

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74LCX07F, TC74LCX07FK

Low-Voltage HEX Buffer with 5-V Tolerant Inputs and Outputs (open drain)

The TC74LCX07 is a high-performance CMOS buffer. Designed for use in 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

The TC74LCX07 has high performance MOS N-channel transistor. (open-drain outputs)

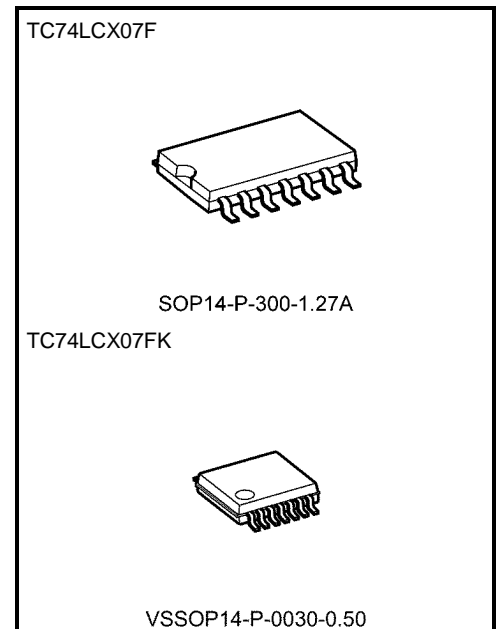
The device is designed for low-voltage (3.3 V)  $V_{CC}$  applications, but it could be used to interface to 5-V supply\* environment for inputs.

All inputs are equipped with protection circuits against static discharge.

\* $I_{OUT}$  absolute maximum rating must be observed.

## Features

- Low-voltage operation:  $V_{CC} = 1.65$  to  $5.5$  V
- High-speed operation:  $t_{pZ} = 3.7$  ns (max) ( $V_{CC} = 3.0$  to  $3.6$  V)
- Output current:  $I_{OL} = 24$  mA (min) ( $V_{CC} = 3.0$  V)
- Latch-up performance:  $> -500$  mA
- Available in JEITA SOP, VSSOP (US)
- Open-drain outputs
- Power-down protection provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 07 type

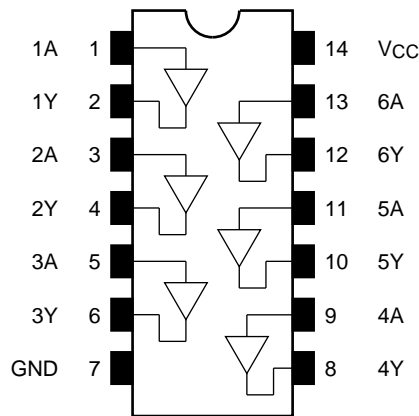


Weight	
SOP14-P-300-1.27A	: 0.18 g ( typ.)
VSSOP14-P-0030-0.50	: 0.02 g ( typ.)

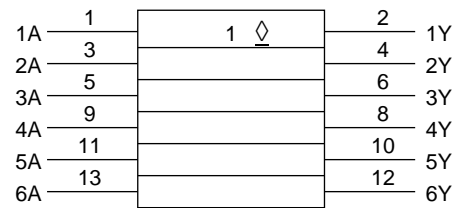
Note: The Electrical Characteristics of  $V_{CC} = 1.8 \pm 0.15$  V and that of  $V_{CC} = 5.0 \pm 0.5$  V are only applicable for products which manufactured from January 2009 onward.

Start of commercial production  
1999-10

### Pin Assignment (top view)



### IEC Logic Symbol

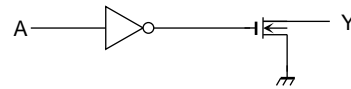


### Truth Table

Inputs	Outputs
A	Y
L	L
H	Z

Z: High impedance

### System Diagram (per gate)



### Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V <sub>CC</sub>	-0.5 to 7.0	V
DC input voltage	V <sub>IN</sub>	-0.5 to 7.0	V
DC output voltage	V <sub>OUT</sub>	-0.5 to 7.0 (Note 2)	V
Input diode current	I <sub>IK</sub>	-50	mA
Output diode current	I <sub>OK</sub>	-50 (Note 3)	mA
DC output current	I <sub>OUT</sub>	50	mA
Power dissipation	P <sub>D</sub>	180	mW
DC V <sub>CC</sub> /ground current	I <sub>CC</sub> /I <sub>GND</sub>	±100	mA
Storage temperature	T <sub>stg</sub>	-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: Output in OFF state. I<sub>OUT</sub> absolute maximum rating must be observed (Output in low state)

