

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

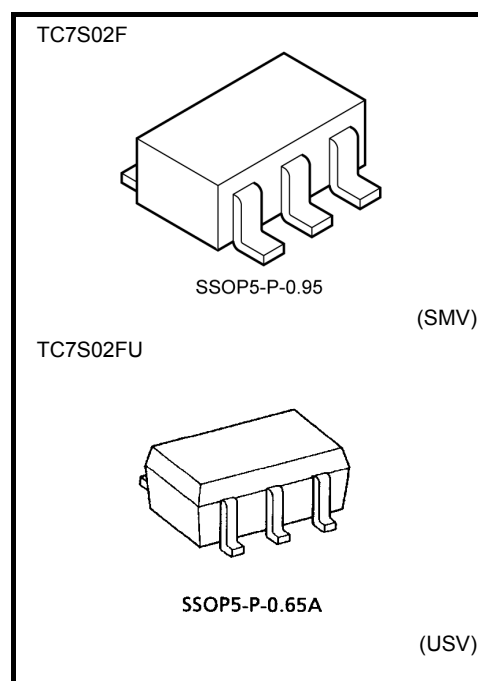
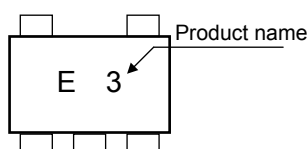
## TC7S02F, TC7S02FU

### 2-Input NOR Gate

#### Features

- High Speed :  $t_{pd} = 7\text{ns}$  (typ.) at  $V_{CC} = 5\text{V}$
- Low power dissipation :  $I_{CC} = 1\text{ }\mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity :  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Output drive capability : 5 LSTTL Loads
- Symmetrical Output Impedance :  $|I_{OH}| = I_{OL} = 2\text{mA}$  (min)
- Balanced propagation delays :  $t_{pLH} \doteq t_{pHL}$
- Wide operating voltage range :  $V_{CC} = 2\text{ to }6\text{V}$

#### Marking

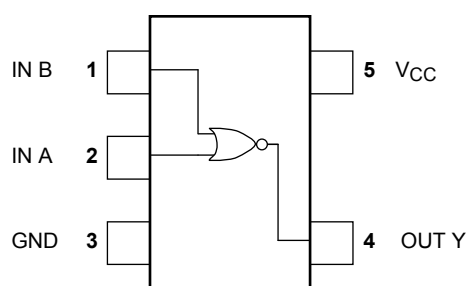


Weight  
SSOP5-P-0.95 : 0.016 g (typ.)  
SSOP5-P-0.65A : 0.006 g (typ.)

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

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 7.0	V
DC input voltage	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V
DC output voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	$\pm 20$	mA
Output diode current	$I_{OK}$	$\pm 20$	mA
DC output current	$I_{OUT}$	$\pm 12.5$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 25$	mA
Power dissipation	$P_D$	200	mW
Storage temperature	$T_{stg}$	-65 to 150	$^\circ\text{C}$
Lead temperature (10 s)	$T_L$	260	$^\circ\text{C}$

#### Pin Assignment (top view)

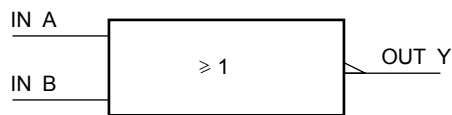


Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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).

Start of commercial production  
1987-08

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	$V_{CC}$	2.0 to 6.0	V
Input voltage	$V_{IN}$	0 to $V_{CC}$	V
Output voltage	$V_{OUT}$	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	-40 to 85	°C
Input rise and fall time	$t_r, t_f$	0 to 1000 ( $V_{CC} = 2.0\text{ V}$ )	ns
		0 to 500 ( $V_{CC} = 4.5\text{ V}$ )	
		0 to 400 ( $V_{CC} = 6.0\text{ V}$ )	

