TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MH573FK

Octal D-Type Latch with 3-State Output

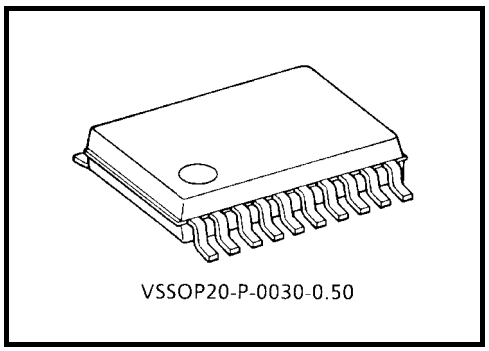
The TC7MH573FK is an advanced high speed CMOS octal latch with 3-state output fabricated with silicon gate C^2MOS technology.

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

This 8 bit D-type latch is controlled by a latch enable input (LE) 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.

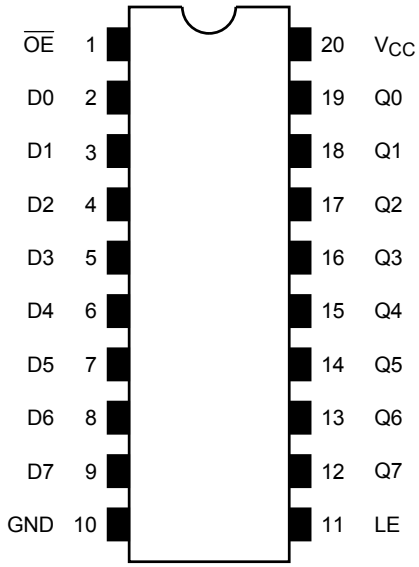


Weight: 0.03 g (typ.)

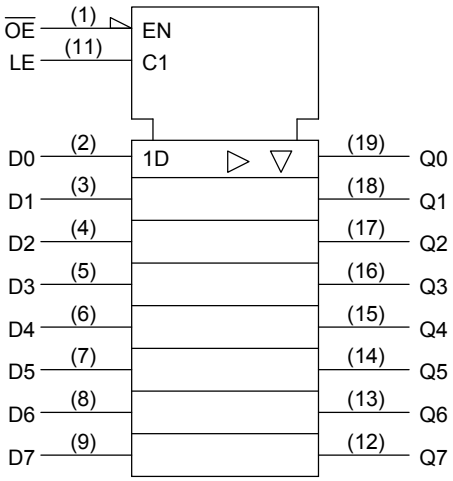
Features

- High speed: t_{pd} = 4.5 ns (typ.) (V_{CC} = 5 V)
- Low power dissipation: I_{CC} = 4 μA (max) (Ta = 25°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: $V_{CC\ (opr)}$ = 2~5.5 V
- Low noise: V_{OLP} = 1.0 V (max)
- Pin and function compatible with 74ALS573

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

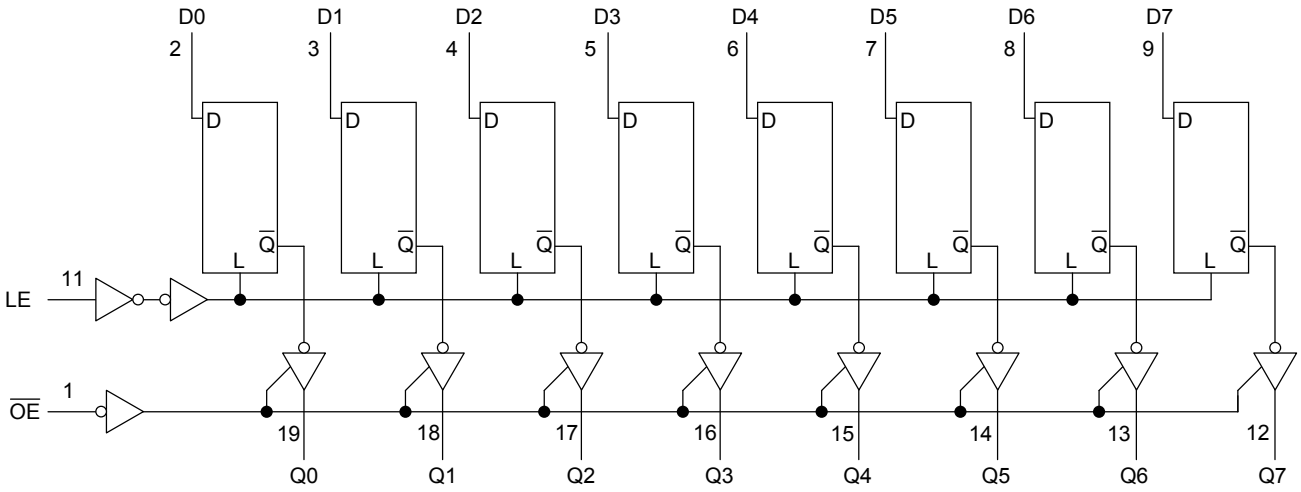
Inputs			Outputs
$\overline{OE}$	LE	D	
H	X	X	Z
L	L	X	Q_n
L	H	L	L
L	H	H	H

