

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**TC74VHCT138AF, TC74VHCT138AFN, TC74VHCT138AFT**

**3-TO-8 LINE DECODER**

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

The TC74VHCT138 is an advanced high speed CMOS 3-TO-8 LINE DECODER fabricated with silicon gate C<sup>2</sup>MOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

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.

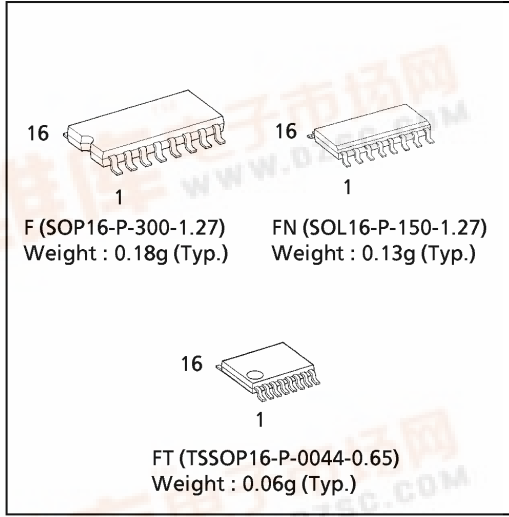
The input voltage are compatible with TTL output voltage. This device may be used as a level converter for interfacing 3.3V to 5V system.

Input protection and output circuit ensure that 0 to 5.5V can be applied to the input and output\*1 pins without regard to the supply voltage. These structure prevents device destruction due to mismatched supply and input/output voltages such as battery back up, hot board insertion, etc.

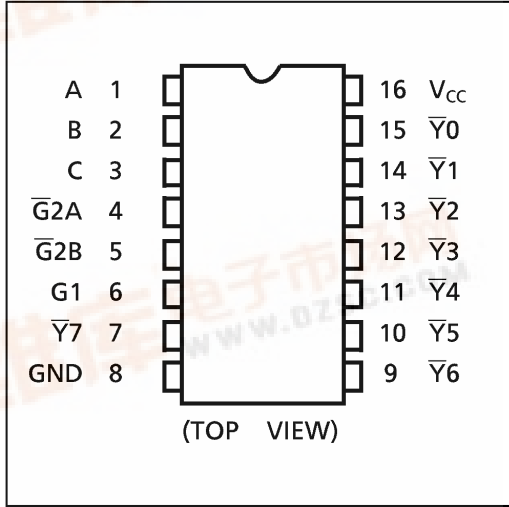
\*1:  $V_{CC}=0V$

**FEATURES:**

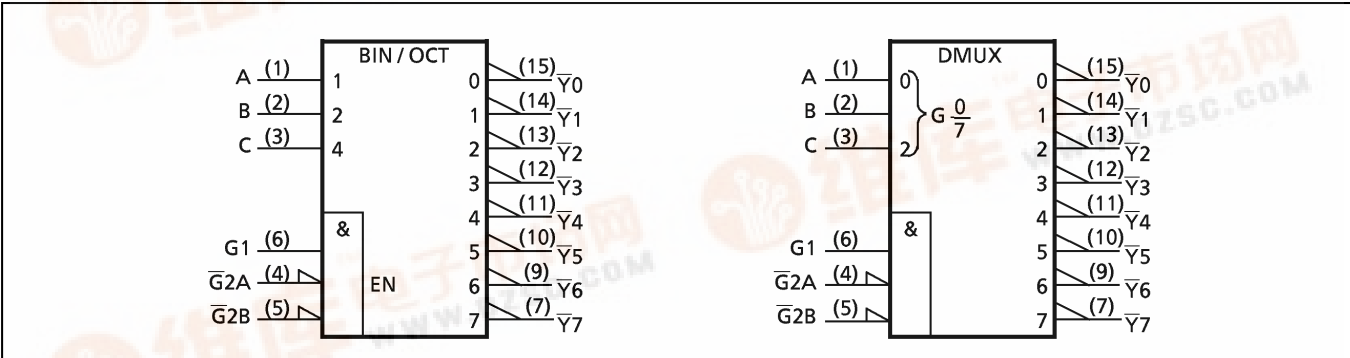
- High Speed..... $t_{pd} = 7.6ns$ (typ.) at  $V_{CC} = 5V$
- Low Power Dissipation..... $I_{CC} = 4\mu A$ (Max.) at  $T_a = 25^\circ C$
- Compatible with TTL outputs ...  $V_{IL} = 0.8V$  (Max.)  
 $V_{IH} = 2.0V$  (Min.)
- Power Down Protection is provided on all inputs and outputs
- Balanced Propagation Delays..... $t_{pLH} \approx t_{pHL}$
- Pin and Function Compatible with the 74 series (74AC/HC /F/ALS/LS etc.) 138 type.



