Low-Voltage CMOS 3-to-8 Decoder/Demultiplexer

With 5 V-Tolerant Inputs

The MC74LCX138 is a high performance, 3-to-8 decoder/demultiplexer operating from a 2.3 to 3.6 V supply. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance. A $V_{\rm I}$ specification of 5.5 V allows MC74LCX138 inputs to be safely driven from 5 V devices. The MC74LCX138 is suitable for memory address decoding and other TTL level bus-oriented applications.

The MC74LCX138 high–speed 3–to–8 decoder/demultiplexer accepts three binary weighted inputs (A0, A1, A2) and, when enabled, provides eight mutually exclusive active–LOW outputs $(\overline{O0}-\overline{O7})$. The LCX138 features three Enable inputs, two active–LOW $(\overline{E1},\overline{E2})$ and one active–HIGH (E3). All outputs will be HIGH unless $\overline{E1}$ and $\overline{E2}$ are LOW, and E3 is HIGH. This multiple enabled function allows easy parallel expansion of the device to a 1–of–32 (5 lines to 32 lines) decoder with just four LCX138 devices and one inverter (see Figure 1). 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.

Current drive capability is 24 mA at the outputs.

Features

- Designed for 2.3 V to 3.6 V V_{CC} Operation
- 5 V Tolerant Inputs Interface Capability With 5 V TTL Logic
- LVTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current (10 μA) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- ESD Performance: Human Body Model >2000 V

Machine Model >200 V

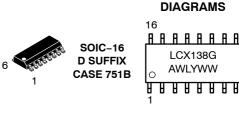
1

- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb–Free, Halogen Free/BFR Free and are RoHS Compliant

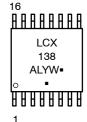


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MARKING

A = Assembly Location

WL, L = Wafer Lot Y = Year WW, W = Work Week G or ■ = 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 3 of this data sheet.

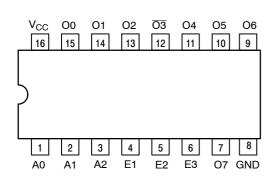


Figure 1. Pinout: 16-Lead (Top View)

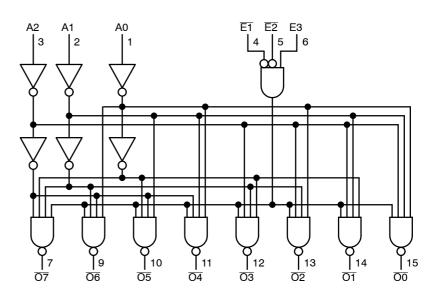


Figure 2. Logic Diagram

PIN NAMES

Pins	Function
<u>A0-A2</u>	Address Inputs
E1-E2	Enable Inputs
<u>E3</u>	Enable Input
00-07	Outputs

TRUTH TABLE

Inputs					Outputs								
E1	E2	E3	A0	A1	A2	00	01	02	<u>O3</u>	04	0 5	0 6	07
Н	Х	Х	Х	Х	Х	Н	Н	Н	Н	Н	Н	Н	Н
X	Н	X	X	X	X	Н	Н	Н	Н	Н	Н	Н	Н
X	X	L	Х	X	Х	Н	Н	Н	Н	Н	Н	Н	Н
L	L	Н	L	L	L	L	Н	Н	Н	Н	Н	Н	Н
L	L	Н	Н	L	L	Н	L	Н	Н	Н	Н	Н	Н
L	L	Н	L	Н	L	Н	Н	L	Н	Н	Н	Н	Н
L	L	Н	Н	Н	L	Н	Н	Н	L	Н	Н	Н	Н
L	L	Н	L	L	Н	Н	Н	Н	Н	L	Н	Н	Н
L	L	Н	Н	L	Н	Н	Н	Н	Н	Н	L	Н	Н
L	L	Н	L	Н	Н	Н	Н	Н	Н	Н	Н	L	Н
L	L	Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	Н	L

