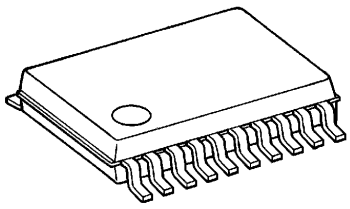
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC7MZ574FK

LOW VOLTAGE OCTAL D-TYPE FLIP-FLOP WITH 5 V TOLERANT INPUTS AND OUTPUTS

The TC7MZ574 is a high performance CMOS OCTAL D-TYPE FLIP FLOP. Designed for use in 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.
The device is designed for low-voltage (3.3 V) V_{CC} 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.



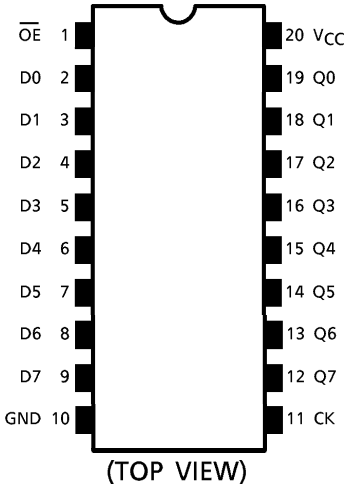
VSSOP20-P-0030-0.50

Weight : 0.03 g (typ.)

Features

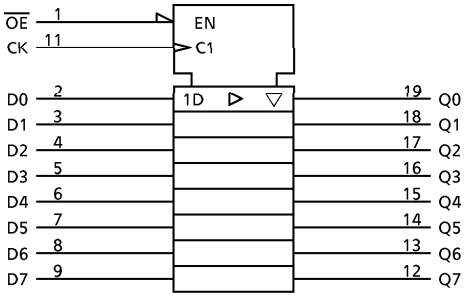
- Low voltage operation : V_{CC} = 2.0~3.6 V
- High speed operation : t_{pd} = 8.5 ns (max) (V_{CC} = 3.0~3.6 V)
- Output current : $|I_{OH}| / I_{OL}$ = 24 mA (min) (V_{CC} = 3.0 V)
- Latch-up performance : ± 500 mA
- Available in VSSOP (US20)
- Power down protection is provided on all inputs and outputs.
- Pin and function compatible with the 74 series (74AC / VHC / HC / F / ALS / LS etc.) 574 type.

Pin Assignment



(TOP VIEW)

IEC Logic Symbol

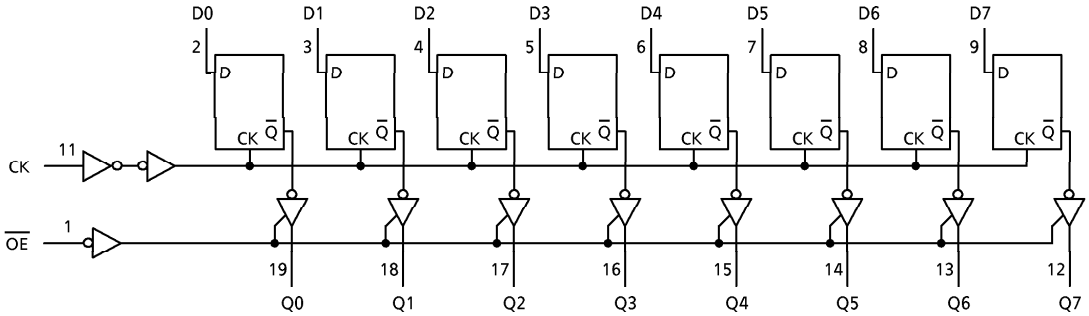


Truth Table

INPUTS			OUTPUTS
$\overline{OE}$	CK	D	
H	X	X	Z
L	↓	X	Qn
L	↑	L	L
L	↑	H	H

X : Don't Care
Z : High Impedance
Qn : No change

System Diagram



Maximum Ratings

PARAMETER	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 (Note 1)	V
		−0.5~V_{CC} + 0.5 (Note 2)	
Input Diode Current	I_{IK}	−50	mA
Output Diode Current	I_{OK}	±50 (Note 3)	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

(Note 1): Output in Off-State
(Note 2): High or Low State. I_{OUT} absolute maximum rating must be observed.
(Note 3): V_{OUT} < GND, V_{OUT} > V_{CC}

Recommended Operating Conditions

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	2.0~3.6	V
		1.5~3.6 (Note 4)	
Input Voltage	V_{IN}	0~5.5	V
Output Voltage	V_{OUT}	0~5.5 (Note 5)	V
		0~ V_{CC} (Note 6)	
Output Current	I_{OH} / I_{OL}	±24 (Note 7)	mA
		±12 (Note 8)	
Operating Temperature	T_{opr}	−40~85	°C
Input Rise And Fall Time	dt / dv	0~10 (Note 9)	ns / V

