

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

**TC7MZ574FK**

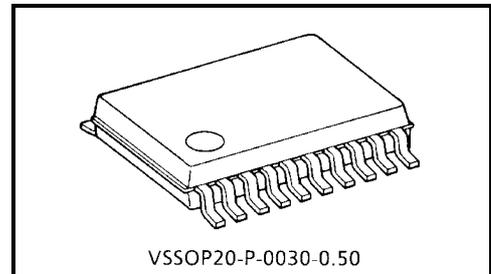
Low Voltage Octal D-Type Flip-Flop with 5 V Tolerant Inputs and Outputs

The TC7MZ574FK is a high performance CMOS octal D-type flip flop. 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.

This 8 bit D-type flip-flop is controlled by a clock input (CK) and an output enable input ( $\overline{OE}$ ). When the  $\overline{OE}$  input is high, the eight outputs are in a high impedance state.

All inputs are equipped with protection circuits against static discharge.



VSSOP20-P-0030-0.50

Weight: 0.03 g (typ.)

**Features**

- Low voltage operation:  $V_{CC} = 2.0\sim 3.6\text{ V}$
- High speed operation:  $t_{pd} = 8.5\text{ ns (max)}$  ( $V_{CC} = 3.0\sim 3.6\text{ V}$ )
- 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)
- 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.) 574 type.

000630EBA1

• 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..

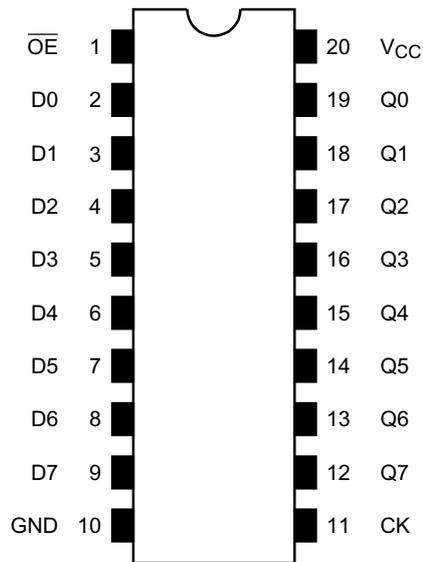
• The Toshiba products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These Toshiba products are neither intended nor warranted for usage in equipment 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.

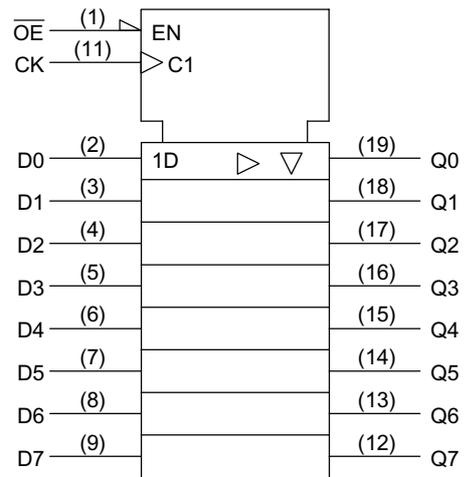
• The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.

• The information contained herein is subject to change without notice.

## Pin Assignment (top view)



## IEC Logic Symbol



## Truth Table

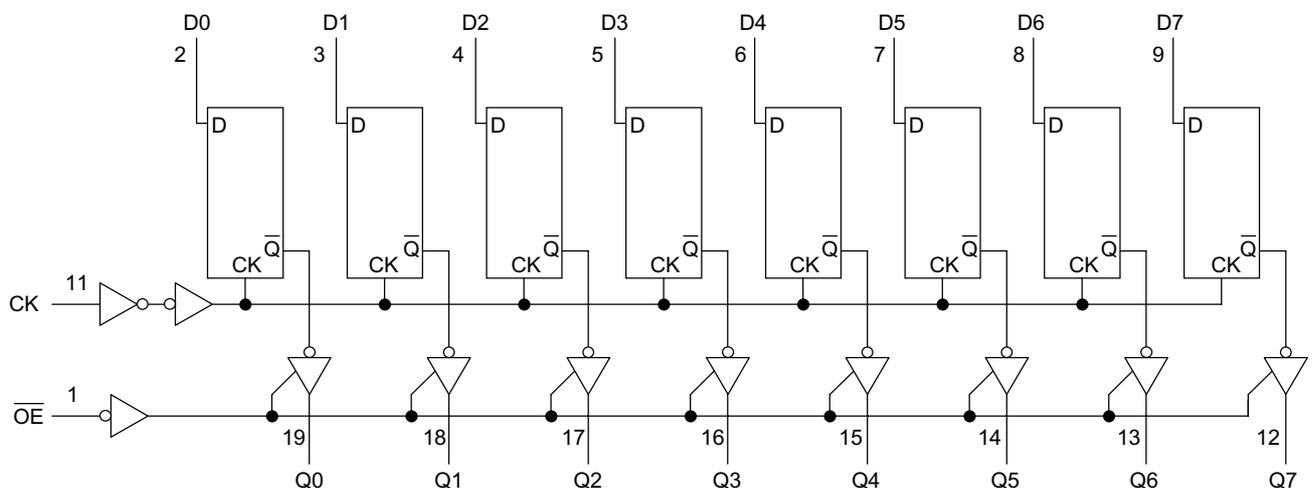
Inputs			Outputs
$\overline{OE}$	CK	D	
H	X	X	Z
L		X	$Q_n$
L		L	L
L		H	H

