

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**TC74LCX138F, TC74LCX138FN, TC74LCX138FT****LOW VOLTAGE 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 ( $Y_0$ - $Y_7$ ) will go low.

When enable input  $G_1$  is held low or either  $\overline{G_2A}$  or  $\overline{G_2B}$  is held high, decoding function is inhibited and all outputs go high.

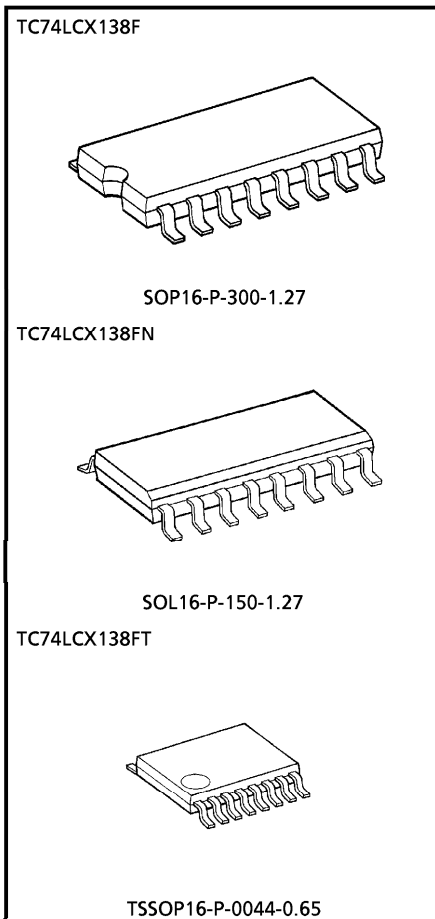
$G_1$ ,  $\overline{G_2A}$ , and  $\overline{G_2B}$  inputs are provided to ease cascade connection and for use as an address decoder for memory systems.

All inputs are equipped with protection circuits against static discharge.

**FEATURES**

- Low voltage operation :  $V_{CC} = 2.0 \sim 3.6V$
- High speed operation :  $t_{pd} = 6.0ns$  (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 TSSOP
- Power down protection is provided on all inputs and outputs.
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 138 type.

(Note) The JEDEC SOP (FN) is not available in Japan.

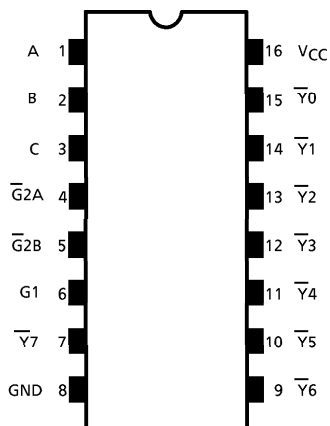


Weight  
 SOP16-P-300-1.27 : 0.18g (Typ.)  
 SOL16-P-150-1.27 : 0.12g (Typ.)  
 TSSOP16-P-0044-0.65 : 0.06g (Typ.)

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PIN ASSIGNMENT



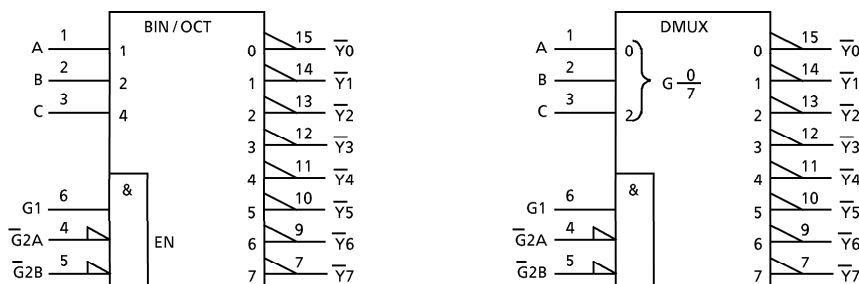
(TOP VIEW)

TRUTH TABLE

INPUTS						OUTPUTS								SELECTED OUTPUT	
ENABLE			SELECT			Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7		
G1	G2A	G2B	C	B	A										
L	X	X	X	X	X	H	H	H	H	H	H	H	H	H	NONE
X	H	X	X	X	X	H	H	H	H	H	H	H	H	H	NONE
X	X	H	X	X	X	H	H	H	H	H	H	H	H	H	NONE
H	L	L	L	L	L	L	H	H	H	H	H	H	H	H	Y0
H	L	L	L	L	H	H	L	H	H	H	H	H	H	H	Y1
H	L	L	L	H	L	H	H	L	H	H	H	H	H	H	Y2
H	L	L	L	H	H	H	H	H	L	H	H	H	H	H	Y3
H	L	L	H	L	L	H	H	H	H	L	H	H	H	H	Y4
H	L	L	H	H	L	H	H	H	H	H	L	H	H	H	Y5
H	L	L	H	H	L	H	H	H	H	H	H	L	H	H	Y6
H	L	L	H	H	H	H	H	H	H	H	H	H	L	H	Y7

