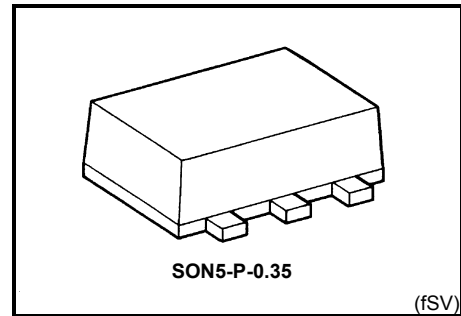


# TC7SG02AFS

## 2 Input NOR Gate

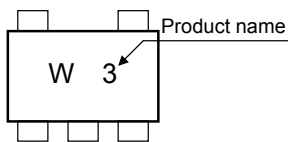
### Features

- High-level output current:  $I_{OH}/I_{OL} = \pm 8 \text{ mA (min)}$   
at  $V_{CC} = 3.0 \text{ V}$
- High-speed operation:  $t_{pd} = 2.4 \text{ ns (typ.)}$   
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.

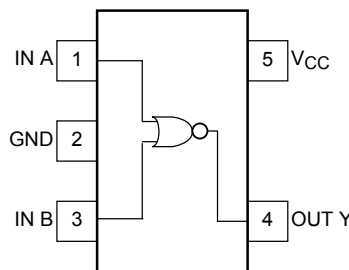


Weight: 0.001 g (typ.)

### Marking



### Pin Assignment (top view)



### 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~ $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$ (Note 1)	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	50	mW
Storage temperature	$T_{stg}$	-65~150	°C

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.

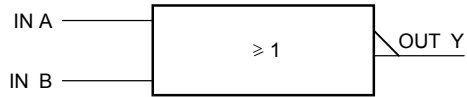
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

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

**Truth Table**

A	B	Y
L	L	H
L	H	L
H	L	L
H	H	L

**IEC Logic Symbol**



**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~ $V_{CC}$	V
Output Current	$I_{OH}/I_{OL}$	$\pm 8.0$ (Note 2)	mA
		$\pm 4.0$ (Note 3)	
		$\pm 3.0$ (Note 4)	
		$\pm 1.7$ (Note 5)	
		$\pm 0.3$ (Note 6)	
		$\pm 0.02$ (Note 7)	
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	dt/dV	0~10 (Note 8)	ns/V

Note 2:  $V_{CC} = 3.0\sim 3.6$  V

Note 3:  $V_{CC} = 2.3\sim 2.7$  V

Note 4:  $V_{CC} = 1.65\sim 1.95$  V

Note 5:  $V_{CC} = 1.4\sim 1.6$  V

Note 6:  $V_{CC} = 1.1\sim 1.3$  V

Note 7:  $V_{CC} = 0.9$  V

Note 8:  $V_{IN} = 0.8\sim 2.0$  V,  $V_{CC} = 3.0$  V

**DC Electrical Characteristics**

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit		
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max	
High-level input voltage	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 input voltage	V <sub>IL</sub>	—	0.9	—	—	GND	—	GND	V	
			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		
High-level output voltage	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 output voltage	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	V
			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> = 0~5.5V	0~3.6	—	—	±0.1	—	±1.0	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 Electrical Characteristics (input  $t_r = t_f = 3$  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 <sub>PLH</sub> t <sub>PHL</sub>	C <sub>L</sub> = 10 pF, R <sub>L</sub> = 1 MΩ	0.9	—	17.0	—	—	ns	
			1.1~1.3	—	8.8	18.4	1.0		34.2
			1.4~1.6	—	5.0	8.5	1.0		10.0
			1.65~1.95	—	3.8	6.2	1.0		6.7
			2.3~2.7	—	2.7	3.9	1.0		4.4
			3.0~3.6	—	2.1	3.1	1.0		3.7
		C <sub>L</sub> = 15 pF, R <sub>L</sub> = 1 MΩ	0.9	—	20.7	—	—		—
			1.1~1.3	—	10.6	21.5	1.0		37.2
			1.4~1.6	—	5.9	9.3	1.0		11.2
			1.65~1.95	—	4.5	6.9	1.0		7.1
			2.3~2.7	—	3.0	4.4	1.0		5.0
			3.0~3.6	—	2.4	3.4	1.0		3.9
		C <sub>L</sub> = 30 pF, R <sub>L</sub> = 1 MΩ	0.9	—	29.6	—	—		—
			1.1~1.3	—	14.8	29.6	1.0		56.0
			1.4~1.6	—	8.0	13.1	1.0		15.9
			1.65~1.95	—	6.0	9.2	1.0		9.6
			2.3~2.7	—	3.9	5.7	1.0		6.1
			3.0~3.6	—	3.0	4.4	1.0		4.8
Input capacitance	C <sub>IN</sub>	—	3.6	—	3	—	—	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note9)	0.9~3.6	—	6	—	—	—	pF