## Electrical Characteristics

## DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V <sub>IH</sub>	—		2.0	1.5	—	—	1.5	—	V
				4.5	3.15	—	—	3.15	—	
				6.0	4.2	—	—	4.2	—	
Low-level input voltage	V <sub>IL</sub>	—		2.0	—	—	0.5	—	0.5	
				4.5	—	—	1.35	—	1.35	
				6.0	—	—	1.8	—	1.8	
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -20 μA	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
				6.0	5.9	6.0	—	5.9	—	
			I <sub>OH</sub> = -2 mA	4.5	4.18	4.31	—	4.13	—	
			I <sub>OH</sub> = -2.6 mA	6.0	5.68	5.80	—	5.63	—	
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> = 20 μA	2.0	—	0.0	0.1	—	0.1	
				4.5	—	0.0	0.1	—	0.1	
				6.0	—	0.0	0.1	—	0.1	
			I <sub>OL</sub> = 2 mA	4.5	—	0.17	0.26	—	0.33	
			I <sub>OL</sub> = 2.6 mA	6.0	—	0.18	0.26	—	0.33	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	1.0	—	10.0	μA

Output currents are 1/2 compared to TC74HC series models.

## AC Characteristics ( $C_L = 15\text{pF}$ , $V_{CC} = 5\text{V}$ , Input: $t_r = t_f = 6\text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			Min	Typ.	Max	
Output transition time	$t_{TLH}$ $t_{THL}$	—	—	5	10	ns
Propagation delay time	$t_{pLH}$ $t_{pLH}$	—	—	7	15	ns

## AC Characteristics ( $C_L = 50\text{pF}$ , Input: $t_r = t_f = 6\text{ ns}$ )

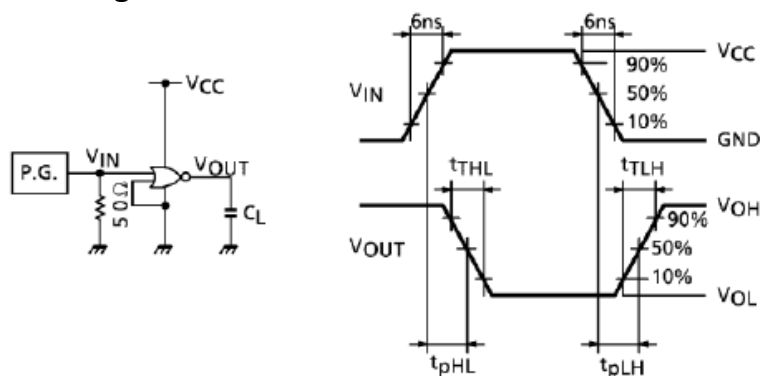
Characteristics	Symbol	Test Condition	VCC (V)	Ta = 25°C			Ta = -40 to 85°C		Unit
				Min	Typ.	Max	Min	Max	
Output transition time	$t_{TLH}$ $t_{THL}$	—	2.0	—	50	125	—	155	ns
			4.5	—	14	25	—	31	
			6.0	—	12	21	—	26	
Propagation delay time	$t_{pLH}$ $t_{pHL}$	—	2.0	—	48	100	—	125	ns
			4.5	—	12	20	—	25	
			6.0	—	9	17	—	21	
Input capacitance	$C_{IN}$	—	—	—	5	10	—	10	pF
Power dissipation capacitance	$C_{PD}$	(Note 1)	—	—	10	—	—	—	pF

Note 1:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

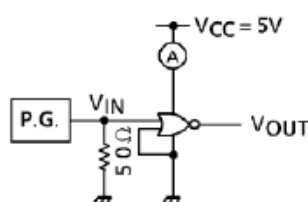
Average operating current can be obtained by the equation:

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

## Switching Characteristics Test Circuit



## $I_{CC}(\text{opr.})$ Test Circuit

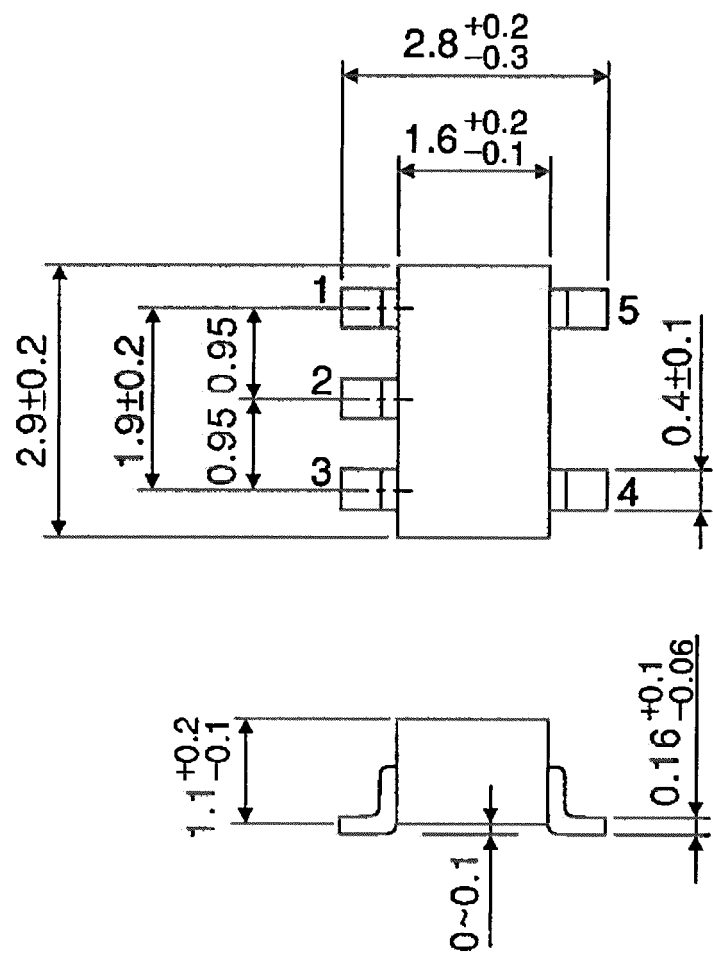


Input waveform is the same as that in case of switching characteristics test.

Package Dimensions

SSOP5-P-0.95

Unit : mm

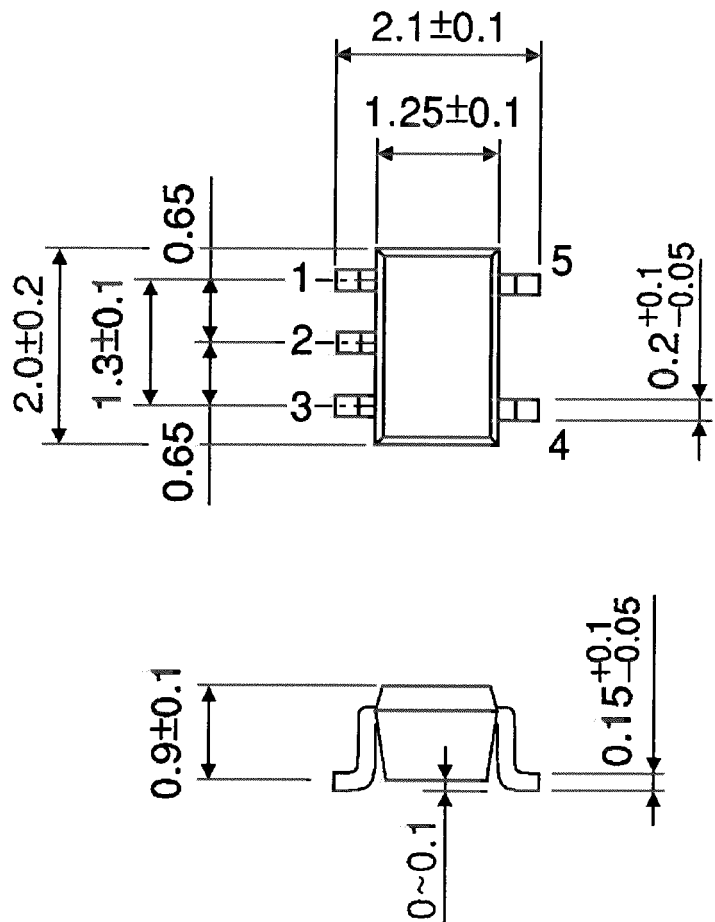


Weight: 0.016 g (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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