

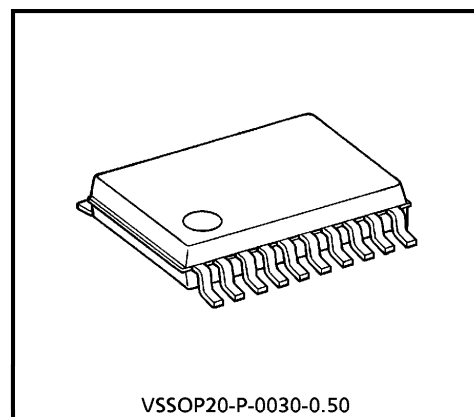
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC7MZ374FK**LOW VOLTAGE OCTAL D-TYPE FLIP-FLOP
WITH 5 V TOLERANT INPUTS AND OUTPUTS**

The TC7MZ374 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 5V supply environment for both inputs and outputs.

This 8 bit D-type flip-flop is controlled by a clock input (CK) and a 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.)

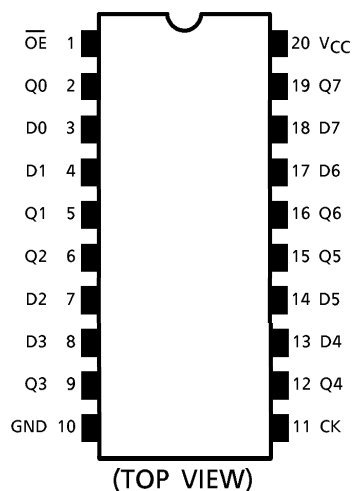
Features

- 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 : $\pm 500 \text{ mA}$
- 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.) 374 type.

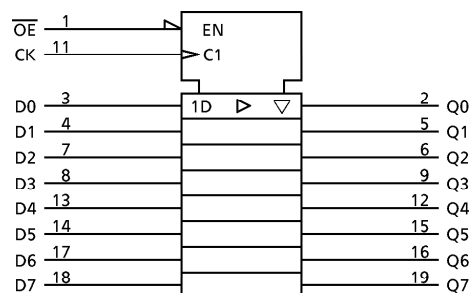
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Pin Assignment



IEC Logic Symbol

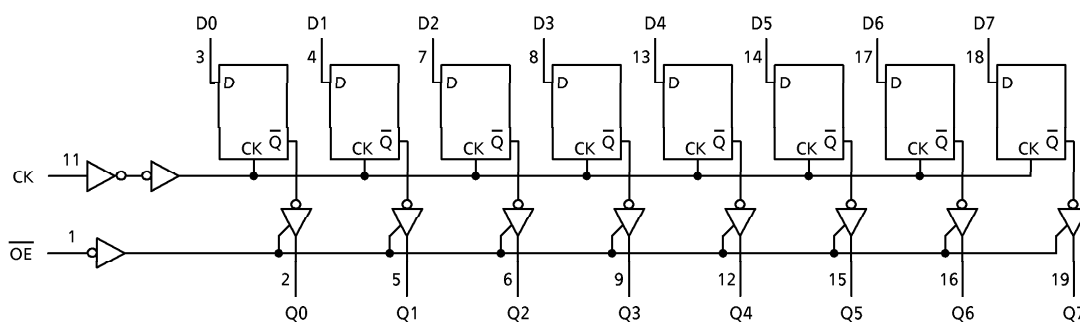


Truth Table

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}	$-0.5 \sim 7.0$	V
DC Input Voltage	V_{IN}	$-0.5 \sim 7.0$	V
DC Output Voltage	V_{OUT}	$-0.5 \sim 7.0$ (Note 1)	V
		$-0.5 \sim V_{CC} + 0.5$ (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}	$-65 \sim 150$	$^{\circ}\text{C}$

(Note 1): Output in Off-State

(Note 2): High or Low State. I_{OUT} absolute maximum rating must be observed.(Note 3): $V_{OUT} < \text{GND}$, $V_{OUT} > V_{CC}$

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}	$-40 \sim 85$	$^{\circ}\text{C}$
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): $V_{CC} = 3.0 \sim 3.6 \text{ V}$ (Note 8): $V_{CC} = 2.7 \sim 3.0 \text{ V}$ (Note 9): $V_{IN} = 0.8 \sim 2.0 \text{ V}$, $V_{CC} = 3.0 \text{ V}$

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	—	8.5	ns
			3.3 ± 0.3	1.5	7.5	
Minimum Pulse Width (CK)	t _w (H) t _w (L)	(Fig.1, 2)	2.7	4.0	—	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 Ω)

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

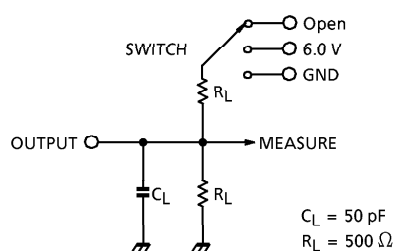
(Note 11): C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption.

