

# Low Voltage 1-of-8 Decoder/Demultiplexer

With 5 V Tolerant Inputs

## 74LCX138

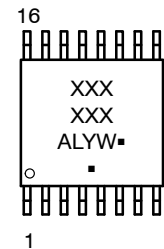
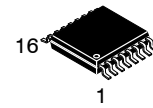
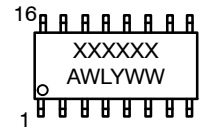
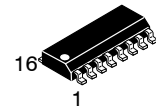
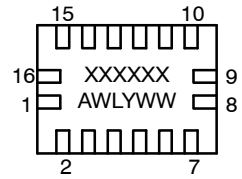
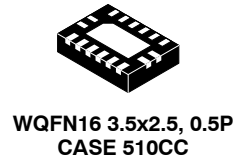
The LCX138 is a high-speed 1-of-8 decoder/demultiplexer. This device is ideally suited for high-speed memory chip select address decoding. The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three LCX138 devices or a 1-of-32 decoder using four LCX138 devices and one inverter.

The 74LCX138 is fabricated with advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

### Features

- 5 V Tolerant Inputs
- 1.65 V to 5.5 V  $V_{CC}$  Specifications Provided
- 6.0 ns  $t_{PD}$  Max ( $V_{CC} = 3.3$  V), 10  $\mu$ A  $I_{CC}$  Max
- Power Down High Impedance Inputs and Outputs
- $\pm 24$  mA Output Drive ( $V_{CC} = 3.0$  V)
- Implements Patented Noise/EMI Reduction Circuitry
- Latch-up Performance Exceeds 100 mA
- ESD Performance: Human Body Model >2000 V
- These are Pb-Free Devices

### MARKING DIAGRAMS



- A = Assembly Location
  - WL, L = Wafer Lot
  - Y = Year
  - WW, W = Work Week
  - G or  $\blacksquare$  = Pb-Free Package
- (Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

# 74LCX138

## Connection Diagrams

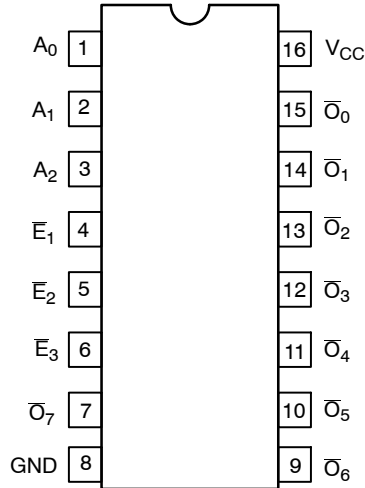


Figure 1. Pin Assignment for SOIC, SOP, and TSSOP

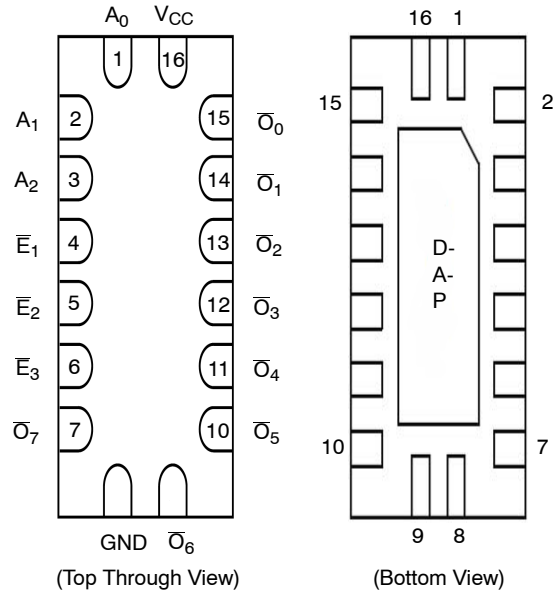


Figure 2. Pad Assignment for WQFN

## PIN DESCRIPTIONS

Pin Names	Description
A <sub>0</sub> -A <sub>2</sub>	Address Inputs
$\bar{E}_1$ - $\bar{E}_2$	Enable Inputs
E <sub>3</sub>	Enable Input
$\bar{O}_0$ - $\bar{O}_7$	Outputs
DAP	No Connect

NOTE: DAP (Die Attach Pad)

