

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

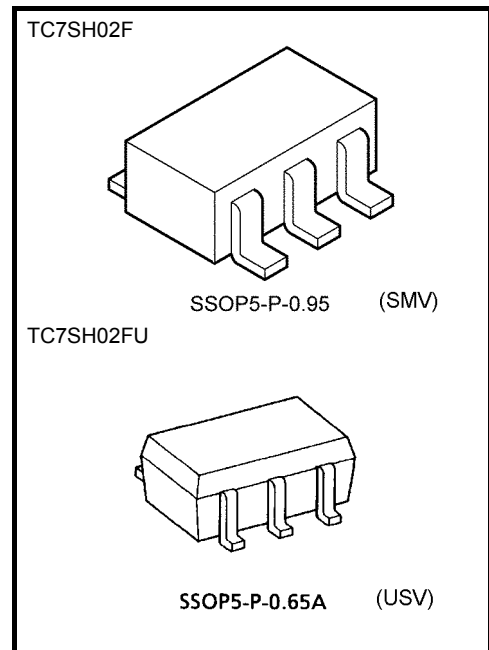
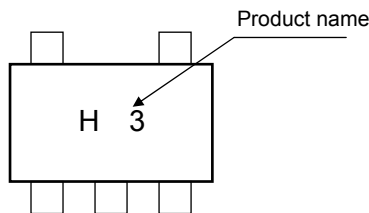
## TC7SH02F, TC7SH02FU

### 2-Input NOR Gate

#### Features

- High Speed Operation :  $t_{pd} = 3.6 \text{ ns (typ.)}$   
at  $V_{CC} = 5 \text{ V}$ ,  $15 \text{ pF}$
- Low Power Dissipation :  $I_{CC} = 2\mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- Balanced Propagation Delays :  $t_{pLH} \cong t_{pHL}$
- High noise immunity :  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- 5.5-V Tolerant Inputs
- Wide Operating Voltage Range :  $V_{CC} = 2 \text{ to } 5.5\text{V}$

#### Marking

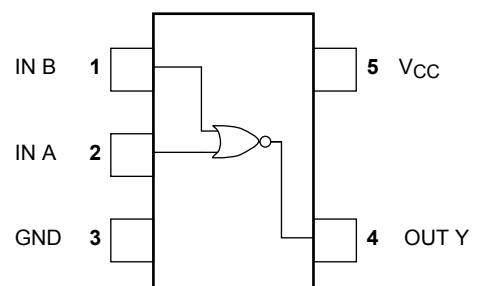


Weight  
 SSOP5-P-0.95 : 0.016 g (typ.)  
 SSOP5-P-0.65A : 0.006 g (typ.)

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

Characteristics	Symbol	Rating	Unit
Supply Voltage	$V_{CC}$	- 0.5 to 7	V
DC Input Voltage	$V_{IN}$	- 0.5 to 7	V
DC Output Voltage	$V_{OUT}$	- 0.5 to $V_{CC} + 0.5$	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	$P_D$	200	mW
Storage Temperature	$T_{stg}$	- 65 to 150	°C
Lead Temperature(10s)	$T_L$	260	°C

#### Pin Assignment (top view)



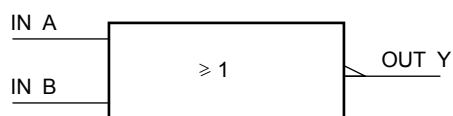
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

Note1:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

Start of commercial production  
 1995-03

## 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 to 5.5	V
Input Voltage	$V_{IN}$	0 to 5.5	V
Output Voltage	$V_{OUT}$	0 to $V_{CC}$	V
Operating Temperature	$T_{opr}$	-40 to 85	°C
Input Rise and Fall Time	dt/dv	0 to 100 ( $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ )	ns/V
		0 to 20 ( $V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$ )	

## 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	
				3.0 to 5.5	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7		—
Low-level input voltage	V <sub>IL</sub>	—		2.0	—	—	0.5	—	V	
				3.0 to 5.5	—	—	V <sub>CC</sub> × 0.3	—		V <sub>CC</sub> × 0.3
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	2.0	1.9	2.0	—	1.9	V	
				3.0	2.9	3.0	—	2.9		—
			I <sub>OH</sub> = -4 mA	4.5	4.4	4.5	—	4.4		—
				I <sub>OH</sub> = -8 mA	4.5	3.94	—	—		3.80
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> = 50 μA	2.0	—	0	0.1	—	V	
				3.0	—	0	0.1	—		0.1
			I <sub>OL</sub> = 4 mA	4.5	—	0	0.1	—		0.1
				I <sub>OL</sub> = 8 mA	3.0	—	—	0.36		—
			I <sub>OL</sub> = 8 mA	4.5	—	—	0.36	—	0.44	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	—	—	±0.1	—	±1.0 μA	
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	2.0	—	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)	C <sub>L</sub> (pF)	Min	Typ.	Max	Min	Max	
Propagation delay time	t <sub>pLH</sub>	3.3 ± 0.3	15	—	5.6	7.9	1.0	9.5	ns
			50	—	8.1	11.4	1.0	13.0	
	t <sub>pHL</sub>	5.0 ± 0.5	15	—	3.6	5.5	1.0	6.5	
			50	—	5.1	7.5	1.0	8.5	
Input capacitance	C <sub>IN</sub>			—	4	10	—	10	pF
Power dissipation capacitance	C <sub>PD</sub>	(Note 2)		—	15	—	—	—	pF

