

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.

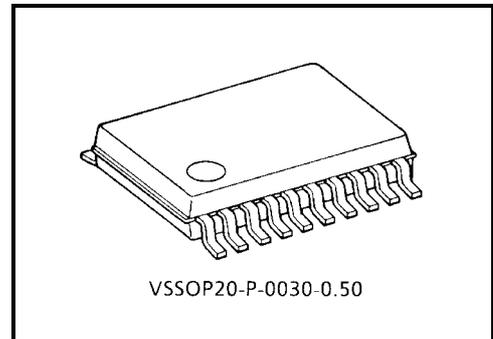
The device is designed for low-voltage (3.3-V) applications, but can also be used to interface both inputs and outputs with a 5-V supply environment.

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.

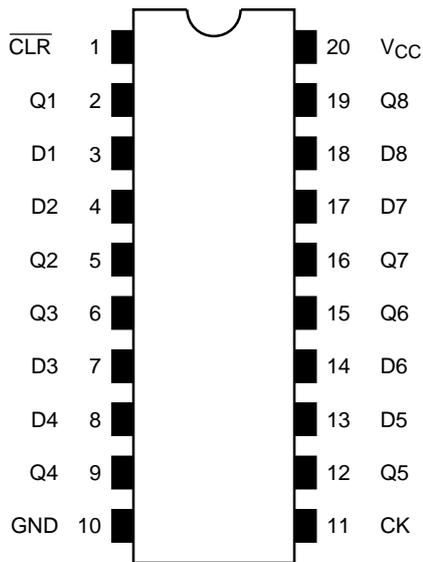
Features

- 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.

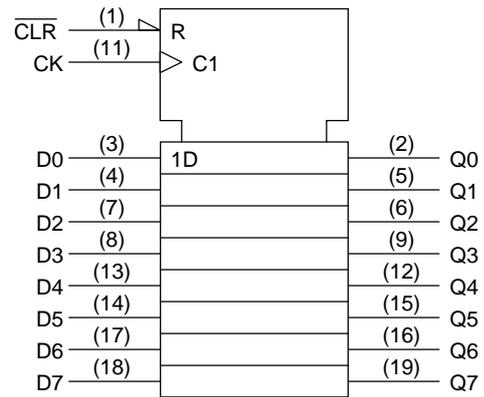


Weight: 0.03 g (typ.)

Pin Assignment (top view)