## Functional Description

The LCX138 high-speed 1-of-8 decoder/demultiplexer accepts three binary weighted inputs (A<sub>0</sub>, A<sub>1</sub>, A<sub>2</sub>) and, when enabled, provides eight mutually exclusive active-LOW outputs (O<sub>0</sub>-O<sub>7</sub>). The LCX138 features three Enable inputs, two active-LOW (E<sub>1</sub>, E<sub>2</sub>) and one active-HIGH (E<sub>3</sub>). All outputs will be HIGH unless E<sub>1</sub> and E<sub>2</sub> are LOW and E<sub>3</sub> is HIGH. The LCX138 can be used as an 8-output demultiplexer by using one of the active LOW Enable inputs as the data input and the other Enable inputs as strobes. The Enable inputs which are not used must be permanently tied to their appropriate active-HIGH or active-LOW state.

## TRUTH TABLE

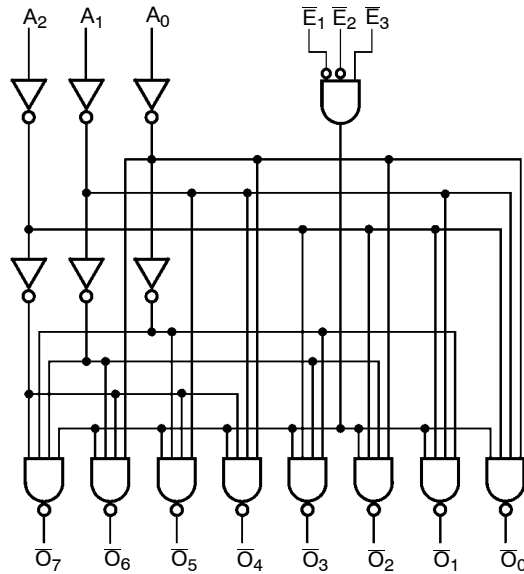
Inputs						Outputs							
$\bar{E}_1$	$\bar{E}_2$	E <sub>3</sub>	A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>	$\bar{O}_0$	$\bar{O}_1$	$\bar{O}_2$	$\bar{O}_3$	$\bar{O}_4$	$\bar{O}_5$	$\bar{O}_6$	$\bar{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

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**Figure 3. Logic Diagram**

NOTE: 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

Symbol	Parameter	Value	Unit	
$V_{CC}$	DC Supply Voltage	-0.5 to +6.5	V	
$V_I$	DC Input Voltage (Note 1)	-0.5 to +6.5	V	
$V_O$	DC Output Voltage (Note 1)	Active-Mode (High or Low State) Tri-State Mode Power-Down Mode ( $V_{CC} = 0$ V)	-0.5 to $V_{CC} + 0.5$ -0.5 to +6.5 -0.5 to +6.5	V
$I_{IK}$	DC Input Diode Current	$V_I < GND$	-50	mA
$I_{OK}$	DC Output Diode Current	$V_O < GND$	-50	mA
$I_O$	DC Output Source/Sink Current		$\pm 50$	mA
$I_{CC}$ or $I_{GND}$	DC Supply Current per Supply Pin or Ground Pin		$\pm 100$	mA
$T_{STG}$	Storage Temperature Range		-65 to +150	$^{\circ}C$
$T_L$	Lead Temperature, 1 mm from Case for 10 secs		260	$^{\circ}C$
$T_J$	Junction Temperature Under Bias		+150	$^{\circ}C$
$\theta_{JA}$	Thermal Resistance (Note 1)	SOIC-16 WQFN-16 TSSOP-16	126 114 159	$^{\circ}C/W$
$P_D$	Power Dissipation in Still Air at 125 $^{\circ}C$	SOIC-16 WQFN-16 TSSOP-16	995 1094 787	mW
MSL	Moisture Sensitivity		Level 1	-
$F_R$	Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	-
$V_{ESD}$	ESD Withstand Voltage (Note 3)	Human Body Model Charged Device Model	2000 N/A	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- $I_O$  absolute maximum rating must be observed.
- Measured with minimum pad spacing on an FR4 board, using 76 mm-by-114 mm, 2-ounce copper trace no air flow per JESD51-7.
- HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.