Note 2: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

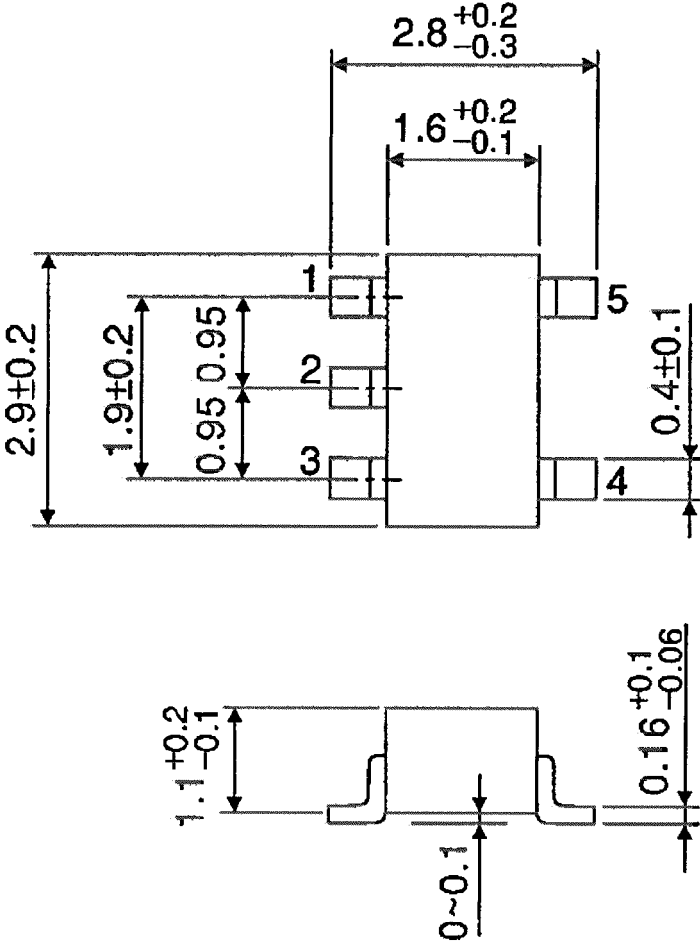
Average operating current can be obtained by the equation :

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

Package Dimensions

SSOP5-P-0.95

Unit : mm

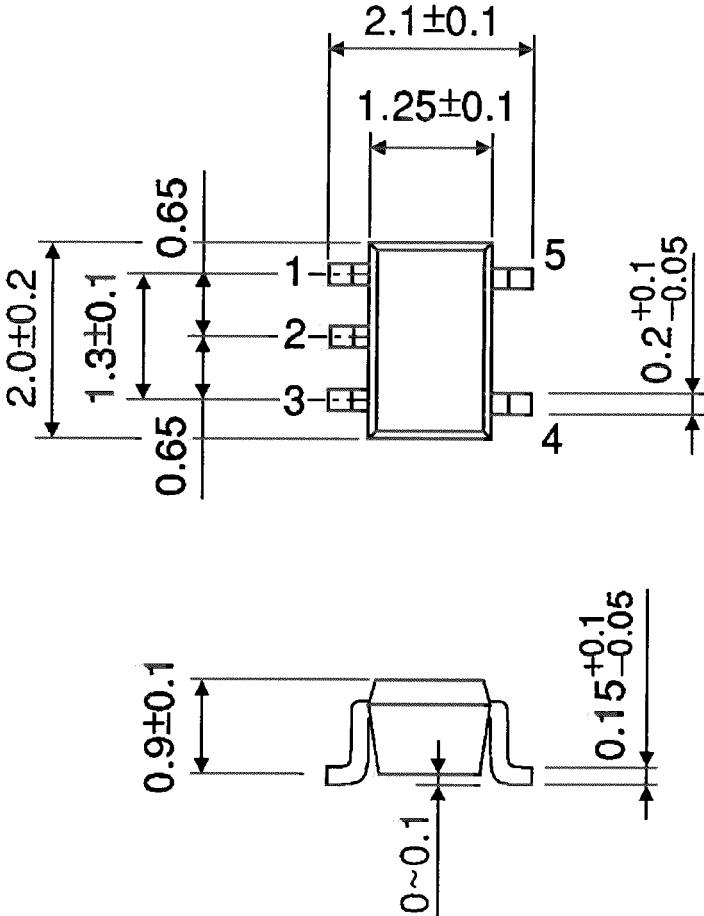


Weight: 0.016 g (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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