X : Don't Care

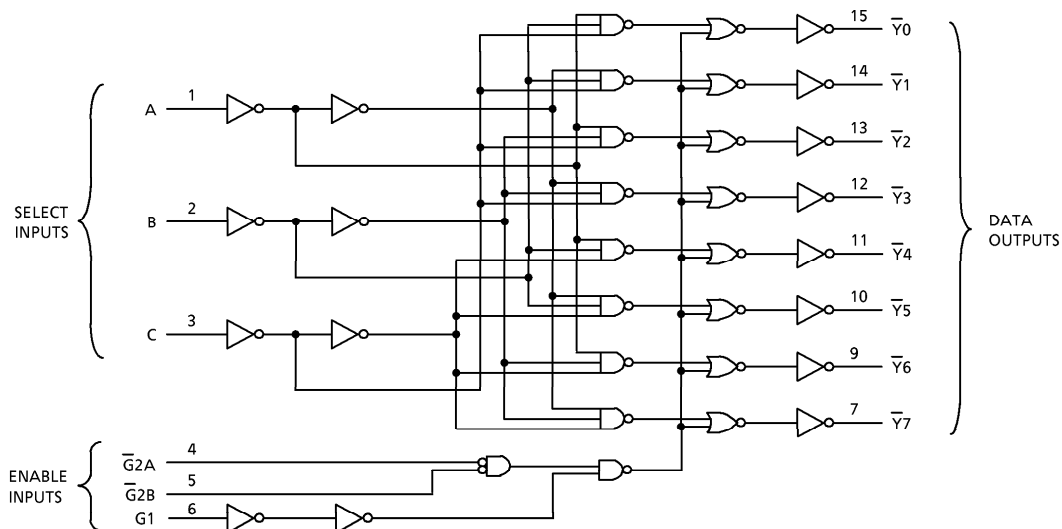
IEC LOGIC SYMBOL



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SYSTEM DIAGRAM



MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	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)  $V_{CC} = 0V$

(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	RATING	UNIT
Supply Voltage	V <sub>CC</sub>	2.0~3.6	V
		1.5~3.6 (Note 4)	
Input Voltage	V <sub>IN</sub>	0~5.5	V
Output Voltage	V <sub>OUT</sub>	0~5.5 (Note 5)	V
		0~V <sub>CC</sub> (Note 6)	
Output Current	I <sub>OH</sub> /I <sub>OL</sub>	±24 (Note 7)	mA
		±12 (Note 8)	
Operating Temperature	T <sub>opr</sub>	-40~85	°C
Input Rise And Fall Time	dt/dv	0~10 (Note 9)	ns/V

- (Note 4) Data Retention Only
- (Note 5) V<sub>CC</sub> = 0V
- (Note 6) High or Low State
- (Note 7) V<sub>CC</sub> = 3.0~3.6V
- (Note 8) V<sub>CC</sub> = 2.7~3.0V
- (Note 9) V<sub>IN</sub> = 0.8~2.0V, V<sub>CC</sub> = 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		
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>OL</sub> = 100μA	2.7~3.6	—	0.2	
				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 <sub>pLH</sub> t <sub>pHL</sub>	(Fig.1, 2)	2.7	—	7.0	ns
			3.3 ± 0.3	1.5	6.0	
Propagation Delay Time (G1- $\bar{Y}$ )	t <sub>pLH</sub> t <sub>pHL</sub>	(Fig.1, 2)	2.7	—	8.0	ns
			3.3 ± 0.3	1.5	7.0	
Propagation Delay Time (G2- $\bar{Y}$ )	t <sub>pLH</sub> t <sub>pHL</sub>	(Fig.1, 2)	2.7	—	7.0	ns
			3.3 ± 0.3	1.5	6.0	
Output To Output Skew	t <sub>osLH</sub> t <sub>osHL</sub>	(Note 10)	2.7	—	—	ns
			3.3 ± 0.3	—	1.0	

(Note 10) Parameter guaranteed by design.  
 (t<sub>osLH</sub> = |t<sub>pLHm</sub> - t<sub>pLHn</sub>|, t<sub>osHL</sub> = |t<sub>pHLm</sub> - t<sub>pHLn</sub>|)