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## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit	
V <sub>CC</sub>	Supply Voltage	Operating	3.3	5.5	V	
		Data Retention Only	1.5	3.3		
V <sub>I</sub>	Digital Input Voltage	0	–	5.5	V	
V <sub>O</sub>	Output Voltage	Active Mode (High or Low State)	0	–	V <sub>CC</sub>	V
		Tri-State Mode	0	–	5.5	
		Power Down Mode (V <sub>CC</sub> = 0 V)	0	–	5.5	
T <sub>A</sub>	Operating Free-Air Temperature	–40	–	+125	°C	
t <sub>r</sub> , t <sub>f</sub>	Input Rise or Fall Rate	V <sub>CC</sub> = 1.65 V to 1.95 V	0	–	20	nS/V
		V <sub>CC</sub> = 2.3 V to 2.7 V	0	–	20	
		V <sub>IN</sub> from 0.8 V to 2.0 V, V <sub>CC</sub> = 3.0 V	0	–	10	
		V <sub>CC</sub> = 4.5 V to 5.5 V	0	–	5	
			0	–		

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

4. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V<sub>CC</sub>). Unused outputs must be left open.

## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = –40°C to +85°C		T <sub>A</sub> = –40°C to +125°C		Unit
				Min	Max	Min	Max	
V <sub>IH</sub>	HIGH Level Input Voltage		1.65 – 1.95	0.65 x V <sub>CC</sub>	–	0.65 x V <sub>CC</sub>	–	V
			2.3 – 2.7	1.7	–	1.7	–	
			3.0 – 3.6	2.0	–	2.0	–	
			4.5 – 5.5	0.70 x V <sub>CC</sub>	–	0.70 x V <sub>CC</sub>	–	
V <sub>IL</sub>	LOW Level Input Voltage		1.65 – 1.95	–	0.35 x V <sub>CC</sub>	–	0.35 x V <sub>CC</sub>	V
			2.3 – 2.7	–	0.7	–	0.7	
			3.0 – 3.6	–	0.8	–	0.8	
			4.5 – 5.5	–	0.30 x V <sub>CC</sub>	–	0.30 x V <sub>CC</sub>	
V <sub>OH</sub>	High-Level Output Voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = –100 μA I <sub>OH</sub> = –4 mA I <sub>OH</sub> = –8 mA I <sub>OH</sub> = –12 mA I <sub>OH</sub> = –16 mA I <sub>OH</sub> = –24 mA I <sub>OH</sub> = –32 mA	1.65 – 5.5	V <sub>CC</sub> – 0.1	–	V <sub>CC</sub> – 0.1	–	V
			1.65	1.29	–	1.29	–	
			2.3	1.8	–	1.8	–	
			2.7	2.2	–	2.2	–	
			3.0	2.4	–	2.4	–	
			3.0	2.2	–	2.2	–	
			4.5	3.7	–	3.7	–	
V <sub>OL</sub>	Low-Level Output Voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OL</sub> = 100 μA I <sub>OL</sub> = 4 mA I <sub>OL</sub> = 8 mA I <sub>OL</sub> = 12 mA I <sub>OL</sub> = 16 mA I <sub>OL</sub> = 24 mA I <sub>OL</sub> = 32 mA	1.65 – 5.5	–	0.1	–	0.1	V
			1.65	–	0.24	–	0.24	
			2.3	–	0.3	–	0.3	
			2.7	–	0.4	–	0.4	
			3.0	–	0.4	–	0.4	
			3.0	–	0.55	–	0.55	
			4.5	–	0.6	–	0.6	
I <sub>I</sub>	Input Leakage Current	V <sub>I</sub> = 0 to 5.5 V	1.65 – 5.5	–	±5.0	–	±5.0	μA
I <sub>OFF</sub>	Power Off Leakage Current	V <sub>I</sub> = 5.5 V or V <sub>O</sub> = 5.5 V	0	–	10	–	10	μA
I <sub>CC</sub>	Quiescent Supply Current	V <sub>I</sub> = 5.5 V or GND	1.65 – 5.5	–	10	–	10	μA
ΔI <sub>CC</sub>	Increase in I <sub>CC</sub> per Input	V <sub>IH</sub> = V <sub>CC</sub> – 0.6 V	2.3 – 3.6	–	500	–	500	μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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## AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C		T <sub>A</sub> = -40°C to +125°C		Unit
				Min	Max	Min	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, A <sub>n</sub> to $\overline{O_n}$	See Figures 4 and 5	1.65 to 1.95	-	11.5	-	11.5	ns
			2.3 to 2.7	-	7.2	-	7.2	
			2.7	-	7.0	-	7.0	
			3.0 to 3.6	-	6.0	-	6.0	
			4.5 to 5.5	-	5.0	-	5.0	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, E <sub>1</sub> , E <sub>2</sub> to $\overline{O_n}$	See Figures 4 and 5	1.65 to 1.95	-	12.0	-	12.0	ns
			2.3 to 2.7	-	8.4	-	8.4	
			2.7	-	7.5	-	7.5	
			3.0 to 3.6	-	6.5	-	6.5	
			4.5 to 5.5	-	5.5	-	5.5	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, E <sub>3</sub> to $\overline{O_n}$	See Figures 4 and 5	1.65 to 1.95	-	11.5	-	11.5	ns
			2.3 to 2.7	-	7.2	-	7.2	
			2.7	-	7.0	-	7.0	
			3.0 to 3.6	-	6.0	-	6.0	
			4.5 to 5.5	-	5.0	-	5.0	
t <sub>OSSL</sub> , t <sub>OSLH</sub>	Output to Output Skew (Note 5)		1.65 to 1.95	-	-	-	-	ns
			2.3 to 2.7	-	-	-	-	
			2.7	-	-	-	-	
			3.0 to 3.6	-	1.0	-	1.0	
			4.5 to 5.5	-	-	-	-	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

