

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7MZ273FK

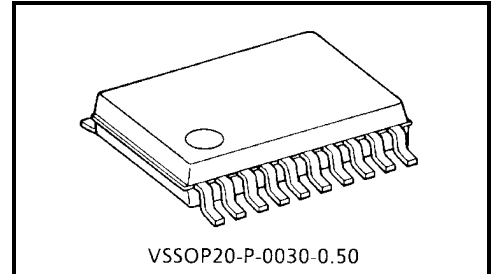
Low-Voltage Octal D-Type Flip-Flop with Clear with 5-V Tolerant Inputs and Outputs

The TC7MZ273FK 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 CMOS low power dissipation.

The device is designed for low-voltage (3.3-V) applications, but can also be used to interface both inputs and outputs with a 5-V supply environment.

D-input signal is sent to Q-output when clock rises. Clear input is Low-active and all flip-flop outputs are reset Low.

All inputs are equipped with protection circuits to guard against static discharge.



VSSOP20-P-0030-0.50

Weight: 0.03 g (typ.)

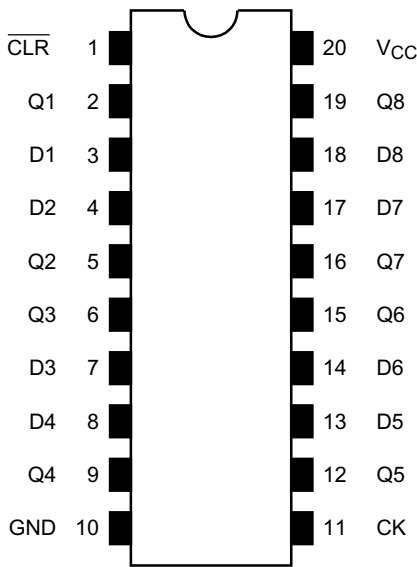
## Features

- Low voltage operation:  $V_{CC} = 2.0\text{ V} \sim 3.6\text{ V}$
- High-speed operation:  $t_{pd} = 8.5\text{ ns (max)}$  ( $V_{CC} = 3.0\text{ V} \sim 3.6\text{ V}$ )
- 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 for all inputs and outputs.
- Pin and function compatible with the 74 Series (74AC/VHC/HC/F/ALS/LS etc.) 273 type.

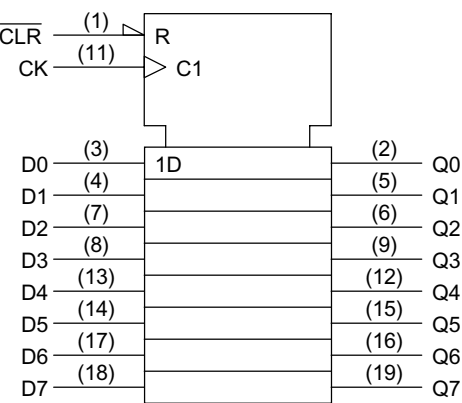
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Pin Assignment (top view)



IEC Logic Symbol

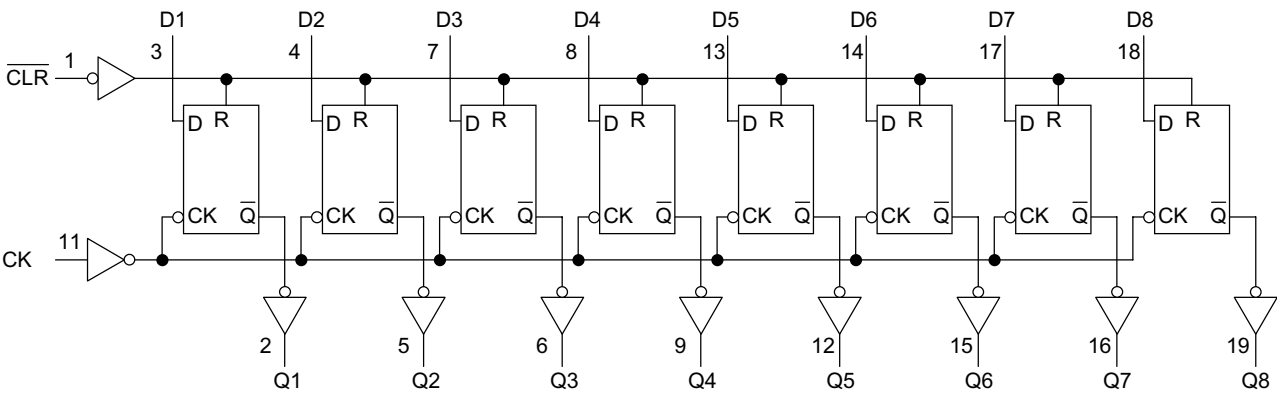


Truth Table

Inputs			Outputs	Function
CLR	D	CK	Q	
L	X	X	L	Clear
H	L		L	—
H	H		H	—
H	X		Qn	No change

