

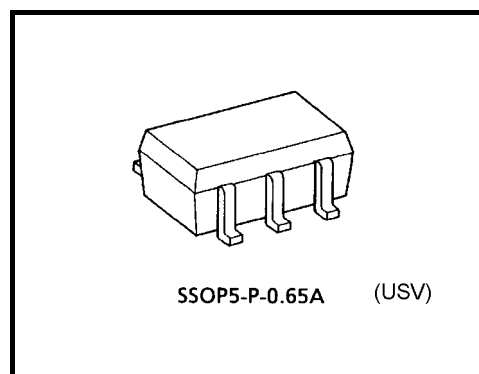
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC7SG04FU

Inverter

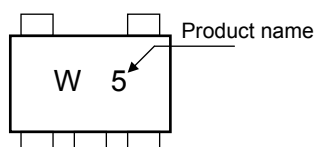
### Features

- High-level output current:  $I_{OH}/I_{OL} = \pm 8 \text{ mA (min)}$   
at  $V_{CC} = 3.0 \text{ V}$
- High-speed operation:  $t_{pd} = 2.3 \text{ ns (typ.)}$   
at  $V_{CC} = 3.3 \text{ V}, 15\text{pF}$
- Operating voltage range:  $V_{CC} = 0.9 \sim 3.6 \text{ V}$
- 5.5-V tolerant input.
- 3.6-V power down protection output.

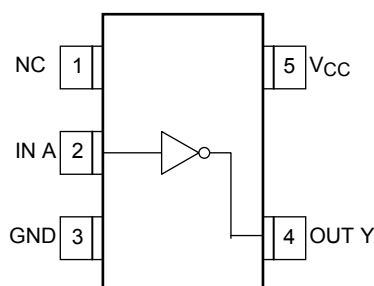


Weight: 0.006 g (typ.)

### Marking



### Pin Assignment (top view)



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

Characteristics	Symbol	Value	Unit
Power supply voltage	$V_{CC}$	$-0.5 \sim 4.6$	V
DC input voltage	$V_{IN}$	$-0.5 \sim 7.0$	V
DC output voltage	$V_{OUT}$	$-0.5 \sim 4.6$ (Note 1)	V
		$-0.5 \sim V_{CC} + 0.5$ (Note 2)	
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	-20 (Note 3)	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	$T_{stg}$	$-65 \sim 150$	$^\circ\text{C}$

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.

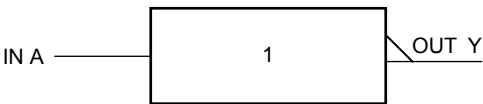
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

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

Note 2: High or Low State.  $I_{OUT}$  absolute maximum rating must be observed.

Note 3:  $V_{OUT} < \text{GND}$

IEC Logic Symbol



Truth Table

A	Y
L	H
H	L

Operating Ranges

Characteristics	Symbol	Value	Unit
Power supply voltage	V <sub>CC</sub>	0.9~3.6	V
Input voltage	V <sub>IN</sub>	0~5.5	V
Output voltage	V <sub>OUT</sub>	0~3.6 (Note 4)	V
		0~V <sub>CC</sub> (Note 5)	
Output Current	I <sub>OH</sub> /I <sub>OL</sub>	±8.0 (Note 6)	mA
		±4.0 (Note 7)	
		±3.0 (Note 8)	
		±1.7 (Note 9)	
		±0.3 (Note 10)	
		±0.02 (Note 11)	
Operating temperature	T <sub>opr</sub>	-40~85	°C
Input rise and fall time	dt/dV	0~10 (Note 12)	ns/V

- Note 4: V<sub>CC</sub> = 0V
- Note 5: High or Low state.
- Note 6: V<sub>CC</sub> = 3.0~3.6 V
- Note 7: V<sub>CC</sub> = 2.3~2.7 V
- Note 8: V<sub>CC</sub> = 1.65~1.95 V
- Note 9: V<sub>CC</sub> = 1.4~1.6 V
- Note 10: V<sub>CC</sub> = 1.1~1.3 V
- Note 11: V<sub>CC</sub> = 0.9 V
- Note 12: V<sub>IN</sub> = 0.8~2.0 V, V<sub>CC</sub> = 3.0 V

