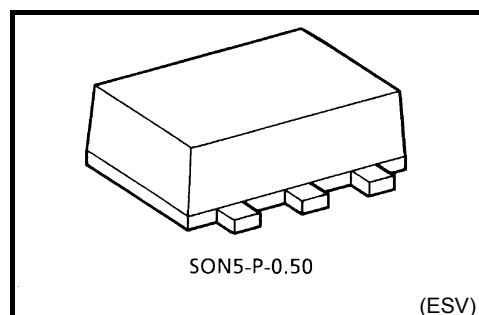


TC7SG02FE

2-Input NOR Gate

Features

- High output current : ± 8 mA (min) at $V_{CC} = 3.0$ V
- Super high speed operation : $t_{pd} = 2.4$ ns (typ.)
at $V_{CC} = 3.3$ V, 15pF
- Operating voltage range : $V_{CC} = 0.9$ to 3.6 V
- 5.5-V tolerant inputs
- 3.6-V power down protection output

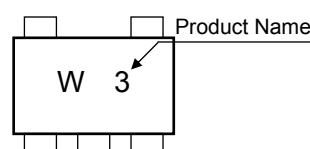


Weight: 0.003 g (typ.)

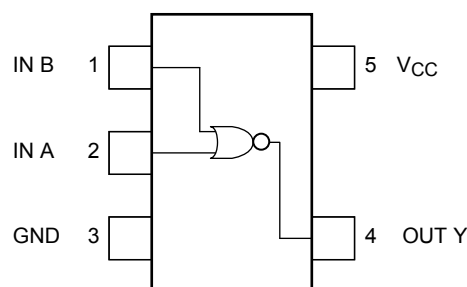
Absolute Maximum Ratings ($T_a = 25^\circ\text{C}$)

Characteristics	Symbol	Rating	Unit
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}	± 50	mA
Power dissipation	P_D	150	mW
Storage temperature	T_{stg}	-65 to 150	$^\circ\text{C}$

Marking



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.

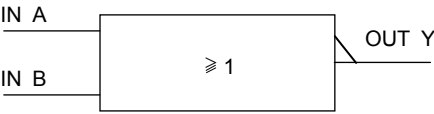
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Note 1: $V_{CC} = 0$ V

Note 2: High or Low state. Do not exceed I_{OUT} of absolute maximum ratings.

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

IEC Logic Symbol



Truth Table

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

Operating Ranges

Characteristics	Symbol	Rating	Unit
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

Electrical Characteristics

DC 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 _{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	—	—	1.0	—	10.0	μA
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND		3.6	—	—	1.0	—	10.0	μA

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

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit
			V _{CC} (V)	Min	Typ.	Max	Min	Max
Propagation delay time	t_{pLH} t_{pHL}	$C_L = 10$ pF, $R_L = 1$ M Ω	0.9	—	17.0	—	—	—
			1.1 to 1.3	—	8.8	18.4	1.0	34.2
			1.4 to 1.6	—	5.0	8.5	1.0	10.0
			1.65 to 1.95	—	3.8	6.2	1.0	6.7
			2.3 to 2.7	—	2.7	3.9	1.0	4.4
			3.0 to 3.6	—	2.1	3.1	1.0	3.7
		$C_L = 15$ pF, $R_L = 1$ M Ω	0.9	—	20.7	—	—	—
			1.1 to 1.3	—	10.6	21.5	1.0	37.2
			1.4 to 1.6	—	5.9	9.3	1.0	11.2
			1.65 to 1.95	—	4.5	6.9	1.0	7.1
			2.3 to 2.7	—	3.0	4.4	1.0	5.0
			3.0 to 3.6	—	2.4	3.4	1.0	3.9
		$C_L = 30$ pF, $R_L = 1$ M Ω	0.9	—	29.6	—	—	—
			1.1 to 1.3	—	14.8	29.6	1.0	56.0
			1.4 to 1.6	—	8.0	13.1	1.0	15.9
			1.65 to 1.95	—	6.0	9.2	1.0	9.6
			2.3 to 2.7	—	3.9	5.7	1.0	6.1
			3.0 to 3.6	—	3.0	4.4	1.0	4.8
Input capacitance	C_{IN}	—	3.6	—	3	—	—	pF
Power dissipation capacitance	C_{PD}	(Note 13)	0.9 to 3.6	—	6	—	—	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.

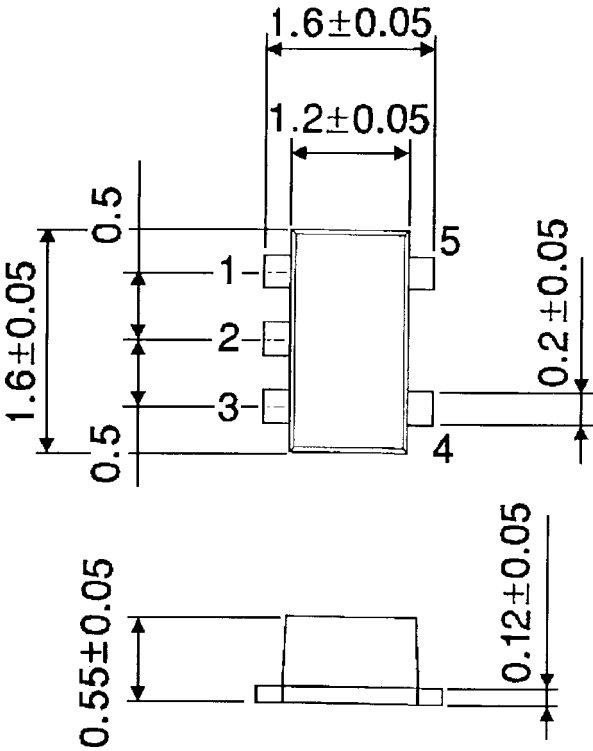
Average operating current can be obtained by the equation:

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

Package Dimensions

SON5-P-0.50

Unit : mm



Weight: 0.003 g (typ.)

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