H = High Voltage Level

For $I_{\mbox{\footnotesize CC}}$ reasons, DO NOT FLOAT Inputs

L = Low Voltage Level

X = High or Low Voltage Level and Transitions are Acceptable

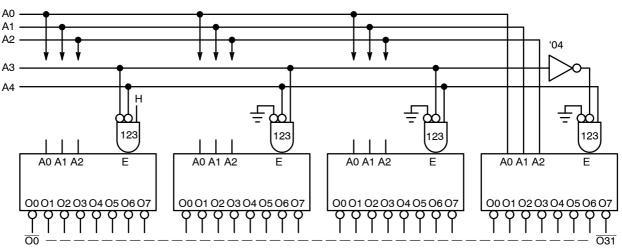


Figure 3. Expansion to 1-of-32 Decoding

ORDERING INFORMATION

Device	Package	Shipping [†]
MC74LCX138DR2G	SOIC-16 (Pb-Free)	2500 Tape & Reel
MC74LCX138DTG	TSSOP-16 (Pb-Free)	96 Units / Rail
MC74LCX138DTR2G	TSSOP-16 (Pb-Free)	2500 Tape & Reel
NLV74LCX138DR2G*	SOIC-16 (Pb-Free)	2500 Tape & Reel

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MAXIMUM RATINGS

Symbol	Parameter	Value	Condition	Units
V _{CC}	DC Supply Voltage	-0.5 to +7.0		V
VI	DC Input Voltage	$-0.5 \le V_{I} \le +7.0$		V
Vo	DC Output Voltage	$-0.5 \le V_{O} \le V_{CC} + 0.5$	Output in HIGH or LOW State (Note 1)	V
I _{IK}	DC Input Diode Current	-50	V _I < GND	mA
I _{OK}	DC Output Diode Current	-50	V _O < GND	mA
		+50	Vo > Vcc	mA
Io	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 Range	-65 to +150		°C
MSL	Moisture Sensitivity		Level 1	

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

^{*}NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

^{1.} I_{O} absolute maximum rating must be observed.

RECOMMENDED OPERATING CONDITIONS

Symbol	Pa	rameter	Min	Тур	Max	Units
V _{CC}	Supply Voltage	Operating Data Retention Only	2.0 1.5	2.5, 3.3 2.5, 3.3	3.6 3.6	V
VI	Input Voltage		0		5.5	V
Vo	Output Voltage	(HIGH or LOW State) (3-State)	0		V _{CC}	V
Іон	HIGH Level Output Current	$V_{CC} = 3.0 \text{ V} - 3.6 \text{ V}$ $V_{CC} = 2.7 \text{ V} - 3.0 \text{ V}$ $V_{CC} = 2.3 \text{ V} - 2.7 \text{ V}$			-24 -12 -8	mA
I _{OL}	LOW Level Output Voltage	$V_{CC} = 3.0 \text{ V} - 3.6 \text{ V}$ $V_{CC} = 2.7 \text{ V} - 3.0 \text{ V}$ $V_{CC} = 2.3 \text{ V} - 2.7 \text{ V}$			+24 +12 +8	mA
T _A	Operating Free-Air Temperature	9	-40		+85	°C
Δt/ΔV	Input Transition Rise or Fall Rat	e, V _{IN} from 0.8 V to 2.0 V, V _{CC} = 3.0 V	0		10	ns/V

