

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7MZ540FK

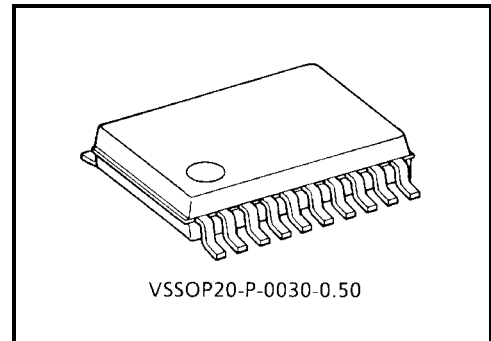
## Low Voltage Octal Bus Buffer (inverted) with 5 V Tolerant Inputs and Outputs

The TC7MZ540FK 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 TC7MZ540FK is an inverting 3-state buffer having two active-low output enables. When either  $\overline{OE1}$  or  $\overline{OE2}$  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.

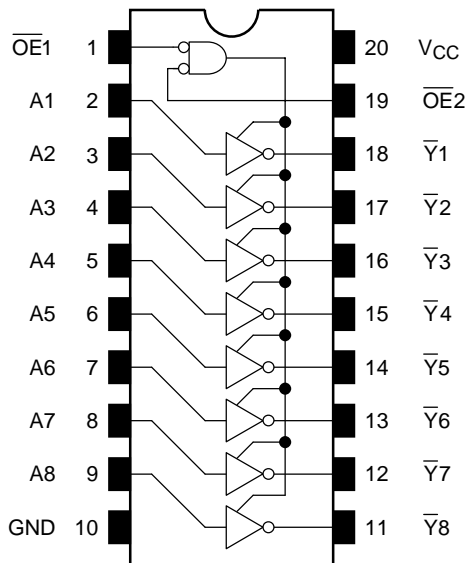


Weight: 0.03 g (typ.)

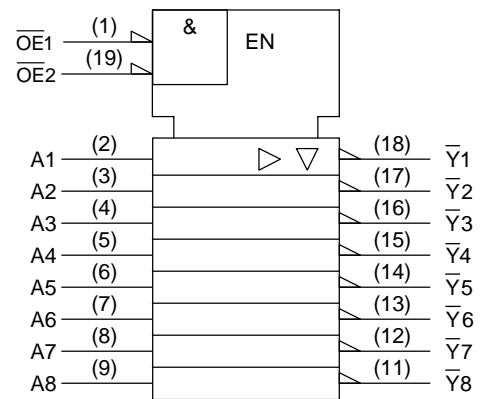
### Features

- 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:  $\pm 500$  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.) 540 type.

## Pin Assignment (top view)



## IEC Logic Symbol



## Truth Table

Inputs			Outputs
$\overline{OE1}$	$\overline{OE2}$	$A_n$	
H	X	X	Z
X	H	X	Z
L	L	H	L
L	L	L	H

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	$I_{OK}$	$\pm 50$ (Note3)	mA
DC output current	$I_{OUT}$	$\pm 50$	mA
Power dissipation	$P_D$	180	mW
DC $V_{CC}$ /ground current	$I_{CC}/I_{GND}$	$\pm 100$	mA
Storage temperature	$T_{stg}$	-65~150	$^{\circ}C$

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	$I_{OH}/I_{OL}$	$\pm 24$ (Note7)	mA
		$\pm 12$ (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 $V_{IL}$	$I_{OH} = -100 \mu\text{A}$	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		$I_{IN}$	$V_{IN} = 0\sim 5.5$ V	2.7~3.6	—	$\pm 5.0$	$\mu\text{A}$	
3-state output off-state current		$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = 0\sim 5.5$ V	2.7~3.6	—	$\pm 5.0$	$\mu\text{A}$	
Power off leakage current		$I_{OFF}$	$V_{IN}/V_{OUT} = 5.5$ V	0	—	10.0	$\mu\text{A}$	
Quiescent supply current		$I_{CC}$	$V_{IN} = V_{CC}$ or GND	2.7~3.6	—	10.0	$\mu\text{A}$	
			$V_{IN}/V_{OUT} = 3.6\sim 5.5$ V	2.7~3.6	—	$\pm 10.0$		
Increase in $I_{CC}$ per input		$\Delta I_{CC}$	$V_{IH} = V_{CC} - 0.6$ V	2.7~3.6	—	500		

## AC Characteristics (Ta = -40~85°C)

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
Propagation delay time	t <sub>pLH</sub>	Figure 1, Figure 2	2.7	—	7.5	ns
	t <sub>pHL</sub>		3.3 ± 0.3	1.5	6.5	
Output enable time	t <sub>pZL</sub>	Figure 1, Figure 3	2.7	—	9.5	ns
	t <sub>pZH</sub>		3.3 ± 0.3	1.5	8.5	
Output disable time	t <sub>pLZ</sub>	Figure 1, Figure 3	2.7	—	8.5	ns
	t <sub>pHZ</sub>		3.3 ± 0.3	1.5	7.5	
Output to output skew	t <sub>osLH</sub>	(Note10)	2.7	—	—	ns
	t <sub>osHL</sub>		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<sub>r</sub> = t<sub>f</sub> = 2.5 ns, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 500 Ω)

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit	
Quiet output maximum dynamic	V <sub>OL</sub>	V <sub>OLP</sub>	V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V	3.3	0.8	V
Quiet output minimum dynamic	V <sub>OL</sub>	V <sub>OLV</sub>	V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V	3.3	0.8	V

