

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MZ138FK

Low Voltage 3-to-8 Line Decoder with 5 V Tolerant Inputs and Outputs

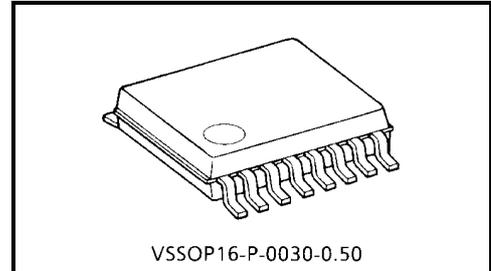
The TC7MZ138FK is a high performance CMOS 3-to-8 decoder. Designed for use in 3.3 V systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

The device is designed for low-voltage (3.3 V) VCC applications, but it could be used to interface to 5 V supply environment for inputs.

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.

All inputs are equipped with protection circuits against static discharge.



VSSOP16-P-0030-0.50

Weight: 0.02 g (typ.)

Features

- Low voltage operation: $V_{CC} = 2.0 \sim 3.6$ V
- High speed operation: $t_{pd} = 6.0$ ns (max) ($V_{CC} = 3.0 \sim 3.6$ V)
- Output current: $|I_{OH}|/I_{OL} = 24$ mA (min) ($V_{CC} = 3.0$ V)
- Latch-up performance: ± 500 mA
- Package: VSSOP (US16)
- 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.

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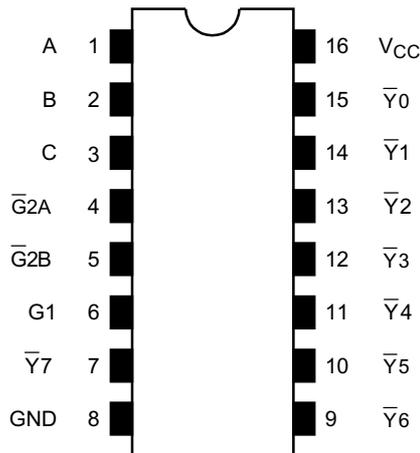
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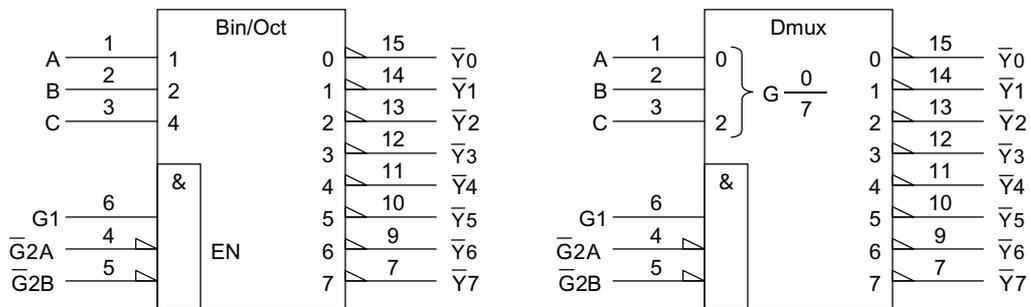
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Pin Assignment (top view)



