

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

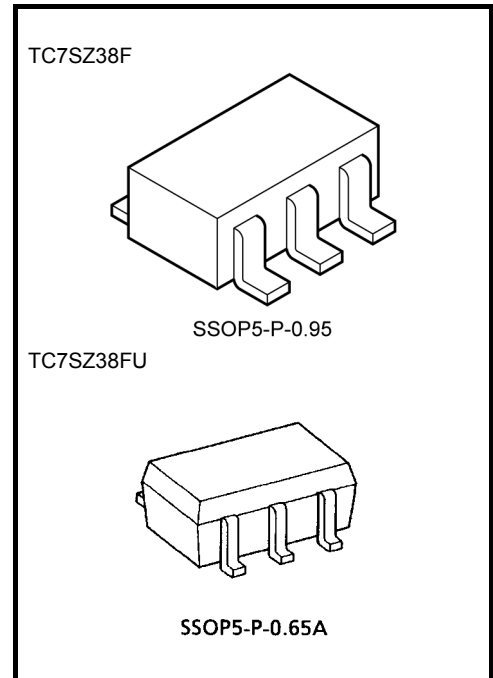
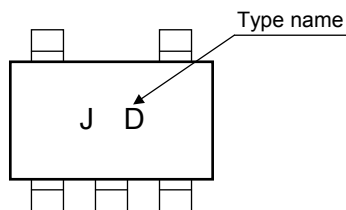
# TC7SZ38F, TC7SZ38FU

## 2-Input NAND Gate(Open Drain Output)

### Features

- High output drive: 24 mA (min) @VCC = 3 V
- Super high speed operation:  
 $t_{pZ} = 2.2 \text{ ns (typ.) @ } V_{CC} = 5 \text{ V, } 50 \text{ pF}$
- Operation voltage range:  $V_{CC (opr)} = 1.80 \sim 5.5 \text{ V}$
- 5.5V tolerant inputs.
- Power down protection is provided on output.
- Matches the performance of TC74LCX series when operated at 3.3 V VCC.

### Marking

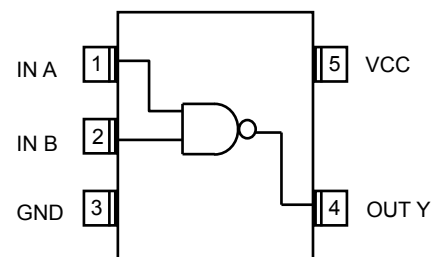


Weight  
 SSOP5-P-0.95 : 0.016 g (typ.)  
 SSOP5-P-0.65A : 0.006 g (typ.)

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

Characteristics	Symbol	Rating	Unit
Power supply voltage	V <sub>CC</sub>	-0.5~6	V
DC input voltage	V <sub>IN</sub>	-0.5~6	V
DC output voltage	V <sub>OUT</sub>	-0.5~6	V
Input diode current	I <sub>IK</sub>	-20	mA
Output diode current	I <sub>OK</sub>	-20	mA
DC output current	I <sub>OUT</sub>	50	mA
DC V <sub>CC</sub> /ground current	I <sub>CC</sub>	±50	mA
Power dissipation	P <sub>D</sub>	200	mW
Storage temperature	T <sub>stg</sub>	-65~150	°C
Lead temperature (10s)	T <sub>L</sub>	260	°C

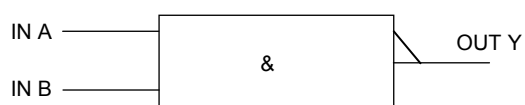
### Pin Assignment (top view)



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).

