

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7MZ245FK

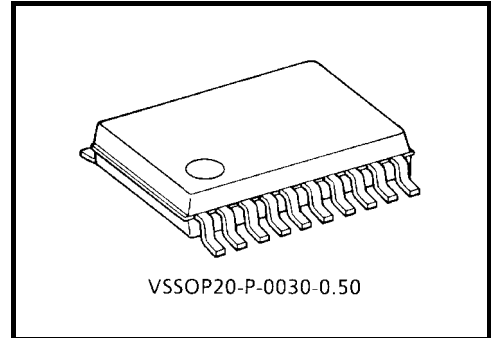
## Low Voltage Octal Bus Transceiver with 5 V Tolerant Inputs and Outputs

The TC7MZ245FK is a high performance CMOS octal bus transceiver. 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 direction of data transmission is determined by the level of the DIR input. The enable input ( $\overline{OE}$ ) can be used to disable the device so that the busses are effectively isolated.

All inputs are equipped with protection circuits against static discharge.



Weight: 0.03 g (typ.)

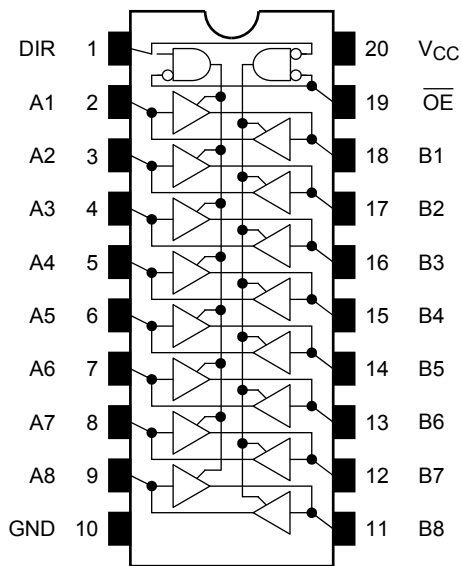
### Features

- Low voltage operation:  $V_{CC} = 2.0\sim 3.6$  V
- High speed operation:  $t_{pd} = 7.0$  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 (US20)
- Bidirectional interface between 3.3 V and 5.0 V signals.
- 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.) 245 type.

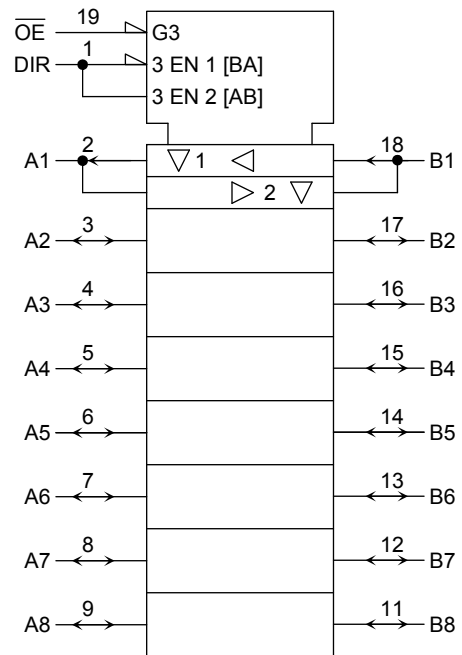
Note: Do not apply a signal to any bus terminal when it is in the output mode. Damage may result.

All floating (high impedance) bus terminals must have their input levels fixed by means of pull up or pull down resistors.

## Pin Assignment (top view)



## IEC Logic Symbol



## Truth Table

Inputs		Outputs	Function	
$\overline{OE}$	DIR		A-Bus	B-Bus
L	L	A = B	Output	Input
L	H	B = A	Input	Output
H	X	Z	High Impedance	

X: Don't care

Z: High impedance

## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5~7.0	V
DC input voltage (DIR, $\overline{OE}$ )	$V_{IN}$	-0.5~7.0	V
DC bus I/O voltage	$V_{I/O}$	-0.5~7.0 (Note 2)	V
		-0.5~ $V_{CC}$ + 0.5 (Note 3)	
Input diode current	$I_{IK}$	-50	mA
Output diode current	$I_{OK}$	±50 (Note 4)	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

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 2: Output in off-state

Note 3: High or low state.  $I_{OUT}$  absolute maximum rating must be observed.