(Note 4): Data Retention Only
(Note 5): Output in Off-State
(Note 6): High or Low State
(Note 7): V_{CC} = 3.0~3.6 V
(Note 8): V_{CC} = 2.7~3.0 V
(Note 9): V_{IN} = 0.8~2.0 V, V_{CC} = 3.0 V

Electrical Characteristics

DC characteristics (Ta = −40~85°C)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	Min	Max	UNIT
Input Voltage	"H" Level	V_{IH}			2.7~3.6	2.0	—	V
	"L" Level	V_{IL}			2.7~3.6	—	0.8	
Output Voltage	"H" 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	—	
	"L" 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 Cuurent		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	μA

AC characteristics (Ta = −40~85°C)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	Min	Max	UNIT
Maximum Clock Frequency	f_{MAX}	(Fig.1, 2)	2.7	—	—	MHz
			3.3 ± 0.3	150	—	
Propagation Delay Time (CK-Q)	t_{pLH} t_{pHL}	(Fig.1, 2)	2.7	—	9.5	ns
			3.3 ± 0.3	1.5	8.5	
Output Enable Time	t_{pZL} t_{pZH}	(Fig.1, 3)	2.7	—	9.5	ns
			3.3 ± 0.3	1.5	8.5	
Output Disable Time	t_{pLZ} t_{pHZ}	(Fig.1, 3)	2.7	—	7.0	ns
			3.3 ± 0.3	1.5	6.5	
Minimum Pulse Width (CK)	t_w (H) t_w (L)	(Fig.1, 2)	2.7	3.3	—	ns
			3.3 ± 0.3	3.3	—	
Minimum Set-Up Time	t_s	(Fig.1, 2)	2.7	2.5	—	ns
			3.3 ± 0.3	2.5	—	
Minimum Hold Time	t_h	(Fig.1, 2)	2.7	1.5	—	ns
			3.3 ± 0.3	1.5	—	
Output To Output Skew	t_{osLH} t_{osHL}	(Note 10)	2.7	—	—	ns
			3.3 ± 0.3	—	1.0	

(Note 10): Parameter 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, $R_L = 500\ \Omega$)

PARAMETER	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

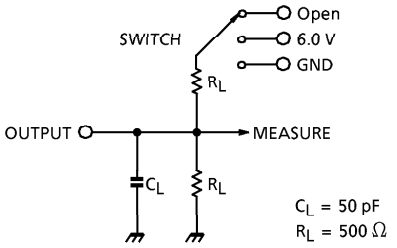
Capacitive Characteristics (Ta = 25°C)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	Typ.	UNIT
Input Capacitance	C_{IN}	—	3.3	7	pF
Output Capacitance	C_{OUT}		3.3	8	pF
Power Dissipation Capacitance	C_{PD}	f_{IN} = 10 MHz (Note 11)	3.3	25	pF

(Note 11): 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)

Test Circuit

Fig.1



PARAMETER	SWITCH
t_{pLH}, t_{pHL}	Open
t_{pLZ}, t_{pZL}	6.0 V
t_{pHZ}, t_{pZH}	GND
t_w, t_s, t_h, f_{MAX}	Open

