

74LCX38

Low Voltage Quad 2-Input NAND Gate (Open Drain) with 5V Tolerant Inputs

General Description

The LCX38 contains four 2-input open drain NAND gates. The inputs tolerate voltages up to 7V allowing the interface of 5V systems to 3V systems.

The 74LCX38 is fabricated with advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Features

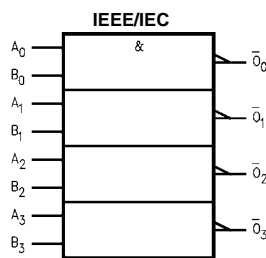
- 5V tolerant inputs
- 2.3V–3.6V V_{CC} specifications provided
- 6.5 ns t_{PD} max ($V_{CC} = 3.3V$), 10 μA I_{CC} max
- Power down high impedance inputs and outputs
- ± 24 mA output drive ($V_{CC} = 3.0V$)
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds 500 mA
- ESD performance:
 - Human body model > 2000V
 - Machine model > 150V

Ordering Code:

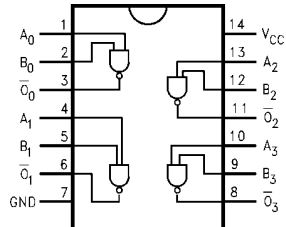
Order Number	Package Number	Package Description
74LCX38M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150" Narrow
74LCX38SJ	M14D	14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCX38MTC	MTC14	14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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

Logic Symbol



Connection Diagram



Pin Descriptions

Pin Names	Description
A_n, B_n	Inputs
\bar{O}_n	Outputs

74LCX38 Low Voltage Quad 2-Input NAND Gate (Open Drain) with 5V Tolerant Inputs

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	$V_I < \text{GND}$	mA	
I_{OK}	DC Output Diode Current	-50	$V_O < \text{GND}$	mA	
		+50	$V_O > V_{CC}$		
I_O	DC Output Source/Sink Current	± 50		mA	
I_{CC}	DC Supply Current per Supply Pin	± 100		mA	
I_{GND}	DC Ground Current per Ground Pin	± 100		mA	
T_{STG}	Storage Temperature	-65 to +150		°C	

Recommended Operating Conditions (Note 3)					
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	$V_{CC} = 3.0V - 3.6V$		± 24	mA
		$V_{CC} = 2.7V - 3.0V$		± 12	
		$V_{CC} = 2.3V - 2.7V$		± 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 beyond which the safety of the device cannot be guaranteed. The device should not be operating 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)	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		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_{OL}	LOW Level Output Voltage	$I_{OL} = 100\mu\text{A}$	2.3 - 3.6		0.2	V
		$I_{OL} = 8\text{mA}$	2.3		0.6	
		$I_{OL} = 12\text{mA}$	2.7		0.4	
		$I_{OL} = 16\text{mA}$	3.0		0.4	
		$I_{OL} = 24\text{mA}$	3.0		0.55	
I_I	Input Leakage Current	$0 \leq V_I \leq 5.5V$	2.3 - 3.6		± 5.0	μA
I_{OFF}	Power-Off Leakage Current	V_I or $V_O = 5.5V$	0		10	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.3 - 3.6		10	μA
		$3.6V \leq V_I \leq 5.5V$	2.3 - 3.6		± 10	
ΔI_{CC}	Increase in I_{CC} per Input	$V_{IH} = V_{CC} - 0.6V$	2.3 - 3.6		500	μA

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	
t_{PZL}	Propagation Delay Time	1.5	5.0	1.5	5.5	1.5	6.5	ns
t_{PLZ}		1.5	5.0	1.5	5.5	1.5	6.0	
t_{OSHL} t_{OSLH}	Output to Output Skew (Note 4)		1.0					ns

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)	$T_A = 25^\circ\text{C}$	Units
				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_{OLV}	Quiet Output Dynamic Valley 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