5. 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<sub>OSSL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>). Parameter guaranteed by design.

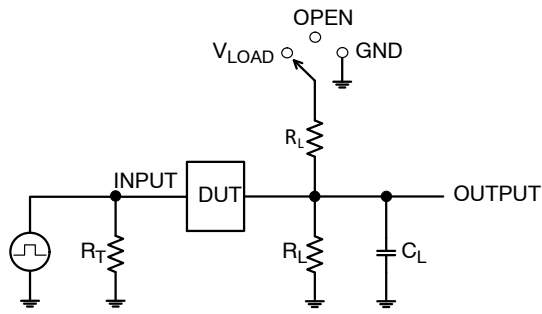
## DYNAMIC SWITCHING CHARACTERISTICS

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C	Unit
				Typical	
V <sub>OLP</sub>	Quiet Output Dynamic Peak V <sub>OL</sub>	C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V	3.3	0.8	V
		C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V	2.5	0.6	
V <sub>OLV</sub>	Quiet Output Dynamic Valley V <sub>OL</sub>	C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V	3.3	-0.8	V
		C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V	2.5	-0.6	

## CAPACITANCE

Symbol	Parameter	Condition	Typical	Units
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = Open, V <sub>I</sub> = 0 V or V <sub>CC</sub>	7.0	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>CC</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CC</sub>	8.0	pF
C <sub>PD</sub>	Power Dissipation Capacitance	V <sub>CC</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CC</sub> , f = 10 MHz	25.0	pF

