

## 74LCX74

### Low Voltage Dual D-Type Positive Edge-Triggered Flip-Flop with 5V Tolerant Inputs

#### General Description

The LCX74 is a dual D-type flip-flop with Asynchronous Clear and Set inputs and complementary (Q,  $\bar{Q}$ ) outputs. Information at the input is transferred to the outputs on the positive edge of the clock pulse. After the Clock Pulse input threshold voltage has been passed, the Data input is locked out and information present will not be transferred to the outputs until the next rising edge of the Clock Pulse input.

Asynchronous Inputs:

LOW input to  $\bar{S}_D$  (Set) sets Q to HIGH level

LOW input to  $\bar{C}_D$  (Clear) sets Q to LOW level

Clear and Set are independent of clock

Simultaneous LOW on  $\bar{C}_D$  and  $\bar{S}_D$  makes both Q and  $\bar{Q}$  HIGH

#### Features

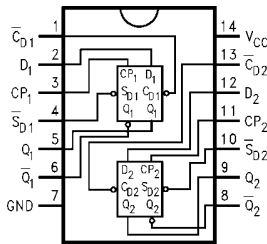
- 5V tolerant inputs
- 2.3V–3.6V  $V_{CC}$  specifications provided
- 7.0 ns  $t_{PD}$  max ( $V_{CC} = 3.3V$ ), 10  $\mu A$   $I_{CC}$  max
- Power down high impedance inputs and outputs
- $\pm 24$  mA output drive ( $V_{CC} = 3.0V$ )
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds 500 mA
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V

#### Ordering Code:

Order Number	Package Number	Package Description
74LCX74M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow
74LCX74SJ	M14D	14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCX74MTC	MTC14	14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

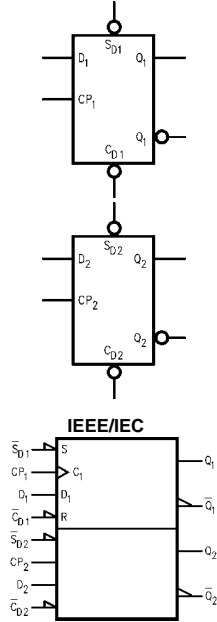
#### Connection Diagram



#### Pin Descriptions

Pin Names	Description
$D_1, D_2$	Data Inputs
$CP_1, CP_2$	Clock Pulse Inputs
$\bar{C}_D1, \bar{C}_D2$	Direct Clear Inputs
$\bar{S}_D1, \bar{S}_D2$	Direct Set Inputs
$Q_1, \bar{Q}_1, Q_2, \bar{Q}_2$	Outputs

**Logic Symbols**



**Truth Table**

(Each Half)

Inputs				Outputs	
$\overline{S}_D$	$\overline{C}_D$	CP	D	Q	$\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H	H
H	H	↗	H	H	L
H	H	↘	L	L	H
H	H	L	X	$Q_0$	$\overline{Q}_0$

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 ↗ = LOW-to-HIGH Clock Transition  
 ↘ = LOW-to-HIGH Clock Transition  
 $Q_0(\overline{Q}_0)$  = Previous  $Q(\overline{Q})$  before LOW-to-HIGH Transition of Clock

Absolute Maximum Ratings (Note 1)					
Symbol	Parameter	Value	Conditions	Units	
$V_{CC}$	Supply Voltage	-0.5 to +7.0		V	
$V_I$	DC Input Voltage	-0.5 to +7.0		V	
$V_O$	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	Output in HIGH or LOW State (Note 2)	V	
$I_{IK}$	DC Input Diode Current	-50	$V_I < GND$	mA	
$I_{OK}$	DC Output Diode Current	-50 +50	$V_O < GND$ $V_O > V_{CC}$	mA	
$I_O$	DC Output Source/Sink Current	$\pm 50$		mA	
$I_{CC}$	DC Supply Current per Supply Pin	$\pm 100$		mA	
$I_{GND}$	DC Ground Current per Ground Pin	$\pm 100$		mA	
$T_{STG}$	Storage Temperature	-65 to +150		°C	