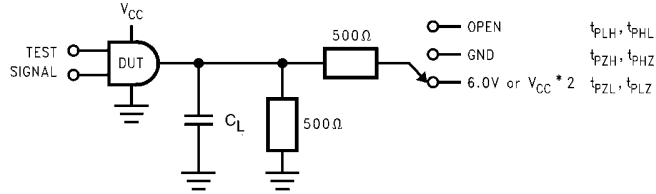
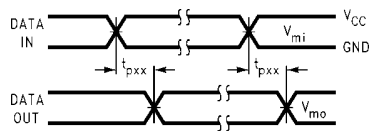
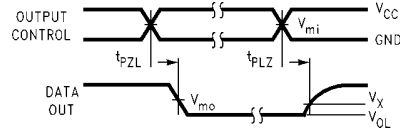


FIGURE 1. AC Test Circuit
(C_L includes probe and jig capacitance)

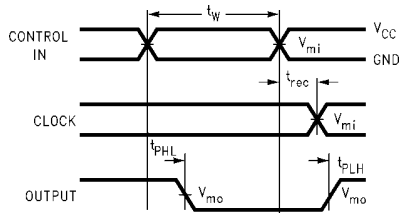
Test	Switch
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
t_{PZH}, t_{PHZ}	GND



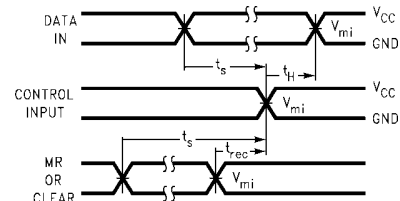
Waveform for Inverting and Non-Inverting Functions



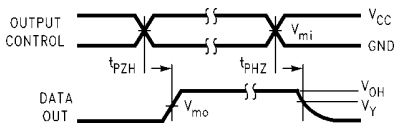
3-STATE Output Low Enable and Disable Times for Logic



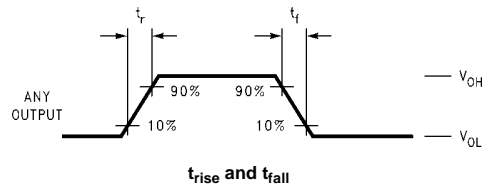
Propagation Delay, Pulse Width and t_{rec} Waveforms



