

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74LVX04F, TC74LVX04FT

### Hex Inverter

The TC74LVX04F/FT is a high-speed CMOS hex inverter fabricated with silicon gate CMOS technology. Designed for use in 3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

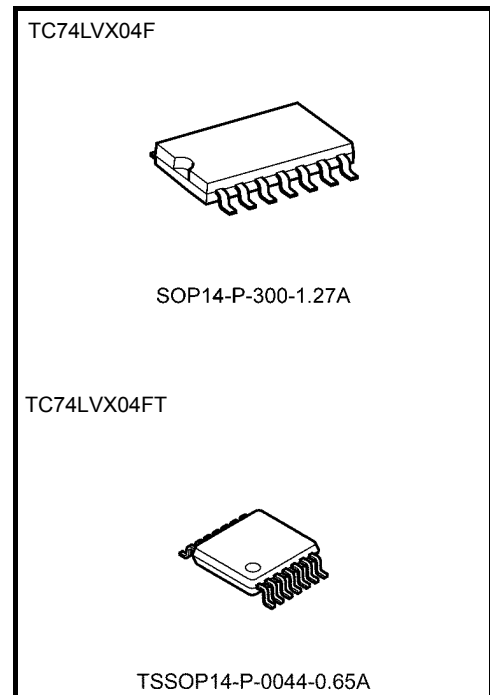
This device is suitable for low-voltage and battery operated systems.

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

An input protection circuit ensures that 0 to 5.5V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

### Features

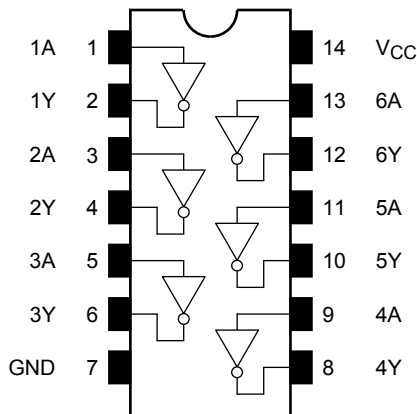
- High-speed:  $t_{pd} = 4.1 \text{ ns (typ.) (} V_{CC} = 3.3 \text{ V)}$
- Low power dissipation:  $I_{CC} = 2 \text{ } \mu\text{A (max) (} T_a = 25^\circ\text{C)}$
- Input voltage level:  $V_{IL} = 0.8 \text{ V (max) (} V_{CC} = 3 \text{ V)}$   
 $V_{IH} = 2.0 \text{ V (min) (} V_{CC} = 3 \text{ V)}$
- Power-down protection provided on all inputs
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Low noise:  $V_{OLP} = 0.5 \text{ V (max)}$
- Pin and function compatible with 74HC04



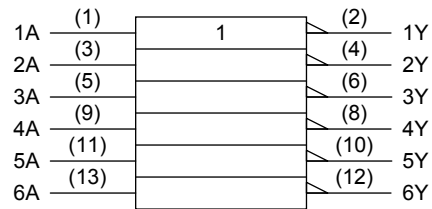
#### Weight

SOP14-P-300-1.27A	: 0.18 g (typ.)
TSSOP14-P-0044-0.65A	: 0.06 g (typ.)

## Pin Assignment (top view)



## IEC Logic Symbol



## Truth Table

Inputs	Outputs
A	Y
L	H
H	L

## Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to 7.0	V
DC input voltage	$V_{IN}$	-0.5 to 7.0	V
DC output voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	180	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

Note: 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).

## Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2.0 to 3.6	V
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	-40 to 85	$^{\circ}C$
Input rise and fall time	dt/dv	0 to 100	ns/V

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

### DC Characteristics

Characteristics		Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
					V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
Input voltage	H-level	V <sub>IH</sub>	—		2.0	1.5	—	—	1.5	—	V
					3.0	2.0	—	—	2.0	—	
					3.6	2.4	—	—	2.4	—	
	L-level	V <sub>IL</sub>	—		2.0	—	—	0.5	—	0.5	
					3.0	—	—	0.8	—	0.8	
					3.6	—	—	0.8	—	0.8	
Output voltage	H-level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	2.0	1.9	2.0	—	1.9	—	V
				I <sub>OH</sub> = -50 μA	3.0	2.9	3.0	—	2.9	—	
				I <sub>OH</sub> = -4 mA	3.0	2.58	—	—	2.48	—	
	L-level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 50 μA	2.0	—	0.0	0.1	—	0.1	
				I <sub>OL</sub> = 50 μA	3.0	—	0.0	0.1	—	0.1	
				I <sub>OL</sub> = 4 mA	3.0	—	—	0.36	—	0.44	
Input leakage current		I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		3.6	—	—	±0.1	—	±1.0	μA
Quiescent supply current		I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		3.6	—	—	2.0	—	20.0	μA

