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TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

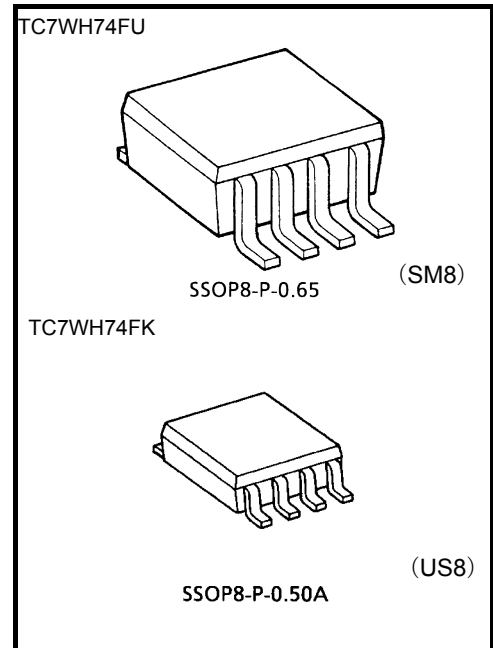
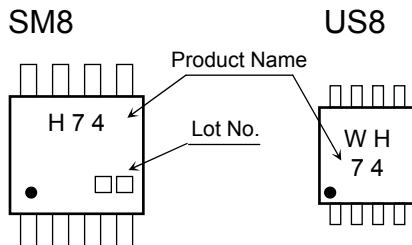
TC7WH74FU, TC7WH74FK

D-Type flip flop with preset and clear

Features

- High speed: $f_{MAX} = 170$ MHz (typ.) at $V_{CC} = 5V$
- Low power dissipation: $I_{CC} = 2\mu A$ (max) at $T_a = 25^\circ C$
- High noise immunity: $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (min)
- 5.5-V tolerant inputs
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} = 2$ to $5.5V$

Marking

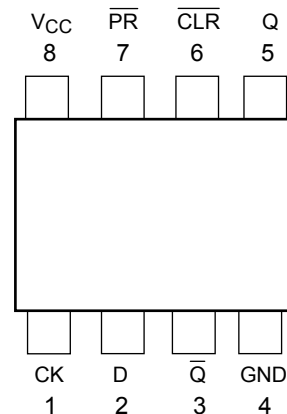


Weight
 SSOP8-P-0.65: 0.02 g (typ.)
 SSOP8-P-0.50A: 0.01 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	-0.5 to 7.0	V
DC input voltage	V_{IN}	-0.5 to 7.0	V
DC output voltage	V_{OUT}	-0.5 to $V_{CC} + 0.5$	V
Input diode current	I_{IK}	-20	mA
Output diode current	I_{OK}	± 20 (Note 1)	mA
DC output current	I_{OUT}	± 25	mA
DC V_{CC} /ground current	I_{CC}	± 50	mA
Power dissipation	P_D	300 (SM8)	mW
		200 (US8)	
Storage temperature	T_{stg}	-65 to 150	$^\circ C$
Lead temperature (10 s)	T_L	260	$^\circ C$

Pin Assignment (top view)

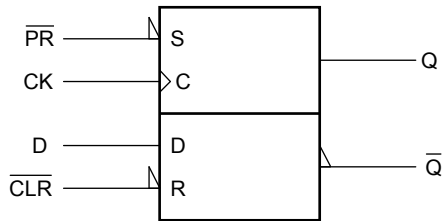


Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

IEC Logic Symbol



Truth Table

Inputs				Outputs		Function
$\overline{\text{CLR}}$	$\overline{\text{PR}}$	D	CK	Q	$\overline{\text{Q}}$	
L	H	X	X	L	H	Clear
H	L	X	X	H	L	Preset
L	L	X	X	H	H	—
H	H	L	\uparrow	L	H	—
H	H	H	\uparrow	H	L	—
H	H	X	\downarrow	Q n	$\overline{\text{Q}} n$	No Change

X: Don't care

Operating Range

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2.0 to 5.5	V
Input voltage	V_{IN}	0 to 5.5	V
Output voltage	V_{OUT}	0 to V_{CC}	V
Operating temperature	T_{opr}	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 100 ($V_{CC} = 3.3 \pm 0.3 \text{ V}$)	ns/V
		0 to 20 ($V_{CC} = 5.0 \pm 0.5 \text{ V}$)	

Electrical Characteristics

DC Characteristics

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V _{CC} (V)	Min	Typ.	Max	Min		Max	
High-level input voltage	V _{IH}	—	2.0	1.5	—	—	1.5	—	V	
			3.0 to 5.5	V _{CC} × 0.7	—	—	V _{CC} × 0.7	—		
Low-level input voltage	V _{IL}	—	2.0	—	—	0.5	—	0.5	V	
			3.0 to 5.5	—	—	V _{CC} × 0.3	—	V _{CC} × 0.3		
High-level output voltage	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	—	
			I _{OH} = -4 mA	4.5	4.4	4.5	—	4.4	—	
				3.0	2.58	—	—	2.48	—	
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50 μA	2.0	—	0.0	0.1	—	0.1	V
				3.0	—	0.0	0.1	—	0.1	
			I _{OL} = 4 mA	4.5	—	0.0	0.1	—	0.1	
				3.0	—	—	0.36	—	0.44	
I _{OL} = 8 mA	4.5	—	—	0.36	—	0.44				
	3.0	—	—	0.36	—	0.44				
Input leakage current	I _{IN}	V _{IN} = 5.5 V or GND	0 to 5.5	—	—	±0.1	—	±1.0	μA	
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND	5.5	—	—	2.0	—	20.0	μA	

