

## 74LCX374 Low-Voltage Octal D Flip-Flop with 5V Tolerant Inputs and Outputs

### General Description

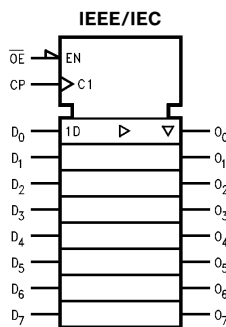
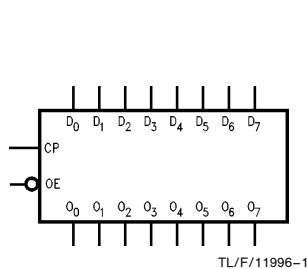
The LCX374 consists of eight D-type flip-flops featuring separate D-type inputs for each flip-flop and TRI-STATE® outputs for bus-oriented applications. A buffered clock (CP) and Output Enable ( $\overline{OE}$ ) are common to all flip-flops. The LCX374 is designed for low-voltage (3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment.

The LCX374 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

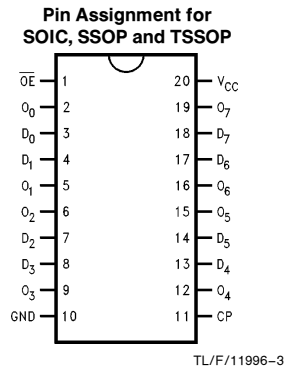
### Features

- 5V tolerant inputs and outputs
- 8.5 ns  $t_{PD}$  max, 10  $\mu A$   $I_{CCQ}$  max
- Power-down high impedance inputs and outputs
- Supports live insertion/withdrawal
- 2.0V–3.6V  $V_{CC}$  supply operation
- $\pm 24$  mA output drive
- Implements patented Quiet Series™ noise/EMI reduction circuitry
- Functionally compatible with the 74 series 374
- Latch-up performance exceeds 500 mA
- ESD performance:
  - Human Body Model > 2000V
  - Machine Model > 200V

### Logic Symbols



### Connection Diagram



Pin Names	Description
$D_0$ – $D_7$	Data Inputs
CP	Clock Pulse Input
$\overline{OE}$	Output Enable Input
$O_0$ – $O_7$	TRI-STATE Outputs



	SOIC JEDEC	SOIC EIAJ	SSOP Type II	TSSOP JEDEC
Order Number	74LCX374WM 74LCX374WMX	74LCX374SJ 74LCX374SJX	74LCX374MSA 74LCX374MSAX	74LCX374MTC 74LCX374MTCX
See NS Package Number	M20B	M20D	MSA20	MTC20


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## Functional Description

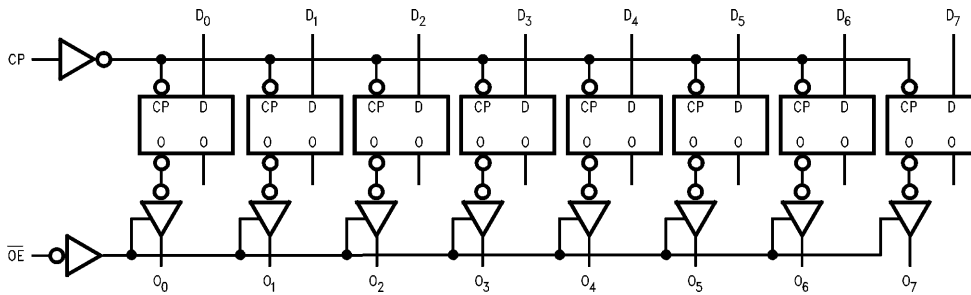
The LCX374 consists of eight edge-triggered flip-flops with individual D-type inputs and TRI-STATE true outputs. The buffered clock and buffered Output Enable are common to all flip-flops. The eight flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. With the Output Enable ( $\overline{OE}$ ) LOW, the contents of the eight flip-flops are available at the outputs. When the  $\overline{OE}$  is HIGH, the outputs go to the high impedance state. Operation of the  $\overline{OE}$  input does not affect the state of the flip-flops.

