

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

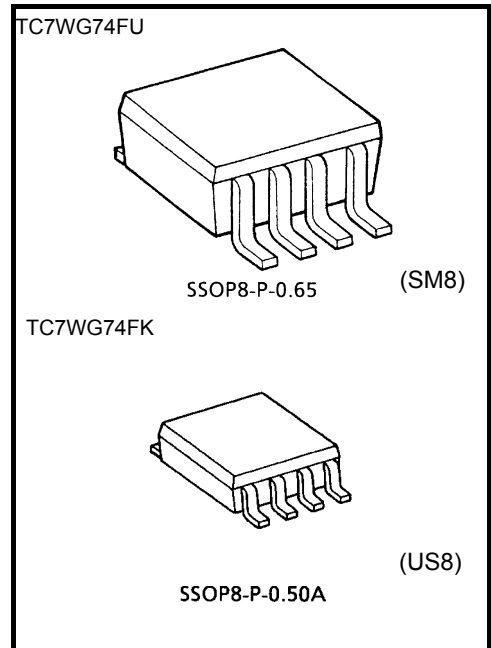
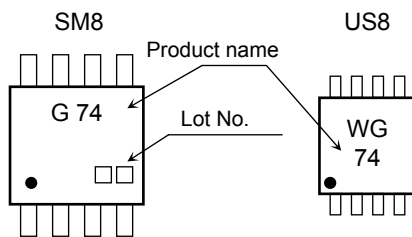
TC7WG74FU, TC7WG74FK

D-Type Flip Flop with Preset and Clear

Features

- High-speed : $f_{MAX} = 246 \text{ MHz (Typ.)}$
at $V_{CC} = 3 \text{ V}$, $CL=15\text{pF}$
- High-level output current : $\pm 8 \text{ mA (min)}$ at $V_{CC} = 3 \text{ V}$
- Operation voltage range : $V_{CC(opr)}=0.9 \text{ to } 3.6\text{V}$
- 5.5-V tolerant inputs
- 3.6-V power down protection outputs

Marking

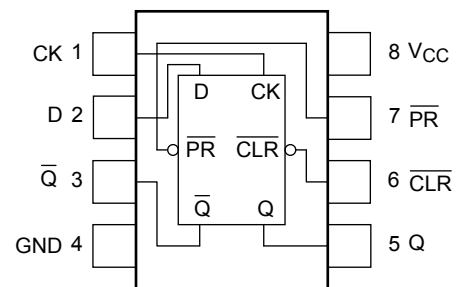


Weight
 SSOP8-P-0.65 : 0.02 g (typ.)
 SSOP8-P-0.50A : 0.01 g (typ.)

Absolute Maximum Ratings

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.5 to 4.6	V
DC input voltage	V_{IN}	-0.5 to 7.0	V
DC output voltage	V_{OUT}	-0.5 to 4.6 (Note 1)	V
		-0.5 to $V_{CC} + 0.5$ (Note 2)	
Input diode current	I_{IK}	-20	mA
Output diode current	I_{OK}	-20 (Note 3)	mA
DC output current	I_{OUT}	± 25	mA
DC V_{CC} / ground current	I_{CC}	± 100	mA
Power dissipation	P_D	300 (SM8) 200 (US8)	mW
Storage temperature	T_{stg}	-65 to 150	$^{\circ}\text{C}$

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: $V_{CC} = 0\text{V}$

Note 2: High or Low State. I_{OUT} absolute maximum rating must be observed.

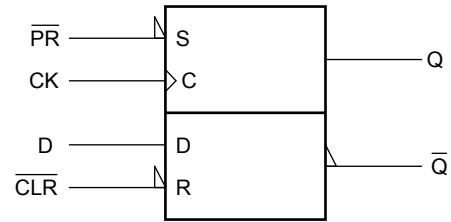
Note 3: $V_{OUT} < \text{GND}$

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	Qn	$\overline{\text{Qn}}$	No Change

X: Don't care

IEC logic Symbol



Operating Ranges

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	0.9 to 3.6	V
Input voltage	V_{IN}	0 to 5.5	V
Output voltage	V_{OUT}	0 to 3.6 (Note 4)	V
		0 to V_{CC} (Note 5)	
Output Current	I_{OH}/I_{OL}	± 8.0 (Note 6)	mA
		± 4.0 (Note 7)	
		± 3.0 (Note 8)	
		± 1.7 (Note 9)	
		± 0.3 (Note 10)	
		± 0.02 (Note 11)	
Operating temperature	T_{opr}	-40 to 85	$^{\circ}\text{C}$
Input rise and fall time	dt/dv	0 to 10 (Note 12)	ns/V