**PIN ASSIGNMENT**



**IEC LOGIC SYMBOL**



980910EBA2

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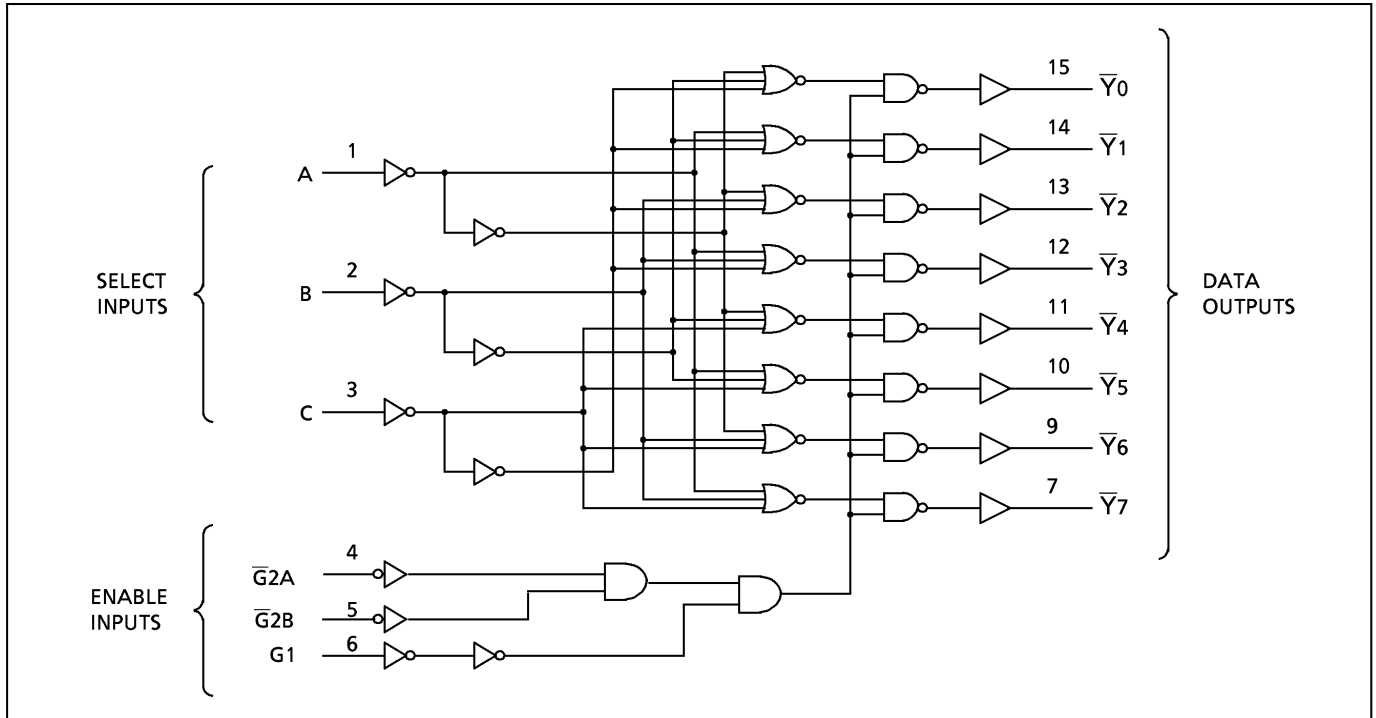


**TRUTH TABLE**

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	L	H	H	H	H	H	$\bar{Y}3$
H	L	L	H	L	L	H	H	H	L	H	H	H	H	$\bar{Y}4$
H	L	L	H	L	H	H	H	H	H	L	H	H	H	$\bar{Y}5$
H	L	L	H	H	L	H	H	H	H	H	L	H	H	$\bar{Y}6$
H	L	L	H	H	H	H	H	H	H	H	H	L	H	$\bar{Y}7$

X : Don't Care

**SYSTEM DIAGRAM**



980910EBA2'

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## 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	$I_{IK}$	-20	mA
Output Diode Current	$I_{OK}$	$\pm 20$ (Note 3)	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	$T_{stg}$	-65~150	$^{\circ}C$

(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	VALUE	UNIT
Supply Voltage	$V_{CC}$	4.5~5.5	V
Input Voltage	$V_{IN}$	0~5.5	V
Output Voltage	$V_{OUT}$	0~5.5 (Note 4)	V
		0~ $V_{CC}$ (Note 5)	
Operating Temperature	$T_{opr}$	-40~85	$^{\circ}C$
Input Rise and Fall Time	$dt/dV$	0~20	ns/V

(Note 4)  $V_{CC}=0V$

(Note 5) High or Low State.

