

TC74LCX138F, TC74LCX138FN, TC74LCX138FT

Low-Voltage 3-to-8 Line Decoder with 5-V Tolerant Inputs and Outputs

The TC74LCX138F/FN/FT is a high-performance CMOS 3-to-8 decoder. Designed for use in 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low-power dissipation.

The device is designed for low-voltage (3.3 V) VCC applications, but it could be used to interface to 5-V supply environment for inputs.

When the device is enabled, 3 binary select inputs (A, B and C) determine which one of the outputs ($\overline{Y0}$ - $\overline{Y7}$) will go low. When enable input G1 is held low or either $\overline{G2A}$ or $\overline{G2B}$ is held high, decoding function is inhibited and all outputs go high.

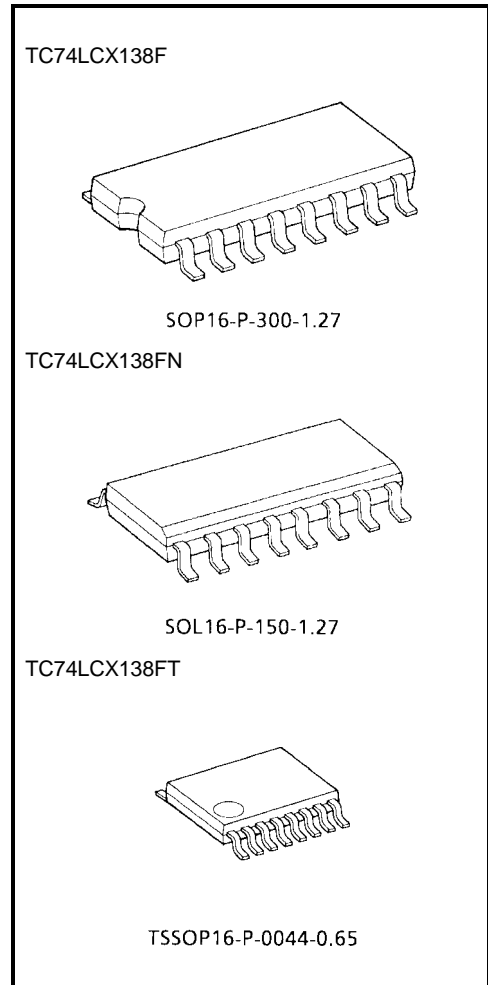
G1, $\overline{G2A}$, and $\overline{G2B}$ inputs are provided to ease cascade connection and for use as an address decoder for memory systems.

All inputs are equipped with protection circuits against static discharge.

Features

- Low-voltage operation: VCC = 2.0 to 3.6 V
- High-speed operation: t_{pd} = 6.0 ns (max) (VCC = 3.0 to 3.6 V)
- Output current: |I_{OH}|/I_{OL} = 24 mA (min) (VCC = 3.0 V)
- Latch-up performance: ±500 mA
- Available in JEDEC SOP, JEITA SOP and TSSOP
- Power-down protection provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 138 type

Note: xxxFN (JEDEC SOP) is not available in Japan.



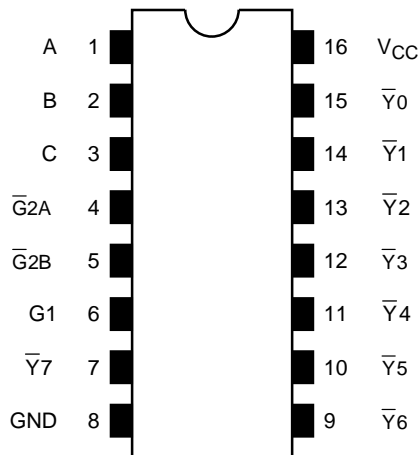
Weight

SOP16-P-300-1.27: 0.18 g (typ.)