## DC Electrical Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C				Ta = -40~85°C		Unit
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min	Max	
High-level input voltage	V <sub>IH</sub>	—		0.9	V <sub>CC</sub>	—	—	V <sub>CC</sub>	—	V
				1.1~1.3	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7	—	
				1.4~1.6	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—	
				1.65~1.95	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—	
				2.3~2.7	1.7	—	—	1.7	—	
				3.0~3.6	2.0	—	—	2.0	—	
Low-level input voltage	V <sub>IL</sub>	—		0.9	—	—	GND	—	GND	V
				1.1~1.3	—	—	V <sub>CC</sub> × 0.3	—	V <sub>CC</sub> × 0.3	
				1.4~1.6	—	—	V <sub>CC</sub> × 0.35	—	V <sub>CC</sub> × 0.35	
				1.65~1.95	—	—	V <sub>CC</sub> × 0.35	—	V <sub>CC</sub> × 0.35	
				2.3~2.7	—	—	0.7	—	0.7	
				3.0~3.6	—	—	0.8	—	0.8	
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -0.02 mA	0.9	0.75	—	—	0.75	—	V
			I <sub>OH</sub> = -0.3 mA	1.1~1.3	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
			I <sub>OH</sub> = -1.7 mA	1.4~1.6	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
			I <sub>OH</sub> = -3.0 mA	1.65~1.95	V <sub>CC</sub> -0.45	—	—	V <sub>CC</sub> -0.45	—	
			I <sub>OH</sub> = -4.0 mA	2.3~2.7	2.0	—	—	2.0	—	
			I <sub>OH</sub> = -8.0 mA	3.0~3.6	2.48	—	—	2.48	—	
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 0.02 mA	0.9	—	—	0.1	—	0.1	V
			I <sub>OL</sub> = 0.3 mA	1.1~1.3	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
			I <sub>OL</sub> = 1.7 mA	1.4~1.6	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
			I <sub>OL</sub> = 3.0 mA	1.65~1.95	—	—	0.45	—	0.45	
			I <sub>OL</sub> = 4.0 mA	2.3~2.7	—	—	0.4	—	0.4	
			I <sub>OL</sub> = 8.0 mA	3.0~3.6	—	—	0.4	—	0.4	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 0~5.5V		0~3.6	—	—	±0.1	—	±1.0	μA
Power off leakage current	I <sub>OFF</sub>	V <sub>IN</sub> = 0~5.5V V <sub>OUT</sub> = 0~3.6V		0	—	—	1.0	—	10.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		3.6	—	—	1.0	—	10.0	μA

AC Electrical Characteristics (input  $t_r = t_f = 3 \text{ ns}$ )

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	$t_{PLH}$ $t_{PHL}$	$C_L = 10 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	0.9	—	18.6	—	—	—
			1.1~1.3	—	8.7	18.4	1.0	34.2
			1.4~1.6	—	4.9	8.5	1.0	10.0
			1.65~1.95	—	3.8	6.2	1.0	6.7
			2.3~2.7	—	2.6	3.9	1.0	4.4
			3.0~3.6	—	2.1	3.1	1.0	3.7
		$C_L = 15 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	0.9	—	21.0	—	—	—
			1.1~1.3	—	9.8	21.5	1.0	37.1
			1.4~1.6	—	5.4	9.3	1.0	11.2
			1.65~1.95	—	4.2	6.9	1.0	7.1
			2.3~2.7	—	2.8	4.4	1.0	5.0
			3.0~3.6	—	2.3	3.4	1.0	3.9
		$C_L = 30 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	0.9	—	31.2	—	—	—
			1.1~1.3	—	13.8	29.6	1.0	56.0
			1.4~1.6	—	7.4	13.1	1.0	15.9
			1.65~1.95	—	5.6	9.2	1.0	9.6
			2.3~2.7	—	3.7	5.7	1.0	6.1
			3.0~3.6	—	2.9	4.4	1.0	4.8
Input capacitance	$C_{IN}$	—	3.6	—	3	—	—	pF
Power dissipation capacitance	$C_{PD}$	(Note 13)	0.9~3.6	—	6	—	—	pF

Note 13:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

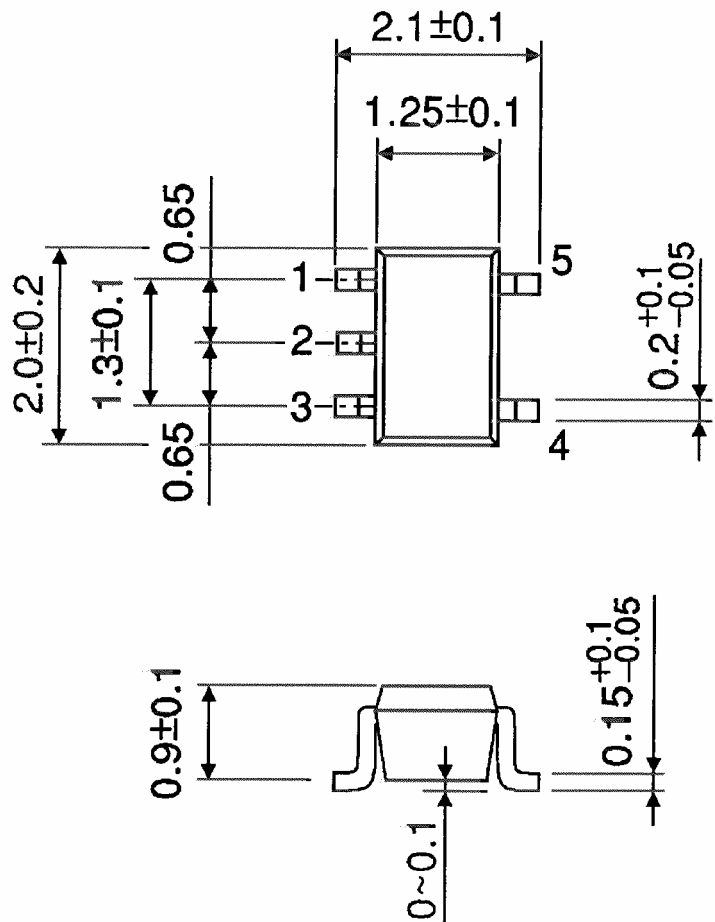
Average operating current can be obtained by the equation:

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

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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20070701-EN GENERAL

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