

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MZ541FK

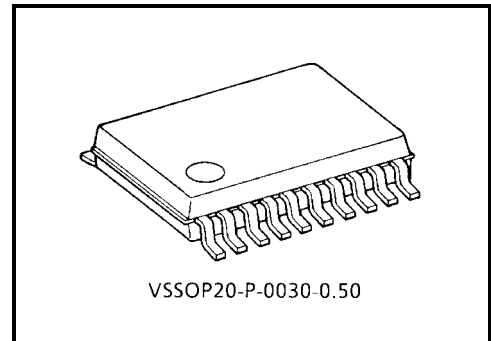
Low Voltage Octal Bus Buffer with 5 V Tolerant Inputs and Outputs

The TC7MZ541FK is a high performance CMOS octal bus buffer. 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 both inputs and outputs.

The TC7MZ541FK is a non-inverting 3-state buffer having two active-low output enables. When either $\overline{OE}1$ or $\overline{OE}2$ are high, the terminal outputs are in the high-impedance state. This device is designed to be used with 3-state memory address drivers, etc.

All inputs are equipped with protection circuits against static discharge.

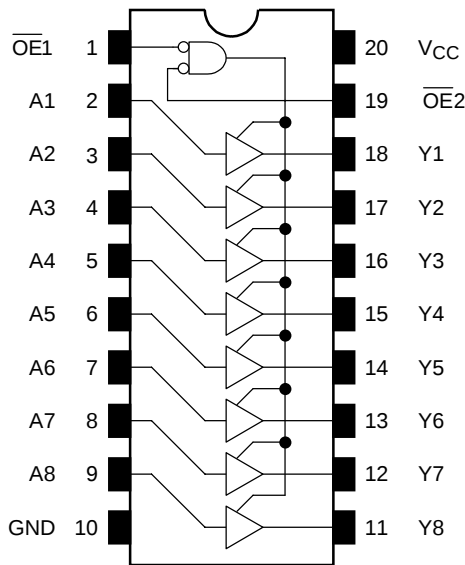


Weight: 0.03 g (typ.)

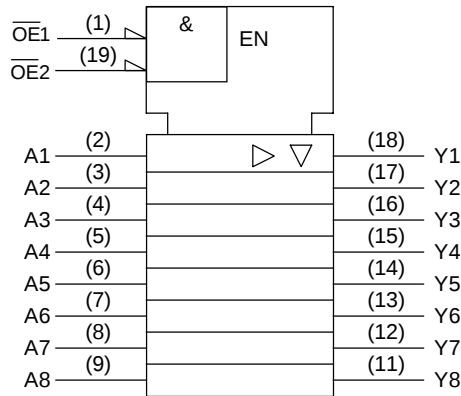
Features

- Low voltage operation: $V_{CC} = 2.0 \sim 3.6$ V
- High speed operation: $t_{pd} = 6.5$ 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 (US20)
- 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.) 541 type.

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

Inputs			Outputs
OE1	OE2	A _n	
H	X	X	Z
X	H	X	Z
L	L	H	H
L	L	L	L

X: Don't care
Z: High impedance

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	°C

Note1: Output in off-state
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: Output in off-state

Note6: High or low state

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

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

Note9: $V_{IN} = 0.8\sim 2.0$ V, $V_{CC} = 3.0$ 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 μA	2.7~3.6	V _{CC} - 0.2	—	V
				I _{OH} = -12 mA	2.7	2.2	—	
				I _{OH} = -18 mA	3.0	2.4	—	
				I _{OH} = -24 mA	3.0	2.2	—	
	Low level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.7~3.6	—	0.2	
				I _{OL} = 12 mA	2.7	—	0.4	
				I _{OL} = 16 mA	3.0	—	0.4	
				I _{OL} = 24 mA	3.0	—	0.55	
Input leakage current		I _{IN}	V _{IN} = 0~5.5 V		2.7~3.6	—	±5.0	μA
3-state output off-state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0~5.5 V		2.7~3.6	—	±5.0	μA
Power off leakage current		I _{OFF}	V _{IN} /V _{OUT} = 5.5 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} /V _{OUT} = 3.6~5.5 V		2.7~3.6	—	±10.0	
Increase in I _{CC} per input		ΔI _{CC}	V _{IH} = V _{CC} - 0.6 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	t _{pLH}	Figure 1, Figure 2	2.7	—	7.5	ns
	t _{pHL}		3.3 ± 0.3	1.5	6.5	
Output enable time	t _{pZL}	Figure 1, Figure 3	2.7	—	9.5	ns
	t _{pZH}		3.3 ± 0.3	1.5	8.5	
Output disable time	t _{pLZ}	Figure 1, Figure 3	2.7	—	8.5	ns
	t _{pHZ}		3.3 ± 0.3	1.5	7.5	
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}	—	3.3	8	pF
Power dissipation capacitance	C _{PD}	f _{IN} = 10 MHz (Note11)	3.3	40	pF

Note11: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption.