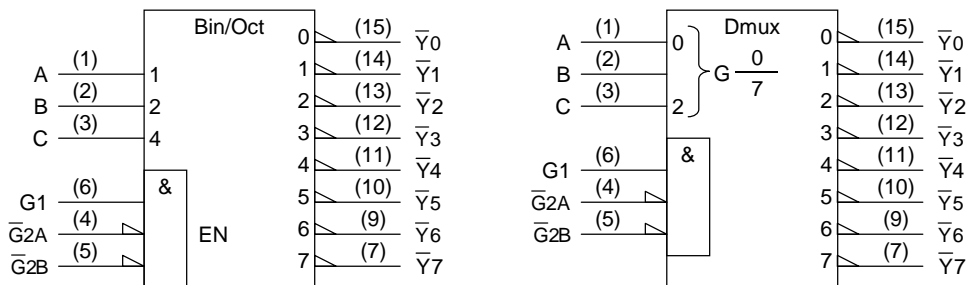
SOL16-P-150-1.27: 0.12 g (typ.)

TSSOP16-P-0044-0.65: 0.06 g (typ.)

Pin Assignment (top view)



IEC Logic Symbol

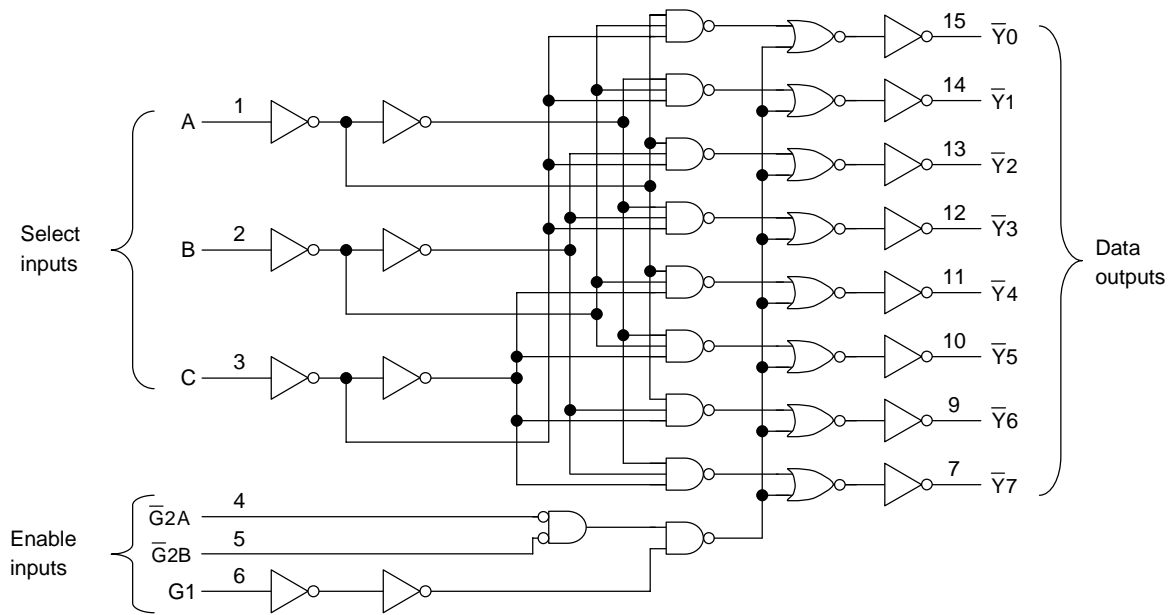


Truth Table

Inputs						Outputs								Selected Output
Enable			Select			$\bar{Y}0$	$\bar{Y}1$	$\bar{Y}2$	$\bar{Y}3$	$\bar{Y}4$	$\bar{Y}5$	$\bar{Y}6$	$\bar{Y}7$	
G1	$\bar{G}2A$	$\bar{G}2B$	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	$\bar{Y}0$
H	L	L	L	L	H	H	L	H	H	H	H	H	H	$\bar{Y}1$
H	L	L	L	H	L	H	H	L	H	H	H	H	H	$\bar{Y}2$
H	L	L	L	H	H	H	H	H	L	H	H	H	H	$\bar{Y}3$
H	L	L	H	L	L	H	H	H	H	L	H	H	H	$\bar{Y}4$
H	L	L	H	L	H	H	H	H	H	H	L	H	H	$\bar{Y}5$
H	L	L	H	H	L	H	H	H	H	H	H	L	H	$\bar{Y}6$
H	L	L	H	H	H	H	H	H	H	H	H	H	L	$\bar{Y}7$