Note 4:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

## Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2.0~3.6	V
		1.5~3.6 (Note 2)	
Input voltage (DIR, $\overline{OE}$ )	$V_{IN}$	0~5.5	V
Bus I/O voltage	$V_{I/O}$	0~5.5 (Note 3)	V
		0~ $V_{CC}$ (Note 4)	
Output current	$I_{OH}/I_{OL}$	±24 (Note 5)	mA
		±12 (Note 6)	
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	dt/dv	0~10 (Note 7)	ns/V

Note 1: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs and bus inputs must be tied to either  $V_{CC}$  or GND. Please connect both bus inputs and the bus outputs with  $V_{CC}$  or GND when the I/O of the bus terminal changes by the function. In this case, please note that the output is not short-circuited.

Note 2: Data retention only

Note 3: Output in off-state

Note 4: High or low state

Note 5:  $V_{CC} = 3.0\sim 3.6$  V

Note 6:  $V_{CC} = 2.7\sim 3.0$  V

Note 7:  $V_{IN} = 0.8\sim 2.0$  V,  $V_{CC} = 3.0$  V

## Electrical Characteristics

### DC Characteristics (Ta = -40~85°C)

Characteristics		Symbol	Test Condition		V <sub>CC</sub> (V)	Min	Max	Unit
Input voltage	High level	V <sub>IH</sub>	—		2.7~3.6	2.0	—	V
	Low level	V <sub>IL</sub>	—		2.7~3.6	—	0.8	
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> = -100 μA	2.7~3.6	V <sub>CC</sub> - 0.2	—	V
				I <sub>OH</sub> = -12 mA	2.7	2.2	—	
				I <sub>OH</sub> = -18 mA	3.0	2.4	—	
				I <sub>OH</sub> = -24 mA	3.0	2.2	—	
	Low level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 100 μA	2.7~3.6	—	0.2	
				I <sub>OL</sub> = 12 mA	2.7	—	0.4	
				I <sub>OL</sub> = 16 mA	3.0	—	0.4	
				I <sub>OL</sub> = 24 mA	3.0	—	0.55	
Input leakage current		I <sub>IN</sub>	V <sub>IN</sub> = 0~5.5 V		2.7~3.6	—	±5.0	μA
3-state output off-state current		I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = 0~5.5 V		2.7~3.6	—	±5.0	μA
Power off leakage current		I <sub>OFF</sub>	V <sub>IN</sub> /V <sub>OUT</sub> = 5.5 V		0	—	10.0	μA
Quiescent supply current		I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		2.7~3.6	—	10.0	μA
			V <sub>IN</sub> /V <sub>OUT</sub> = 3.6~5.5 V		2.7~3.6	—	±10.0	
Increase in I <sub>CC</sub> per input		ΔI <sub>CC</sub>	V <sub>IH</sub> = V <sub>CC</sub> - 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	—	8.0	ns
	t <sub>pHL</sub>		3.3 ± 0.3	1.5	7.0	
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>	(Note)	2.7	—	—	ns
	t <sub>osHL</sub>		3.3 ± 0.3	—	1.0	

Note: 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)

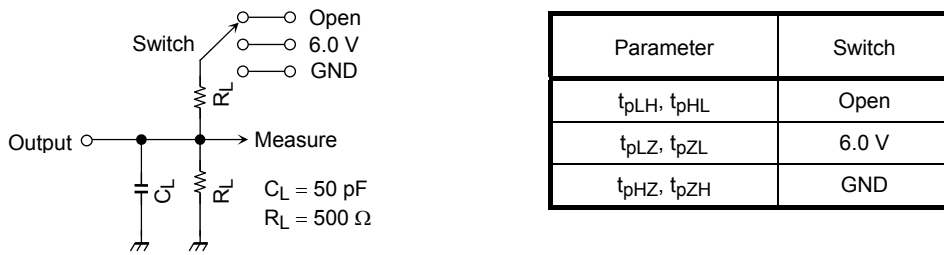
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit	
Input capacitance	C <sub>IN</sub>	DIR, $\overline{OE}$	3.3	7	pF	
Bus input capacitance	C <sub>I/O</sub>	A <sub>n</sub> , B <sub>n</sub>	3.3	8	pF	
Power dissipation capacitance	C <sub>PD</sub>	f <sub>IN</sub> = 10 MHz	(Note)	3.3	25	pF

Note: 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:

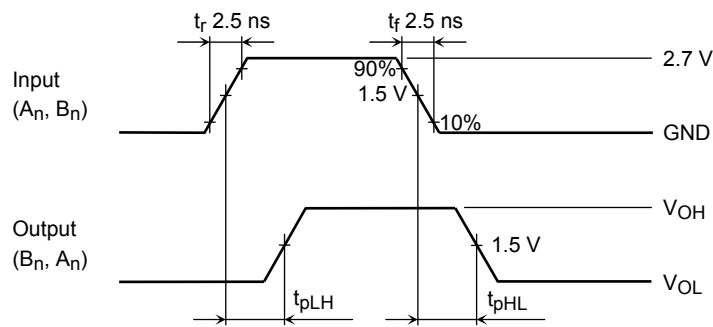
$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per bit)}$$

**AC Test Circuit**

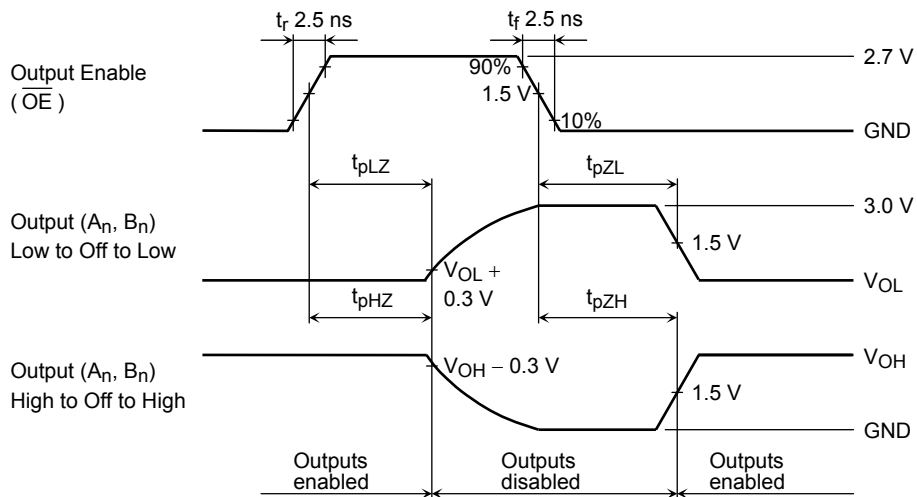


**Figure 1**

**AC Waveform**



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

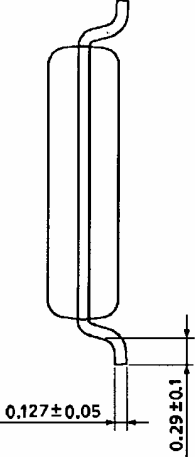
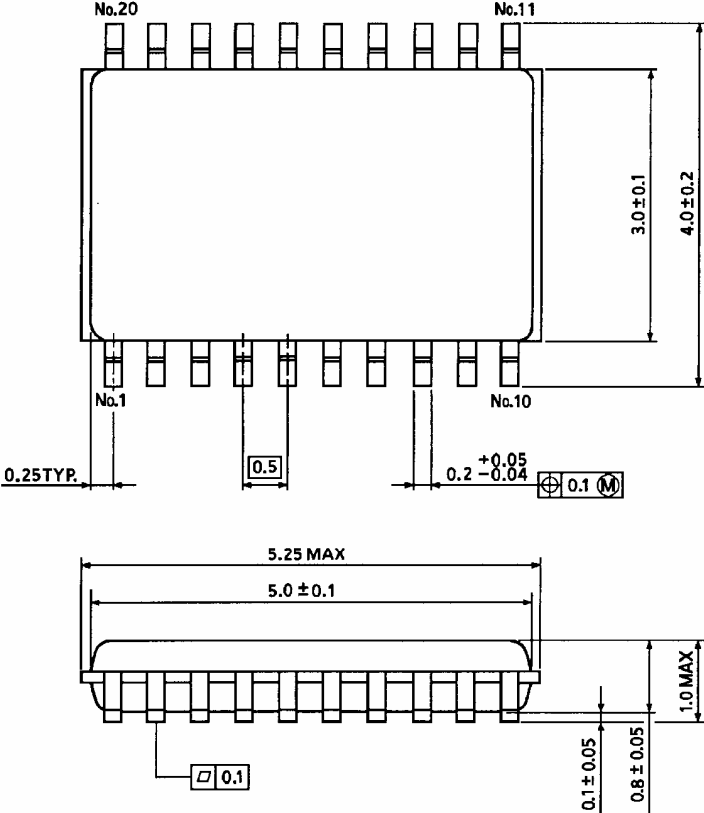


**Figure 3  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$**

Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)

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20070701-EN

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