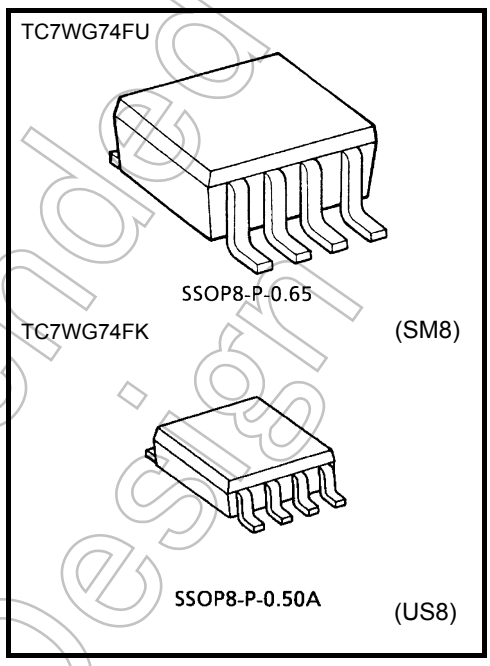
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7WG74FU, TC7WG74FK

D-Type Flip Flop with Preset and Clear

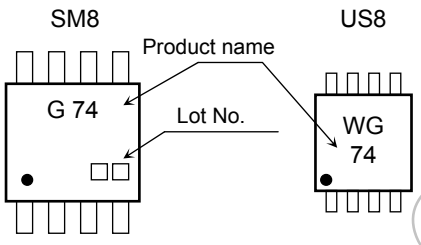
Features

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



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

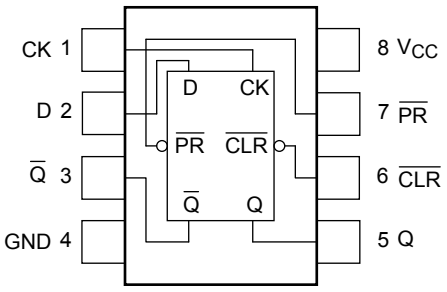
Marking



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	°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} = 0V

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

Note 3: V_{OUT} < GND

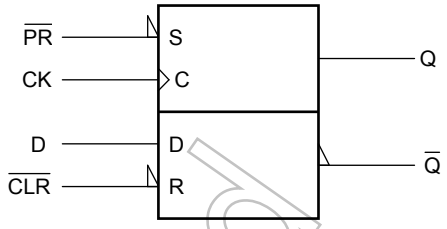
Start of commercial production
2006-08

Truth Table

Inputs				Outputs		Function
$\overline{CLR}$	$\overline{PR}$	D	CK	Q	$\overline{Q}$	
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	↓	Qn	$\overline{Qn}$	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		°C
Input rise and fall time	dt/dv	0 to 10	(Note 12)	ns/V

Note 4: V_{CC} = 0V

Note 5: High or Low state

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

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

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

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

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

Note 11: V_{CC} = 0.9 V

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

DC Electrical Characteristics

Characteristics	Symbol	Test Condition		V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40 to 85°C Min	Ta = −40 to 85°C Max	Unit
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: $t_r = t_f = 3$ ns)

Characteristic	Symbol	Test condision	Ta = 25°C			Ta = −40 to 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 ($\overline{CLR}$, $\overline{PR}$)	$t_{W(L)}$	0.9	—	22.8	—	—	—	
		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	—	—	—	
		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	—	—	—	
		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 ($\overline{CLR}$, $\overline{PR}$)	t_{rem}	0.9	—	17.9	—	—	—	
		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 deley time (CK – 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 deley time ($\overline{CLR}$, $\overline{PR}$ – 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	