X: Don't care

System Diagram



Maximum Ratings

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.5 to 7.0	V
DC input voltage	V_{IN}	-0.5 to 7.0	V
DC output voltage	V_{OUT}	-0.5 to 7.0 (Note 1)	V
		-0.5 to $V_{CC} + 0.5$ (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 to 150	$^{\circ}C$

Note 1: $V_{CC} = 0$ V

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

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	2.0 to 3.6	V
		1.5 to 3.6 (Note 4)	
Input voltage	V_{IN}	0 to 5.5	V
Output voltage	V_{OUT}	0 to 5.5 (Note 5)	V
		0 to V_{CC} (Note 6)	
Output current	I_{OH}/I_{OL}	± 24 (Note 7)	mA
		± 12 (Note 8)	
Operating temperature	T_{opr}	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 10 (Note 9)	ns/V

Note 4: Data retention only

Note 5: $V_{CC} = 0$ V

Note 6: High or low state

Note 7: $V_{CC} = 3.0$ to 3.6 V

Note 8: $V_{CC} = 2.7$ to 3.0 V

Note 9: $V_{IN} = 0.8$ to 2.0 V, $V_{CC} = 3.0$ V

Electrical Characteristics

DC Characteristics ($T_a = -40$ to 85°C)

Characteristics		Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit	
Input voltage	H-level	V_{IH}	—	2.7 to 3.6	2.0	—	V	
	L-level	V_{IL}	—	2.7 to 3.6	—	0.8		
Output voltage	H-level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100 \mu\text{A}$	2.7 to 3.6	$V_{CC} - 0.2$	—	V
				$I_{OH} = -12 \text{ mA}$	2.7	2.2	—	
				$I_{OH} = -18 \text{ mA}$	3.0	2.4	—	
				$I_{OH} = -24 \text{ mA}$	3.0	2.2	—	
	L-level	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 100 \mu\text{A}$	2.7 to 3.6	—	0.2	
				$I_{OL} = 12 \text{ mA}$	2.7	—	0.4	
				$I_{OL} = 16 \text{ mA}$	3.0	—	0.4	
				$I_{OL} = 24 \text{ mA}$	3.0	—	0.55	
Input leakage current		I_{IN}	$V_{IN} = 0$ to 5.5 V	2.7 to 3.6	—	± 5.0	μA	
Power-off leakage current		I_{OFF}	$V_{IN}/V_{OUT} = 5.5$ V	0	—	10.0	μA	
Quiescent supply current		I_{CC}	$V_{IN} = V_{CC}$ or GND	2.7 to 3.6	—	10.0	μA	
			$V_{IN} = 3.6$ to 5.5 V	2.7 to 3.6	—	± 10.0		
Increase in I_{CC} per input		ΔI_{CC}	$V_{IH} = V_{CC} - 0.6$ V	2.7 to 3.6	—	500		

AC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Propagation delay time (A, B, C- \bar{Y})	t _{pLH} t _{pHL}	Figure 1, Figure 2	2.7	—	7.0	ns
			3.3 ± 0.3	1.5	6.0	
Propagation delay time (G1- \bar{Y})	t _{pLH} t _{pHL}	Figure 1, Figure 2	2.7	—	8.0	ns
			3.3 ± 0.3	1.5	7.0	
Propagation delay time ($\bar{G}2$ - \bar{Y})	t _{pLH} t _{pHL}	Figure 1, Figure 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 = 2.5 ns, C_L = 50 pF, R_L = 500 Ω)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V _{OL}	V _{OLP}	V _{IH} = 3.3 V, V _{IL} = 0 V	3.3	0.8	V
Quiet output minimum dynamic V _{OL}	V _{OLV}	V _{IH} = 3.3 V, V _{IL} = 0 V	3.3	0.8	V

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Input capacitance	C _{IN}	—	3.3	7	pF
Output capacitance	C _{OUT}	—	0	8	pF
Power dissipation capacitance	C _{PD}	f _{IN} = 10 MHz (Note 11)	3.3	25	pF

Note 11: C_{PD} 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:

$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

AC Test Circuit

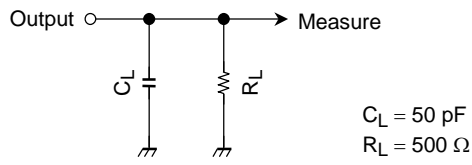


Figure 1

AC Waveform

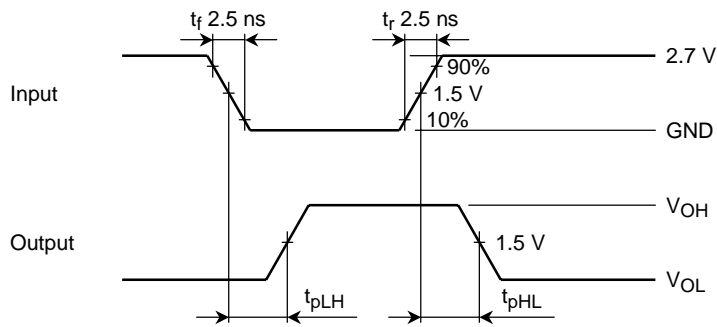
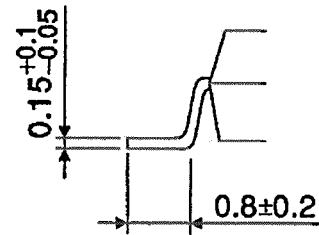
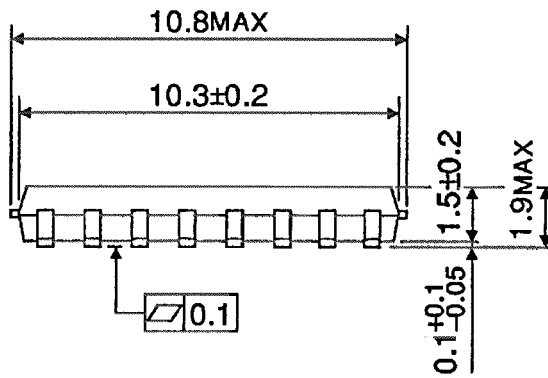
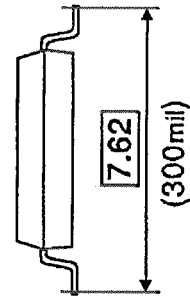
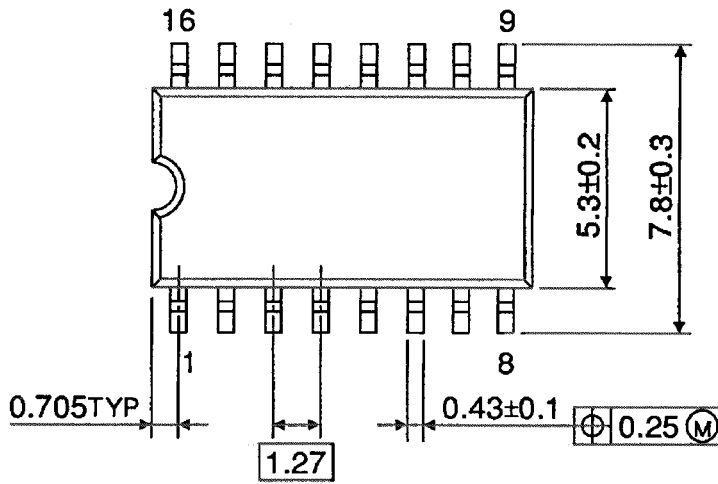