X: Don't care

Z: High impedance

$Q_n$ : No change

## 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	$I_{OK}$	$\pm 50$ (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	°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 (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
Maximum clock frequency	f <sub>max</sub>	Figure 1, Figure 2	2.7	—	—	MHz
			3.3 ± 0.3	150	—	
Propagation delay time (CK-Q)	t <sub>pLH</sub>	Figure 1, Figure 2	2.7	—	9.5	ns
	t <sub>pHL</sub>		3.3 ± 0.3	1.5	8.5	
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	—	7.0	ns
	t <sub>pHZ</sub>		3.3 ± 0.3	1.5	6.5	
Minimum pulse width (CK)	t <sub>w</sub> (H)	Figure 1, Figure 2	2.7	3.3	—	ns
	t <sub>w</sub> (L)		3.3 ± 0.3	3.3	—	
Minimum set-up time	t <sub>s</sub>	Figure 1, Figure 2	2.7	2.5	—	ns
			3.3 ± 0.3	2.5	—	
Minimum hold time	t <sub>h</sub>	Figure 1, Figure 2	2.7	1.5	—	ns
			3.3 ± 0.3	1.5	—	
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)

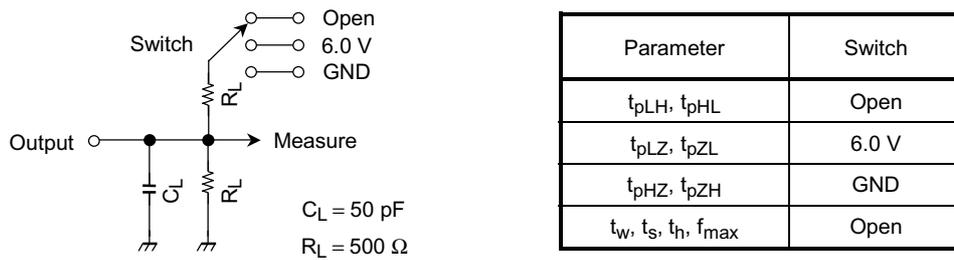
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit	
Input capacitance	C <sub>IN</sub>	—	3.3	7	pF	
Output capacitance	C <sub>OUT</sub>	—	3.3	8	pF	
Power dissipation capacitance	C <sub>PD</sub>	f <sub>IN</sub> = 10 MHz	(Note11)	3.3	25	pF

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:

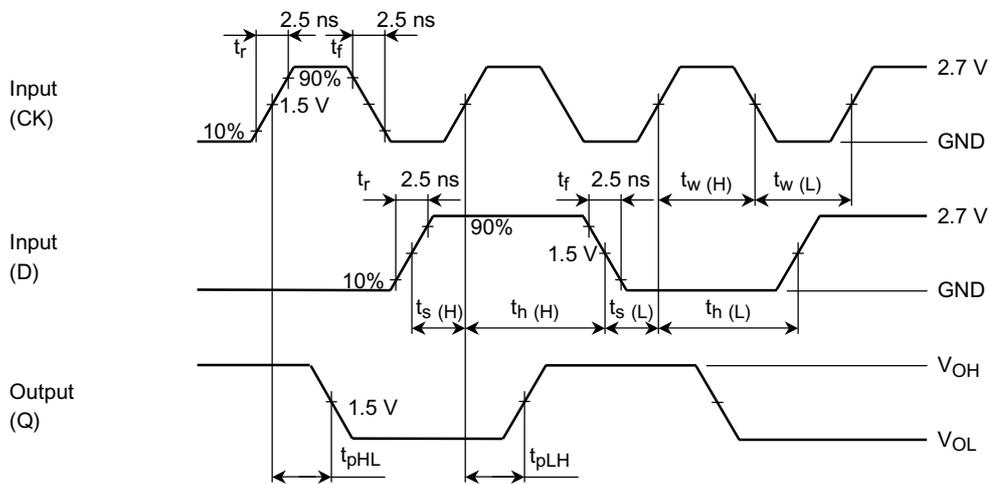
$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per bit)}$$