IEC Logic Symbol

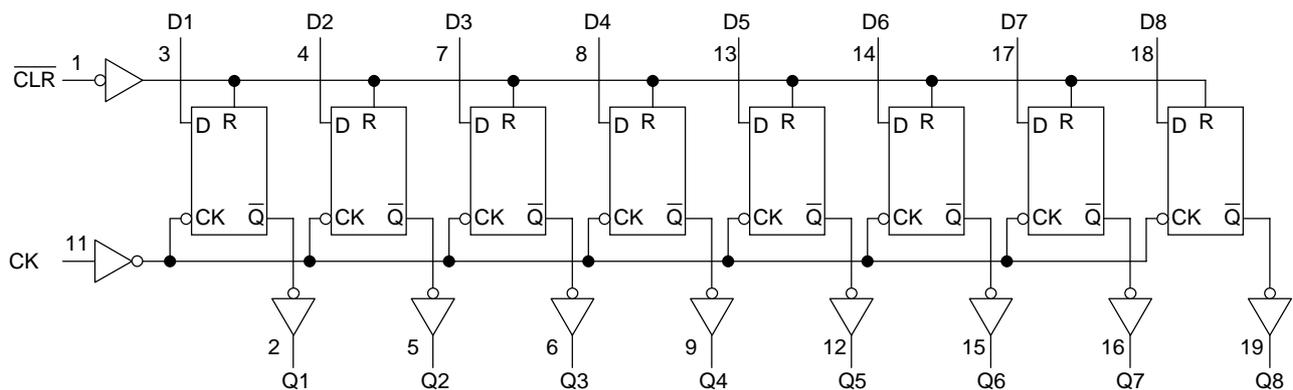


Truth Table

Inputs			Outputs	Function
$\overline{\text{CLR}}$	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	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	
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} = 3.6~5.5 V	2.7~3.6	—	±10.0		
Increase in I _{CC} per input		ΔI _{CC}	V _{IN} = 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
Maximum clock frequency	f _{MAX}	Figure 1, Figure 2	2.7	—	—	MHz	
			3.3 ± 0.3	150	—		
Propagation delay time (CK-Q)	t _{PLH} t _{PHL}	Figure 1, Figure 2	2.7	—	9.5	ns	
			3.3 ± 0.3	1.5	8.5		
Propagation delay time (CLR-Q)	t _{PHL}	Figure 1, Figure 3	2.7	—	9.5	ns	
			3.3 ± 0.3	1.5	8.5		
Minimum pulse width (CK)	t _w (H) t _w (L)	Figure 1, Figure 2	2.7	3.3	—	ns	
			3.3 ± 0.3	3.3	—		
Minimum bus width (CLR)	t _w (L)	Figure 3	2.7	3.3	—	ns	
			3.3 ± 0.3	3.3	—		
Minimum set-up time	t _s	Figure 1, Figure 2	2.7	2.5	—	ns	
			3.3 ± 0.3	2.5	—		
Minimum hold time	t _h	Figure 1, Figure 2	2.7	1.5	—	ns	
			3.3 ± 0.3	1.5	—		
Minimum removal time	t _{rem}	Figure 4	2.7	2.5	—	ns	
			3.3 ± 0.3	2.0	—		
Output to output skew	t _{osLH} t _{osHL}	(Note10)	2.7	—	—	ns	
			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: tr = tf = 2.5 ns, CL = 50 pF, RL = 500 Ω)

Characteristics	Symbol	Test Condition	VCC (V)	Typ.	Unit
Quiet output maximum dynamic VOL	VOLP	V _{IH} = 3.3 V, V _{IL} = 0 V	3.3	0.8	V
Quiet output minimum dynamic VOL	VOLV	V _{IH} = 3.3 V, V _{IL} = 0 V	3.3	0.8	V

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	VCC (V)	Typ.	Unit
Input capacitance	C _{IN}	—	3.3	7	pF
Output capacitance	C _{OUT}	—	0	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:

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

AC Test Circuit

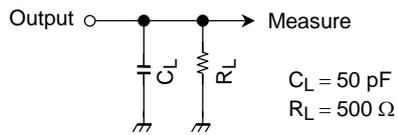


Figure 1

AC Waveform

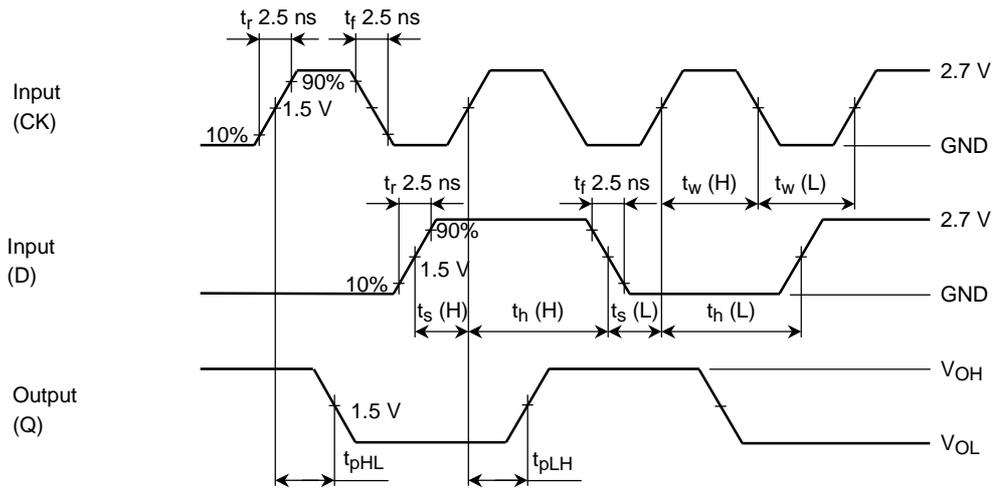


Figure 2 t_{pLH} , t_{pHL} , t_w , t_s , t_h

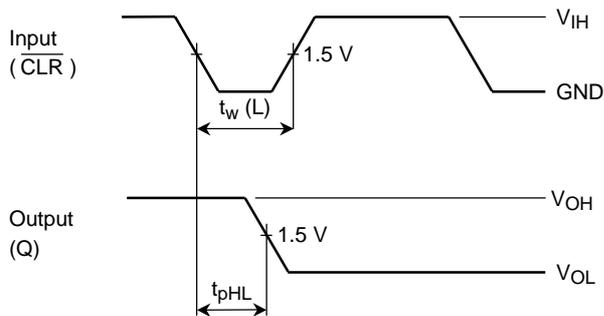


Figure 3 t_{pLH} , t_{pHL}

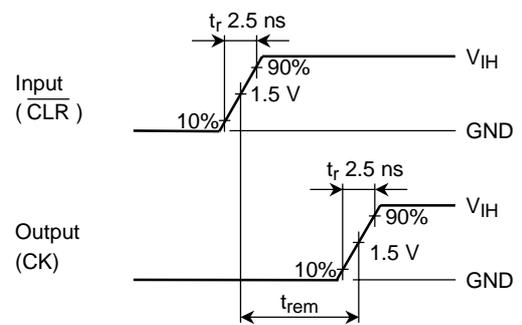
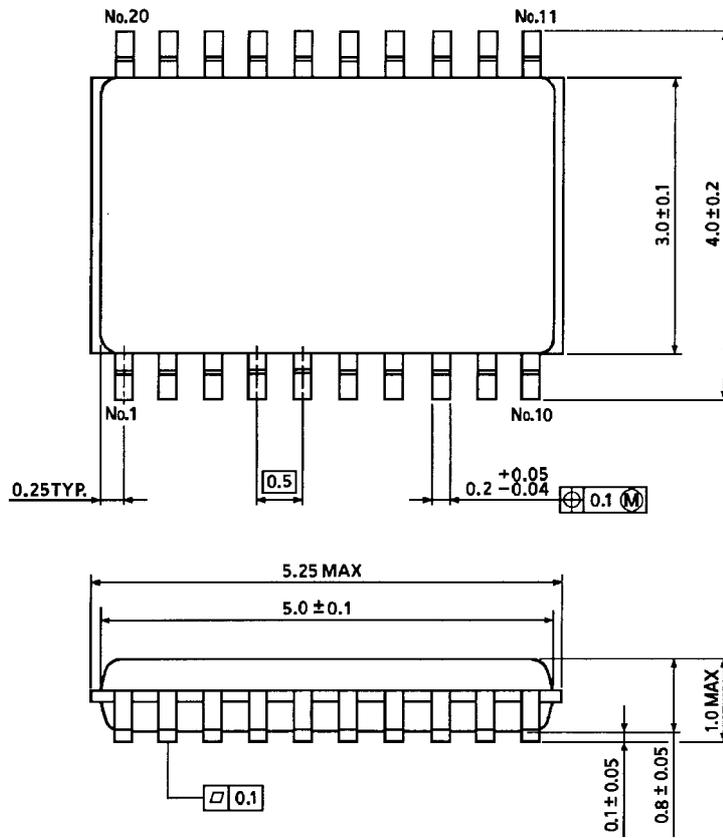


Figure 4 t_{rem}

Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)

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