

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

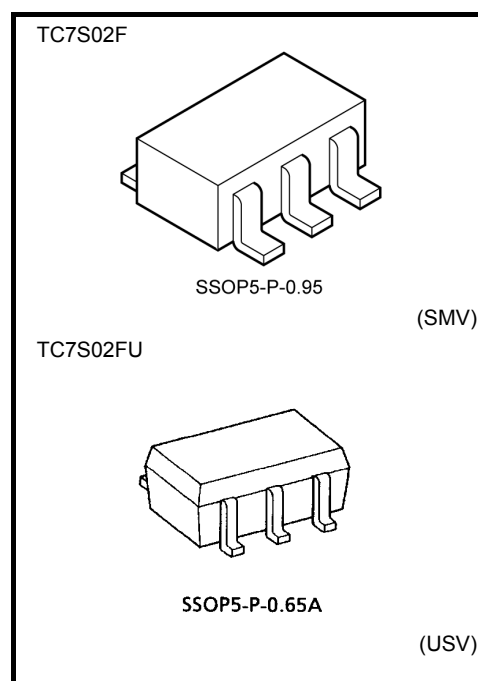
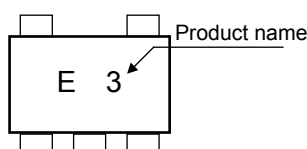
TC7S02F, TC7S02FU

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

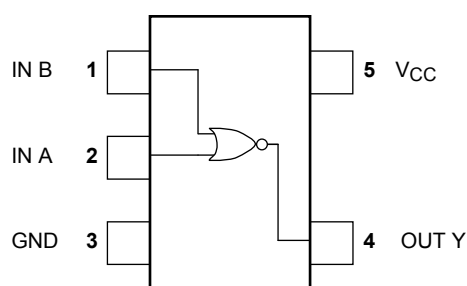


Weight
SSOP5-P-0.95 : 0.016 g (typ.)
SSOP5-P-0.65A : 0.006 g (typ.)

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}	± 20	mA
Output diode current	I_{OK}	± 20	mA
DC output current	I_{OUT}	± 12.5	mA
DC V_{CC} /ground current	I_{CC}	± 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)

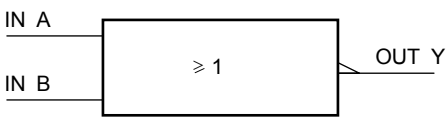


Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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 _{CC} (V)	Min	Typ.	Max	Min	Max
High-level input voltage	V _{IH}	—		2.0	1.5	—	—	1.5	V
				4.5	3.15	—	—	3.15	
				6.0	4.2	—	—	4.2	
Low-level input voltage	V _{IL}	—		2.0	—	—	0.5	—	V
				4.5	—	—	1.35	—	
				6.0	—	—	1.8	—	
High-level output voltage	V _{OH}	V _{IN} = V _{IL}	I _{OH} = -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 _{OH} = -2 mA	4.5	4.18	4.31	—	4.13	
			I _{OH} = -2.6 mA	6.0	5.68	5.80	—	5.63	
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 20 µA	2.0	—	0.0	0.1	—	V
				4.5	—	0.0	0.1	—	
				6.0	—	0.0	0.1	—	
			I _{OL} = 2 mA	4.5	—	0.17	0.26	—	
			I _{OL} = 2.6 mA	6.0	—	0.18	0.26	—	
Input leakage current	I _{IN}	V _{IN} = V _{CC} or GND		6.0	—	—	±0.1	—	µA
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND		6.0	—	—	1.0	—	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: $t_r = t_f = 6\text{ ns}$)

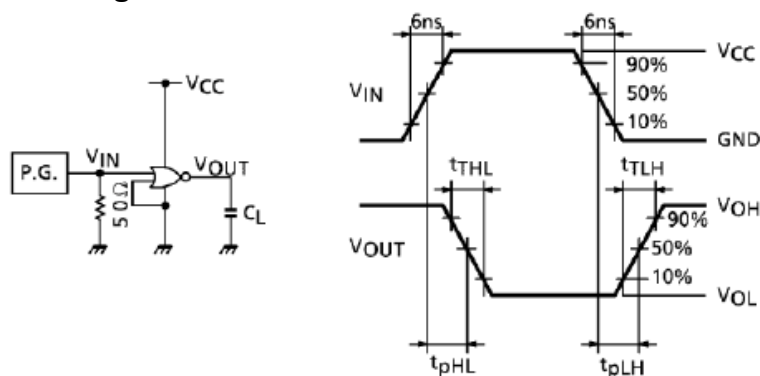
Characteristics	Symbol	Test Condition	VCC (V)	Ta = 25°C			Ta = -40 to 85°C		Unit
				Min	Typ.	Max	Min	Max	
Output transition time	t_{TLH} t_{THL}	—	2.0	—	50	125	—	155	ns
			4.5	—	14	25	—	31	
			6.0	—	12	21	—	26	
Propagation delay time	t_{pLH} t_{pHL}	—	2.0	—	48	100	—	125	ns
			4.5	—	12	20	—	25	
			6.0	—	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.