DC ELECTRICAL CHARACTERISTICS

			T _A = -40°C	to +85°C	
Symbol	Characteristic	Condition	Min	Min Max	
V _{IH}	HIGH Level Input Voltage (Note 2)	2.3 V ≤ V _{CC} ≤ 2.7 V	1.7		V
		2.7 V ≤ V _{CC} ≤ 3.6 V	2.0		
V _{IL}	LOW Level Input Voltage (Note 2)	2.3 V ≤ V _{CC} ≤ 2.7 V		0.7	V
		2.7 V ≤ V _{CC} ≤ 3.6 V		0.8	
V _{OH}	HIGH Level Output Voltage	$2.3 \text{ V} \le \text{V}_{CC} \le 3.6 \text{ V}; \text{I}_{OH} = -100 \mu\text{A}$	V _{CC} - 0.2		V
		V _{CC} = 2.3 V; I _{OH} = -8 mA	1.8		
		V _{CC} = 2.7 V; I _{OH} = -12 mA	2.2		
		V _{CC} = 3.0 V; I _{OH} = -18 mA	2.4		
		V _{CC} = 3.0 V; I _{OH} = -24 mA	2.2		
V _{OL}	LOW Level Output Voltage	$2.3 \text{ V} \le \text{V}_{CC} \le 3.6 \text{ V}; \text{I}_{OL} = 100 \mu\text{A}$		0.2	V
		V _{CC} = 2.3 V; I _{OL} = 8 mA		0.6	
		V _{CC} = 2.7 V; I _{OL} = 12 mA		0.4	
		V _{CC} = 3.0 V; I _{OL} = 16 mA		0.4	
		V _{CC} = 3.0 V; I _{OL} = 24 mA		0.55	
I _{OFF}	Power Off Leakage Current	V _{CC} = 0, V _{IN} = 5.5 V or V _{OUT} = 5.5 V		10	μΑ
I _{IN}	Input Leakage Current	V _{CC} = 3.6 V, V _{IN} = 5.5 V or GND		±5	μΑ
I _{CC}	Quiescent Supply Current	V _{CC} = 3.6 V, V _{IN} = 5.5 V or GND		10	μΑ
ΔI_{CC}	Increase in I _{CC} per Input	$2.3 \le V_{CC} \le 3.6 \text{ V}; V_{IH} = V_{CC} - 0.6 \text{ V}$		500	μΑ

^{2.} These values of V_I are used to test DC electrical characteristics only.

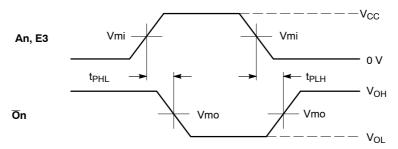
AC CHARACTERISTICS (t_R = t_F = 2.5 ns; R_L = 500 $\Omega)$

				Limits					
				$T_A = -40^{\circ}C$ to $+85^{\circ}C$					
			V _{CC} = 3.3	8 V ± 0.3 V	V _{CC} =	2.7 V	V _{CC} = 2.5	V ± 0.2 V	
			C _L =	50 pF	C _L =	50 pF	C _L =	30 pF	
Symbol	Parameter	Waveform	Min	Max	Min	Max	Min	Max	Units
t _{PLH} t _{PHL}	Propagation Delay An to On	1, 2	1.5 1.5	6.0 6.0	1.5 1.5	7.0 7.0	1.5 1.5	7.2 7.2	ns
t _{PLH} t _{PHL}	Propagation Delay E1, E2 to On	2	1.5 1.5	6.5 6.5	1.5 1.5	7.5 7.5	1.5 1.5	8.4 8.4	ns
t _{PLH} t _{PHL}	Propagation Delay E3 to On	1	1.5 1.5	6.0 6.0	1.5 1.5	7.0 7.0	1.5 1.5	7.2 7.2	ns
t _{OSHL} t _{OSLH}	Output-to-Output Skew (Note 3)			1.0 1.0					ns

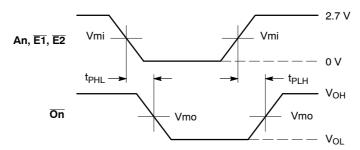
^{3.} Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}); parameter guaranteed by design.

