

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC7WH74FU, TC7WH74FK

## D-TYPE FLIP FLOP WITH PRESET AND CLEAR

The TC7WH74 is an advanced high speed CMOS D-FLIP FLOP fabricated with silicon gate CMOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

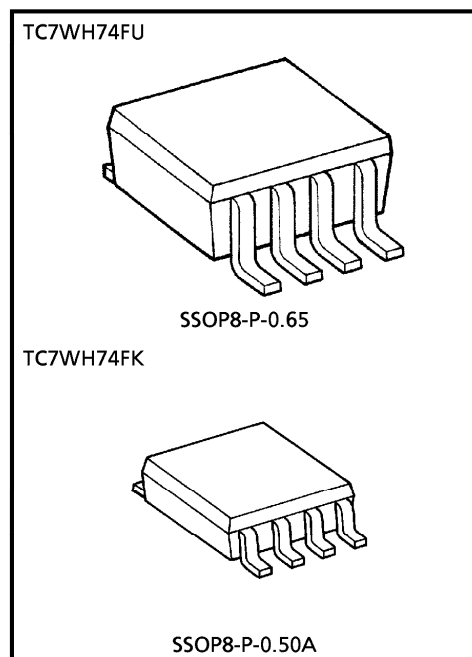
The signal level applied to the D INPUT is transferred to Q OUTPUT during the positive going transition of the CK pulse.

CLR and PR are independent of the CK and are accomplished by setting the appropriate input low.

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

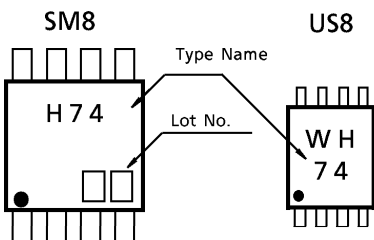
### FEATURES

- High Speed .....  $f_{MAX} = 170\text{MHz (Typ.) at } V_{CC} = 5\text{V}$
- Low Power Dissipation .....  $I_{CC} = 2\mu\text{A (Max.) at } T_a = 25^\circ\text{C}$
- 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 Operation Voltage Range ...  $V_{CC} (\text{opr}) = 2 \sim 5.5\text{V}$

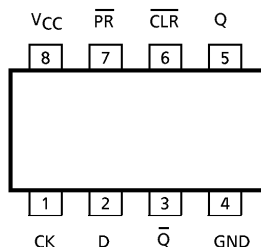


Weight  
 SSOP8-P-0.65 : 0.02g (Typ.)  
 SSOP8-P-0.50A : 0.01g (Typ.)

### MARKING



### PIN ASSIGNMENT (TOP VIEW)



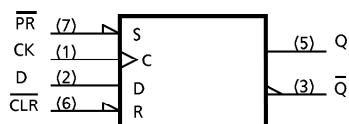
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**MAXIMUM RATINGS (Ta = 25°C)**

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage Range	V <sub>CC</sub>	-0.5~7.0	V
DC Input Voltage	V <sub>IN</sub>	-0.5~7.0	V
DC Output Voltage	V <sub>OUT</sub>	-0.5~V <sub>CC</sub> + 0.5	V
Input Diode Current	I <sub>IK</sub>	-20	mA
Output Diode Current	I <sub>OK</sub>	±20	mA
DC Output Current	I <sub>OUT</sub>	±25	mA
DC V <sub>CC</sub> /Ground Current	I <sub>CC</sub>	±50	mA
Power Dissipation	P <sub>D</sub>	300 (SM8)	mW
		200 (US8)	
Storage Temperature	T <sub>stg</sub>	-65~150	°C
Lead Temperature (10 s)	T <sub>L</sub>	260	°C

**LOGIC DIAGRAM**



**TRUTH TABLE**

INPUTS				OUTPUTS		FUNCTION
CLR	PR	D	CK	Q	Q̄	
L	H	x	x	L	H	CLEAR
H	L	x	x	H	L	PRESET
L	L	x	x	H	H	—
H	H	L	↓	L	H	—
H	H	H	↑	H	L	—
H	H	x	⊥	Q <sub>n</sub>	Q̄ <sub>n</sub>	NO CHANGE

x : Don't care

**RECOMMENDED OPERATING CONDITIONS**

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V <sub>CC</sub>	2~5.5	V
Input Voltage	V <sub>IN</sub>	0~V <sub>CC</sub>	V
Output Voltage	V <sub>OUT</sub>	0~V <sub>CC</sub>	V
Operating Temperature	T <sub>opr</sub>	-40~85	°C
Input Rise and Fall Time	dt/dv	0~100 (V <sub>CC</sub> = 3.3 ± 0.3V)	ns/V
		0~20 (V <sub>CC</sub> = 5 ± 0.5V)	

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**DC ELECTRICAL CHARACTERISTICS**