## Truth Table

Inputs			Outputs
$D_n$	CP	$\overline{OE}$	$O_n$
H		L	H
L		L	L
X	L	L	$O_0$
X	X	H	Z

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance  
 = LOW-to-HIGH Transition  
 $O_0$  = Previous  $O_0$  before HIGH to LOW of CP

## Logic Diagram



TL/F/11996-4

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

## Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Symbol	Parameter	Value	Conditions	Units
V <sub>CC</sub>	Supply Voltage	-0.5 to +7.0		V
V <sub>I</sub>	DC Input Voltage	-0.5 to +7.0		V
V <sub>O</sub>	DC Output Voltage	-0.5 to +7.0	Output in TRI-STATE	V
		-0.5 to V <sub>CC</sub> + 0.5	Output in High or Low State (Note 2)	V
I <sub>IJK</sub>	DC Input Diode Current	-50	V <sub>I</sub> < GND	mA
I <sub>OK</sub>	DC Output Diode Current	-50	V <sub>O</sub> < GND	mA
		+50	V <sub>O</sub> > V <sub>CC</sub>	
I <sub>O</sub>	DC Output Source/Sink Current	±50		mA
I <sub>CC</sub>	DC Supply Current per Supply Pin	±100		mA
I <sub>GND</sub>	DC Ground Current per Ground Pin	±100		mA
T <sub>STG</sub>	Storage Temperature	-65 to +150		°C

**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" table are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**Note 2:** I<sub>O</sub> Absolute Maximum Rating must be observed.

## Recommended Operating Conditions

Symbol	Parameter	Min	Max	Units	
V <sub>CC</sub>	Supply Voltage	Operating	2.0	3.6	V
		Data Retention	1.5	3.6	
V <sub>I</sub>	Input Voltage	0	5.5	V	
V <sub>O</sub>	Output Voltage	HIGH or LOW State	0	V <sub>CC</sub>	V
		TRI-STATE	0	5.5	
I <sub>OH</sub> /I <sub>OL</sub>	Output Current			±24 ±12	mA
T <sub>A</sub>	Free-Air Operating Temperature	-40	85	°C	
Δt/ΔV	Input Edge Rate, V <sub>IN</sub> = 0.8V-2.0V, V <sub>CC</sub> = 3.0V	0	10	ns/V	

## DC Electrical Characteristics

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C		Units
				Min	Max	
V <sub>IH</sub>	HIGH Level Input Voltage		2.7-3.6	2.0		V
V <sub>IL</sub>	LOW Level Input Voltage		2.7-3.6		0.8	V
V <sub>OH</sub>	HIGH Level Output Voltage	I <sub>OH</sub> = -100 μA	2.7-3.6	V <sub>CC</sub> - 0.2		V
		I <sub>OH</sub> = -12 mA	2.7	2.2		V
		I <sub>OH</sub> = -18 mA	3.0	2.4		V
		I <sub>OH</sub> = -24 mA	3.0	2.2		V
V <sub>OL</sub>	LOW Level Output Voltage	I <sub>OL</sub> = 100 μA	2.7-3.6		0.2	V
		I <sub>OL</sub> = 12 mA	2.7		0.4	V
		I <sub>OL</sub> = 16 mA	3.0		0.4	V
		I <sub>OL</sub> = 24 mA	3.0		0.55	V
I <sub>I</sub>	Input Leakage Current	0 ≤ V <sub>I</sub> ≤ 5.5V	2.7-3.6		±5.0	μA
I <sub>OZ</sub>	TRI-STATE Output Leakage	0 ≤ V <sub>O</sub> ≤ 5.5V V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	2.7-3.6		±5.0	μA
I <sub>OFF</sub>	Power-Off Leakage Current	V <sub>I</sub> or V <sub>O</sub> = 5.5V	0		10	μA
I <sub>CC</sub>	Quiescent Supply Current	V <sub>I</sub> = V <sub>CC</sub> or GND	2.7-3.6		10	μA
		3.6V ≤ V <sub>I</sub> , V <sub>O</sub> ≤ 5.5V	2.7-3.6		±10	μA
ΔI <sub>CC</sub>	Increase in I <sub>CC</sub> per Input	V <sub>IH</sub> = V <sub>CC</sub> - 0.6V	2.7-3.6		500	μA

