TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MZ273FK

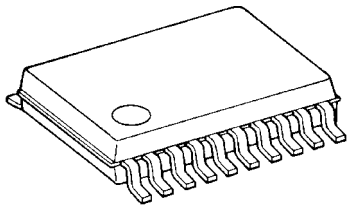
Low-Voltage Octal D-Type Flip-Flop with Clear with 5-V Tolerant Inputs and Outputs

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.



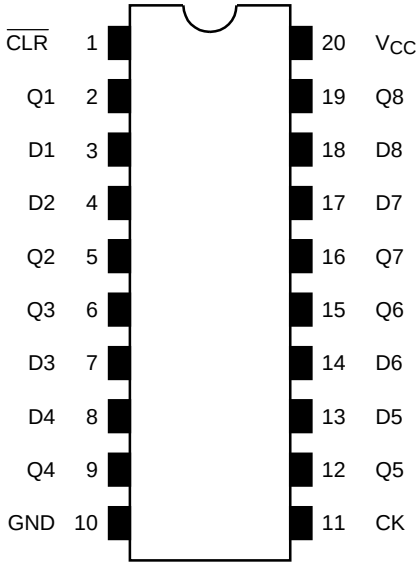
VSSOP20-P-0030-0.50

Weight: 0.03 g (typ.)

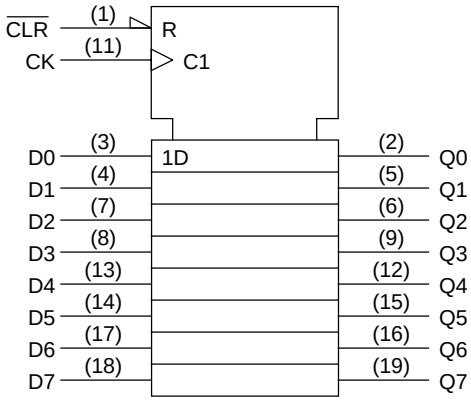
Features

- Low voltage operation: V_{CC} = 2.0 V~3.6 V
- High-speed operation: t_{pd} = 8.5 ns (max) (V_{CC} = 3.0 V~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)
- 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.

Pin Assignment (top view)



IEC Logic Symbol

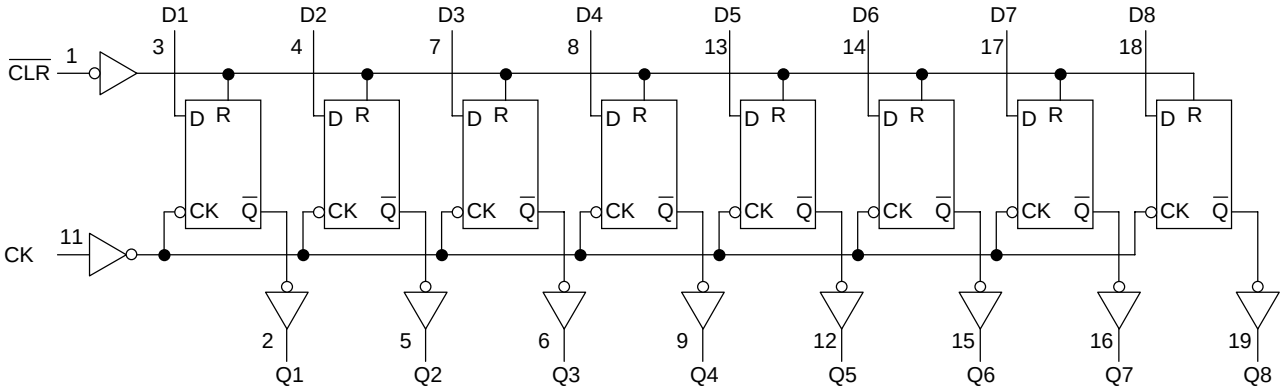


Truth Table

Inputs			Outputs	Function
$\overline{CLR}$	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} = 3.0~3.6 V

Note8: V_{CC} = 2.7~3.0 V

Note9: V_{IN} = 0.8~2.0 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 ($\overline{CLR}$ -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 ($\overline{CLR}$)	$t_{w\,(L)}$	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: $t_r = t_f = 2.5$ ns, $C_L = 50$ pF, $R_L = 500\ \Omega$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
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}	—	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:
$I_{CC\ (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8$ (per bit)