AC Waveform

Fig.2 t_{pLH}, t_{pHL}, t_w, t_s, t_h

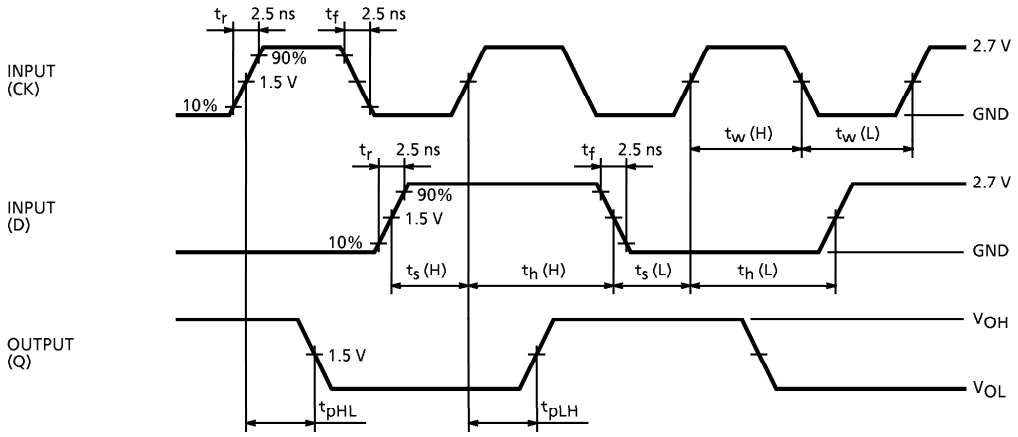
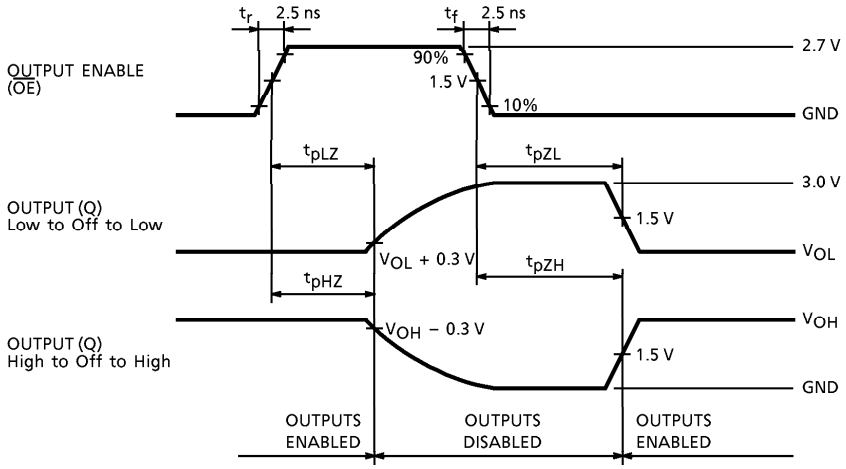
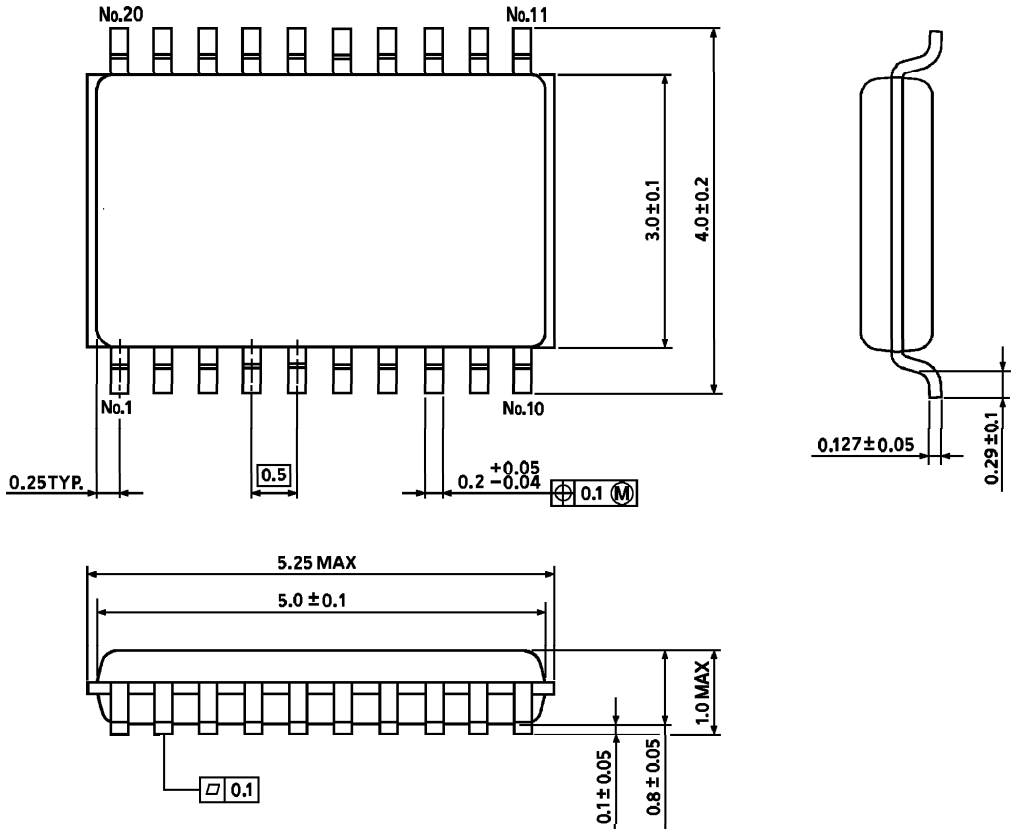


Fig.3 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}



PACKAGE DIMENSIONS

VSSOP20-P-0030-0.50 Unit : mm



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