

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

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)

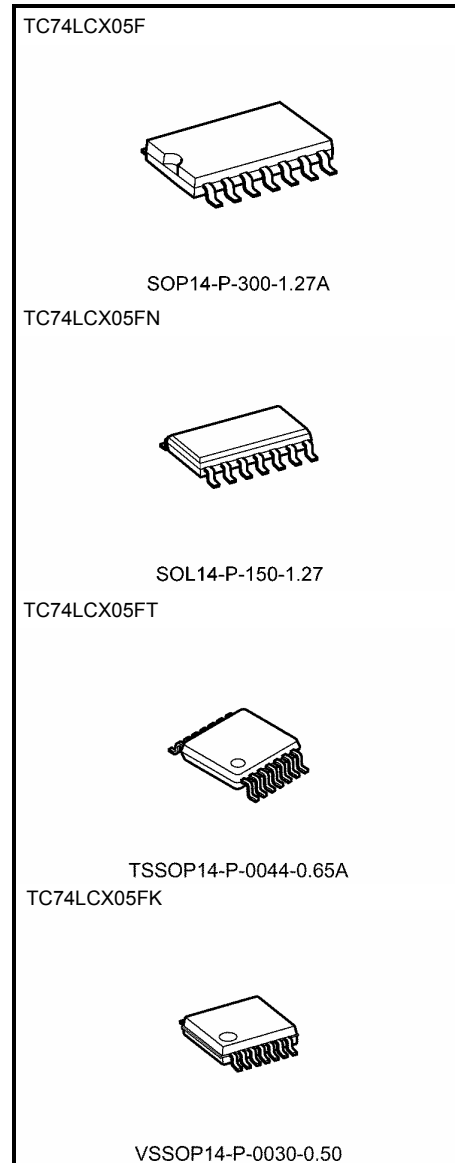
The device is designed for low-voltage (3.3 V) V_{CC} applications, but it could be used to interface to 5-V supply environment for inputs.

All inputs are equipped with protection circuits against static discharge.

Features

- Low-voltage operation: $V_{CC} = 2.0$ 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/HCF/ALS/LS etc.) 05 type

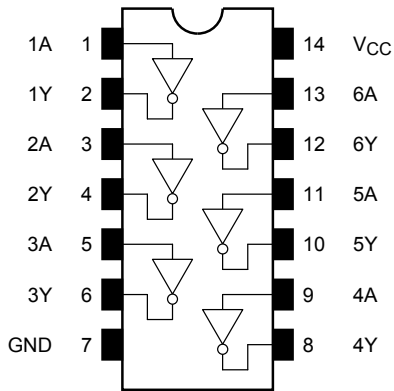
Note: xxxFN (JEDEC SOP) is not available in Japan.



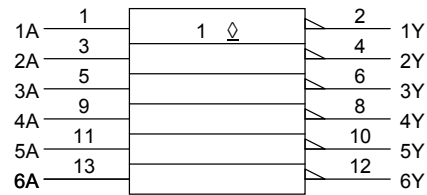
Weight

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

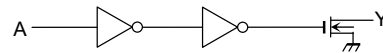


Truth Table

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_{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 7.0 (Note 2)	V
		-0.5 to $V_{CC} + 0.5$ (Note 3)	
Input diode current	I_{IK}	-50	mA
Output diode current	I_{OK}	-50 (Note 4)	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 to 150	$^{\circ}C$

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_{OUT} absolute maximum rating must be observed.

Note 4: $V_{OUT} < GND$

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°C)

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

AC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Output enable time	t _{pZL}	Figure 1, Figure 2	2.7	1.0	6.0	ns
			3.3 ± 0.3	0.8	5.0	
Output disable time	t _{pLZ}	Figure 1, Figure 2	2.7	1.0	6.0	ns
			3.3 ± 0.3	0.8	5.0	
Output to output skew	t _{osZL}	(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_r = t_f = 2.5 ns, C_L = 50 pF, R_L = 500 Ω)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V _{OL}	V _{OLP}	V _{IH} = 3.3 V, V _{IL} = 0 V	3.3	0.8	V
Quiet output minimum dynamic V _{OL}	V _{OLV}	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)	Typ.	Unit
Input capacitance	C _{IN}	—	3.3	7	pF
Output capacitance	C _{OUT}		3.3	8	pF
Power dissipation capacitance	C _{PD}	f _{IN} = 10 MHz (Note)	3.3	5	pF

Note: 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:

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

AC Test Circuit

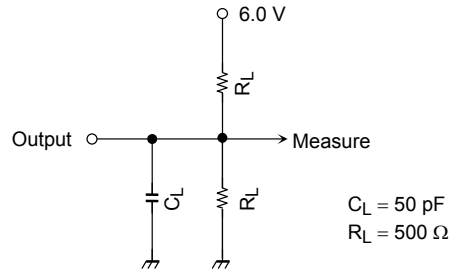


Figure 1

AC Waveform

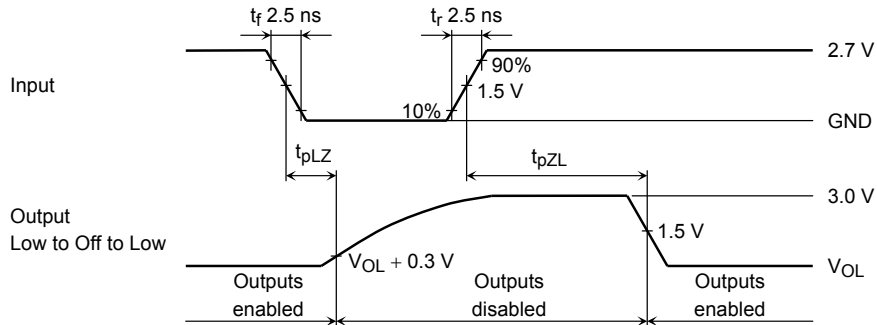
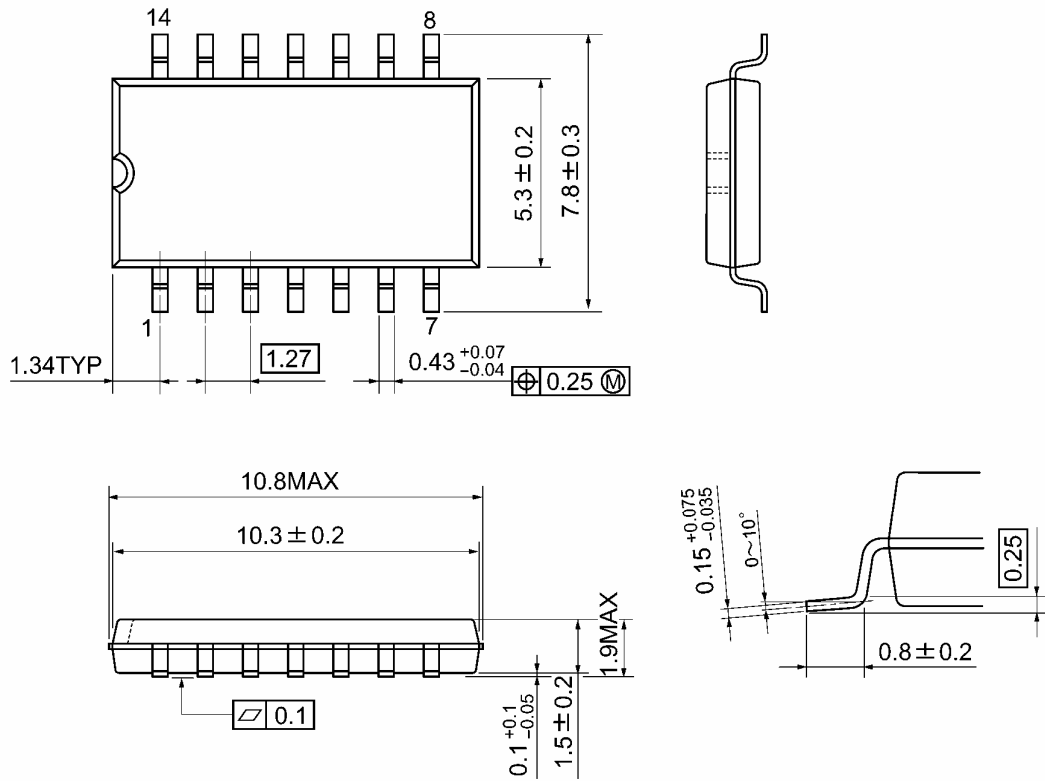