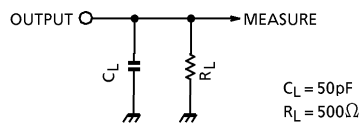
CAPACITIVE CHARACTERISTICS (Ta = 25°C)

PARAMETER	SYMBOL	TEST CONDITION	V <sub>CC</sub> (V)	TYP	UNIT
Input Capacitance	C <sub>IN</sub>	—	3.3	7	pF
Output Capacitance	C <sub>OUT</sub>		0	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 :  
 $I_{CC(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

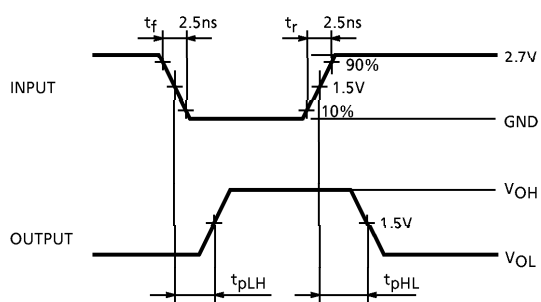
**TEST CIRCUIT**

Fig.1



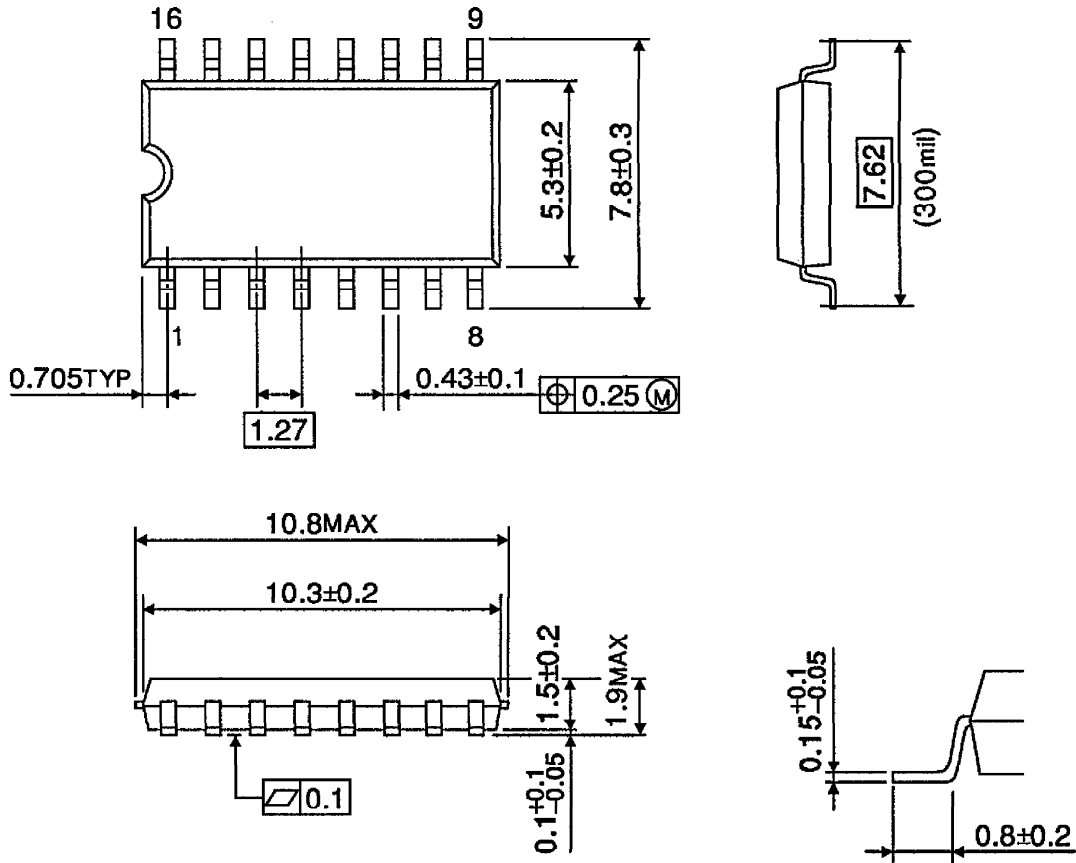
**AC WAVEFORM**

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



