

TOSHIBA CMOS Digital Integrated Circuit   Silicon Monolithic

# **TC7MH238FK**

## 3-to-8 Line Decoder

The TC7MH238FK is an advanced high speed CMOS 3-to-8 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 (Y0-Y7) will go high.

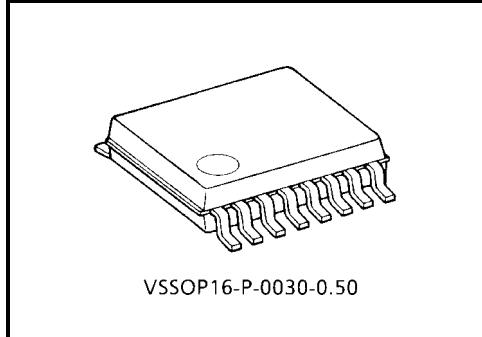
When enable input G1 is held low or either  $\bar{G}2A$  or  $\bar{G}2B$  is held high, decoding function is inhibited and all outputs go low.

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

An input protection circuit ensures that 0 to 7 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

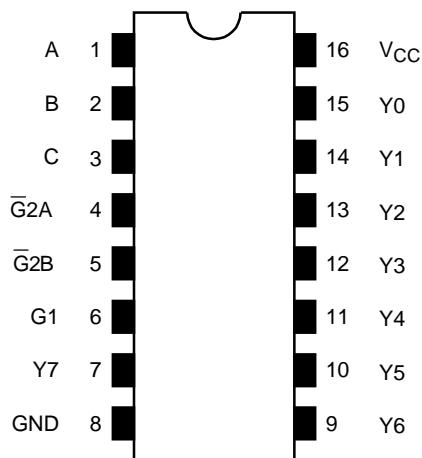
## Features

- High speed:  $t_{pd} = 5.5$  ns (typ.) ( $VCC = 5$  V)
- Low power dissipation:  $ICC = 4$   $\mu$ A (max) ( $Ta = 25^\circ C$ )
- High noise immunity:  $VNIH = VNIL = 28\%$   $VCC$  (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $VCC$  (opr) = 2~5.5 V
- Pin and function compatible with 74ALS238

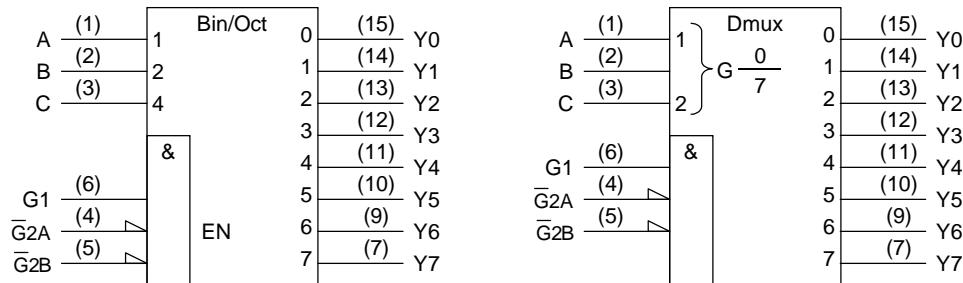


Weight: 0.02 g (typ.)

