

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MH574FK

Octal D-Type Flip-Flop with 3-State Output

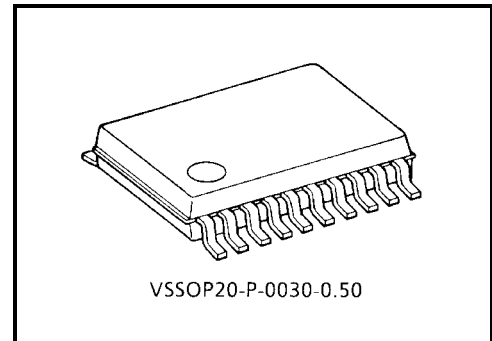
The TC7MH574FK is an advanced high speed CMOS octal flip-flop with 3-state output fabricated with silicon gate C²MOS technology.

It achieves the high speed operation similar to equivalent bipolar schottky TTL while maintaining the CMOS low power dissipation.

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.

An input protection circuit ensures that 0 to 7 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

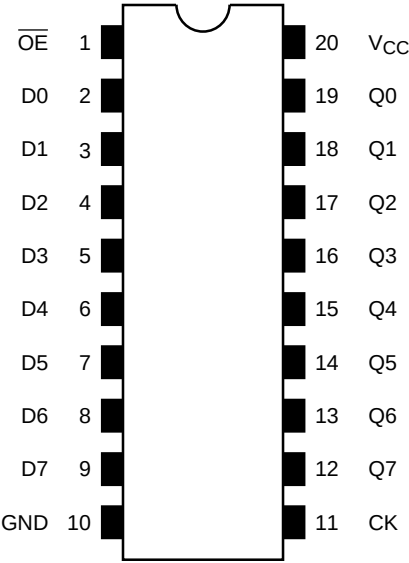


Weight: 0.03 g (typ.)

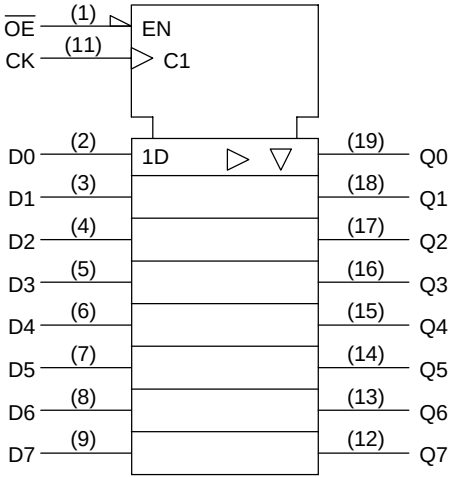
Features

- High speed: $f_{\max} = 180 \text{ MHz}$ (typ.) ($V_{CC} = 5 \text{ V}$)
- Low power dissipation: $I_{CC} = 4 \text{ }\mu\text{A}$ (max) ($T_a = 25^\circ\text{C}$)
- High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC}(\text{opr}) = 2\sim 5.5 \text{ V}$
- Low noise: $V_{OLP} = 1.0 \text{ V}$ (max)
- Pin and function compatible with 74ALS574

Pin Assignment (top view)