## Logic Diagram



## Truth Table

Input		Output
A	B	Y
L	L	*Z
L	H	*Z
H	L	*Z
H	H	L

\*: High Impedance

## Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	1.8~5.5	V
		1.5~5.5 (Note 1)	
Input voltage	$V_{IN}$	0~5.5	V
Output voltage	$V_{OUT}$	0~5.5 (Note 2)	V
		0~ $V_{CC}$ (Note 3)	
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	dt/dv	0~20 ( $V_{CC} = 1.8\text{ V}, 2.5\text{ V} \pm 0.2\text{ V}$ )	ns/V
		0~10 ( $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ )	
		0~5 ( $V_{CC} = 5.5\text{ V} \pm 0.5\text{ V}$ )	

Note 1: Data retention only

Note 2: OFF state

Note 3: Low state

## 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>	—	1.8	0.75 × V <sub>CC</sub>	—	—	0.75 × V <sub>CC</sub>	—	V	
				2.3~5.5	0.7 × V <sub>CC</sub>	—	—	0.7 × V <sub>CC</sub>	—		
	Low level	V <sub>IL</sub>	—	1.8	—	—	0.25 × V <sub>CC</sub>	—	0.25 × V <sub>CC</sub>		
				2.3~5.5	—	—	0.3 × V <sub>CC</sub>	—	0.3 × V <sub>CC</sub>		
High level output leakage current		I <sub>LKG</sub>	V <sub>IN</sub> = V <sub>IL</sub>	1.8~5.5	—	—	±5	—	±10	μA	
Output voltage	Low level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OL</sub> = 100 μA	1.8	—	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> = 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	0~5.5	—	—	±1	—	±10	μA	
Power off leakage current		I <sub>OFF</sub>	V <sub>IN</sub> or V <sub>OUT</sub> = 5.5 V	0.0	—	—	1	—	10	μA	
Quiescent supply current		I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5	—	—	2	—	20	μA	

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

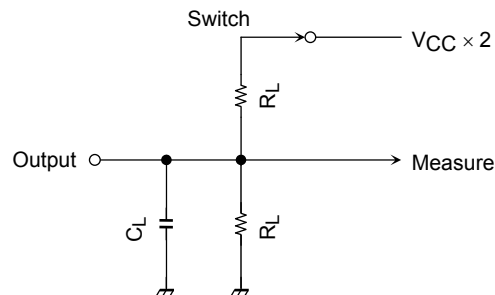
Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit	
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
Propagation delay time	t <sub>pZL</sub>	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω	1.65	1.5	6.5	12.7	1.5	13.2	ns
			1.8	1.5	5.4	10.5	1.5	11.0	
			2.5 ± 0.2	0.8	3.5	7.0	0.8	7.5	
			3.3 ± 0.3	0.8	2.8	5.0	0.8	5.2	
			5.0 ± 0.5	0.5	2.2	4.3	0.5	4.5	
	t <sub>pLZ</sub>	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω	1.65	1.5	5.5	12.7	1.5	13.2	ns
			1.8	1.5	4.6	10.5	1.5	11.0	
			2.5 ± 0.2	0.8	3.0	7.0	0.8	7.5	
			3.3 ± 0.3	0.8	2.1	5.0	0.8	5.2	
			5.0 ± 0.5	0.5	1.3	4.3	0.5	4.5	
Input capacitance	C <sub>IN</sub>	—	0~5.5	—	4	—	—	pF	
Output capacitance	C <sub>OUT</sub>	—	5.5	—	3	—	—	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note 4)	3.3	—	6.7	—	—	—	pF
			5.5	—	13	—	—	—	

Note 4: 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:

