

# TC74LVX138F, TC74LVX138FT

## 3-to-8 Line Decoder

The TC74LVX138F/ FT is a high-speed CMOS 3-to-8 line decoder fabricated with silicon gate CMOS technology. Designed for use in 3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

This device is suitable for low-voltage and battery operated systems.

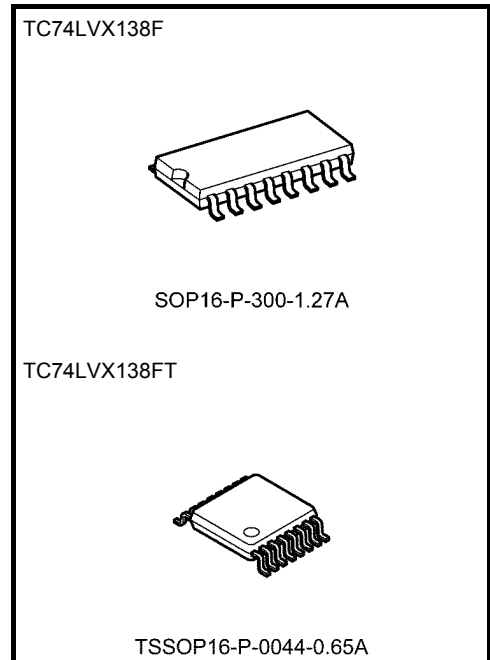
When the device is enabled, 3 Binary Select inputs (A, B and C) determine which one of the outputs ( $\overline{Y}0 - \overline{Y}7$ ) will go low. When enable input G1 is held low or either  $\overline{G}2A$  or  $\overline{G}2B$  is held high, decoding function is inhibited and all outputs go high.

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

An input protection circuit ensures that 0 to 5.5V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

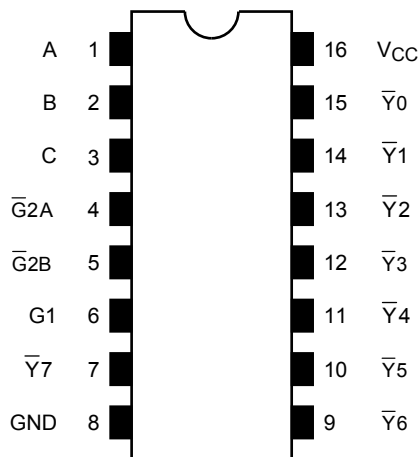
### Features

- High-speed:  $t_{pd} = 5.5$  ns (typ.) ( $V_{CC} = 3.3$  V)
- Low power dissipation:  $I_{CC} = 4$   $\mu$ A (max) ( $T_a = 25^\circ$ C)
- Input voltage level:  $V_{IL} = 0.8$  V (max) ( $V_{CC} = 3$  V)  
 $V_{IH} = 2.0$  V (min) ( $V_{CC} = 3$  V)
- Power-down protection provided on all inputs
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Pin and function compatible with 74HC138

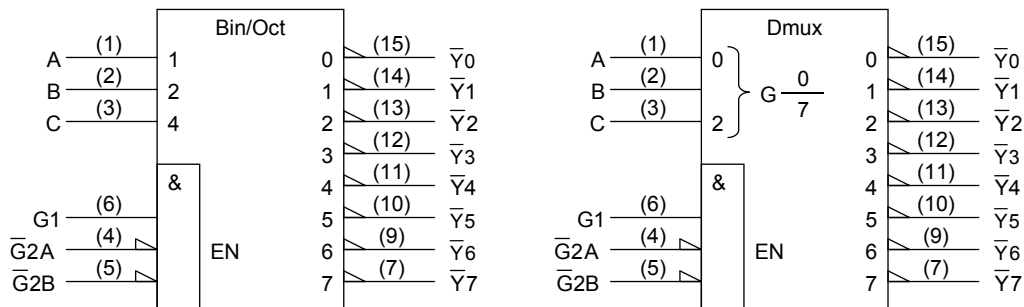


Weight	
SOP16-P-300-1.27A	: 0.18 g (typ.)
TSSOP16-P-0044-0.65A	: 0.06 g (typ.)

