

## TC74LCX05F, TC74LCX05FN, TC74LCX05FT, TC74LCX05FK

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

The TC74LCX05 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.

Pin configuration and function are the same as the TC74LCX04, but the TC74LCX05F/FN/FT has high performance MOS N-channel transistor. (open-drain outputs)

The device is designed for low-voltage (3.3 V) VCC applications, but it could be used to interface to 5-V supply environment for inputs.

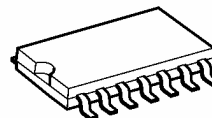
All inputs are equipped with protection circuits against static discharge.

### Features

- Low-voltage operation:  $V_{CC} = 2.0$  to  $3.6$  V
- High-speed operation:  $t_{pZ} = 5.0$  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 JEDEC SOP, JEITA SOP, TSSOP and VSSOP (US)
- Open-drain outputs
- Power-down protection is provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 05 type

Note: xxxFN (JEDEC SOP) is not available in Japan.

TC74LCX05F



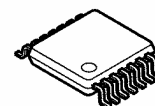
SOP14-P-300-1.27A

TC74LCX05FN



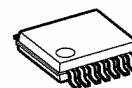
SOL14-P-150-1.27

TC74LCX05FT



TSSOP14-P-0044-0.65A

TC74LCX05FK

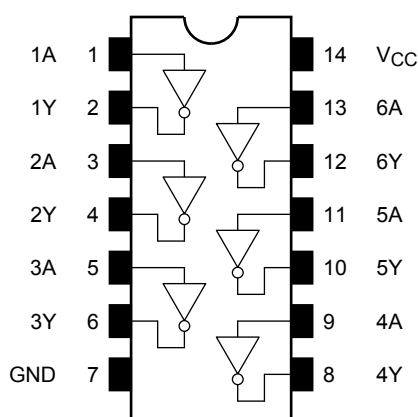


VSSOP14-P-0030-0.50

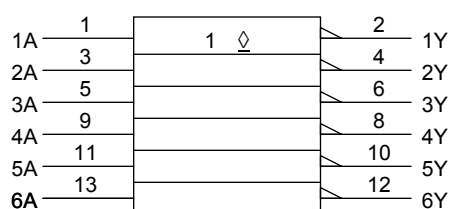
### Weight

SOP14-P-300-1.27A	: 0.18 g (typ.)
SOL14-P-150-1.27	: 0.12 g (typ.)
TSSOP14-P-0044-0.65A	: 0.06 g (typ.)
VSSOP14-P-0030-0.50	: 0.02 g (typ.)

## Pin Assignment (top view)



## IEC Logic Symbol

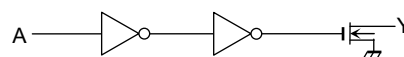


## Truth Table

Inputs	Outputs
A	Y
L	Z
H	L

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
		-0.5 to V <sub>CC</sub> + 0.5 (Note 3)	
Input diode current	I <sub>IK</sub>	-50	mA
Output diode current	I <sub>OK</sub>	-50 (Note 4)	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

Note 3: Low state. I<sub>OUT</sub> absolute maximum rating must be observed.

Note 4: V<sub>OUT</sub> < GND

## Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	$V_{CC}$	2.0 to 3.6	V
		1.5 to 3.6 (Note 2)	
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to 5.5 (Note 3)	V
		0 to $V_{CC}$ (Note 4)	
Output current	$I_{OL}$	24 (Note 5)	mA
		12 (Note 6)	
Operating temperature	$T_{opr}$	-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  $V_{CC}$  or GND.