## Capacitive Characteristics (Ta = 25°C)

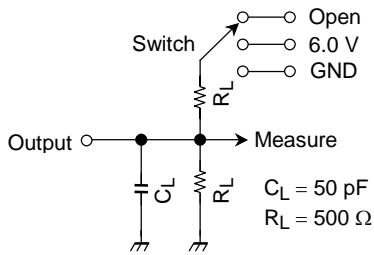
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit	
Input capacitance	C <sub>IN</sub>	—	3.3	7	pF	
Output capacitance	C <sub>OUT</sub>	—	3.3	8	pF	
Power dissipation capacitance	C <sub>PD</sub>	f <sub>IN</sub> = 10 MHz	(Note11)	3.3	40	pF

Note11: C<sub>PD</sub> 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:

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

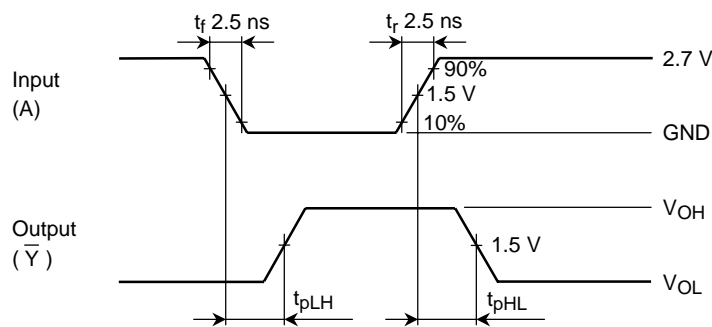
**AC Test Circuit**



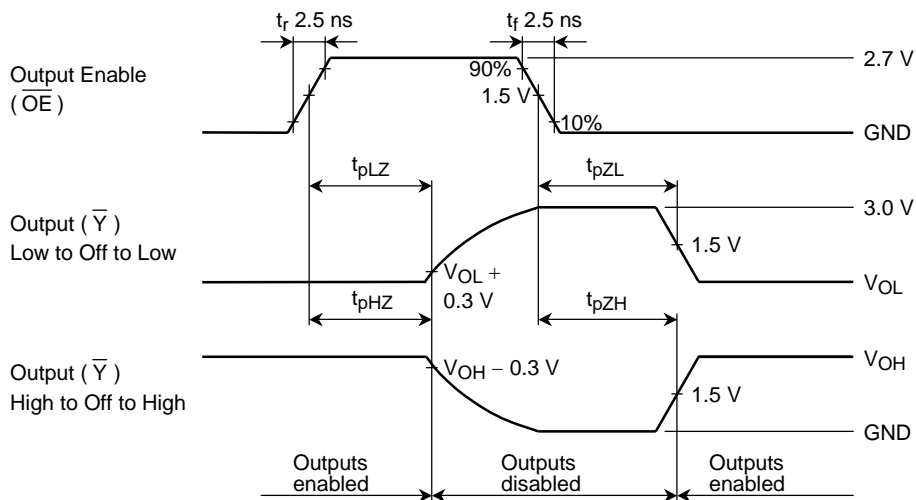
Parameter	Switch
$t_{pLH}, t_{pHL}$	Open
$t_{pLZ}, t_{pZL}$	6.0 V
$t_{pHZ}, t_{pZH}$	GND

**Figure 1**

**AC Waveform**



**Figure 2  $t_{pLH}, t_{pHL}$**

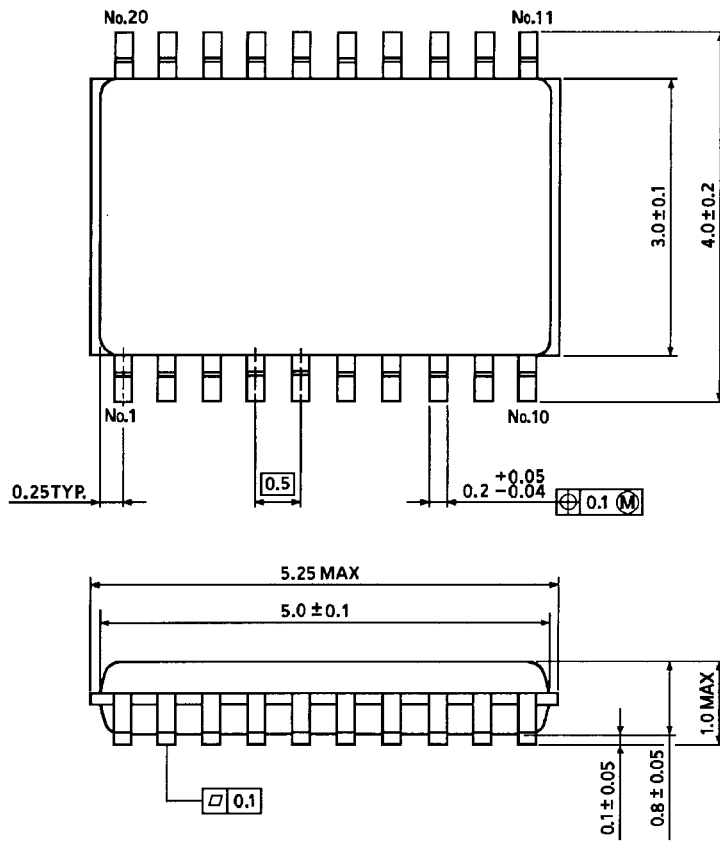


**Figure 3  $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$**

## Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)

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