## Pin Assignment (top view)



## IEC Logic Symbol

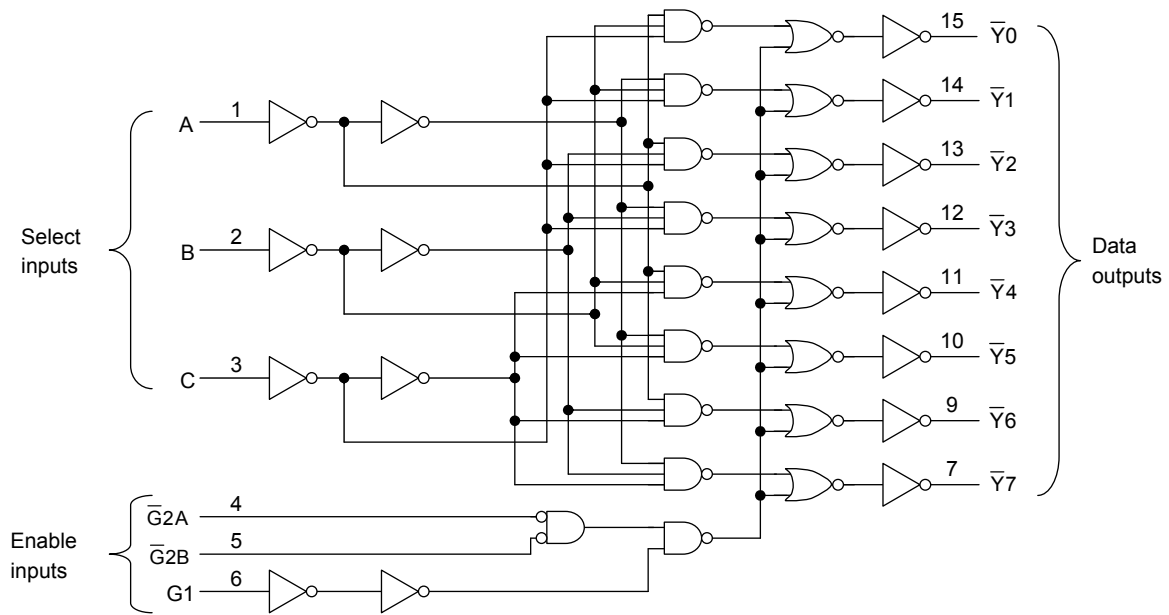


## Truth Table

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**



**Absolute Maximum Ratings (Note)**

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-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 $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 75$	mA
Power dissipation	$P_D$	180	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

**Operating Ranges (Note)**

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2.0 to 3.6	V
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	-40 to 85	$^{\circ}C$
Input rise and fall time	$dt/dv$	0 to 100	ns/V

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

**Electrical Characteristics**

**DC Characteristics**

Characteristics		Symbol	Test Condition	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40 to 85°C		Unit	
					Min	Typ.	Max	Min	Max		
Input voltage	H-level	V <sub>IH</sub>	—	2.0	1.5	—	—	1.5	—	V	
				3.0	2.0	—	—	2.0	—		
				3.6	2.4	—	—	2.4	—		
	L-level	V <sub>IL</sub>	—	2.0	—	—	0.5	—	0.5		
				3.0	—	—	0.8	—	0.8		
				3.6	—	—	0.8	—	0.8		
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> = -50 μA	2.0	1.9	2.0	—	1.9	—	V
				I <sub>OH</sub> = -50 μA	3.0	2.9	3.0	—	2.9	—	
				I <sub>OH</sub> = -4 mA	3.0	2.58	—	—	2.48	—	
	L-level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50 μA	2.0	—	0	0.1	—	0.1	
				I <sub>OL</sub> = 50 μA	3.0	—	0	0.1	—	0.1	
				I <sub>OL</sub> = 4 mA	3.0	—	—	0.36	—	0.44	
Input leakage current		I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND	3.6	—	—	±0.1	—	±1.0	μA	
Quiescent supply current		I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	3.6	—	—	4.0	—	40.0	μA	

