

### Low-Voltage Quad 3-TO-8 LINE DECODER with 5V Tolerant Inputs and Outputs

The TC74LCX138 is a high performance CMOS 3-to-8 DECODER. Designed for use in 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

The device is designed for low voltage (3.3V)  $V_{CC}$  applications, but it could be used to interface to 5V supply environment for inputs.

When the device is enabled, 3 Binary Select inputs (A, B and C) determine which one of the outputs ( $\bar{Y}0$  -  $\bar{Y}7$ ) will go low.

When enable input G1 is held low or either  $\bar{G}2A$  or  $\bar{G}2B$  is held high, decoding function is inhibited and all outputs go high.

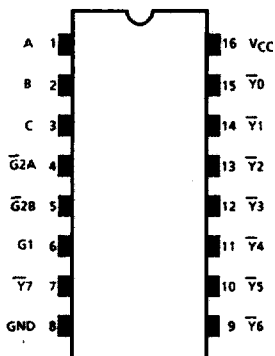
G1,  $\bar{G}2A$ , and  $\bar{G}2B$  inputs are provided to ease cascade connection and for use as an address decoder for memory systems.

All inputs are equipped with protection circuits against static discharge.

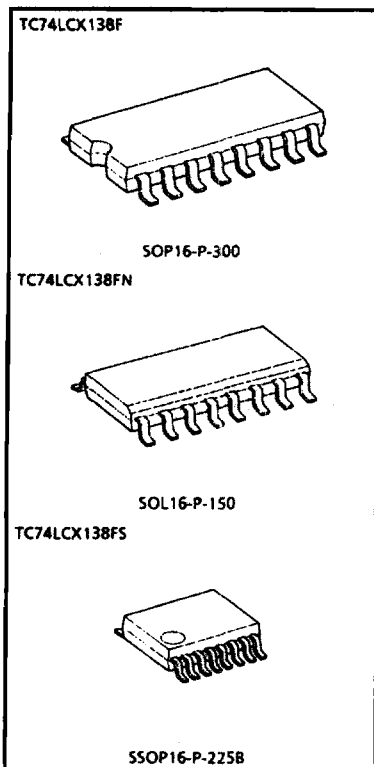
### Features

- Low Voltage Operation:  $V_{CC} = 2.0 \sim 3.6V$
- High Speed:  $t_{pd} = 6.0ns$  (Max.) ( $V_{CC} = 3.0 \sim 3.6V$ )
- Output Current:  $I_{OH}/I_{OL} = 24mA$  (Min.) ( $V_{CC} = 3.0V$ )
- Latch up Performance:  $\pm 500mA$
- Available in JEDEC SOP, EIAJ SOP and SSOP
- Power down protection is provided on all inputs and outputs
- Pin and Function Compatible with 74 series
  - (74AC/VHC/HC/F/ALS/LS, etc.) 138 type

### Pin Connection



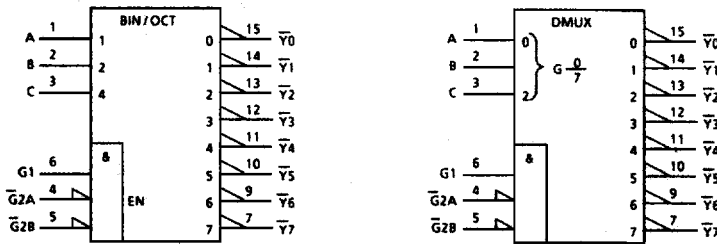
(TOP VIEW)



Weight SOP16-P-300 : 0.18g (Typ.)  
 SOL16-P-150 : 0.12g (Typ.)  
 SSOP16-P-225B : 0.07g (Typ.)

