

## TC74LCX74F, TC74LCX74FN, TC74LCX74FT

### Low-Voltage Dual D-Type Flip-Flop with 5-V Tolerant Inputs and Outputs

The TC74LCX74F/FN/FT is a high-performance CMOS D-type flip-flop. 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 V) VCC applications, but it could be used to interface to 5-V supply environment for inputs.

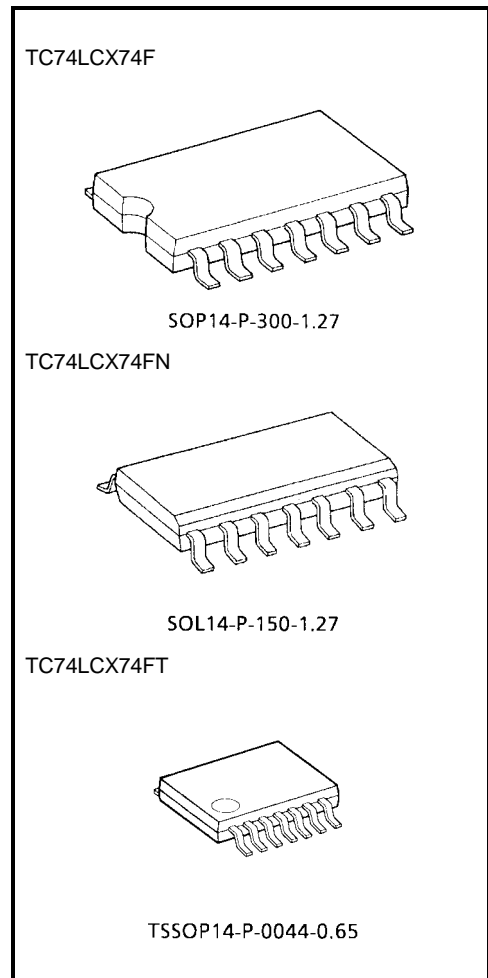
The signal level applied to the D input is transferred to Q output during the positive going transition of the CK pulse. CLR and PR are independent of the CK and are accomplished by setting the appropriate input low.

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:  $t_{pd} = 7.0$  ns (max) ( $V_{CC} = 3.0$  to  $3.6$  V)
- Output current:  $|I_{OH}|/I_{OL} = 24$  mA (min) ( $V_{CC} = 3.0$  V)
- Latch-up performance:  $\pm 500$  mA
- Available in JEDEC SOP, JEITA SOP and TSSOP
- Power-down protection provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 74 type

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



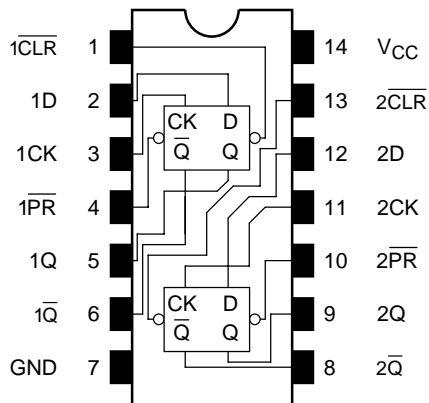
### Weight

SOP14-P-300-1.27: 0.18 g (typ.)

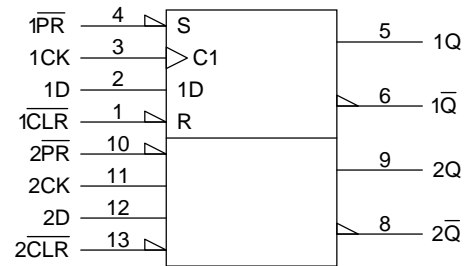
SOL14-P-150-1.27: 0.12 g (typ.)

TSSOP14-P-0044-0.65: 0.06 g (typ.)

## Pin Assignment (top view)



## IEC Logic Symbol



## Truth Table

Inputs				Outputs		Function
CLR	PR	D	CK	Q	Q̄	
L	H	X	X	L	H	Clear
H	L	X	X	H	L	Preset
L	L	X	X	H	H	—
H	H	L	↑	L	H	—
H	H	H	↑	H	L	—
H	H	X	↓	Q <sub>n</sub>	Q̄ <sub>n</sub>	No change

X: Don't care

## Maximum Ratings

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 1)	V
		-0.5 to $V_{CC} + 0.5$ (Note 2)	
Input diode current	$I_{IK}$	-50	mA
Output diode current	$I_{OK}$	±50 (Note 3)	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	°C

Note 1:  $V_{CC} = 0$  V

Note 2: High or low state.  $I_{OUT}$  absolute maximum rating must be observed.

