

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7MET138AFK

## 3-to-8 Line Decoder

The TC7MET138AFK 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.

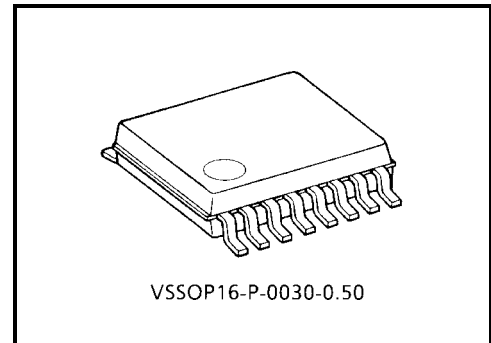
This device may be used as a level converter for interfacing 3.3 V to 5 V system.

Input protection and output circuit ensure that 0 to 5.5 V can be applied to the input and output (\*) 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.

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

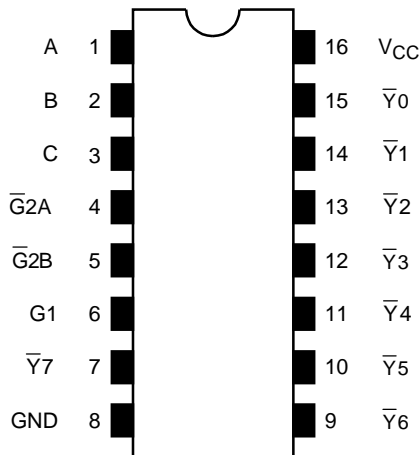
## Features

- High speed:  $t_{pd} = 7.6 \text{ ns (typ.) (} V_{CC} = 5 \text{ V)}$
- Low power dissipation:  $I_{CC} = 4 \mu\text{A (max) (} T_a = 25^\circ\text{C)}$
- Compatible with TTL outputs:  $V_{IL} = 0.8 \text{ V (max)}$   
 $V_{IH} = 2.0 \text{ V (min)}$
- 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/ALS/LS etc.) 138 type.

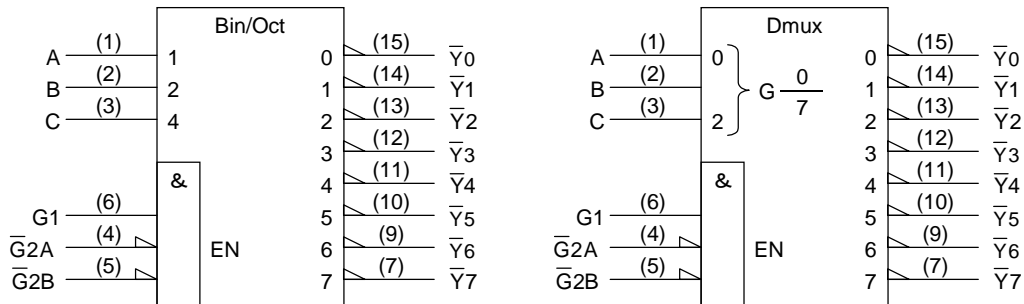


Weight: 0.02 g (typ.)

## Pin Assignment (top view)



## IEC Logic Symbol

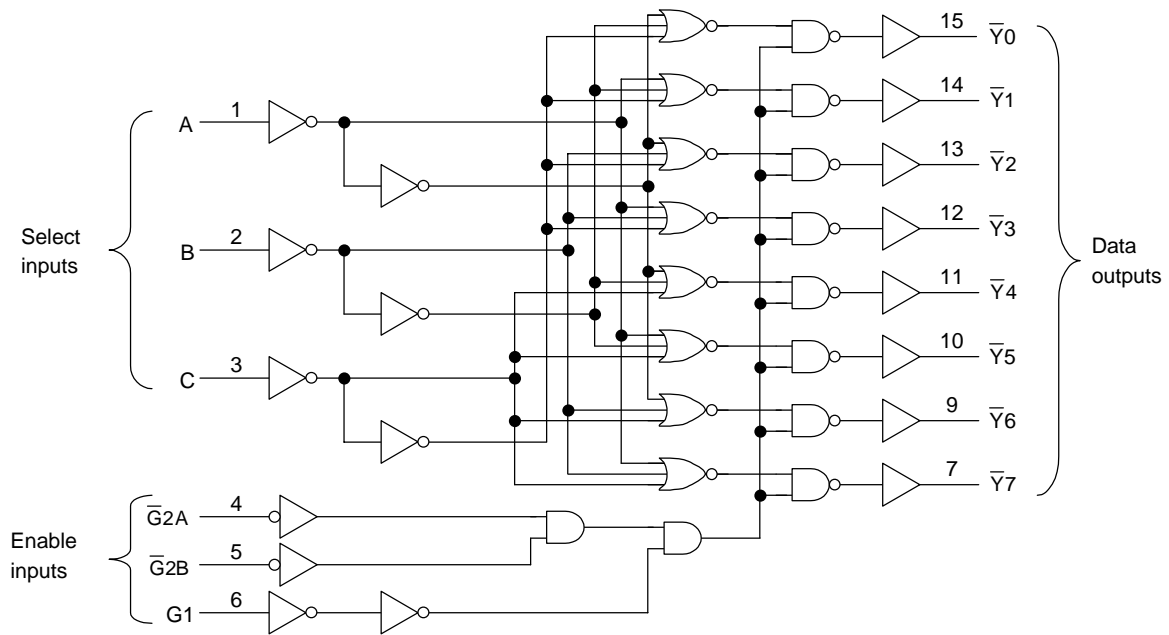


## Truth Table

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
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 (Note1)	V
		-0.5~ $V_{CC} + 0.5$ (Note2)	
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$ (Note3)	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	$^{\circ}C$

Note1:  $V_{CC} = 0 V$

Note2: High or low state.  $I_{OUT}$  absolute maximum rating must be observed.