### AC Characteristics (input: t<sub>r</sub> = t<sub>f</sub> = 3 ns)

Characteristics		Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
					V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Typ.	Max		Min
Propagation delay time	t <sub>pLH</sub>	—	—	2.7	15	—	5.4	10.1	1.0	12.5	ns
					50	—	7.9	13.6	1.0	16.0	
	t <sub>pHL</sub>			3.3 ± 0.3	15	—	4.1	6.2	1.0	7.5	
					50	—	6.6	9.7	1.0	11.0	
Output to output skew	t <sub>osLH</sub>	(Note 1)	—	2.7	50	—	—	1.5	—	1.5	ns
	t <sub>osHL</sub>				3.3 ± 0.3	50	—	—	1.5	—	
Input capacitance	C <sub>IN</sub>	(Note 2)			—	4	10	—	10	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note 3)			—	18	—	—	—	pF	

Note 1: Parameter guaranteed by design.  
 (t<sub>osLH</sub> = |t<sub>pLHm</sub> - t<sub>pLHn</sub>|; t<sub>osHL</sub> = |t<sub>pHLm</sub> - t<sub>pHLn</sub>|)

Note 2: Parameter guaranteed by design.

Note 3: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption.

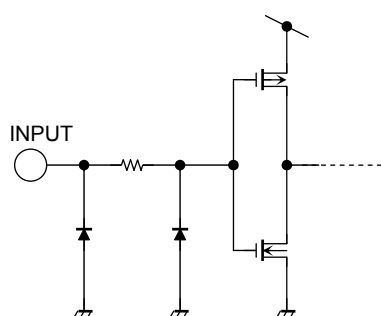
Average operating current can be obtained by the equation:

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

### Noise Characteristics (Ta = 25°C, input: tr = tf = 3 ns, CL = 50 pF)

Characteristics	Symbol	Test Condition	VCC (V)	Typ.	Limit	Unit
Quiet output maximum dynamic VOL	VOLP	—	3.3	0.3	0.5	V
Quiet output minimum dynamic VOL	VOLV	—	3.3	-0.3	-0.5	V
Minimum high level dynamic input voltage VIH	VIHD	—	3.3	—	2.0	V
Maximum low level dynamic input voltage VIL	VILD	—	3.3	—	0.8	V