Note 3:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

## Recommended Operating Conditions

Characteristics	Symbol	Rating	Unit
Power supply voltage	$V_{CC}$	2.0 to 3.6	V
		1.5 to 3.6 (Note 4)	
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to 5.5 (Note 5)	V
		0 to $V_{CC}$ (Note 6)	
Output current	$I_{OH}/I_{OL}$	$\pm 24$ (Note 7)	mA
		$\pm 12$ (Note 8)	
Operating temperature	$T_{opr}$	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 10 (Note 9)	ns/V

Note 4: Data retention only

Note 5:  $V_{CC} = 0$  V

Note 6: High or low state

Note 7:  $V_{CC} = 3.0$  to 3.6 V

Note 8:  $V_{CC} = 2.7$  to 3.0 V

Note 9:  $V_{IN} = 0.8$  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	H-level	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -100 \mu A$	2.7 to 3.6	$V_{CC} - 0.2$	V
				$I_{OH} = -12$ mA	2.7	2.2	
				$I_{OH} = -18$ mA	3.0	2.4	
				$I_{OH} = -24$ mA	3.0	2.2	
	L-level	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 100 \mu A$	2.7 to 3.6	—	0.2
				$I_{OL} = 12$ mA	2.7	—	0.4
				$I_{OL} = 16$ mA	3.0	—	0.4
				$I_{OL} = 24$ mA	3.0	—	0.55
Input leakage current		$I_{IN}$	$V_{IN} = 0$ to 5.5 V	2.7 to 3.6	—	$\pm 5.0$	$\mu A$
Power-off leakage current		$I_{OFF}$	$V_{IN}/V_{OUT} = 5.5$ V	0	—	10.0	$\mu A$
Quiescent supply current		$I_{CC}$	$V_{IN} = V_{CC}$ or GND	2.7 to 3.6	—	10.0	$\mu A$
			$V_{IN} = 3.6$ to 5.5 V	2.7 to 3.6	—	$\pm 10.0$	
Increase in $I_{CC}$ per input		$\Delta I_{CC}$	$V_{IH} = V_{CC} - 0.6$ V	2.7 to 3.6	—	500	

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

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
Maximum clock frequency	f <sub>max</sub>	Figure 1, Figure 2	2.7	—	—	MHz
			3.3 ± 0.3	150	—	
Propagation delay time (CK-Q, $\bar{Q}$ )	t <sub>pLH</sub> t <sub>pHL</sub>	Figure 1, Figure 2	2.7	—	8.0	ns
			3.3 ± 0.3	1.5	7.0	
Propagation delay time ( $\bar{CLR}$ , $\bar{PR}$ -Q, $\bar{Q}$ )	t <sub>pLH</sub> t <sub>pHL</sub>	Figure 1, Figure 4	2.7	—	8.0	ns
			3.3 ± 0.3	1.5	7.0	
Minimum pulse width (CK)	t <sub>W</sub> (H) t <sub>W</sub> (L)	Figure 1, Figure 2	2.7	3.3	—	ns
			3.3 ± 0.3	3.3	—	
Minimum pulse width ( $\bar{CLR}$ , $\bar{PR}$ )	t <sub>W</sub> (L)	Figure 1, Figure 4	2.7	3.6	—	ns
			3.3 ± 0.3	3.3	—	
Minimum setup time	t <sub>s</sub>	Figure 1, Figure 2	2.7	2.5	—	ns
			3.3 ± 0.3	2.5	—	
Minimum hold time	t <sub>h</sub>	Figure 1, Figure 2	2.7	1.5	—	ns
			3.3 ± 0.3	1.5	—	
Minimum removal time	t <sub>rem</sub>	Figure 1, Figure 3	2.7	3.0	—	ns
			3.3 ± 0.3	2.5	—	
Output to output skew	t <sub>osLH</sub> t <sub>osHL</sub>	(Note 10)	2.7	—	—	ns
			3.3 ± 0.3	—	1.0	