IEC Logic Symbol

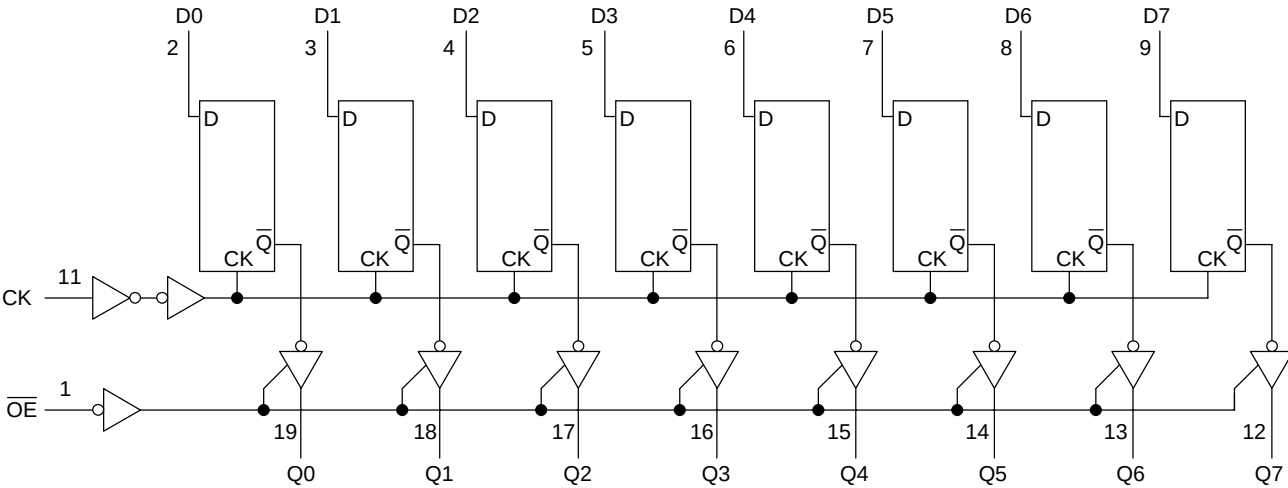


Truth Table

Inputs			Outputs
OE	CK	D	
H	X	X	Z
L		X	Q _n
L		L	L
L		H	H

X: Don't care
Z: High impedance
Q_n: No change

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~ $V_{CC} + 0.5$	V
Input diode current	I_{IK}	-20	mA
Output diode current	I_{OK}	±20	mA
DC output current	I_{OUT}	±25	mA
DC V_{CC} /ground current	I_{CC}	±75	mA
Power dissipation	P_D	180	mW
Storage temperature	T_{stg}	-65~150	°C

Recommended Operating Conditions

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2.0~5.5	V
Input voltage	V_{IN}	0~5.5	V
Output voltage	V_{OUT}	0~ V_{CC}	V
Operating temperature	T_{opr}	-40~85	°C
Input rise and fall time	dt/dv	0~100 ($V_{CC} = 3.3 \pm 0.3$ V)	ns/V
		0~20 ($V_{CC} = 5 \pm 0.5$ V)	

Electrical Characteristics

DC Characteristics

Characteristics		Symbol	Test Condition		Ta = 25°C				Ta = -40~85°C		Unit				
					VCC (V)	Min	Typ.	Max	Min	Max					
Input voltage	High level	VIH	—		2.0	1.50	—	—	1.50	—	V				
					3.0~5.5	VCC × 0.7	—	—	VCC × 0.7	—					
	Low level	VIL	—		2.0	—	—	0.50	—	0.50					
					3.0~5.5	—	—	VCC × 0.3	—	VCC × 0.3					
Output voltage	High level	VOH	VIN = VIH or VIL	IOH = -50 μA	2.0	1.9	2.0	—	1.9	—	V				
					3.0	2.9	3.0	—	2.9	—					
					4.5	4.4	4.5	—	4.4	—					
				IOH = -4 mA	3.0	2.58	—	—	2.48	—					
					IOH = -8 mA	4.5	3.94	—	—	3.80		—			
	Low level	VOL	VIN = VIH or VIL	IOL = 50 μA	2.0	—	0	0.1	—	0.1					
					3.0	—	0	0.1	—	0.1					
					4.5	—	0	0.1	—	0.1					
				IOL = 4 mA	3.0	—	—	0.36	—	0.44					
					IOL = 8 mA	4.5	—	—	0.36	—		0.44			
				3-state output off-state current		IOZ	VIN = VIH or VIL VOUT = VCC or GND	5.5	—	—		±0.25	—	±2.50	μA
				Input leakage current		IIN	VIN = 5.5 V or GND	0~5.5	—	—		±0.1	—	±1.0	μA
Quiescent supply current		ICC	VIN = VCC or GND	5.5	—	—	4.0	—	40.0	μA					

Timing Requirements (Input: t_r = t_f = 3 ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C	Unit
			V _{CC} (V)	Typ.	Limit	Limit	
Minimum pulse width (CK)	t _w (H) t _w (L)	—	3.3 ± 0.3	—	5.0	5.0	ns
			5.0 ± 0.5	—	5.0	5.0	
Minimum set-up time	t _s	—	3.3 ± 0.3	—	3.5	3.5	ns
			5.0 ± 0.5	—	3.5	3.5	
Minimum hold time	t _h	—	3.3 ± 0.3	—	1.5	1.5	ns
			5.0 ± 0.5	—	1.5	1.5	

AC Characteristics (Input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition			Ta = 25°C			Ta = -40~85°C		Unit
			V _{CC} (V)	C _L (pF)	Min	Typ.	Max	Min	Max	
Propagation delay time (CK-Q)	t_{pLH} t_{pHL}	—	3.3 ± 0.3	15	—	8.5	13.2	1.0	15.5	ns
				50	—	11.0	16.7	1.0	19.0	
			5.0 ± 0.5	15	—	5.6	8.6	1.0	10.0	
				50	—	7.1	10.6	1.0	12.0	
3-state output enable time	t_{pZL} t_{pZH}	$R_L = 1 \text{ k}\Omega$	3.3 ± 0.3	15	—	8.2	12.8	1.0	15.0	ns
				50	—	10.7	16.3	1.0	18.5	
			5.0 ± 0.5	15	—	5.9	9.0	1.0	10.5	
				50	—	7.4	11.0	1.0	12.5	
3-state output disable time	t_{pLZ} t_{pHZ}	$R_L = 1 \text{ k}\Omega$	3.3 ± 0.3	50	—	11.0	15.0	1.0	17.0	ns
			5.0 ± 0.5	50	—	7.1	10.1	1.0	11.5	
Maximum clock frequency	f_{max}	—	3.3 ± 0.3	15	80	125	—	65	—	MHz
				50	50	75	—	45	—	
			5.0 ± 0.5	15	130	180	—	110	—	
				50	85	115	—	75	—	
Output to output skew	t_{osLH} t_{osHL}	(Note1)	3.3 ± 0.3	50	—	—	1.5	—	1.5	ns
			5.0 ± 0.5	50	—	—	1.0	—	1.0	
Input capacitance	C _{IN}	—	—	—	—	4	10	—	10	pF
Output capacitance	C _{OUT}	—	—	—	—	6	—	—	—	pF
Power dissipation capacitance	C _{PD}	(Note2)	—	—	—	28	—	—	—	pF

