

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

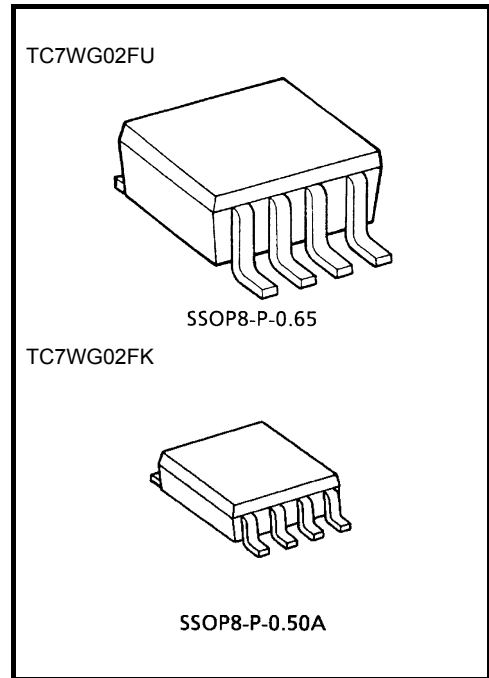
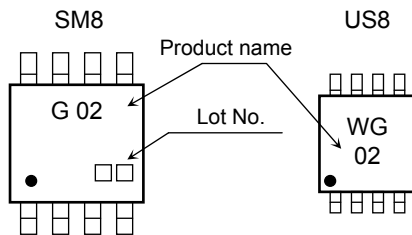
# TC7WG02FU, TC7WG02FK

## Dual 2-Input NOR Gate

### Features

- High-level output current:  $I_{OH}/I_{OL} = \pm 8 \text{ mA}$  (min) at  $V_{CC} = 3 \text{ V}$
- High-speed operation:  $t_{pd} = 2.8 \text{ ns}$  (typ.) at  $V_{CC} = 3.3 \text{ V}, 15\text{pF}$
- Operating voltage range:  $V_{CC} = 0.9\sim 3.6 \text{ V}$
- 5.5-V tolerant inputs
- 3.6-V power down protection outputs

### Marking

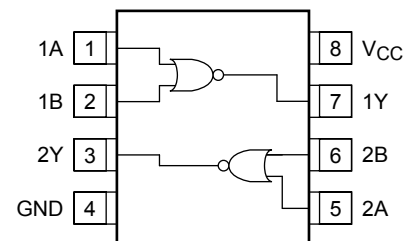


Weight  
 SSOP8-P-0.65 : 0.02 g (typ.)  
 SSOP8-P-0.50A : 0.01 g (typ.)

### Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Value	Unit
Power supply voltage	$V_{CC}$	-0.5~4.6	V
DC input voltage	$V_{IN}$	-0.5~7.0	V
DC output voltage	$V_{OUT}$	-0.5~4.6 (Note 1)	V
		-0.5~ $V_{CC} + 0.5$ (Note 2)	
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	-20 (Note 3)	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ / ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	300 (SM8) 200 (US8)	mW
Storage temperature	$T_{stg}$	-65~150	°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:  $V_{CC} = 0 \text{ V}$

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

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

## IEC Logic Symbol



## Truth Table

Inputs		Outputs
A	B	Y
L	L	H
L	H	L
H	L	L
H	H	L

## Operating Ranges

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

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

Note 5: High or Low state.

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

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

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

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

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

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

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

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit			
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max		
Input voltage	High level	V <sub>IH</sub>	—	0.9	V <sub>CC</sub>	—	—	V <sub>CC</sub>	—	V	
				1.1~1.3	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7	—		
				1.4~1.6	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—		
				1.65~1.95	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—		
				2.3~2.7	1.7	—	—	1.7	—		
				3.0~3.6	2.0	—	—	2.0	—		
	Low level	V <sub>IL</sub>	—	0.9	—	—	GND	—	GND		
				1.1~1.3	—	—	V <sub>CC</sub> × 0.3	—	V <sub>CC</sub> × 0.3		
				1.4~1.6	—	—	V <sub>CC</sub> × 0.35	—	V <sub>CC</sub> × 0.35		
				1.65~1.95	—	—	V <sub>CC</sub> × 0.35	—	V <sub>CC</sub> × 0.35		
				2.3~2.7	—	—	0.7	—	0.7		
				3.0~3.6	—	—	0.8	—	0.8		
Output voltage	High level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -0.02 mA	0.9	0.75	—	—	0.75	—	V
				I <sub>OH</sub> = -0.3 mA	1.1~1.3	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
				I <sub>OH</sub> = -1.7 mA	1.4~1.6	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
				I <sub>OH</sub> = -3.0 mA	1.65~1.95	V <sub>CC</sub> -0.45	—	—	V <sub>CC</sub> -0.45	—	
				I <sub>OH</sub> = -4.0 mA	2.3~2.7	2.0	—	—	2.0	—	
				I <sub>OH</sub> = -8.0 mA	3.0~3.6	2.48	—	—	2.48	—	
	Low level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 0.02 mA	0.9	—	—	0.1	—	0.1	
				I <sub>OL</sub> = 0.3 mA	1.1~1.3	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
				I <sub>OL</sub> = 1.7 mA	1.4~1.6	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
				I <sub>OL</sub> = 3.0 mA	1.65~1.95	—	—	0.45	—	0.45	
				I <sub>OL</sub> = 4.0 mA	2.3~2.7	—	—	0.4	—	0.4	
				I <sub>OL</sub> = 8.0 mA	3.0~3.6	—	—	0.4	—	0.4	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 0~5.5 V	0~3.6	—	—	±0.1	—	±1.0	μA		
Power off leakage current	I <sub>OFF</sub>	V <sub>IN</sub> = 0~5.5 V V <sub>OUT</sub> = 0~3.6 V	0	—	—	1.0	—	10.0	μA		
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	3.6	—	—	1.0	—	10.0	μA		