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

## AC Characteristics Measurement Circuit

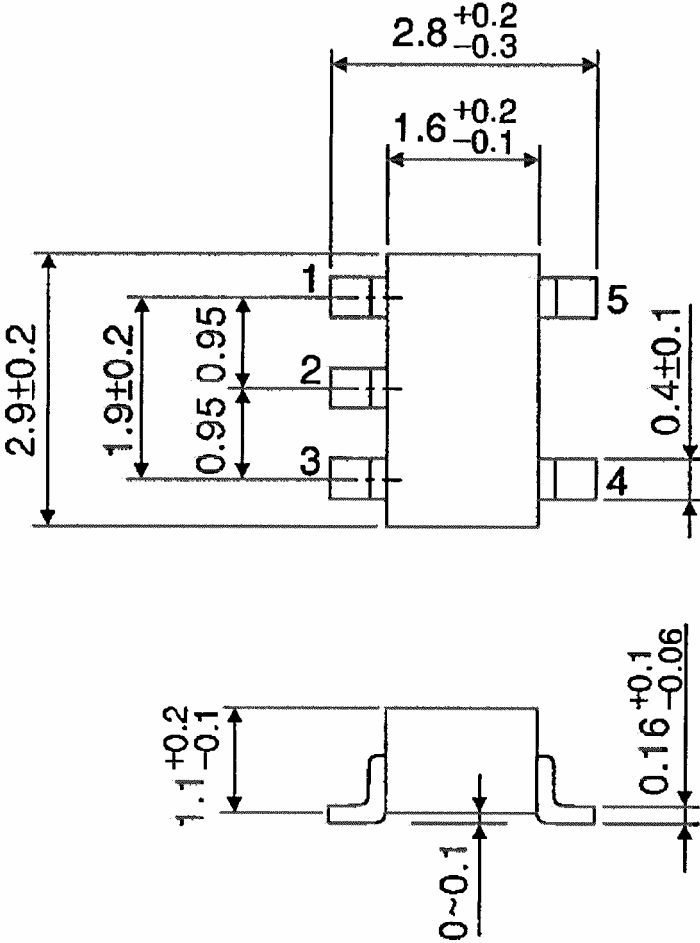


Characteristics	Switch
t <sub>pLZ</sub> , t <sub>pZL</sub>	V <sub>CC</sub> × 2

Package Dimensions

SSOP5-P-0.95

Unit : mm

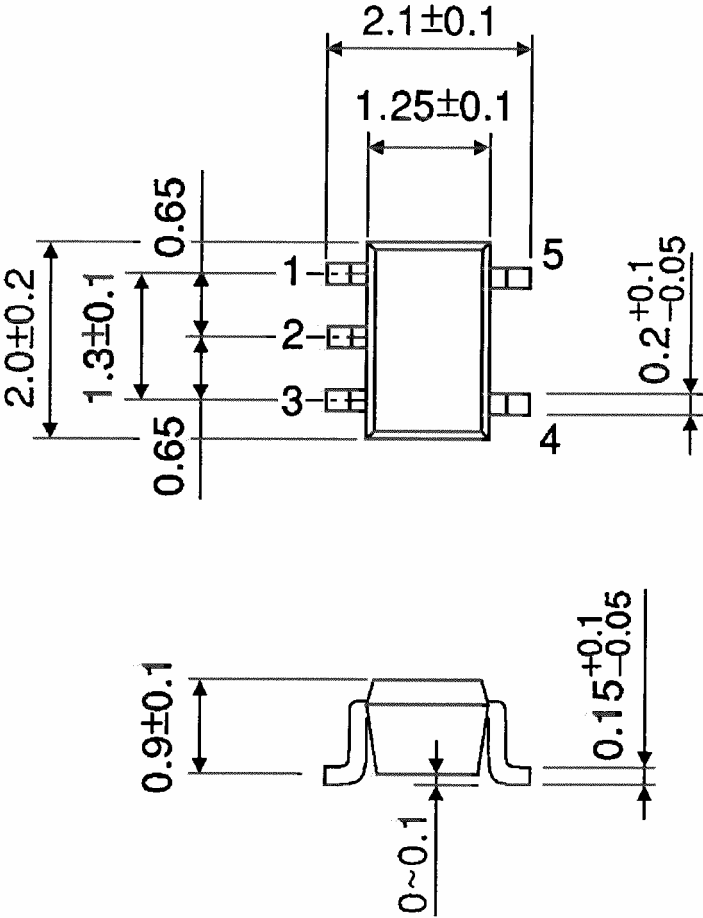


Weight: 0.016 g (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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20070701-EN GENERAL

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