X: Don't care

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	$I_{OK}$	±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 (Ta = -40~85°C)

Characteristics		Symbol	Test Condition		Min	Max	Unit	
			V <sub>CC</sub> (V)					
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	
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> = 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>IN</sub> = V <sub>CC</sub> - 0.6 V	2.7~3.6	—	500		

## AC Characteristics (Ta = -40~85°C)

Characteristics		Symbol	Test Condition		Min	Max	Unit
				V <sub>CC</sub> (V)			
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> t <sub>PHL</sub>	Figure 1, Figure 2	2.7	—	9.5	ns
				3.3 ± 0.3	1.5	8.5	
Propagation delay time ( $\overline{\text{CLR}}$ -Q)		t <sub>PHL</sub>	Figure 1, Figure 3	2.7	—	9.5	ns
				3.3 ± 0.3	1.5	8.5	
Minimum pulse width (CK)		t <sub>w</sub> (H) t <sub>w</sub> (L)	Figure 1, Figure 2	2.7	3.3	—	ns
				3.3 ± 0.3	3.3	—	
Minimum bus width ( $\overline{\text{CLR}}$ )		t <sub>w</sub> (L)	Figure 3	2.7	3.3	—	ns
				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	—	
Minimum removal time		t <sub>rem</sub>	Figure 4	2.7	2.5	—	ns
				3.3 ± 0.3	2.0	—	
Output to output skew		t <sub>osLH</sub> t <sub>osHL</sub>	(Note10)	2.7	—	—	ns
				3.3 ± 0.3	—	1.0	

Note10: This parameter is guaranteed by design.

(t<sub>osLH</sub> = |t<sub>pLHm</sub> - t<sub>pLHn</sub>|, t<sub>osHL</sub> = |t<sub>pHLm</sub> - t<sub>pHLn</sub>|)

**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 <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	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	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>	—	0	8	pF
Power dissipation capacitance	CPD	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:

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

AC Test Circuit

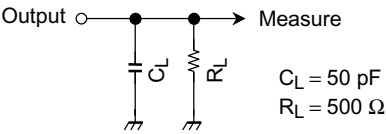


Figure 1

AC Waveform

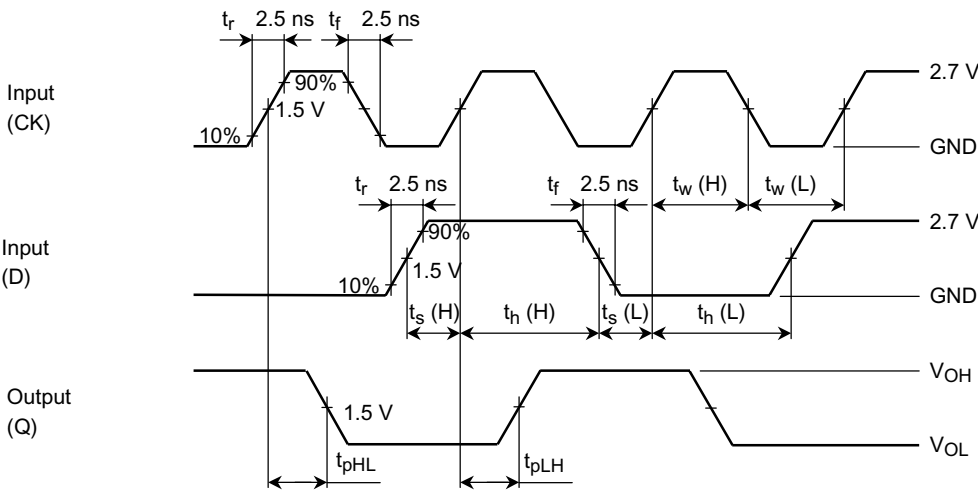


Figure 2  $t_{pLH}$ ,  $t_{pHL}$ ,  $t_w$ ,  $t_s$ ,  $t_h$

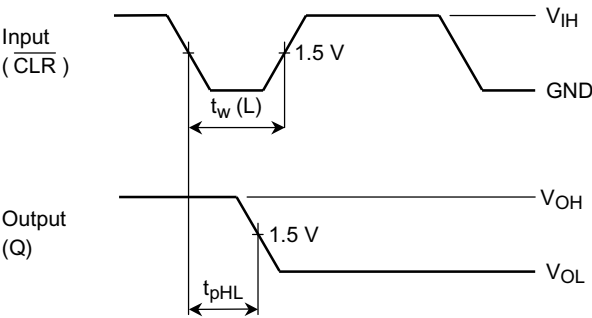


Figure 3  $t_{pLH}$ ,  $t_{pHL}$

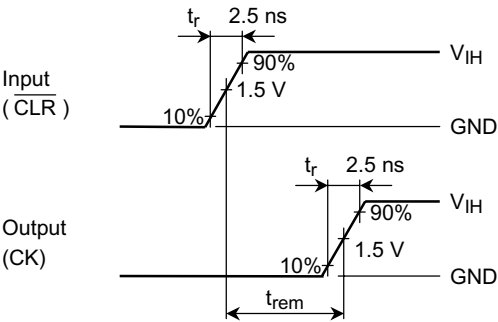
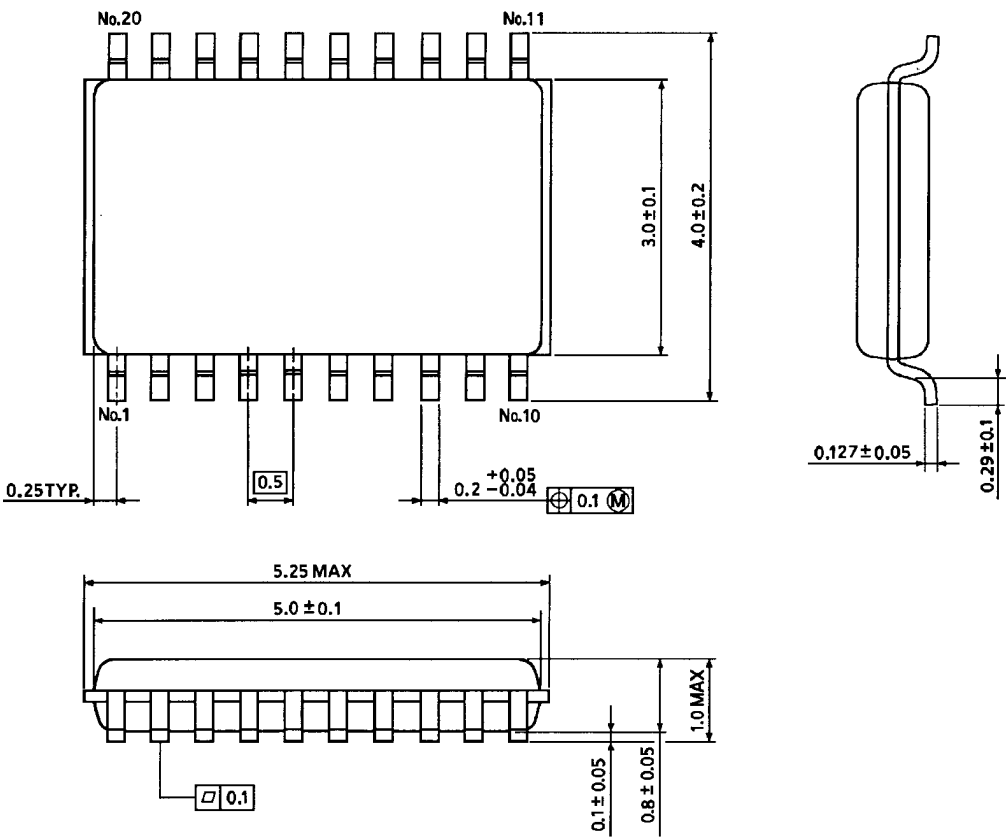


Figure 4  $t_{rem}$

Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)