Note 9: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

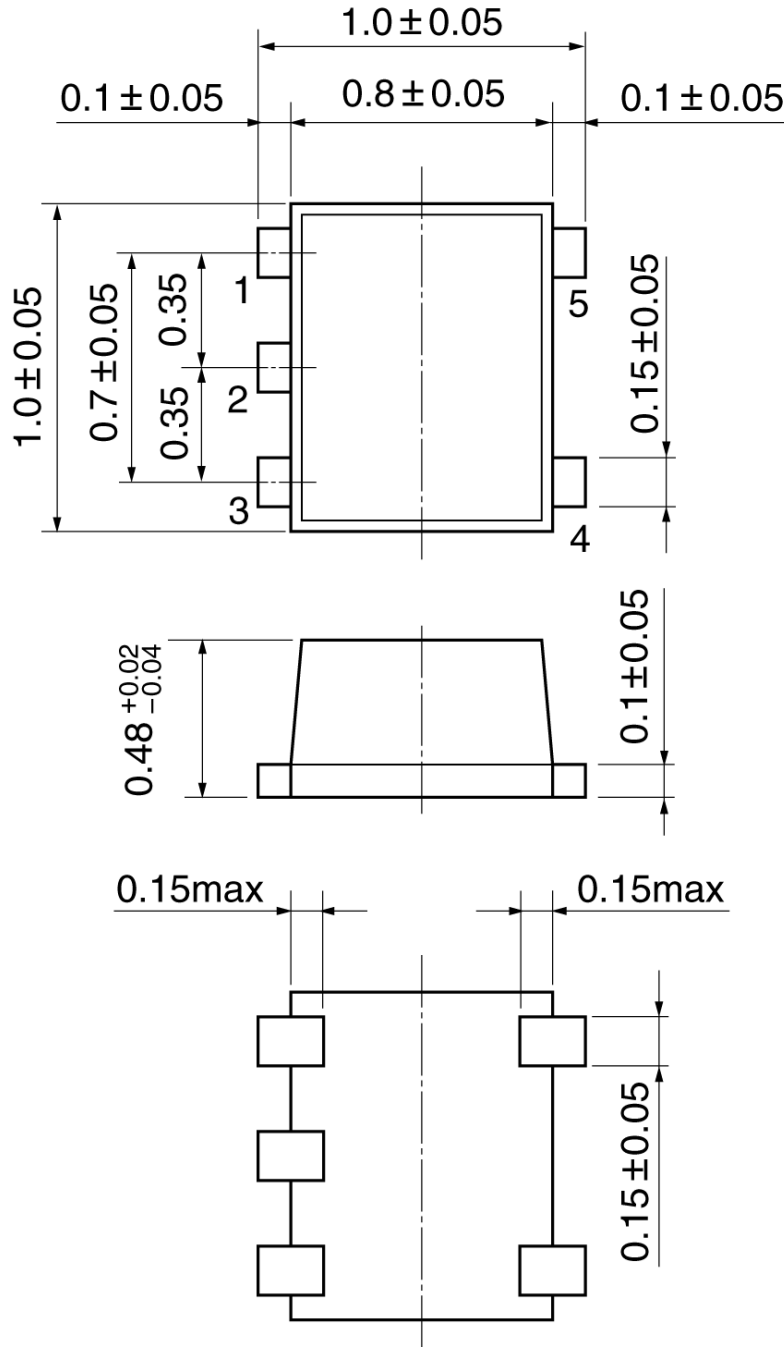
Average operating current can be obtained by the equation:

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

**Package Dimensions**

SON5-P-0.35

Unit:mm



Weight: 0.001 g (typ.)

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20070701-EN GENERAL

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