

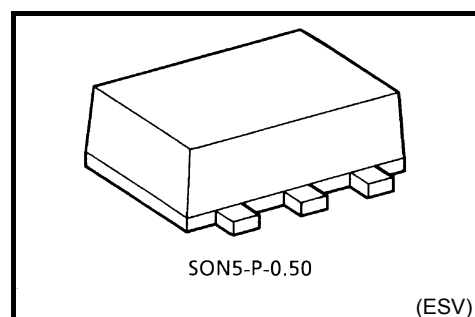
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7SZ00FE

## 2-Input NAND Gate

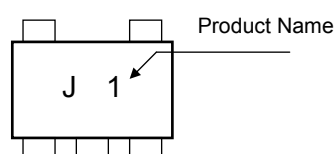
### Features

- High output current :  $\pm 24$  mA (min) at  $V_{CC} = 3$  V
- Super high speed operation :  $t_{pd} = 2.4$  ns (typ.)  
at  $V_{CC} = 5$  V, 50pF
- Operating voltage range :  $V_{CC} = 1.65$  to 5.5 V
- 5.5-V tolerant inputs
- 5.5-V power down protection output
- Matches the performance of TC74LCX series when operated at 3.3-V  $V_{CC}$

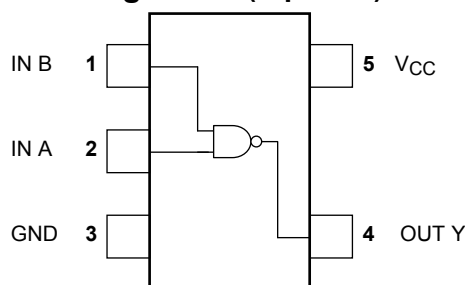


Weight: 0.003 g (typ.)

### Marking



### Pin Assignment (top view)



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

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 6	V
DC input voltage	$V_{IN}$	-0.5 to 6	V
DC output voltage	$V_{OUT}$	-0.5 to 6 (Note 1)	V
		-0.5 to $V_{CC} + 0.5$ V (Note 2)	
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	-20 (Note 3)	mA
DC output current	$I_{OUT}$	$\pm 50$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	150	mW
Storage temperature	$T_{stg}$	-65 to 150	$^\circ\text{C}$
Lead temperature (10 s)	$T_L$	260	$^\circ\text{C}$

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.

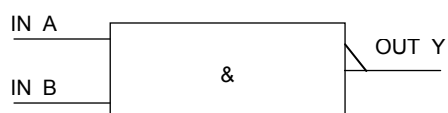
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

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

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

Note 3:  $V_{OUT} < GND$

## IEC Logic Symbol



## Truth Table

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

## Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	1.65 to 5.5	V
		1.5 to 5.5 (Note 4)	
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to 5.5 (Note 5)	V
		0 to $V_{CC}$ (Note 6)	
Operating temperature	$T_{opr}$	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 20 ( $V_{CC} = 1.80\text{ V} \pm 0.15\text{ V}$ , $2.5\text{ V} \pm 0.2\text{ V}$ )	ns/V
		0 to 10 ( $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ )	
		0 to 5 ( $V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$ )	