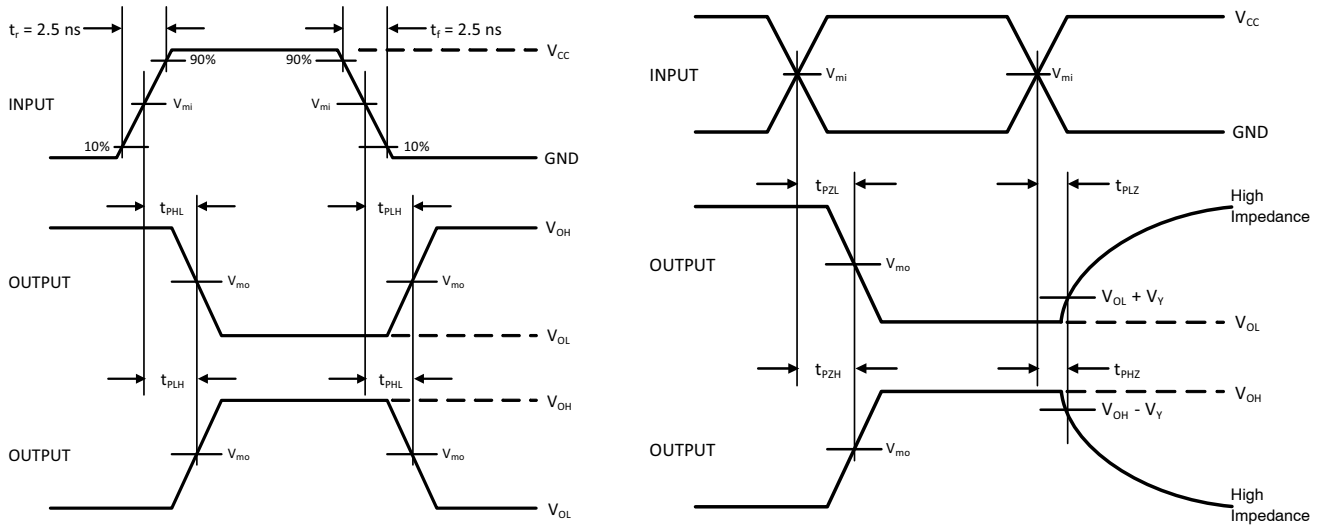
# 74LCX138



$C_L$  includes probe and jig capacitance  
 $R_T$  is  $Z_{OUT}$  of pulse generator (typically 50  $\Omega$ )  
 $f = 1$  MHz

Test	Switch Position
$t_{PLH} / t_{PHL}$	Open
$t_{PLZ} / t_{PZL}$	$V_{LOAD}$
$t_{PHZ} / t_{PZH}$	GND

Figure 4. Test Circuit



$V_{CC}, V$	$R_L, \Omega$	$C_L, pF$	$V_{LOAD}$	$V_m, V$	$V_Y, V$
1.65 to 1.95	500	30	$2 \times V_{CC}$	$V_{CC}/2$	0.15
2.3 to 2.7	500	30	$2 \times V_{CC}$	$V_{CC}/2$	0.15
2.7	500	50	6 V	1.5	0.3
3.0 to 3.6	500	50	6 V	1.5	0.3
4.5 to 5.5	500	50	$2 \times V_{CC}$	$V_{CC}/2$	0.3

Figure 5. Switching Waveforms

# 74LCX138

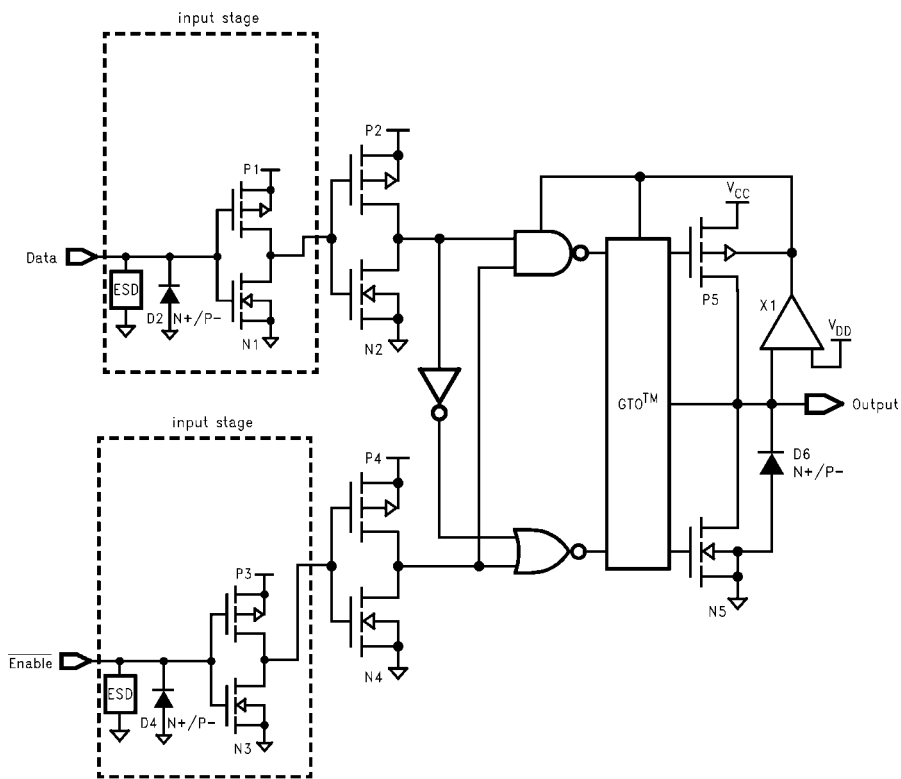


Figure 6. Schematic Diagram (Generic for LCX Family)