Recommended Operating Conditions (Note 4)					
Symbol	Parameter	Min	Max	Units	
$V_{CC}$	Supply Voltage	Operating	2.0	3.6	V
		Data Retention	1.5	3.6	
$V_I$	Input Voltage	0	5.5	V	
$V_O$	Output Voltage	0	$V_{CC}$	V	
$I_{OH}/I_{OL}$	Output Current	$V_{CC} = 3.0V - 3.6V$		$\pm 24$	mA
		$V_{CC} = 2.7V - 3.0V$		$\pm 12$	
		$V_{CC} = 2.3V - 2.7V$		$\pm 8$	
$T_A$	Free-Air Operating Temperature	-40	85	°C	
$\Delta t/\Delta V$	Input Edge Rate, $V_{IN} = 0.8V - 2.0V$ , $V_{CC} = 3.0V$	0	10	ns/V	

**Note 1:** The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 2:**  $I_O$  Absolute Maximum Rating must be observed.

**Note 3:** Unused inputs must be held HIGH or LOW. They may not float.

### DC Electrical Characteristics

Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A = -40^\circ C$ to $+85^\circ C$		Units
				Min	Max	
$V_{IH}$	HIGH Level Input Voltage		2.3 - 2.7	1.7		V
			2.7 - 3.6	2.0		
$V_{IL}$	LOW Level Input Voltage		2.3 - 2.7		0.7	V
			2.3 - 3.6		0.8	
$V_{OH}$	HIGH Level Output Voltage	$I_{OH} = -100\mu A$	2.3 - 3.6	$V_{CC} - 0.2$		V
			2.3	1.8		
			2.7	2.2		
			3.0	2.4		
			3.0	2.2		
$V_{OL}$	LOW Level Output Voltage	$I_{OL} = 100\mu A$	2.3 - 3.6		0.2	V
			2.3		0.6	
			2.7		0.4	
			3.0		0.4	
			3.0		0.55	
$I_I$	Input Leakage Current	$0 \leq V_I \leq 5.5V$	2.3 - 3.6		$\pm 5.0$	$\mu A$
$I_{OFF}$	Power-Off Leakage Current	$V_I$ or $V_O = 5.5V$	0		10	$\mu A$
$I_{CC}$	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.3 - 3.6		10	$\mu A$
		$3.6V \leq V_I \leq 5.5V$	2.3 - 3.6		$\pm 10$	
$\Delta I_{CC}$	Increase in $I_{CC}$ per Input	$V_{IH} = V_{CC} - 0.6V$	2.3 - 3.6		500	$\mu A$

AC Electrical Characteristics								
Symbol	Parameter	$T_A = -40^\circ\text{C to } +85^\circ\text{C}, R_L = 500\Omega$						Units
		$V_{CC} = 3.3V \pm 0.3V$		$V_{CC} = 2.7V$		$V_{CC} = 2.5V \pm 0.2V$		
		$C_L = 50\text{ pF}$		$C_L = 50\text{ pF}$		$C_L = 30\text{ pF}$		
		Min	Max	Min	Max	Min	Max	
$f_{MAX}$	Maximum Clock Frequency	150		150		150		MHz
$t_{PHL}$	Propagation Delay	1.5	7.0	1.5	8.0	1.5	8.4	ns
$t_{PLH}$	$CP_n$ to $Q_n$ or $\overline{Q}_n$	1.5	7.0	1.5	8.0	1.5	8.4	
$t_{PHL}$	Propagation Delay	1.5	7.0	1.5	8.0	1.5	8.4	ns
$t_{PLH}$	$\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to $Q_n$ or $\overline{Q}_n$	1.5	7.0	1.5	8.0	1.5	8.4	
$t_S$	Setup Time	2.5		2.5		4.0		ns
$t_H$	Hold Time	1.5		1.5		2.0		ns
$t_W$	Pulse Width CP	3.3		3.3		4.0		ns
$t_W$	Pulse Width and $\overline{C}_D, \overline{S}_D$	3.3		3.6		4.0		ns
$t_{REC}$	Recovery Time	2.5		3.0		4.5		ns
$t_{OSHL}$	Output to Output Skew		1.0					ns
$t_{OSLH}$	(Note 4)		1.0					

