table

Inputs	Outputs
А	Y
L	Н
н	L

Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V _{CC}	-0.5 to 7.0	V
DC input voltage	VIN	-0.5 to 7.0	V
		-0.5 to 7.0 (Note 2)	
DC output voltage	Vout	-0.5 to V _{CC} + 0.5 (Note 3)	V
Input diode current	lıĸ	-50	mA
Output diode current	lok	±50 (Note 4)	mA
DC output current	IOUT	±50	mA
Power dissipation	PD	180	mW
DC V _{CC} /ground current	ICC/IGND	±100	mA
Storage temperature	T _{stg}	-65 to 150	°C

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 2: VCC = 0 V

- Note 3: High or low state. IOUT absolute maximum rating must be observed.
- Note 4: VOUT < GND, VOUT > VCC

Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit	
	Vee	1.65 to 3.6	V	
Power supply voltage	Vcc	1.5 to 3.6 (Note 2)	v	
Input voltage	Vin	0 to 5.5	V	
Output voltage	Vout	0 to 5.5 (Note 3)	V	
Output voltage		0 to V _{CC} (Note 4)	v	
	Іон/Іог	±24 (Note 5)	mA	
Output current	IOH/IOL	±12 (Note 6)	ША	
Operating temperature	Topr	-40 to 85	°C	
Input rise and fall time	dt/dv	0 to 10 (Note 7)	ns/V	

Note 1: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either VCC or GND.

Note 2: Data retention only

Note 3: VCC = 0 V

Note 4: High or low state (However, it can not exceed IOUT of absolute maximum ratings.)

Note 5: VCC = 3.0 to 3.6 V

Note 6: VCC = 2.7 to 3.0 V

Note 7: $V_{IN} = 0.8$ to 2.0 V, $V_{CC} = 3.0$ V

Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C)

Characteri	stics	Symbol	Test C	Test Condition VCC (V)		Min	Max	Unit
		1				V _{CC} × 0.9	_	
	H-level	Vін	н — Г		2.3 to 2.7	1.7		
			2.7 to 3.6	2.0				
Input voltage					1.65 to 2.3	_	Vcc×0.1	V
	L-level	VIL	-	_	2.3 to 2.7	_	0.7	
					2.7 to 3.6	—	0.8	
				$I_{OH} = -100 \ \mu A$	1.65 to 3.6	Vcc-0.2	_	
				Ioh = -4 mA	1.65	1.05	_	V
	H-level	Veu	VIN = VIL	IOH = -8 mA	2.3	1.7	—	
	n-level	Vон		Ioh = -12 mA	2.7	2.2	—	
				IOH = -18 mA	3.0	2.4	—	
Output weltere				I _{OH} = -24 mA	3.0	2.2	_	
Output voltage		Vol		I _{OL} = 100 μA	1.65 to 3.6		0.2	
				IOL = 4 mA	1.65		0.45	
				I _{OL} = 8 mA	2.3		0.7	
	L-level		VIN = VIH	I _{OL} = 12 mA	2.7		0.4	
				I _{OL} = 16 mA	3.0		0.4	
				I _{OL} = 24 mA	3.0		0.55	
Input leakage current		lın	V _{IN} = 0 to 5.5 V		1.65 to 3.6		±5.0	μΑ
Power-off leakage curr	ent	IOFF	IOFF VIN/VOUT = 5.5 V		0	— 10.0		μA
	ant.		$V_{IN} = V_{CC} \text{ or } G$	$V_{IN} = V_{CC} \text{ or } GND$		_	10.0	
Quiescent supply curre	fil	Icc	V _{IN} = 3.6 to 5.5	V _{IN} = 3.6 to 5.5 V			±10.0	μA
Increase in Icc per inp	ut	Δlcc	$V_{IH} = V_{CC} - 0.6$	SV (per 1 input)	2.7 to 3.6		500	

AC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition V _{CC} (V)		Min	Max	Unit
			$\textbf{1.8}\pm\textbf{0.15}$	_	20.0	
Propagation delay time	^t pLH ^t pHL	Figure 1, Figure 2	$\textbf{2.5}\pm\textbf{0.2}$	_	7.0	ns
			2.7	_	6.0	
			$\textbf{3.3}\pm\textbf{0.3}$	1.5	5.2	
Output to output skew	t _{osLH}	(Note)	2.7		_	ns
	t _{osHL}	(Note)	$\textbf{3.3}\pm\textbf{0.3}$	_	1.0	115

Note: Parameter guaranteed by design.