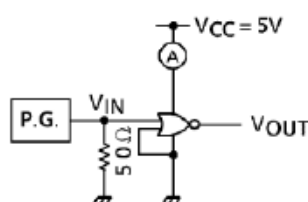
Average operating current can be obtained by the equation:

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

Switching Characteristics Test Circuit



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

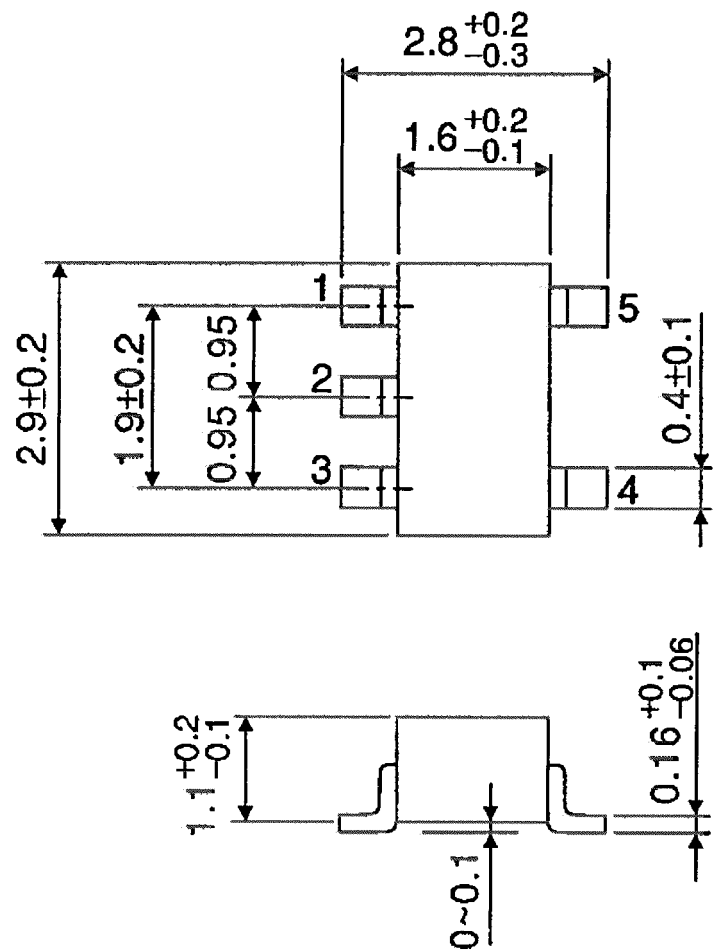


Input waveform is the same as that in case of switching characteristics test.

Package Dimensions

SSOP5-P-0.95

Unit : mm

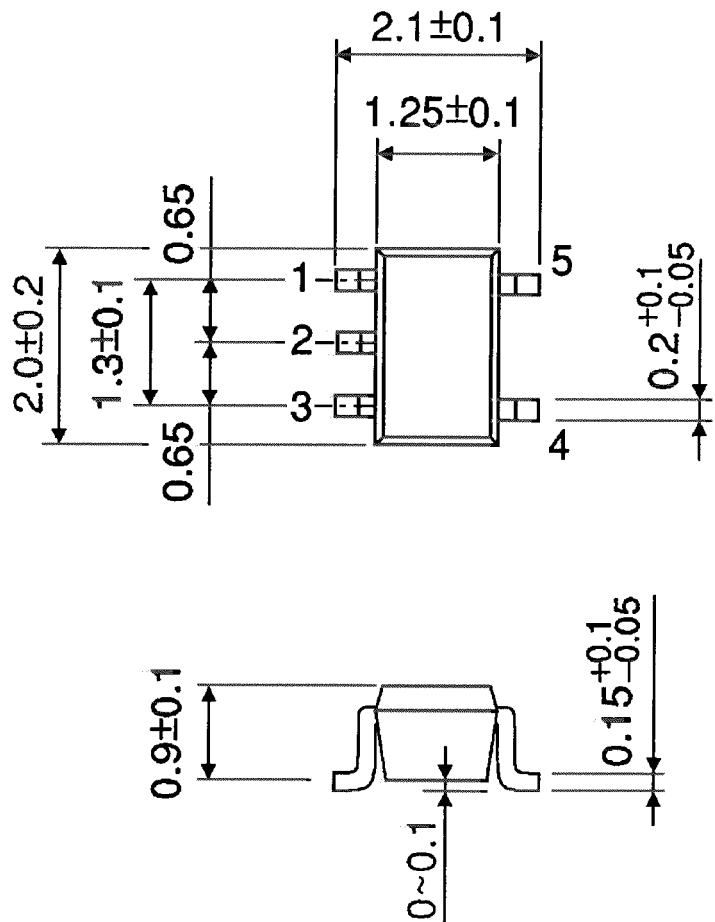


Weight: 0.016 g (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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