**DC ELECTRICAL CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITON		V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40~85°C		UNIT
					MIN.	TYP.	MAX.	MIN.	MAX.	
High - Level Input Voltage	V <sub>IH</sub>			4.5~5.5	2.0	—	—	2.0	—	V
Low - Level Input Voltage	V <sub>IL</sub>			4.5~5.5	—	—	0.8	—	0.8	V
High - Level Output Voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50μA	4.5	4.40	4.50	—	4.40	—	V
			I <sub>OH</sub> = -8mA	4.5	3.94	—	—	3.80	—	
Low - Level Output Voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50μA	4.5	—	0.0	0.1	—	0.1	V
			I <sub>OL</sub> = 8mA	4.5	—	—	0.36	—	0.44	
Input Leakage Current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5V or GND		0~5.5	—	—	±0.1	—	±1.0	μA
Quiescent Supply Current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	4.0	—	20.0	
		I <sub>CCT</sub>	PER INPUT : V <sub>IN</sub> = 3.4V OTHER INPUT : V <sub>CC</sub> or GND	5.5	—	—	1.35	—	1.50	mA
Output Leakage Current	I <sub>OPD</sub>	V <sub>OUT</sub> = 5.5V		0	—	—	0.5	—	5.0	μA

**AC ELECTRICAL CHARACTERISTICS ( Input  $t_r = t_f = 3ns$  )**

PARAMETER	SYMBOL	TEST CONDITION		Ta = 25°C			Ta = -40~85°C		UNIT
		V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	MIN.	TYP.	MAX.	MIN.	MAX.	
Propagation Delay Time ( A, B, C - $\bar{Y}$ )	$t_{pLH}$ $t_{pHL}$	5.0 ± 0.5	15	—	7.6	10.4	1.0	12.0	ns
			50	—	8.1	11.4	1.0	13.0	
Propagation Delay Time ( G1 - $\bar{Y}$ )	$t_{pLH}$ $t_{pHL}$	5.0 ± 0.5	15	—	6.6	9.1	1.0	10.5	ns
			50	—	7.1	10.1	1.0	11.5	
Propagation Delay Time ( $\bar{G}2$ - $\bar{Y}$ )	$t_{pLH}$ $t_{pHL}$	5.0 ± 0.5	15	—	7.0	9.6	1.0	11.0	MHz
			50	—	7.5	10.6	1.0	12.0	
Input Capacitance	C <sub>IN</sub>			—	4	10	—	10	pF
Power Dissipation Capacitance	C <sub>PD</sub>	(Note 1)		—	49	—	—	—	

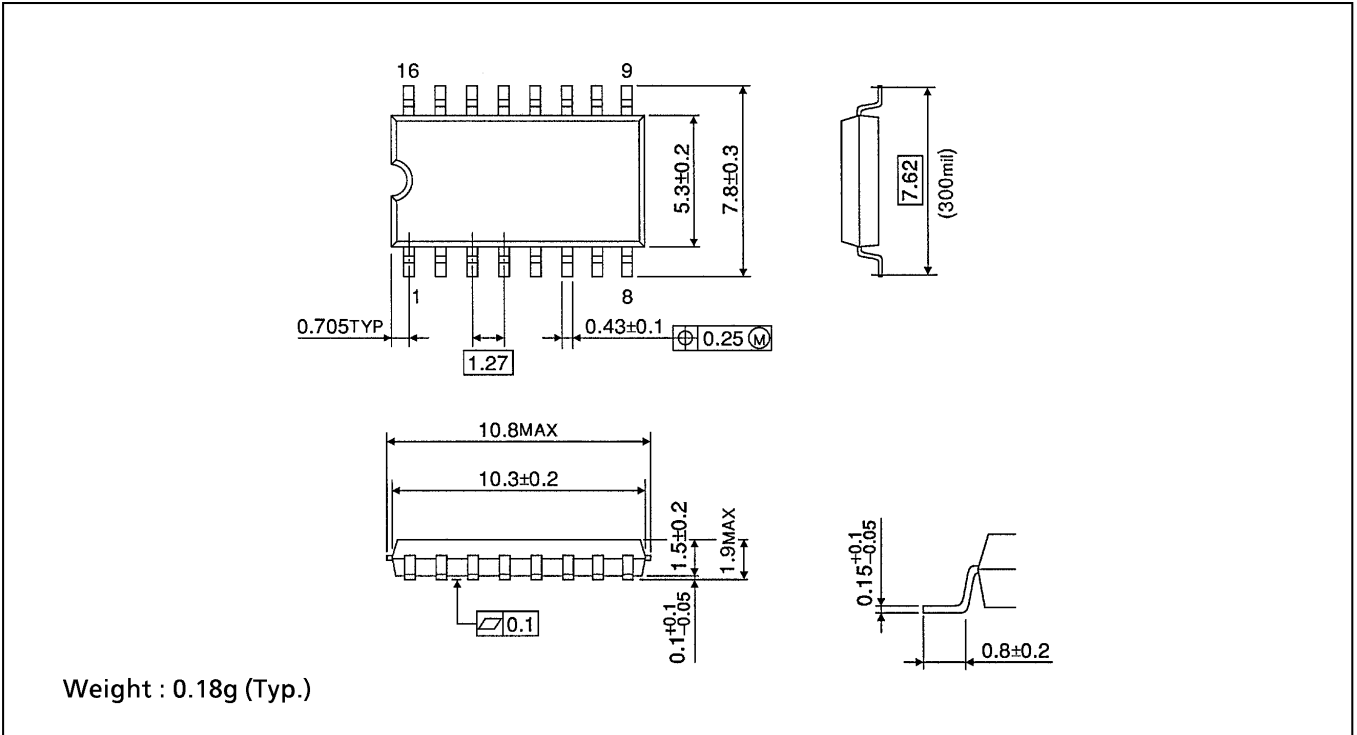
Note (1) C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

