

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MZ245FK

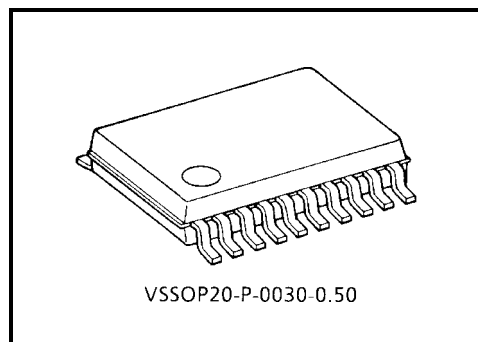
Low Voltage Octal Bus Transceiver with 5 V Tolerant Inputs and Outputs

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.)

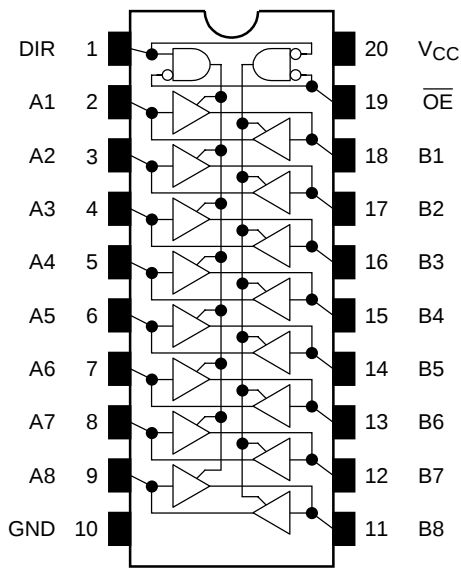
Features

- Low voltage operation: $V_{CC} = 2.0\sim 3.6\text{ V}$
- High speed operation: $t_{pd} = 7.0\text{ ns (max)}$ ($V_{CC} = 3.0\sim 3.6\text{ V}$)
- Output current: $|I_{OH}|/I_{OL} = 24\text{ mA (min)}$ ($V_{CC} = 3.0\text{ V}$)
- Latch-up performance: $\pm 500\text{ mA}$
- 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.

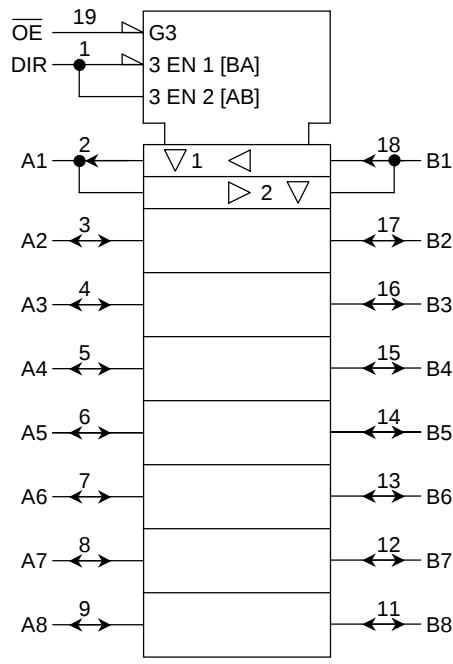
Note: Do not apply a signal to any bus terminal when it is in the output mode. Damage may result.

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	
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

Maximum Ratings

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 (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 (DIR, $\overline{OE}$)	V_{IN}	0~5.5	V
Bus I/O voltage	$V_{I/O}$	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 (Ta = -40~85°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	—	8.0	ns
	t _{pHL}		3.3 ± 0.3	1.5	7.0	
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		Typ.	Unit	
			V _{CC} (V)			
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}	DIR, $\overline{\text{OE}}$	3.3	7	pF
Bus input capacitance	C _{I/O}	A _n , B _n	3.3	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.