**AC Characteristics (Input:  $t_r = t_f = 3 \text{ ns}$ )**

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit	
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
Propagation delay time	$t_{pLH}$ $t_{pHL}$	$C_L = 10 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	0.9	—	19.8	—	—	ns	
			1.1~1.3	—	10.1	18.7	1.0		34.5
			1.4~1.6	—	5.9	8.9	1.0		10.8
			1.65~ 1.95	—	4.5	6.4	1.0		6.9
			2.3~2.7	—	3.1	4.2	1.0		4.7
			3.0~3.6	—	2.3	3.4	1.0		4.0
		$C_L = 15 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	0.9	—	22.5	—	—		—
			1.1~1.3	—	11.6	21.5	1.0		37.2
			1.4~1.6	—	6.6	9.8	1.0		12.0
			1.65~ 1.95	—	5.0	7.1	1.0		7.3
			2.3~2.7	—	3.5	4.5	1.0		5.1
			3.0~3.6	—	2.8	3.8	1.0		4.4
		$C_L = 30 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	0.9	—	30.0	—	—		—
			1.1~1.3	—	15.0	29.6	1.0		56.0
			1.4~1.6	—	8.5	13.1	1.0		15.9
			1.65~ 1.95	—	6.3	9.2	1.0		9.6
			2.3~2.7	—	4.3	5.7	1.0		6.1
			3.0~3.6	—	3.5	4.4	1.0		4.8
Input capacitance	$C_{IN}$	—	3.6	—	3	—	—	pF	
Power dissipation capacitance	$C_{PD}$	(Note13)	0.9 ~ 3.6	—	11	—	—	—	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.

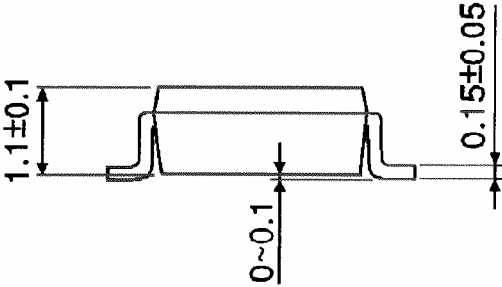
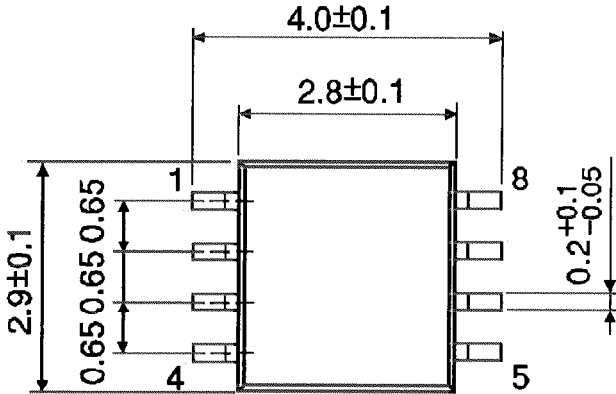
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$$

**Package Dimensions**

SSOP8-P-0.65

Unit : mm

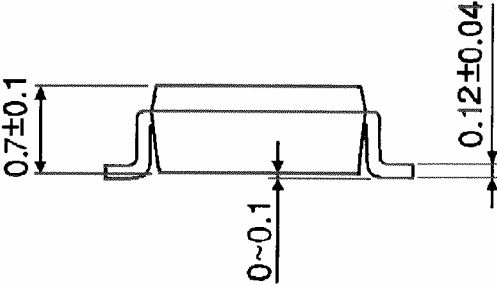
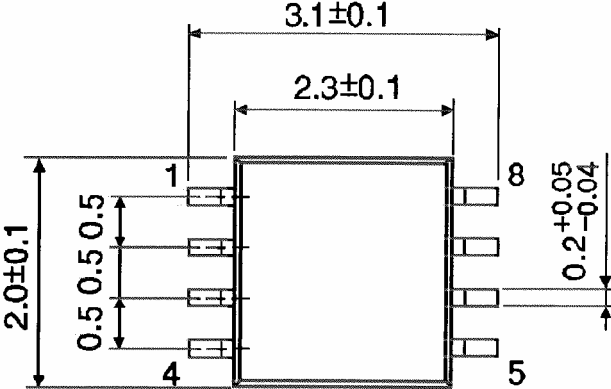


Weight: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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20070701-EN GENERAL

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