Note 4: $V_{CC} = 0\text{V}$

Note 5: High or Low state

Note 6: $V_{CC} = 3.0$ to 3.6V

Note 7: $V_{CC} = 2.3$ to 2.7V

Note 8: $V_{CC} = 1.65$ to 1.95V

Note 9: $V_{CC} = 1.4$ to 1.6V

Note 10: $V_{CC} = 1.1$ to 1.3V

Note 11: $V_{CC} = 0.9\text{V}$

Note 12: $V_{IN} = 0.8$ to 2.0V , $V_{CC} = 3.0\text{V}$

DC Electrical 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}	—	0.9	V _{CC}	—	—	V _{CC}	—	V	
			1.1 to 1.3	V _{CC} × 0.7	—	—	V _{CC} × 0.7	—		
			1.4 to 1.6	V _{CC} × 0.65	—	—	V _{CC} × 0.65	—		
			1.65 to 1.95	V _{CC} × 0.65	—	—	V _{CC} × 0.65	—		
			2.3 to 2.7	1.7	—	—	1.7	—		
			3.0 to 3.6	2.0	—	—	2.0	—		
Low-level input voltage	V _{IL}	—	0.9	—	—	GND	—	GND	V	
			1.1 to 1.3	—	—	V _{CC} × 0.3	—	V _{CC} × 0.3		
			1.4 to 1.6	—	—	V _{CC} × 0.35	—	V _{CC} × 0.35		
			1.65 to 1.95	—	—	V _{CC} × 0.35	—	V _{CC} × 0.35		
			2.3 to 2.7	—	—	0.7	—	0.7		
			3.0 to 3.6	—	—	0.8	—	0.8		
High-level output voltage	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -0.02 mA	0.9	0.75	—	—	0.75	—	V
			I _{OH} = -0.3 mA	1.1 to 1.3	V _{CC} × 0.75	—	—	V _{CC} × 0.75	—	
			I _{OH} = -1.7 mA	1.4 to 1.6	V _{CC} × 0.75	—	—	V _{CC} × 0.75	—	
			I _{OH} = -3.0 mA	1.65 to 1.95	V _{CC} - 0.45	—	—	V _{CC} - 0.45	—	
			I _{OH} = -4.0 mA	2.3 to 2.7	2.0	—	—	2.0	—	
			I _{OH} = -8.0 mA	3.0 to 3.6	2.48	—	—	2.48	—	
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 0.02 mA	0.9	—	—	0.1	—	0.1	V
			I _{OL} = 0.3 mA	1.1 to 1.3	—	—	V _{CC} × 0.25	—	V _{CC} × 0.25	
			I _{OL} = 1.7 mA	1.4 to 1.6	—	—	V _{CC} × 0.25	—	V _{CC} × 0.25	
			I _{OL} = 3.0 mA	1.65 to 1.95	—	—	0.45	—	0.45	
			I _{OL} = 4.0 mA	2.3 to 2.7	—	—	0.4	—	0.4	
			I _{OL} = 8.0 mA	3.0 to 3.6	—	—	0.4	—	0.4	
Input leakage current	I _{IN}	V _{IN} = 0 to 5.5V	0 to 3.6	—	—	±0.1	—	±1.0	μA	
Power off leakage current	I _{OFF}	V _{IN} = 0 to 5.5V V _{OUT} = 0 to 3.6V	0.0	—	—	1.0	—	10.0	μA	
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND	3.6	—	—	1.0	—	10.0	μA	

Timing Requirements (Input: $t_r = t_f = 3 \text{ ns}$)