Average operating current can be obtained by the equation:

$$I_{CC} (opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per bit)}$$

Switch

Open

6.0 V

GND

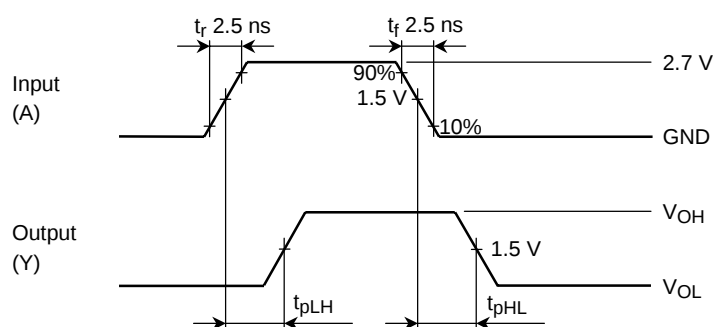
Output

Measure

$C_L = 50 \text{ pF}$

$R_L = 500 \Omega$

Parameter	Switch
t_{pLH}, t_{pHL}	Open
t_{pLZ}, t_{pZL}	6.0 V
t_{pHZ}, t_{pZH}	GND



The diagram shows three signals over time:

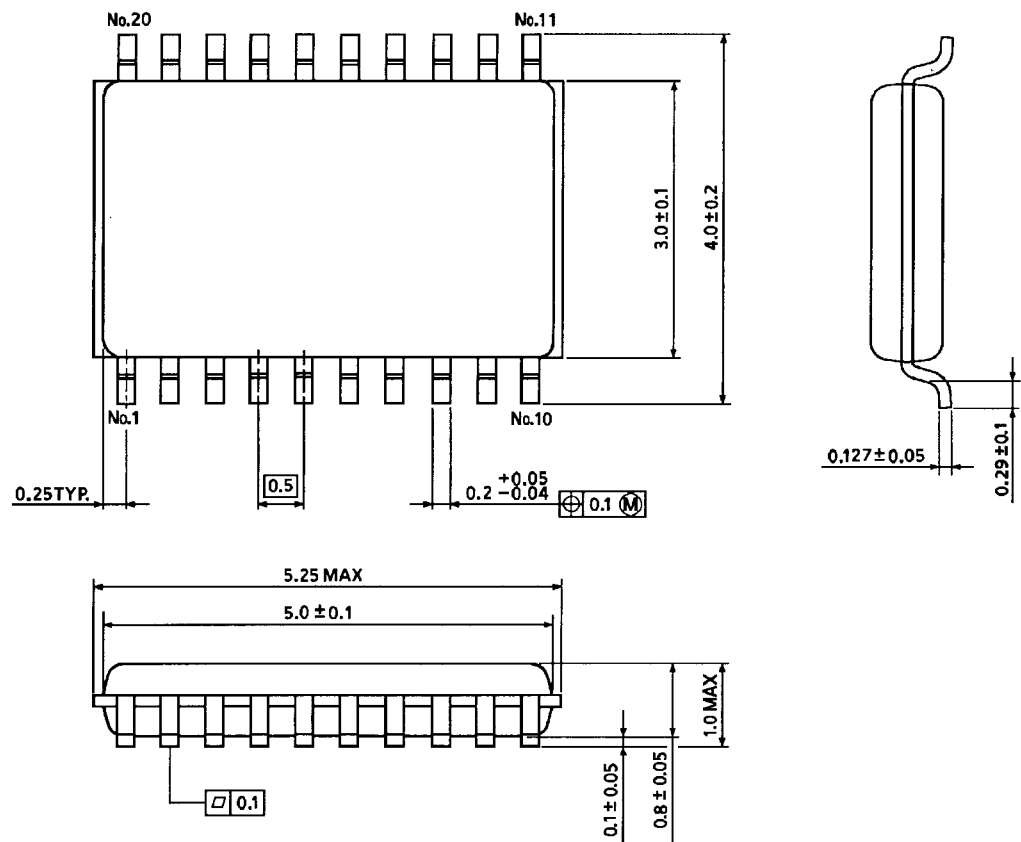
- Output Enable ($\overline{OE}$):** A square wave that transitions from low to high (enabling outputs) and high to low (disabling outputs). The rise time (t_r) and fall time (t_f) are both specified as 2.5 ns.
- Output (Y) Low to Off to Low:** When $\overline{OE}$ is low, the output is at a low level (V_{OL}). When $\overline{OE}$ goes high, the output transitions to a high-impedance state ($V_{OL} + 0.3\text{ V}$). When $\overline{OE}$ goes low again, the output returns to V_{OL} . The propagation delay from $\overline{OE}$ rising to the output rising is t_{pLZ} . The propagation delay from $\overline{OE}$ falling to the output falling is t_{pZL} . The output voltage during the high-impedance state is $V_{OL} + 0.3\text{ V}$.
- Output (Y) High to Off to High:** When $\overline{OE}$ is low, the output is at a high level (V_{OH}). When $\overline{OE}$ goes high, the output transitions to a high-impedance state ($V_{OH} - 0.3\text{ V}$). When $\overline{OE}$ goes low again, the output returns to V_{OH} . The propagation delay from $\overline{OE}$ rising to the output rising is t_{pHZ} . The propagation delay from $\overline{OE}$ falling to the output falling is t_{pZH} . The output voltage during the high-impedance state is $V_{OH} - 0.3\text{ V}$.

Additional voltage levels shown are 2.7 V, 3.0 V, and 1.5 V. The 1.5 V level is indicated for the output during the high-impedance state for both low and high output levels.

Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)

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000707EBA

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