**Note 4:** Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW ( $t_{OSHL}$ ) or LOW-to-HIGH ( $t_{OSLH}$ ).

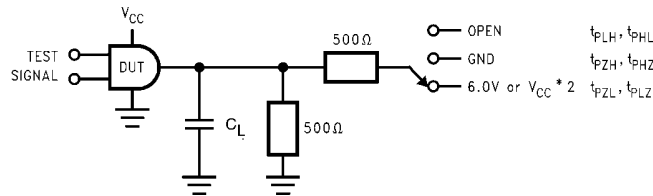
### Dynamic Switching Characteristics

Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A = 25^\circ\text{C}$	Unit
				Typical	
$V_{OLP}$	Quiet Output Dynamic Peak $V_{OL}$	$C_L = 50\text{ pF}, V_{IH} = 3.3V, V_{IL} = 0V$ $C_L = 30\text{ pF}, V_{IH} = 2.5V, V_{IL} = 0V$	3.3 2.5	-0.8 0.6	V
$V_{OLP}$	Quiet Output Dynamic Peak $V_{OL}$	$C_L = 50\text{ pF}, V_{IH} = 3.3V, V_{IL} = 0V$ $C_L = 30\text{ pF}, V_{IH} = 2.5V, V_{IL} = 0V$	3.3 2.5	-0.8 0.6	V

### Capacitance

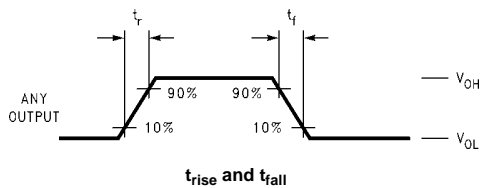
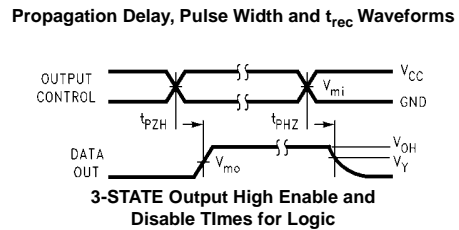
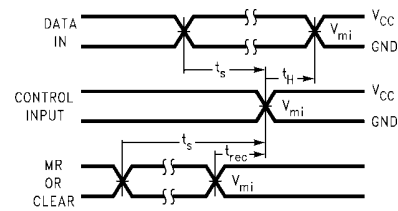
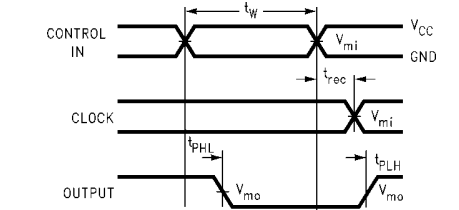
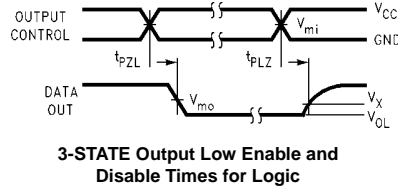
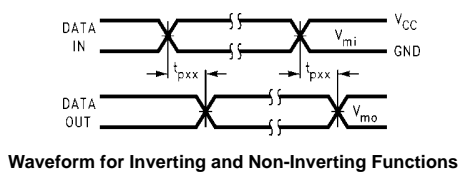
Symbol	Parameter	Conditions	Typical	Units
$C_{IN}$	Input Capacitance	$V_{CC} = \text{Open}, V_I = 0V \text{ or } V_{CC}$	7	pF
$C_{OUT}$	Output Capacitance	$V_{CC} = 3.3V, V_I = 0V \text{ or } V_{CC}$	8	pF
$C_{PD}$	Power Dissipation Capacitance	$V_{CC} = 3.3V, V_I = 0V \text{ or } V_{CC}, f = 10\text{ MHz}$	25	pF