Setup Time, Hold Time and Recovery Time for Logic



3-STATE Output High Enable and Disable Times for Logic

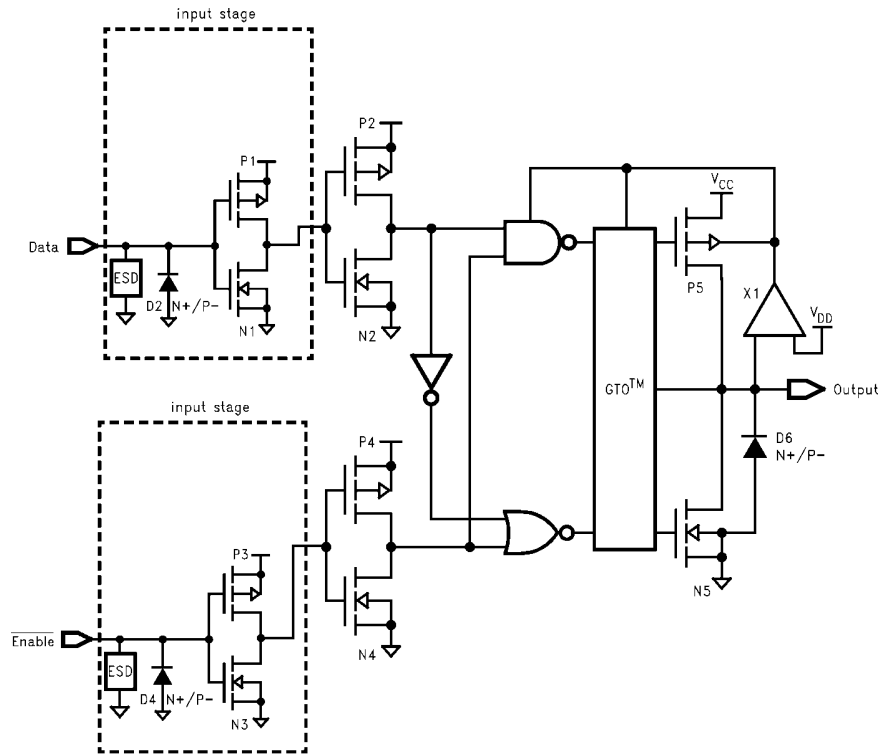


t_{rise} and t_{fall}

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

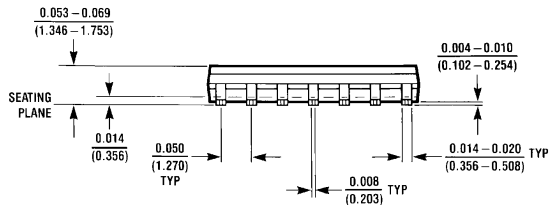
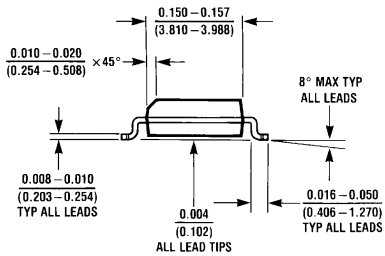
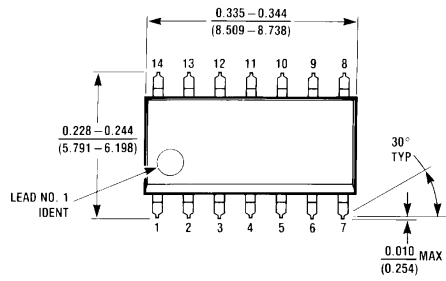
Symbol	V_{CC}		
	$3.3V \pm 0.3V$	2.7V	$2.5V \pm 0.2V$
V_{mi}	1.5V	1.5V	$V_{CC}/2$
V_{mo}	1.5V	1.5V	$V_{CC}/2$
V_x	$V_{OL} + 0.3V$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$
V_y	$V_{OH} - 0.3V$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$

Schematic Diagram

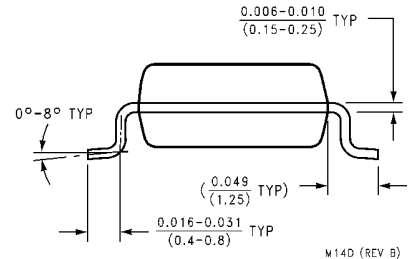
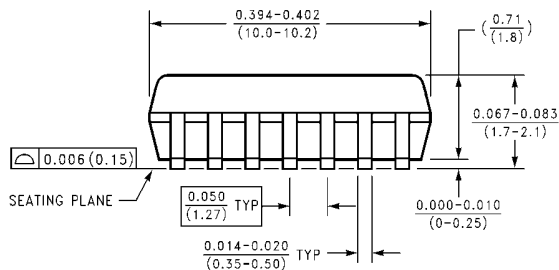
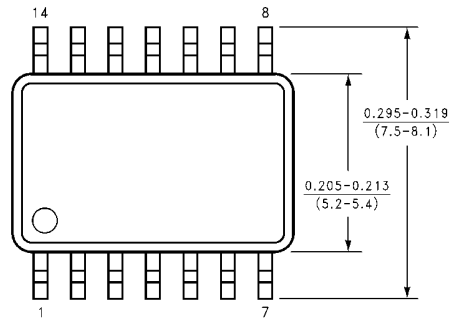


74LCX38

Physical Dimensions inches (millimeters) unless otherwise noted



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



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

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

PIN #1 IDENT.

ALL LEAD TIPS

LAND PATTERN RECOMMENDATION

SEE DETAIL A

DETAIL A

NOTES:

- CONFORMS TO JEDEC REGISTRATION MO-153 VARIATION AB, REF NOTE 6, DATED 7/93
- DIMENSIONS ARE IN MILLIMETERS
- DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS

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

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