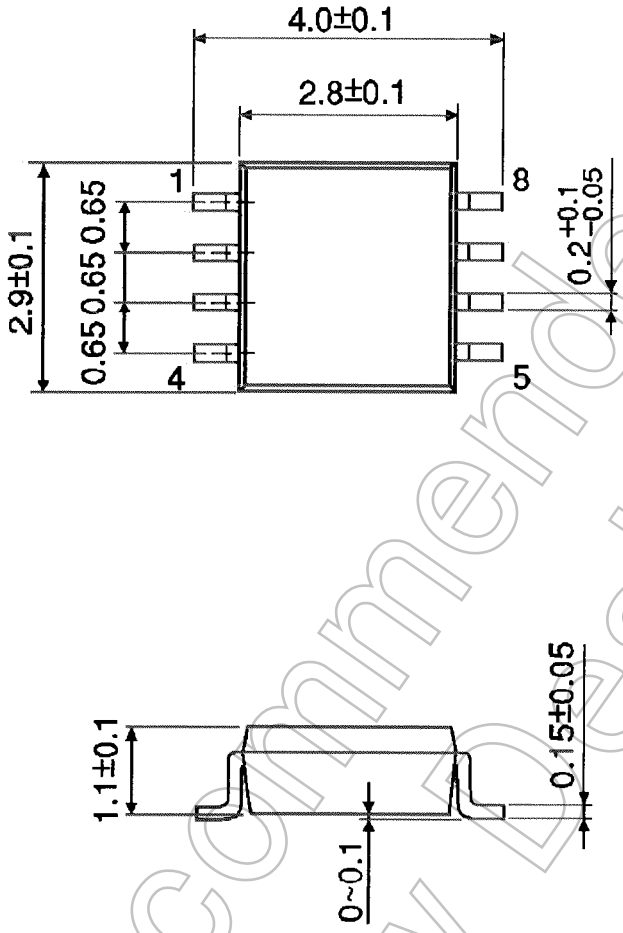
AC Electrical Characteristics (unless otherwise specified, Input : $t_r = t_f = 3$ ns)

Characteristic	Symbol	Test condition		Ta = 25°C			Ta = −40 to 85°C		Unit
			V_{CC} (V)	Min	Typ.	Max	Min	Max	
Clock frequency	f_{MAX}	CL = 10 pF	0.9	—	14	—	—	—	MH_Z
			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 capacitanse	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:
$I_{CC\ (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

Package Dimensions

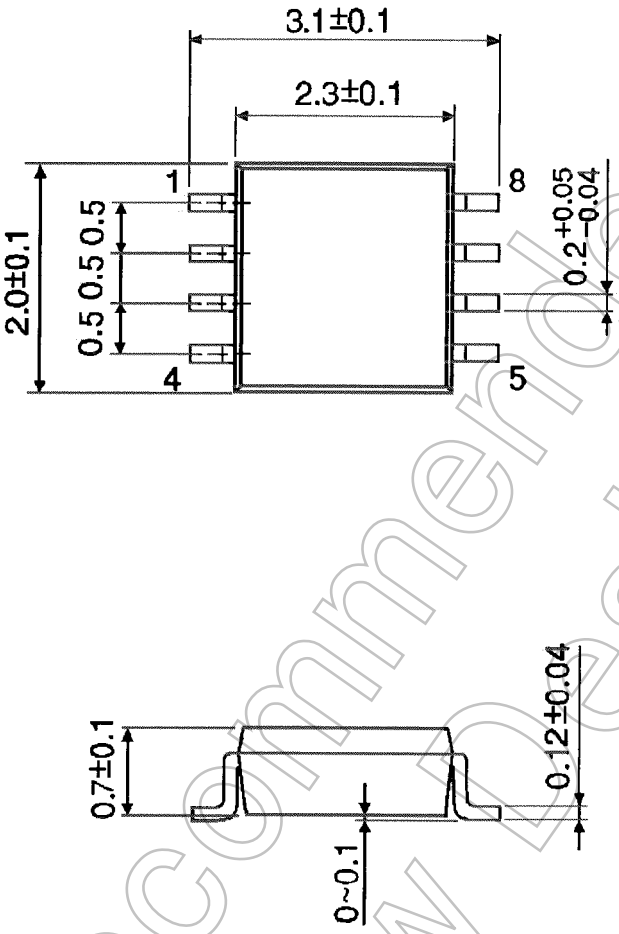
SSOP8-P-0.65 Unit : mm



Weight: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A Unit : mm



Weight: 0.01 g (typ.)

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