## AC Electrical Characteristics

Symbol	Parameter	$T_A = -40^{\circ}\text{C to } +85^{\circ}\text{C}$				Units
		$V_{CC} = 3.3\text{V} \pm 0.3\text{V}$		$V_{CC} = 2.7\text{V}$		
		Min	Max	Min	Max	
$f_{MAX}$	Maximum Clock Frequency	150				MHz
$t_{PHL}$ $t_{PLH}$	Propagation Delay CP to $O_n$	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
$t_{PZL}$ $t_{PZH}$	Output Enable Time	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
$t_{PLZ}$ $t_{PHZ}$	Output Disable Time	1.5 1.5	7.5 7.5	1.5 1.5	8.5 8.5	ns
$t_s$	Setup Time	2.5		2.5		ns
$t_H$	Hold Time	1.5		1.5		ns
$t_W$	Pulse Width	3.3		3.3		ns
$t_{OSHL}$ $t_{OSLH}$	Output to Output Skew (Note 1)		1.0 1.0			ns

**Note 1:** 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

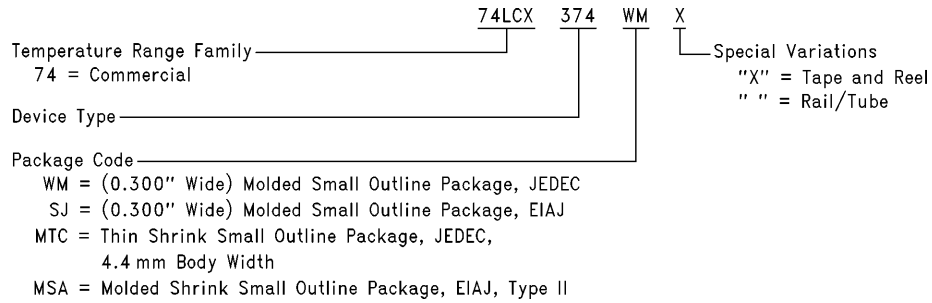
Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A = 25^{\circ}\text{C}$	Units
				Typical	
$V_{OLP}$	Quiet Output Dynamic Peak $V_{OL}$	$C_L = 50\text{ pF}, V_{IH} = 3.3\text{V}, V_{IL} = 0\text{V}$	3.3	0.8	V
$V_{OLV}$	Quiet Output Dynamic Valley $V_{OL}$	$C_L = 50\text{ pF}, V_{IH} = 3.3\text{V}, V_{IL}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

## Capacitance

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

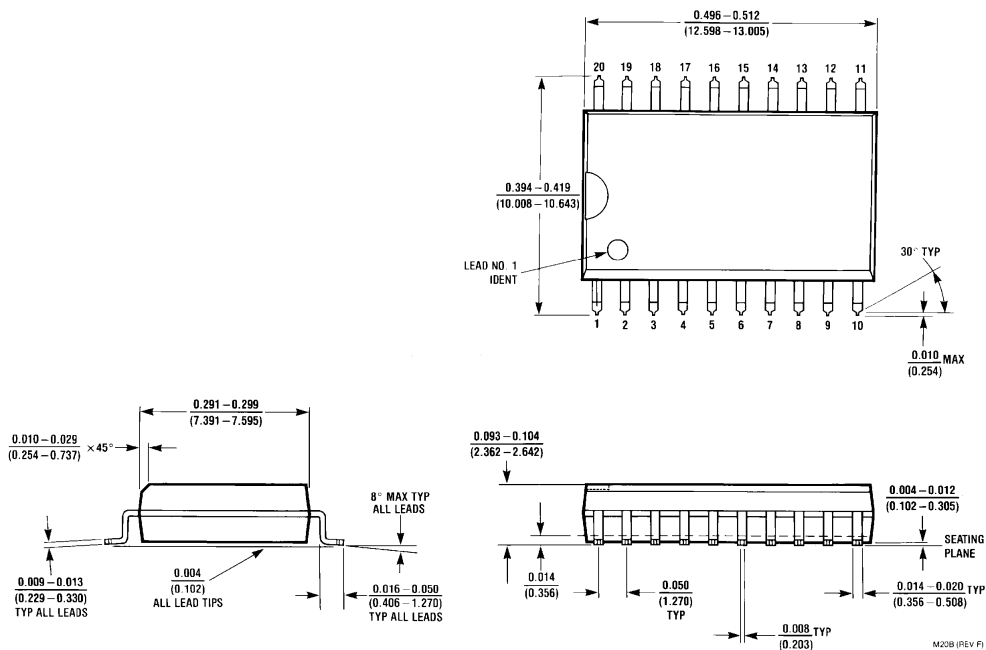
## 74LCX374 Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