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Condition	Typical	Units
C _{IN}	Input Capacitance	$V_{CC} = 3.3 \text{ V}, V_I = 0 \text{ V or } V_{CC}$	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	10 MHz, V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	25	pF



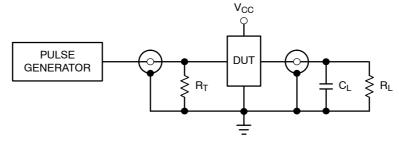
WAVEFORM 1: PROPAGATION DELAYS FOR INVERTING OUTPUTS



WAVEFORM 2: PROPAGATION DELAYS FOR NON-INVERTING OUTPUTS

	Vcc							
Symbol	3.3 V <u>+</u> 0.3 V	2.7 V	2.5 V <u>+</u> 0.2 V					
Vmi	1.5 V	1.5 V	Vcc/2					
Vmo	1.5 V	1.5 V	Vcc/2					

Figure 4. AC Waveforms



 C_L = 50 pF at V_{CC} = 3.3 ± 0.3 V or equivalent (includes jig and probe capacitance) C_L = 30 pF at V_{CC} = 2.5 ± 0.2 V or equivalent (includes jig and probe capacitance) R_L = R_1 = 500 Ω or equivalent

 $R_T = Z_{OUT}$ of pulse generator (typically 50 Ω)

Figure 5. Test Circuit

MECHANICAL CASE OUTLINE



DATE 29 DEC 2006

- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI
- THE NOTION AND TOLETANOING FER ANSI'Y 14.5M, 1982.
 CONTROLLING DIMENSION: MILLIMETER.
 DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- PHOI HUSION.

 MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.

 DIMENSION D DOES NOT INCLUDE DAMBAR
 PROTRUSION. ALLOWABLE DAMBAR PROTRUSION

 SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D

 DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIN	IETERS	INC	HES	
DIM	MIN	MAX	MIN	MAX	
Α	9.80	10.00	0.386	0.393	
В	3.80	4.00	0.150	0.157	
C	1.35	1.75	0.054	0.068	
D	0.35	0.49	0.014	0.019	
F	0.40	1.25	0.016	0.049	
G	1.27	BSC	0.050 BSC		
7	0.19	0.25	0.008	0.009	
K	0.10	0.25	0.004	0.009	
M	0°	7°	0°	7°	
Р	5.80	6.20	0.229	0.244	
R	0.25	0.50	0.010	0.019	

