

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

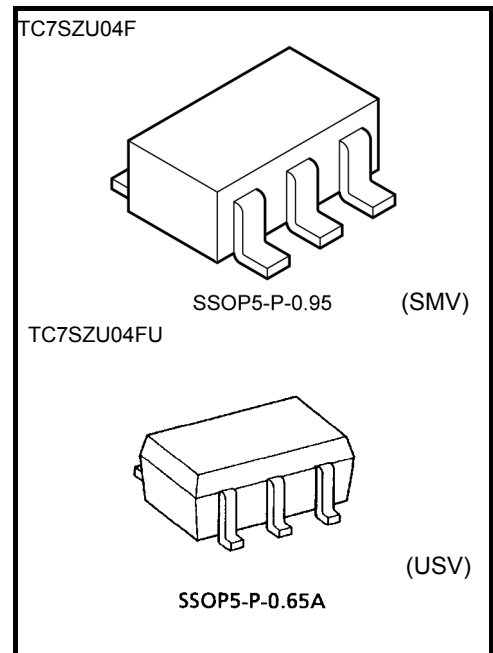
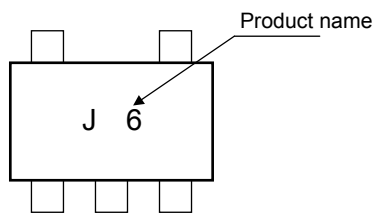
# TC7SZU04F, TC7SZU04FU

## Inverter (Unbuffered)

### Features

- High output drive:  $\pm 16$  mA (min) at  $V_{CC} = 4.5$  V
- Low quiescent power:  $I_{CC} = 2$   $\mu$ A (max)  
at  $V_{CC} = 5.5$  V,  $T_a = 25^\circ\text{C}$
- Operation voltage range:  $V_{CC}(\text{opr}) = 1.8$  to  $5.5$  V
- 5.5-V tolerant input

### Marking

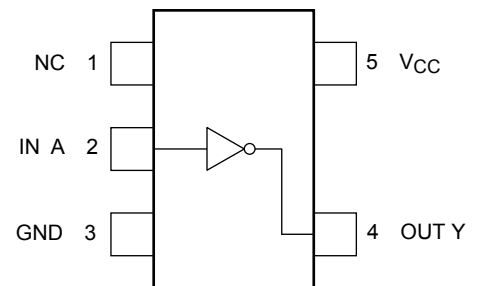


Weight  
 SSOP5-P-0.95 : 0.016 g (typ.)  
 SSOP5-P-0.65A: 0.006 g (typ.)

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

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 6	V
DC input voltage	$V_{IN}$	-0.5 to 6	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	$I_{OUT}$	$\pm 50$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 50$	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)

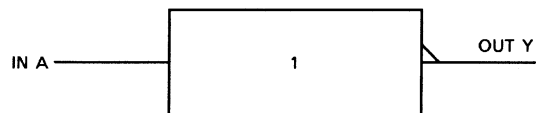


Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

Note 1:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

## IEC Logic Symbol



## Truth Table

A	Y
L	H
H	L

## Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	1.8 to 5.5	V
		1.5 to 5.5 (Note 2)	
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

Note 2: Data retention only

## 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>	—		1.8	V <sub>CC</sub> × 0.85	—	—	V <sub>CC</sub> × 0.85	—	V	
				2.3 to 5.5	V <sub>CC</sub> × 0.8	—	—	V <sub>CC</sub> × 0.8	—		
Low-level input voltage	V <sub>IL</sub>	—		1.8	—	—	V <sub>CC</sub> × 0.15	—	V <sub>CC</sub> × 0.15	V	
				2.3 to 5.5	—	—	V <sub>CC</sub> × 0.2	—	V <sub>CC</sub> × 0.2		
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -100 μA	1.8	1.6	1.8	—	1.6	—	V	
				2.3	2.1	2.3	—	2.1	—		
				3.0	2.7	3.0	—	2.7	—		
				4.5	4.0	4.4	—	4.0	—		
	V <sub>IN</sub> = GND	I <sub>OH</sub> = -4 mA	2.3	1.9	2.14	—	1.9	—			
			I <sub>OH</sub> = -8 mA	3.0	2.4	2.75	—	2.4	—		
				I <sub>OH</sub> = -12 mA	3.0	2.3	2.61	—	2.3		—
					I <sub>OH</sub> = -16 mA	4.5	3.8	4.13	—		3.8
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 100 μA	1.8	—	0	0.2	—	0.2	V	
				2.3	—	0	0.2	—	0.2		
				3.0	—	0	0.3	—	0.3		
				4.5	—	0	0.5	—	0.5		
	V <sub>IN</sub> = V <sub>CC</sub>	I <sub>OL</sub> = 4 mA	2.3	—	0.1	0.3	—	0.3			
			I <sub>OL</sub> = 8 mA	3.0	—	0.17	0.4	—	0.4		
				I <sub>OL</sub> = 12 mA	3.0	—	0.25	0.55	—		0.55
					I <sub>OL</sub> = 16 mA	4.5	—	0.26	0.55		—
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	—	—	±1	—	±10	μA	
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	2	—	20	μA	

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

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40 to 85°C		Unit
				Min	Typ.	Max	Min	Max	
Propagation delay time	t <sub>PLH</sub>	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 1 MΩ	1.8	1.0	—	8.5	1.0	9.0	ns
			2.5 ± 0.2	0.8	—	6.2	0.8	6.5	
	t <sub>PHL</sub>		3.3 ± 0.3	0.5	—	4.5	0.5	4.8	
	5.0 ± 0.5		0.5	—	3.9	0.5	4.1		
	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω		3.3 ± 0.3	1.0	—	6.0	1.5	6.5	
			5.0 ± 0.5	0.8	—	5.0	0.8	5.5	
Input capacitance	C <sub>IN</sub>	—	0 to 5.5	—	4.5	—	—	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note 3)	3.3	—	6.3	—	—	—	pF
			5.5	—	9.5	—	—	—	

Note3: 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-0.95

Unit : mm



Weight: 0.016 g (typ.)

## Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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