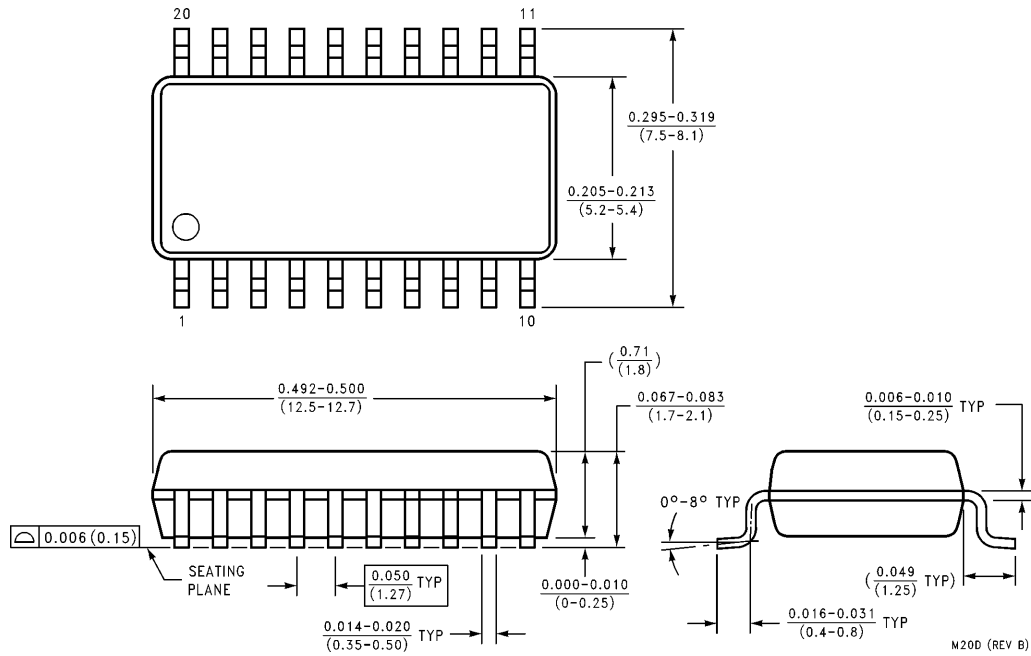
TL/F/11996-5

## Physical Dimensions inches (millimeters) unless otherwise noted



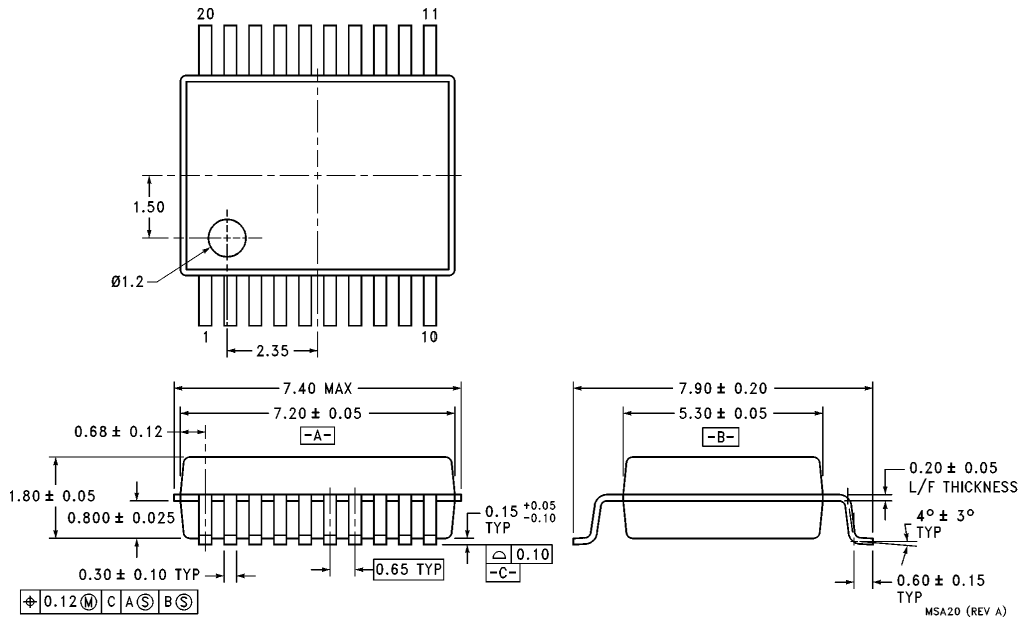
**20-Lead (0.300" Wide) Molded Small Outline Package, JEDEC**  
**Order Number 74LCX374WM or 74LCX374WMX**  
**NS Package Number M20B**