16. COLLECTOR 16. CATHODE 16. COLLECTOR, #4 16. EMITTER, #1 STYLE 5: STYLE 6: STYLE 7: PIN 1. DRAIN, DYE #1 PIN 1. CATHODE 2. COMMON DRAIN (OUTPUT) 3. DRAIN, #1 2. CATHODE 2. COMMON DRAIN (OUTPUT) 4. DRAIN, #2 3. CATHODE 3. COMMON DRAIN (OUTPUT) 5. DRAIN, #3 5. CATHODE 4. GATE P-CH 7. DRAIN, #3 6. CATHODE 5. COMMON DRAIN (OUTPUT) 8. DRAIN, #4 7. CATHODE 7. COMMON DRAIN (OUTPUT) 8. DRAIN, #4 8. CATHODE 8. SOURCE P-CH 9. GATE, #4 9. ANODE 9. SOURCE P-CH 10. SOURCE, #4 10. ANODE 10. COMMON DRAIN (OUTPUT) 11. GATE, #3 11. ANODE 11. COMMON DRAIN (OUTPUT) 12. SOURCE, #3 12. ANODE 13. GATE N-CH 14. SOURCE, #2 14. ANODE 14. COMMON DRAIN (OUTPUT) 15. GATE, #1 15. ANODE 16. SOURCE N-CH 16. SOURCE, #1 16. ANODE 16. SOURCE N-CH	STYLE 1: PIN 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14.	COLLECTOR BASE EMITTER NO CONNECTION EMITTER BASE	2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.	CATHODE CATHODE ANODE NO CONNECTION CATHODE CATHODE NO CONNECTION	STYLE 3: PIN 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14.	COLLECTOR, DYE #1 BASE, #1 EMITTER, #1 COLLECTOR, #1 COLLECTOR, #2 BASE, #2 EMITTER, #2 COLLECTOR, #2 COLLECTOR, #3 BASE, #3 EMITTER, #3 COLLECTOR, #3 COLLECTOR, #4	STYLE 4: PIN 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13.	COLLECTOR, DYE #1 COLLECTOR, #1 COLLECTOR, #2 COLLECTOR, #3 COLLECTOR, #3 COLLECTOR, #4 COLLECTOR, #4 EMITTER, #4 BASE, #4 EMITTER, #4 BASE, #3 EMITTER, #3 BASE, #2 EMITTER, #2 BASE, #1		FOOTPRINT
STYLE 5:										
	PIN 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13.	DRAIN, #1 DRAIN, #2 DRAIN, #2 DRAIN, #3 DRAIN, #3 DRAIN, #3 DRAIN, #4 DRAIN, #4 GATE, #4 SOURCE, #4 GATE, #3 SOURCE, #3 GATE, #2 SOURCE, #2 GATE, #1	PIN 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13.	CATHODE CATHODE CATHODE CATHODE CATHODE CATHODE CATHODE CATHODE CATHODE ANODE	PIN 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13.	COMMON DRAIN (OUTPUT COMMON DRAIN (OUTPUT GATE P-CH COMMON DRAIN (OUTPUT COMMON DRAIN (OUTPUT COMMON DRAIN (OUTPUT SOURCE P-CH SOURCE P-CH COMMON DRAIN (OUTPUT COMMON DRAIN (OUTPUT COMMON DRAIN (OUTPUT GATE N-CH COMMON DRAIN (OUTPUT GATE N-CH COMMON DRAIN (OUTPUT COMMON DRAIN COMMON DRAIN (OUTPUT COMMON DRAIN COMMON DRAIN COMMON DRAIN (OUTPUT COMMON DRAIN COMMON DRAIN COMMON DRAIN COMMON DRAIN COMMON DRAI	n n n n n n	16X 0.58	<u> </u>	16X 1.12

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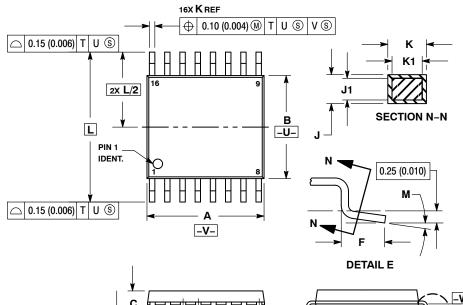
-T- SEATING PLANE





TSSOP-16 CASE 948F-01 ISSUE B

DATE 19 OCT 2006



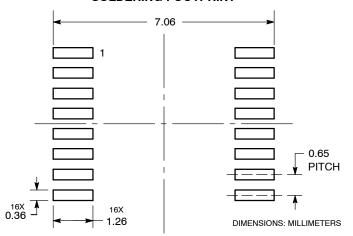
NOTES

- JIES:
 DIMENSIONING AND TOLERANCING PER
 ANSI Y14.5M, 1982.
 CONTROLLING DIMENSION: MILLIMETER.
 DIMENSION A DOES NOT INCLUDE MOLD
 FLASH. PROTRUSIONS OR GATE BURRS.
 MOLD EL ROLL OF GATE BURDS SUAL NO.
- MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
 DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION.
 INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
- DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION. TERMINAL NUMBERS ARE SHOWN FOR
- REFERENCE ONLY.
- DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
Α	4.90	5.10	0.193	0.200
В	4.30	4.50	0.169	0.177
C		1.20		0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
Н	0.18	0.28	0.007	0.011
7	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
Ы	6.40 BSC		0.252 BSC	
М	0 °	8 °	0 °	8 °

SOLDERING FOOTPRINT

G



GENERIC MARKING DIAGRAM*

168888888 XXXX XXXX **ALYW** 188888888

XXXX = Specific Device Code Α = Assembly Location

= Wafer Lot L Υ = Year W = Work Week = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot " ■", may or may not be present.

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