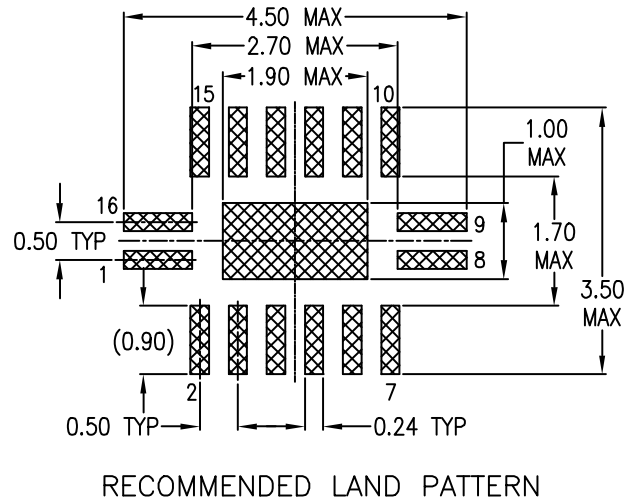
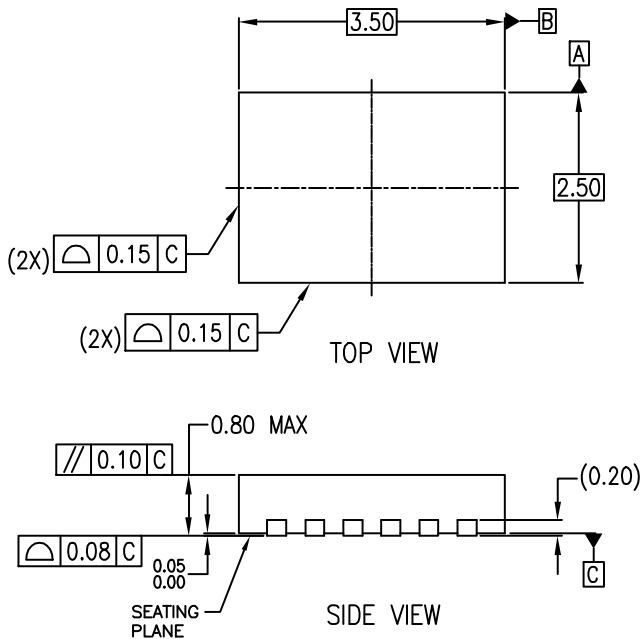
## ORDERING INFORMATION

Device	Marking	Package	Shipping†
74LCX138BQX	LCX138	WQFN-16 (Pb-Free)	3000 Units / Tape & Reel
74LCX138MX	LCX138	SOIC-16 (Pb-Free)	2500 Units / Tape & Reel
74LCX138MTCX	LCX 138	TSSOP-16 (Pb-Free)	2500 Units / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

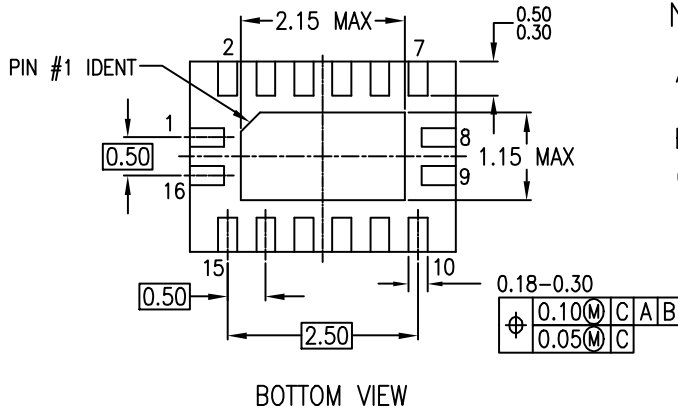
**WQFN16 3.5x2.5, 0.5P**  
CASE 510CC  
ISSUE O