Note 10: Parameter guaranteed by design.

$$(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)$$

## 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)

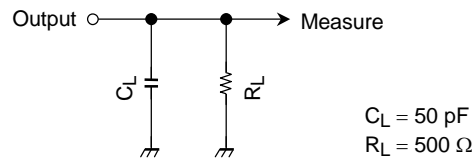
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Input capacitance	C <sub>IN</sub>	—	3.3	7	pF
Output capacitance	C <sub>OUT</sub>	—	0	8	pF
Power dissipation capacitance	C <sub>PD</sub>	f <sub>IN</sub> = 10 MHz (Note 11)	3.3	25	pF

Note 11: 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:

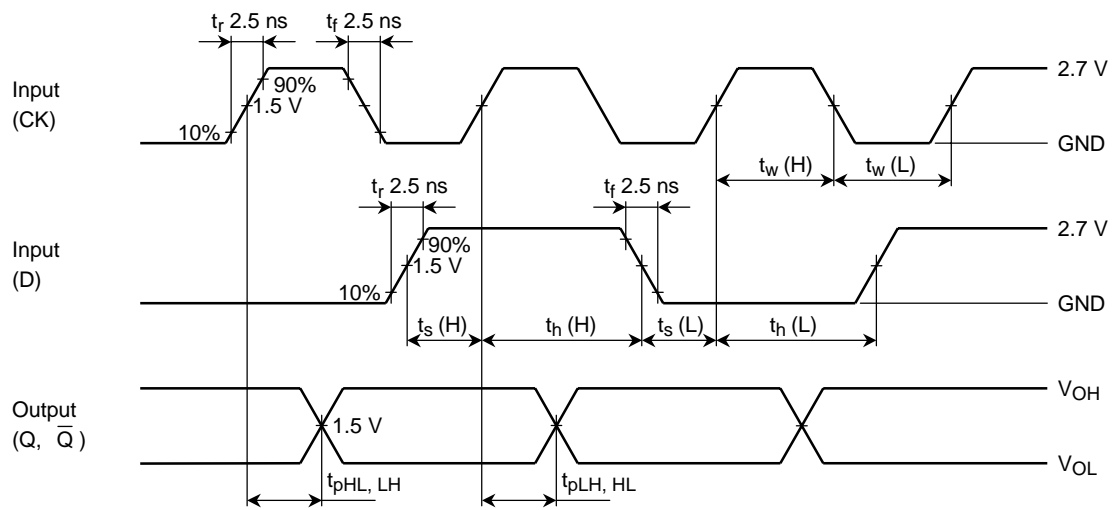
$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2 \text{ (per bit)}$$