IEC Logic Symbol

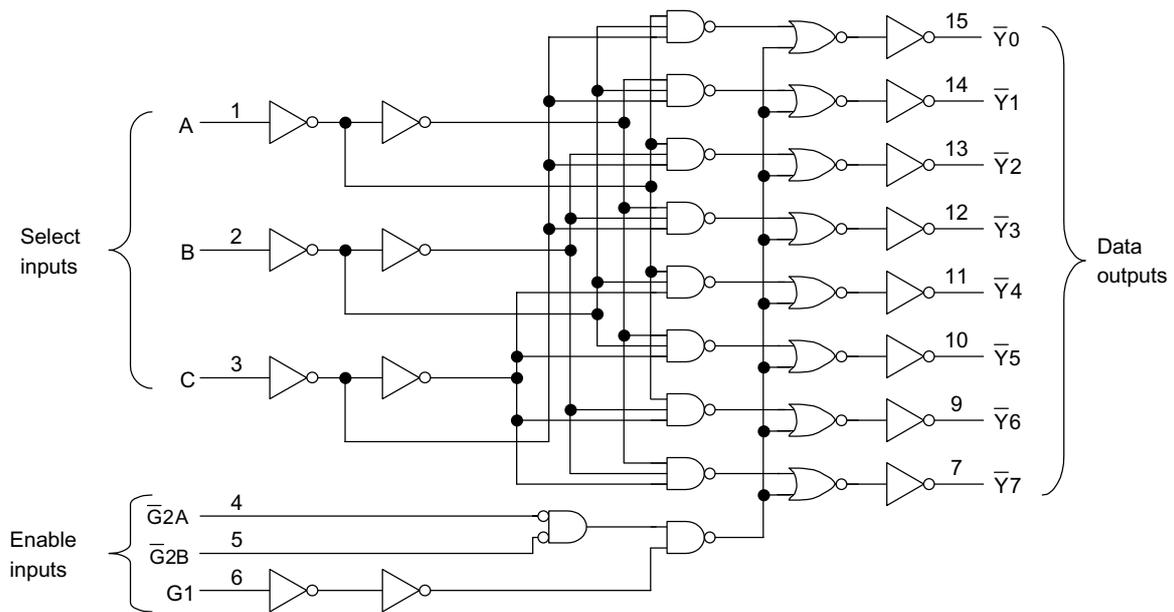


Truth Table

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}	-50	mA
Output diode current	I_{OK}	± 50 (Note3)	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	$^{\circ}C$

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}	2.0~3.6	V
		1.5~3.6 (Note4)	
Input voltage	V_{IN}	0~5.5	V
Output voltage	V_{OUT}	0~5.5 (Note5)	V
		0~ V_{CC} (Note6)	
Output current	I_{OH}/I_{OL}	± 24 (Note7)	mA
		± 12 (Note8)	
Operating temperature	T_{opr}	-40~85	°C
Input rise and fall time	dt/dv	0~10 (Note9)	ns/V

Note4: Data retention only

Note5: $V_{CC} = 0\text{ V}$

Note6: High or low state

Note7: $V_{CC} = 3.0\sim 3.6\text{ V}$

Note8: $V_{CC} = 2.7\sim 3.0\text{ V}$

Note9: $V_{IN} = 0.8\sim 2.0\text{ V}$, $V_{CC} = 3.0\text{ V}$

Electrical Characteristics

DC Characteristics ($T_a = -40\sim 85^\circ\text{C}$)

Characteristics		Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit	
Input voltage	High level	V_{IH}	—	2.7~3.6	2.0	—	V	
	Low level	V_{IL}	—	2.7~3.6	—	0.8		
Output voltage	High level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100\ \mu\text{A}$	2.7~3.6	$V_{CC} - 0.2$	—	V
				$I_{OH} = -12\ \text{mA}$	2.7	2.2	—	
				$I_{OH} = -18\ \text{mA}$	3.0	2.4	—	
				$I_{OH} = -24\ \text{mA}$	3.0	2.2	—	
	Low level	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 100\ \mu\text{A}$	2.7~3.6	—	0.2	
				$I_{OL} = 12\ \text{mA}$	2.7	—	0.4	
				$I_{OL} = 16\ \text{mA}$	3.0	—	0.4	
				$I_{OL} = 24\ \text{mA}$	3.0	—	0.55	
Input leakage current		I_{IN}	$V_{IN} = 0\sim 5.5\text{ V}$	2.7~3.6	—	± 5.0	μA	
Power off leakage current		I_{OFF}	$V_{IN}/V_{OUT} = 5.5\text{ V}$	0	—	10.0	μA	
Quiescent supply current		I_{CC}	$V_{IN} = V_{CC}$ or GND	2.7~3.6	—	10.0	μA	
			$V_{IN} = 3.6\sim 5.5\text{ V}$	2.7~3.6	—	± 10.0		
Increase in I_{CC} per input		ΔI_{CC}	$V_{IH} = V_{CC} - 0.6\text{ V}$	2.7~3.6	—	500		

