

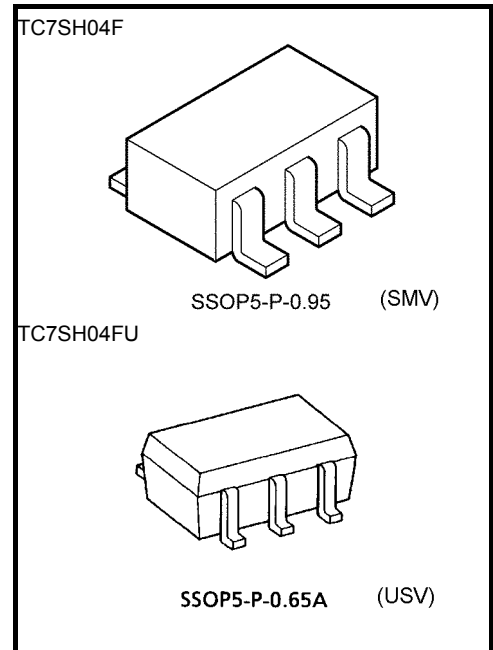
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7SH04F, TC7SH04FU

## INVERTER

### Features

- High Speed :  $t_{pd} = 3.8\text{ns}$  (typ.)  
at  $V_{CC} = 5\text{V}$ ,  $C_L = 15\text{pF}$
- Low power dissipation :  $I_{CC} = 2\ \mu\text{A}$  (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity :  $V_{NIH} = V_{NIF} = 28\% V_{CC}$  (min)
- 5.5-V tolerant input
- Wide operating voltage range :  $V_{CC} = 2$  to  $5.5\text{V}$
- Identical pin assignment and function with TC7S04



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

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

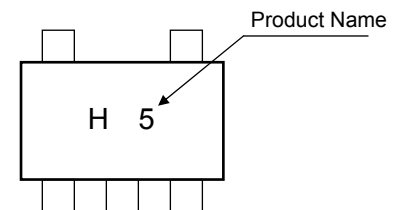
Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 7	V
DC input voltage	$V_{IN}$	-0.5 to 7	V
DC output voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$ (Note1)	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground 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

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.

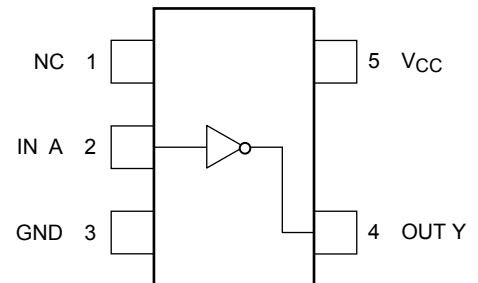
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

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

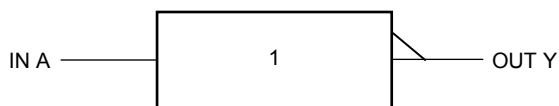
### Marking



### Pin Assignment (top view)



## IEC Logic Symbol



## Truth Table

A	Y
L	H
H	L

## Operating Range

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

Parameter	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit		
			$V_{CC}$ (V)	Min	Typ.	Max	Min		Max	
High-level input voltage	$V_{IH}$	—	2.0	1.5	—	—	1.5	—	V	
			3.0 to 5.5	$V_{CC} \times 0.7$	—	—	$V_{CC} \times 0.7$	—		
Low-level input voltage	$V_{IL}$	—	2.0	—	—	0.5	—	0.5	V	
			3.0 to 5.5	—	—	$V_{CC} \times 0.3$	—	$V_{CC} \times 0.3$		
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IL}$	$I_{OH} = -50 \mu\text{A}$	2.0	1.9	2.0	—	1.9	—	V
				3.0	2.9	3.0	—	2.9	—	
			$I_{OH} = -4 \text{ mA}$	4.5	4.4	4.5	—	4.4	—	
				4.5	3.94	—	—	3.80	—	
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$	$I_{OL} = 50 \mu\text{A}$	2.0	—	0	0.1	—	0.1	V
				3.0	—	0	0.1	—	0.1	
			$I_{OL} = 4 \text{ mA}$	4.5	—	0	0.1	—	0.1	
				4.5	—	—	0.36	—	0.44	
Input leakage current	$I_{IN}$	$V_{IN} = 5.5 \text{ V or GND}$	0 to 5.5	—	—	$\pm 0.1$	—	$\pm 1.0$	$\mu\text{A}$	
			5.5	—	—	2.0	—	20.0	$\mu\text{A}$	

## AC Characteristics (unless otherwise specified, input: $t_r = t_f = 3$ ns)

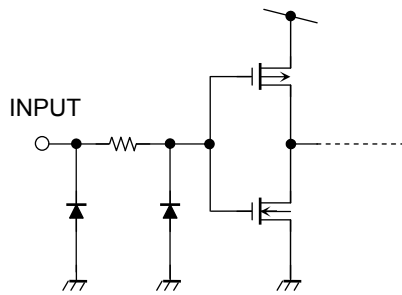
Parameter	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit
		V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Typ.	Max	Min	Max	
Propagation delay time	t <sub>PLH</sub>	3.3 ± 0.3	15	—	5.0	7.1	1.0	8.5	ns
			50	—	7.5	10.6	1.0	12.0	
	5.0 ± 0.5	15	—	3.8	5.5	1.0	6.5		
		50	—	5.3	7.5	1.0	8.5		
Input capacitance	C <sub>IN</sub>			—	4	10	—	10	pF
Power dissipation capacitance	C <sub>PD</sub>	(Note 2)		—	13	—	—	—	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.