DATE 31 AUG 2016



**NOTES:**

- A. CONFORMS TO JEDEC REGISTRATION MO-241, VARIATION AB
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994



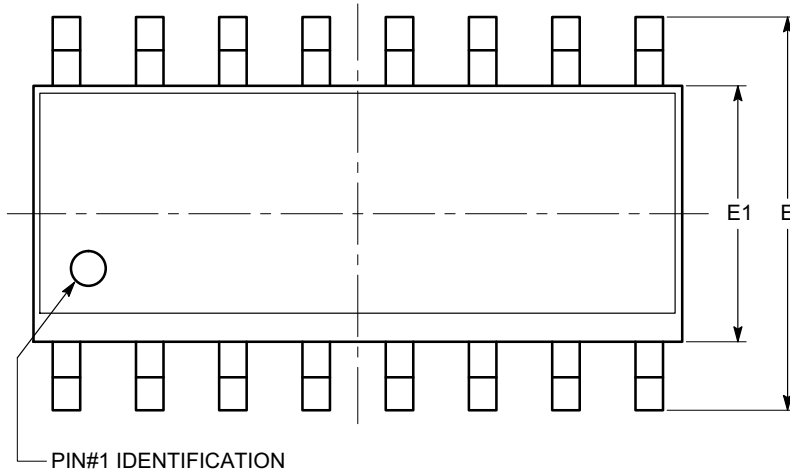
<b>DOCUMENT NUMBER:</b>	<b>98AON13644G</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>WQFN16 3.5X2.5, 0.5P</b>	<b>PAGE 1 OF 1</b>

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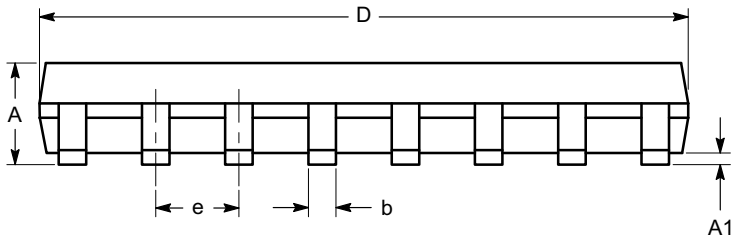
**SOIC-16, 150 mils**  
**CASE 751BG**  
**ISSUE O**

DATE 19 DEC 2008

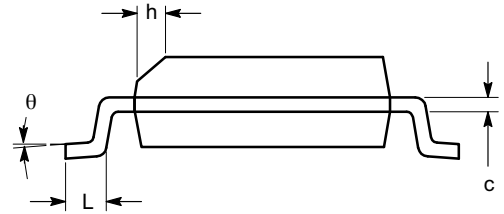


SYMBOL	MIN	NOM	MAX
A	1.35		1.75
A1	0.10		0.25
b	0.33		0.51
c	0.19		0.25
D	9.80	9.90	10.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
h	0.25		0.50
L	0.40		1.27
$\theta$	0°		8°