## Pin Assignment (top view)



## IEC Logic Symbol

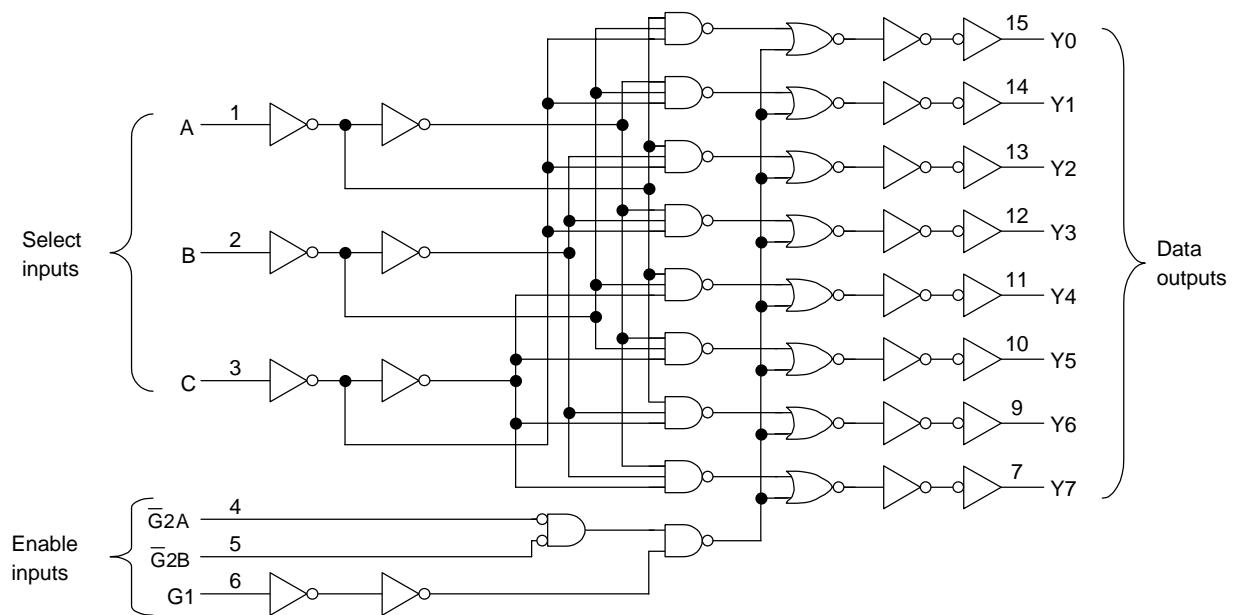


## Truth Table

Inputs						Outputs								Selected Output
Enable			Select			Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	
G1	$\bar{G}2A$	$\bar{G}2B$	C	B	A									
L	X	X	X	X	X	L	L	L	L	L	L	L	L	None
X	H	X	X	X	X	L	L	L	L	L	L	L	L	None
X	X	H	X	X	X	L	L	L	L	L	L	L	L	None
H	L	L	L	L	L	L	H	L	L	L	L	L	L	Y0
H	L	L	L	L	L	H	L	H	L	L	L	L	L	Y1
H	L	L	L	H	L	L	L	H	L	L	L	L	L	Y2
H	L	L	L	H	H	L	L	L	H	L	L	L	L	Y3
H	L	L	H	L	L	L	L	L	L	H	L	L	L	Y4
H	L	L	H	L	H	L	L	L	L	L	H	L	L	Y5
H	L	L	H	H	L	L	L	L	L	L	H	L	L	Y6
H	L	L	H	H	H	L	L	L	L	L	L	L	H	Y7

X: Don't care

## System Diagram



## Maximum Ratings

Characteristics	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~ $V_{CC} + 0.5$	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	$T_{stg}$	-65~150	°C

## Recommended Operating Conditions

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2.0~5.5	V
Input voltage	$V_{IN}$	0~5.5	V
Output voltage	$V_{OUT}$	0~ $V_{CC}$	V
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	$dt/dv$	0~100 ( $V_{CC} = 3.3 \pm 0.3$ V)	ns/V
		0~20 ( $V_{CC} = 5 \pm 0.5$ V)	

## Electrical Characteristics

## DC Characteristics

Characteristics		Symbol	Test Condition	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40~85°C		Unit		
					Min	Typ.	Max	Min	Max			
Input voltage	High level	V <sub>IH</sub>	—	2.0	1.50	—	—	1.50	—	V		
				3.0~5.5	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7	—			
	Low level	V <sub>IL</sub>	—	2.0	—	—	0.50	—	0.50			
				3.0~5.5	—	—	V <sub>CC</sub> × 0.3	—	V <sub>CC</sub> × 0.3			
Output voltage	High 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		
					3.0	2.9	3.0	—	2.9			
					4.5	4.4	4.5	—	4.4			
				I <sub>OH</sub> = -4 mA	3.0	2.58	—	—	2.48			
	Low level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50 μA	4.5	3.94	—	—	3.80	V		
					2.0	—	0	0.1	—			
					3.0	—	0	0.1	—			
					4.5	—	0	0.1	—			
				I <sub>OL</sub> = 4 mA	3.0	—	—	0.36	—			
				I <sub>OL</sub> = 8 mA	4.5	—	—	0.36	—			
Input leakage current		I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V 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	—	40.0	μA	

AC Characteristics (Input:  $t_r = t_f = 3$  ns)