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

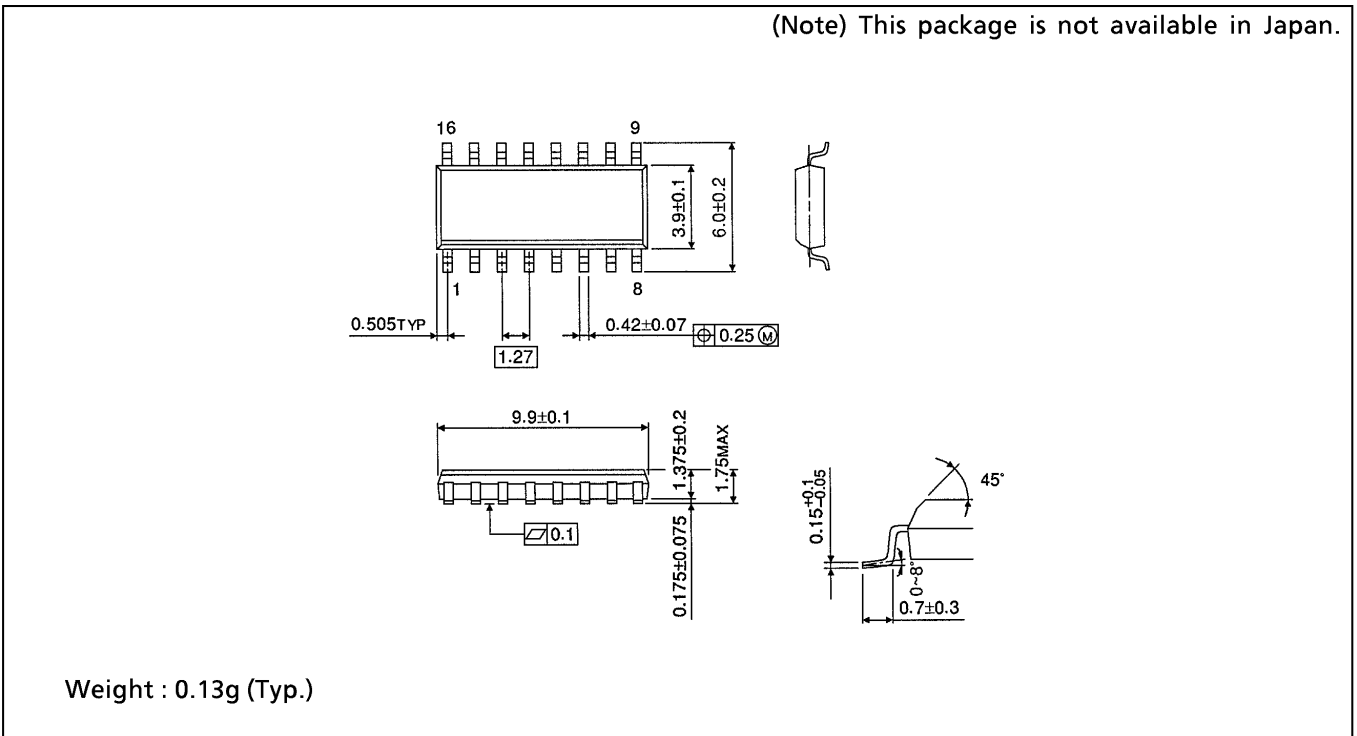
**SOP 16PIN (200mil BODY) PACKAGE DIMENSIONS (SOP16-P-300-1.27)**

Unit in mm



**SOP 16PIN (150mil BODY) PACKAGE DIMENSIONS (SOP16-P-150-1.27)**

Unit in mm



**TSSOP 16PIN PACKAGE DIMENSIONS (TSSOP16-P-0044-0.65)**

Unit in mm