Note3:  $V_{OUT} < GND, V_{OUT} > V_{CC}$

## Recommended Operating Conditions

Characteristics	Symbol	Rating	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 (Note4)	V
		0~ $V_{CC}$ (Note5)	
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	dt/dv	0~20	ns/V

Note4:  $V_{CC} = 0\text{ V}$

Note5: High or low state.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40\sim 85^\circ\text{C}$		Unit			
			$V_{CC}$ (V)	Min	Typ.	Max	Min		Max		
Input voltage	High level	$V_{IH}$	—	4.5~5.5	2.0	—	—	2.0	—	V	
	Low level	$V_{IL}$	—	4.5~5.5	—	—	0.8	—	0.8		
Output voltage	High level	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -50\ \mu\text{A}$	4.5	4.4	4.5	—	4.4	—	V
				$I_{OH} = -8\ \text{mA}$	4.5	3.94	—	—	3.80	—	
	Low level	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 50\ \mu\text{A}$	4.5	—	0	0.1	—	0.1	
				$I_{OL} = 8\ \text{mA}$	4.5	—	—	0.36	—	0.44	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5\ \text{V}$ or GND	0~5.5	—	—	$\pm 0.1$	—	$\pm 1.0$	$\mu\text{A}$		
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	5.5	—	—	4.0	—	40.0	$\mu\text{A}$		
	$I_{CCT}$	Per input: $V_{IN} = 3.4\ \text{V}$ Other input: $V_{CC}$ or GND	5.5	—	—	1.35	—	1.50	mA		
Output leakage current	$I_{OPD}$	$V_{OUT} = 5.5\ \text{V}$	0	—	—	0.5	—	5.0	$\mu\text{A}$		

### AC Characteristics (Input: $t_r = t_f = 3\ \text{ns}$ )

Characteristics	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40\sim 85^\circ\text{C}$		Unit		
			$V_{CC}$ (V)	$C_L$ (pF)	Min	Typ.	Max		Min	Max
Propagation delay time (A, B, C- $\bar{Y}$ )	$t_{pLH}$ $t_{pHL}$	—	$5.0 \pm 0.5$	15	—	7.6	10.4	1.0	12.0	ns
				50	—	8.1	11.4	1.0	13.0	
Propagation delay time (G1- $\bar{Y}$ )	$t_{pLH}$ $t_{pHL}$	—	$5.0 \pm 0.5$	15	—	6.6	9.1	1.0	10.5	ns
				50	—	7.1	10.1	1.0	11.5	
Propagation delay time ( $\bar{G}2 - \bar{Y}$ )	$t_{pLH}$ $t_{pHL}$	—	$5.0 \pm 0.5$	15	—	7.0	9.6	1.0	11.0	ns
				50	—	7.5	10.6	1.0	12.0	
Input capacitance	$C_{IN}$	—	—	—	4	10	—	10	pF	
Power dissipation capacitance	$C_{PD}$	(Note6)	—	—	49	—	—	—	pF	

Note6:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

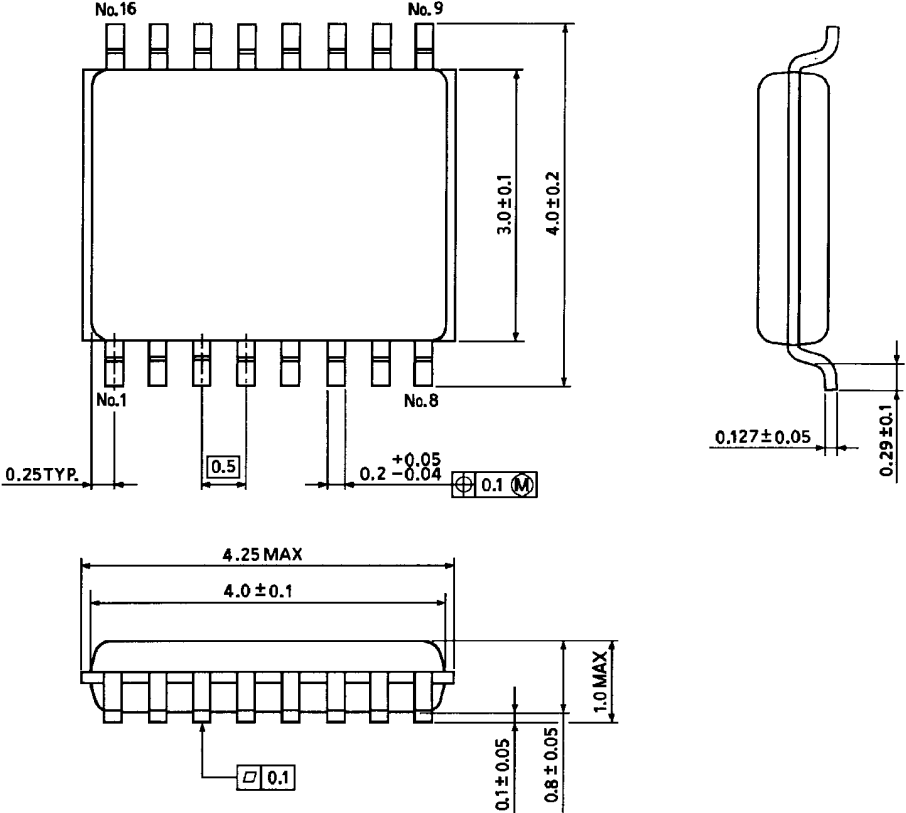
Average operating current can be obtained by the equation:

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

Package Dimensions

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)

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