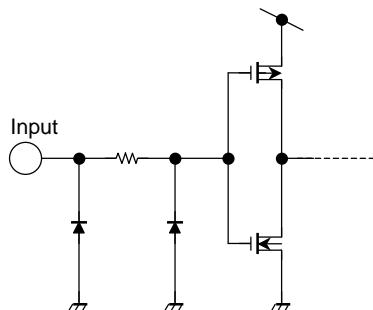
Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit	
			V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Typ.	Max		
Propagation delay time (A, B, C-Y)	t <sub>pLH</sub> t <sub>pHL</sub>	—	3.3 ± 0.3	15	—	8.0	12.3	1.0	14.5
				50	—	10.5	15.8	1.0	18.0
			5.0 ± 0.5	15	—	5.5	8.1	1.0	9.5
				50	—	7.0	10.1	1.0	11.5
Propagation delay time (G1-Y)	t <sub>pLH</sub> t <sub>pHL</sub>	—	3.3 ± 0.3	15	—	8.1	12.8	1.0	15.0
				50	—	10.6	16.3	1.0	18.5
			5.0 ± 0.5	15	—	5.4	8.1	1.0	9.5
				50	—	6.9	10.1	1.0	11.5
Propagation delay time (G2-Y)	t <sub>pLH</sub> t <sub>pHL</sub>	—	3.3 ± 0.3	15	—	8.1	12.3	1.0	14.5
				50	—	10.6	15.8	1.0	18.0
			5.0 ± 0.5	15	—	5.7	8.1	1.0	9.5
				50	—	7.2	10.1	1.0	11.5
Input capacitance	C <sub>IN</sub>	—	—	—	4	—	—	10	pF
Power dissipation capacitance	C <sub>PD</sub>	(Note)			—	37	—	—	pF

Note: 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:

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

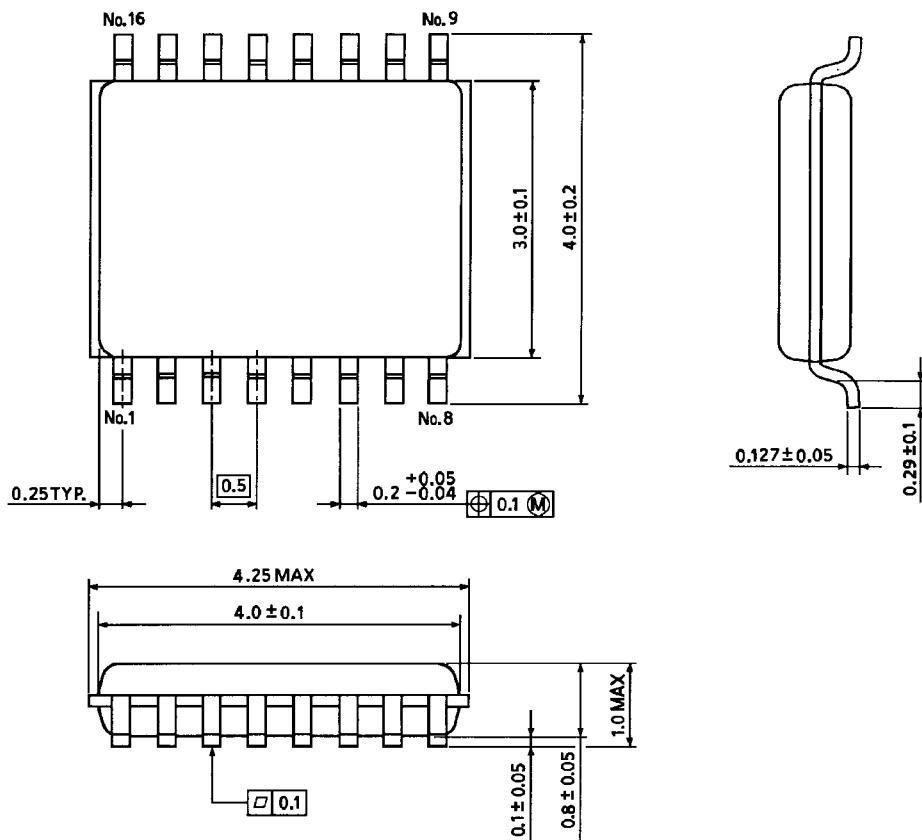
## Input Equivalent Circuit



**Package Dimensions**

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)

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