TIMING REQUIREMENTS (unless otherwise specified, Input: t_r = t_f = 3 ns)

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 to 85°C		Unit
			V _{CC} (V)	Limit	Limit		
Minimum pulse width (CK)	t _W (L) t _W (H)	—	3.3 ± 0.3	6.0	7.0	ns	
			5.0 ± 0.5	5.0	5.0		
Minimum pulse width ($\overline{\text{CLR}}$, $\overline{\text{PR}}$)	t _W (L)	—	3.3 ± 0.3	6.0	7.0	ns	
			5.0 ± 0.5	5.0	5.0		
Minimum setup time	t _s	—	3.3 ± 0.3	6.0	7.0	ns	
			5.0 ± 0.5	5.0	5.0		
Minimum hold time	t _h	—	3.3 ± 0.3	0.5	0.5	ns	
			5.0 ± 0.5	0.5	0.5		
Minimum removal time ($\overline{\text{CLR}}$, $\overline{\text{PR}}$)	t _{rem}	—	3.3 ± 0.3	5.0	5.0	ns	
			5.0 ± 0.5	3.0	3.0		

AC Characteristics (unless otherwise specified, Input: $t_r = t_f = 3$ ns)

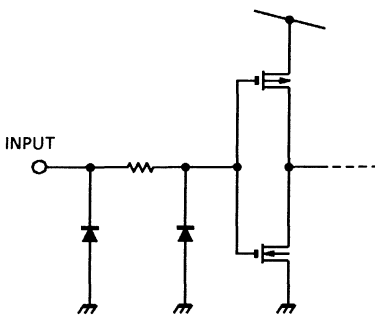
Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit		
			V _{CC} (V)	C _L (pF)	Min	Typ.	Max		Min	Max
Propagation delay time (CK-Q, \bar{Q})	t_{pLH}		3.3 ± 0.3	15	—	6.7	11.9	1.0	14.0	ns
				50	—	9.2	15.4	1.0	17.5	
	5.0 ± 0.5		15	—	4.6	7.3	1.0	8.5		
			50	—	6.1	9.3	1.0	10.5		
Propagation delay time (\bar{CLR} , \bar{PR} -Q, \bar{Q})	t_{pLH}		3.3 ± 0.3	15	—	7.6	12.3	1.0	14.5	ns
				50	—	10.1	15.8	1.0	18.0	
	5.0 ± 0.5		15	—	4.8	7.7	1.0	9.0		
			50	—	6.3	9.7	1.0	11.0		
Maximum clock frequency	f_{MAX}		3.3 ± 0.3	15	80	125	—	70	—	MHz
				50	50	75	—	45	—	
			5.0 ± 0.5	15	130	170	—	110	—	
				50	90	115	—	75	—	
Input capacitance	C _{IN}			—	4	10	—	10	pF	
Power dissipation capacitance	C _{PD}	(Note 2)			—	22	—	—	—	pF

Note 2: 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:

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

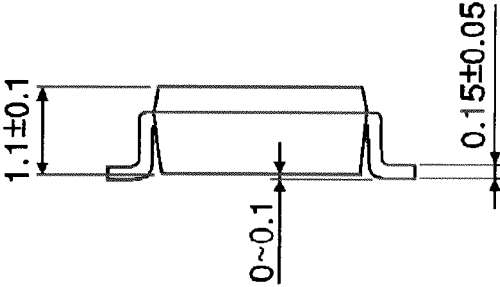
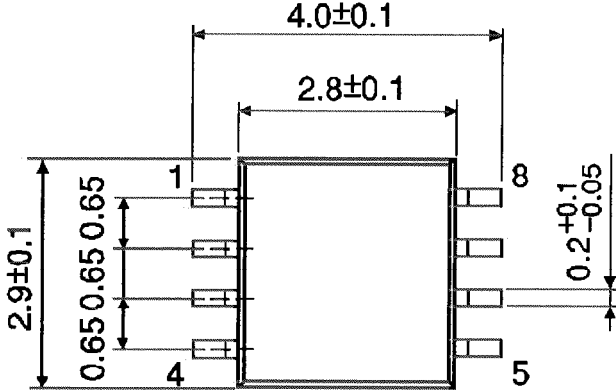
Input Equivalent Circuit



Package Dimensions

SSOP8-P-0.65

Unit : mm

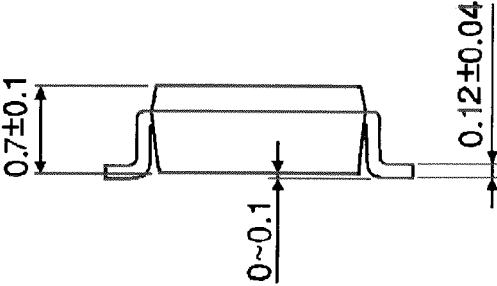
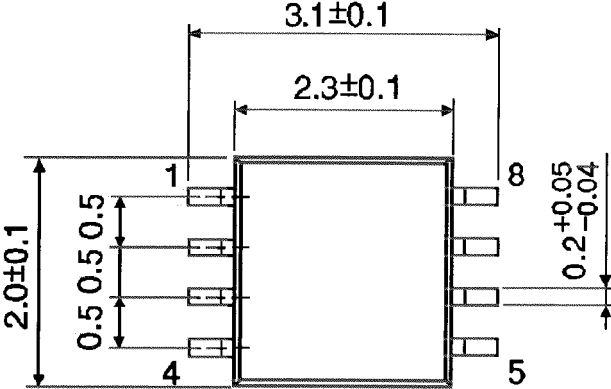


Mass: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Mass: 0.01 g (typ.)

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