Note1: This parameter is guaranteed by design.

$$t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|$$

Note2: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

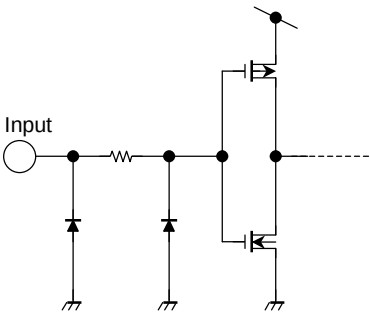
And the total C_{PD} when n pcs of latch operate can be gained by the following equation:

$$C_{PD(\text{total})} = 20 + 8 \cdot n$$

Noise Characteristics (Input: $t_r = t_f = 3\text{ ns}$)

Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			V _{CC} (V)	Typ.	Limit	
Quiet output maximum dynamic V _{OL}	V _{OLP}	C _L = 50 pF	5.0	0.8	1.0	V
Quiet output minimum dynamic V _{OL}	V _{OLV}	C _L = 50 pF	5.0	-0.8	-1.0	V
Minimum high level dynamic input voltage V _{IH}	V _{IHD}	C _L = 50 pF	5.0	—	3.5	V
Maximum low level dynamic input voltage V _{IL}	V _{ILD}	C _L = 50 pF	5.0	—	1.5	V

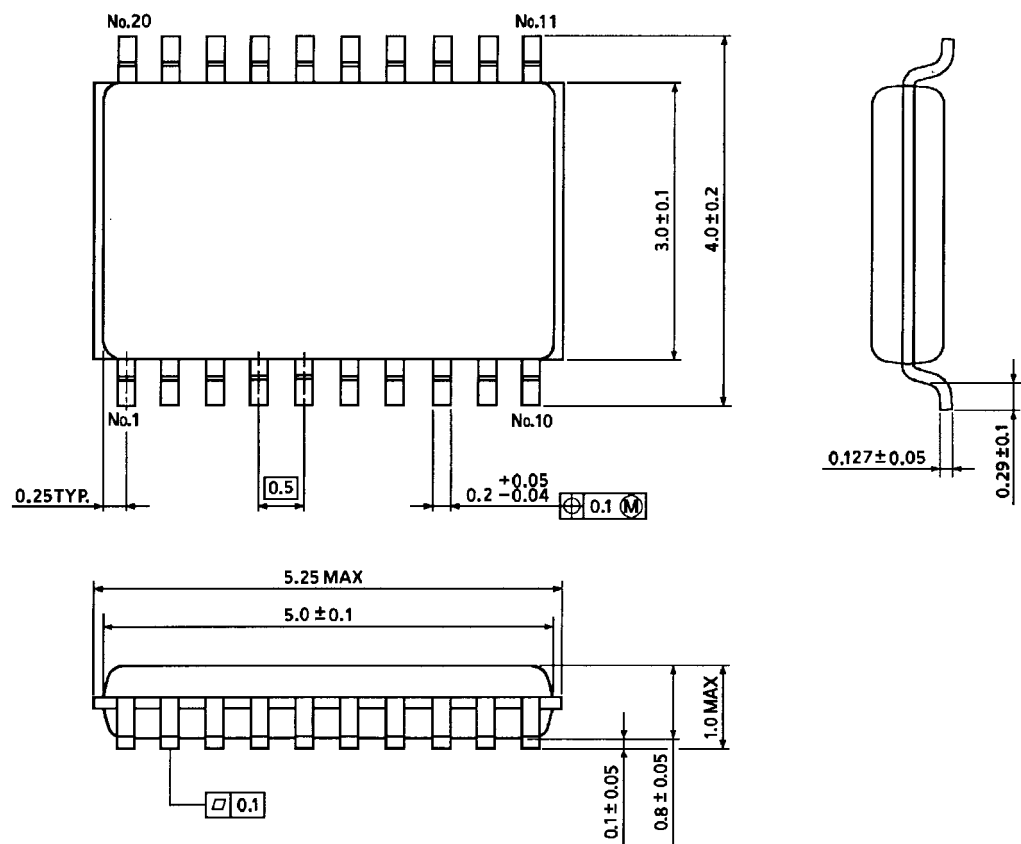
Input Equivalent Circuit



Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)

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