Figure 2 t_{pLH} , t_{pHL}

Package Dimensions

SOP16-P-300-1.27

Unit : mm



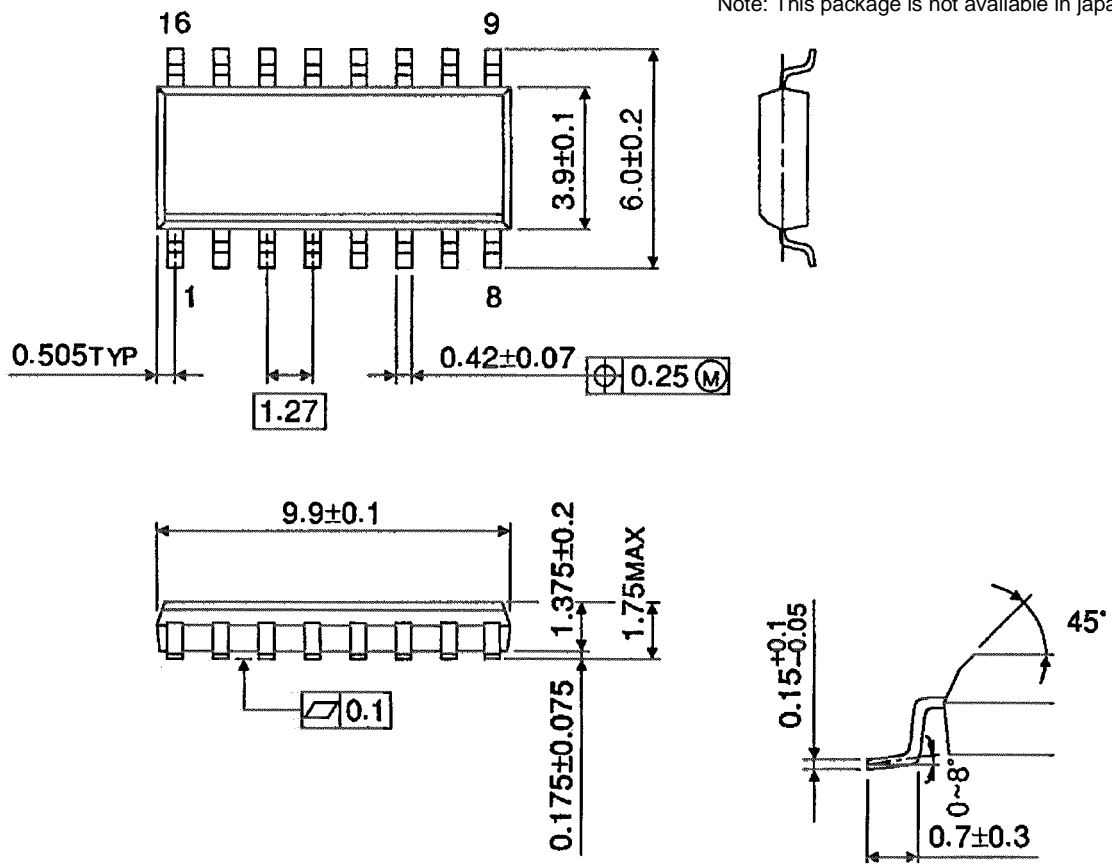
Weight: 0.18 g (typ.)

Package Dimensions

SOL16-P-150-1.27

Unit : mm

Note: This package is not available in Japan.

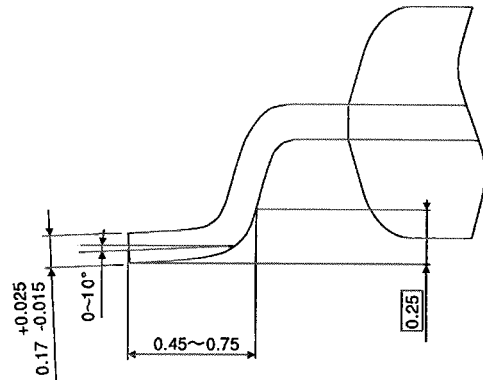
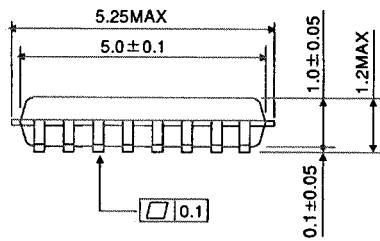
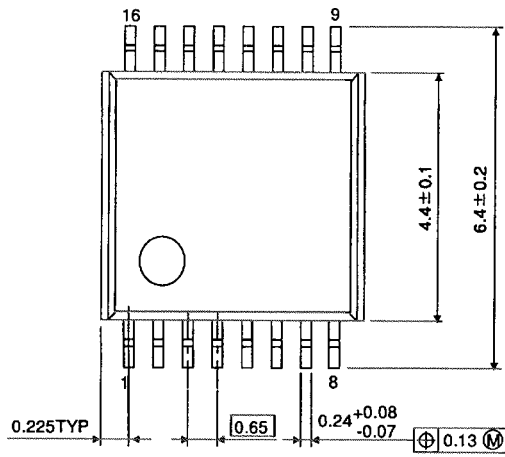


Weight: 0.12 g (typ.)

Package Dimensions

TSSOP16-P-0044-0.65

Unit : mm



Weight: 0.06 g (typ.)

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