

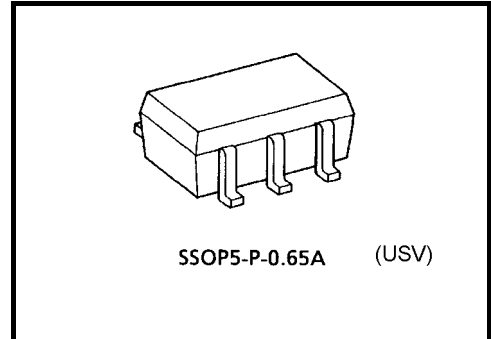
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7SG04FU

## Inverter

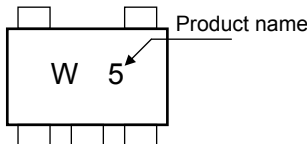
### Features

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

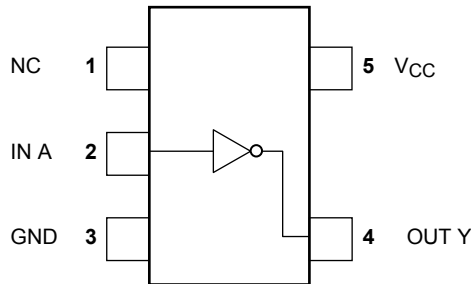


Weight: 0.006 g (typ.)

### Marking



### Pin Assignment (top view)



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

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 4.6	V
DC input voltage	$V_{IN}$	-0.5 to 7.0	V
DC output voltage	$V_{OUT}$	-0.5 to 4.6 (Note 1)	V
		-0.5 to $V_{CC} + 0.5$ (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 to 150	°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).

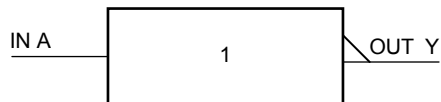
Note 1:  $V_{CC} = 0$  V

Note 2: High or Low state. Do not exceed  $I_{OUT}$  of absolute maximum ratings.

Note 3:  $V_{OUT} < GND$

Start of commercial production  
2005-02

## IEC Logic Symbol



## Truth Table

A	Y
L	H
H	L

## Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	0.9 to 3.6	V
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to 3.6 (Note 4)	V
		0 to $V_{CC}$ (Note 5)	
Output Current	$I_{OH}/I_{OL}$	$\pm 8.0$ (Note 6)	mA
		$\pm 4.0$ (Note 7)	
		$\pm 3.0$ (Note 8)	
		$\pm 1.7$ (Note 9)	
		$\pm 0.3$ (Note 10)	
		$\pm 0.02$ (Note 11)	
Operating temperature	$T_{opr}$	-40 to 85	$^{\circ}C$
Input rise and fall time	$dt/dv$	0 to 10 (Note 12)	ns/V

Note 4:  $V_{CC} = 0V$

Note 5: High or Low state.

Note 6:  $V_{CC} = 3.0$  to  $3.6V$

Note 7:  $V_{CC} = 2.3$  to  $2.7V$

Note 8:  $V_{CC} = 1.65$  to  $1.95V$

Note 9:  $V_{CC} = 1.4$  to  $1.6V$

Note 10:  $V_{CC} = 1.1$  to  $1.3V$

Note 11:  $V_{CC} = 0.9V$

Note 12:  $V_{IN} = 0.8$  to  $2.0V$ ,  $V_{CC} = 3.0V$

## 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>	—	0.9	V <sub>CC</sub>	—	—	V <sub>CC</sub>	—	V	
			1.1 to 1.3	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7	—		
			1.4 to 1.6	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—		
			1.65 to 1.95	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—		
			2.3 to 2.7	1.7	—	—	1.7	—		
			3.0 to 3.6	2.0	—	—	2.0	—		
Low-level input voltage	V <sub>IL</sub>	—	0.9	—	—	GND	—	GND	V	
			1.1 to 1.3	—	—	V <sub>CC</sub> × 0.3	—	V <sub>CC</sub> × 0.3		
			1.4 to 1.6	—	—	V <sub>CC</sub> × 0.35	—	V <sub>CC</sub> × 0.35		
			1.65 to 1.95	—	—	V <sub>CC</sub> × 0.35	—	V <sub>CC</sub> × 0.35		
			2.3 to 2.7	—	—	0.7	—	0.7		
			3.0 to 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 to 1.3	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
			I <sub>OH</sub> = -1.7 mA	1.4 to 1.6	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
			I <sub>OH</sub> = -3.0 mA	1.65 to 1.95	V <sub>CC</sub> - 0.45	—	—	V <sub>CC</sub> - 0.45	—	
			I <sub>OH</sub> = -4.0 mA	2.3 to 2.7	2.0	—	—	2.0	—	
			I <sub>OH</sub> = -8.0 mA	3.0 to 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 to 1.3	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
			I <sub>OL</sub> = 1.7 mA	1.4 to 1.6	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
			I <sub>OL</sub> = 3.0 mA	1.65 to 1.95	—	—	0.45	—	0.45	
			I <sub>OL</sub> = 4.0 mA	2.3 to 2.7	—	—	0.4	—	0.4	
			I <sub>OL</sub> = 8.0 mA	3.0 to 3.6	—	—	0.4	—	0.4	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 0 to 5.5V	0 to 3.6	—	—	±0.1	—	±1.0	μA	
Power off leakage current	I <sub>OFF</sub>	V <sub>IN</sub> = 0 to 5.5V V <sub>OUT</sub> = 0 to 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 Characteristics (unless otherwise specified, Input:  $t_r = t_f = 3$  ns)**