Note 3: V<sub>OUT</sub> < GND

### Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	VCC	1.65 to 5.5	V
		1.5 to 5.5 (Note 2)	
Input voltage	V <sub>IN</sub>	0 to 5.5	V
Output voltage	V <sub>OUT</sub>	0 to 5.5	V
Output current	I <sub>OL</sub>	32 (Note 3)	mA
		24 (Note 4)	
		12 (Note 5)	
Operating temperature	T <sub>opr</sub>	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 10 (Note 6)	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 = 4.5 to 5.5 V

Note 4: VCC = 3.0 to 3.6 V

Note 5: VCC = 2.7 to 3.0 V

Note 6: VCC = 1.65 to 5.5 V

### Electrical Characteristics

#### DC Characteristics (Ta = -40 to 85°C)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Input voltage	H-level	VIH	—		1.65 to 2.3	VCC × 0.9	—	V
					2.3 to 2.7	1.7	—	
					2.7 to 3.6	2.0	—	
					4.5 to 5.5	VCC × 0.7	—	
	L-level	VIL	—		1.65 to 2.3	—	VCC × 0.1	
					2.3 to 2.7	—	0.7	
					2.7 to 3.6	—	0.8	
					4.5 to 5.5	—	VCC × 0.3	
Output voltage	L-level	VOL	VIN = VIL	IOL = 100 μA	1.65 to 5.5	—	0.2	V
				IOL = 4 mA	1.65	—	0.45	
				IOL = 8 mA	2.3	—	0.7	
				IOL = 12 mA	2.7	—	0.4	
				IOL = 16 mA	3.0	—	0.4	
				IOL = 24 mA	3.0	—	0.55	
				IOL = 32 mA	4.5	—	0.55	
Input leakage current		IIN	VIN = 0 to 5.5 V		1.65 to 5.5	—	±5.0	μA
Output OFF state current		IOZ	VIN = VIH, VOUT = 0 to 5.5 V		1.65 to 5.5	—	±5.0	μA
Power-off leakage current		IOFF	VIN/VOUT = 5.5 V		0	—	10.0	μA
Quiescent supply current		ICC	VIN = VCC or GND		1.65 to 5.5	—	10.0	μA
Increase in ICC per input		ΔICC	VIN = VCC - 0.6 V (per 1 input)		2.7 to 3.6	—	500	
					4.5 to 5.5	—	1	mA

### AC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition	VCC (V)	Min	Max	Unit
Output enable time	tpZL	Figure 1, Figure 2	1.8 ± 0.15	1.5	22.0	ns
			2.5 ± 0.2	1.2	11.0	
			2.7	1.0	4.4	
			3.3 ± 0.3	0.8	3.7	
			5.0 ± 0.5	0.5	3.0	
Output disable time	tpLZ	Figure 1, Figure 2	1.8 ± 0.15	1.5	22.0	ns
			2.5 ± 0.2	1.2	11.0	
			2.7	1.0	4.4	
			3.3 ± 0.3	0.8	3.7	
			5.0 ± 0.5	0.5	3.0	
Output to output skew	tosZL	(Note)	2.7	—	—	ns
			3.3 ± 0.3	—	1.0	

Note: Parameter guaranteed by design.  
(tosZL = |tpZLm - tpZLn|)

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

Characteristics	Symbol	Test Condition	VCC (V)	Typ.	Unit
Quiet output maximum dynamic VOL	VOLP	VIH = 3.3 V, VIL = 0 V	3.3	0.8	V
Quiet output minimum dynamic VOL	VOLV	VIH = 3.3 V, VIL = 0 V	3.3	0.8	V

### Capacitive Characteristics (Ta = 25°C)

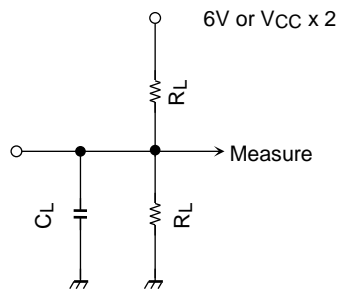
Characteristics	Symbol	Test Condition	VCC (V)	Typ.	Unit	
Input capacitance	CIN	—	3.3	7	pF	
Output capacitance	COU		3.3	8	pF	
Power dissipation capacitance	CPD	fIN = 10 MHz	(Note)	3.3	5	pF