AC Test Circuit

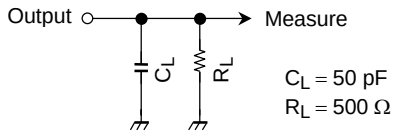


Figure 1

AC Waveform

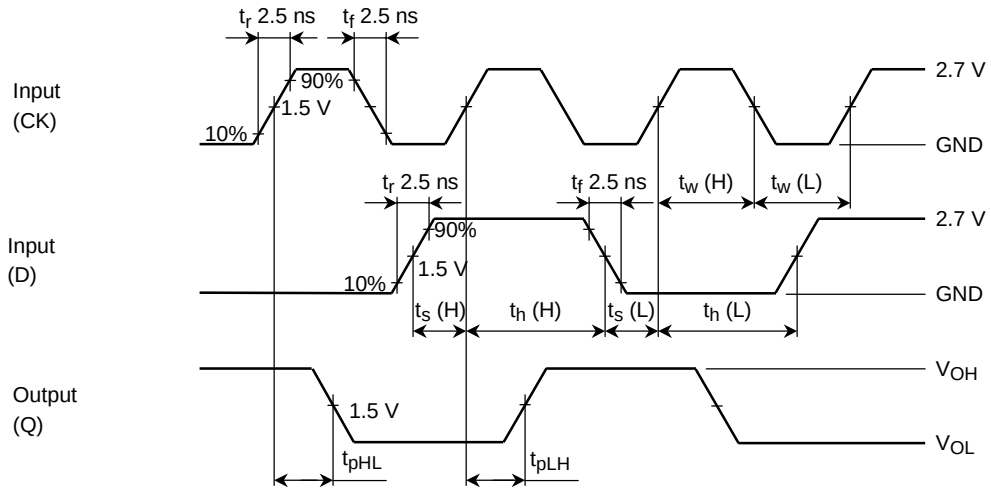


Figure 2 t_{pLH}, t_{pHL}, t_w, t_s, t_h

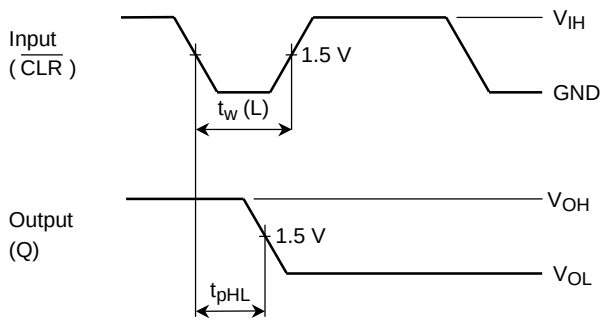


Figure 3 t_{pLH}, t_{pHL}

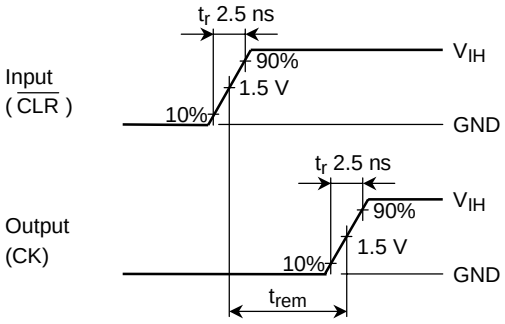
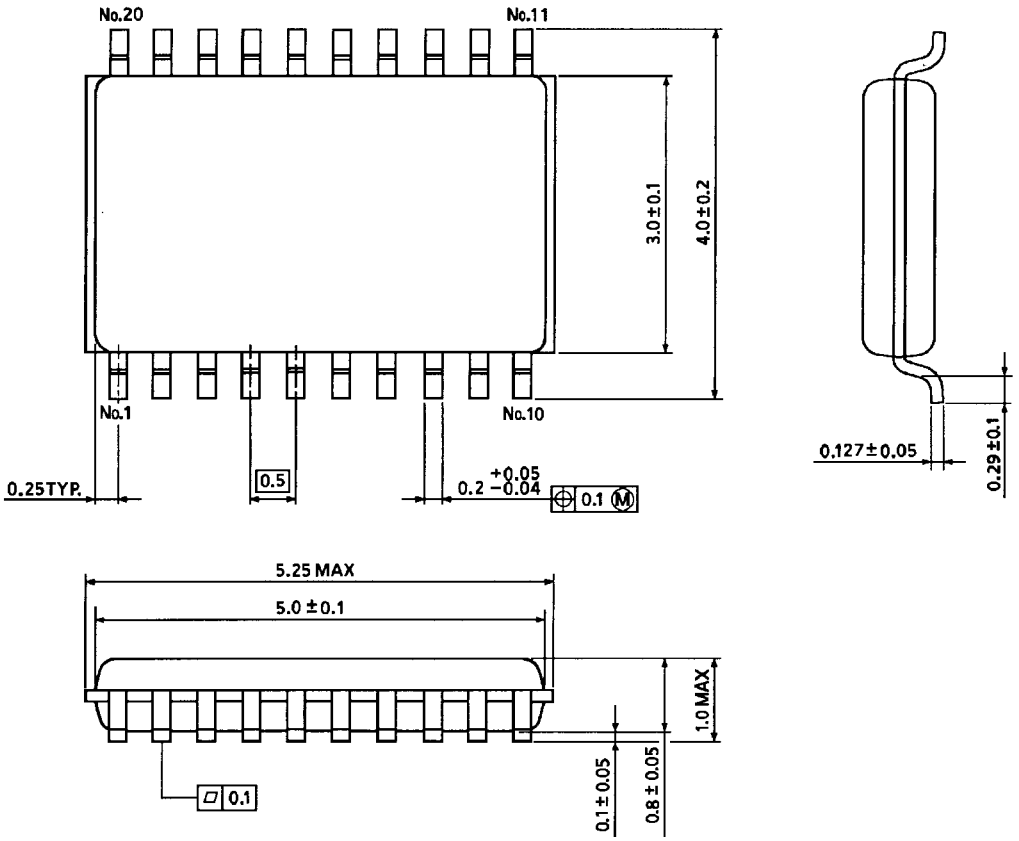


Figure 4 t_{rem}

Package Dimensions

VSSOP20-P-0030-0.50 Unit : mm



Weight: 0.03 g (typ.)

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.