## AC Characteristics (input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Typ.	Max		Min	Max
Propagation delay time (A, B, C- $\bar{Y}$ )	$t_{pLH}$	—	2.7	15	—	7.1	13.8	1.0	16.5	ns
				50	—	9.6	17.3	1.0	20.0	
	$t_{pHL}$		3.3 ± 0.3	15	—	5.5	8.8	1.0	10.5	
				50	—	8.0	12.3	1.0	14.0	
Propagation delay time (G1- $\bar{Y}$ )	$t_{pLH}$	—	2.7	15	—	8.7	16.3	1.0	19.5	ns
				50	—	11.2	19.8	1.0	23.0	
	$t_{pHL}$		3.3 ± 0.3	15	—	6.8	10.6	1.0	12.5	
				50	—	9.3	14.1	1.0	16.0	
Propagation delay time ( $\bar{G}2$ - $\bar{Y}$ )	$t_{pLH}$	—	2.7	15	—	8.8	16.0	1.0	18.5	ns
				50	—	11.3	19.5	1.0	22.0	
	$t_{pHL}$		3.3 ± 0.3	15	—	6.9	10.4	1.0	11.5	
				50	—	9.4	13.9	1.0	15.0	
Output to output skew	$t_{oS LH}$	(Note 1)	2.7	50	—	—	2.5	—	2.5	ns
	$t_{oS HL}$		3.3 ± 0.3	50	—	—	2.5	—	2.5	
Input capacitance	C <sub>IN</sub>	(Note 2)		—	4	10	—	10	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note 3)		—	34	—	—	—	pF	

Note 1: Parameter guaranteed by design.  
 ( $t_{oS LH} = |t_{pLHm} - t_{pLHn}|$ ,  $t_{oS HL} = |t_{pHLm} - t_{pHLn}|$ )

Note 2: Parameter guaranteed by design.

Note 3: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption.

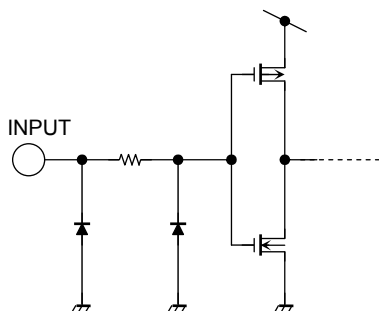
Average operating current can be obtained by the equation:

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

## Noise Characteristics (Ta = 25°C, input: $t_r = t_f = 3$ ns, C<sub>L</sub> = 50 pF)

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Limit	Unit
			3.3			
Quiet output maximum dynamic V <sub>OL</sub>	V <sub>OLP</sub>	—	3.3	—	0.5	V
Quiet output minimum dynamic V <sub>OL</sub>	V <sub>OLV</sub>	—	3.3	—	-0.5	V
Minimum high level dynamic input voltage V <sub>IH</sub>	V <sub>IHD</sub>	—	3.3	—	2.0	V
Maximum low level dynamic input voltage V <sub>IL</sub>	V <sub>ILD</sub>	—	3.3	—	0.8	V