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:

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

### AC Test Circuit



Parameter	Switch
$t_{pLZ}$ , $t_{pZL}$	6.0 V @ $V_{CC} = 3.3 \pm 0.3$ V @ $V_{CC} = 2.7$ V
	$V_{CC} \times 2$ @ $V_{CC} = 5.0 \pm 0.5$ V @ $V_{CC} = 2.5 \pm 0.2$ V @ $V_{CC} = 1.8 \pm 0.15$ V

Figure 1

### AC Waveform

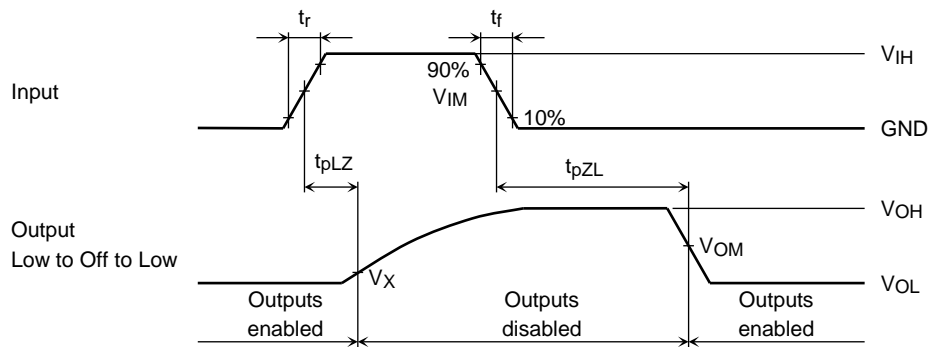


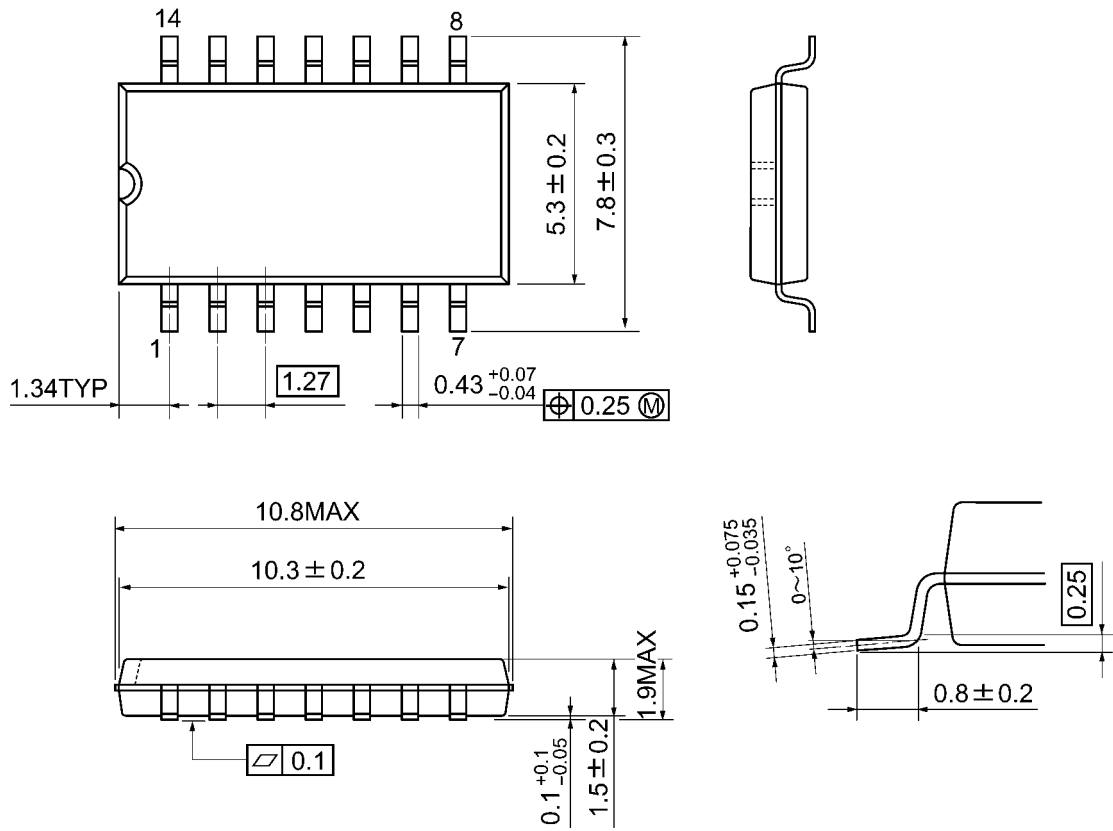
Figure 2  $t_{pLZ}$ ,  $t_{pZL}$

	Symbol	$V_{CC}$			
		$5.0 \pm 0.5$ V	$3.3 \pm 0.3$ V 2.7 V	$2.5 \pm 0.2$ V	$1.8 \pm 0.15$ V