Average operating current can be obtained by the equation :

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

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

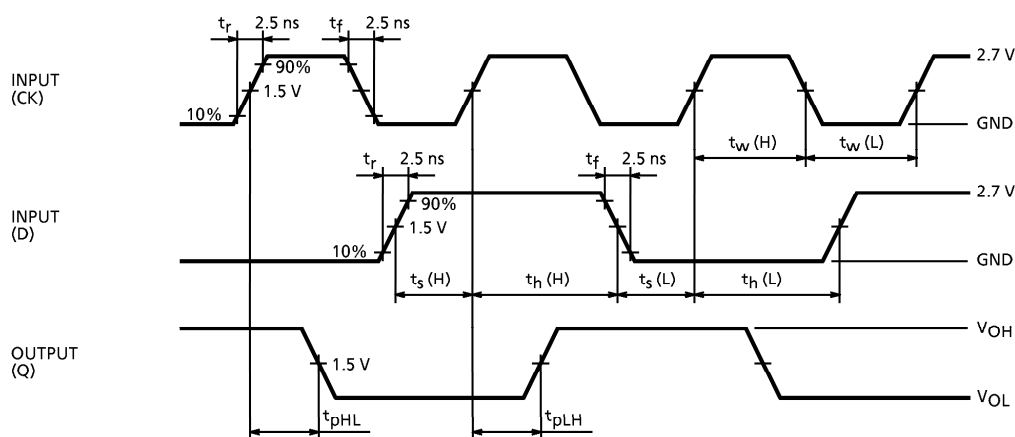
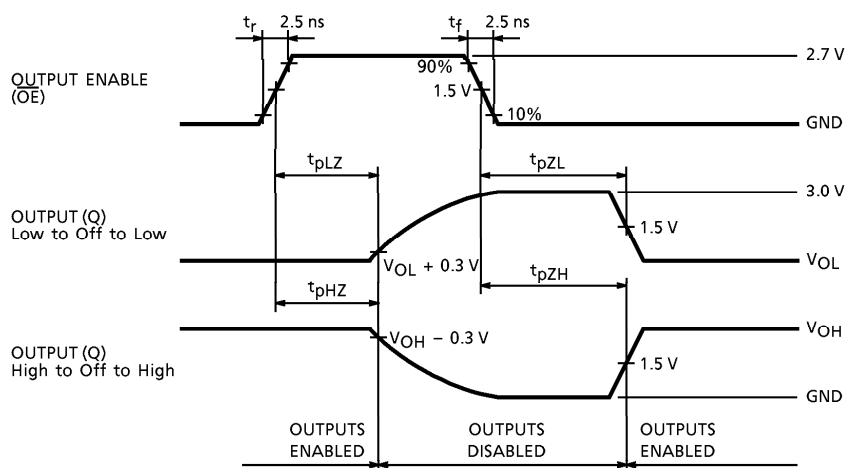
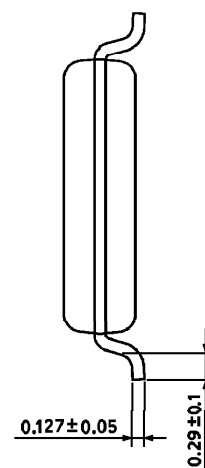
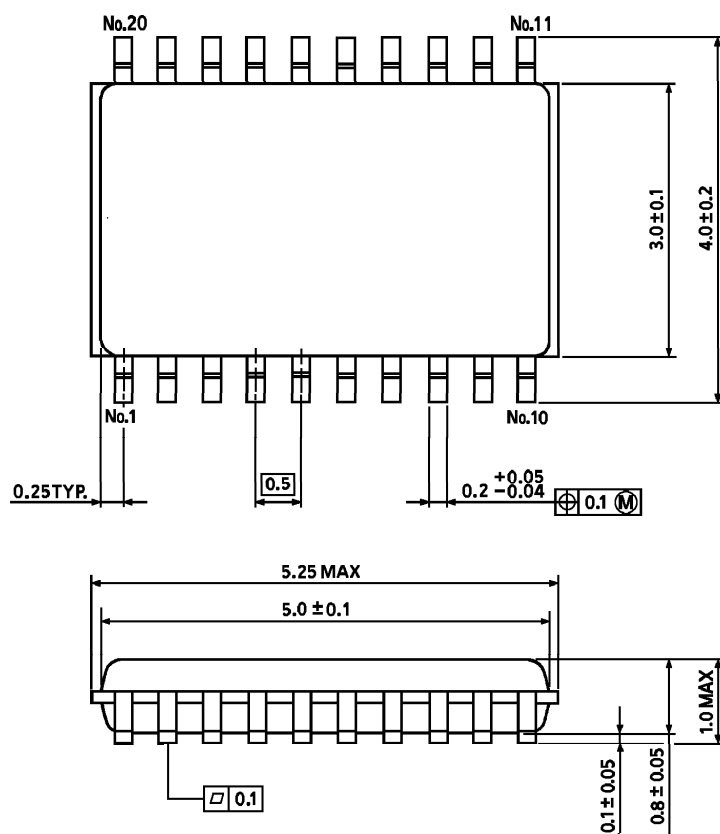


Fig.3 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}



PACKAGE DIMENSIONS
VSSOP20-P-0030-0.50

Unit : mm



Weight : 0.03 g (typ.)