Characteristic	Symbol	Test condition	Ta = 25°C			Ta = -40~85°C		Unit	
			V _{CC} (V)	Min.	Typ.	Max.	Min.		Max.
Pulse width (CK)	$t_{W(L)}$ $t_{W(H)}$		0.9	—	26.4	—	—	ns	
			1.1 to 1.3	12.4	—	—	22.7		—
			1.4 to 1.6	5.5	—	—	6.7		—
			1.65 to 1.95	4.3	—	—	4.7		—
			2.3 to 2.7	3.5	—	—	3.5		—
			3.0 to 3.6	3.2	—	—	3.2		—
Pulse width ($\overline{\text{CLR}}$, $\overline{\text{PR}}$)	$t_{W(L)}$		0.9	—	22.8	—	—	ns	
			1.1 to 1.3	11.6	—	—	20.4		—
			1.4 to 1.6	5.3	—	—	6.5		—
			1.65 to 1.95	4.2	—	—	4.6		—
			2.3 to 2.7	3.3	—	—	3.3		—
			3.0 to 3.6	3.2	—	—	3.2		—
Set-up time	t_s		0.9	—	31.9	—	—	ns	
			1.1 to 1.3	14.4	—	—	21.7		—
			1.4 to 1.6	6.4	—	—	7.2		—
			1.65 to 1.95	4.4	—	—	4.8		—
			2.3 to 2.7	2.5	—	—	2.9		—
			3.0 to 3.6	1.9	—	—	2.3		—
Hold time	t_h		0.9	—	0.5	—	—	ns	
			1.1 to 1.3	0.1	—	—	0.1		—
			1.4 to 1.6	0.1	—	—	0.1		—
			1.65 to 1.95	0.1	—	—	0.1		—
			2.3 to 2.7	0.1	—	—	0.1		—
			3.0 to 3.6	0.1	—	—	0.1		—
Removal time ($\overline{\text{CLR}}$, $\overline{\text{PR}}$)	t_{rem}		0.9	—	17.9	—	—	ns	
			1.1 to 1.3	8.6	—	—	13		—
			1.4 to 1.6	3.9	—	—	4.4		—
			1.65 to 1.95	2.6	—	—	3.1		—
			2.3 to 2.7	1.5	—	—	1.9		—
			3.0 to 3.6	1.2	—	—	1.5		—

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

Characteristic	Symbol	Test condition	Ta = 25°C			Ta = -40 to 85°C		Unit	
			V _{CC} (V)	Min.	Typ.	Max.	Min.		Max.
Propagation delay time ($\overline{CK} - \overline{Q}, \overline{Q}$)	t_{pLH} t_{pHL}	CL = 10 pF	0.9	—	36.6	—	1.0	—	ns
			1.1 to 1.3	—	15.7	23.2	1.0	34.6	
			1.4 to 1.6	—	8.0	10.5	1.0	11.5	
			1.65 to 1.95	—	5.9	7.4	1.0	7.9	
			2.3 to 2.7	—	3.8	4.7	1.0	5.1	
			3.0 to 3.6	—	3.0	3.8	1.0	4.2	
		CL = 15 pF	0.9	—	40.8	—	1.0	—	
			1.1 to 1.3	—	17.1	25.3	1.0	38.5	
			1.4 to 1.6	—	8.8	11.5	1.0	12.7	
			1.65 to 1.95	—	6.4	8.1	1.0	8.6	
			2.3 to 2.7	—	4.1	5.1	1.0	5.5	
			3.0 to 3.6	—	3.3	4.1	1.0	4.5	
		CL = 30 pF	0.9	—	54.8	—	1.0	—	
			1.1 to 1.3	—	22.6	34.7	1.0	54.4	
			1.4 to 1.6	—	11.4	15.0	1.0	16.8	
			1.65 to 1.95	—	8.2	10.3	1.0	10.8	
			2.3 to 2.7	—	5.2	6.3	1.0	6.6	
			3.0 to 3.6	—	4.1	5.0	1.0	5.3	
Propagation delay time ($\overline{CLR}, \overline{PR} - \overline{Q}, \overline{Q}$)	t_{pLH} t_{pHL}	CL = 10 pF	0.9	—	46.9	—	1.0	—	ns
			1.1 to 1.3	—	18.8	27.8	1.0	45.2	
			1.4 to 1.6	—	9.5	12.4	1.0	14.0	
			1.65 to 1.95	—	6.9	8.7	1.0	9.1	
			2.3 to 2.7	—	4.3	5.3	1.0	5.7	
			3.0 to 3.6	—	3.3	4.2	1.0	4.6	
		CL = 15 pF	0.9	—	50.1	—	1.0	—	
			1.1 to 1.3	—	20.2	29.8	1.0	49.4	
			1.4 to 1.6	—	10.1	13.2	1.0	15.1	
			1.65 to 1.95	—	7.3	9.2	1.0	9.7	
			2.3 to 2.7	—	4.5	5.6	1.0	6.2	
			3.0 to 3.6	—	3.6	4.5	1.0	4.9	
		CL = 30 pF	0.9	—	64.4	—	1.0	—	
			1.1 to 1.3	—	25.6	39.2	1.0	64.6	
			1.4 to 1.6	—	12.6	16.8	1.0	19.1	
			1.65 to 1.95	—	9.0	11.3	1.0	11.8	
			2.3 to 2.7	—	5.6	6.8	1.0	7.1	
			3.0 to 3.6	—	4.4	5.3	1.0	5.6	