**TOP VIEW**



**SIDE VIEW**



**END VIEW**

**Notes:**

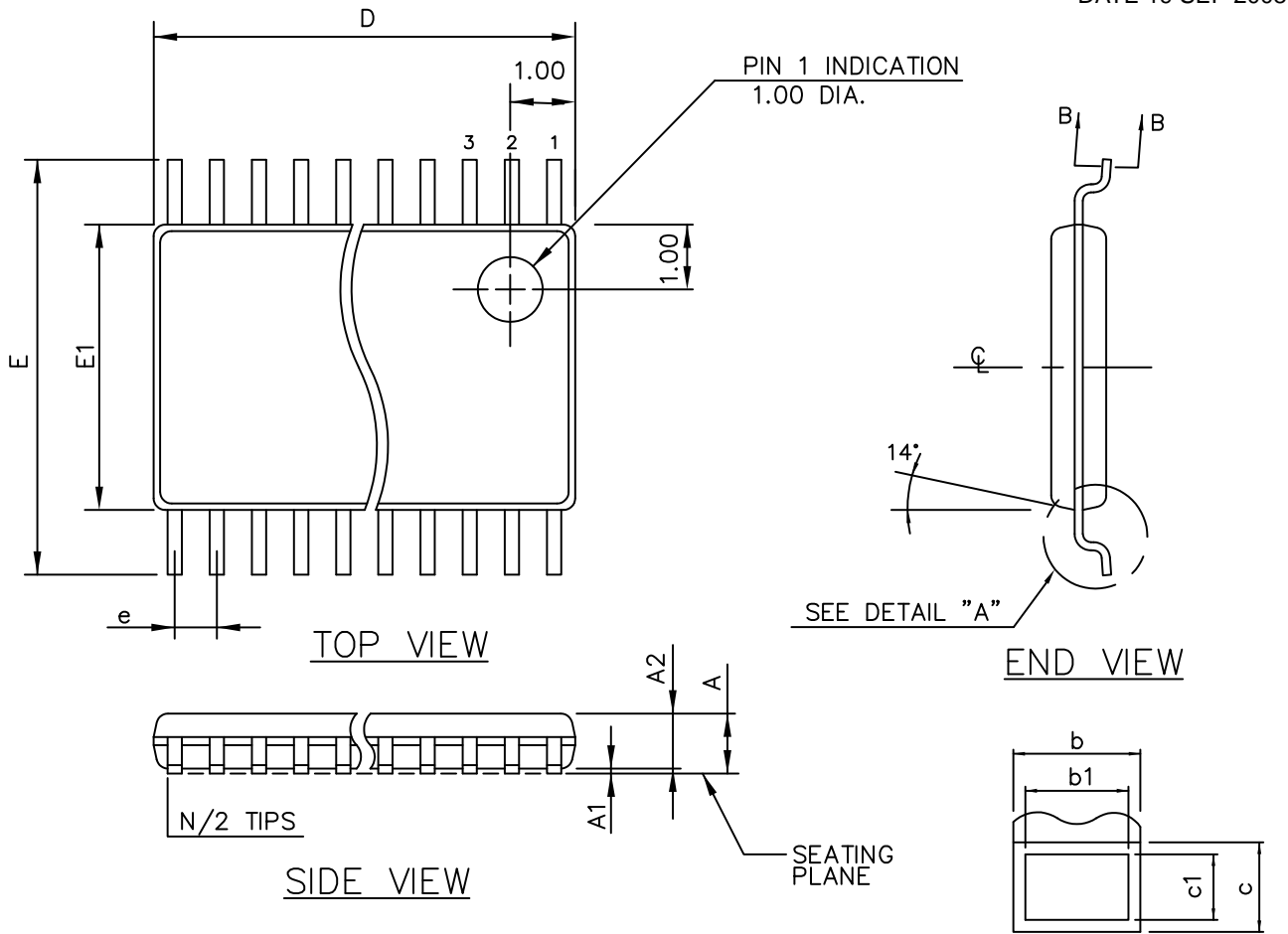
- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MS-012.

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<b>DESCRIPTION:</b>	<b>SOIC-16, 150 mils</b>	<b>PAGE 1 OF 1</b>

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**TSSOP 16**  
**CASE 948AH**  
**ISSUE O**

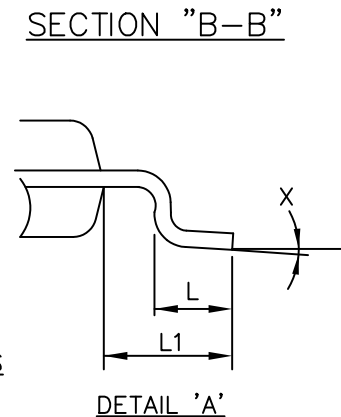
DATE 19 SEP 2008



THIS TABLE FOR 0.65mm PITCH

SYMBOL	COMMON DIMENSIONS			NOTE VARIATIONS	D	N
	MIN.	NOM.	MAX.			
A	—	—	1.10	AA/AAT	3.00 BSC	8
A <sub>1</sub>	0.05	—	0.15	AB-1/ABT	5.00 BSC	14
A <sub>2</sub>	0.85	0.90	0.95	AB/ABT	5.00 BSC	16
b	0.19	—	0.30	AD/ADT	7.80 BSC	24
b1	0.19	0.22	0.25			
c	0.09	—	0.20			
c1	0.09	0.127	0.16			
D	SEE VARIATIONS					
E1	4.30	4.40	4.50			
e	0.65 BSC					
E	6.40 BSC					
L	0.50	0.60	0.70			
L1	1.00 REF					
N	SEE VARIATIONS					
X	0°	—	8°			

ALL DIMENSIONS IN MILLIMETERS



MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15mm ON D PER SIDE

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