**AC Loading and Waveforms** Generic for LCX Family



**FIGURE 1. AC Test Circuit**  
 ( $C_L$  includes probe and jig capacitance)

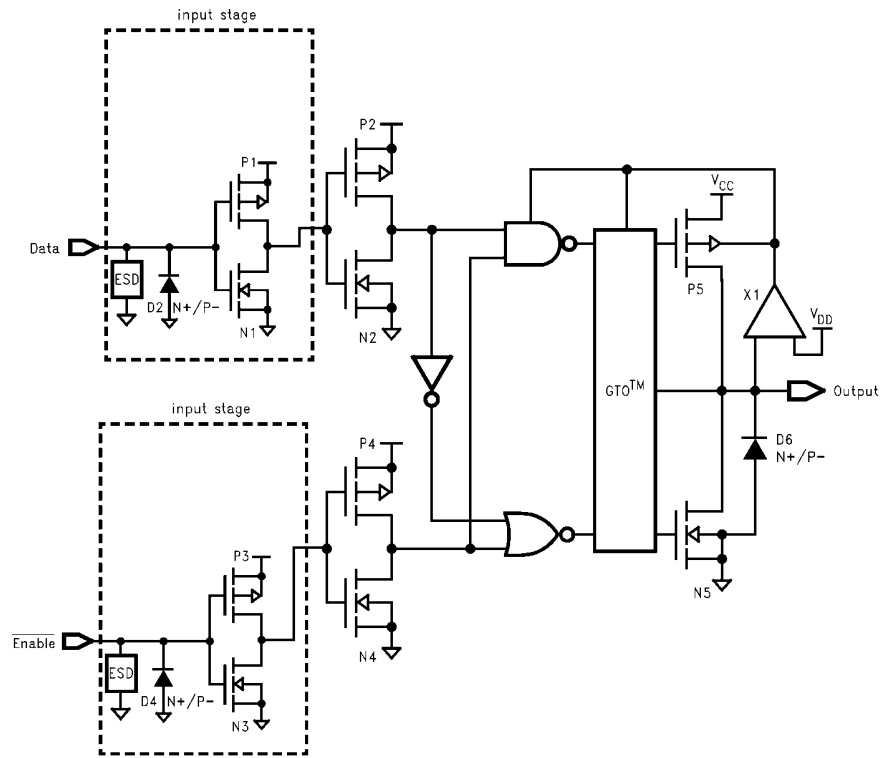
Test	Switch
$t_{PLH}, t_{PHL}$	Open
$t_{PZL}, t_{PLZ}$	6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
$t_{PZH}, t_{PHZ}$	GND



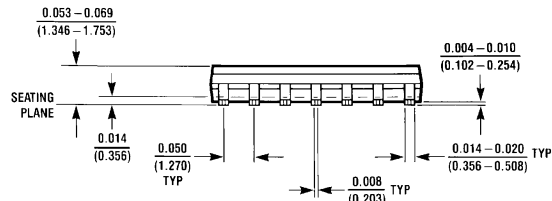
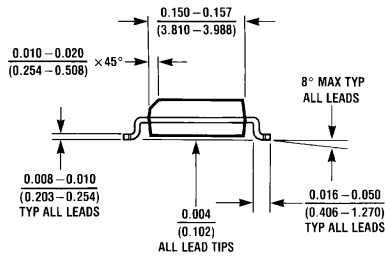
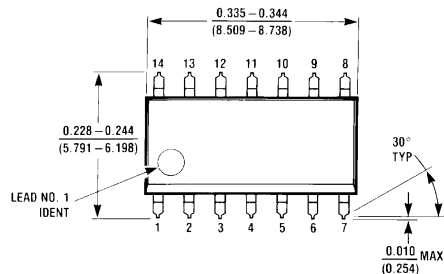
**FIGURE 2. Waveforms**  
 (Input Pulse Characteristics;  $f=1MHz, t_r=t_f=3ns$ )

Symbol	$V_{CC}$		
	$3.3V \pm 0.3V$	2.7V	$2.5V \pm 0.2V$
$V_{mi}$	1.5V	1.5V	$V_{CC}/2$
$V_{mo}$	1.5V	1.5V	$V_{CC}/2$
$V_x$	$V_{OL} + 0.3V$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$
$V_y$	$V_{OH} - 0.3V$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$

**Schematic Diagram** Generic for LCX Family

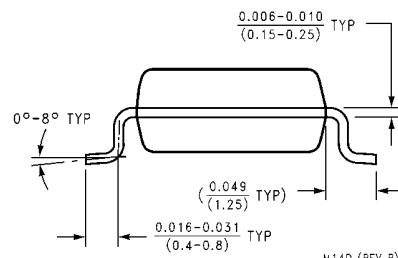
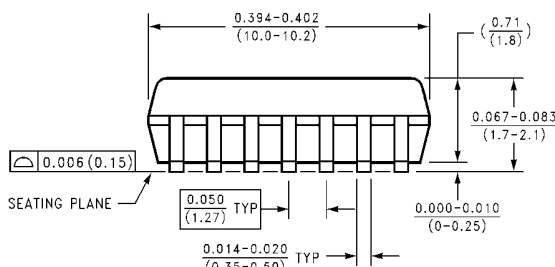
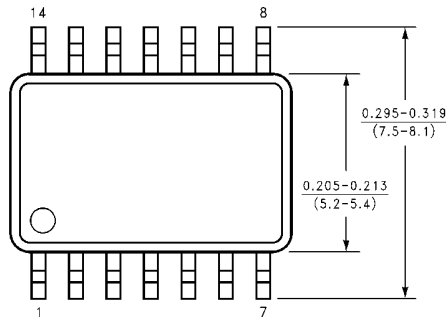