AC Characteristics (Ta = -40~85°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Propagation delay time (A, B, C- \bar{Y})	t_{pLH}	Figure 1, Figure 2	2.7	—	7.0	ns
	t_{pHL}		3.3 ± 0.3	1.5	6.0	
Propagation delay time (G1- \bar{Y})	t_{pLH}	Figure 1, Figure 2	2.7	—	8.0	ns
	t_{pHL}		3.3 ± 0.3	1.5	7.0	
Propagation delay time ($\bar{G}2$ - \bar{Y})	t_{pLH}	Figure 1, Figure 2	2.7	—	7.0	ns
	t_{pHL}		3.3 ± 0.3	1.5	6.0	
Output to output skew	t_{osLH}	(Note10)	2.7	—	—	ns
	t_{osHL}		3.3 ± 0.3	—	1.0	

Note10: This parameter is guaranteed by design.

$$(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)$$

Dynamic Switching Characteristics

(Ta = 25°C, Input: $t_r = t_f = 2.5$ ns, $C_L = 50$ pF, $R_L = 500$ Ω)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit	
Quiet output maximum dynamic	V_{OL}	V_{OLP}	$V_{IH} = 3.3$ V, $V_{IL} = 0$ V	3.3	0.8	V
Quiet output minimum dynamic	V_{OL}	$ V_{OLV} $	$V_{IH} = 3.3$ V, $V_{IL} = 0$ V	3.3	0.8	V

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit	
Input capacitance	C_{IN}	—	3.3	7	pF	
Output capacitance	C_{OUT}	—	0	8	pF	
Power dissipation capacitance	C_{PD}	$f_{IN} = 10$ MHz	(Note11)	3.3	25	pF

Note11: 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:

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

AC Test Circuit

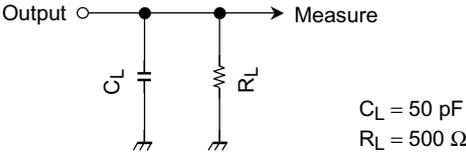


Figure 1

AC Waveform

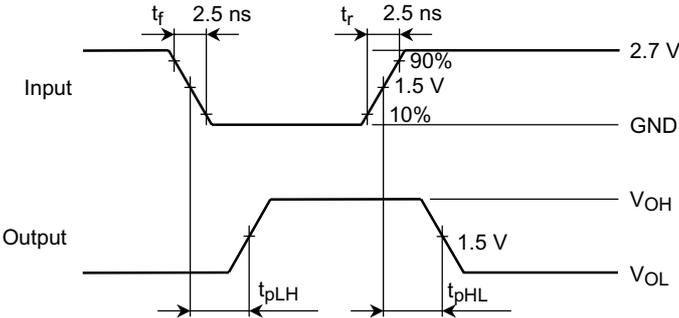
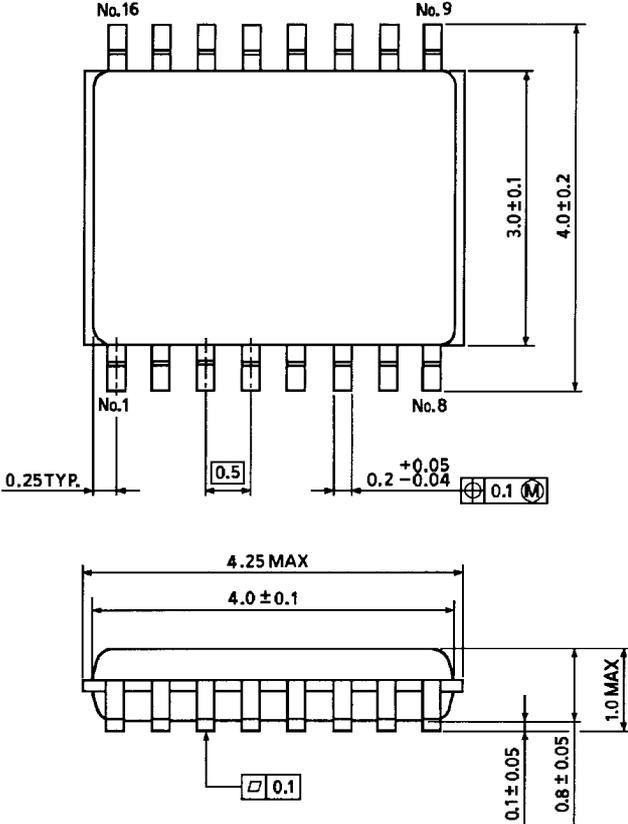


Figure 2 t_{pLH} , t_{pHL}

Package Dimensions

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)