**OUTLINE DRAWING**  
SOP16-P-300-1.27

Unit : mm

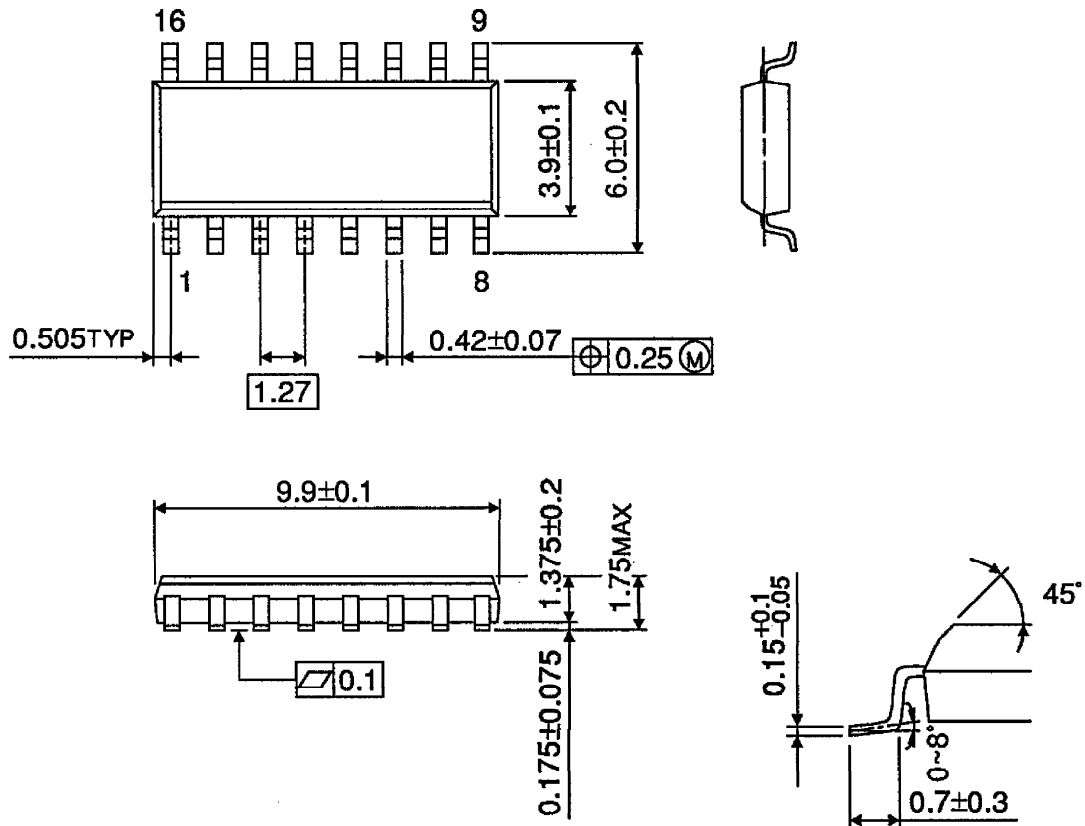


Weight : 0.18g (Typ.)

OUTLINE DRAWING  
SOL16-P-150-1.27

Unit : mm

(Note) This package is not available in Japan.



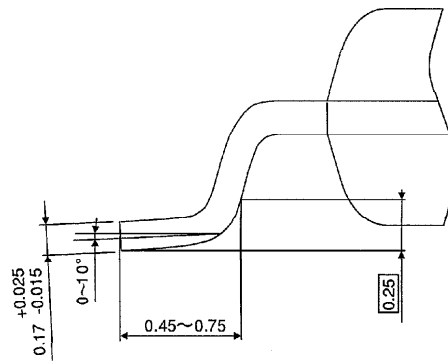
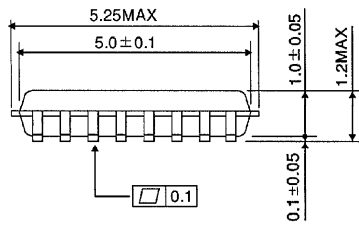
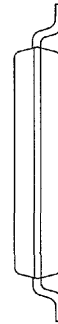
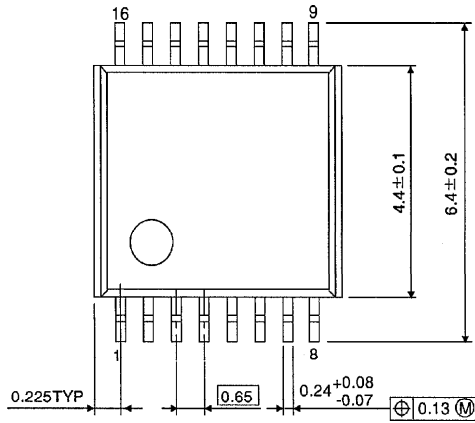
Weight : 0.12g (Typ.)



**OUTLINE DRAWING**

TSSOP16-P-0044-0.65

Unit : mm



Weight : 0.06g (Typ.)