**Physical Dimensions** inches (millimeters) unless otherwise noted



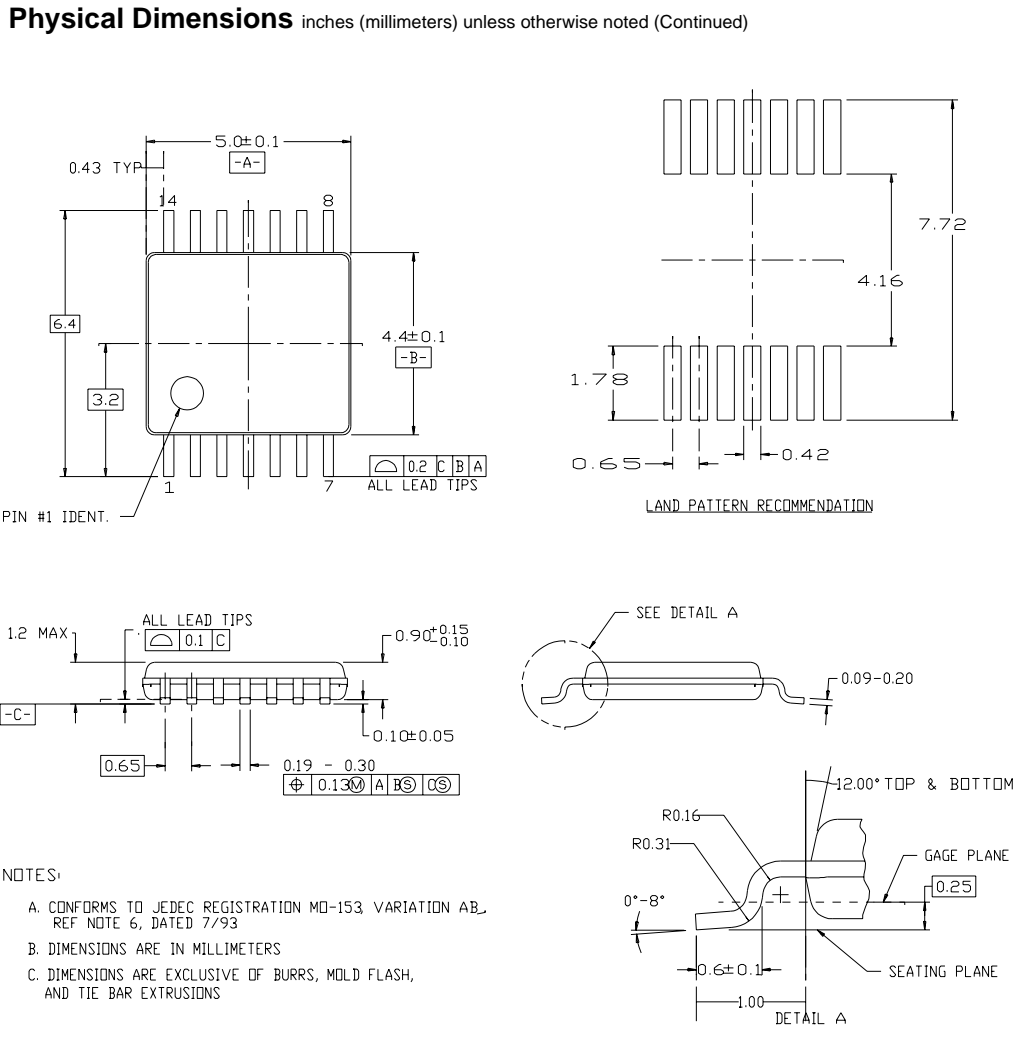
M14A (REV H)

**14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow  
Package Number M14A**



M14D (REV B)

**14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
Package Number M14D**



**14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  
Package Number MTC14**

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