Input	$V_{IH}$	$V_{CC}$	2.7 V	$V_{CC}$	$V_{CC}$
	$V_{IM}$	$V_{CC}/2$	1.5 V	$V_{CC}/2$	$V_{CC}/2$
	$t_r$ , $t_f$	2.5 ns	2.5 ns	2.0 ns	2.0 ns
Output	$V_{OM}$	$V_{CC}/2$	1.5 V	$V_{OH}/2$	$V_{OH}/2$
	$V_X$	$V_{OL} + 0.3$ V	$V_{OL} + 0.3$ V	$V_{OL} + 0.15$ V	$V_{OL} + 0.15$ V
Load	$C_L$	50 pF	50 pF	30 pF	30 pF
	$R_L$	500 $\Omega$	500 $\Omega$	500 $\Omega$	1 k $\Omega$

### Package Dimensions

SOP14-P-300-1.27A

Unit: mm

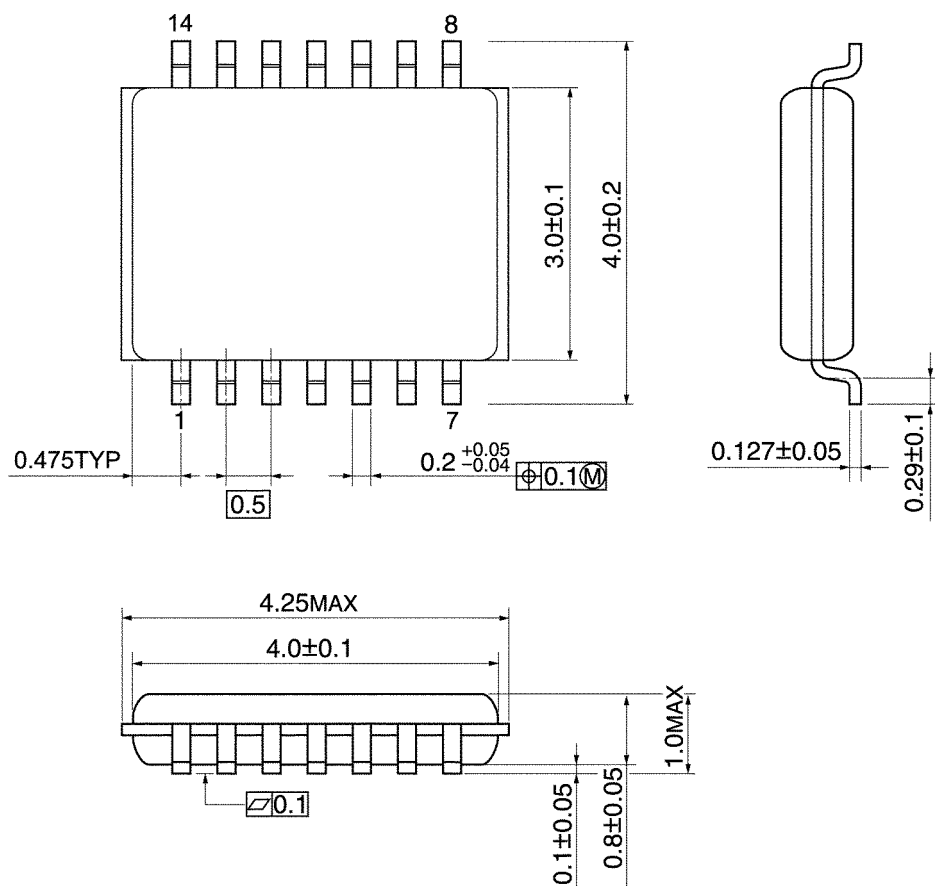


Weight: 0.18 g (typ.)

### Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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