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit	
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
Propagation delay time	t <sub>PLH</sub> t <sub>PHL</sub>	C <sub>L</sub> = 10 pF, R <sub>L</sub> = 1 MΩ	0.9	—	18.6	—	—	ns	
			1.1 to 1.3	—	8.7	18.4	1.0		34.2
			1.4 to 1.6	—	4.9	8.5	1.0		10.0
			1.65 to 1.95	—	3.8	6.2	1.0		6.7
			2.3 to 2.7	—	2.6	3.9	1.0		4.4
			3.0 to 3.6	—	2.1	3.1	1.0		3.7
		C <sub>L</sub> = 15 pF, R <sub>L</sub> = 1 MΩ	0.9	—	21.0	—	—		—
			1.1 to 1.3	—	9.8	21.5	1.0		37.1
			1.4 to 1.6	—	5.4	9.3	1.0		11.2
			1.65 to 1.95	—	4.2	6.9	1.0		7.1
			2.3 to 2.7	—	2.8	4.4	1.0		5.0
		C <sub>L</sub> = 30 pF, R <sub>L</sub> = 1 MΩ	3.0 to 3.6	—	2.3	3.4	1.0		3.9
			0.9	—	31.2	—	—		—
			1.1 to 1.3	—	13.8	29.6	1.0		56.0
			1.4 to 1.6	—	7.4	13.1	1.0		15.9
			1.65 to 1.95	—	5.6	9.2	1.0		9.6
			2.3 to 2.7	—	3.7	5.7	1.0		6.1
		3.0 to 3.6	—	2.9	4.4	1.0	4.8		
Input capacitance	C <sub>IN</sub>	—	3.6	—	3	—	—	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note 13)	0.9 to 3.6	—	6	—	—	—	pF

Note 13: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

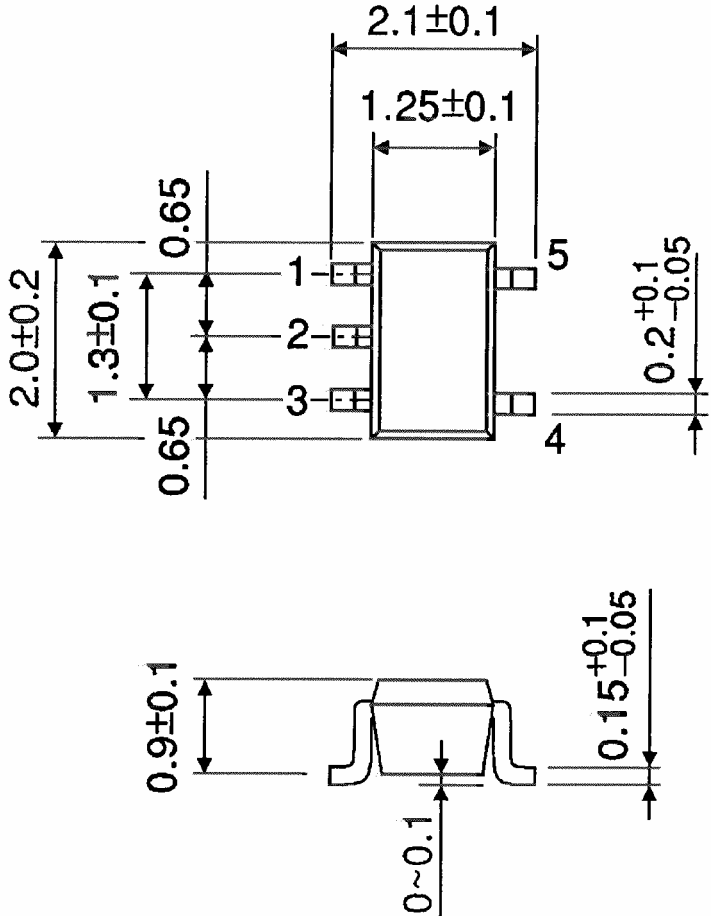
Average operating current can be obtained by the equation:

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

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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