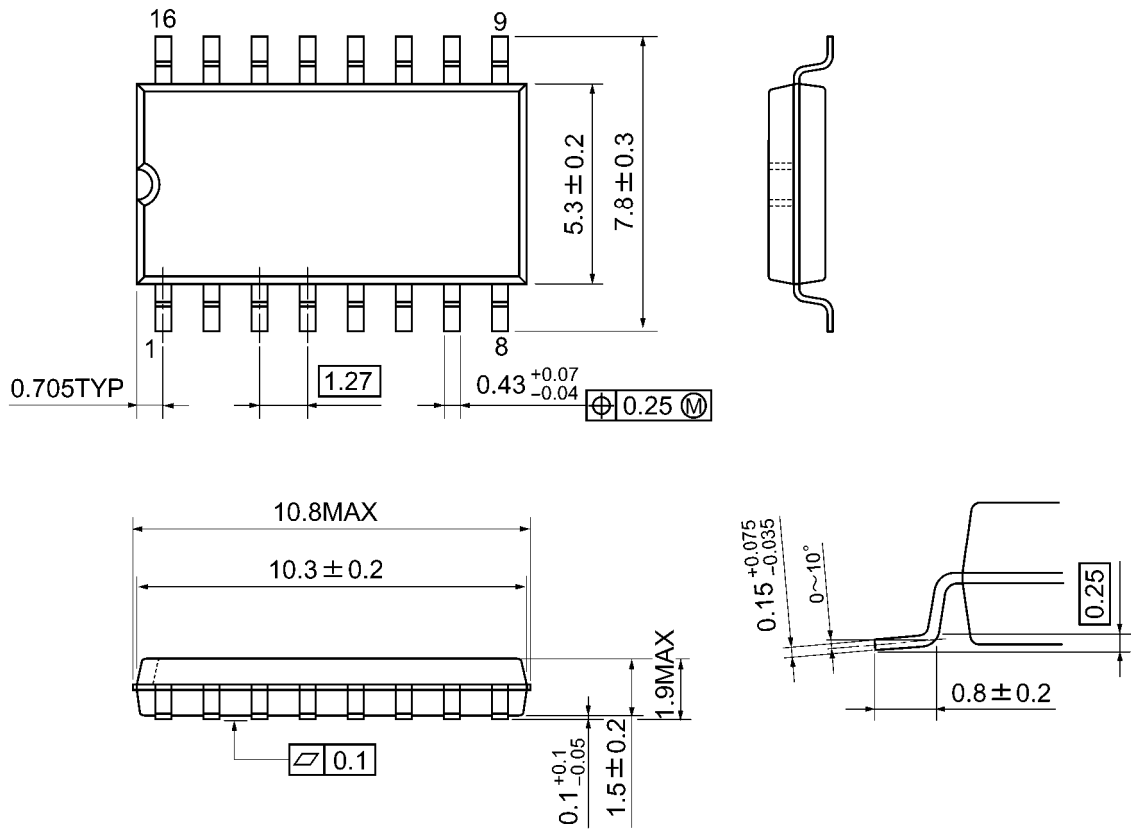
## Input Equivalent Circuit



**Package Dimensions**

SOP16-P-300-1.27A

Unit: mm

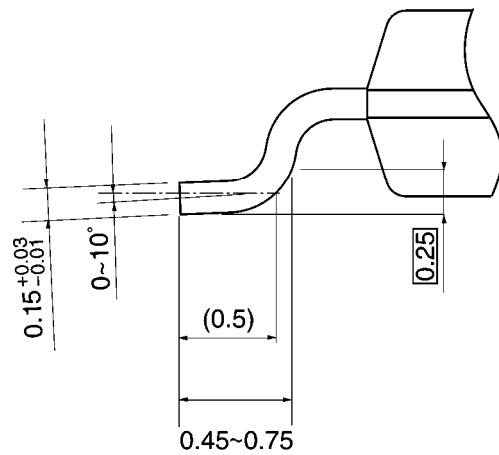
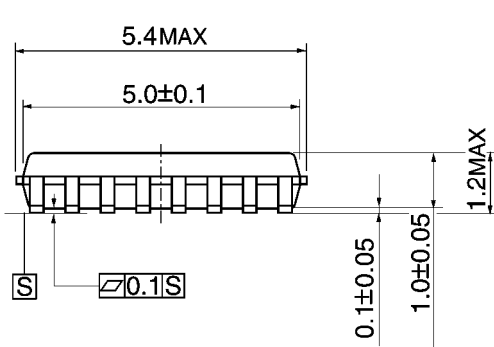
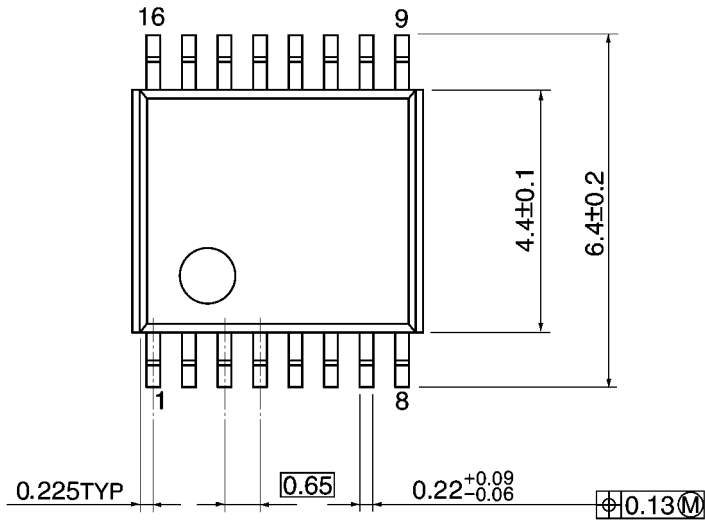


Weight: 0.18 g (typ.)

**Package Dimensions**

TSSOP16-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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