Note 2: Data retention only

Note 3: Output in OFF state

Note 4: Low state

Note 5:  $V_{CC} = 3.0$  to  $3.6$  V

Note 6:  $V_{CC} = 2.7$  to  $3.0$  V

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

## Electrical Characteristics

### DC Characteristics ( $T_a = -40$ to $85^\circ\text{C}$ )

Characteristics		Symbol	Test Condition		Min	Max	Unit	
					V <sub>CC</sub> (V)			
Input voltage	H-level	V <sub>IH</sub>	—		2.7 to 3.6	2.0	—	V
	L-level	V <sub>IL</sub>	—		2.7 to 3.6	—	0.8	
Output voltage	L-level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 100 μA	2.7 to 3.6	—	0.2	V
				I <sub>OL</sub> = 12 mA	2.7	—	0.4	
				I <sub>OL</sub> = 16 mA	3.0	—	0.4	
				I <sub>OL</sub> = 24 mA	3.0	—	0.55	
Input leakage current		I <sub>IN</sub>	V <sub>IN</sub> = 0 to 5.5 V		2.7 to 3.6	—	±5.0	μA
Output OFF state current		I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IL</sub> , V <sub>OUT</sub> = 0 to 5.5 V		2.7 to 3.6	—	±5.0	μA
Power-off leakage current		I <sub>OFF</sub>	V <sub>IN</sub> /V <sub>OUT</sub> = 5.5 V		0	—	10.0	μA
Quiescent supply current		I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		2.7 to 3.6	—	10.0	μA
			V <sub>IN</sub> /V <sub>OUT</sub> = 3.6 to 5.5 V		2.7 to 3.6	—	±10.0	
Increase in I <sub>CC</sub> per input		ΔI <sub>CC</sub>	V <sub>IH</sub> = V <sub>CC</sub> – 0.6 V		2.7 to 3.6	—	500	

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

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
Output enable time	t <sub>pZL</sub>	Figure 1, Figure 2	2.7	1.0	6.0	ns
			3.3 ± 0.3	0.8	5.0	
Output disable time	t <sub>pLZ</sub>	Figure 1, Figure 2	2.7	1.0	6.0	ns
			3.3 ± 0.3	0.8	5.0	
Output to output skew	t <sub>osZL</sub>	(Note)	2.7	—	—	ns
			3.3 ± 0.3	—	1.0	

Note: Parameter guaranteed by design.

$$(t_{osZL} = |t_{pZLm} - t_{pZLn}|)$$

**Dynamic Switching Characteristics (Ta = 25°C, input: t<sub>r</sub> = t<sub>f</sub> = 2.5 ns, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 500 Ω)**

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Quiet output maximum dynamic V <sub>OL</sub>	V <sub>OLP</sub>	V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V	3.3	0.8	V
Quiet output minimum dynamic V <sub>OL</sub>	V <sub>OLV</sub>	V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V	3.3	0.8	V

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

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Input capacitance	C <sub>IN</sub>	—	3.3	7	pF
Output capacitance	C <sub>OUT</sub>		3.3	8	pF
Power dissipation capacitance	C <sub>PD</sub>	f <sub>IN</sub> = 10 MHz (Note)	3.3	5	pF

Note: C<sub>PD</sub> 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:

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

AC Test Circuit

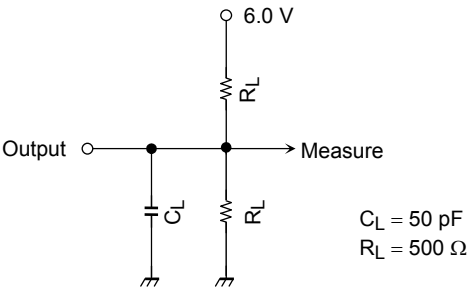


Figure 1

AC Waveform

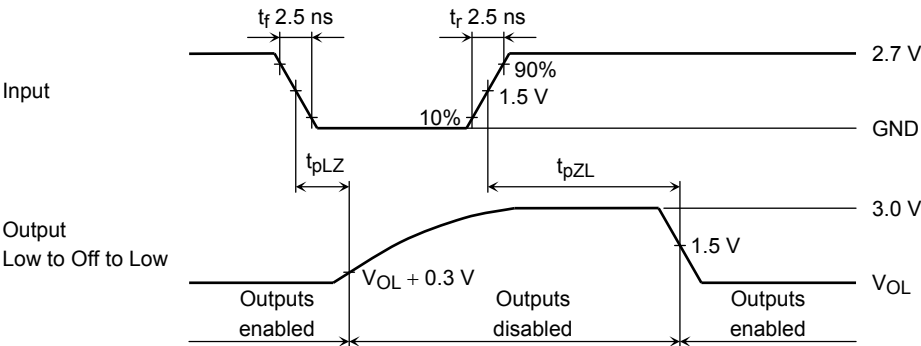
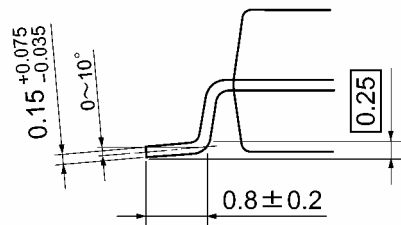
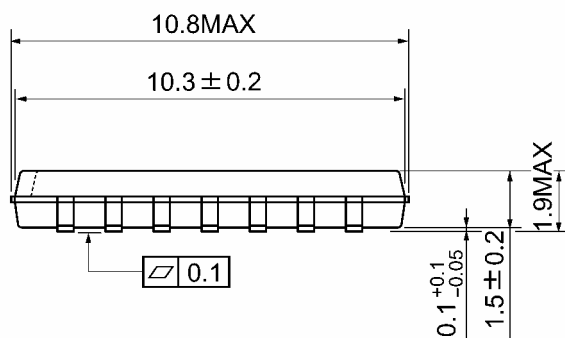
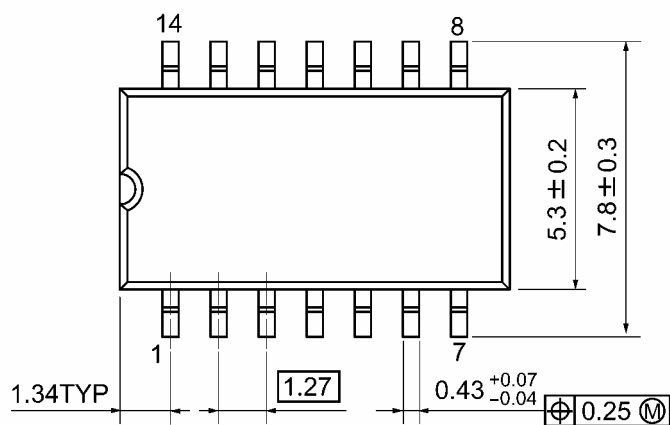