(tosLH = |tpLHm - tpLHn|, tosHL = |tpHLm - tpHLn|)

Dynamic Switching Characteristics (Ta = 25°C, input: tr = tf = 2.5 ns, C_L = 50 pF, RL = 500 Ω)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Тур.	Unit
Quiet output maximum dynamic V_{OL}	VOLP	$V_{IH} = 3.3 \text{ V}, \text{ V}_{IL} = 0 \text{ V}$	3.3	0.8	V
Quiet output minimum dynamic VOL	Volv	$V_{IH}=3.3~V,~V_{IL}=0~V$	3.3	0.8	V

Capacitive Characteristics (Ta = 25°C)

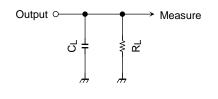
Characteristics	Symbol	Test Condition	V _{CC} (V)	Тур.	Unit
Input capacitance	CIN	_	3.3	7	pF
Output capacitance	Соит	_	0	8	pF
Power dissipation capacitance	Cpd	f _{IN} = 10 MHz (Note)	3.3	25	pF

Note: CPD 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:

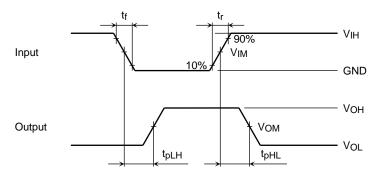
 $ICC (opr) = CPD \cdot VCC \cdot fIN + ICC/6 (per gate)$

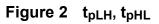
AC Test Circuit





AC Waveform





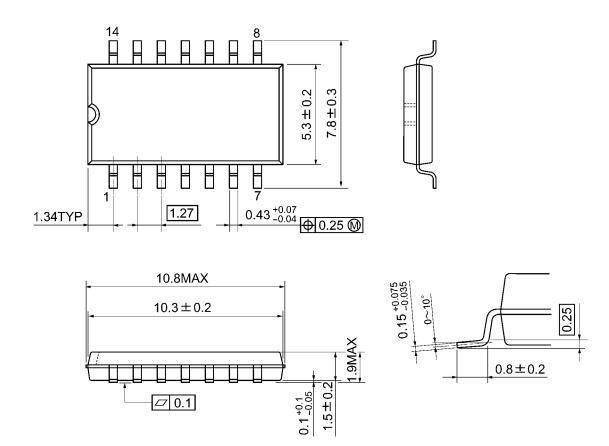
			V _{CC}	
	Symbol	3.3 ± 0.3 V 2.7 V	$2.5\pm0.2\;\text{V}$	$1.8\pm0.15~\text{V}$
Input	VIH	2.7 V	V _{CC}	Vcc
	VIM	1.5 V	V _{CC} /2	V _{CC} /2
	t _r , t _f	2.5 ns	2.0 ns	2.0 ns
Output	Vom	1.5 V	V _{OH} /2	V _{OH} /2
Load	CL	50 pF	30 pF	30 pF
	RL	500 Ω	500 Ω	1 kΩ



Package Dimensions

SOP14-P-300-1.27A

Unit: mm



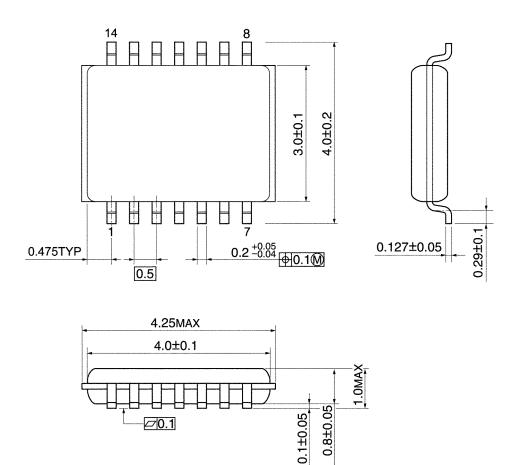
Weight: 0.18 g (typ.)



Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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