### Pin Assignment

IEC Logic Symbol

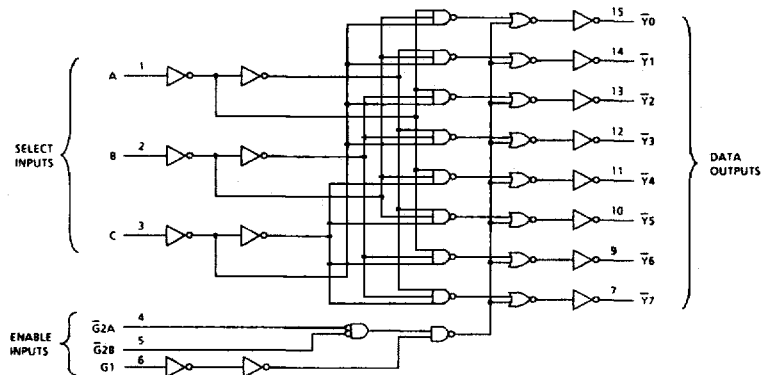


Truth Table

Inputs						Outputs								Selected Output
Enable			Select			Y <sub>0</sub>	Y <sub>1</sub>	Y <sub>2</sub>	Y <sub>3</sub>	Y <sub>4</sub>	Y <sub>5</sub>	Y <sub>6</sub>	Y <sub>7</sub>	
G1	G2A	G2B	C	B	A									
L	X	X	X	X	X	H	H	H	H	H	H	H	H	None
X	H	X	X	X	X	H	H	H	H	H	H	H	H	None
X	X	H	X	X	X	H	H	H	H	H	H	H	H	None
H	L	L	L	L	L	L	H	H	H	H	H	H	H	Y <sub>0</sub>
H	L	L	L	L	H	H	L	H	H	H	H	H	H	Y <sub>1</sub>
H	L	L	L	H	L	H	H	L	H	H	H	H	H	Y <sub>2</sub>
H	L	L	L	H	H	H	H	H	L	H	H	H	H	Y <sub>3</sub>
H	L	L	H	L	L	H	H	H	H	L	H	H	H	Y <sub>4</sub>
H	L	L	H	L	H	H	H	H	H	L	H	H	H	Y <sub>5</sub>
H	L	L	H	H	L	H	H	H	H	H	L	H	H	Y <sub>6</sub>
H	L	L	H	H	H	H	H	H	H	H	H	L	H	Y <sub>7</sub>

X: Don't Care

System Diagram



**Absolute Maximum Ratings**

Parameter	Symbol	Value	Unit
Supply Voltage Range	$V_{CC}$	-0.5 ~ 7.0	V
DC Input Voltage	$V_{IN}$	-0.5 ~ 7.0	V
DC Output Voltage	$V_{OUT}$	-0.5 ~ 7.0 (Note 1)	V
		-0.5 ~ $V_{CC} + 0.5$ (Note 2)	
Input Diode Current	$I_{IK}$	-50	mA
Output Diode Current	$I_{OK}$	±50 (Note 3)	mA
DC Output Current	$I_{OUT}$	±50	mA
Power Dissipation	$P_D$	180	mW
DC $V_{CC}$ /Ground Current	$I_{CC}/I_{GND}$	±100	mA
Storage Temperature	$T_{stg}$	-65 ~ 150	°C

(Note 1) Off-State

(Note 2) High or Low State.  $I_{OUT}$  absolute maximum rating must be observed.

(Note 3)  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

**Recommended Operating Conditions**

Parameter	Symbol	Value	Unit
Supply Voltage	$V_{CC}$	2.0 ~ 3.6	V
		1.5 ~ 3.6 (Note 4)	
Input Voltage	$V_{IN}$	0 ~ 5.5	V
Bus Output Voltage	$V_{OUT}$	0 ~ 5.5 (Note 5)	V
		0 ~ $V_{CC}$ (Note 6)	
Output Current	$I_{OH}/I_{OL}$	±24 (Note 7)	mA
		±12 (Note 8)	
Operating Temperature	$T_{opr}$	-40 ~ 85	°C
Input Rise and Fall Time	$dt/dv$	0 ~ 10 (Note 9)	ns/V