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

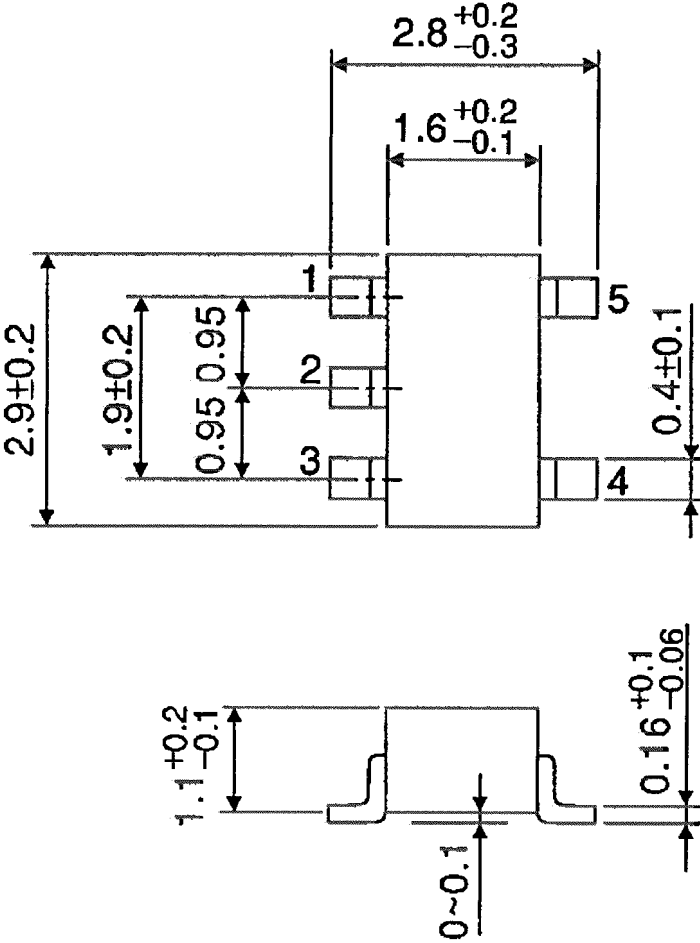
## INPUT EQUIVALENT CIRCUIT



Package Dimensions

SSOP5-P-0.95

Unit : mm

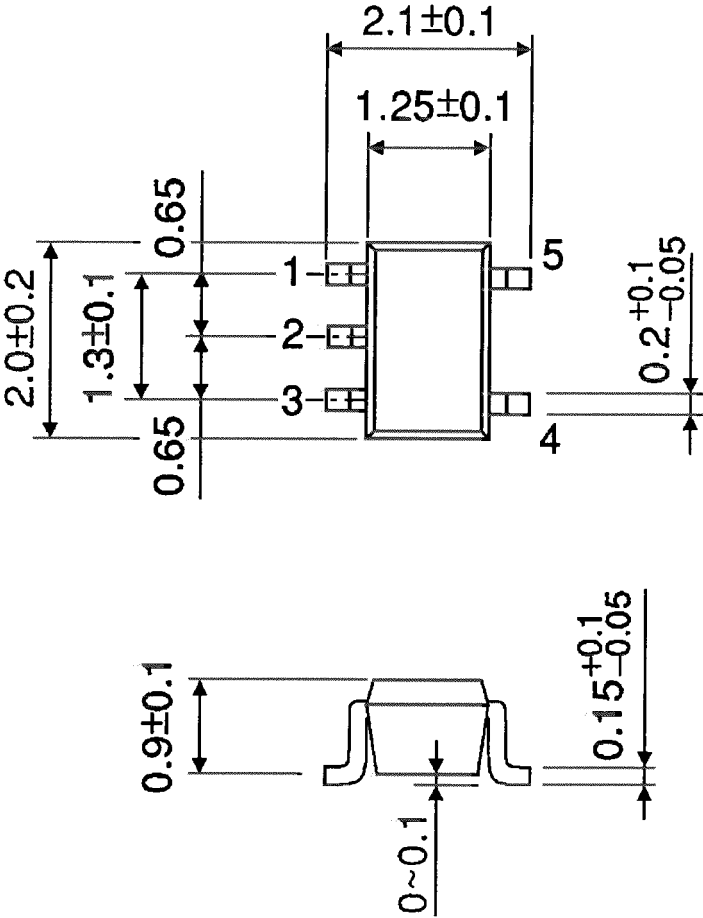


Weight: 0.016 g (typ.)

Package Dimension

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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