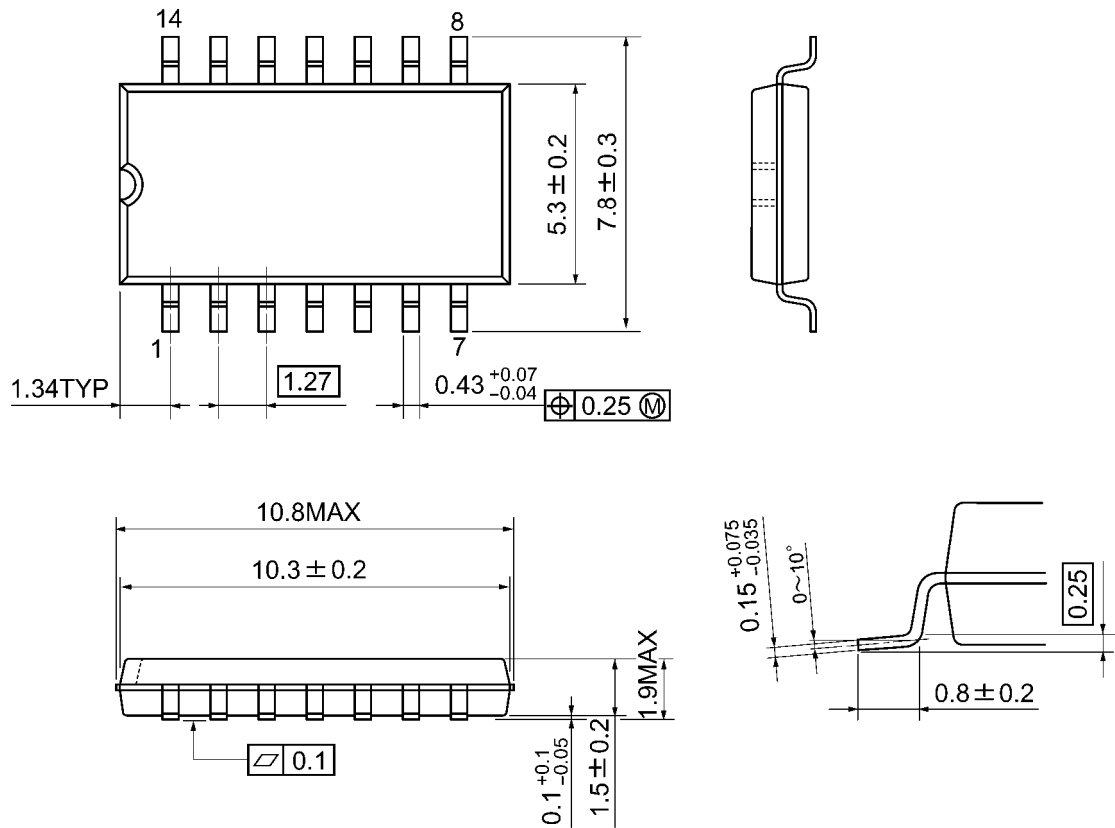
### Input Equivalent Circuit



**Package Dimensions**

SOP14-P-300-1.27A

Unit: mm

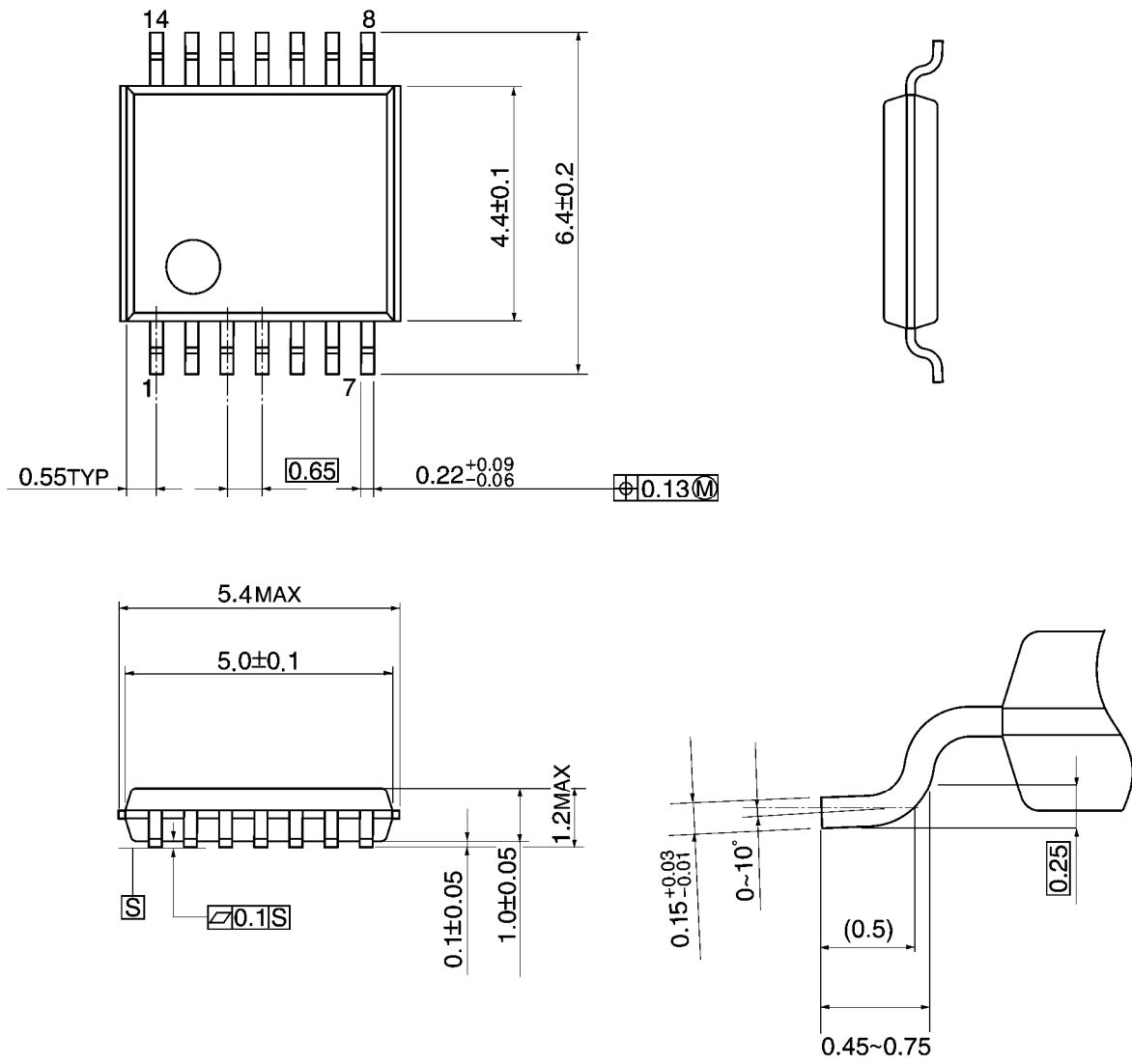


Weight: 0.18 g (typ.)

**Package Dimensions**

TSSOP14-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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