X: Don't care

Z: High impedance

Q_n: Q outputs are latched at the time when the LE input is taken to a low logic level.

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 ± 0.3 V)	ns/V
		0~20 (V_{CC} = 5 ± 0.5 V)	

Electrical Characteristics

DC Characteristics

Characteristics		Symbol	Test Condition		V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40~85°C Min	Ta = −40~85°C Max	Unit
Input voltage	High level	V_{IH}	—		2.0	1.50	—	—	1.50	—	V
					3.0~5.5	$V_{CC} \times 0.7$	—	—	$V_{CC} \times 0.7$	—	
	Low level	V_{IL}	—		2.0	—	—	0.50	—	0.50	
					3.0~5.5	—	—	$V_{CC} \times 0.3$	—	$V_{CC} \times 0.3$	
Output voltage	High level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50$ 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	—	
				$I_{OH} = -4$ mA	3.0	2.58	—	—	2.48	—	
				$I_{OH} = -8$ mA	4.5	3.94	—	—	3.80	—	
	Low level	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50$ μA	2.0	—	0	0.1	—	0.1	
					3.0	—	0	0.1	—	0.1	
					4.5	—	0	0.1	—	0.1	
				$I_{OL} = 4$ mA	3.0	—	—	0.36	—	0.44	
				$I_{OL} = 8$ mA	4.5	—	—	0.36	—	0.44	
3-state output off-state current		I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND		5.5	—	—	±0.25	—	±2.50	μA
Input leakage current		I_{IN}	$V_{IN} = 5.5$ V or GND		0~5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current		I_{CC}	$V_{IN} = V_{CC}$ or GND		5.5	—	—	4.0	—	40.0	μA

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

Characteristics	Symbol	Test Condition	V_{CC} (V)	Ta = 25°C Typ.	Ta = 25°C Limit	Ta = −40~85°C Limit	Unit
Minimum pulse width (LE)	$t_{w(H)}$	—	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: $t_r = t_f = 3$ 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 (LE-Q)	t_{pLH} t_{pHL}	—	3.3 ± 0.3	15	—	7.6	11.9	1.0	14.0	ns
				50	—	10.1	15.4	1.0	17.5	
			5.0 ± 0.5	15	—	5.0	7.7	1.0	9.0	
				50	—	6.5	9.7	1.0	11.0	
Propagation delay time (D-Q)	t_{pLH} t_{pHL}	—	3.3 ± 0.3	15	—	7.0	11.0	1.0	13.0	ns
				50	—	9.5	14.5	1.0	16.5	
			5.0 ± 0.5	15	—	4.5	6.8	1.0	8.0	
				50	—	6.0	8.8	1.0	10.0	
3-state output enable time	t_{pZL} t_{pZH}	R_L = 1 kΩ	3.3 ± 0.3	15	—	7.3	11.5	1.0	13.5	ns
				50	—	9.8	15.0	1.0	17.0	
			5.0 ± 0.5	15	—	5.2	7.7	1.0	9.0	
				50	—	6.7	9.7	1.0	11.0	
3-state output disable time	t_{pLZ} t_{pHZ}	R_L = 1 kΩ	3.3 ± 0.3	50	—	10.7	14.5	1.0	16.5	ns
			5.0 ± 0.5	50	—	6.7	9.7	1.0	11.0	
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)			—	29	—	—	—	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:

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

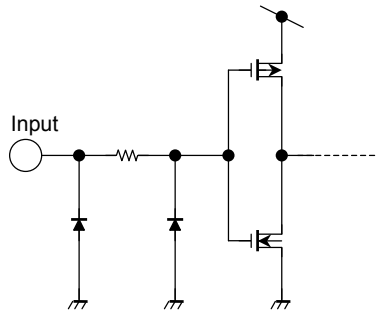
And the total C_{PD} when n pcs of latch operate can be gained by the following equation:

$C_{PD}\ (total) = 21 + 8 \cdot n$

Noise Characteristics (Input: $t_r = t_f = 3$ ns)

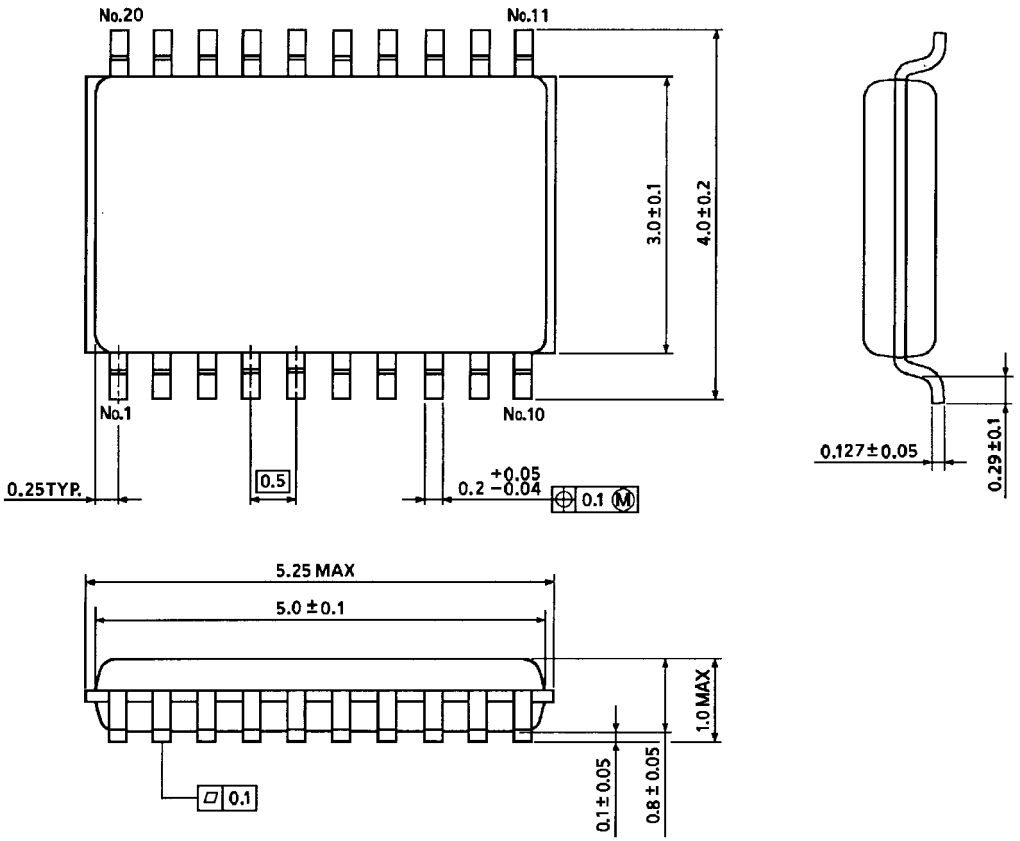
Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			V_{CC} (V)	Typ.	Limit	
Quiet output maximum dynamic V_{OL}	V_{OLP}	C_L = 50 pF	5.0	0.8	1.0	V
Quiet output minimum dynamic V_{OL}	V_{OLV}	C_L = 50 pF	5.0	−0.8	−1.0	V
Minimum high level dynamic input voltage V_{IH}	V_{IHD}	C_L = 50 pF	5.0	—	3.5	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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