**AC Test Circuit**

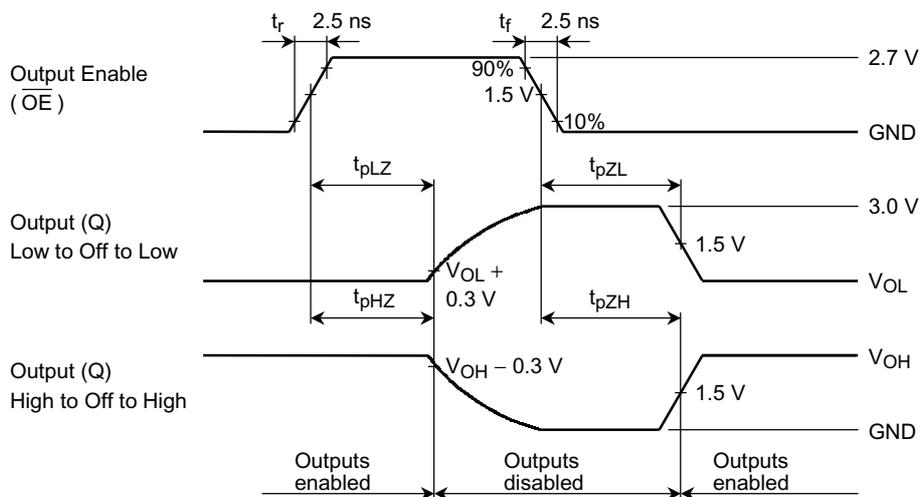


**Figure 1**

**AC Waveform**



**Figure 2  $t_{pLH}, t_{pHL}, t_w, t_s, t_h$**

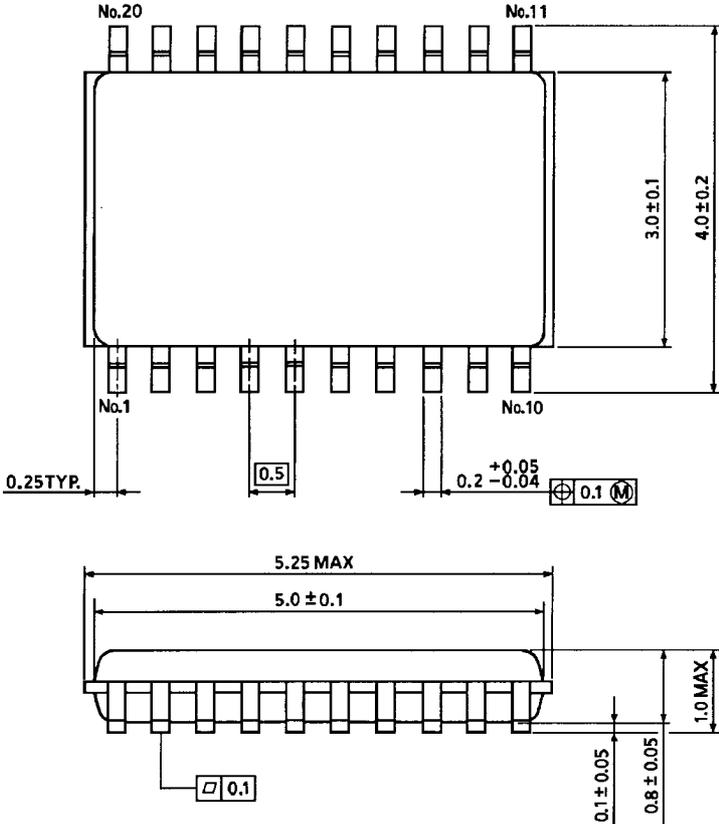


**Figure 3  $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$**

Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)