Note 4: Data retention only

Note 5:  $V_{CC} = 0\text{ V}$

Note 6: High or Low State

## Electrical Characteristics

## DC Electrical Characteristics

Characteristics		Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit					
					V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max				
Input Voltage	High level	V <sub>IH</sub>	—	1.65 to 1.95	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	V					
				2.3 to 5.5	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7	—						
	Low level	V <sub>IL</sub>	—	1.65 to 1.95	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25						
				2.3 to 5.5	—	—	V <sub>CC</sub> × 0.3	—	V <sub>CC</sub> × 0.3						
Output voltage	High level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -100 μA	1.65	1.55	1.65	—	1.55	—	V				
					2.3	2.2	2.3	—	2.2	—					
					3.0	2.9	3.0	—	2.9	—					
					4.5	4.4	4.5	—	4.4	—					
				I <sub>OH</sub> = -4 mA	1.65	1.29	1.52	—	1.29	—					
					I <sub>OH</sub> = -8 mA	2.3	1.9	2.15	—	1.9		—			
					I <sub>OH</sub> = -16 mA	3.0	2.4	2.8	—	2.4		—			
					I <sub>OH</sub> = -24 mA	3.0	2.3	2.68	—	2.3		—			
					I <sub>OH</sub> = -32 mA	4.5	3.8	4.2	—	3.8		—			
	Low level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 100 μA	1.65	—	0	0.1	—	0.1					
					2.3	—	0	0.1	—	0.1					
					3.0	—	0	0.1	—	0.1					
					4.5	—	0	0.1	—	0.1					
				I <sub>OL</sub> = 4 mA	1.65	—	0.08	0.24	—	0.24					
					I <sub>OL</sub> = 8 mA	2.3	—	0.1	0.3	—		0.3			
				I <sub>OL</sub> = 16 mA	3.0	—	0.15	0.4	—	0.4					
					I <sub>OL</sub> = 24 mA	3.0	—	0.22	0.55	—		0.55			
				I <sub>OL</sub> = 32 mA	4.5	—	0.22	0.55	—	0.55					
				Input leakage current		I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND	0 to 5.5	—	—		±1	—	±10	μA
				Power off leakage current		I <sub>OFF</sub>	V <sub>IN</sub> or V <sub>OUT</sub> = 5.5V	0.0	—	—		1	—	±10	μA
Quiescent supply current		I <sub>CC</sub>	V <sub>IN</sub> = 5.5 V or GND	5.5	—	—	2	—	20	μA					

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

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min	Max
Propagation delay time	$t_{pLH}$ $t_{pHL}$	$C_L = 15 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	$1.80 \pm 0.15$	2.0	4.5	9.6	2.0	9.8
			$2.5 \pm 0.2$	0.8	3.2	5.3	0.8	5.7
			$3.3 \pm 0.3$	0.5	2.4	3.7	0.5	4.0
			$5.0 \pm 0.5$	0.5	1.9	2.9	0.5	3.2
		$C_L = 50 \text{ pF}$ , $R_L = 500 \Omega$	$3.3 \pm 0.3$	1.5	3.0	4.6	1.5	4.9
			$5.0 \pm 0.5$	0.8	2.4	3.6	0.8	3.9
Input capacitance	$C_{IN}$	—	0 to 5.5	—	4	—	—	pF
Power dissipation capacitance	$C_{PD}$	(Note 7)	3.3	—	19	—	—	pF
			5.5	—	27	—	—	

Note 7:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

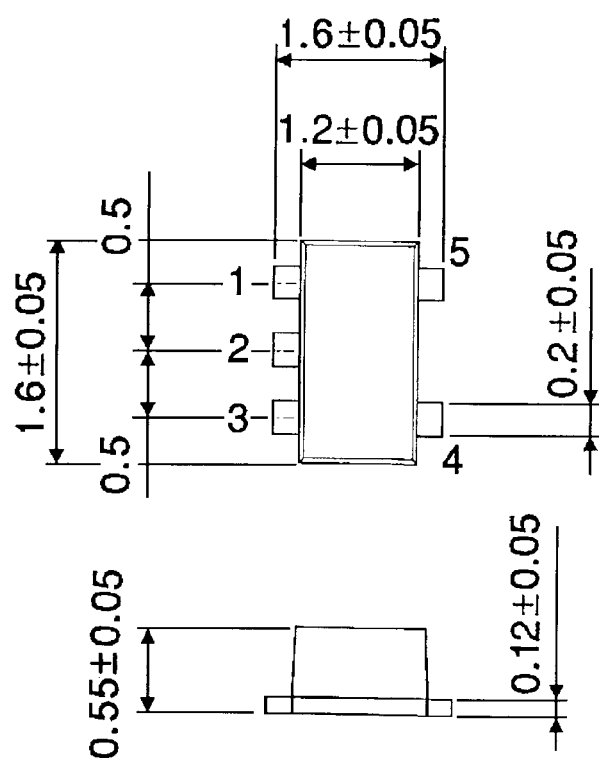
Average operating current can be obtained by the equation.

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

## Package Dimensions

SON5-P-0.50

Unit : mm



Weight: 0.003 g (typ.)

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