Figure 2 t_{pLZ} , t_{pZL}

Package Dimensions

SOP14-P-300-1.27A

Unit: mm

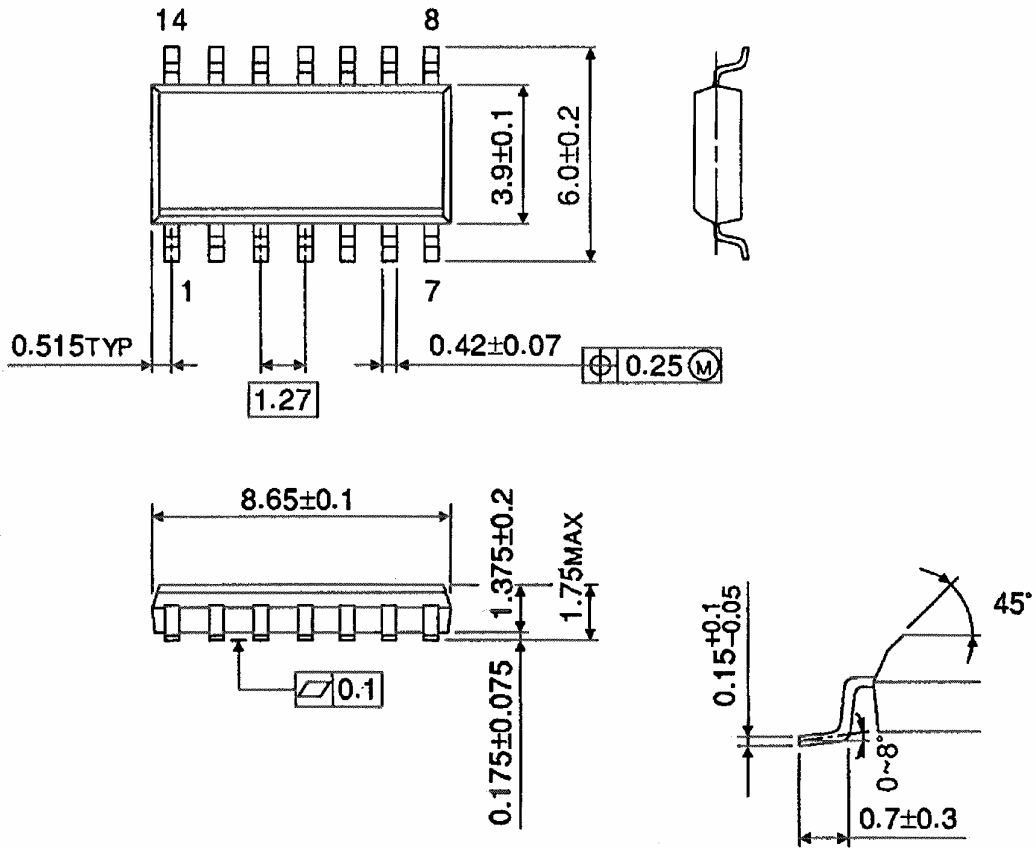


Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



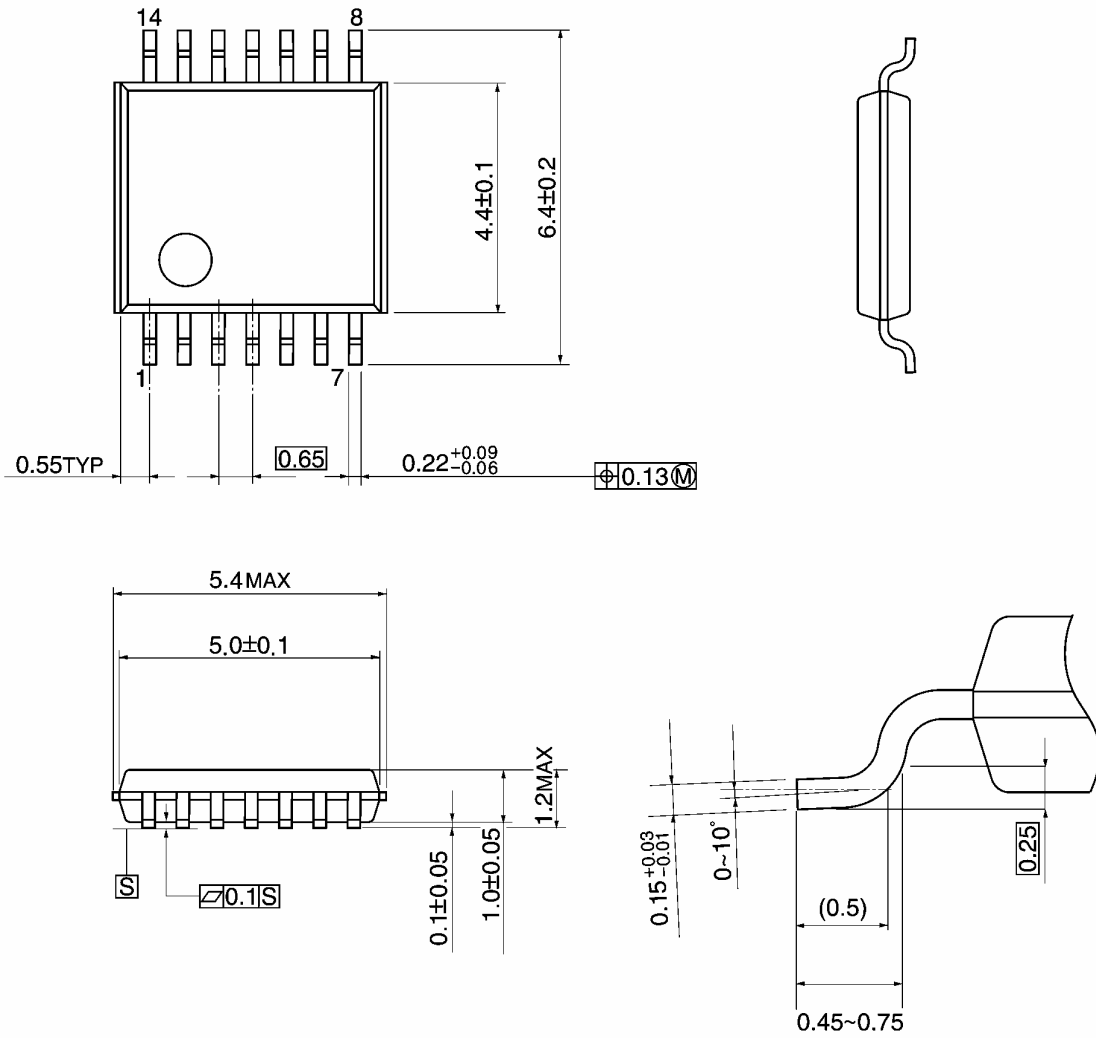
Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm

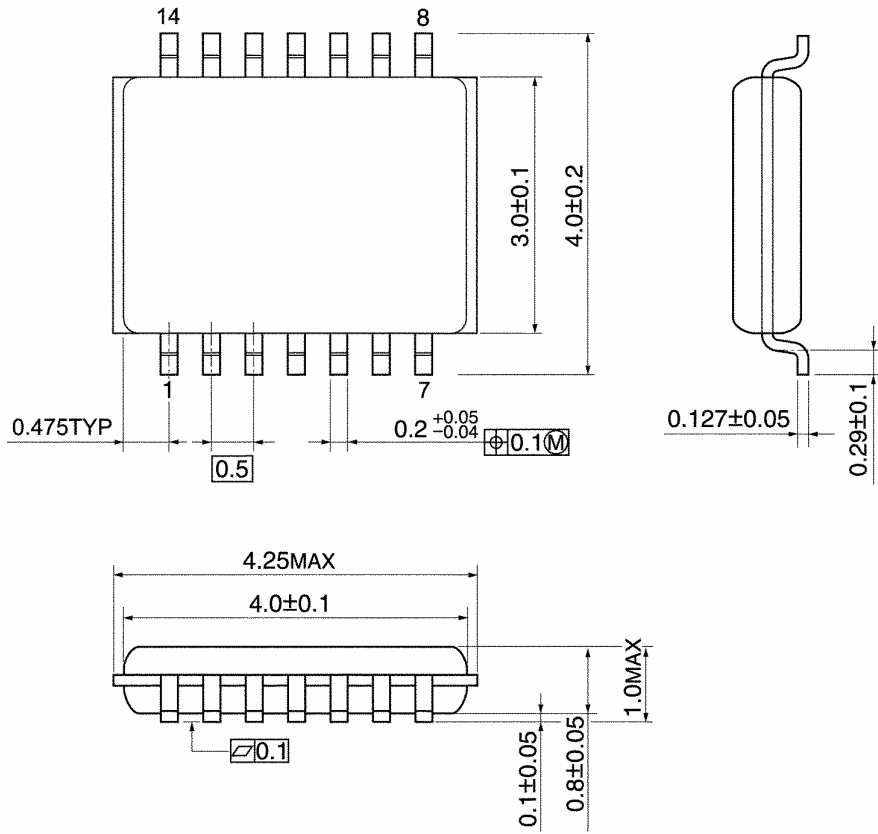


Weight: 0.06 g (typ.)

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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