**AC Test Circuit**

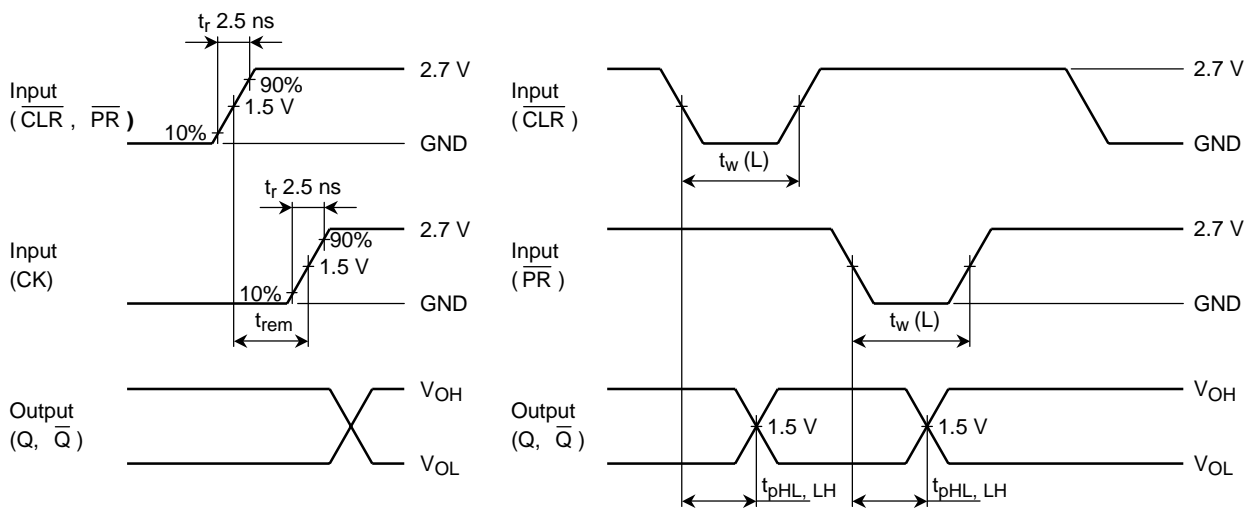


**Figure 1**

**AC Waveform**



**Figure 2  $t_{pLH}$ ,  $t_{pHL}$ ,  $t_w$ ,  $t_s$ ,  $t_h$**



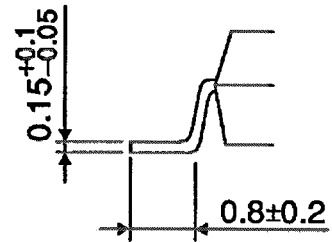
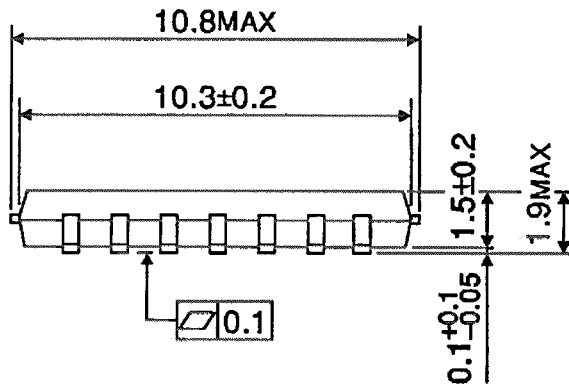
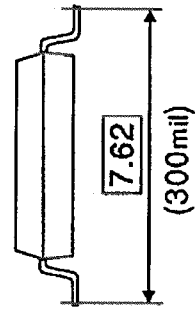
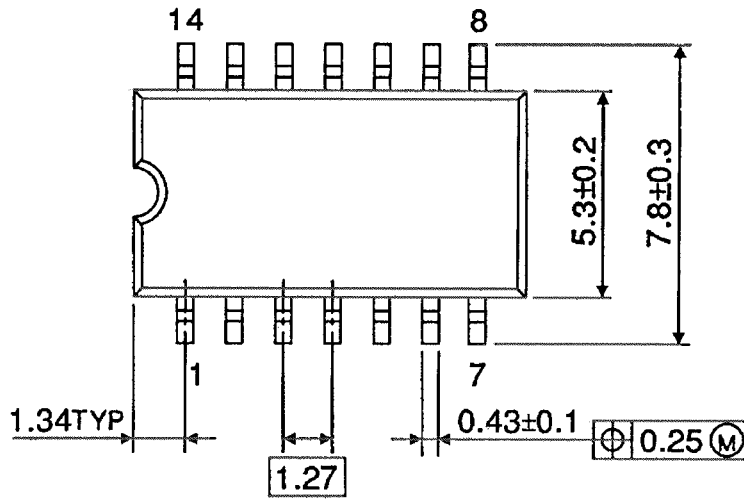
**Figure 3  $t_{rem}$**