CHARACTERISTIC	SYMBOL	TEST CONDITION	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40~85°C		UNIT	
				MIN.	TYP.	MAX.	MIN.	MAX.		
High-Level Input Voltage	V <sub>IH</sub>	—	2.0	1.5	—	—	1.5	—	V	
			3.0~5.5	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7	—		
Low-Level Input Voltage	V <sub>IL</sub>	—	2.0	—	—	0.5	—	0.5	V	
			3.0~5.5	—	—	V <sub>CC</sub> × 0.3	—	V <sub>CC</sub> × 0.3		
High-Level Output Voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50μA	2.0	1.9	2.0	—	1.9	—	V
				3.0	2.9	3.0	—	2.9	—	
			I <sub>OH</sub> = -4mA	4.5	4.4	4.5	—	4.4	—	
				3.0	2.58	—	—	2.48	—	
I <sub>OH</sub> = -8mA	4.5	3.94	—	—	3.80	—				
	Low-Level Output Voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50μA	2.0	—	0.0	0.1	—	0.1
3.0					—	0.0	0.1	—	0.1	
4.5					—	0.0	0.1	—	0.1	
I <sub>OL</sub> = 4mA				3.0	—	—	0.36	—	0.44	
	4.5	—	—	0.36	—	0.44				
Input Leakage Current	I <sub>IIN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	0~5.5	—	—	±0.1	—	±1.0	μA	
Quiescent Supply Current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5	—	—	2.0	—	20.0	μA	

**TIMING REQUIREMENTS (Input t<sub>r</sub> = t<sub>f</sub> = 3ns)**

CHARACTERISTIC	SYMBOL	TEST CONDITION	V <sub>CC</sub> (V)	Ta = 25°C		Ta = -40~85°C	UNIT
				TYP.	LIMIT	LIMIT	
Minimum Pulse Width (CLOCK)	t <sub>W</sub> (L)		3.3 ± 0.3	—	6.0	7.0	ns
	t <sub>W</sub> (H)		5.0 ± 0.5	—	5.0	5.0	
Minimum Pulse Width (CLR, PR)	t <sub>W</sub> (L)		3.3 ± 0.3	—	6.0	7.0	ns
			5.0 ± 0.5	—	5.0	5.0	
Minimum Set-up Time	t <sub>s</sub>		3.3 ± 0.3	—	7.0	7.0	ns
			5.0 ± 0.5	—	5.0	5.0	
Minimum Hold Time	t <sub>h</sub>		3.3 ± 0.3	—	0.5	0.5	ns
			5.0 ± 0.5	—	0.5	0.5	
Minimum Removal Time (CLR, PR)	t <sub>rem</sub>		3.3 ± 0.3	—	5.0	5.0	ns
			5.0 ± 0.5	—	3.0	3.0	

**AC ELECTRICAL CHARACTERISTICS** (Input  $t_r = t_f = 3\text{ns}$ )

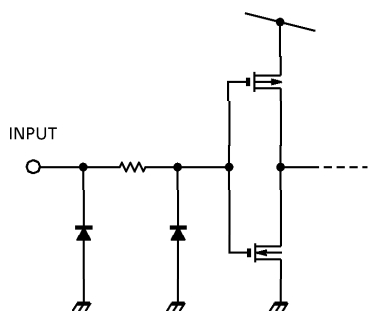
CHARACTERISTIC	SYMBOL	TEST CONDITION		Ta = 25°C			Ta = -40~85°C		UNIT
		V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	MIN.	TYP.	MAX.	MIN.	MAX.	
Propagation Delay Time (CK-Q, $\bar{Q}$ )	$t_{pLH}$ $t_{pHL}$	3.3 ± 0.3	15	—	6.7	11.9	1.0	14.0	ns
			50	—	9.2	15.4	1.0	17.5	
		5.0 ± 0.5	15	—	4.6	7.3	1.0	8.5	
			50	—	6.1	9.3	1.0	10.5	
Propagation Delay Time ( $\bar{CLR}$ , $\bar{PR-Q}$ , $\bar{Q}$ )	$t_{pLH}$ $t_{pHL}$	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 <sub>MAX</sub>	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 <sub>IN</sub>			—	4	10	—	10	pF
Power Dissipation Capacitance	C <sub>PD</sub>	(Note 1)		—	22	—	—	—	pF

(Note 1) : C<sub>PD</sub> 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 :

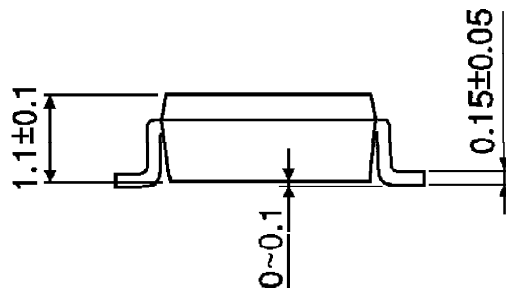
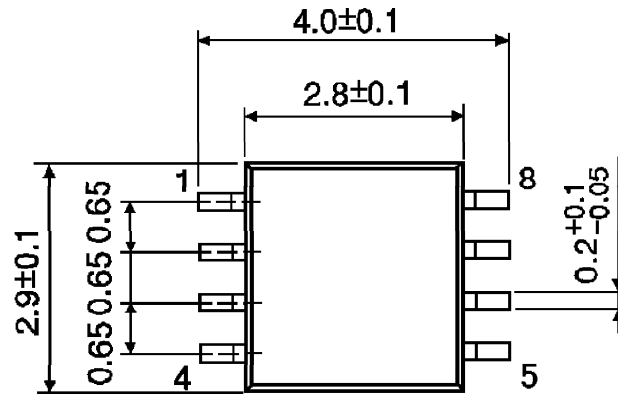
$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

**INPUT EQUIVALENT CIRCUIT**



OUTLINE DRAWING  
SSOP8-P-0.65

Unit : mm



Weight : 0.02g (Typ.)