AC Electrical Characteristics (unless otherwise specified, Input : $t_r = t_f = 3 \text{ ns}$)

Characteristic	Symbol	Test condition	Ta = 25°C			Ta = -40~85°C		Unit	
			V _{CC} (V)	Min.	Typ.	Max.	Min.		Max.
Clock frequency	f _{MAX}	CL = 10 pF	0.9	—	14	—	—	MHz	
			1.1 to 1.3	22	35	—	14		
			1.4 to 1.6	57	75	—	51		
			1.65 to 1.95	90	111	—	84		
			2.3 to 2.7	169	194	—	145		
			3.0 to 3.6	233	254	—	200		
		CL = 15 pF	0.9	—	13	—	—		—
			1.1 to 1.3	20	32	—	13		—
			1.4 to 1.6	59	74	—	48		—
			1.65 to 1.95	84	104	—	80		—
			2.3 to 2.7	156	179	—	139		—
			3.0 to 3.6	225	246	—	189		—
		CL = 30 pF	0.9	—	14	—	—		—
			1.1 to 1.3	17	30	—	11		—
			1.4 to 1.6	45	63	—	39		—
			1.65 to 1.95	71	91	—	68		—
			2.3 to 2.7	135	159	—	120		—
			3.0 to 3.6	189	214	—	163		—
Input capacitance	C _{IN}	—	3.6	—	3	—	—	pF	
Power dissipation capacitance	C _{PD}	(Note 13)	0.9 to 3.6	—	14	—	—	—	pF

Note 13: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

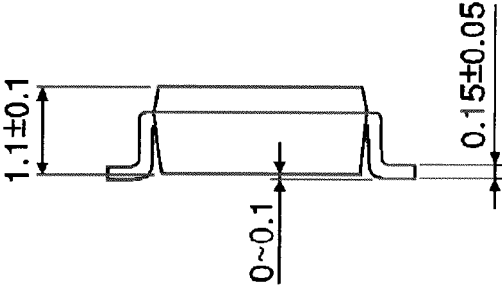
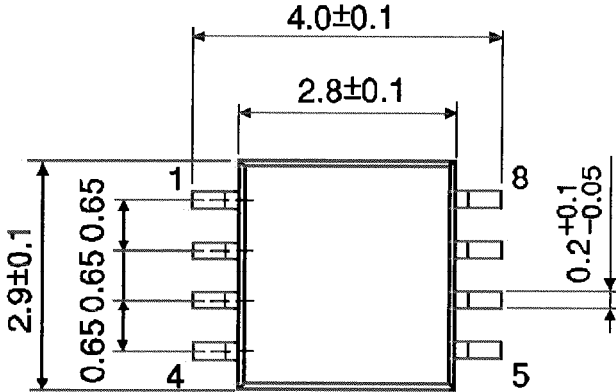
Average operating current can be obtained by the equation:

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

Package Dimensions

SSOP8-P-0.65

Unit : mm

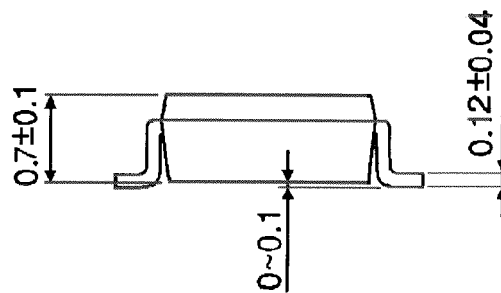
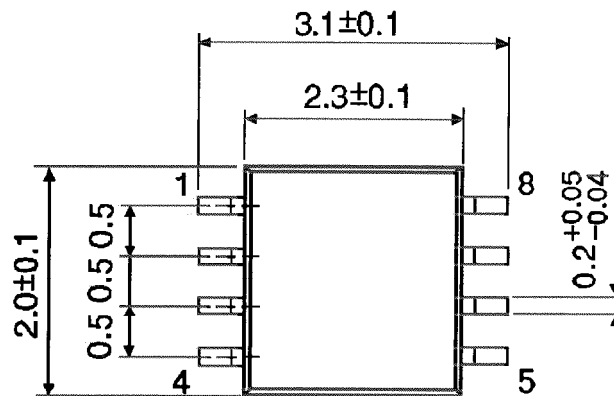


Weight: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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