**Figure 4  $t_{pLH}$ ,  $t_{pHL}$**

Package Dimensions

SOP14-P-300-1.27

Unit : mm



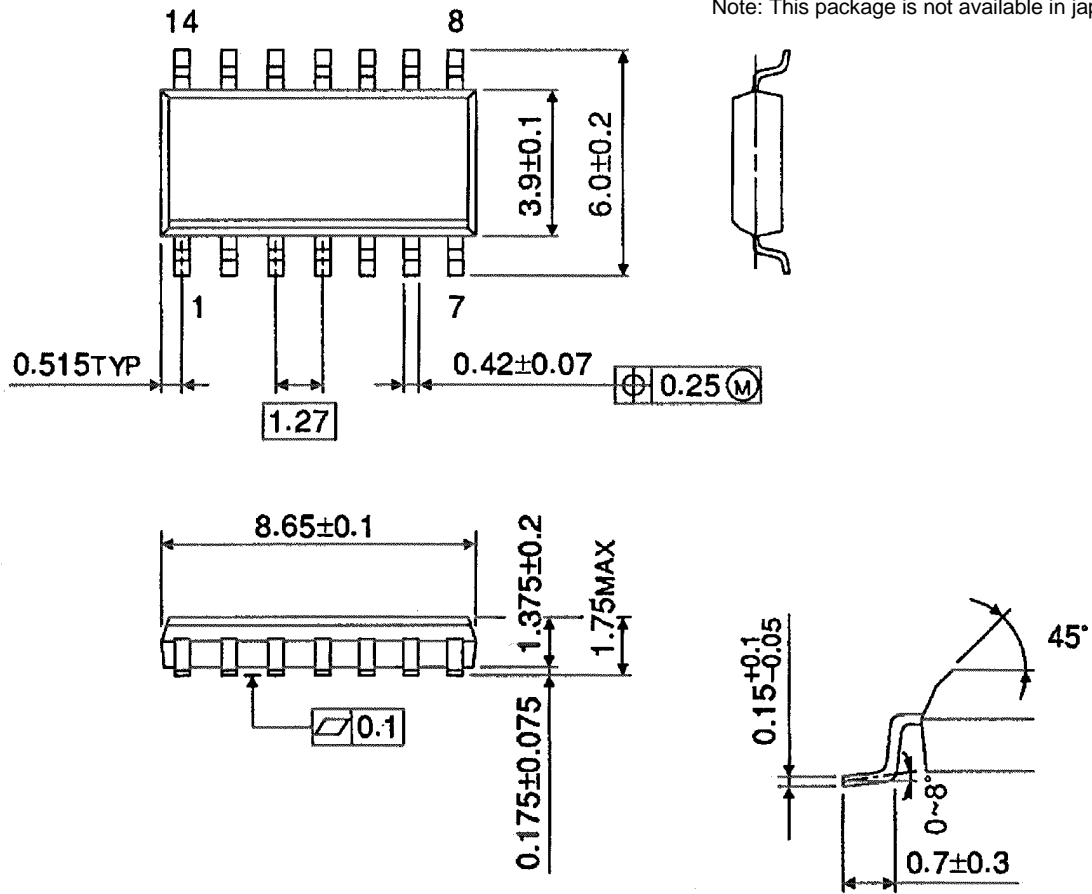
Weight: 0.18 g (typ.)

## Package Dimensions

SOL14-P-150-1.27

Unit : mm

Note: This package is not available in japan.

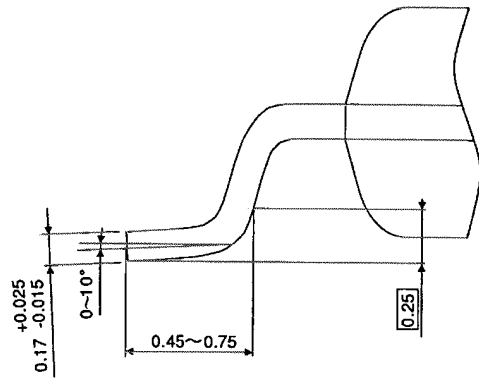
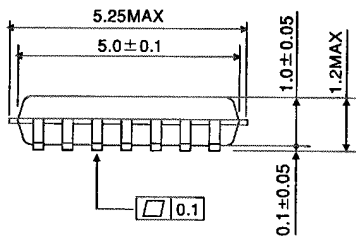
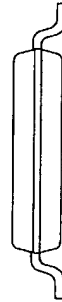
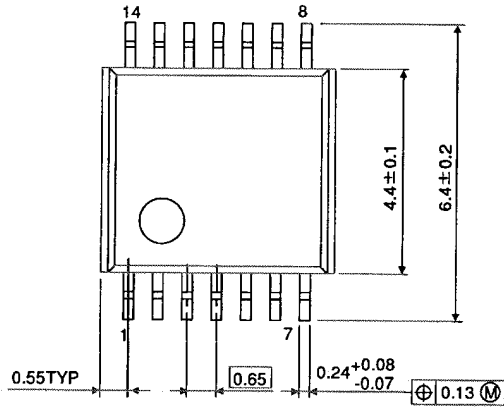


Weight: 0.12 g (typ.)

**Package Dimensions**

TSSOP14-P-0044-0.65

Unit : mm



Weight: 0.06 g (typ.)



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