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



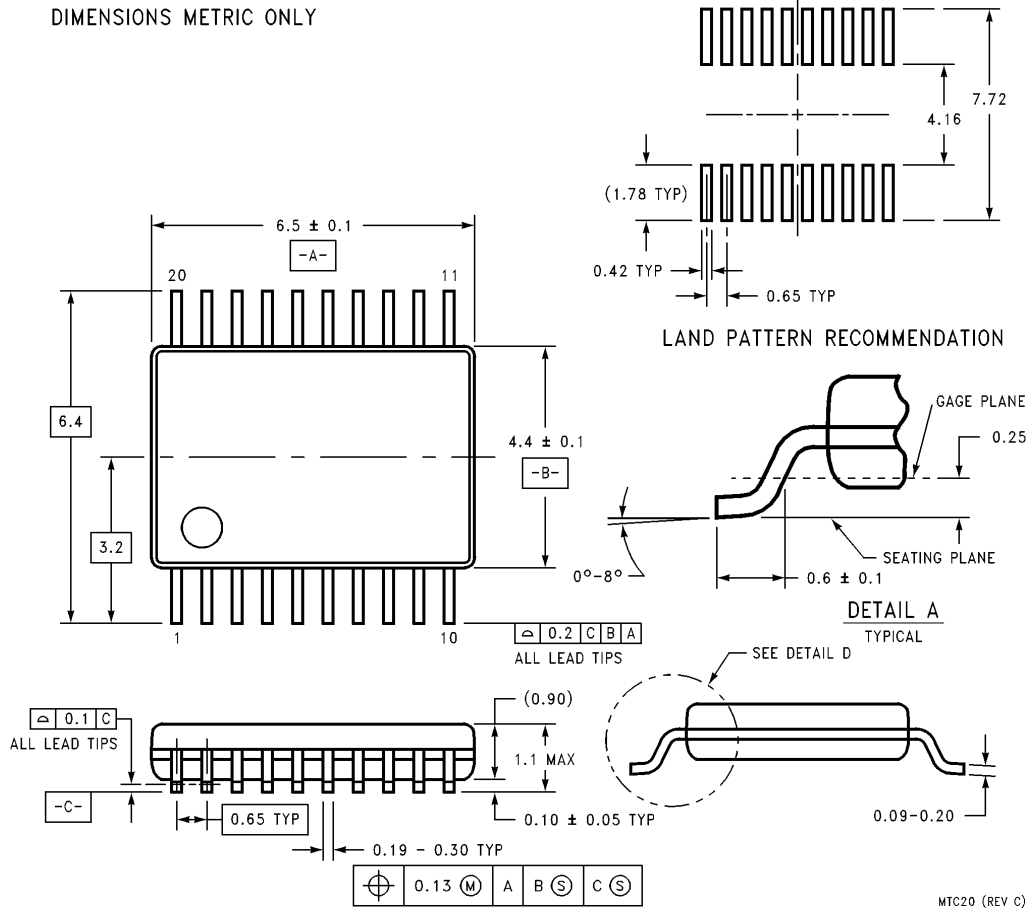
**20-Lead (0.300" Wide) Molded Small Outline Package, EIAJ**  
**Order Number 74LCX374SJ or 74LCX374SJX**  
**NS Package Number M20D**

**Physical Dimensions** All dimensions are in millimeters (Continued)



**20-Lead Molded Shrink Small Outline Package, EIAJ, Type II**  
**Order Number 74LCX374MSA or 74LCX374MSAX**  
**NS Package Number MSA20**

**Physical Dimensions** All dimensions are in millimeters (Continued)



**20-Lead Thin Shrink Small Outline Package, JEDEC**  
**Order Number 74LCX374MTC or 74LCX374MTCX**  
**NS Package Number MTC20**

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