(Note 4) Data Retention Only

(Note 5) Off-State

(Note 6) High or Low State

(Note 7)  $V_{CC} = 3.0 \sim 3.6V$

(Note 8)  $V_{CC} = 2.7 \sim 3.0V$

(Note 9)  $V_{IN} = 0.8 \sim 2.0V$ ,  $V_{CC} = 3.0V$

## Electrical Characteristics

## DC Characteristics (Ta = -40 ~ 85°C)

Parameter	Symbol	Test Condition		V <sub>CC</sub> (V)	Min.	Max.	Unit	
Input Voltage	"H" Level	V <sub>IH</sub>	—	2.7 - 3.6	2.0	—	V	
	"L" Level	V <sub>IL</sub>	—	2.7 - 3.6	—	0.8	V	
Output Voltage	"H" Level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -100μA	2.7 - 3.6	V <sub>CC</sub> - 0.2	—	V
				I <sub>OH</sub> = -12mA	2.7	2.2	—	
				I <sub>OH</sub> = -18mA	3.0	2.4	—	
				I <sub>OH</sub> = -24mA	3.0	2.2	—	
"L" Level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = 100μA	2.7 - 3.6	—	0.2	V	
			I <sub>OL</sub> = 12mA	2.7	—	0.4		
			I <sub>OL</sub> = 16mA	3.0	—	0.4		
			I <sub>OL</sub> = 24mA	3.0	—	0.55		
Input Leakage Current	I <sub>IN</sub>	V <sub>IN</sub> = 0 - 5.5V		2.7 - 3.6	—	±5.0	μA	
Power Off Leakage Current	I <sub>OFF</sub>	V <sub>IN</sub> /V <sub>OUT</sub> = 5.5V		0	—	10.0	μA	
Quiescent Supply Current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		2.7 - 3.6	—	10.0	μA	
		V <sub>IN</sub> /V <sub>OUT</sub> = 3.6 - 5.5V		2.7 - 3.6	—	±10.0		
Increase in I <sub>CC</sub> per Input	ΔI <sub>CC</sub>	V <sub>IH</sub> = V <sub>CC</sub> - 0.6V		2.7 - 3.6	—	500	μA	

**AC Characteristics (Ta = -40 ~ 85°C)**

Parameter	Symbol	Test Condition	V <sub>CC</sub> (V)	Min.	Max.	Unit
Propagation Delay Time (A, B, C - $\bar{Y}$ )	$t_{pLH}$ $t_{pHL}$	(Fig. 1, 2)	2.7	~	7.0	ns
			3.3 ± 0.3	1.5	6.0	
Propagation Delay Time (G1 - $\bar{Y}$ )	$t_{pZL}$ $t_{pZH}$	(Fig. 1, 2)	2.7	~	7.5	ns
			3.3 ± 0.3	1.5	6.5	
Propagation Delay Time ( $\bar{G}2$ - $\bar{Y}$ )	$t_{pLZ}$ $t_{pHZ}$	(Fig. 1, 2)	2.7	~	7.0	ns
			3.3 ± 0.3	1.5	6.0	
Output to Output Skew	$t_{osLH}$ $t_{osHL}$	(Note 10)	2.7	~	~	ns
			3.3 ± 0.3	~	1.0	

(Note 10) Parameter guaranteed by design.  $t_{osLH} = (t_{pLHm} - t_{pLHn})$ ,  $t_{osHL} = (t_{pHLm} - t_{pHLn})$

**Dynamic Switching Characteristics (Ta = 25°C, Input  $t_r = t_f = 2.5ns$ , C<sub>L</sub> = 50pF, R<sub>L</sub> = 500Ω)**

Parameter	Symbol	Test Condition	V <sub>CC</sub> (V)	Typical	Unit
Quiet Output Maximum Dynamic V <sub>OL</sub>	V <sub>OLP</sub>	V <sub>H</sub> = 3.3V, V <sub>L</sub> = 0V	3.3	0.8	V
Quiet Output Minimum Dynamic V <sub>OL</sub>	V <sub>OLV</sub>	V <sub>H</sub> = 3.3V, V <sub>L</sub> = 0V	3.3	0.8	V

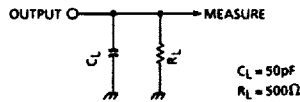
**Capacitive Characteristics (Ta = 25°C)**

Parameter	Symbol	Test Condition	V <sub>CC</sub> (V)	Typical	Unit
Input Capacitance	C <sub>IN</sub>	-	3.3	7	pF
Bus Input Capacitance	C <sub>OUT</sub>		3.3	8	pF
Power Dissipation Capacitance	C <sub>PD</sub>	f <sub>IN</sub> = 10MHz (Note 11)	3.3	25	pF

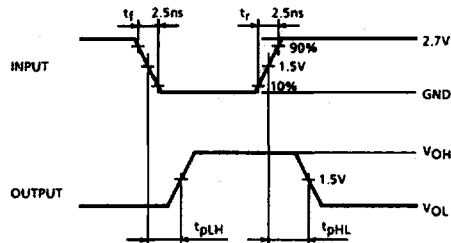
(Note 11) C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I<sub>CC (opr.)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>IN</sub> + I<sub>CC</sub>.

## TEST CIRCUIT

Fig.1



## AC WAVEFORM

Fig.2  $t_{pLH}$ ,  $t_{pHL}$ 

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