Figure 2  $t_{pLZ}$ ,  $t_{pZL}$

## Package Dimensions

SOP14-P-300-1.27A

Unit: mm

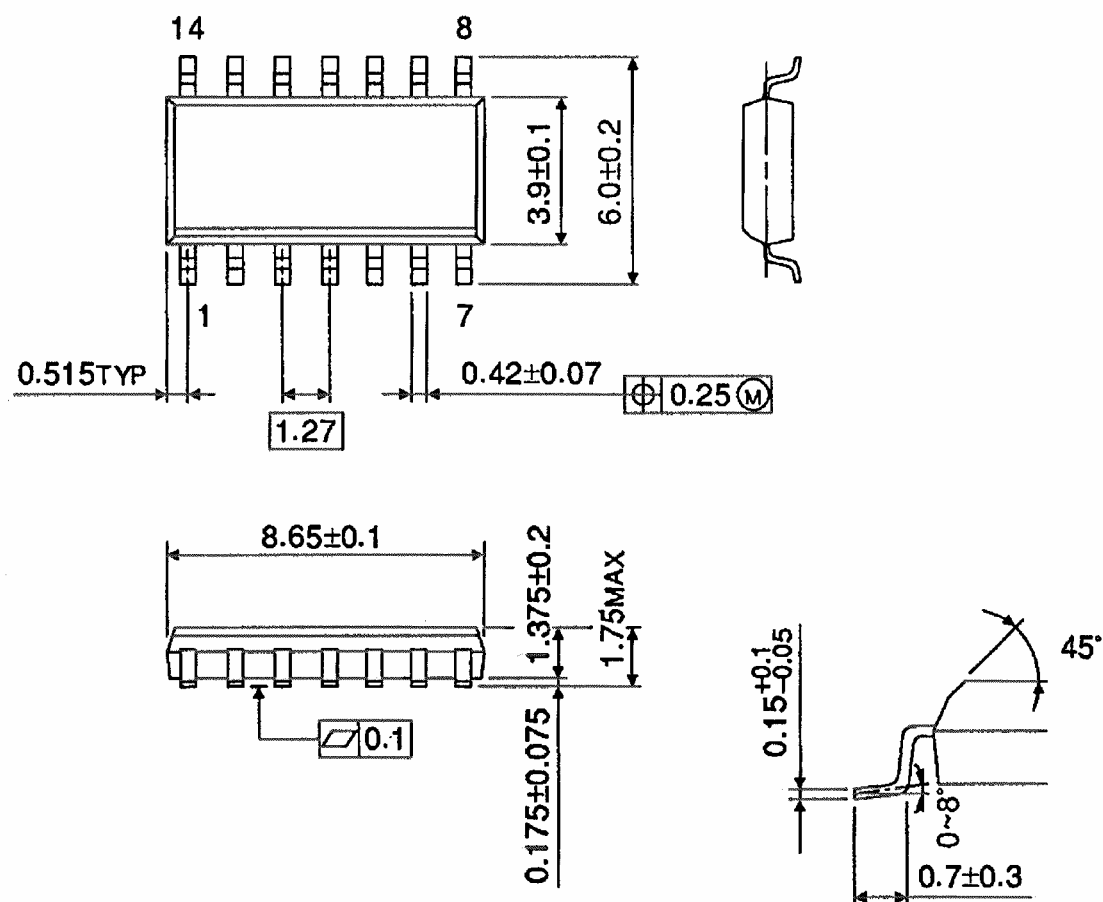


Weight: 0.18 g (typ.)

## Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



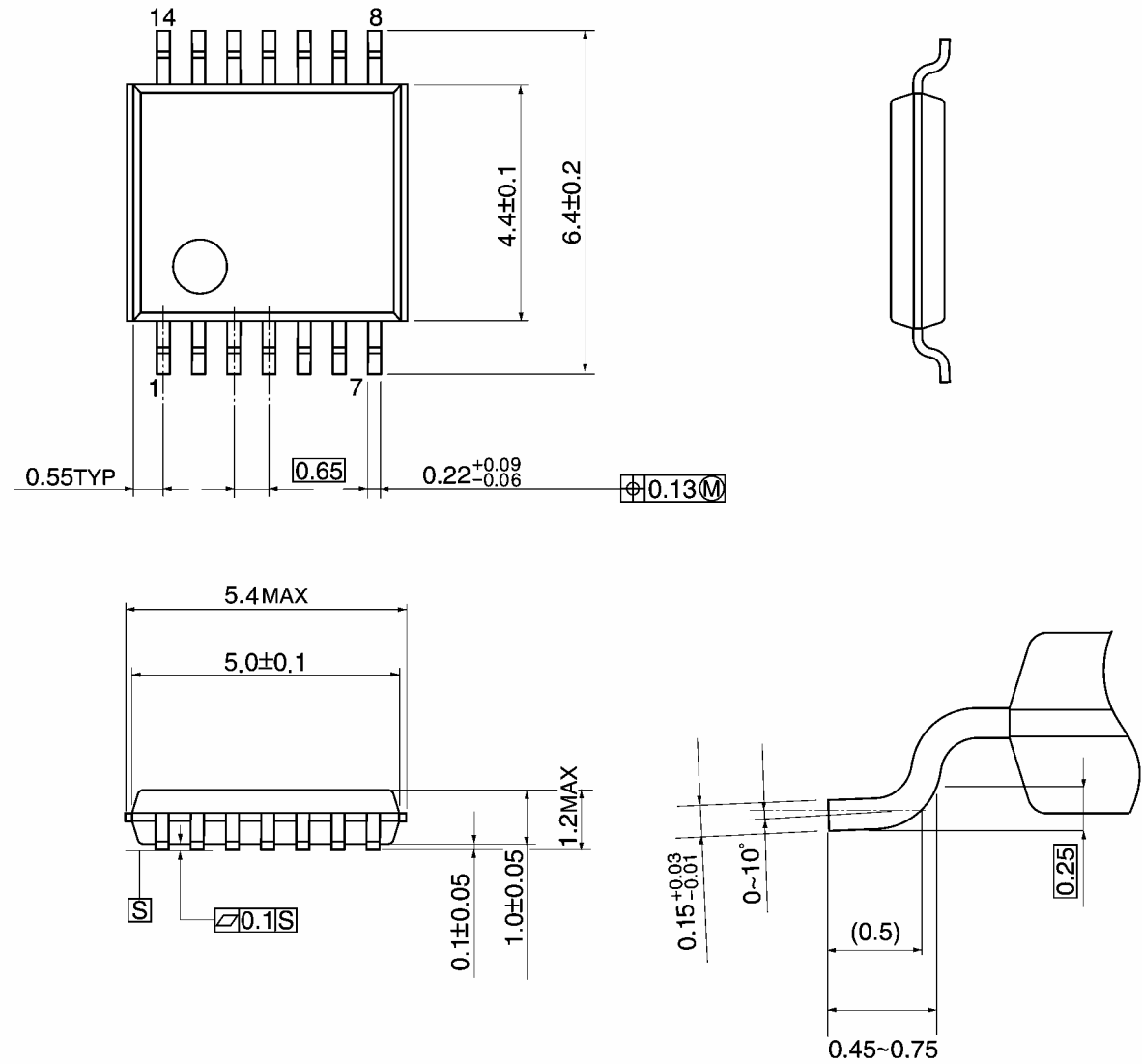
Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm



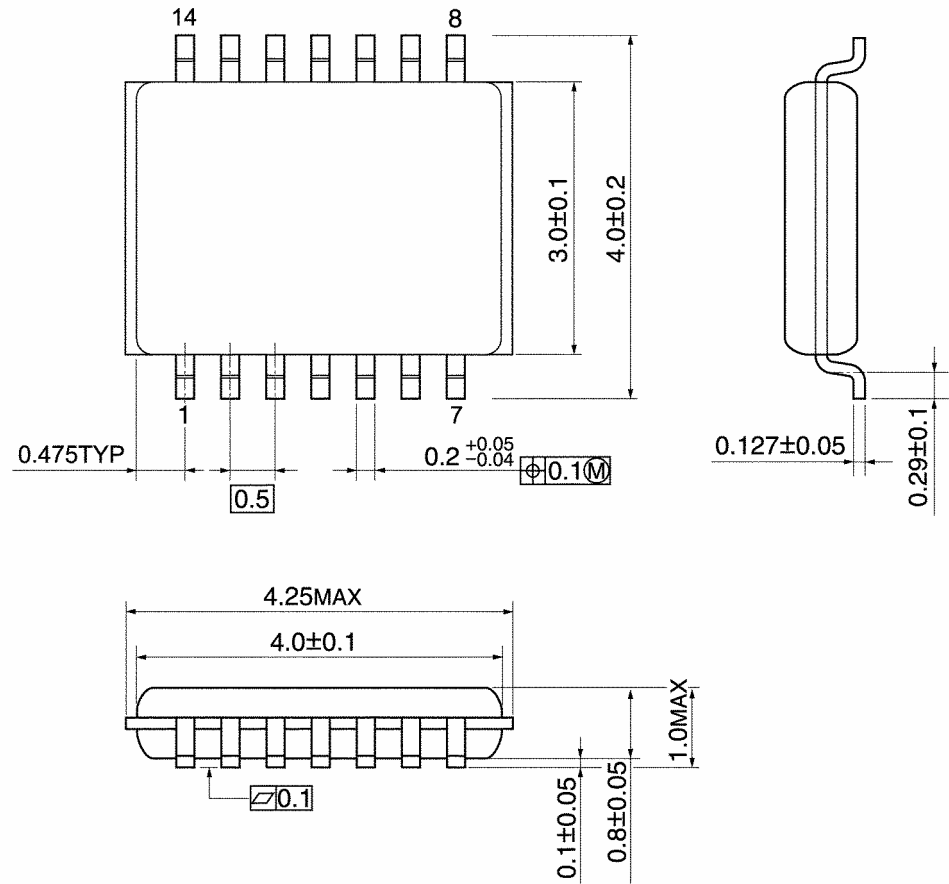
Weight: 0.06 g (typ.)



Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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20070701-EN GENERAL

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