Average operating current can be obtained by the equation:

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

Switch

Open

6.0 V

GND

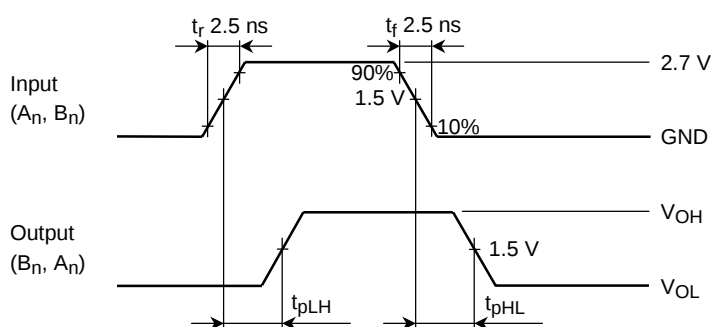
Output

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

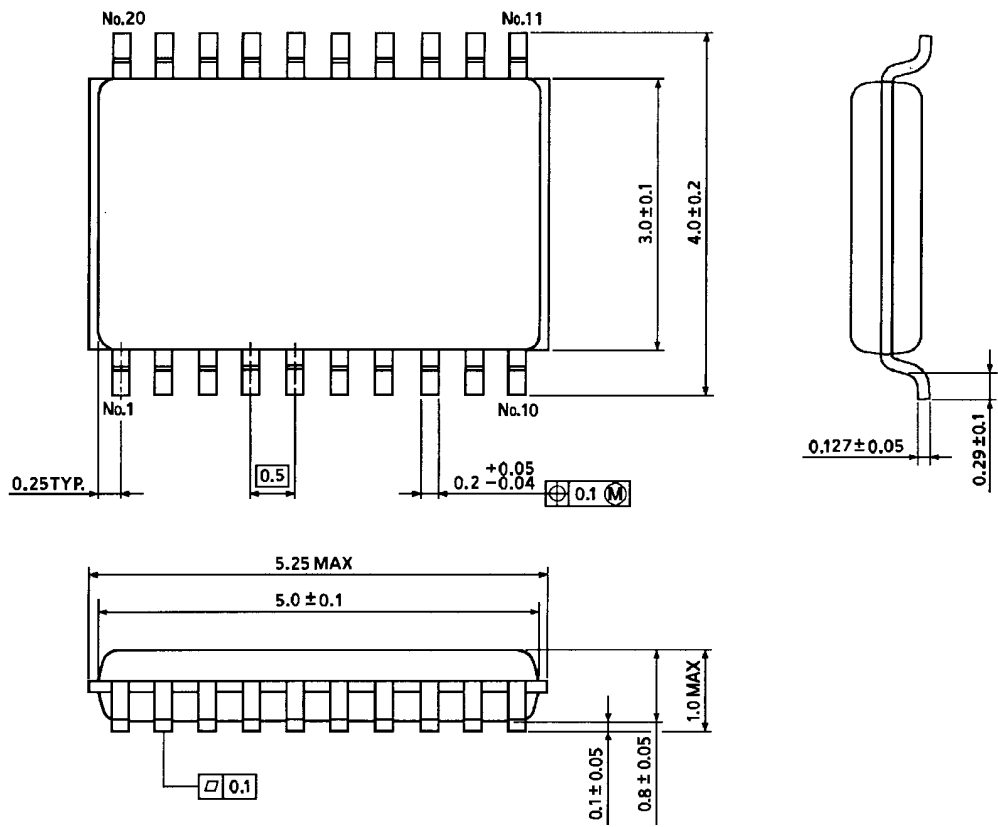


Timing diagram for the 74VHC04 inverter. The diagram shows three signals: Output Enable ($\overline{OE}$), Output (A_n, B_n) Low to Off to Low, and Output (A_n, B_n) High to Off to High. The OE signal is active-low and has a rise time (t_r) and fall time (t_f) of 2.5 ns. The output signals show propagation delays (t_{pLZ} , t_{pZH}) and output voltages (V_{OL} , V_{OH}) during the disabled state. The disabled state output voltages are specified as $V_{OL} + 0.3\text{ V}$ and $V_{OH} - 0.3\text{ V}$. The output signals also show a 1.5 V voltage level during the disabled state.

Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.